Cisco AS5350 and Cisco AS5400 Universal Gateway Software Configuration Guide

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

Text Part Number: OL-3418-02 B0

CONTENTS

Preface

This preface discusses how this guide is organized, explains how to use the guide, describes how to get the latest version of the guide, the conventions used in the guide, related documentation, and how to obtain documentation and technical assistance.

Objective

Whether you are a corporate end user or a competitive Internet service provider (ISP), you have purchased a Cisco AS5350 or Cisco AS5400 universal gateway to provide dial-up services that facilitate accessibility for remote or roaming personnel, or Internet admission to consumers for e-mail, e-commerce, and web browsing. This guide assists you in configuring basic features to get you started.

Organization and Use

This software configuration guide is organized into the following chapters and appendixes:

Table 1 Document Organization

Chapter	Title	Description
Chapter 1	Understanding Basic Hardware Architecture and Cisco IOS Software	Briefly overviews the Cisco AS5350 and Cisco AS5400 universal gateway architecture, and describes how to upgrade Cisco IOS software.
Chapter 2	Verifying Basic Setup	Describes how to analyze your system, execute basic tasks, and configure your system to commission the universal gateway using the CLI.
Chapter 3	Basic Configuration Using the Command-Line Interface	Describes how to configure additional basic system features.
Chapter 4	Continuing Configuration Using the Command-Line Interface	Describes how to use the Cisco IOS software command-line interface (CLI) to commission your gateway.
Chapter 5	Managing and Troubleshooting the Universal Port Card	Describes how to manage your universal port modules using the CLI.

Organization and Use

Table 1 Document Organization (continued)

Chapter	Title	Description
Chapter 6	Configuring Voice over IP	Provides a brief overview of the VoIP call process and explains how to configure VoIP on your gateway.
Appendix A	Using the Setup Script	Describes how to power on the gateway and configure it using the prompt-driven setup script.
Appendix B	ROM Monitor	Describes how to use theROM monitor to isolate or rule out hardware problems encountered when installing your gateway.
Appendix C	Comprehensive Configuration Examples	Provides basic and advanced configuration examples for reference.

The following details where you can find your basic and advanced configuration information:

- Chapter 1—Get familiar with your Cisco AS5350 or Cisco AS5400, learn how to use the command-line interface (CLI), and upgrade your Cisco IOS software, if necessary.
- Chapter 2—Analyze your system, execute basic tasks and system configuration.
- Chapters 3 and 4—Begin to commission the Cisco AS5350 or Cisco AS5400 using the command-line interface (CLI).
- The remaining chapters and appendixes—Reference these for your additional configuration, management, and troubleshooting needs.

To obtain advanced feature-configuration information that is supported on your Cisco AS5350 or Cisco AS5400 universal gateway, you can go to the following locations:

- Cisco AS5350 or Cisco AS5400 platform website, which includes platform-specific documentation such as hardware books and release notes
  - *Cisco AS5350 (or Cisco AS5400) Universal Gateway Chassis Installation Guide*
  - *Cisco AS5350 (or Cisco AS5400) Universal Gateway Card Installation Guide*
  - *Cisco AS5350 (or Cisco AS5400) Universal Gateway Regulatory Compliance and Safety Information*

  Note The Cisco AS5350 and Cisco AS5400 platform websites are available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5350/index.htm and http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm

  - *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available at http://www.cisco.com/univercd/cc/td/doc/product/software/.
    Select your Cisco IOS release and search for this title.
- Cisco Technical Assistance Center website for the Cisco AS5350 and Cisco AS5400 universal gateways, available at
  http://www.cisco.com/pcgi-bin/Support/PSP/psp_view.pl?p=Hardware:AS5350
  and
  http://www.cisco.com/pcgi-bin/Support/PSP/psp_view.pl?p=Hardware:AS5400

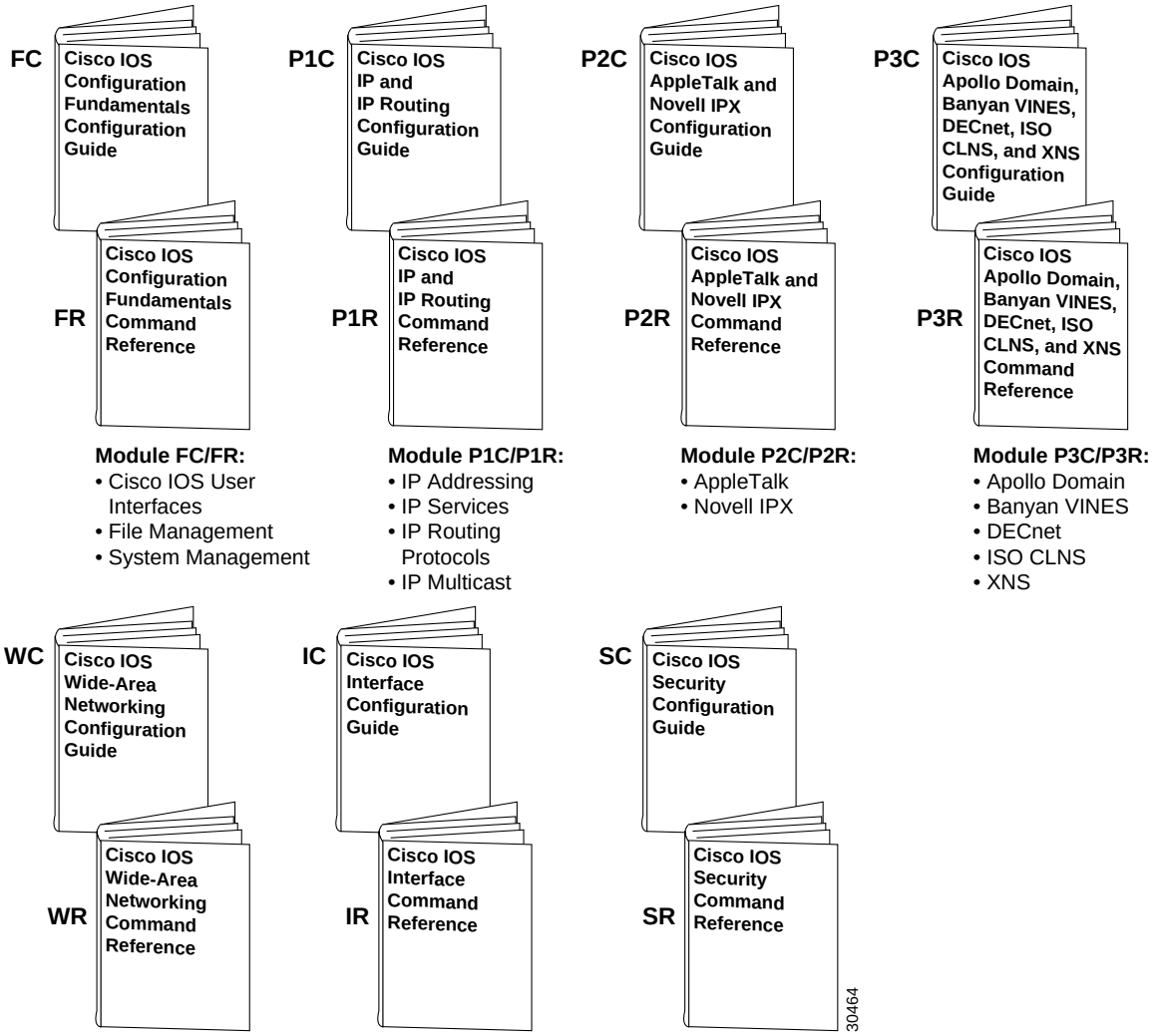
- Cisco IOS documentation set, which includes:
  - *Cisco IOS Command Summary*
  - *Cisco IOS System Error Messages*
  - *Cisco IOS Debug Command Reference*
  - *Cisco IOS Dial Services Quick Configuration Guide*
  - New feature module documentation and release notes
  - Configuration guides and command references (see Figure 1)

Note The Cisco IOS documentation set for your release is available online at http://www.cisco.com/univercd/cc/td/doc/product/software/

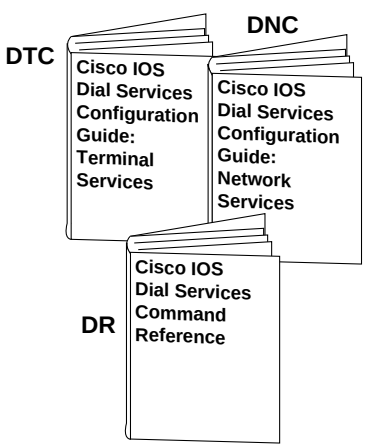
Note The abbreviations next to the book icons are page designators (for example, FC, FR, and so on), which are defined in a key in the index of each document to help with navigation. The bulleted lists under each module describe the major technology areas discussed in their corresponding books.

Organization and Use

Figure 1 Cisco IOS Software Documentation Modules

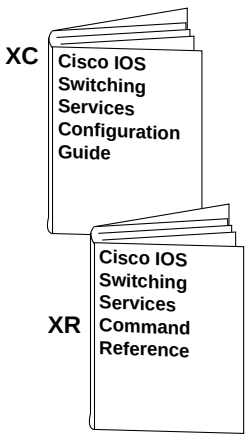


Organization and Use

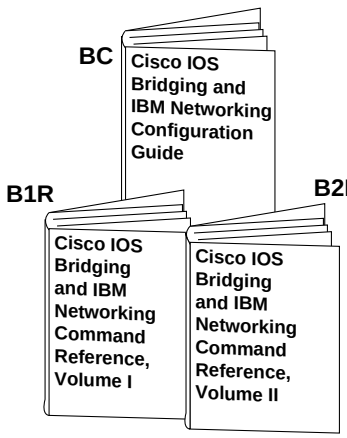


Module DTC/DR:
- Dial Access
- Modem Management
- ISDN BRI Services
- Point-to-Point Protocols
- Dial-on-Demand Routing
- Dial Backup
- Terminal Services

Module DNC/DR:
- Large-Scale Dial Solutions
- Cost-Control Solutions
- Virtual Private Networks
- X.25 on ISDN Solutions
- Telco Solutions
- Dial-Related Addressing Services
- Internetworking Dial Access Scenarios

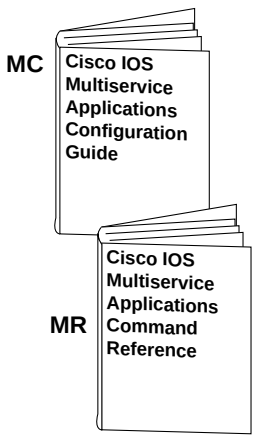


Module XC/XR:
- Cisco IOS Switching Paths
- Cisco Express Forwarding
- NetFlow Switching
- Multiprotocol Label Switching
- Multilayer Switching
- Multicast Distributed Switching
- Virtual LANs
- LAN Emulation

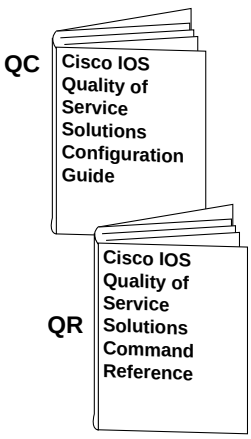


Module BC/B1R:
- Transparent Bridging
- Source-Route Bridging
- Token Ring Inter-Switch Link
- Token Ring Route Switch Module
- Remote Source-Route Bridging
- Data-Link Switching Plus
- Serial Tunnel and Block Serial Tunnel
- LLC2 and SDLC
- IBM Network Media Translation
- SNA Frame Relay Access
- NCIA Client/Server
- Airline Product Set

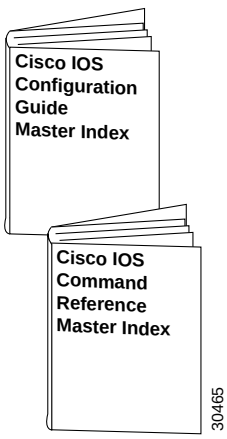
Module BC/B2R:
- DSPU and SNA Service Point
- SNA Switching Services
- Cisco Transaction Connection
- Cisco Mainframe Channel Connection
- CLAW and TCP/IP Offload
- CSNA, CMPC, and CMPC+
- TN3270 Server



Module MC/MR:
- Voice over IP
- Voice over Frame Relay
- Voice over ATM
- Voice over HDLC
- Video Support
- Universal Broadband Features



Module QC/QR:
- Packet Classification
- Congestion Management
- Congestion Avoidance
- Policing and Shaping
- Signalling
- Link Efficiency Mechanisms



Where to Get the Latest Version of This Guide

Where to Get the Latest Version of This Guide

This guide is available online and is updated continuously to integrate the latest enhancements to the product. You can access the current online copy of this guide on the World Wide Web at http://www.cisco.com, http://www-china.cisco.com, or http://www-europe.cisco.com.
See also the "Obtaining Documentation" section on page xvi.

Document Conventions

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

Table 2 Document Conventions

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

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

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

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

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

Warning **This warning symbol means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Waarschuwing **Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.**

Varoitus **Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).**

Attention **Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.**

Warnung **Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.**

Avvertenza **Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.**

Advarsel **Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.**

Aviso **Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.**

¡Advertencia! **Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.**

Varning! **Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. Se förklaringar av de varningar som förkommer i denna publikation i dokumentet *Regulatory Compliance and Safety Information* (Efterrättelse av föreskrifter och säkerhetsinformation), vilket medföljer denna anordning.**

Obtaining Documentation

These sections explain how to obtain documentation from Cisco Systems.

World Wide Web

You can access the most current Cisco documentation on the World Wide Web at this URL:

http://www.cisco.com

Translated documentation is available at this URL:

http://www.cisco.com/public/countries_languages.shtml

Documentation CD-ROM

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

Ordering Documentation

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Networking Products MarketPlace:

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

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

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

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, U.S.A.) at 408 526-7208 or, elsewhere in North America, by calling 800 553-NETS (6387).

Documentation Feedback

You can submit comments electronically on Cisco.com. In the Cisco Documentation home page, click the **Fax** or **Email** option in the "Leave Feedback" section at the bottom of the page.

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

You can submit your comments by mail by using the response card behind the front cover of your document or by writing to the following address:

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

We appreciate your comments.

Obtaining Technical Assistance

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain online documentation, troubleshooting tips, and sample configurations from online tools by using the Cisco Technical Assistance Center (TAC) Web Site. Cisco.com registered users have complete access to the technical support resources on the Cisco TAC Web Site.

Cisco.com

Cisco.com is the foundation of a suite of interactive, networked services that provides immediate, open access to Cisco information, networking solutions, services, programs, and resources at any time, from anywhere in the world.

Cisco.com is a highly integrated Internet application and a powerful, easy-to-use tool that provides a broad range of features and services to help you with these tasks:

- Streamline business processes and improve productivity
- Resolve technical issues with online support
- Download and test software packages
- Order Cisco learning materials and merchandise
- Register for online skill assessment, training, and certification programs

If you want to obtain customized information and service, you can self-register on Cisco.com. To access Cisco.com, go to this URL:

http://www.cisco.com

Technical Assistance Center

The Cisco Technical Assistance Center (TAC) is available to all customers who need technical assistance with a Cisco product, technology, or solution. Two levels of support are available: the Cisco TAC Web Site and the Cisco TAC Escalation Center.

Cisco TAC inquiries are categorized according to the urgency of the issue:

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.
- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.
- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

The Cisco TAC resource that you choose is based on the priority of the problem and the conditions of service contracts, when applicable.

Cisco TAC Web Site

You can use the Cisco TAC Web Site to resolve P3 and P4 issues yourself, saving both cost and time. The site provides around-the-clock access to online tools, knowledge bases, and software. To access the Cisco TAC Web Site, go to this URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco service contract have complete access to the technical support resources on the Cisco TAC Web Site. The Cisco TAC Web Site requires a Cisco.com login ID and password. If you have a valid service contract but do not have a login ID or password, go to this URL to register:

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

If you are a Cisco.com registered user, and you cannot resolve your technical issues by using the Cisco TAC Web Site, you can open a case online by using the TAC Case Open tool at this URL:

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

If you have Internet access, we recommend that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

The Cisco TAC Escalation Center addresses priority level 1 or priority level 2 issues. These classifications are assigned when severe network degradation significantly impacts business operations. When you contact the TAC Escalation Center with a P1 or P2 problem, a Cisco TAC engineer automatically opens a case.

To obtain a directory of toll-free Cisco TAC telephone numbers for your country, go to this URL:

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

Before calling, please check with your network operations center to determine the level of Cisco support services to which your company is entitled: for example, SMARTnet, SMARTnet Onsite, or Network Supported Accounts (NSA). When you call the center, please have available your service agreement number and your product serial number.

Understanding Basic Hardware Architecture and Cisco IOS Software

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

This chapter provides a brief profile of the Cisco AS5350 and Cisco AS5400 universal gateway hardware components and functionality, details how to use the Cisco IOS command-line interface (CLI), and describes how to upgrade your Cisco IOS software:

The Cisco AS5350 and Cisco AS5400 universal gateways are versatile data and voice communications platforms that provide the functions of a gateway, router, and digital modems in a single modular chassis.

The gateways are intended for Internet service providers (ISPs), telecommunications carriers, and other service providers that offer managed Internet connections, and also medium to large sites that provide both digital and analog access to users on an enterprise network.

Basic Hardware Architecture

Note The cards that reside in the AS5350 and AS5400 chassis, sometimes referred to as dial feature cards (DFC), are of two types: trunk cards, which provide an E1, T1, or T3 interface, and universal port cards, which host the universal digital signal processors (DSPs) that dynamically handle voice, dial, and fax calls.

Figure 1-1 shows the logical and physical system architecture for the Cisco AS5350 and Cisco AS5400, and illustrates the components used to process a call.

Figure 1-1 Cisco AS5350 and Cisco AS5400 Basic System Architecture

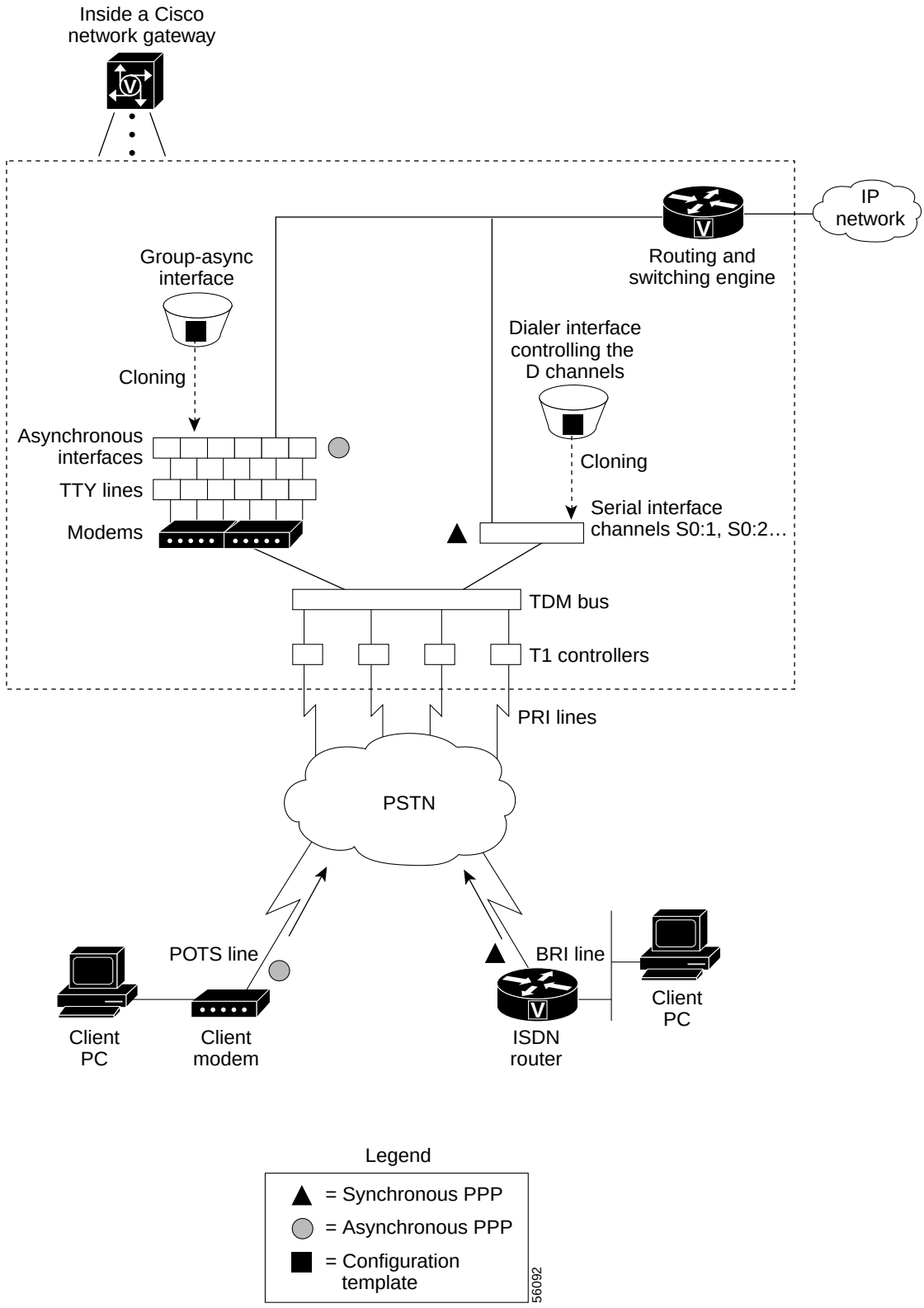


Figure 1-1 shows the following:

- Client modems and Integrated Services Digital Network (ISDN) routers dial into the gateway through the public switched telephone network (PSTN).
- Analog Point-to-Point Protocol (PPP) calls connect to modems inside the gateway.
- Each modem inside the gateway provides a corresponding TTY line and asynchronous interface for terminating character and packet mode services.
- Asynchronous interfaces clone their configurations from a group-async interface.
- Synchronous PPP calls connect to serial interface channels (for example, Se2/0:1 and Se2/0:2).
- Synchronous interfaces clone their configurations from a dialer interface.

One analog PPP call uses the following resources:

- One T1 DS0 channel
- One channel in a TDM bus
- One integrated modem
- One TTY line
- One asynchronous interface

One synchronous PPP call uses the following resources:

- One T1 DS0 channel
- One serial interface channel

Exploring the Cisco IOS File System

The Cisco IOS File System (IFS) feature provides a single interface to the following:

- Flash memory file system
- Network file system (TFTP, rcp, and FTP)
- Any other endpoint for reading or writing data (such as NVRAM, modem firmware, the running configuration, ROM, raw system memory, Xmodem, and Flash load helper log)

IFS first appeared in Cisco IOS Releases 11.3 AA and 12.0. For more information about IFS, refer to the chapter "Using the Cisco IOS File System" in the *Cisco IOS Release 12.0 Configuration Fundamentals Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt2/fcifs.htm

Figure 1-2 illustrates the memory locations and Table 1-1 describes the memory locations.

Figure 1-2 Cisco AS5350 and Cisco AS5400 Memory Locations

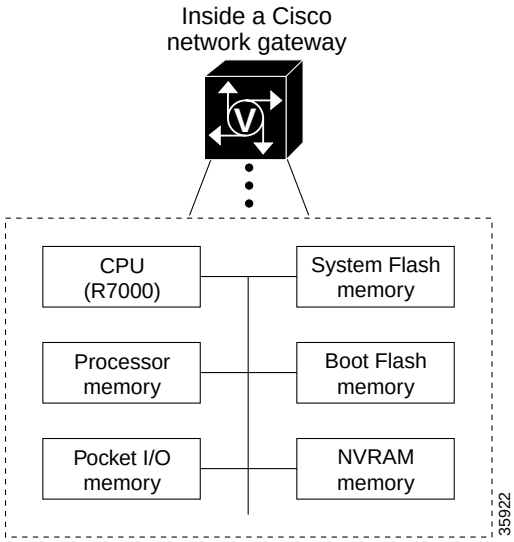


Table 1-1 Memory Location Descriptions

Component	Description
CPU	250 MHz (Cisco AS5350 and Cisco AS5400) 390 MHz (Cisco AS5400HPX)
Processor memory	The Cisco IOS image is initially read out of Flash memory, decompressed, and loaded into processor memory (also known as main memory or DRAM). Routing tables, call control blocks, and other data structures are also stored here.
Packet I/O memory	Packets are temporarily stored in I/O memory.
System Flash and boot Flash memory	Memory that stores Cisco IOS images, modem firmware/portware, and custom web pages.
NVRAM memory	Nonvolatile configuration memory that retains its contents when a unit is powered off.

To inspect the file system, enter the **show file systems** command and the **dir** command as shown in the following procedure.

Step 1 View the different file storage areas and file management functions:

```
Router# show file systems
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
      520184      520184     nvram     rw   nvram:
           -           -    opaque     rw   null:
           -           -    opaque     rw   system:
           -           -   network     rw   tftp:
           -           -    opaque     wo   vfc:
*   32768000    22992256     flash     rw   flash:
     7602176     4634364     flash     rw   bootflash:
           -           -    opaque     wo   lex:
           -           -   network     rw   rcp:
           -           -   network     rw   ftp:
```

In addition, verify that you have everything that you ordered (for example, 32 megabytes of Flash memory). The asterisk (*****) indicates the current directory.

Step 2 Display the objects in the system memory directory:

```
Router# dir system:
Directory of system:/

    4  dr-x           0              <no date>  memory
    1  -rw-        5026              <no date>  running-config
    2  dr-x           0              <no date>  ucode
   14  dr-x           0              <no date>  vfiles
```

Note Remember to include the trailing colon (**:**) in **dir** commands.

Step 3 Inspect the contents of bootflash:

```
Router# dir bootflash:
Directory of bootflash:/

  1  -rw-     1962796   Jan 01 2000 00:00:59  c5350-boot-mz.Jan7
  2  -rw-      182684   Jun 05 2000 22:04:15  crashinfo_20000605-220415
  3  -rw-      172464   Jun 26 2000 19:21:04  crashinfo_20000626-192104
  5  -rw-      167594   Jun 26 2000 19:24:37  crashinfo_20000626-192437
  6  -rw-      163300   Aug 02 2000 00:14:08  crashinfo_20000802-001408
  7  -rw-      131250   Aug 02 2000 00:14:19  crashinfo_20000802-001419
  8  -rw-      158171   Aug 08 2000 23:21:40  crashinfo_20000808-232140
7602176 bytes total (4634364 bytes free)
```

In the example, the bootflash image is `c5350-boot-mz.Jan7`. The compressed file size is `1962796` bytes. The total Boot Flash memory size is `7602176` bytes. The number of free bytes is `4634364`. The crashinfo file is a collection of useful information related to the current crash stored in Boot Flash or Flash memory.

Note For more information on crashinfo files, refer to *Retrieving Information from the Crashinfo File*, available online at http://www.cisco.com/warp/public/63/crashinfo.html.

Step 4 Display the contents of Flash memory:

```
Router# pwd
flash:
Router# dir
1  -rw-     9950528   Jan 01 2000 00:48:59  c5350-js-mz.121-1.XD1.bin

32768000 bytes total (22817344 bytes free)

The Cisco IOS image named c5350-js-mz.121-1.XD1.bin is present.
```

Step 5 Inspect the NVRAM directory:

```
Router# dir nvram:
Directory of nvram:/

  1 -rw-        0                <no date>  startup-config
  2 ----        0                <no date>  private-config

520184 bytes total (520184 bytes free)
```

In the example, the startup-config and private-config are present. The private-config file is a secure file that is part of the startup configuration. It supports encryption technologies, but it is not user accessible.

Exploring Cisco IOS Software

This section describes what you need to know about the Cisco IOS software (the software that runs the gateway) before you configure the gateway using the CLI. This section includes:

- Getting Help, page 1-6
- Understanding Command Modes, page 1-7
- Finding Command Options, page 1-7
- Undoing a Command or Feature, page 1-9
- Saving Configuration Changes, page 1-10

Understanding these concepts saves you time if you have no or minimal experience using the Cisco IOS software.

Getting Help

Use the question mark (**?**) and arrow keys to help you enter commands, where `Router>` is the prompt for the top level of the Cisco IOS software for the Cisco AS5350 or Cisco AS5400 universal gateway.

Note The examples in this guide show prompts for either a Cisco AS5350 or a Cisco AS5400 gateway. However, regardless of the prompt or output shown, all examples apply to either type of gateway.

- 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 **show** command followed by a space and a question mark:

  ```
  Router> show ?
  ```

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

Understanding Command Modes

You need to use many different command modes to configure the gateway. Each command mode restricts you to a subset of commands.

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

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

```
Router> enable
Router> password
Router# configure terminal
Router(config)# interface fastethernet 0/0
Router(config-if)# ip address 172.16.254.250
Router(config-if)# exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

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

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

Finding Command Options

This section explains how to display options for a command. To display options for a command, enter a **?** at the configuration prompt, or after entering part of a command followed by a space. The configuration parser displays options available with the command. For example, if you were in global configuration mode, typed the command **arap**, and wanted to see all the keywords and arguments for that command, you would type **arap ?**

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enters enable mode. Enters the password. You are in enable mode when the prompt changes to `Router#`.

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

Step 3	`Router(config)# controller t1 1/?`
	`<0-1> Controller port number`
	`Router(config)# controller t1 1/0`
		Specifies the T1 controller that you want to configure using the **controller T1** number global configuration command.

Step 4	`Router(config-controller)# ?`
	`Controller configuration commands:`
	`cablelength` Specify cable length for a DS1 link
	`channel-group` Specify timeslots to channel-group mapping for an interface
	`default` Set a command to its defaults
	`description` Controller specific description
	`ds0` ds0 commands
	`ds0-group` Replacement of cas-group Configure group of timeslots to a particular signaling type
	`exit` Exit from controller configuration mode
	`fdl` Specify the FDL standard for a DS1 data link
	`framing` Specify the type of Framing on a DS1 link
	`help` Description of the interactive help system
	`linecode` Specify the line encoding method for a DS1 link
	`loopback` Put the entire T1 line into loopback
	`no` Negate a command or set its defaults
	`pri-group` Configure the specified timeslots for PRI
	`shutdown` Shut down a DS1 link (send Blue Alarm)
		Displays controller configuration commands.

Step 5	`Router(config-controller)# ds0-group ?` `<0-23> Channel number`	Displays the options for the ds0-group controller configuration command. This command is used to configure the channel-associated signaling on a T1 controller.
Step 6	`Router(config-controller)# ds0-group 1 ?` `timeslots List of timeslots in the ds0-group`	Displays the only command (**timeslots**) available in **ds0-group 1**.

	Command	Purpose
Step 7	`Router(config-controller)# ds0-group 1 timeslots ?` `  <1-24>  List of timeslots which comprise the ds0-group`	Displays the range for the timeslot option. Specify a timeslot range of values from 1 to 24. You can specify timeslot ranges (for example, 1-24), individual timeslots separated by commas (for example 1, 3, 5), or a combination of the two (for example 1-3, 8, 17-24). The 16th timeslot is not specified in the command line, because it is reserved for transmitting the channel signaling.

Step 8	`Router(config-controller)# ds0-group 1 timeslots 1-24 ?`
	`  service  Specify the type of service`
	`  type  Specify the type of signaling`
		Displays the two commands (**service** and **type**) available for the timeslots.

Step 9	`Router(config-controller)# ds0-group 1 timeslots 1-24 type ?`
	`  e&m-fgb  E & M Type II FGB`
	`  e&m-fgd  E & M Type II FGD`
	`  e&m-immediate-start  E & M Immediate Start`
	`  fxs-ground-start  FXS Ground Start`
	`  fxs-loop-start  FXS Loop Start`
	`  sas-ground-start  SAS Ground Start`
	`  sas-loop-start  SAS Loop Start`
		Lists supported signaling types.

Step 10	`Router(config-controller)# ds0-group 1 timeslots 1-24 type e&m-fgb ?`
	`  dtmf  DTMF tone signaling`
	`  mf  MF tone signaling`
	`  service  Specify the type of service`
	`  <cr>`
		Displays the types of channel-associated signaling available for the e&m-fgb type.

Step 11	`Router(config-controller)# ds0-group 1 timeslots 1-24 type e&m-fgb dtmf ?`
	`  dnis  DNIS addr info provisioned`
	`  service  Specify the type of service`
	`  <cr>`
		Displays the options supported for the DTMF tone signaling option.

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

Enter the **copy running-config startup-config** command to save your configuration changes to nonvolatile random-access memory (NVRAM) so that they 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#
```

Timesaver You can use the question mark (**?**) and arrow keys to help you enter commands.

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

Timesaver If you want to disable a feature, enter the keyword **no** before the command; for example, **no ip routing**.

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

Upgrading to a New Cisco IOS Release

Obtain new Cisco IOS features and more stable code by upgrading to a new Cisco IOS release.

Step 1 Display the contents of Flash memory:

```
Router# cd flash:
Router# dir
Directory of flash:/

1  -rw-     9950528   Jan 01 2000 00:48:59  c5350-js-mz.121-1.XD1.bin

32768000 bytes total (13041600 bytes free)
```

Step 2 Copy the new image from the remote TFTP server into Flash memory. Make sure that you specify your own TFTP server's IP address and Cisco IOS filename. If you encounter issues with upgrading the image, be sure that you can ping the TFTP server and that appropriate directory permissions are configured on the TFTP server. To see the bangs (!) during the download operation, enable line wrap in your terminal emulation software.

Note If you have available space for two images, leave both images in Flash memory. If necessary, you can easily revert back to the previous image. Enter the **boot system flash** *newiosname***.bin** command to point to the new image filename. By default, the first image in Flash memory is loaded.

If you do not have available space, during the copy operation the system displays a message telling you to delete the current file and squeeze the flash to make room for the new image. Enter the **delete flash:***version* command, followed by the **squeeze flash** command, to perform this delete-and-squeeze operation. Then proceed with the copy operation.

```
Router# copy tftp flash
Address or name of remote host [172.22.191.135]? 172.22.191.135
Source filename [c5350-js-mz.121-1.XD1.bin]? c5350-js-mz.121-3.T.bin
Destination filename [c5350-js-mz.121-3.T.bin]?
Accessing tftp://172.22.191.135/c5350-js-mz.121-3.T.bin...
Loading c5350-js-mz.121-3.T.bin from 172.22.191.135 (via FastEthernet0/0): !!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 9775616/19551232 bytes]

9775616 bytes copied in 66.424 secs (148115 bytes/sec)
```

Caution Occasionally TFTP errors occur. Make sure that the verifying checksum reports "OK." Do *not* reload the gateway if the checksum reports errors.

Step 3 Verify that the new image was downloaded. In this example, notice that the Cisco IOS Release 12.1(1)XD image is the first in Flash memory, so it is loaded during the boot sequence. To boot using the new image, you must either delete the unwanted image or use the **boot system** command to specify the alternate image to use during the boot sequence.

```
Router# dir flash:
Directory of flash:/

  1  -rw-     9950528   Jan 01 2000 00:48:59  c5350-js-mz.121-1.XD1.bin
  2  -rw-     9775616   Jan 01 2000 00:59:10  c5350-js-mz.121-3.T.bin

32768000 bytes total (13041600 bytes free)
```

For more information on deleting the image, refer to the document *Cisco IOS File System*, available online at
http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113aa/113aa_2/allplats/ifs.htm

Note The Cisco AS5350 and Cisco AS5400, unlike the Cisco AS5200 and Cisco AS5300, use a Class A Flash File System.

Step 4 To specify the alternate image that is to be used during the boot sequence use the **boot system flash** *newiosname***.bin** command to specify the location (device) and name of the image to be used:

```
Router(config)# boot system flash c5350-js-mz.121-3.T.bin
Router(config)# ^Z
Router# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

To verify that this command is in effect, use the **show running-configuration** command. Save your running configuration before the reload so that the gateway loads the correct image.

Step 5 Reload the Cisco AS5350 or Cisco AS5400 to run the new image. If you erased the old Cisco IOS image, make sure that the **boot system flash** *oldiosname***.bin** command is not enabled and pointing to the old image file name; otherwise, the gateway gets stuck trying to reload the old image over and over again.

```
Router# reload
Proceed with reload? [confirm]

System Bootstrap, Version 12.0(20000106:234457) [tombnyg-rommon_1_6 106],
SOFTWARE REV 1.6
Copyright (c) 1994-2000 by cisco Systems, Inc.
AS5400 platform with 131072 Kbytes of main memory


Self decompressing the image : ##################################################
################################################## [OK]
Self decompressing the image : ##################################################
################################################################################
################################################################################
################################################################################
################################################################################
########################################################################## [OK]
Press RETURN to get started!
```

Note Most sections of the boot sequence have been omitted from the example.

For more information about TFTP, refer to the document *Loading and Maintaining System Images and Microcode*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt2/fcimages.htm

Tip On system reload, if the console session freezes or displays unusual characters on the screen, you may have a console session mismatch between the Cisco IOS console line speed and the terminal server speed. This mismatch may occur because of the program settings of your console or your terminal server speed.

Note Before you proceed to correct session mismatch, verify that your problem is not due to a defective cable or improper cable connection. Check your cable connection or replace cable and reload system again.

To correct a console session mismatch, do one of the following:

- Change your console line speed.
- Change your terminal server speed.
- If the above two solutions do not correct console session, install the console jumper on the motherboard to set your default console port speed to 9600 bps.

  For Revision 1 motherboards, the jumper is set at motherboard pin location or row J3, where the top two pins (toward the back of the board) are jumpered. For Revision 3 motherboards, pins 1 and 2 for row J1 must be shorted out.

Changing Console Line Speed

Caution Changing your console line speed on an active Cisco AS5350 or Cisco AS5400 results in a temporary loss of synchronization between the console line and terminal port speeds. At this point the gateway may recognize a false **send break** command that may result in your system crashing.

To avoid this problem, you can do one of the following:

- If the configuration register on your Cisco AS5350 or Cisco AS5400 already has the **Break Abort Effect** bit set (mask is 0x0100), then you are protected and the false send break event does not occur. (You can change the configuration register to have this bit set, but the change does not take effect until your gateway is rebooted.)
- If the configuration register does not have the **Break Abort Effect** bit set (mask 0x0100), then disconnect the cable on the console port and either log into the Cisco AS5350 or Cisco AS5400 through the AUX port or telnet in through a VTY session. Change the console line speed and the related terminal server speed, then reconnect the console cable.

Log in to your Cisco AS5350 or Cisco AS5400 through the AUX port or Telnet VTY session. Enter the **show running-config** command and determine what speed your line console is set. Possible console speeds are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. The default setting is 9600.

If your gateway is in ROM monitor mode, then the AUX port is not functioning. You must then change the terminal server port speed through your console port connection until the `rommon>` prompt is displayed. See Appendix B, “ROM Monitor.”

Changing Gateway Line Speed

The following example shows how to configure line speed on a Cisco AS5350 or Cisco AS5400, beginning in global configuration mode:

```
Router(config)# line 3
Router(config-line)# speed speed_value
```

Where to Go Next

At this point you should go to:

- Chapter 2, "Verifying Basic Setup" to analyze your system and execute basic tasks and system configuration before configuring the Cisco AS5350 or Cisco AS5400 universal gateway using the CLI. To commission is to systematically execute basic configuration tasks that prepare your system for data call processing.

Tip The following publications are available on the Documentation CD-ROM that came with your gateway, or on the World Wide Web from the Cisco home page.

- Cisco IOS publications *Dial Solutions Configuration Guide* and *Dial Solutions Command Reference* provide additional basic-configuration information. For more advanced configuration topics, refer to the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- Check *Configuring Selected 12.1 Cisco IOS Software Features*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm
- For troubleshooting information, refer to the *System Error Messages* and *Debug Command Reference* publications.

Verifying Basic Setup

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

This chapter details the tasks required to verify that your basic system components are functioning normally:

Analyzing the System Boot Dialog

The Cisco AS5350 and Cisco AS5400 have a specific boot sequence. To view the boot sequence through a terminal session, you must have a console connection to the gateway before it powers up.

Note If you observe no messages on the console port, check that the baud rate is configured correctly. The Cisco AS5350 and Cisco AS5400 console port can support a baud rate up to 115200.

The following boot sequence occurs. Step numbers and comments are inserted in the example to describe the boot sequence.

Step 1 In the following segment, the gateway decompresses the system boot image, tests the NVRAM for validity, and decompresses the Cisco IOS image.

```
System Bootstrap, Version 12.0(20000106:234457) [tombnyg-rommon_1_6 106],
SOFTWARE REV 1.6
Copyright (c) 1994-2000 by cisco Systems, Inc.
AS5350 platform with 131072 Kbytes of main memory

Self decompressing the image : ##################################################
################################################## [OK]
Self decompressing the image : ##################################################
################################################################################
################################################################ [OK]
```

Step 2 Cisco IOS release, available memory, hardware interfaces, and modem lines are displayed:

Note If a card type is not recognized, verify that you are running the optimum version of Cisco IOS software. Refer to the hardware-software compatibility matrix, available online at http://cco-sj-1.cisco.com/cgi-bin/front.x/Support/HWSWmatrix/hwswmatrix.cgi

```
Restricted Rights Legend

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

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

Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(3)T,  RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Thu 20-Jul-00 03:02 by ccai
Image text-base: 0x60008968, data-base: 0x61000000
cisco AS5400 (R7K) processor (revision O) with 131072K/65536K bytes of memory.
Processor board ID JAB0351040G
R7000 CPU at 250Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3 Cache
Last reset from IOS reload
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.
Primary Rate ISDN software, Version 1.1.
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x31,
 Board Hardware Version 3.21, Item Number 800-5171-01,
 Board Revision 017, Serial Number JAB0351040G,
 PLD/ISP Version 1.0,  Manufacture Date 6-Jan-2000.
Processor 0xFF, MAC Address 0x03096F818
Backplane HW Revision FF.FF, Flash Type 5V
2 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
108 terminal line(s)
8 Channelized T1/PRI port(s)
512K bytes of non-volatile configuration memory.
32768K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)
```

Step 3 Because the gateway has never been configured, it cannot find a startup-config file. Therefore, the software asks, “Would you like to enter the initial configuration dialog? [yes/no]”

Enter **no**. In this example, the Cisco IOS software is configured manually. The automatic setup script is not used. Configuring the Cisco IOS software manually develops your expertise.

Enter **yes** to terminate autoinstall.

```
--- System Configuration Dialog ---

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

Would you like to terminate autoinstall? [yes]: yes
```

Step 4 This example shows the LAN interfaces and the slots in which port cards are not inserted. The universal-port-card (formerly called NextPort) module firmware version is displayed (version 1.1.6.81). The gateway attempts to switch to a better clock source but does not find a suitable source because the T1s are not yet configured.

```
00:00:03: %NP_MD-6-SLOT_INSERTED: Slot 1 (108 ports max) inserted
00:00:16: %CARRIER-3-NO_DFC: DFC is not present - DFC 3
00:00:16: %CARRIER-3-NO_DFC: DFC is not present - DFC 4
00:00:16: %CARRIER-3-NO_DFC: DFC is not present - DFC 5
00:00:16: %CARRIER-3-NO_DFC: DFC is not present - DFC 6
00:00:16: %CARRIER-3-NO_DFC: DFC is not present - DFC 7
00:00:19: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
00:00:19: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
00:00:19: %LINK-3-UPDOWN: Interface Serial0/0, changed state to down
00:00:19: %LINK-3-UPDOWN: Interface Serial0/1, changed state to down
00:00:20: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state
to up
00:00:20: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state
to down
00:00:20: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to down
00:00:20: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed state to down
00:00:23: %NP_BS-6-MODULE_STARTED: NextPort module 1/0/0 Started - 1.1.6.81
00:00:26: %NP_BS-6-MODULE_STARTED: NextPort module 1/0/1 Started - 1.1.6.81
00:00:30: %NP_MD-6-MODULE_UP: NextPort module 1/0/0 up
00:00:30: %NP_BS-6-MODULE_STARTED: NextPort module 1/0/2 Started - 1.1.6.81
00:00:33: %NP_MD-6-MODULE_UP: NextPort module 1/0/1 up
00:00:37: %NP_MD-6-MODULE_UP: NextPort module 1/0/2 up
00:01:05: %LINK-5-CHANGED: Interface Serial0/0, changed state to administratively down
00:01:05: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state to administratively
down
00:01:05: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively
down
00:01:05: %LINK-5-CHANGED: Interface Serial0/1, changed state to administratively down
00:01:06: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state
to down
00:01:10: %SYS-5-RESTART: System restarted --
Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(1)XD1, EARLY DEPLOYMENT RELEASE SOFTWARE
(fc2)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Sun 09-Jul-00 07:06 by beliu
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 1 priority 205 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 2 priority 204 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 3 priority 205 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 4 priority 204 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 5 priority 205 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 6 priority 204 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-SWITCH: Switching to the clock on slot 2 port 7 priority 205 as
the current primary has gone bad
00:01:10: %TRUNK_CLOCK-6-BAD_CLOCKS: There are no good clocks in the system. Remain in
HOLDOVER mode
00:01:10: %TRUNK_CLOCK-6-BAD_CLOCKS: There are no good clocks in the system. Remain in
HOLDOVER mode
00:01:10: %TRUNK_CLOCK-6-BAD_CLOCKS: There are no good clocks in the system. Remain in
HOLDOVER mode
```

```
00:01:10: %TRUNK_CLOCK-6-BAD_CLOCKS: There are no good clocks in the system. Remain in
HOLDOVER mode
00:01:10: %TRUNK_CLOCK-6-BAD_CLOCKS: There are no good clocks in the system. Remain in
HOLDOVER mode
```

Step 5 Enter the **show version** command to check the system hardware, Cisco IOS image name, uptime, and restart reason:

```
Router> show version

Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(20001028:174051)]
Copyright (c) 1986-2001 by cisco Systems, Inc.
Compiled Mon 19-Feb-01 04:10 by
Image text-base: 0x60008968, data-base: 0x61180000

ROM: System Bootstrap, Version 12.0(19991122:230447)
BOOTFLASH: 5350 Software (C5350-BOOT-M), Version 12.0(19991112:131]

AS5400 uptime is 1 day, 4 hours, 29 minutes
System returned to ROM by reload at 12:34:33 UTC Tue Nov 30 1999
System image file is "flash:c5350-js-mz.xm.Feb19"

cisco AS5400 (R7K) processor (revision L) with 131072K/65536K bytes of memory.
Processor board ID 99290068
R7000 CPU at 250Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3 Cache
Last reset from warm-reset
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.
Primary Rate ISDN software, Version 1.1.
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x31,
 Board Hardware Version 1.21, Item Number 800-5171-01,
 Board Revision 011, Serial Number 99290068,
 PLD/ISP Version 0.0,  Manufacture Date 2-Aug-1999.
Processor 0xFF, MAC Address 0x0503EFF5F4C
Backplane HW Revision FF.FF, Flash Type 5V
2 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
108 terminal line(s)
8 Channelized T1/PRI port(s)
512K bytes of non-volatile configuration memory.
16384K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102
```

Table 2-1 describes the significant output fields in the previous example.

Table 2-1 Show Version Command Field Descriptions

Field	Description
`AS5400 uptime is....`	Watch for unscheduled reloads by inspecting this field.
`System returned to ROM by reload at....`	Tells you why the gateway last reloaded. If the field displays “power-on,” a power interruption caused the reload.
`System image file is....`	The gateway booted from this image location.

Checking the Initial Running Configuration

The Cisco IOS software creates an initial running configuration. Inspect the configuration to get familiar with the default settings. User input is shown in boldface type.

```
Router> enable
Password:
Router# show running-config

Building configuration...

Current configuration : 7653 bytes
!
version 12.1
no service single-slot-reload-enable
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
no boot startup-test
logging rate-limit console 10 except errors
!
!
resource-pool disable
!
!
voice-fastpath enable
ip subnet-zero
no ip routing
no ip finger
ip name-server 172.16.11.48
ip name-server 172.16.2.132
ip name-server 172.16.2.133
!
call rsvp-sync
!
!
fax interface-type modem
mta receive maximum-recipients 0
!
!
controller T1 1/0
!
controller T1 1/1
```

```
!
controller T1 1/2
!
controller T1 1/3
!
controller T1 1/4
!
controller T1 1/5
!
controller T1 1/6
!
controller T1 1/7
!
!
interface FastEthernet0/0
 ip address 172.21.101.21 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 duplex auto
 speed 100
 no mop enabled
!
interface FastEthernet0/1
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Async4/00
 no ip address
 no ip route-cache
!
interface Async4/01
 no ip address
 no ip route-cache
!
interface Async4/02
 no ip address
 no ip route-cache
.
.
.
interface Async4/107
 no ip address
 no ip route-cache
!
```

```
interface Group-Async0
 no ip address
 no ip route-cache
 no group-range
!
ip kerberos source-interface any
ip classless
no ip http server
!
!
line con 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password cisco
 login
line 4/00 4/107
 no flush-at-activation
 modem InOut
!
scheduler allocate 10000 400
end
```

The Cisco AS5350 or Cisco AS5400 displays every asynchronous interface it recognizes. Therefore, if your system has a large number of asynchronous interfaces, the running-configuration will be very long. To aggregate the asynchronous interfaces, you must assign them to a Group-Async Interface using the command **group-range**. See the "Configuring the Asynchronous Group Interface" section on page 3-7.

Group-async interfaces are templates used to control the configuration of multiple asynchronous interfaces on the gateway. Each asynchronous interface corresponds to one of the modem lines and uses the same number as its corresponding line. Configuring the asynchronous interfaces as a group-async saves you time and configuration file size.

Investigating Memory Usage

Use the **show memory summary** command to:

- Understand how memory is used for different processor and I/O memory processes.
- Identify memory fragmentation and memory leaks.
  - Memory leak—Memory that is not released back to the processor. Memory leaks are indicated by steady decreases of free memory. However, the preferred way to track memory leaks is to monitor the FreeMem variable in the OID MIB (object-identifier management information base).
  - Memory fragmentation—Indicated by the largest block of memory not being equal to the lowest block. Fragmentation increases as the numbers grow further apart.

```
Router# show memory summary

               Head    Total(b)     Used(b)     Free(b)   Lowest(b)  Largest(b)
Processor   61952B00   107664640    24210716    83453924    82827184    82866768
      I/O   40000000    67108880    28952352    38156528    38156528    38156412
.
.
.
```

The sum of the used and free memory equals the total memory. Most of the **show memory summary** command output has been removed for brevity.

Note Do not enter the **show memory summary** command with the **terminal length 0** command enabled. If you do, many screens of output might interrupt your session.

Note To learn more about management information bases (MIBs), see the online references at http://www.cisco.com/univercd/cc/td/doc/product/software/.
Select your Cisco IOS release and search under new feature documentation.

Inspecting CPU Utilization

Enter the **show process cpu** command and then the **show process cpu history** command to investigate high CPU utilization. High utilization causes network performance problems. For example, knowing when the router is running at over 50% utilization is critical. The router might start dropping packets if an unexpected traffic burst comes through or if Open Shortest Path First (OSPF) is recalculated. Fast switching can also be used to reduce CPU utilization.

```
Router# show process cpu

CPU utilization for five seconds: 0%/0%; one minute: 1%; five minutes: 1%
 PID  Runtime(ms)  Invoked  uSecs    5Sec   1Min   5Min TTY Process
   1           0    20232      0   0.00%  0.00%  0.00%   0 Load Meter
   2           0       12      0   0.00%  0.00%  0.00%   0 EST msg processing
   3      305688    23808  12839   0.00%  0.39%  0.29%   0 Check heaps
   4           0        1      0   0.00%  0.00%  0.00%   0 Chunk Manager
   5           4       10    400   0.00%  0.00%  0.00%   0 Pool Manager
   6           0        2      0   0.00%  0.00%  0.00%   0 Timers
   7         112    20205      5   0.00%  0.00%  0.00%   0 ALARM_TRIGGER_SC
   8           0        2      0   0.00%  0.00%  0.00%   0 Serial Background
   9           0        1      0   0.00%  0.00%  0.00%   0 RM PROCESS
  10           0        1      0   0.00%  0.00%  0.00%   0 RM PROCESS
  11           0        1      0   0.00%  0.00%  0.00%   0 RM PROCESS
  12           0        1      0   0.00%  0.00%  0.00%   0 RM PROCESS
  13           0        2      0   0.00%  0.00%  0.00%   0 CAS Process
  14         220     2803     78   0.00%  0.00%  0.00%   0 ARP Input
  15           0     5058      0   0.00%  0.00%  0.00%   0 HC Counter Timer
  16           0        2      0   0.00%  0.00%  0.00%   0 DDR Timers
  17           0        2      0   0.00%  0.00%  0.00%   0 Dialer event
  18           4        2   2000   0.00%  0.00%  0.00%   0 Entity MIB API
  19           0        1      0   0.00%  0.00%  0.00%   0 SERIAL A'detect
  20           0        1      0   0.00%  0.00%  0.00%   0 Critical Background
  21          72    13826      5   0.00%  0.00%  0.00%   0 Net Background
 PID  Runtime(ms)  Invoked  uSecs    5Sec   1Min   5Min TTY Process
43           0        3      0   0.00%  0.00%  0.00%   0 AAA Accounting
.
.
.
```

```
Router# show process cpu history

                                  11111
     44               11111       99999               33333
100
 90
 80
 70
 60
 50
 40
 30
 20                               *****
 10                               *****
   0....5....1....1....2....2....3....3....4....4....5....5....
             0    5    0    5    0    5    0    5    0    5

              CPU% per second (last 60 seconds)


     1
     924444444444444444434444444444344344444444443444444424444
100
 90
 80
 70
 60
 50
 40
 30
 20  *
 10  *
   0....5....1....1....2....2....3....3....4....4....5....5....
             0    5    0    5    0    5    0    5    0    5

              CPU% per minute (last 60 minutes)
             * = maximum CPU%   # = average CPU%

                                1
                          1     0
     4444444444444444444449444440
100                       *
 90                       *
 80                       *
 70                       *
 60                       *
 50                       *
 40                       *
 30                       *
 20                   *   *
 10                   *   *
   0....5....1....1....2....2....3....3....4....4....5....5....6....6....7.
             0    5    0    5    0    5    0    5    0    5    0    5    0

                  CPU% per hour (last 72 hours)
                 * = maximum CPU%   # = average CPU%
```

If you see high utilization numbers in the top line of the output, for example over 50%, inspect the columns 5Sec, 1Min, and 5Min. Find the process that uses the most CPU power.

Where to Go Next

At this point you should go to:

- Chapter 3, "Basic Configuration Using the Command-Line Interface" to commission your Cisco AS5350 or Cisco AS5400 universal gateway.

Tip The following publications are available on the Documentation CD-ROM that shipped with your gateway, or on the World Wide Web from the Cisco home page.

- For additional basic configuration information, refer to *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm. For more advanced configuration topics, refer to the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- Check *Configuring Selected 12.1 Cisco IOS Software Features*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm
- For troubleshooting information, refer to the *System Error Messages* and *Debug Command Reference* publications.

Basic Configuration Using the Command-Line Interface

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

After you have verified your basic setup, you are ready to begin configuring basic tasks that prepare your system for data call processing.

This chapter describes how to use the Cisco IOS software command-line interface (CLI) to commission your Cisco AS5350 or Cisco AS5400 universal gateway and includes the following tasks:

Note After commissioning your gateway, proceed to Chapter 4 to configure the software features that are most commonly used on your system.

Tip

- For further help with AS5350 universal gateway configurations, refer to the Cisco Technical Marketing Engineering configurations website at http://dial.cisco.com/products/as5350/as5350-configs/index.html
- For advanced configuration topics and procedures, go to *Configuring Selected 12.1 Cisco IOS Software Features*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm

  You can also view these publications on the Documentation CD-ROM that arrived with your gateway.
- If you are experienced using the Cisco IOS software, you might find the "Where to Go Next" section on page 3-42 a useful reference for configuration.

Configuring the Host Name, Password, and Time Stamps

The first configuration tasks you might want to execute are assign a host name to your Cisco AS5350 or Cisco AS5400, set an encrypted password, and turn on time stamps because:

- Assigning a host name allows you to distinguish between different network devices.
- Setting an encrypted password in the configuration file adds greater security on your gateway.
- Time stamps help you trace debug output for testing connections. Not knowing exactly when an event occurs hinders you from examining background processes.

Configure

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enters enable mode (also called privileged EXEC mode). Enters the password. You are in enable mode when the prompt changes to `Router#`.

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

Step 3	`Router(config)# hostname AS5400` `AS5400(config)#`	Changes the name of the gateway to a meaningful name. Substitute your host name for `AS5400`.
Step 4	`AS5400(config)# enable secret guessme`	Enters an enable secret password. This password provides access to privileged EXEC mode. When you type **enable** at the EXEC prompt (`AS5350>` or `AS5400>`), you must enter the enable secret password to gain access to configuration mode. Substitute your enable secret for **guessme**.

	Command	Purpose
Step 5	`AS5400(config)# service password-encryption`	Applies password encryption. When password encryption is enabled, the encrypted form of the password is displayed when a **show configuration** command is entered. **Note** You cannot recover a lost encrypted password.
Step 6	`AS5400(config)# service timestamps debug datetime msec`	Enters timestamp debugging messages to include milliseconds in the date and time stamp.
Step 7	`AS5400(config)# service timestamps log datetime msec`	Enters timestamp logging messages to include milliseconds in the date and time stamp.
Step 8	`AS5400(config)# line con 0`	Enters line configuration mode to configure the console port. You are in configuration mode when the prompt changes to `AS5350(config-line)#` or `AS5400(config-line)#`.
Step 9	`AS5400(config-line)# exec-timeout 0 0`	Prevents the gateway's EXEC facility from timing out if you do not type any information on the console screen for an extended period.
Step 10	`AS5400(config-line)# exit` `AS5400(config)#`	Exits global configuration mode.

Note The **enable password** command is obsolete. Do not use it.

Verify

To verify that you configured the right host name and passwords:

- Enter the **show configuration** command:

```
AS5400(config)# show configuration
Using 1888 out of 512000 bytes
!
version XX.X
.
.
!
hostname AS5400
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1loO/w8/
.
```

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

- Exit global configuration mode and attempt to login using the new enable secret password. The **show privilege** command shows the current security privilege level.

```
AS5400# exit

AS5400 con0 is now available
Press RETURN to get started.
AS5400> enable
Password:
AS5400# show privilege
Current privilege level is 15
AS5400#
```

Configuring Local AAA Security

Configure authentication, authorization, and accounting (AAA) to perform login authentication by using the local username database. The **login** keyword authenticates EXEC shell users. Additionally, configure PPP authentication to use the local database if the session was not already authenticated by **login**.

AAA (called triple A) is the Cisco IOS security model used on all Cisco devices. AAA provides the primary framework through which you set up access control on the Cisco AS5350 or Cisco AS5400.

The same authentication method is used on all interfaces. AAA is set up to use the local database configured on the gateway. This local database is created with the **username** configuration commands.

Step 1 Create a local login username database in global configuration mode. In this example, the administrator's username is *admin*. The remote client's login username is *Harry*.

```
AS5400(config)# username admin password adminpasshere
AS5400(config)# username Harry password Harrypasshere
```

Caution This step also prevents you from getting locked out of the gateway. If you get locked out, you must reboot the device and perform password recovery.

Step 2 Configure local AAA security in global configuration mode. You *must* enter the **aaa new-model** command before the other two authentication commands.

```
AS5400(config)# aaa new-model
AS5400(config)# aaa authentication login default local
AS5400(config)# aaa authentication ppp default if-needed local
```

Table 3-1 explains the previous configuration example.

Table 3-1 Local AAA Commands

Command	Purpose
`AS5400(config)# aaa new-model`	Initiates the AAA access control system. This command immediately locks down login and PPP authentication.

Table 3-1 Local AAA Commands (continued)

Command	Purpose
AS5400(config)# **aaa authentication login default local**	Configures AAA to perform login authentication by using the local username database. The **login** keyword authenticates EXEC shell users.
AS5400(config)# **aaa authentication ppp default if-needed local**	Configures PPP authentication to use the local database if the session was not already authenticated by **login**.

Step 3 Log in with your username and password:

```
AS5400# login

User Access Verification

Username: admin
Password:

AS5400#
```

A successful login means that your local username works on any TTY or VTY line. Do not disconnect your session until you can log in.

Note For comprehensive information about how to implement a Cisco AAA-based security environment for dial-based and router environments, see *Cisco AAA Implementation Case Study*, available online at http://www.cisco.com/univercd/cc/td/doc/cisintwk/intsolns/aaaisg/index.htm

Creating a Login Banner

A banner shows you which unit you are connected to (or are connecting through, in the case of a console server).

Step 1 Create the banner:

```
AS5400(config)# banner login |
Enter TEXT message.  End with the character '|'.
This is a secured device.
Unauthorized use is prohibited by law.
|
AS5400(config)# ^Z
AS5400#
```

Step 2 Test the banner:

```
AS5400# login

This is a secured device.
Unauthorized use is prohibited by law.

User Access Verification
```

```
Username: admin
Password:

AS5400#
```

Configuring Loopback Interfaces, Fast Ethernet Interfaces, and IP Route

To commission a basic dial access service perform the following tasks:

- Create two loopback interfaces.
- Bring up the Fast Ethernet interface.
- Add an IP route to the default gateway.

Step 1 Assign the IP addresses as in the following example, and create an IP route to the default gateway:

```
AS5400(config)# interface loopback 0
AS5400(config-if)# ip address 172.22.99.1 255.255.255.255
AS5400(config-if)# exit
AS5400(config)# interface loopback 1
AS5400(config-if)# ip address 172.22.90.1 255.255.255.0
AS5400(config-if)# exit
AS5400(config)# interface FastEthernet 0/0
AS5400(config-if)# ip address 172.28.186.55 255.255.255.240
AS5400(config-if)# no shutdown
AS5400(config-if)# exit
AS5400(config)# ip route 0.0.0.0 0.0.0.0 172.28.186.49
```

In this example:

- Interface loopback 0—Identifies with a unique and stable IP address. One unique IP address from a common block of addresses is assigned to each device in the IP network. This technique makes security-filtering easy for the Network Operations Center (NOC). One class C subnet used for device identification can support 254 distinct devices with unique loopback addresses.
- Interface loopback 1—Hosts a pool of IP addresses for the remote nodes. In this way, one route, instead of 254 routes, is summarized and propagated to the backbone. Pick the IP address for loopback 1 from the range of addresses that you will assign to the local address pool.

Step 2 Verify that the Fast Ethernet interface is up. Ping the default gateway to verify this.

```
AS5400# ping 172.28.186.49

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.28.186.49, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/4 ms
```

This step verifies that you have IP connectivity with another device on the subnet. If the ping succeeds to the default gateway, try pinging the DNS server in your backbone. Make sure that the backbone routers are configured to get to the gateway; otherwise, the ping does not work. Configure the backbone routers to support the routes to the networks you are using.

Note An 80% ping-success rate is normal for the first time you ping an external device. The Cisco AS5350 and Cisco AS5400 do not have an Address Resolution Protocol (ARP) entry for the external device. A 100% success rate is achieved the next time you ping the device.

Configuring the Asynchronous Group Interface

Asynchronous group interfaces allow administrators to easily configure a large number of asynchronous interfaces by allowing them to clone from one managed copy. This can also reduce the number of lines in the configuration, because each individual asynchronous interface configuration can be replaced by at least one group-async. To assign the asynchronous interfaces to a group-async interface, first determine the number of asynchronous lines that need to be aggregated. This can be determined from the running configuration.

Notice that, in the "Checking the Initial Running Configuration" section on page 2-5, the asynchronous lines are numbered from 0 to 107.

Configure

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters the **enable** command. Enters your password. You are in privileged EXEC mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5540(config)#` or `AS5350(config)#`.

Step 3	`AS5400(config)# interface group-async 1` `AS5400(config-if)#`	Places all asynchronous interfaces in a single group, so that you configure the same parameters quickly on all interfaces at one time.

Step 4	`AS5400(config-if)# group-range slot/port slot/port`
	`Building configuration...`
	`AS5400(config-if)#`
		Defines the slot/port group range of the interface. The range that you specify depends on the number of asynchronous interfaces you have on your gateway. If your gateway has 108 asynchronous interfaces, you can specify **group-range 1/1 1/107.**

Step 5	`AS5400(config-if)# Ctrl-Z` `AS5400#`	Returns to enable mode.

Verify

To verify your group interface configuration:

- Enter the **show interface async** command to check if the protocol is up:

  `AS5400# show interface async 4/0`

```
Async4/00 is down, line protocol is down
  modem(slot/port)=4/0, state=IDLE
  dsx1(slot/unit/channel)=NONE, status=VDEV_STATUS_UNLOCKED
  Hardware is Async Serial
  MTU 1500 bytes, BW 115 Kbit, DLY 100000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation SLIP, loopback not set
  DTR is pulsed for 5 seconds on reset
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/10/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/32 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 86 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 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
     0 carrier transitions
```

Tip If you are having trouble:

- Enter the **show async status** command to check for errors and local and remote addresses:

```
AS5400# show async status

Async protocol statistics:

Int    Local            Remote    Qd      InPack   OutPac Inerr  Drops  MTU
 1/00  42.1.1.1         None       0      0        0      0      0      1500
 1/01  192.168.10.100   None       0      0        0      0      0      1500
 1/02  192.168.10.100   None       0      0        0      0      0      1500
 1/03  192.168.10.100   None       0      0        0      0      0      1500
 1/04  192.168.10.100   None       0      0        0      0      0      1500
 1/05  192.168.10.100   None       0      0        0      0      0      1500
 4/52  192.168.10.100   None       0      0        0      0      0      1500
.
.
.
*6/00  192.168.10.100   34.6.42.1  0      130      50     5      0      1500
*6/01  192.168.10.100   34.6.92.1  0      131      53     5      0      1500
*6/02  192.168.10.100   34.5.92.1  0      130      50     5      0      1500
*6/03  192.168.10.100   34.4.14.1  0      116      40     4      0      1500
.
.
.
*7/102 192.168.10.100    34.1.89.1  0      119     40     4      0      1500
*7/103  192.168.10.100   34.4.34.1  0      118     40     4      0      1500
*7/104  192.168.10.100   34.1.67.1  0      105     40     4      0      1500
 7/105  192.168.10.100   None       0      0       0      0      0      1500
*7/106  192.168.10.100   34.4.90.1  0      119     40     4      0      1500
*7/107  192.168.10.100   34.1.42.1  0      119     40     4      0      1500

 Rcvd: 25762 packets, 1052214 bytes
    0 format errors, 891 checksum errors, 0 overrun
 Sent: 8891 packets, 222264 bytes, 0 dropped
```

Configuring Channelized T1 and E1 Trunk Cards

On a Cisco AS5350 or Cisco AS5400, you can allocate the available channels for channelized E1 and T1 in the following ways:

- All channels can be configured to support ISDN PRI.
- If you are not running ISDN PRI, all channels can be configured to support robbed-bit signaling (also known as channel-associated signaling).
- All channels can be configured in a single channel group.
- Mix and match channels supporting ISDN PRI, channel grouping, and channel-associated signaling (CAS).
- Mix and match channels supporting ISDN PRI, channel grouping, and robbed-bit signaling across the same T1 line. For example, on the same channelized T1 you can configure the **pri-group timeslots 1-10,24** command, **channel-group 11 timeslots 11-16** command, and **ds0-group 17 timeslots 17-23 type e&m-fgb** command. This is an unusual configuration because it requires you to align the correct range of timeslots on both ends of the connection.

Note For configuration information about leased-line or nondial use, see the Cisco IOS publication *Configuration Fundamentals Configuration Guide* available online.

Note You can install, in one Cisco AS5350 or Cisco AS5400 chassis, a maximum of two T1 trunk cards, two E1 trunk cards, or one CT3 trunk card.

Controller Numbering

The CT1/E1 controller numbering convention is dfc-slot/port in CLI commands. Trunk-card slot numbering starts from the motherboard and works up from left to right. Slot **0** is reserved for the motherboard. CT1/E1 trunk-card slots are numbered sequentially from **1** to **7**. Port numbering is from **0** to **7**.

Configure

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters enable mode. Enters the password. You have entered enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

	Command (continued)	Purpose (continued)
Step 3	AS5400(config)# **controller** [**t1** | **e1**] *slot/port* AS5400(config-controller)#	Enters controller configuration mode to configure your controller slot and port. Slot values range from **1** to **7**. Port values range from **0** to **7** for T1 and E1.
Step 4	AS5400(config-controller)# **framing esf**	Enters your telco's framing type: **esf** or **sf**.
Step 5	AS5400(config-controller)# **linecode b8zs**	Enters your telco's line code type: **ami** or **b8zs**.
Step 6	AS5400(config-controller)# **Ctrl-Z** AS5400#	Returns to enable mode.

Verify

To verify that your controller is up and running and no alarms have been reported:

- Enter the **show controller** command and specify the controller type, slot, and port numbers:

```
AS5400# show controller t1 1/7

T1 1/7 is up.
  No alarms detected.
  Framing is ESF, Line Code is B8ZS, Clock Source is Line Primary.
  Version info of slot 2:  HW: 2, Firmware: 14, NEAT PLD: 13, NR Bus PLD: 19
  Data in current interval (476 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Total Data (last 24 hours)
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

- Note the following:
  - The controller must report being up.
  - No errors should be reported.

  The TDM subsystem troubleshooting commands are not used during normal system operation. Instead, the Cisco IOS commands show the current status and settings of the TDM backplane, enable debug output for display to the user when TDM programming occurs, and provide a set of test commands to test the functionality of the TDM path. TDM commands are generally used only by a Cisco technical support representative during troubleshooting of data continuity problems.

Note For details on the TDM feature, refer to the Cisco IOS software configuration guide and command reference publications. These publications are available on the Documentation CD-ROM that ships with your gateway and on the World Wide Web from the Cisco home page, or you can order printed copies. See "Obtaining Documentation" on page xvi.

Tip If you are having trouble:

- First decide if the problem is due to the T1 or E1 line or with a particular channel group. If the problem is with a single channel group, you have a potential interface problem. If the problem is with the T1 or E1 line, or with all channel groups, you have a potential controller problem. (See the "Configuring ISDN PRI" section on page 3-13.)
- To troubleshoot your E1 or T1 controllers, first check that the configuration is correct. The framing type and line code should match to what the service provider has specified. Then check channel group and PRI-group configurations, especially to verify that the timeslots and speeds are what the service provider has specified. At this point, the **show controller t1** or **show controller e1** commands should be used to check for T1 or E1 errors. Use the command several times to determine if error counters are increasing, or if the line status is continually changing. If this is occurring, you need to work with the service provider.
- Another common reason for failure is the **dial-tdm-clock priority** setting. The default setting is a free-running clock that causes clock slip problems if not set properly. (See the "Configuring Clocking" section on page 3-31.)

Configuring a Channelized T3 Trunk Card

Your AS54-DFC-CT3 trunk card offers 28 individual T1 channels (bundled in the T3) for serial transmission of data. The CT3 link supports the maintenance data link channel in C-Bit parity mode and also payload and network loopbacks. The T1s multiplexed in the CT3 link support facilities data link (FDL) in extended super frame (ESF) framing.

Additionally, you can allocate your CT1 channels as described in the "Configuring Channelized T1 and E1 Trunk Cards" section on page 3-9.

Controller Numbering

The CT3 controller numbering convention is dfc-slot/port in CLI commands. Trunk-card slot numbering starts from the motherboard and works up from left to right. Slot **0** is reserved for the motherboard. Trunk-card slots are numbered sequentially from **1** to **7**. Port number value is always **0**.

Under the CT3, the CT1 controller numbering convention is dfc-slot/port:channel in CLI commands. Port numbering values range from **1** to **28**.

Configure

	Command	Purpose
Step 1	AS5400> **enable** Password: *password* AS5400#	Enters enable mode. Enters the password. You are in enable mode when the prompt changes to AS5350# or AS5400#.
Step 2	AS5400# **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. AS5400(config)#	Enters global configuration mode. You are in global configuration mode when the prompt changes to AS5350(config)# or AS5400(config)#.
Step 3	AS5400(config)# **controller t3 1/0** AS5400(config-controller)#	Enters controller configuration mode to configure your T3 controller for slot **1** port **0**. Slot values range from **1** to **7**. Port number is always **0**.
Step 4	AS5400(config-controller)# **framing c-bit**	Enters your telco's framing type: **c-bit** or **m23**.
Step 5	AS5400(config-controller)# **clock source line**	Enters your clock source: **internal** or **line**.
Step 6	AS5400(config-controller)# **cablelength 450**	Enters your cablelength: values range from **0** to **450** feet.
Step 7	AS5400(config-controller)# **t1 1-28 controller** or AS5400(config-controller)# **t1 1-10,15-20,23 controller**	Configures your T1 controllers. Range is **1** to **28**. In this instance, all 28 T1s are configured at once. or Omits specified T1 controllers while provisioning others. In this instance, T1 controllers 11-14, 21, 22, and 24-28 are unprovisioned. **Note** This CLI command is backward compatible only.
Step 8	AS5400(config-controller)# **Ctrl-Z** AS5400#	Returns to enable mode.

Verify

To verify that your controller is up and running and no alarms have been reported:

- Enter the **show controller** command and specify the controller type, slot, and port numbers:

```
AS5400# show controller t3 1/0

T3 1/0 is down.
  Applique type is Channelized T3
  Transmitter is sending remote alarm.
  Receiver has loss of signal.
  FEAC code received: No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Line
  Data in current interval (330 seconds elapsed):
     0 Line Code Violations, 0 P-bit Coding Violation
     0 C-bit Coding Violation, 0 P-bit Err Secs
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
     0 Unavailable Secs, 0 Line Errored Secs
     0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  Total Data (last 24 hours)
```

```
9944 Line Code Violations, 0 P-bit Coding Violation,
0 C-bit Coding Violation, 0 P-bit Err Secs,
0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
86400 Unavailable Secs, 0 Line Errored Secs,
0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
```

Tip If you are having trouble, make sure the **show controller** output is not reporting alarms or violations. Also, see "Configuring Channelized T1 and E1 Trunk Cards" section on page 3-9.

Configuring ISDN PRI

Your ISDN PRI interfaces are configured on the following Cisco AS5350 and Cisco AS5400 trunk cards: AS54-DFC-8CT1, AS54-DFC-8CE1 and AS54-DFC-CT3. ISDN provides out-of-band signaling using the D channel for signaling and the B channels for user data.

Channelized T1 ISDN PRI offers 23 B channels and 1 D channel. Channelized E1 ISDN PRI offers 30 B channels and 1 D channel. Channel 24 is the D channel for T1, and channel 16 is the D channel for E1.

For a complete description of the commands mentioned in this chapter, refer to the *Dial Technologies Command Reference,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm.

Request PRI Line and Switch Configuration from a Telco Service Provider

Before configuring ISDN PRI on your Cisco router, you need to order a correctly provisioned ISDN PRI line from your telecommunications service provider.

This process varies from provider to provider on a national and international basis. However, some general guidelines follow:

- Determine if the outgoing B channel calls are made in ascending or descending order. The Cisco IOS software default is descending order; however, if the switch from the service providers is configured for outgoing calls made in ascending order, the router can be configured to match the switch configuration of the service provider.
- Ask for delivery of calling line identification. Providers sometimes call this CLI or automatic number identification (ANI).
- If the gateway will be attached to an ISDN bus (to which other ISDN devices might be attached), ask for point-to-multipoint service (subaddressing is required) and a voice-and-data line.

Table 3-2 provides a sample of the CT1 configuration attributes you might request for a PRI switch.

Table 3-2 CT1 Configuration Attributes

Attribute	Value
Line format	Extended Superframe Format (ESF)
Line coding	Binary 8-zero substitution (B8ZS)
Call type	23 incoming channels and 23 outgoing channels
Speed	64 kbps
Call-by-call capability	Enabled

Table 3-2 CT1 Configuration Attributes (continued)

Attribute	Value
Channels	23 B + D
Trunk selection sequence	Either ascending order (from 1 to 23) or descending order (from 23 to 1)
B + D glare	Yield
Directory numbers	Only 1 directory number assigned by service provider
SPIDs required?	None

Controller Numbering

The CT1/E1 controller numbering convention is dfc-slot/port in CLI commands. Trunk-card slot numbering starts from the motherboard and works up from left to right. Slot **0** is reserved for the motherboard. CT1/E1 trunk-card slots are numbered sequentially from **1** to **7**. Port numbering is from **0** to **7**.

The CT3 controller numbering convention is dfc-slot/port in CLI commands. Trunk-card slot numbering starts from the motherboard and works up from left to right. Slot **0** is reserved for the motherboard. Trunk-card slots are numbered sequentially from **1** to **7**. Port number value is always **0**.

Under the CT3, the CT1 controller numbering convention is dfc-slot/port:channel in CLI commands. Port numbering values range from **1** to **28**.

Configure

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters enable mode. Enters the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 3	`AS5400(config)# isdn switch-type` `switch-type`	Selects a service provider switch type that accommodates PRI. (Refer to Table 3-3 for a list of supported switch type keywords.)

	Command	Purpose
Step 4	`AS5400(config)# controller t1 1/0`	Specifies T1 controller dfc-slot, port number, and channel. On the CT3 trunk card, port-number values range from **1** to **28**. On the CT1 trunk card, port-number values range from **0** to **7**.
	or	or
	`AS5400(config)# controller e1 1/0`	Specifies E1 controller dfc-slot, port number, and channel. On the CE1 trunk card, port number values range from **0** to **7**.
		Note After you configure the CT1or CE1 controller, a corresponding D-channel serial interface is created instantly. See the "Configuring the D Channels for ISDN Signaling" section on page 3-23 to learn how to configure your D channel.
Step 5	`AS5400(config-controller)# framing esf`	Enters framing type for the CT3 or CT1 trunk card.
	or	or
	`AS5400(config-controller)# framing crc4`	Enters framing type for the CE1 trunk card.
Step 6	`AS5400(config-controller)# linecode b8zs`	Defines the line code as binary 8 zero substitution (B8ZS) for the CT3 or CT1 trunk card.
	or	or
	`AS5400(config-controller)# linecode hdb3`	Defines the line code as high-density bipolar 3 (HDB3) for the CE1 trunk card.
Step 7	`AS5400(config-controller)# pri-group [timeslots range]`[1]	Configures ISDN PRI. If you do not specify the timeslots, the controller is configured for 23 B channels and 1 D channel.
Step 8	`AS5400(config-controller)# Ctrl-Z` `AS5400#`	Returns to enable mode.

1. On CT1, timeslots range 1 to 24. You can specify a range of timeslots (for example, **pri-group timeslots 12-24**) if other timeslots are used for non-PRI channel groups.

For CT1 ISDN PRI—If you do not specify the timeslots, the specified controller is configured for 23 B channels and 1 D channel. B channel numbers range **1** to **23**; channel 24 is the D channel for T1. Corresponding serial interface numbers range **0** to **23**. In commands, the D channel is **interface serial** *slot/port***:23**—for example, **interface serial 1/0:23**.

For CE1 ISDN PRI—If you do not specify the timeslots, the specified controller is configured for 30 B channels and 1 D channel. B channel numbers range **1** to **31**; channel 16 is the D channel for E1. Corresponding serial interface numbers range **0** to **30**. In commands, the D channel is **interface serial** *slot/port***:15**—for example, **interface serial 1/0:15**.

Table 3-3 ISDN Service-Provider PRI Switch Types

Area	Keyword	Switch Type
none	none	No switch defined
Australia	**primary-ts014**	Australia PRI switches
Europe	**primary-net5**	European, New Zealand, and Asia ISDN PRI switches (covers the Euro-ISDN E-DSS1 signaling system and is European Telecommunication Standards Institute or ETSI-compliant)
Japan	**primary-ntt**	Japanese ISDN PRI switches
North America	**primary-4ess**	AT&T 4ESS switch type for the United States
	primary-5ess	AT&T 5ESS switch type for the United States
	primary-dms100	NT DMS-100 switch type for the United States
	primary-ni	National ISDN switch type

Verify

To verify that you have configured the interfaces correctly:

- Enter the **show controller t3** command and specify the slot and port numbers. Verify that the controller is up and that you do not have excessive errors; otherwise your controller might go down frequently. This could indicate switch problems.

```
AS5400# show controller t3 1/0

T3 1/0 is up.
  Applique type is Channelized T3
  No alarms detected.
  MDL transmission is disabled

  FEAC code received:No code is being received
  Framing is C-BIT Parity, Line Code is B3ZS, Clock Source is Internal
  Data in current interval (270 seconds elapsed):
     0 Line Code Violations, 0 P-bit Coding Violation
     0 C-bit Coding Violation, 0 P-bit Err Secs
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
     0 Unavailable Secs, 0 Line Errored Secs
     0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  Total Data (last 32 15 minute intervals):
     0 Line Code Violations, 0 P-bit Coding Violation,
     0 C-bit Coding Violation, 0 P-bit Err Secs,
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
     0 Unavailable Secs, 0 Line Errored Secs,
     0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
```

- Enter the **show controller t1** command and specify the slot and port numbers.

```
AS5400# show controller t1 1/0

T1 1/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info of slot 1: HW:768, PLD Rev:4
  Framer Version:0x8

Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x041,
 Board Hardware Version 3.0, Item Number 73-4089-03,
 Board Revision 05, Serial Number JAB99432626,
 PLD/ISP Version 0.1,  Manufacture Date 11-Nov-1999.

  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (264 seconds elapsed):
     3 Line Code Violations, 1 Path Code Violations
     5 Slip Secs, 0 Fr Loss Secs, 1 Line Err Secs, 1 Degraded Mins
     5 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
.
.
.
```

- Enter the **show isdn status** command to view layer status information.

```
AS5400# show isdn status

Global ISDN Switchtype = primary-5ess
ISDN Serial1/0:1:23 interface
    dsl 0, interface ISDN Switchtype = primary-5ess
    Layer 1 Status:
       ACTIVE
    Layer 2 Status:
       TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
       0 Active Layer 3 Call(s)
    Activated dsl 0 CCBs = 0
    The Free Channel Mask: 0x807FFFFF
.
.
.
ISDN Serial1/0:28:23 interface
    dsl 27, interface ISDN Switchtype = primary-5ess
    Layer 1 Status:
       ACTIVE
    Layer 2 Status:
       TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
       0 Active Layer 3 Call(s)
    Activated dsl 27 CCBs = 0
    The Free Channel Mask: 0x807FFFFF
    Total Allocated ISDN CCBs = 0
```

Note the following information for Serial 1/0:1:23 (the first half of the messages):

- Layer 1 Status should be “Active.”
- Layer 2 Status should be “Multiple_Frame_Established.” (It might take several seconds for Layer 2 status to appear.)
- Layer 3 Status should be “0 Active Layer 3 Call(s).”
- The second half of the messages display information for Serial 1/0:28:23.

- Monitor ISDN channels and service by entering the **show isdn service** command:

```
AS5400# show isdn service

PRI Channel Statistics:
ISDN Se0:23, Channel (1-31)
  Activated dsl 0
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 0 0 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se1:23, Channel (1-31)
  Activated dsl 1
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se2:23, Channel (1-31)
  Activated dsl 2
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 0 0 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se3:23, Channel (1-31)
  Activated dsl 3
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se4:23, Channel (1-31)
  Activated dsl 4
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se5:23, Channel (1-31)
  Activated dsl 5
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 0 0 0 0 0 0 0 0 0 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se6:23, Channel (1-31)
  Activated dsl 6
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
ISDN Se7:23, Channel (1-31)
  Activated dsl 7
  State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint)
  2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 3 3 3 3 3 3 3 3
  Channel (1-31) Service (0=Inservice 1=Maint 2=Outofservice)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2 2 2 2
```

Note Your Cisco AS5350 or Cisco AS5400 supports a total of 248 ISDN channels per ingress trunk card. If you are configuring individual T1 channels of your CT3 for backup links or serial backhaul connections, the CT1s must be configured into channel-groups—each channel-group using 24 timeslots or channels. For example, to configure 6 CT1s (6x24), 144 ISDN channels are in use leaving a remainder of 104 (248–144) channels for ISDN use. See the "Configuring ISDN PRI" section on page 3-13.

In the following **show running-config** example, six CT1s are configured into channel-groups:

```
AS5400# show running-config

Building configuration...

Current configuration:
!
! Last configuration change at 15:49:30 UTC Mon Apr 3 2000 by admin
! NVRAM config last updated at 01:35:05 UTC Fri Mar 17 2000 by admin
!
version 12.0
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
---text omitted---
!
controller T3 1/0
 framing m23
 clock source line
 t1 1-28 controller
!
controller T1 1/0:11
 framing esf
 channel-group 20 timeslots 1-24 speed 64
!
controller T1 1/0:12
 framing esf
 channel-group 20 timeslots 1-24 speed 64
!
controller T1 1/0:13
 framing esf
 channel-group 20 timeslots 1-24 speed 64
!
controller T1 1/0:14
 framing esf
 channel-group 20 timeslots 1-24 speed 64
!
controller T1 1/0:15
 framing esf
 channel-group 20 timeslots 1-24 speed 64
!
controller T1 1/0:16
 framing esf
 channel-group 20 timeslots 1-24 speed 64
```

Tip If you are having trouble:

- Make sure the cable connection is not loose or disconnected if the Layer 1 Status is "Deactivated." This status message indicates a problem at the physical layer.
- There may be a problem with your telco or the framing and line code types you entered may not match your telco's. A Layer 2 error indicates that the gateway cannot communicate with the telco. There is a problem at the data link layer.

Configuring DS0 Trunk Group Dial Out

The DS0 Trunk Group Dial Out feature adds functionality that enhances outbound call routing by giving the user control over individual DS0s for outbound calls. Previous to this feature, outbound DS0s could not be configured separately from DS1s. The dial out capabilities of a DS1 applied to all DS0s under that DS1.

Currently, the aggregation of DS1s into trunk groups is done via the Trunk Group Resource Manager (TGRM). The DS0 Trunk Group Dial Out feature enables the TGRM subsystem to aggregate DS0s into trunk groups also. The dial out capabilities of these DS0 trunk groups can then be configured directly at the DS0 level, via the TGRM CLI and by setting the Authentication Authorization and Accounting (AAA) attributes.

The configuration of DS0s for outbound calls enables the Dial on Demand feature to initiate outbound calls over a set of B channels.

DS0 Dial Out Trunk Groups are configured on a Network Access Server (NAS). They support both digital and asynchronous calls and can be configured for the following types of circuits.

- Integrated Services Digital Network (ISDN)
  - Primary Rate Interface (PRI)
  - Non-Facility Associated Signaling (NFAS)

A trunk group is a logical grouping of multiple T1/E1 interfaces with the same signaling characteristics. A single trunk group can contain up to 64 trunks. Each trunk group can consist of DS0s from different circuits, but each individual DS0 can belong to only one trunk group. Trunk groups configured for ISDN can consist of both PRI and NFAS interfaces.

Note DS0 Dial Out Trunk Groups can be provisioned for dial out only at present and should not be provisioned as targets of dial-peers.

Note DS0 Dial Out Trunk Groups do not support for voice interfaces.

Trunk Group Resource Manager

The Trunk Group Resource Manager (TGRM) supports the logical grouping, configuration, and joint management of one or more interfaces. The TGRM is used to store configuration information and to accept or select an interface from a trunk group when requested.

A trunk group is provisioned as the target of a dial peer or a dial out profile on an AAA server, and the TGRM transparently selects the specific interface and channels to use for incoming or outgoing calls. Trunks are selected based on the trunk that is least used (default configuration) or the hunt-scheme configured.

Using trunk groups simplifies the task of configuring dial peers and interfaces, and also enables the dynamic selection of interfaces as needed in the access server.

A trunk group can include any number of interfaces, but all the interfaces in a trunk group must use the same type of signaling.

The TGRM subsystem has been enhanced to add fractional trunks to a trunk group. A fractional trunk is a single DS0 or a group of DS0s from a trunk.

Configure

The **trunk-group** command assigns a trunk to a trunk group by specifying the trunk group *label* parameter and optionally setting the *preference* parameter.

The DS0 Dial Out Trunk Group feature adds two new optional keywords:

- **timeslots** <*list of timeslots*>
- **preference** <*preference*>

The **timeslots** keyword allows you to selectively add DS0s from a signaling circuit. Fractional trunk-groups are configured from the controller configuration mode only (as a PRI serial interface may represent multiple member interfaces, including NFAS). If the **timeslots** option is not specified, all the DS0s in the signaling circuit are assigned to the trunk-group.

The **preference** keyword is configured after the **timeslots** option and is visible only when the **timeslots** option is used. This helps to differentiate between the *list of timeslots* number and the *preference* number.

The following example shows the syntax for configuring selected DS0s using the **timeslots** keyword and the **preference** keyword.

```
trunk-group <label> timeslot <list of timeslots> preference <preference>
```

The following example shows the syntax for configuring all the DS0s in the signaling circuit:

```
trunk-group <label> <preference>
```

Syntax Parameter Descriptions

label	Trunk group label. Maximum length of the trunk group label is 127 alphanumeric characters.
list of timeslots	List of the interfaces from the signalling circuit to be added to the trunk group. Range is 1 to 64.
preference	Priority of the trunk group member in a trunk group. Range is from 1 (highest priority) to 64 (lowest priority). *Preference* can be used to sort a list of trunks in order. A trunk with no *preference* is given the highest preference.

The following examples show the configuration steps for PRI signalling. Controller T1 3 is a trunk configured for PRI.

PRI Trunk Configuration

Step 1 Configure framing, clock source, DS0 group, etc.

```
AS5400(config)#controller T1 3
AS5400(config-controller)#framing esf
AS5400(config-controller)#clock source line secondary 3
AS5400(config-controller)#linecode b8zs
AS5400(config-controller)#pri-group timeslots 1-24
AS5400(config-controller)#!
```

Step 2 Configure trunk group label.

```
AS5400(config)#interface Serial3:23
AS5400(config-if)#no ip address
AS5400(config-if)#trunk-group PRI-TRUNK-GROUP
```

Note The **timeslots** option is NOT available in the serial interface configuration mode since a serial interface may represent an NFAS serial interface.

Step 3 Configure timeslots and preference.

```
AS5400(config)#controller T1 3
AS5400(config-controller)#framing esf
AS5400(config-controller)#clock source line secondary 3
AS5400(config-controller)#linecode b8zs
AS5400(config-controller)#pri-group timeslots 1-24
AS5400(config-controller)#trunk-group PRI-TRUNK-GROUP-1  timeslots 1-10
AS5400(config-controller)#trunk-group PRI-TRUNK-GROUP-2  timeslots 11-15
AS5400(config-controller)#trunk-group PRI-TRUNK-GROUP-3  timeslots 20-22 preference 10
```

Note When a PRI/NFAS trunk is fractionally added to a trunk-group, the **timeslots** keyword is compulsory.

Verify

The **show trunk group** command displays the DS0s that belong to a particular trunk group. A trunk-group can be a group of DS0s from various signaling channels.

Show Trunk Group Example 2 – Trunk Group with PRI Trunks

```
AS5400#show trunk group pri-tg
Trunk group: pri-tg
         Description:
         trunk group label: pri-tg

         Translation profile (Incoming):
         Translation profile (Outgoing):

         Hunt Scheme is least-used
         Max Calls (Incoming):   NOT-SET (Any)   NOT-SET (Voice) NOT-SET (Data)
         Max Calls (Outgoing):   NOT-SET (Any)   NOT-SET (Voice) NOT-SET (Data)
         Retries: 0

         Trunk 2/1:23     Preference 10
```

```
        Channels :  1-23
        Total channels available : 23
        Data = 0, Voice = 0, Modem = 0, Pending = 0, Free = 23
Total calls for trunk group: Data = 0, Voice = 0, Modem = 0
                             Pend = 0, Free = 23

advertise_flag 0x00000040, capacity timer 25 sec tripl_config_mask 0x00000000
AC_curr 24, FD_curr 0, SD_curr 0

succ_curr 0 tot_curr 0
succ_report 0 tot_report 0
changed 0 replacement position 0
```

Configuring the D Channels for ISDN Signaling

The ISDN D channels carry the control and signaling information for your ISDN calls—for both circuit-switched data calls, and analog modem calls.

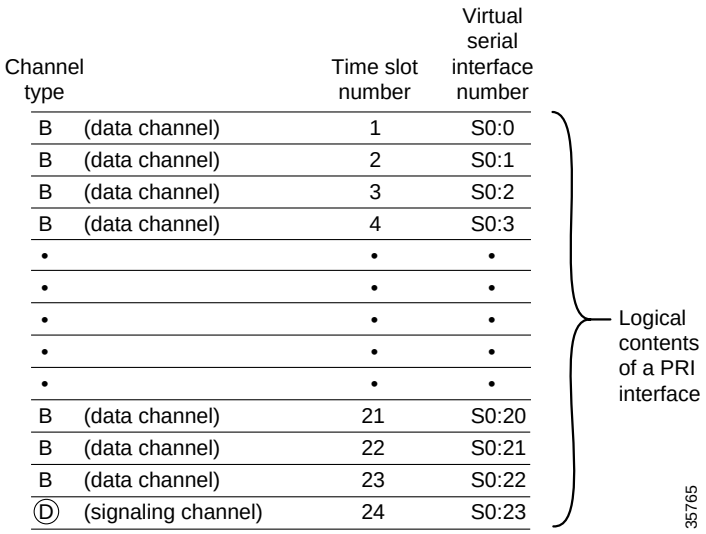
The D channel notifies the central office switch to send the incoming call to particular timeslots on the Cisco gateway or router. Each one of the B channels carries data or voice. The D channel carries signaling for the B channels. The D channel identifies if the call is a circuit switched digital call or an analog modem call. Analog modem calls are decoded and then get sent off to the onboard modems. Circuit-switched digital calls are directly relayed off to the ISDN processor in the gateway.

When you configured your ISDN PRI on the CT1 or CE1 controller, you automatically created a serial interface that corresponds to the PRI group timeslots. This interface is a logical entity that is associated with the specific controller. After the serial interface is created, you must configure the D channel serial interface that carries signaling. The configuration applies to all the PRI B channels (timeslots) for that pri group.

Figure 3-1 shows the logical contents of a ISDN PRI interface used in a T1 network configuration. The logical contents includes 23 B channels, one D channel, 24 timeslots, and 24 virtual serial interfaces (total number of Bs + D).

Note To allow a single D channel to control multiple PRI interfaces, see the "Configuring the D Channels for ISDN Signaling" section on page 3-23.

Figure 3-1 Logical Relationship of ISDN PRI Components for T1



Note When you configure your CT1 controller for an NFAS backup D channel, a serial interface is automatically created only when your primary D channel fails. See the "Configuring the D Channels for ISDN Signaling" section on page 3-23.

Configure

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters enable mode. Enters the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 3	`AS5400(config)# interface serial 1/0:23` `AS5400(config-if)#`	Enters serial interface configuration mode. After configuring the CT1 controller, a corresponding D channel serial interface is automatically created. For example, serial interface **1/0:23** is the D channel for CT1 controller **1**. You must configure each serial interface to receive incoming and send outgoing signaling. **Note** On a CE1 PRI line, the serial interface is 1/0:15.
Step 4	`AS5400(config-if)# ip address 172.16.254.254 255.255.255.0`	Assigns an IP address and subnet mask to the interface.

	Command	Purpose
Step 5	`AS5400(config-if)# isdn incoming-voice modem`	Configures all incoming voice calls. **Note** This command has two possible keywords: **data** and **modem**. You must use the **modem** keyword to enable both modem and voice calls. The **modem** keyword represents bearer capabilities of speech.
Step 6	`AS5400(config-if)# exit`	Exits interface configuration mode.

Verify

To verify your D channel configuration:

- Enter the **show interface serial** command and make sure the line protocol is up and you are using the correct IP interface. Also, make sure that excessive errors are not being reported.

```
AS5400# show interface serial 1/0:23

Serial1/0:23 is up, line protocol is up (spoofing)
  Hardware is DSX1
  Internet address is 172.16.254.254/16
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set
  Last input 00:00:03, output never, output hang never
  Last clearing of "show interface" counters 00:00:01
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  1 minute input rate 0 bits/sec, 0 packets/sec
  1 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 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
     0 carrier transitions
  Timeslot(s) Used:24, Transmitter delay is 0 flags
AS5400#
```

Tip If you are having trouble:

- Make sure the serial interface and protocol are up by entering the **show interface serial** command.
- Check the IP address.

```
AS5400# show interface serial 1/0:23

Serial1/0:23 is up, line protocol is up (spoofing)
  Hardware is DSX1
  Internet address is 172.16.254.254/16
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set
  Last input 00:00:07, output never, output hang never
  Last clearing of "show interface" counters 00:00:06
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  1 minute input rate 0 bits/sec, 0 packets/sec
  1 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 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
     0 carrier transitions
  Timeslot(s) Used:24, Transmitter delay is 0 flags
AS5400#
```

Configuring the Universal Port Card and Lines

Rather than the more traditional line/modem one-to-one correspondence, lines are mapped to a Service Process Element (SPE) that resides on the universal port card. Associated SPE firmware serves a function similar to modem code on a MICA modem.

One SPE provides services for multiple ports. Busyout and shutdown can be configured at the SPE or port level. There are several universal port cards, each with a different number or ports, available for the Cisco AS5350 and Cisco AS5400.

The universal port card performs the following functions:

- Converts pulse code modulation (PCM) bitstreams to digital packet data
- Forwards converted and packetized data to the main processor, which examines the data and forwards it to the backhaul egress interface
- Supports all modem standards (such as V.34 and V.42*bis*) and features, including dial-in and dial-out

Note For further information, refer to Chapter 5, "Managing and Troubleshooting the Universal Port Card."

For detailed information about CLI commands supported on the universal port card, refer to *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/. Select your Cisco IOS release and search for this title.

SPE Firmware

SPE firmware is automatically downloaded to a universal port card from the Cisco AS5350 or Cisco AS5400 when you boot the system for the first time or when you insert a universal port card while the system is operating. When you insert cards while the system is operating, the Cisco IOS image recognizes the cards and downloads the required firmware to the cards.

The SPE firmware image is bundled with the gateway Cisco IOS image. The SPE firmware image uses an *auto detect* mechanism, which enables the universal port card to service multiple call types. An SPE detects the call type and automatically configures itself for that operation. The firmware is upgradable independent of Cisco IOS upgrades, and different firmware versions can be configured to run on SPEs in the same card.

The universal port card supports the modem standards and features listed in Table 3-4.

Table 3-4 Modem Standards and Supported Features

Feature	Description
Carrier protocols	ITU V.23 at 75/1200 bps Telcordia Technologies (formerly Bellcore) 103 at 300 bps ITU V.21 at 300 bps ITU V.22 at 1200 bps Telcordia Technologies (formerly Bellcore) 212A at 1200 bps ITU V.22*bis* at 2400 bps ITU V.32 up to 9600 bps ITU V.32*bis* up to 14,400 bps V.32 turbo up to 19,200 bps V.FC up to 28,800 bps V.34 up to 28,800 bps V.34+ up to 33.6 bps TIA/ITU V.90 K56flex
Error-correcting link-access protocols	V.42 LAPM, MNP 2-4
Compression protocols	V.42*bis* (includes MNP 5)
Command interface	Superset of the AT command set

Table 3-4 Modem Standards and Supported Features (continued)

Feature	Description
In-band signaling/tone generation and detection	DTMF generation DTMF detection MF generation MF detection
Other	Out-of-band access for management PPP and SLIP framing

Configure

Configure the lines and ports to allow users to dial in to your network.

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters the **enable** command. Enters your password. You are in privileged EXEC mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 3	`AS5400(config)# spe country country name`	Specifies the country to set the universal-port-card parameters (including country code and encoding). This setting is applied at the system level. All universal port cards use the same country code. The default is **usa** if the gateway is configured with T1 interfaces and **e1-default** if the gateway is configured with E1 interfaces. Use the **no** form of this command to set the country code to the default of domestic. **Note** All sessions on all universal port cards in all slots must be IDLE for this command to execute.
Step 4	`AS5400(config)# line slot/port slot/port` `AS5400(config-line)#`	Enters the numbers of the ports to configure. If you wish to configure 108 ports on slot 3, enter **line 3/00 3/107**. If you wish to configure 324 ports on slots 3-5, enter **line 3/00 5/107**.
Step 5	`AS5400(config-line)# transport input all`	Allows all protocols to be used when connecting to the line.
Step 6	`AS5400(config-line)# autoselect ppp`	Enables remote IP users running a PPP application to dial in, bypass the EXEC facility, and connect directly to the network.

	Command	Purpose
Step 7	`AS5400(config-line)# modem inout`	Enables incoming and outgoing calls.
Step 8	`AS5400(config-line)# Ctrl-Z` `AS5400#`	Returns to enable mode.

Modems and lines are configured after:

- The ISDN channels are operational
- POTS telephone calls are successfully routed to the modems

Each modem is mapped to a dedicated asynchronous line inside the gateway. After the modem inout command is applied to the lines, the gateway is ready to accept modem calls.

AAA security is applied to the lines by the **aaa new-model** command and **aaa authentication login default local** command. AAA performs login authentication by using the local username database. The **login** keyword authenticates EXEC shell users. For more information about the AAA commands, see the "Configuring Local AAA Security" section on page 3-4.

Note The modem speed 115200 bps and hardware flow control are the default settings for integrated modems.

Resetting to Default Values for Country Codes

To reset to default settings for country codes, enter the following commands in global configuration mode:

- **no spe country**—Resets to default setting.

Verify

To verify your SPE configuration:

- Enter the **show spe** command to display a summary for all the lines:

```
AS5400# show spe

SPE settings:
==============
Country code configuration: default T1 (u Law)
Polling interval: 8 secs.
History log events: 50(per port)
Port legends:
============
Port state: (s)shutdown (t)test (r)recovery (d)download
            (b)busiedout (p)busyout pending, (B)bad (a)active call
Call type: (m)modem (d)digital (f)fax-relay (v)voice (_)not in use
System resources summary:
======================
Total ports: 108, in use ports: 0, disabled ports: 0, free ports: 108
Total active calls: modem    0,  voice    0,  digital    0,  fax-relay    0
```

```
                    SPE          SPE     SPE  SPE   Port         Call
SPE#    Port #      State        Busyout Shut Crash State        Type
4/00    0000-0005   ACTIVE             0    0     0 ______       ______
4/01    0006-0011   ACTIVE             0    0     0 ______       ______
4/02    0012-0017   ACTIVE             0    0     0 ______       ______
4/03    0018-0023   ACTIVE             0    0     0 ______       ______
4/04    0024-0029   ACTIVE             0    0     0 ______       ______
.
.
.
```

- Enter the **show line** *number* command to display a summary for a single line:

```
AS5400# show line 1

   Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
     1 AUX   9600/9600  -    -      -    -    -      0       0     0/0       -
  Ready

Line 1, Location: "", Type: ""
Length: 24 lines, Width: 80 columns
Baud rate (TX/RX) is 9600/9600, no parity, 2 stopbits, 8 databits
Status: Ready
Capabilities: none
Modem state: Ready
Group codes:    0
Modem hardware state: noCTS noDSR  DTR RTS
 TTY NUMBER 1
Parity Error = 0 Framing Error = 0 Receive Error = 0 Overrun = 0
Outcount = 0 totalout = 39 incount = 0 totalin = 0

Special Chars: Escape  Hold  Stop  Start  Disconnect  Activation
                ^^x    none   -     -       none
Timeouts:      Idle EXEC    Idle Session   Modem Answer  Session   Dispatch
               00:10:00        never                       none     not set
                            Idle Session Disconnect Warning
                              never
                            Login-sequence User Response
```

Tip If you are having trouble, make sure you turned on the protocols for connecting to the lines (**transport input all**) and configured for incoming and outgoing calls (**modem inout**).

Configuring Clocking

The time-division multiplexing (TDM) bus on the Cisco AS5350 and Cisco AS5400 backplane can receive an input clock from one of four basic sources on the gateway:

- CT1, CE1, and CT3 trunk cards
- An external T1/E1 clock source feed directly through the Building Integrated Timing Supply (BITS) interface port on the motherboard
- Free-running clock providing clock from an oscillator

Note Building Integrated Timing Supply (BITS) is a single building master timing supply. BITS generally supplies DS1 and DS0 level timing throughout an office. In North America, BITS are the clocks that provide and distribute timing to a wireline network's lower levels.

Trunk-Card Ports

The TDM bus can be synchronized with any trunk cards. On the CT1/CE1 trunk card, each port receives the clock from the T1/E1 line. The CT3 trunk card uses an M13 multiplexer to receive the DS1 clock. Each port on each trunk-card slot has a default clock priority. Also, clock priority is configurable through the **dial-tdm-clock priority** CLI command.

External Clock

The TDM bus can be synchronized with an external clock source that can be used as an additional network reference. If no clocks are configured, the system uses a primary clock through a software-controlled default algorithm. If you want the external T1/E1 clock (via the BITs interface) as the primary clock source, you must configure it using the **dial-tdm-clock priority** CLI command; the external clock is never selected by default.

The BITs interface requires a T1 line composite clock reference set at 1.544 MHz and an E1 line composite clock reference set at 2.048 MHz.

Free-Running Clock

If there is no good clocking source from a trunk card or an external clock source, then select the free-running clock from the local oscillator through the **dial-tdm-clock priority** CLI command.

The following table lists commands to help you configure the clock source and clock source priority used by the TDM bus:

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters enable mode. Enters the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5400(config)#`
		Enters global configuration mode. The example uses the terminal configuration option. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 3		Perform step a or b, depending on your configuration.
a.	`AS5400(config)# dial-tdm-clock priority priority# {external | freerun | slot/ds1 port}`	Configures the CT1/CE trunk-card clock priority, trunk slot, and port that is providing the clocking source. Priority range is a value between **1** and **99**. Trunk-card slot is a value between **1** and **7**. DS1 port number controller is a value between **0** and **7**. **Note** DS1 port specifies T1 port.
b.	`AS5400(config)# dial-tdm-clock priority priority# {external | freerun | slot/ds3 port:ds1 port}`	Configures the CT3 trunk-card clock priority, trunk slot, and port that is providing the clocking source. Priority range is a value between **1** and **99**. Trunk-card slot is a value between **1** and **7**. DS3 port specifies the T3 port. DS1 port number controller is a value between **1** and **28.** **Note** A clock with priority of 100 cannot drive the TDM clock.
Step 4	`AS5400(config)# Ctrl-Z` `AS5400#`	Returns to privileged EXEC mode.
Step 5	`AS5400# copy running-config startup-config`	Saves your changes when ready.

Configuration Examples

In the following example, BITS clock is set at priority 1.

```
AS5400(config)# dial-tdm-clock priority 1 external
AS5400(config)# exit
AS5400#
```

In the following example, a trunk clock from an CT1 trunk card is set at priority 2 and uses slot 4 and ds1 port (controller) 6.

```
AS5400(config)# dial-tdm-clock priority 2 4/6
AS5400(config)# exit
```

In the following example, a trunk clock from a CT3 trunk card is set at priority 2 and uses slot 1, ds3 port 0, and ds1 port 19.

```
AS5400(config)# dial-tdm-clock priority 2 1/0:19
AS5400(config)# exit
```

In the following example, free-running clock is set at priority 3.

```
AS5400(config)# dial-tdm-clock priority 3 free
AS5400(config)# exit
```

Verify

You can verify the system primary and backup clocks, status of all trunk-card controller clocks, and information about and history of last 20 TDM clock changes and the events that caused them.

- Verify your default system clocks and clock history using the **show tdm clocks** command (this example is for T1/E1):

```
AS5400# show tdm clocks

Primary Clock:
--------------
TDM Bus Master Clock Generator State = HOLDOVER

Backup clocks for primary:
Source  Slot  Port  DS3-Port  Priority      Status      State
-----------------------------------------------------------------

Trunk cards controllers clock health information
------------------------------------------------
Slot  Type  7 6 5 4 3 2 1 0
1      T1   B B B B B B B B
```

```
CLOCK CHANGE HISTORY
--------------------------

CLOCK        Event                                  Time
-----        -----                                  ----
1/1     Loss Of Signal (LOS)                   00:00:22 UTC Tue Nov 30 1999
1/2     Loss Of Signal (LOS)                   00:00:22 UTC Tue Nov 30 1999
1/3     Alarm Indication Signal (AIS)          00:00:22 UTC Tue Nov 30 1999
1/4     Alarm Indication Signal (AIS)          00:00:22 UTC Tue Nov 30 1999
1/5     Alarm Indication Signal (AIS)          00:00:22 UTC Tue Nov 30 1999
1/6     Alarm Indication Signal (AIS)          00:00:22 UTC Tue Nov 30 1999
1/7     Alarm Indication Signal (AIS)          00:00:22 UTC Tue Nov 30 1999
AS5400#
```

- Verify your tdm clock history using the **show tdm clocks** command (this example is for CT3):

```
AS5400# show tdm clocks

Primary Clock:
--------------
System primary is slot 7 ds3_port 0 ds1_port 1 of priority 1
TDM Bus Master Clock Generator State = NORMAL

Backup clocks for primary:
Source  Slot  Port  DS3-Port  Priority      Status      State
-------------------------------------------------------------
Trunk   7     8       YES      214          Good        Default
Trunk   7     9       YES      215          Good        Default

Trunk cards controllers clock health information
------------------------------------------------
      CT3         2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1
Slot  Port  Type  8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1
7     0      T3   G G G G G G G G G G G G G G G G G G G G G G G G G G G G



CLOCK CHANGE HISTORY
--------------------------

CLOCK        Event                                  Time
-----        -----                                  ----
7/1     Signal recovered from LOS              00:03:29 UTC Sat Jan 1 2000
7/8     Alarm Indication Signal (AIS)          11:27:48 UTC Fri Feb 25 2000
7/1     Signal recovered from LOS              11:30:22 UTC Fri Feb 25 2000
AS5400#
```

- Verify your user-configured trunk clock selection using the **show tdm clocks** command:

```
AS5400# show tdm clocks

Primary Clock:
System primary is slot 2 port 0 of priority 15
TDM Bus Master Clock Generator State = NORMAL
Backup clocks for primary:
Source  Slot  Port  DS3-Port  Priority      Status      State
Trunk   2     1       NO       205          Good        Default
Trunk cards controllers clock health information
Slot  Type  7 6 5 4 3 2 1 0
2      T1   B B B B G G G G
```

```
CLOCK CHANGE HISTORY

CLOCK        Event                                  Time
2/1     Controller shutdown                    23:23:06 UTC Tue Nov 30 1999
2/0     Change in CLI configuration            23:27:25 UTC Tue Nov 30 1999
AS5400#
```

- Verify your free-running clock selection using the **show tdm clocks** command:

```
AS5400# show tdm clocks

Primary Clock:
System primary is FREE RUNNING with priority 2
TDM Bus Master Clock Generator State = FREERUN
Backup clocks for primary:
Source  Slot  Port  DS3-Port  Priority      Status      State
Trunk   2     0       NO       204          Good        Default
Trunk   2     1       NO       205          Good        Default
Trunk cards controllers clock health information
Slot  Type  7 6 5 4 3 2 1 0
2      T1   B B B B G G G G
CLOCK CHANGE HISTORY

CLOCK        Event                                  Time
Freerun Change in CLI configuration            23:27:25 UTC Tue Nov 30 1999
AS5400#
```

- Verify your BITS clock selection using the **show tdm clocks** command:

```
AS5400# show tdm clocks

Primary Clock:
System primary is external with priority 1
TDM Bus Master Clock Generator State = NORMAL
Backup clocks for primary:
Source  Slot  Port  DS3-Port  Priority      Status      State
Trunk   2     0       NO       204          Good        Default
Trunk   2     1       NO       205          Good        Default
Trunk cards controllers clock health information
Slot  Type  7 6 5 4 3 2 1 0
2      T1   B B B B G G G G
CLOCK CHANGE HISTORY

CLOCK        Event                                  Time
External Change in CLI configuration           23:27:25 UTC Tue Nov 30 1999
AS5400#
```

Tip The most common reason for clock slip problems is that the **dial-tdm-clock priority** parameter is set improperly. Change the default setting for **dial-tdm-clock priority** from free-running clock to a setting that matches your system requirements.

Enabling IP Basic Setup

Fine-tune the IP routing functions and domain-name services for EXEC shell users, by performing the following steps:

Step 1 Optimize IP routing functions in global configuration mode:

```
AS5400(config)# ip subnet-zero
AS5400(config)# no ip source-route
AS5400(config)# ip classless
AS5400(config)# ip domain-lookup
```

Table 3-5 describes the commands in the example.

Table 3-5 IP Routing Commands

Command	Purpose
ip subnet-zero	Specifies that 172.22.0.0 is a legal subnet.
no ip source-route	Tightens security by ensuring that IP-header packets cannot define their own paths through the gateway.
ip classless	Tightens security by ensuring that IP-header packets cannot define their own paths through the gateway.
ip domain-lookup	Enables IP domain-name lookups.

Step 2 In global configuration mode, enter domain-name service commands to support EXEC shell users:

```
AS5400(config)# ip host mymap 172.22.53.101
AS5400(config)# ip domain-name mydomain.com
AS5400(config)# ip name-server 172.22.11.10
AS5400(config)# ip name-server 172.22.11.11
```

Table 3-6 describes the commands in the example.

Table 3-6 Domain-Name Commands

Command	Purpose
ip host mymap 172.22.53.101	Creates a local name-to-address map. When the gateway is not entered in a DNS server, this map is useful.
ip domain-name mydomain.com	Tells the gateway how to qualify DNS lookups. In this example, **mydomain.com** is appended to the end of each looked-up name.
ip name-server 172.22.11.10 **ip name-server 172.22.12.11**	Specifies the primary and secondary name servers. The **ip name-server** command is used for mapping names to IP addresses.

Testing Asynchronous Shell Connections

This task verifies that the following components are working:

- The physical asynchronous data path
- Basic modem links
- Basic IP functionality to support shell sessions

The Cisco IOS software provides a command-line interface (CLI) called the EXEC. The EXEC:

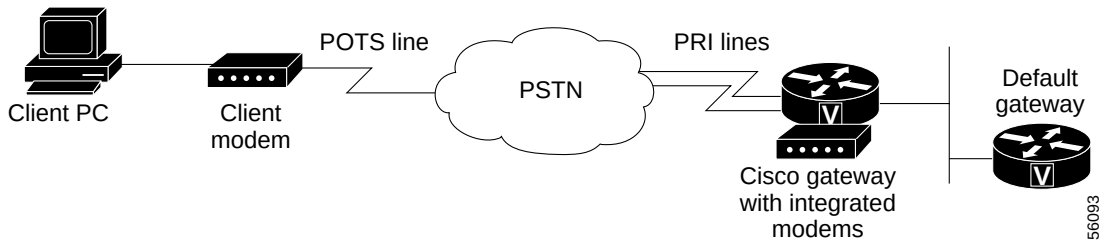
- Can be accessed by dialing in with a modem
- Provides access to terminal-shell services (no PPP) to do the following:
  - Modify configuration files
  - Change passwords
  - Troubleshoot possible problems including modem connections
  - Access other network resources by using Telnet

During this task, some administrators try to make complex services function, such as PPP-based Web browsing. Do not jump ahead. Many other elements still must be configured (for example, PPP and IPCP). The asynchronous-shell test ensures that the EXEC's login prompt can be accessed by a client modem. Taking a layered approach to building a network isolates problems and saves you time.

To test asynchronous-shell connections, perform the following steps:

Step 1 Locate a client PC, client modem, and analog line. From the client PC, open a terminal emulation program (such as Hyper Terminal, not Dial-Up Networking) and connect to the client modem. Figure 3-2 shows the network environment for this test.

Figure 3-2 Test Environment



Step 2 From a terminal-emulation program, test your EIA/TIA-232 connection to the client modem. Enter the **at** command. The modem returns the prompt OK.

```
at
OK
```

Note To learn more about the **at** command set, see the various references available online at the Technical Assistance Center website at http://www.cisco.com/pcgi-bin/Support/PSP/psp_view.pl?p=Internetworking:ASYNC&s=Implementation_and_Configuration

Step 3 Dial the PRI telephone number assigned to the gateway (in this example, the number is 5554100). After the modem successfully connects, a connect message appears.

```
atdt 5554100
CONNECT 33600/REL - LAPM
```

Note Many modems support the **a/** command, which recalls the last AT command. The **ath** command hangs up a modem call. The **atdl** command dials the last telephone number.

Step 4 Log in to the EXEC session on the gateway (from the client PC):

```
This is a secured device.
Unauthorized use is prohibited by law.

User Access Verification

Username: Harry
Password:

AS5400>
```

Step 5 Identify the line where the call landed. The following example shows that line TTY 216 accepted the call. The call has been up and active for 30 seconds.

```
AS5400# show caller
                                                Active    Idle
  Line         User               Service       Time      Time
  con 0        admin              TTY           00:39:09  00:00:00
  tty 216      Harry               TTY           00:00:30  00:00:07

AS5400# show caller user Harry

  User: Harry, line tty 216, service TTY
        Active time 00:00:42, Idle time 00:00:19
  Timeouts:            Absolute  Idle      Idle
                                 Session   Exec
      Limits:          -         -         00:10:00
      Disconnect in:   -         -         00:09:40
  TTY: Line 1/00
  DS0: (slot/unit/channel)=2/0/18
  Line: Baud rate (TX/RX) is 115200/115200, no parity, 1 stopbits, 8 databits
  Status: Ready, Active, No Exit Banner
  Capabilities: No Flush-at-Activation, Hardware Flowcontrol In
                Hardware Flowcontrol Out, Modem Callout, Modem RI is CD
                Integrated Modem
  Modem State: Ready
```

Note The **show caller** command is added to the Cisco IOS software in Cisco IOS Release 11.3 AA and Release 12.0 T. If your software release does not support this command, use the **show user** command.

Step 6 Test the IP functionality to support shell sessions. From the gateway, Telnet to another device in your network.

```
AS5400# telnet 171.68.186.49
Trying 171.68.186.49 ... Open

access-gw line 2

access-gw telnet smart
Translating "smart"...domain server (171.68.10.70) [OK]
Trying smart.cisco.com (171.68.191.135)... Open

UNIX(r) System V Release 4.0 (smart)

login: Router
Password:
No directory! Logging in with home=/
Last login: Fri Aug 18 13:50:07 from dhcp-aus-163-230
Sun Microsystems Inc.   SunOS 5.5.1     Generic May 1996
```

Verifying the Final Running-Configuration

The following is an example of a final running configuration:

```
AS5400# show running-config

Building configuration...

Current configuration : 6017 bytes
!
version 12.2
no service single-slot-reload-enable
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname AS5400
!
boot system tftp c5350-js-mz.xm.Feb19 171.69.20.20
no boot startup-test
no logging buffered
logging rate-limit console 10 except errors
enable secret 5 $1$ltzj$8lGJ1cGmyZRdXdPXncLAo/
!
!
resource-pool disable
!
!
voice-fastpath enable
ip subnet-zero
no ip finger
ip domain-name cisco.com
ip name-server 171.69.11.48
ip name-server 171.69.2.132
ip name-server 171.69.2.133
!
no ip dhcp-client network-discovery
!
```

```
!
fax interface-type modem
mta receive maximum-recipients 0
!
!
crypto mib ipsec flowmib history tunnel size 200
crypto mib ipsec flowmib history failure size 200
!
!
controller T1 1/0
 framing sf
 linecode ami
!
controller T1 1/1
 framing sf
 linecode ami
!
.
.
.
controller T1 1/7
 framing sf
 linecode ami
!
!
interface FastEthernet0/0
 ip address 172.21.101.21 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Async4/00
 no ip address
!
interface Async4/01
 no ip address
!
interface Async4/02
 no ip address
!
.
```

```
.
.
interface Async4/107
 no ip address
!
interface Group-Async0
 no ip address
 no ip route-cache
 no ip mroute-cache
 no group-range
!
    ip classless
ip route 0.0.0.0 0.0.0.0 172.21.101.1
no ip http server
!
!
call rsvp-sync
!
!
line con 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password #1writer
 login
line 4/00 4/107
 no flush-at-activation
 modem InOut
!
scheduler allocate 10000 400
end
```

Saving Configuration Changes

To prevent the loss of the gateway configuration, save it to NVRAM.

Configure

	Command	Purpose

Step 1	`AS5400> enable`
	`Password: password`
	`AS5400#`
		Enters enable mode (also called privileged EXEC mode) and enter the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5400# 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	`AS5400(config-if)# Ctrl-Z` `AS5400#`	Returns to enable mode.

Where to Go Next

At this point you can go to:

- Chapter 4, "Continuing Configuration Using the Command-Line Interface" to continue system configuration of basic features.
- Chapter 5, "Managing and Troubleshooting the Universal Port Card" to configure, manage, and troubleshoot universal-port-card connections on your gateway.
- Appendix C, "Comprehensive Configuration Examples."
- *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/. Select your Cisco IOS release and search for this title.

Tip The following publications are available on the Documentation CD-ROM that came with your gateway or on the World Wide Web from the Cisco home page, or you can order printed copies.

- For additional basic configuration information, refer to *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm. For more advanced configuration topics, refer to the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- For information on available software features available on your Cisco IOS release, refer to the software-configuration documents available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm
- For Cisco AAA-based security information, refer to the *Cisco AAA Implementation Case Study,* available online at http://www.cisco.com/univercd/cc/td/doc/cisintwk/intsolns/aaaisg/index.htm
- For troubleshooting information, refer to the *System Error Messages* and *Debug Command Reference* publications.

CHAPTER 4

Continuing Configuration Using the Command-Line Interface

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

This chapter continues where "Basic Configuration Using the Command-Line Interface" ends. After you have commissioned your Cisco AS5350 or Cisco AS5400 universal gateway, you might want to configure other features that include serial interface support, CT1 channel groups, and signaling.

Proceed to the following sections:

For advanced configuration topics and procedures, go to *Configuring Selected 12.1 Cisco IOS Software Features*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm

You can also view these publications on the Documentation CD-ROM that arrived with your gateway.

If you are experienced using the Cisco IOS software, you might find the "Where to Go Next" section at the end of this chapter a useful reference for configuration.

Configuring Synchronous Serial Interfaces for WAN Support

Configure the synchronous serial interfaces on the motherboard to connect to a WAN through a CSU/DSU.

This section describes how to enable the serial interface, specify IP routing, and set up external clock timing on a DCE or DTE interface. To use a port as a DTE interface, you need only connect a DTE adapter cable to the port. When the system detects the DTE mode cable, it automatically uses the external timing signal. To use a port in DCE mode, you must connect a DCE interface cable and set the clock speed with the **clock rate** configuration command. You must also set the clock rate to perform a loopback test.

Configure

	Command	Purpose
Step 1	AS5350> **enable** Password: *password* AS5350#	Enters enable mode (also called privileged EXEC mode) and enter the password. You are in enable mode when the prompt changes to AS5350# or AS5400#.
Step 2	AS5350# **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. AS5350(config)#	Enters global configuration mode. You are in global configuration mode when the prompt changes to AS5350(config)# or AS5400(config)#.
Step 3	AS5350(config)# **interface serial 0/0**	Specifies the first interface to be configured.
Step 4	AS5350(config-int)# **ip address 172.22.4.67 255.255.255.0**	If IP routing is enabled, assigns an IP address and subnet mask to the interface.
Step 5	AS5350(config-int)# **clock rate 2015232**	Configures the external clock signal only if you are configuring a DCE interface. The available options include 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 56000, 64000, 128000, and 2015232.
Step 6	AS5350(config-int)# **no shutdown**	Changes the shutdown state to up and enables the interface.
Step 7	AS5350(config-controller)# **Ctrl-Z** AS5350#	Returns to enable mode.

Verify

To verify you have configured the interfaces correctly:

- Specify one of the new serial interfaces with the **show interfaces serial** *port* command and verify that the first line of the display specifies the interface with the correct slot number. Also verify that the interface and line protocol are in the correct state: up or down.

```
AS5350# show interfaces serial 0/0
Serial0/0 is up, line protocol is up
  Hardware is 4T
  Internet address is 172.0.0.1/8
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliablility 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, crc 16, loopback not set, keepalive set (10 sec)
  Last input 00:00:08, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     392 packets input, 33312 bytes, 0 no buffer
     Received 392 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     358 packets output, 25157 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

- Display the entire system configuration file with the **show configuration** command. Verify that the configuration is accurate for the system and each interface.

Tip If you are having trouble, make sure the network interface is properly connected and terminated.

Note If you have questions or need assistance, see the “Obtaining Documentation” on page xvi.

Configuring CT1 Channel Groups

You can configure up to 24 channel groups for each CT1 for backup links or serial backhaul connections.

First, you must define the timeslots that belong with each channel group. Channel groups are numbered 0 to 23, and timeslots are numbered 1 to 24. Defining a channel group creates a serial interface; defining multiple channel groups creates an equal number of serial interfaces that you can configure independently.

Note The channel group numbers for each CT1 controller can be arbitrarily assigned.

Configure

Perform the following task in controller configuration mode to define the channel groups and timeslots:

Command	Purpose
AS5350(config-controller)# **channel-group** *number* **timeslots** *range* [**speed** {**48** | **56** | **64**}]	Defines the channel group number and, if needed, circuit speed.[1] **Note** Working with your local service provider, you can create channel-groups with from 1 to 24 timeslots. These timeslots can be in any order, contiguous or noncontiguous.

1. In the United States, channel-group speeds can be either 56 or 64 kbps; the default is 56 kbps. If 64 kbps is used, it is recommended to be used with framing type of ESF and a linecode of B8ZS. The speed you select must match the speed provided by the telephone company.

After you define the T1 channel groups, you can configure each channel group as a serial interface. Meaning, you can think of each channel group as a virtual serial interface. Subinterface configuration is also supported on the created serial interface.

Perform the following task in global configuration mode to enter interface configuration mode and configure the serial interface that corresponds to a channel group:

Command	Purpose
AS5350(config)# **interface serial** *slot/port*:*channel-group*	Defines the serial interface for a CT1 channel group.

Verify

The following example shows a channelized T1 controller configured for channel groups and an ISDN PRI group. The **pri-group** command and the **channel-group** command cannot have overlapping timeslots; note the correct timeslot configuration.

```
AS5350# show running-config

Building configuration...

Current configuration:
!
! Last configuration change at 15:49:30 UTC Mon Apr 3 2000 by admin
! NVRAM config last updated at 01:35:05 UTC Fri Mar 17 2000 by admin
!
version 12.0
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
---text omitted---
!


controller t1 1/0
channel-group 0 timeslot 1-6
channel-group 1 timeslot 7
```

```
channel-group 2 timeslot 8
channel-group 3 timeslot 9-11
pri-group timeslot 12-24
```

Configuring ISDN NFAS on CT1 PRI Groups

ISDN Non-Facility Associated Signaling (NFAS) allows a single D channel to control multiple PRI interfaces. A backup D channel can also be configured for use when the primary NFAS D channel fails.

When configuring NFAS for channelized T1 controllers configured for ISDN, you use an extended version of the ISDN **pri-group** command to specify the following:

- Range of PRI timeslots to be under the control of the D channel (timeslot 24)
- Function to be performed by timeslot 24 (primary D channel, backup, or none); the latter specifies its use as a B channel
- Group identifier number for the interface under control of this D channel

Note Your Cisco AS5350 or Cisco AS5400 must connect to a Primary-4ess, Primary-DMS 100, or Primary-NI switch (see Table 3-3 on page 3-16) and must also have a channelized T1 controller and, as a result, be ISDN PRI capable.

Configure

To configure ISDN NFAS, complete the following tasks in controller configuration mode:

Command	Purpose
`AS5350(config-controller)# pri-group timeslots 1-24 nfas_d primary nfas_interface` *number* `nfas_group` *number*	On one channelized T1 controller, configures the NFAS primary D channel.
`AS5350(config-controller)# pri-group timeslots 1-24 nfas_d backup nfas_interface` *number* `nfas_group` *number*	On a different channelized T1 controller, configures the NFAS backup D channel to be used if the primary D channel fails.
`AS5350(config-controller)# pri-group timeslots 1-24 nfas_d none nfas_interface` *number* `nfas_group` *number*	(Optional) On other channelized T1 controllers, configures a 24 B channel interface, if desired.

Take a Channel or Interface Out of Service

You can take a specified channel or an entire PRI interface out of service or put it into one of the other states that is passed in to the switch.

To do so, complete one of the following tasks in interface configuration mode:

Command	Purpose
`AS5350(config-controller)# isdn service dsl` *number* `b_channel` *number* `state` *state-value*	Takes an individual B channel out of service or set it to a different state.
`AS5350(config-controller)# isdn service dsl` *number* `b_channel 0 state` *state-value*	Sets the entire PRI interface to the specified state.

These are the supported state values:

- 0—In service
- 1—Maintenance
- 2—Out of service

Verify

- Monitor NFAS groups by entering the **show isdn nfas group** *number* command:

```
AS5350# show isdn nfas group 0
ISDN NFAS GROUP 0x0 ENTRIES:

The primary D is Serial0:23.
The backup D is Serial1:23.

There are 2 total nfas members.
There are 24 total available B channels.
The primary D-channel is DSL 0 in state IN SERVICE.
The backup D-channel is DSL 1 in state STANDBY.
The current active layer 2 DSL is 0.
```

Configuring E1 R2 Signaling

R2 signaling is an international signaling standard that is common to channelized E1 networks. You can configure a channelized E1 interface to support different types of R2 signaling, used in older analog telephone networks.

Note The Cisco implementation of R2 signaling has DNIS support turned on by default. If you enable the ANI option, the collection of DNIS information is still performed. Specifying the ANI option does not disable DNIS collection. DNIS is the number being called. ANI is the caller's number. For example, if you are configuring gateway A to call gateway B, then the DNIS number is assigned to gateway B, the ANI number is assigned to gateway A. Also, note that ANI is similar to caller ID.

Configure

To configure E1 R2 signalling, use the following commands beginning in global configuration mode:

	Command	Purpose

Step 1	`AS5350> enable`
	`Password: password`
	`AS5350#`
		Enters enable mode (also called privileged EXEC mode) and enter the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5350# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`AS5350(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 3	`AS5350(config)# controller e1 0/0` `AS5350(config-controller)#`	Enters controller configuration mode to configure your E1 controller port. Specifies E1 controller dfc-slot, port number, and channel. On the CE1 trunk card, port-number values range from **0** to **1**.
Step 4	`AS5350(config-controller)# ds0-group 1 timeslots 1-30 type r2-analog r2-compelled ani`	Configures the timeslots that belong to each E1 circuit for R2 signaling. Sets R2 signaling to R2 ITU Q411, the tone signal to R2 compelled register signaling, and the ANI addr info provisioned option. R2 line signaling options include **r2-analog**, **r2-digital, and r2-pulse**. Tone signaling options include **dtmf** (default), **r2-compelled**, **r2-non-compelled**, and **r2-semi-compelled**. You can also set **ani** (ANI address information provisioned) for any of the above options
Step 5	`AS5350(config-controller-cas)# cas-custom 1`	Enters the channel number to customize.
Step 6	`AS5350(config-ctrl-cas)# country country use-default`	Uses defaults for the specified country. **Note** To view the parameters for the country (if the country defaults are the same as ITU defaults), enter **write term**. The default setting for all countries is **ITU**. See "Country Codes for R2 Signaling" section on page 4-9 for a list of supported countries.

	Command	Purpose
Step 7	`AS5350(config-ctrl-cas)# answer-signal group-b 6`	Sets the **cas custom** command answer-signal to group-b to 6. Cas custom commands include **caller-digits**, **category**, **country**, **unused-abcd**, **invert-abcd**, **metering**, **ka**, **kd**, **dnis-digits**, **answer-signal**, and **nc-congestion** Sets answer-signal group-b to the default ITU value. Resets answer-signal group-b 6 to the default value. **Note** The parameters you do not set are automatically set to the ITU default by the gateway.

	`[or]`
	`AS5350(config-ctrl-cas)# default answer-signal group-b 6`
	`[or]`
	`AS5350(config-ctrl-cas)# no answer-signal group-b 6`	

	`controller E1 0`
	` clock source line primary`
	` ds0-group 0 timeslots 1-15,17-31 type r2-analog`
	` r2-compelled`
	` cas-custom 0`
	`  country singapore use-defaults`
	`  category 2  <--- default category for singapore`
	`  answer-signal group-b 6  <--- default bxfree`
	`  for singapore`
		After you configure a country with default settings, the gateway displays a write term, similar to the one displayed here.

	`AS5350(config-ctrl-cas)# exit` `AS5350(config)#`	Exits cas-custom mode and returns to global configuration mode.
Step 8	`AS5350(config)# spe country {`*`country`*` | e1-default}`	Set the SPE country code or use the E1 default (A-Law). **Note** The gateway must be in idle state (no calls are active) to execute the SPE country command **Note** On the Cisco AS5350 and Cisco AS5400, DS-0 companding law selection is configured for the entire system rather than on individual voice ports.
Step 9	`AS5350(config)# voice-port` *`slot/controller-number:DS0 group-number`* `AS5350(config-voiceport)#`	Enter voice port mode for the port you want to configure.
Step 10	`AS5350(config-voiceport)# cptone` *`contry-code`*	Enter the two-digit country code to configure the regional ring tone.

Step 11	`AS5350(config-voiceport)# Ctrl-Z`
	
	`AS5350#`
		Return to enable mode.

Country Codes for R2 Signaling

Table 4-1 lists the country codes supported for R2 signaling.

Table 4-1 Country Codes for R2 Signaling

argentina	greece	paraguay
australia	guatamala	peru
bolivia	hongkong-china	philippines
brazil	india	saudiarabia
bulgaria	indonesia	singapore
china	israel	southafrica-panaftel
colombia	itu	telmex
costarica	korea	telnor
croatia	laos	thailand
easteurope	malaysia	uraguay
equador-itu	malta	venezuela
ecuador-lme	newzealand	vietnam

Verify

To verify your R2 signaling configuration:

- Enter the **show controller e1** command to view the status for all controllers, or enter the **show controller e1** # to view the status for a particular controller. Make sure the status indicates the controller is up (line 2 in the following example) and no alarms (line 4 in the following example) or errors (lines 9 and 10 in the following example) have been reported.

```
AS5350# show controller e1 0/0
E1 0/0 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  Version info of Slot 0:  HW: 2, Firmware: 4, PLD Rev: 2

Manufacture Cookie is not programmed.

  Framing is CRC4, Line Code is HDB3, Clock Source is Line Primary.
  Data in current interval (785 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Total Data (last 13 15 minute intervals):
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 12 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 12 Unavail Secs
```

Tip If the connection does not go up, check for the following:

- Loose wires, splices, connectors, shorts, bridge taps, and grounds
- Backwards transmit and receive
- Mismatched framing types (for example, CRC-4 and no-CRC-4)
- Transmit and receive pair separation (crosstalk)
- Faulty line cards or repeaters
- Noisy lines (for example, power and crosstalk)

If you see errors on the line or the line is going up and down, check for the following:

- Mismatched line codes (HDB3 versus AMI)
- Receive level
- Frame slips because of poor clocking plan

When the E1 controller comes up, you see the following message:

```
%CONTROLLER-3-UPDOWN: Controller E1 0, changed state to up
```

Configuring Alarms

Facility alarms currently monitor the following failure events:

- Interface down
- CT1/CE1/CT3 controller down
- Trunk card failure
- Redundant power supply (RPS) failure

Cisco IOS software polls every second to detect the failure events that you have configured and turns on the alarm when any one of the failure events is detected. By default, the facility alarm is off. Users have to configure a facility alarm command to enable monitoring of the failure conditions.

Enter **no** before the full command to disable any of the alarm commands.

```
AS5350# no facility-alarm detect rps
```

Configure

	Command	Purpose

Step 1	`AS5350> enable`
	`Password: password`
	`AS5350#`
		Enters enable mode and enters the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5350# configure terminal`
	`Enter configuration commands, one per line.`
	`End with CNTL/Z.`
	`AS5350(config)#`
		Enters global configuration mode. You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

	Command	Purpose
Step 3	`AS5350(config)# facility-alarm detect interface [interface type] [slot/port]`	Turns on the facility alarm when an interface goes down. Enter interface type and slot/port designation.
Step 4	`AS5350(config)# facility-alarm detect controller [t1 | e1 | t3] [slot/port]`	Turns on alarm when controller goes down. The slot values range from **1** to **7**. The port values range from **0** to **7** for T1 and E1. For T3, the port value is always **0**.
Step 5	`AS5350(config)# facility-alarm detect modem-board [slot]`	Turns on alarm when modem board present in slot # fails.
Step 6	`AS5350(config)# facility-alarm detect rps`	Turns on alarm when RPS failure event is detected. Any of the following failures turns on the alarm: • I/P voltage failure • O/P voltage failure • Overvoltage condition • Multiple failures
Step 7	`AS5350(config)# facility-alarm detect temperature`	Turns on alarm if thermal failure event is detected.
Step 8	`AS5350(config)# facility-alarm detect fan`	Turns on alarm if fan failure event is detected.
Step 9	`AS5350(config-if)# Ctrl-Z` `AS5350#`	Returns to enable mode.

Verify

To see the status of the alarms, enter the **show facility-alarm** command:

```
AS5350# show facility-alarm

    Device            State
    ------            -----

  FastEthernet0/0      UP
  Modem Card 4         UP

 Facility Alarm is ON
```

Tip If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure you are using Number 12 or 14 AWG copper wires to connect to the alarm port terminal blocks.
- Make sure your alarm is operational.

Saving Configuration Changes

To prevent the loss of the gateway configuration, save it to NVRAM.

Configure

	Command	Purpose

Step 1	`AS5350> enable`
	`Password: password`
	`AS5350#`
		Enters enable mode (also called privileged EXEC mode) and enter the password. You are in enable mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 2	`AS5350# 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	`AS5350(config-if)# Ctrl-Z` `AS5350#`	Returns to enable mode.

Where to Go Next

At this point you can go to:

- Chapter 5, "Managing and Troubleshooting the Universal Port Card" to configure, manage, and troubleshoot universal-port-card connections on your gateway.
- Appendix C, "Comprehensive Configuration Examples."
- *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/.
  Select your Cisco IOS release and search for this title.

Tip The following publications are available on the Documentation CD-ROM that came with your gateway, on the World Wide Web from the Cisco home page, or you can order printed copies.

- For additional basic configuration information, refer to *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm. For more advanced configuration topics, refer to the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- For troubleshooting information, refer to the *System Error Messages* and *Debug Command Reference* publications.

CHAPTER 5

Managing and Troubleshooting the Universal Port Card

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

Note The cards that reside in the AS5350 and AS5400 chassis, sometimes referred to as dial feature cards (DFC), are of two types: trunk cards, which provide an E1, T1, or T3 interface, and universal port cards, which host the universal DSPs that dynamically handle voice, dial, and fax calls.

A universal port card is a hardware card that processes digital signals for the Cisco AS5350 and Cisco AS5400 universal gateways. Ports on the universal port card support multiple types of services such as modem, fax, digital data, and voice. You can manage your port connections at the universal-port-card slot level, service-processing-element (SPE) level, or port level using monitoring and troubleshooting commands. A port is defined as an endpoint on a trunk card through which multiservice tones, voice, and data flow. There are multiple ports per SPE.

Tip For more information, see these references:

- On the universal port card: *Cisco AS5350 (or Cisco AS5400) Universal Gateway Chassis Installation Guide, Cisco AS5350 (or Cisco AS5400) Universal Gateway Card Installation Guide*, and *Cisco AS5350 (or Cisco AS5400) Universal Gateway Regulatory Compliance and Safety Information*. These publications ship with your Cisco AS5350 or Cisco AS5400 gateway and are available online at
  http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5350/index.htm
  or
  http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm
- On CLI commands supported on the universal port card: *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/. Select your Cisco IOS release and search for this title.
- On how universal-port-card commands compare to MICA modem commands: *Comparing NextPort SPE Commands to MICA Modem Commands*, available online at http://www.cisco.com/warp/public/76/nextport_compare.html

The universal port card introduces slot and SPE software hierarchies. On the Cisco AS5350 and Cisco AS5400, the hierarchy designation is *slot/spe* and *slot/port:*

- Slot values range from **1** to **7**.
- Port values range from **0** to **one less than the total port count available on the card**.
- SPEs range from **0** to **17**.

For example, universal-port-card port 2/5 is the sixth port in the second chassis slot on the gateway. Slot **0** is reserved for the motherboard.

You can perform the following functions on an SPE:

- General configuration such as busyout, shutdown, or clear
- View statistics and states
- Configure auto and manual recovery process
- Upgrade firmware

This chapter includes the following sections:

Managing SPE Performance Statistics

Configuration

By default, an event log is enabled and based on one event queue per SPE port. The log contains raw data in binary form, which must be viewed using the **show** commands listed in the "Viewing SPE Performance Statistics" section on page 5-3. You may configure some aspects of how the record is kept using the following global configuration mode commands (at the `AS5350(config)#` or `AS5400(config)#` prompt):

- **spe call-record modem** *max-userid*—Generates a modem call record after a modem call is terminated. The *max-userid* is the maximum userid size, in bytes, allowable in the modem. The **call-record** default is 30; the range is 0 to 100. You may display this record on the console or a configured syslog server. This call record is not stored in the port event log. To disable this function, use the **no** form. This replaces the **modem call-record** command.
- **spe log-size** *number*—Allows you to configure the size of the history event queue buffer for manageable SPEs in the gateway. The default is 100 events per port. Use the **show port** [**modem** | **voice** | **fax**] **log** command to view port events. It is used in the same way the **modem buffer-size** command is used for MICA modems.
- **show port** [**modem** | **voice** | **fax**] **log reverse** command to view port events with the most recent event first.

The following privileged EXEC mode commands allow you to clear some or all of the log events relating to the SPEs (at the `AS5350#` or `AS5400#` prompt):

- **clear spe log**—Allows you to clear all event entries in the slot history event log.
- **clear spe counters**—Clears statistical counters for all types of services for the specified SPE, SPE range, or all the SPEs. If you do not specify the range of SPEs or a SPE, all SPEs' statistics are cleared. It is used in the same way the **clear modem counters** command is used for MICA modems.
- **clear port log**—Allows you to clear all event entries in the port level history event log. This command clears the entire port log. You cannot remove individual service events from the port log. You can use **show port modem log** or **show port digital log** to display specific service events, but you must use **clear port log** to clear the entire port log.

Viewing SPE Performance Statistics

You can view SPE statistics using the Cisco IOS software with the gateway. To view performance statistics for the universal port cards, enter one or more of the following commands in privileged EXEC mode (at the `AS5350#` or `AS5400#` prompt):

show spe voice Commands

- **show spe voice active**—Displays the active statistics of all SPEs, a specified SPE, or a specified SPE range serving voice traffic.
- **show spe voice** *slot* | *slot*/*spe* **summary**—Displays the history statistics of all SPEs in a particular slot, specified SPE, or specified SPE range serving voice traffic.

show spe digital Commands

- **show spe digital active**—Displays the active statistics of all SPEs, a specified SPE or a specified SPE range serving digital traffic.
- **show spe digital csr**—Displays the digital call success rate statistics for a specific SPE, range of SPEs, or all the SPEs.
- **show spe digital disconnect-reason**—Displays the digital disconnect reasons for the specified SPE or SPE range. The disconnect reasons are displayed with Class boundaries.
- **show spe digital** *slot* | *slot*/*spe* **summary**—Displays the history statistics of all SPEs in a particular slot, specified SPE or the specified SPE range serving digital traffic.

show spe modem Commands

- **show spe modem active**—Displays the active statistics of all SPEs, a specified SPE, or a specified SPE range serving modem traffic. It is used in the same way the **show modem** command is used for MICA modems. (The **show modem** command is not supported on the Cisco AS5350 or Cisco AS5400.)
- **show spe modem csr**—Displays the call success rate statistics for a specific SPE, range of SPEs, or all the SPEs.
- **show spe modem disconnect-reason**—Displays the disconnect reasons for the specified SPE or SPE range. The disconnect reasons are displayed with Class boundaries. It is used in the same way the **show modem call-stats** command is used for MICA modems. (The **show modem call-stats** command is not supported on the Cisco AS5350 or Cisco AS5400.)

- **show spe modem** {**high** | **low**} **speed**—Shows the connect-speeds negotiated within each high/low speed modulation or codecs for a specific range of SPEs or all the SPEs.
- **show spe modem** *slot* | *slot*/*spe* **summary**—Displays the history statistics of all SPEs in a particular slot, specified SPE, or specified SPE range. It is used in the same way the **show modem** command is used for MICA modems. (The **show modem** command is not supported on the Cisco AS5350 or Cisco AS5400.)

show spe Commands

- **show spe log**—Displays the oldest event first from the slot history event log.
- **show spe log reverse**—Displays the latest event first from the log.
- **show spe version**—List all SPEs and the SPE firmware files used. This helps you decide if you need to update your SPE firmware files. It is used in the same way the **show modem mapping** command is used for MICA modems. (The **show modem mapping** command is not supported on the Cisco AS5350 or Cisco AS5400.)
- **show spe fax active** command displays the active statistics of all SPEs, a specified SPE, or a specified SPE range serving fax-relay traffic.

show port Commands

- **show port config**—Displays the configuration information for specified ports or the specified port range. The port should have an active session associated at the time the command is executed.
- **show port** [**digital** | **modem** | **voice** | **fax**] **log**—Displays the event log with oldest event first. For modems, this command is used the same way the **show modem log** command is used for MICA modems. (The **show modem log** command is not supported on the Cisco AS5350 or Cisco AS5400.)
- **show port** [**digital** | **modem** | **voice** | **fax**] **log reverse**—Displays the latest event first from the port history event log.
- **show port modem calltracker**—Displays the port level information for an active modem call using the calltracker database. If there is no call on the specified port, the information of the most recent call is displayed. The call tracker feature must be enabled by invoking the **calltracker enable** command. (For detailed information about the call tracker feature, see *Call Tracker plus ISDN and AAA Enhancements for the Cisco AS5300 and Cisco AS5800*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121x/121xh/121xh_2/dt_cltrk.htm)
- **show port modem test**—Displays the test log for the specified SPE port range or all the SPE ports.
- **show port operational-status**—Displays the operational status of the specified ports or the specified port range. The port should have an active session associated at the time the command is executed.

Managing Ports

This section describes how to manage universal ports. You can clear ports, remove ports from service, and disable ports from dial-up service by using port configuration mode. For details on disabling a port from dial-up service, see the "Troubleshooting" section on page 5-9.

Clear Ports

To clear a port means to deactivate calls on a port or to clear the *Bad* state on a port and reset it. Ports need to be cleared if communication attempts with the port have failed or if the port is to be removed from operation.

Use the **show spe slot/spe** command to view the active ports on an SPE. To clear ports on an SPE, enter the following command in privileged EXEC mode. You can clear all ports on the gateway, all ports on a slot, or a port. This replaces the **clear modem** command.

- The example below clears port 1 on slot 4.

```
AS5400# clear port 4/1
AS5400# This will clear port 4/01 [confirm] yes
AS5400#
```

- The example below clears all active ports on slot 4.

```
AS5400# clear port 4
AS5400# This will clear port 4/00 - 4/107 [confirm] yes
AS5400#
```

  If *slot/port* is specified, the port on that SPE is cleared. If *slot* is specified, all active ports on that particular slot are cleared. If no argument is specified, all ports are cleared.

  Additionally, this command clears the *Bad* state on a port and resets it. However, the port is not cleared if the SPE was previously in a *Bad* state due to an SPE firmware download.

Port Configuration Mode

Port configuration mode allows you to enter a mode similar to line configuration mode. This mode allows individual ports or ranges of ports to be shut down or put in busyout mode. Port configuration mode commands replace the **modem range**, **modem busyout**, and **modem shutdown** commands used with MICA modems.

- The example below demonstrates how to enter port configuration mode for a single port.

```
AS5400# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400(config)# port 3/1
AS5400(config-port)#
```

- The example below demonstrates how to enter port configuration mode for a range of ports.

```
AS5400# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400(config)# port 3/1 3/18
AS5400(config-port)#
```

Port Configuration Mode Commands

The following commands are available in port configuration mode:

- **busyout** *card/port*—Gracefully disables a port or all ports on a trunk card by waiting for the active services on the specified port to terminate. You can busy out all ports or just one port on a card—for example, **busyout 1** specifies all ports on card 1; **busyout 1/4** specifies just port 4 on card 1. Use the **no** form of this command to re-enable the ports. This replaces the **modem busyout** command. Maintenance activities such as testing can still be performed while a port is in busyout mode.

  Note **port busyout** and **spe busyout** are different commands, and do not affect one another. If you busyout a port or spe with one command, you can clear it only with the analogous **clear** command.

- **shutdown**—Clears active calls on the port. No more calls can be placed on the port. The state of the SPEs are reflected in the **show spe** command display. Use the **no** form of this command to re-enable the ports. This command replaces the **modem shutdown** command.

Note When a port is in busyout mode or shutdown mode, the state of the SPE is changed to the consolidated states of all the underlying ports on that SPE.

Managing SPEs

This section describes how to manage SPEs by setting the SPE country code, entering SPE configuration mode, upgrading the SPE firmware, performing busyout on SPEs, and clearing active calls on the SPEs.

SPE Country

On the Cisco AS5350 and Cisco AS5400, DS-0 companding law selection is configured for the entire system rather than on individual voice ports.

To configure companding on your CT1/CE1/CT3 controller lines, you must use the **spe country** command in global configuration mode. (This command replaces the **modem country** command. If you do not specify a country, your controller line uses the default.

For T1 interfaces, the default is **t1-default (Mu-Law);** for E1 interfaces, the default is **e1-default (A-Law)**. Use the **no** form of this command to set the country code to the default.

Supported countries include, but are not limited to, those shown in Table 5-1:

Table 5-1 Supported Countries and Corresponding Companding Law

Country	Companding Law	Country	Companding Law
Australia	A-Law	Netherlands	A-Law
Austria	A-Law	New Zealand	A-Law
Belgium	A-Law	Norway	A-Law
China	A-Law	Poland	A-Law
Cyprus	A-Law	Portugal	A-Law

Table 5-1 Supported Countries and Corresponding Companding Law (continued)

Country	Companding Law	Country	Companding Law
Czech/Slovak Republic	A-Law	Russia	A-Law
Denmark	A-Law	Singapore	A-Law
Finland	A-Law	South Africa	A-Law
France	A-Law	Spain	A-Law
Germany	A-Law	Sweden	A-Law
Hong Kong	Mu-Law	Switzerland	A-Law
India	A-Law	Taiwan	Mu-Law
Ireland	A-Law	Thailand	A-Law
Israel	A-Law	Turkey	A-Law
Italy	A-Law	United Kingdom	A-Law
Japan	Mu-Law	USA	Mu-Law
Malaysia	A-Law	—	—

Note The gateway must be in idle state (no calls are active) to execute the SPE country command.

- The following example sets country code to **usa**.

```
AS5400(config)# spe country usa
AS5400(config)#
```

- The following example verifies that DS-0 companding was set to **usa** (or Mu Law). It also displays the SPE busyout status.

```
AS5400# show spe

SPE settings:
==============
Country code configuration usa
Polling interval: 12 secs.
History log events: 50(per port)
Port legends:
============
Port state: (s)shutdown (t)test (r)recovery (d)download
            (b)busiedout (p)busyout pending, (B)bad (a)active call
Call type: (m)modem (d)digital (v)voice (_)not in use

                    SPE          SPE     SPE  SPE   Port         Call
SPE#    Port #      State        Busyout Shut Crash State        Type
4/00    0000-0005   ACTIVE             0    0     0 _______      _______
4/01    0006-0011   ACTIVE             0    0     0 _______      _______
4/02    0012-0017   ACTIVE             0    0     0 _______      _______
4/03    0018-0023   ACTIVE             0    0     0 _______      _______
4/04    0024-0029   ACTIVE             0    0     0 _______      _______
4/05    0030-0035   ACTIVE             0    0     0 _______      _______
4/06    0036-0041   ACTIVE             0    0     0 _______      _______
4/07    0042-0047   ACTIVE             0    0     0 _______      _______
4/08    0048-0053   ACTIVE             0    0     0 _______      _______
4/09    0054-0059   ACTIVE             0    0     0 _______      _______
4/10    0060-0065   ACTIVE             0    0     0 _______      _______
```

```
4/11    0066-0071    ACTIVE            0    0     0 _______       _______
4/12    0072-0077    ACTIVE            0    0     0 _______       _______
4/13    0078-0083    ACTIVE            0    0     0 _______       _______
4/14    0084-0089    ACTIVE            0    0     0 _______       _______
4/15    0090-0095    ACTIVE            0    0     0 _______       _______
4/16    0096-0101    ACTIVE            0    0     0 _______       _______
4/17    0102-0107    ACTIVE            0    0     0 _______       _______
```

SPE Configuration Mode

SPE configuration mode allows you to enter SPE configuration mode, which is similar to line configuration mode. You can configure an SPE by specifying a slot and an SPE associated with the slot or, you can choose to configure a range of SPEs by specifying the first and last SPE in the range.

The following example demonstrates how to enter SPE configuration mode.

```
AS5400# config t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400(config)# spe 1/1 1/17
AS5400(config-SPE)#
```

SPE Configuration Mode Commands

The following commands are available in SPE configuration mode:

- **firmware location**—Allows you to transfer a specified version of SPE firmware from system Flash memory to the SPEs named upon entering SPE configuration mode. For further information on firmware upgrades, see the "Upgrading SPE Firmware" section on page 5-12.
- **firmware upgrade** *busyout* | *download-maintenance* | *reboot*—Allows you to specify the upgrade method. Three methods of upgrade are available.
  - *Busyout* (the default) upgrades when all calls are terminated on an SPE.
  - *Download-maintenance* waits upgrades at the next download maintenance. For further information on firmware upgrades, see the "Upgrading SPE Firmware" section on page 5-12. The default download-maintenance time is 03:00.
  - *Reboot* upgrades at the next reboot. Note that, for the **firmware upgrade reboot** command to take effect after a reload, you must have saved the running configuration with the **copy running-config startup-config** command.
- **busyout**—Gracefully disables an SPE by waiting for all the active services on the specified SPE to terminate. If there are active ports on the specified SPE, the state of the SPE is changed to *Busiedout*. The SPE is temporarily disabled. Use the **no** form of this command to re-enable the SPEs.
- **shutdown**—Clears active calls on all ports on the SPE. Calls can no longer be placed on the SPE because the SPE state is changed to *Out-of-Service*. The state of the SPEs is reflected in the **show spe** command display. Use the **no** form of this command to re-enable the ports on the SPE.

Troubleshooting

This section provides troubleshooting information that apply to your modems regardless of service type mode. You learn how to perform diagnostic tests on installed ports or SPEs, configure automatic recovery of ports on an SPE, and configure a scheduled recovery of SPEs.

Configure SPE Diagnostic Tests

You can perform three types of diagnostic tests on your SPE modem:

- SPE Startup Test, page 5-9
- SPE Auto-Test, page 5-9
- SPE Back-to-Back Test, page 5-10

SPE Startup Test

To perform diagnostic testing on all your installed SPE ports during the system's initial startup or rebooting process, in global configuration mode with the prompt displayed as `AS5350#` or `AS5400#`, enter the following command:

port modem startup-test—Perform diagnostic testing for all modems.

The results of the SPE port startup test are displayed in the **show port modem test** command output. SPE ports that pass the diagnostic test are *Pass*, *Fail*, and *Unkn*. Ports that fail the diagnostic test are marked as *Bad*. These ports cannot be used for call connections. Depending on how many ports are installed, this diagnostic test may take from 5 to 10 minutes to complete. Perform additional testing on an inoperative SPE port by executing the **test port modem back-to-back** command. The **no port modem startup-test** command disables startup testing.

SPE Auto-Test

To perform diagnostic testing on all the installed SPE ports during the system's initial startup or rebooting process, or during service, in global configuration mode with the prompt displayed as `AS5350(config)#` or `AS5400(config)#`, enter the following command:

port modem autotest—Perform diagnostic testing for all ports.

The results of the SPE port auto-test are displayed in the **show port modem test** command's output. Ports that pass the diagnostic test are marked as *Idle*, *Busy*, *Downloading*, and *Reset*, and are put into service. Ports that fail the diagnostic test are marked as *Bad*, and are not put into service or tested again until they are no longer marked as *Bad*. If all the ports of an SPE are bad, the corresponding SPE is also marked bad. These ports cannot be used for call connections. Depending on how many ports are present and not marked *Bad*, this diagnostic test may take from 5 to 10 minutes to complete. You may perform additional testing on an inoperative port by executing the **test port modem back-to-back** command. The **no port modem autotest** command disables testing.

You may additionally configure the following options:

- **port modem autotest minimum** *ports*—Define the minimum number of free ports available for autotest to begin.
- **port modem autotest time** *hh:mm interval*—Enable autotesting time and interval.
- **port modem autotest error** *threshold*—Define the maximum number of errors detected for autotest to begin.

A sample diagnostic autotest setting the time at 12:45 and at 8 hour intervals looks like the following:

```
AS5400(config)# port modem autotest time 12:45 8
AS5400(config)#
```

SPE Back-to-Back Test

When an SPE port is tested as *Bad*, you may perform additional testing by conducting a series of internal back-to-back connections and data transfers between two SPE ports. All port test connections occur inside the gateway. For example, if mobile users cannot dial into port 2/5 (the sixth port on the universal port card in the second chassis slot), attempt a back-to-back test with port 2/5 and a known-functioning port such as port 2/6.

Enter the following command in privileged EXEC mode (the prompt is displayed as `AS5350#` or `AS5400#`) to perform internal back-to-back port tests between two ports:

test port modem back-to-back *slot/port slot/port* [*num-packets*]—Perform internal back-to-back port tests between two ports, sending test packets of the specified size.

You might need to enable this command on several different combinations of ports to determine which one is not functioning properly. A pair of operable ports successfully connect and complete transmitting data in both directions. An operable port and an inoperable port do not successfully connect with each other.

A sample back-to-back test might look like the following:

```
AS5400# test port modem back-to-back 2/10 3/20

Repetitions (of 10-byte packets) [1]:
*Mar  02 12:13:51.743:%PM_MODEM_MAINT-5-B2BCONNECT:Modems (2/10) and (3/20) connected in
back-to-back test:CONNECT33600/V34/LAP
*Mar  02 12:13:52.783:%PM_MODEM_MAINT-5-B2BMODEMS:Modems (3/20) and (2/10) completed
back-to-back test:success/packets = 2/2
```

A port that has been confirmed to have problems can often be fixed using the **clear spe** command. For more information, see the "Clear an SPE" section on page 5-12.

The results of the **test port modem back-to-back** command are displayed in the **show port modem test** command's output:

```
AS5400# show port modem test

 Date Time             Modem  Test              Reason            State Result
 3/02 12:00:57 PM       2/01  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:00:57 PM       2/00  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:00:58 PM       2/02  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:00:58 PM       2/03  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:00:58 PM       2/04  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:00:58 PM       2/05  Back-To-Back     :STARTUP TEST      Idle  PASS
...
 3/02 12:01:14 PM       3/95  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:01:14 PM       3/94  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:01:15 PM       3/75  Back-To-Back     :STARTUP TEST      Idle  PASS
```

```
 3/02 12:01:15 PM       3/74  Back-To-Back     :STARTUP TEST      Idle  PASS
 3/02 12:13:52 PM       3/20  Back-To-Back     :USER INITIATED    Idle  PASS
 3/02 12:13:52 PM       2/10  Back-To-Back     :USER INITIATED    Idle  PASS
...
 3/02 12:44:00 PM      3/102  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:00 PM      3/103  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:00 PM      3/104  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:00 PM      3/105  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:00 PM      3/106  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:00 PM      3/107  No Test (Time)   :MIN IDLE MODEMS   Idle  NOTST
 3/02 12:44:21 PM       2/73  Back-To-Back     :TIME INTERVAL     Idle  PASS
 3/02 12:44:21 PM       2/72  Back-To-Back     :TIME INTERVAL     Idle  PASS
 3/02 12:44:21 PM       2/33  Back-To-Back     :TIME INTERVAL     Idle  PASS
 3/02 12:44:21 PM       2/32  Back-To-Back     :TIME INTERVAL     Idle  PASS
 3/02 12:44:21 PM       3/37  Back-To-Back     :TIME INTERVAL     Idle  PASS
```

Note The *Reason* column indicates why the test was started. The *TIME INTERVAL* is one of the triggers under autotest; the other is the error threshold.

SPE Recovery

You may configure automatic recovery (removal from service and reloading of SPE firmware) of ports on an SPE at any available time from global configuration mode (the prompt is `AS5350(config)#` or `AS5400(config)#`) as shown:

spe recovery {**port-action** {**disable** | **recover** | **none**} | **port-threshold** *num-failures*}

When an SPE port fails to connect for a certain number of consecutive times, a problem exists in a specific part or the whole of SPE/firmware. Such SPEs have to be recovered by downloading firmware. Any port failing to connect *num-failures* times is moved to a state based on **port-action,** where you can choose to *disable* (mark the port as *Bad*) or *recover* the port when the SPE is in IDLE and has no active calls. The default for *num-failures* is **30**.

You may also schedule recovery using the **spe download maintenance configuration** command.

SPE Download Maintenance

You may configure a scheduled recovery of SPEs from global configuration mode (the prompt is `AS5350(config)#` or `AS5400(config)#`) as shown:

spe download maintenance time *hh:mm* | **stop-time** *hh:mm* | **max-spes** *num-of-spes* | **window** *time-period* | **expired-window** {*drop-call* | *reschedule*}

Download maintenance starts at **time**, steps through all the SPEs that need recovery and SPEs that need a firmware upgrade, and starts maintenance on **max-spes** at a time. It waits for the **window** delay time for all the ports on the SPE to become inactive before moving the SPE to the *idle* state. It downloads firmware immediately after the SPE moves to idle. If the ports are still in use by the end of (**window**), depending on the **expired-window** setting, connections on the SPE ports are shut down and the firmware is downloaded by choosing the *drop-call* option, or the firmware download is rescheduled to the next download maintenance time by choosing the *reschedule* option. This process continues until the number of SPEs under maintenance are below **max-spes,** or until **stop-time** (if set), or until all SPEs marked for recovery or upgrade have had their firmware reloaded. The default download-maintenance time is 03:00.

Clear an SPE

The **clear spe** privileged EXEC mode command allows you to manually recover a port that is frozen in a suspended state. This command causes the firmware configured for that SPE to be downloaded to the specified SPE or the range of SPEs and Power On Self Test (POST) to be executed. This command can be executed regardless of the state of the SPEs. All active ports running on the SPE are prematurely terminated and messages are logged into the appropriate log. This replaces the **clear modem** command.

The following example shows a coldstart on SPE 1 on slot 1:

```
AS5400# clear spe 1/1
AS5400# Are you sure you want to clear SPE 1/1(Y/N)? Y
```

Upgrading SPE Firmware

With new systems, Cisco loads a Cisco IOS software-compatible version of SPE firmware into each installed SPE. A map of the version(s) of SPE firmware copied to RAM for each SPE is stored in nonvolatile random-access memory (NVRAM) so that it is retained over power cycles.

Note You do not have to take any action to use the pre-installed version of SPE firmware with new systems.

You can acquire new SPE firmware from the Cisco Software Center in one of two ways:

- **Bundled** in regular Cisco IOS releases. See the "Using SPE Firmware Bundled with Cisco IOS Software" section on page 5-20 for details.
- **Unbundled** from Cisco.com. This is a more up-to-date version of SPE firmware released before the next Cisco IOS release, or a special version of SPE firmware shipped with a new board. See the "Upgrading SPE Firmware from the Cisco.com FTP Server" section on page 5-14 for details.

When you have the new firmware, you can configure different firmware versions onto individual SPEs or ranges of SPEs on a universal port card. You can also configure different upgrade methods by using the **firmware upgrade** command.

This section provides instructions for the following:

Important Upgrade Commands

There are several commands you use to upgrade SPE firmware. For examples on using the commands, see the "Upgrading SPE Firmware from the Cisco.com FTP Server" section on page 5-14 and the "Using SPE Firmware Bundled with Cisco IOS Software" section on page 5-20.

- Use the **copy tftp flash** *filename* command to copy any version of SPE firmware (no matter how it is obtained) into system Flash memory. You can store several versions of the SPE firmware in system Flash memory under different filenames.
- Use the **firmware location** SPE configuration command to transfer a specified version of SPE firmware from system Flash memory to the SPEs named on entering SPE configuration mode.
- Use the **firmware upgrade** *busyout* | *download-maintenance* | *reboot* SPE configuration command to configure when the file named in the **firmware location** command will be loaded to the SPEs. Three methods of upgrade are available:
  - *Busyout* (the default) upgrades when all calls are terminated on an SPE.
  - *Download-maintenance* waits upgrades at the next download maintenance (see the "SPE Download Maintenance" section on page 5-11). The default download-maintenance time is 03:00.
  - *Reboot* upgrades at the next reboot. Note that, for the **firmware upgrade reboot** command to take effect after a reload, you must have saved the running configuration with the **copy running-config startup-config** command.

Note The **copy ios-bundled** command is not necessary with the universal port card. By default, the version of SPE firmware bundled with the Cisco IOS software release transfers to all SPEs not specifically configured for a different SPE firmware file.

Displaying SPE Firmware Versions

Use the **show spe version** command to list the versions of SPE firmware running on the SPEs, residing in system Flash memory, and bundled with Cisco IOS software. This helps you decide if you need to change the version running on the modems.

Note The version number (version column) may not match the filename (UPG firmware-filename column) for a short period of time while a range of SPEs is in the process of downloading new firmware. The version number updates at the beginning of the upgrade process, whereas the filename updates upon completion of the process. This is done intentionally to enable you to recognize the upgrade process from the **show spe version** output.

```
AS5400# show spe version

IOS-Bundled Default Firmware-Filename            Version  Firmware-Type
====================================             =======  =============
system:/ucode/np_spe_firmware1                   0.0.6.75 SPE firmware

On-Flash Firmware-Filename                       Version  Firmware-Type
==========================                       =======  =============
flash:np.spe                                     0.6.4.5  SPE firmware
flash:np_6_77.spe                                0.0.6.77 SPE firmware
flash:np_6_79.spe                                0.0.6.79 SPE firmware
```

```
SPE-# SPE-Type   SPE-Port-Range     Version    UPG Firmware-Filename
 2/00    CSMV6         0000-0005    0.0.6.75    N/A ios-bundled default
 2/01    CSMV6         0006-0011    0.0.6.75    N/A ios-bundled default
 2/02    CSMV6         0012-0017    0.0.6.75    N/A ios-bundled default
 2/03    CSMV6         0018-0023    0.0.6.75    N/A ios-bundled default
 2/04    CSMV6         0024-0029    0.0.6.75    N/A ios-bundled default
 2/05    CSMV6         0030-0035    0.0.6.75    N/A ios-bundled default
 2/06    CSMV6         0036-0041    0.0.6.77    N/A np_6_77.spe
 2/07    CSMV6         0042-0047    0.0.6.77    N/A np_6_77.spe
 2/08    CSMV6         0048-0053    0.0.6.77    N/A np_6_77.spe
 2/09    CSMV6         0054-0059    0.0.6.77    N/A np_6_77.spe
 2/10    CSMV6         0060-0065    0.0.6.77    N/A np_6_77.spe
 2/11    CSMV6         0066-0071    0.0.6.77    N/A np_6_77.spe
 2/12    CSMV6         0072-0077    0.0.6.79    N/A np_6_79.spe
 2/13    CSMV6         0078-0083    0.0.6.79    N/A np_6_79.spe
 2/14    CSMV6         0084-0089    0.0.6.79    N/A np_6_79.spe
 2/15    CSMV6         0090-0095    0.0.6.79    N/A np_6_79.spe
 2/16    CSMV6         0096-0101    0.0.6.79    N/A np_6_79.spe
 2/17    CSMV6         0102-0107    0.0.6.79    N/A np_6_79.spe
```

Upgrading SPE Firmware from the Cisco.com FTP Server

Upgrading SPE firmware from the Cisco.com FTP server is a three-step process:

- Downloading the SPE firmware from Cisco.com FTP server to a local TFTP server
- Copying the SPE firmware file to the gateway and SPEs (which may also involve removing old firmware)
- Configuring SPEs to use an Upgraded Firmware File

Download SPE Firmware from the Cisco.com FTP Server to a Local TFTP Server

Note You must be a registered Cisco user to log in to Cisco's Software Center.

You can download software from the Cisco.com FTP server using an Internet browser or using an FTP application. Both procedures are described.

Using an Internet Browser

Step 1 Launch an Internet browser.

Step 2 Bring up the Cisco Software Center home page at the following url (subject to change without notice): http://www.cisco.com/kobayashi/sw-center/

Step 3 Under **Software Products & Downloads**, click **Access Software**.

Step 4 Click **AS5350 Series** or **AS5400 Series**.

Step 5 Click the SPE firmware you want and download it to your workstation or PC. For example, to download SPE firmware for the universal, click **Download Universal Images**.

Step 6 Click the SPE firmware file you want to download, and then follow the remaining download instructions. If you are downloading the SPE firmware file to a PC, make sure you download it to the **c:/tftpboot** directory; otherwise, the download process does not work.

Step 7 When the SPE firmware is downloaded to your workstation, transfer the file to a TFTP server in your LAN using a terminal emulation software application.

Step 8 When the SPE firmware is downloaded to your workstation, transfer the file to a TFTP server somewhere in your LAN using a terminal emulation software application.

Using an FTP Application

Note The directory path leading to the SPE firmware files on cco.cisco.com is subject to change without notice. If you cannot access the files using an FTP application, try the Cisco Systems url http://www.cisco.com/cgi-bin/ibld/all.pl?i=support&c=3

Step 1 Log in to the Cisco.com FTP server, called cco.cisco.com:

```
terminal> ftp cco.cisco.com

Connected to cio-sys.cisco.com.
220-
220-  Cisco Connection Online       |        |      Cisco Systems, Inc.
220-  Email: cco-team@cisco.com   |||      |||  170 West Tasman Drive
220-  Phone: +1.800.553.2447  .:|||||:..:|||||:.  San Jose, CA 95134
220-
220- NOTE: As of February 1,1997 ftp.cisco.com will now point to this
220- service. Please be advised. To use the former ftp.cisco.com after
220-  February 1, connect to ftpeng.cisco.com
220-
220-  You may login with:
220- + Your CCO username and password, or
220- + A special access code followed by your e-mail address, or
220- + "anonymous" followed by your e-mail address for guest access.
220-
220 cio-sys FTP server (CIOESD #103 Sun Dec 15 14:43:43 PST 1996) ready.
```

Step 2 Enter your CCO registered username and password (for example, **harry** and **letmein**):

```
Name (cco.cisco.com:harry): harry
331 Password required for harry.
Password: letmein
230-###############################################################
230-#  Welcome to the Cisco Systems CCO FTP server.
230-#  This server has a number of restrictions.  If you are not familiar
230-#  with these, please first get and read the /README or /README.TXT file.
230-#  http://www.cisco.com/acs/info/cioesd.html for more info.
230-###############################################################
230-
230- *****  NOTE: As of February 1, 1997, "cco.cisco.com",   *****
230- *****  "www.cisco.com" and "ftp.cisco.com" are now all  *****
230- *****  logical names for the same machine.              *****
230- *****                                                   *****
230- *****  The old "ftp.cisco.com" is an entirely           *****
230- *****  different machine, which is now known as         *****
230- *****  "ftpeng.cisco.com" or "ftp-eng.cisco.com".       *****
230- *****                                                   *****
230- *****  In general, "ftpeng.cisco.com" is used only for  *****
230- *****  distribution of Cisco Engineering-controlled     *****
230- *****  projects, such as beta programs, early field     *****
230- *****  trials, developing standards documents, etc.     *****
230- *****                                                   *****
```

```
230- *****  Be sure to confirm you have connected to         *****
230- *****  the machine you need to interact with.           *****
230-
230-  If you have any odd problems, try logging in with a minus sign (-) as
230-  the first character of your password.  This will turn off a feature
230-  that may be confusing your ftp client program.
230-  Please send any questions, comments, or problem reports about this
230-  server to cco-team@cisco.com.
230-
230-  NOTE:
230-  o To download files from CCO, you must be running a *passive-mode*
230-    capable FTP client.
230-  o To drop files on this system, you must cd to the /drop directory.
230-  o Mirrors of this server can be found at
230-
230-     + ftp://www-europe.cisco.com European (Amsterdam)
230-     + ftp://www-fr.cisco.com     France     (Paris)
230-     + ftp://www-au.cisco.com     Australia  (Sydney)
230-     + ftp://www-jp.cisco.com     Japan      (Tokyo)
230-     + ftp://www-kr.cisco.com     Korea      (Seoul)
230-
230- Please read the file README
230- it was last modified on Sat Feb  1 12:49:31 1997 - 163 days ago
230  User harry logged in.  Access restrictions apply.
Remote system type is UNIX.
Using binary mode to transfer files.
```

Step 3 Specify the directory path that holds the SPE firmware you want to download. For example, the directory path for the Cisco AS5400 SPE firmware is /cisco/access/5400:

```
ftp> cd /cisco/access/5350

250-Please read the file README
250- it was last modified on Tue May 27 10:07:38 1997 - 48 days ago
250-Please read the file README.txt
250- it was last modified on Tue May 27 10:07:38 1997 - 48 days ago
250 CWD command successful.
```

Step 4 View the contents of the directory with the **ls** command:

```
ftp> ls

227 Entering Passive Mode (192,31,7,130,218,128)
150 Opening ASCII mode data connection for /bin/ls.
total 2688
drwxr-s--T   2 ftpadmin ftpcio    512 Jun 30 18:11 .
drwxr-sr-t  19 ftpadmin ftpcio    512 Jun 23 10:26 ..
lrwxrwxrwx  1  root     3          10 Aug   6 1996     README ->README.txt
-rw-rw-r--   1 root     ftpcio   2304 May 27 10:07 README.txt
-r--r--r-- 1 ftpadmin ftpint 377112 Jul 10 18:08 np-spe-upw-1.0.1.2.bin
-r--r--r-- 1 ftpadmin ftpint 635 Jul 10 18:08 SPE-firmware.3.1.30.readme
226 Transfer complete.
```

Step 5 Specify a binary image transfer:

```
ftp> binary
200 Type set to I.
```

Step 6 Copy the SPE firmware files from the gateway to your local environment with the **get** command.

Step 7 Quit your terminal session:

```
ftp> quit
Goodbye.
```

Step 8 Verify that you successfully transferred the files to your local directory:

```
server% ls -al
total 596
-r--r--r-- 1 280208 Jul 10 18:08 np-spe-upw-1.0.1.2.bin
server% pwd
/auto/tftpboot
```

Step 9 Transfer these files to a local TFTP or RCP server that your gateway or router can access.

Copy the SPE Firmware File from Local TFTP Server to the SPEs

The procedure for copying the SPE firmware file from your local TFTP server to a universal port card is a two-step process:

1. Transfer the SPE firmware to the gateway's Flash memory.
2. Configure the SPEs to use the upgrade firmware.

The upgrade occurs automatically, either as you leave configuration mode or as specified in the configuration.

These two steps are performed only once. After you copy the SPE firmware file into Flash memory for the first time, you should not have to perform these steps again. Because the SPE firmware is configurable for individual SPEs or ranges of SPEs, the Cisco IOS software automatically copies the SPE firmware to each SPE each time the gateway restarts.

Transfer SPE Firmware to Flash Memory

Follow these steps to download the universal SPE firmware to Flash memory:

Step 1 Check the image in the gateway Flash memory:

```
AS5400# show flash
System flash directory:
File  Length   Name/status
  1   4530624  c5350-js-mx
 [498776 bytes used, 16278440 available, 16777216 total]
16384K bytes of processor board System flash (Read/Write)
```

Step 2 Enter the **copy tftp flash** command to download the code file from the TFTP server into the gateway Flash memory. You are prompted for the download destination and the remote host name.

Note The system no longer asks you if you want to erase Flash memory before reloading it. SPE firmware code is small; unlike with system images, you can sometimes hold more than one version of SPE firmware in Flash memory.

If you do not have available space to copy the SPE firmware, during the copy operation the system displays a message telling you to delete the current file and squeeze the Flash memory to make room for the new image. Enter the **delete flash:***version* command, followed by the **squeeze flash** command, to perform this delete-and-squeeze operation. Then proceed with the copy operation.

```
AS5400# copy tftp flash

Address or name of remote host [192.168.19.91]?
Source filename [c5350-js-mz.xm.Feb16]?
Destination filename [c5350-js-mz.xm.Feb16]?
Accessing tftp://192.168.19.91/c5350-js-mz.xm.Feb16...
Loading c5350-js-mz.xm.Feb16 from 192.168.19.91 (via FastEthernet0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 10573848/21147648 bytes]
10573848 bytes copied in 77.356 secs (137322 bytes/sec)
```

Step 3 Verify that the file has been copied into the gateway Flash memory:

```
AS5400# show flash

-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1 .. unknown 12375B0E 92704 6 337539 Feb 21 2001 22:46:51 np.spe
2 .. image 1A58C7EA AA7F9C 20 10573848 Feb 21 2001 23:11:59 c5350-js-mz.xm.Feb16
5079140 bytes available (10911644 bytes used)
```

Configure SPEs to Use an Upgraded Firmware File

Follow these steps to configure the SPEs to use the upgraded firmware:

Step 1 Enter the **enable** command.

```
AS5400> enable
```

Step 2 Enter your password.

```
Password: password
AS5400#
```

You are in privileged EXEC mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 3 Display SPE firmware versions to obtain the On-Flash firmware filename.

Note As explained previously, the version number and UPG firmware filename may not match until the upgrade is complete.

```
AS5400# show spe version

IOS-Bundled Default Firmware-Filename          Version  Firmware-Type
=====================================          =======  =============
system:/ucode/np_spe_firmware1                 0.0.6.75 SPE firmware

On-Flash Firmware-Filename                     Version  Firmware-Type
==========================                     =======  =============
flash:np.spe                                   0.6.4.5  SPE firmware
flash:np_6_77.spe                              0.0.6.77 SPE firmware
flash:np_6_79.spe                              0.0.6.79 SPE firmware
flash:np-spe-upw-1.0.1.2.bin                   1.0.1.2  SPE firmware
```

```
SPE-# SPE-Type   SPE-Port-Range     Version    UPG Firmware-Filename
 2/00    CSMV6         0000-0005    0.0.6.75    N/A ios-bundled default
 2/01    CSMV6         0006-0011    0.0.6.75    N/A ios-bundled default
 2/02    CSMV6         0012-0017    0.0.6.75    N/A ios-bundled default
 2/03    CSMV6         0018-0023    0.0.6.75    N/A ios-bundled default
 2/04    CSMV6         0024-0029    0.0.6.75    N/A ios-bundled default
 2/05    CSMV6         0030-0035    0.0.6.75    N/A ios-bundled default
 2/06    CSMV6         0036-0041    0.0.6.77    N/A np_6_77.spe
 2/07    CSMV6         0042-0047    0.0.6.77    N/A np_6_77.spe
 2/08    CSMV6         0048-0053    0.0.6.77    N/A np_6_77.spe
 2/09    CSMV6         0054-0059    0.0.6.77    N/A np_6_77.spe
 2/10    CSMV6         0060-0065    0.0.6.77    N/A np_6_77.spe
 2/11    CSMV6         0066-0071    0.0.6.77    N/A np_6_77.spe
 2/12    CSMV6         0072-0077    0.0.6.79    N/A np_6_79.spe
 2/13    CSMV6         0078-0083    0.0.6.79    N/A np_6_79.spe
 2/14    CSMV6         0084-0089    0.0.6.79    N/A np_6_79.spe
 2/15    CSMV6         0090-0095    0.0.6.79    N/A np_6_79.spe
 2/16    CSMV6         0096-0101    0.0.6.79    N/A np_6_79.spe
 2/17    CSMV6         0102-0107    0.0.6.79    N/A np_6_79.spe
```

Step 4 Enter global configuration mode by typing the **configure** command. The example uses the terminal configuration option.

```
AS5400# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
AS5400(config)#
```

You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 5 Enter SPE configuration mode, which is similar to line configuration mode. You can choose to configure a single SPE or range of SPEs by specifying the first and last SPE in the range.

```
AS5400(config)# spe slot/spe
```

or

```
AS5400(config)# spe slot/spe slot/spe
```

You are in SPE configuration mode when the prompt changes to `AS5350(config-SPE)#` or `AS5400(config-SPE)#`.

Step 6 Specify the SPE firmware file in Flash memory to use for the selected SPEs. This is the firmware filename that you obtained in Step 3.

```
AS5400(config-SPE)# firmware location np-spe-upw-1.0.1.2.bin
```

Step 7 Specify when the SPE firmware upgrade is to occur.

```
AS5400(config-SPE)# firmware upgrade busyout | download-maintenance | reboot
```

Step 8 Type the **exit** command to exit SPE config mode.

```
AS5400(config-SPE)# exit
AS5400(config)#
```

Step 9 Press the **Enter** key to verify your command registers, then type **Ctrl-Z** to return to privileged EXEC mode.

```
AS5400(config)# Ctrl-Z
AS5400#
```

Step 10 Save your changes when ready.

```
AS5400# copy running-config startup-config
```

Using SPE Firmware Bundled with Cisco IOS Software

Use this procedure to update SPE firmware on the SPEs in your gateway if you decide to use the version of SPE firmware bundled with Cisco IOS software instead of the version already mapped to your ports.

To set the SPE firmware mapping to the SPE firmware version bundled with Cisco IOS software, enter the following commands:

Step 1 Enter the **enable** command.

```
AS5400> enable
```

Step 2 Enter your password.

```
Password: password
AS5400#
```

You are in privileged EXEC mode when the prompt changes to `AS5350#` or `AS5400#`.

Step 3 Enter global configuration mode by typing the **configure** command. The example uses the terminal configuration option.

```
AS5400# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
AS5400(config)#
```

You are in global configuration mode when the prompt changes to `AS5350(config)#` or `AS5400(config)#`.

Step 4 Enter SPE configuration mode, which is similar to line configuration mode. You can choose to delete the configuration for a single SPE or range of SPEs by specifying the first and last SPE in the range. The SPE firmware used by the SPEs automatically reverts to the version bundled with the current Cisco IOS image.

```
AS5400(config)# spe slot/spe
```

or

```
AS5400(config)# spe slot/spe slot/spe
```

You are in SPE configuration mode when the prompt changes to `AS5350(config-SPE)#` or `AS5400(config-SPE)#`.

Step 5 If the previous download was unbundled firmware, enter the no form of the **firmware location** command to revert to the default Cisco IOS bundled SPE firmware:

```
AS5400(config-SPE)# no firmware location
```

Step 6 Type the **exit** command to exit SPE config mode.

```
AS5400(config-SPE)# exit
AS5400(config)#
```

Step 7 Press the **Enter** key to verify your command registers, then type **Ctrl-Z** to return to privileged EXEC mode.

```
AS5400(config)# Ctrl-Z
AS5400#
```

Step 8 Save your changes when ready.

```
AS5400# copy running-config startup-config
```

This process does not delete any existing SPE firmware that resides in system Flash memory in case you later want to revert to it. If you decide to delete the code from system Flash memory, remember that *all* files in system Flash memory are deleted; therefore save and restore any important files (for example, the Cisco IOS software image).

Note If the new Cisco IOS image contains the same SPE firmware as the old one, no new code is downloaded to the SPEs.

Health Monitor

The Health Monitor allows you to see the status of different components of the AS5400:

The **show health-monitor summary** command shows the status of the following components:

- Chassis: Power supply, Temperature, Fans
- Memory: Processor, I/O Memory
- DFC: CT3, E1, T1, NP108

The **show health-monitor summary** command provides high level component status.

The **show health-monitor** command shows more details such as the status of sub components.

The following example shows the display output of the **show health-monitor** command:

```
AS5400#show health-monitor
Chassis:
   Power Supply                          Failure
      Redundant Power System is present.
      PS Input Voltage status:     failure
      PS Output Voltage status:    failure
      PS Fan status:                normal
      PS Thermal status:            normal
      PS OverVoltage status:        normal
   Temperature                              OK
   Fans                                     OK

Memory:
   Free Memory processor                    OK
   Memory Fragmentation Processor           OK
   Free Memory I/O                          OK
   Memory Fragmentation I/O                 OK
   Detailed summary:
               Head    Total(b)     Used(b)     Free(b)   Lowest(b)  Largest(b)
Processor   62EC07E0   219412512    67221920   152190592   142181548   139874020
      I/O   40000000    67110380    46387964    20722416    20722416    20706928

DFC's:
   Slot 1 (NP108 DFC)                       OK
   Slot 2 (NP108 DFC)                       OK
   Slot 3 (NP108 DFC)                       OK
   Slot 4 (NP60 DFC)                        OK
   Slot 5 (NP108 DFC)                       OK, 1 SPE's BAD
   Slot 7 (CT3 DFC)                         OK
AS5400#
AS5400#
AS5400#
AS5400#
AS5400#show health-monitor summ
AS5400#show health-monitor summary ?
  |  Output modifiers
  <cr>
```

The following example shows the display output of the **show health-monitor summary command**:

```
AS5400#show health-monitor summary
Chassis:
   Power Supply                          Failure
   Temperature                              OK
   Fans                                     OK

Memory:
```

```
   Free Memory processor                        OK
   Memory Fragmentation Processor               OK
   Free Memory I/O                              OK
   Memory Fragmentation I/O                     OK

DFC's:
   Slot 1 (NP108 DFC)                           OK
   Slot 2 (NP108 DFC)                           OK
   Slot 3 (NP108 DFC)                           OK
   Slot 4 (NP60 DFC)                            OK
   Slot 5 (NP108 DFC)                           OK
   Slot 7 (CT3 DFC)                             OK
```

Interface Queue Wedge Monitor

The Interface Queue Wedge Monitor displays information about interface queue wedges and the times that they occur. An interface queue is wedged when the packet count that is being transmitted (output queue) or received (input queue) is equal to or greater than the maximum packet count size of the queue, and consequently, no more packets are being transmitted or received.

The Interface Queue Wedge Monitor is enabled or disabled using following commands.

- **interface-monitor enable**
- **[no] interface-monitor enable**

The Interface Queue Wedge Monitor is disabled by default.

When the Interface Queue Wedge Monitor is enabled, it monitors all the input and output queue wedge interfaces. The **show wedged-interfaces [output/input]** command displays the queue wedged interfaces.

The **show wedged-interfaces output** command displays the output queue wedge interfaces and their respective time-since-wedges.

The **show wedged-interfaces input** command displays the input queue wedge interfaces and their respective time-since-wedges.

Interface Queue Wedge Output Procedure

When the Interface Queue Wedge Monitor is enabled, and an interface (such as a FastEthernet0/0 output queue is already wedged, the following message is displayed on the console, syslog, and buffer:

```
Eg:  00:39:15: %HHM-3-INTFWEDGE: FastEthernet0/0 Output Queue Wedged
```

The following procedure shows an example of how to enable, disable, and show the results of a wedged interface output:

Step 1 Enable the Interface Queue Wedge Monitor.

```
AS5400##conf t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400#(config)#interface-monitor enable
AS5400#(config)#^Z
AS5400##
```

Step 2 Show interfaces. (In this case, some interfaces are already wedged.)

```
AS5400##sh wedged-interfaces output
Interface Name            Time Since Wedge
Async4/00                 00:23:33
```

```
Async4/01                 00:23:26
Async4/02                 00:23:21
Async4/03                 00:23:15
FastEthernet0/0           00:24:35
FastEthernet0/1           00:24:50
Virtual-Access2           00:38:19
Virtual-Access3           00:38:19
AS5400##
```

Step 3 Show interface wedge process running.

```
AS5400##show proc cpu | i Intf
  39           0       341          0  0.00%  0.00%  0.00%   0 Intf Wedge Monit
AS5400##
```

Step 4 Disable interface monitor.

```
AS5400##conf t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400#(config)#no interface-monitor enable
AS5400#(config)#^Z
AS5400##
AS5400##
```

Step 5 Show interface wedge process running again. (No process is running now.)

```
AS5400##show proc cpu | i Intf
AS5400##
```

Step 6 Show wedged interface output. (No output.)

```
AS5400##show wedged-interfaces output
Interface Name            Time Since Wedge
AS5400##
AS5400##
```

Step 7 Enable the Interface Queue Wedge Monitor again.

```
AS5400##conf t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400#(config)#interface-monitor enable
AS5400#(config)#^Z

AS5400##
00:39:03: %HHM-3-INTFWEDGE: Async4/00 Output Queue Wedged
00:39:04: %SYS-5-CONFIG_I: Configured from console by console
00:39:06: %HHM-3-INTFWEDGE: Async4/01 Output Queue Wedged
00:39:09: %HHM-3-INTFWEDGE: Async4/02 Output Queue Wedged
00:39:12: %HHM-3-INTFWEDGE: Async4/03 Output Queue Wedged
00:39:15: %HHM-3-INTFWEDGE: FastEthernet0/0 Output Queue Wedged
00:39:18: %HHM-3-INTFWEDGE: FastEthernet0/1 Output Queue Wedged
00:39:39: %HHM-3-INTFWEDGE: Virtual-Access2 Output Queue Wedged
00:39:42: %HHM-3-INTFWEDGE: Virtual-Access3 Output Queue Wedged
AS5400##
AS5400##
AS5400##
```

Step 8 Show wedge output.

```
AS5400##sh wedge out
Interface Name            Time Since Wedge
Async4/00                 00:25:26
Async4/01                 00:25:20
Async4/02                 00:25:15
Async4/03                 00:25:08
```

```
FastEthernet0/0            00:26:29
FastEthernet0/1            00:26:44
Virtual-Access2            00:40:12
Virtual-Access3            00:40:12
AS5400##
```

Step 9 Show interface wedge process running again. (Process is running now.)

```
AS5400##show proc cpu | i Intf
  39           0        25          0  0.00%  0.00%  0.00%   0 Intf Wedge Monit
```

Wedge Interface Input Procedure

The following procedure shows an example of how to enable, disable, and show the results of wedged interface input:

Step 1 Show wedged interfaces. (Interfaces are already wedged.)

```
AS5400##sh wedged-interfaces input
Interface                  Time Since Wedge
Async4/00                  00:21:58
Async4/01                  00:21:51
Async4/02                  00:21:26
Async4/03                  00:21:21
FastEthernet0/0            11:58:28
FastEthernet0/1            11:58:46
Virtual-Access2            00:08:46
Virtual-Access3            00:08:46
AS5400##
AS5400##
```

Step 2 Show interface wedge process running.

```
AS5400##sh proc cpu | i Intf
  39           0        21          0  0.00%  0.00%  0.00%   0 Intf Wedge Monit
AS5400##
AS5400##
AS5400##
```

Step 3 Disable interface monitor.

```
AS5400##conf t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400#(config)#no interface-monitor enable
AS5400#(config)#^Z
AS5400##
AS5400##
AS5400##
```

Step 4 Show interface wedge process running again. (No process is running now.)

```
AS5400##sh proc cpu | i Intf
AS5400##
AS5400##
```

Step 5 Show wedged interface input. (No input.)

```
AS5400##show wedged-interfaces output
Interface                  Time Since Wedge
AS5400##
AS5400##
```

Step 6 Enable the Interface Queue Wedge Monitor again.

```
AS5400##conf t
Enter configuration commands, one per line.  End with CNTL/Z.
AS5400#(config)#interface-monitor enable
AS5400#(config)#^Z
AS5400##
AS5400##

AS5400##
12:00:50: %HHM-3-INTFWEDGE: Async4/00 Input Queue Wedge
12:00:53: %HHM-3-INTFWEDGE: Async4/01 Input Queue Wedge
12:00:56: %HHM-3-INTFWEDGE: Async4/02 Input Queue Wedge
12:00:59: %HHM-3-INTFWEDGE: Async4/03 Input Queue Wedge
12:01:02: %HHM-3-INTFWEDGE: FastEthernet0/0 Input Queue Wedge
12:01:05: %HHM-3-INTFWEDGE: FastEthernet0/1 Input Queue Wedge
12:01:26: %HHM-3-INTFWEDGE: Virtual-Access2 Input Queue Wedge
12:01:29: %HHM-3-INTFWEDGE: Virtual-Access3 Input Queue Wedge
AS5400##
AS5400##
```

Step 7 Show interface wedge process running again. (Process is running now.)

```
AS5400##sh proc cpu | i Intf
  39           8       110         72  0.00%  0.00%  0.00%   0 Intf Wedge Monit
AS5400##
```

Step 8 Show wedge input.

```
Here is the o/p again
---------------------

AS5400##sh wedged-interfaces input
Interface                 Time Since Wedge
Async4/00                 00:24:14
Async4/01                 00:24:06
Async4/02                 00:23:42
Async4/03                 00:23:37
FastEthernet0/0           12:00:44
FastEthernet0/1           12:01:01
Virtual-Access2           00:11:02
Virtual-Access3           00:11:02
```

Where to Go Next

At this point you can go to:

- Chapter 6, "Configuring Voice over IP" to learn how to configure voice and fax traffic over an IP network.
- Appendix C, "Comprehensive Configuration Examples."
- *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/.
  Select your Cisco IOS release and search for this title.

Tip The following publications are useful for those familiar with the Cisco universal gateway products that use MICA modems.

- *Comparing Universal Port SPE Commands to MICA Modem Commands*, available online at http://www.cisco.com/warp/customer/76/nextport_compare.html
- *Managing Port Services on the Cisco AS5350 Universal Gateway*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5350/sw_conf/alxnxpt.htm
- *Managing Port Services on the Cisco AS5400 Universal Gateway,* available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t3/nextport/index.htm.

Tip The following publications are available on the Documentation CD-ROM that came with your gateway, or on the World Wide Web from the Cisco home page.

- For more advanced configuration topics, see the Cisco IOS software configuration guide, feature modules, and command-reference publications *Dial Solutions Configuration Guide* and *Dial Solutions Command Reference Guide* for your Cisco IOS release.

CHAPTER 6

Configuring Voice over IP

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

Voice over IP (VoIP) technology enables voice-capable routers and switches to transport packetized live voice traffic such as telephone calls over IP data intranetworks or internetworks rather than public switched telephone networks (PSTN) or private TDM (PBX) networks. VoIP thus enables toll bypass, remote PBX presence over WANs, unified voice and data trunking, and plain old telephone service (POTS)-Internet telephony gateways. VoIP enables more efficient and full use of your existing IP data network both, reducing transmission costs and possibly your need to support dual (voice and data) networks.

Routers and switches such as the Cisco AS5350 and Cisco AS5400 universal gateways can handle origination, transport, and termination of VoIP traffic. They digitize analog voice signals, compress them, package them into a series of discrete packets, and transport them interleaved with data packets. They can transmit VoIP packets to both VoIP and non-VoIP destinations, and can receive both VoIP and nonVoIP calls. When data lines are busy, they can spill traffic onto the PSTN.

To ensure acceptable quality of service (QoS) for your voice users, it is important that you configure your gateway carefully and monitor its performance vigilantly—to ensure, for voice traffic, priority service with minimal loss and delay. Unlike most other types of data, voice is intolerant of almost any form of loss or delay. Users cannot wait for a destination device to reorder packets and request that the sending device retransmit any that are missing, as it does for most other data types.

To configure basic VoIP, in general you need to do the following:

- Configure signaling on voice ports
- Configure dial peers

You might also need to do the following:

- Configure voice QoS features
- Configure Frame Relay for VoIP
- Configure the gateway to distinguish between voice and modem calls (necessary when the network-access server supports both modem dialup and VoIP users on the same POTS interface)
- Optimize dial-peer and network-interface configurations
- Configure VoIP for Microsoft NetMeeting

This chapter briefly introduces the subject of configuring VoIP and overviews the first few configuration tasks. It describes, at a high level, some of the voice QoS features that you can enable. Most important, it points you to other references from which you can gain a broader and deeper look at the subject.

Contents are as follows:

Tip It is critical that you consult the additional references sited throughout and at the end of the chapter before you configure VoIP. These plus additional references throughout the Cisco website (search for *configure voip* to locate the most current references) provide the information that you need to optimize settings. The more information that you have at your disposal, the greater your probability of success, as measured by cost savings and user acceptance.

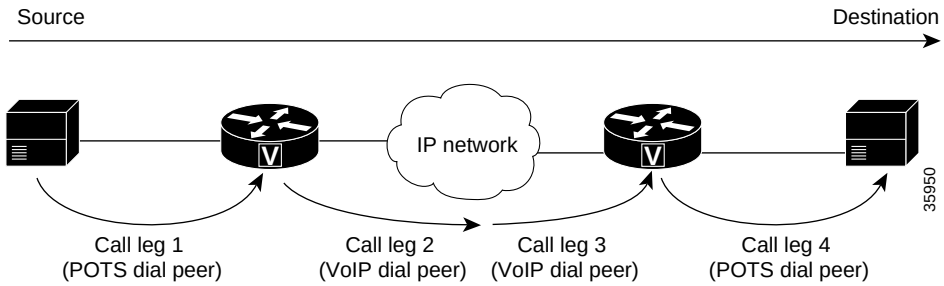
Note Although VoIP technology is primarily software-based, it requires that you install a universal port card into the appropriate slot of your Cisco AS5350 or Cisco AS5400 universal gateway. The number of ports or channels available for sending VoIP data depends on the capacity of your card. For more information, see Chapter 5, "Managing and Troubleshooting the Universal Port Card."

VoIP Basics

Before you configure VoIP on your gateway, it might help to understand at a high level what happens when you place a VoIP call. Think of each event in a call flow as occurring on one of the several "legs" of a call, as shown in the following typical scenario. Other scenarios are possible, of course, including ones where the call destination is an IP phone and the call never leaves the IP network.

- Call-leg 1: Originating device to originating gateway
- Call-leg 2: Originating gateway into the IP network
- Call-leg 3: IP network to destination gateway
- Call-leg 4: Destination gateway to destination device

Figure 6-1 Call Legs



Legs connecting a local device (typically a phone, fax machine, or PBX) to a gateway are called *POTS* (plain old telephone service) legs. Legs connecting a gateway to the IP network are called *VoIP* legs. A POTS or VoIP leg is either *inbound* or *outbound*, from the perspective of the associated gateway.

Table 6-1 Call Legs

A call leg from...	To...	Is of this type...
Originating device	Originating gateway	Inbound POTS
Originating gateway	IP network	Outbound VoIP
IP network	Destination gateway	Inbound VoIP
Destination gateway	Destination device	Outbound POTS

A gateway conferences two call legs—an inbound POTS with an outbound VoIP or an inbound VoIP with an outbound POTS—to create an end-to-end call through the gateway. A call that passes through both an originating gateway and a destination gateway has four call legs.

Call Flow

Table 6-2 and Table 6-3 detail the general call flow from the perspective of an originating and destination gateway respectively.

Table 6-2 VoIP Call Flow, Originating Gateway View

Event	Leg Type
User sends dialed digits via public switched telephone network to gateway.	Inbound POTS
Gateway does the following: • Processes information (maps dialed digits, per information stored in dial-peer configuration tables, either to an IP host that connects directly to the destination gateway or to a PBX at the destination that can complete the call). • Initiates H.323 session across network. • Processes voice signals and sends packets over network. As appropriate, sends call-progress and other in-band signals. • Ends session.	Outbound VoIP

Table 6-3 VoIP Call Flow, Destination Gateway View

Event	Leg Type
Gateway receives dialed digits.	Inbound VoIP
Gateway does the following: • Processes information (maps dialed digits, per information stored in dial-peer configuration tables, to a destination device). • Gateway participates in H.323 session across network. • Processes voice signals and sends packets over network. As appropriate, sends call-progress and other in-band signals. • Ends session.	Outbound POTS plus inbound VoIP

Dial Peers

Each kind of call leg into or out of a gateway—inbound POTS, outbound VoIP, inbound VoIP, and outbound POTS—must have assigned to it a set of allowable call scenarios, called dial peers.

- POTS dial peers associate gateway ports with destination endpoints. You need a POTS dial peer for every port-to-endpoint association.
- VoIP dial peers associate destination phone numbers with IP addresses or other means to send packets to that destination. You need a VoIP dial peer for every set of destination endpoints.

A dial peer is, essentially, a single static route within a routing table. A collection of dial peers constitutes a dial plan.

Syntax

A POTS dial peer has the following syntax:

```
dial-peer voice tag pots
 destination-pattern number
 port port#
 other configurable options
```

where *tag* is a numeric value of local significance only, *number* is the full E.164 phone number of the associated endpoint, and *port#* is the voice port in the gateway through which the call is transmitted once a destination pattern is matched.

A VoIP dial peer has the following syntax:

```
dial-peer voip tag voip
 destination-pattern number
 session target data address
 other configurable options
```

where *tag* is a numeric value of local significance only, *number* is the full E.164 phone number of the associated endpoint, and *data address* is where the gateway sends a call whose destination pattern matches the one in the peer.

Matching Rules

A gateway redirects an incoming call along the most appropriate outbound leg. It selects the most appropriate leg by first finding the POTS or VoIP (depending on call direction) dial peer whose destination pattern matches the call's dialed digits. For outbound VoIP legs, it chooses the longest matching dial peer. If more than one such match exists, it checks whether preferences have been assigned those peers and selects the peer with the lowest preference level.

Example

Let us say, for a very simple example (your implementation will be far more complex), that a company has offices in San Jose and Newark. Extensions in the San Jose office are in the range 5000 to 5999, those in the Newark office in the range 6000 to 6999. A caller at San Jose extension 5000 wants to call Newark extension 6000. The following dial peers are needed to make this connection:

Table 6-4 Sample Dial Peers

Dial-peer (tag) number	Dial peer	Function
San Jose Gateway		

1	`dial-peer voice 1 pots`
	` destination-pattern 5000`
	` port 1/0:1`
		Associates San Jose extension 5000 with San Jose gateway port 1/0:1.

2	`dial-peer voice 2 voip`
	` destination-pattern 6...`
	` session target ipv4:172.16.1.1`
		Transmits San Jose's Newark-bound calls (extensions 6000-6999) to the gateway in Newark whose IP address is 172.16.1.1.

Newark Gateway		

3	`dial-peer voice 3 voip`
	` destination-pattern 5...`
	` session target ipv4:172.19.1.1`
		Transmits Newark's San Jose-bound calls (extensions 5000-5999) to the gateway in San Jose whose IP address is 172.19.1.1.

4	`dial-peer voice 4 pots`
	` destination-pattern 6000`
	` port 1/0:3`
		Associates Newark extension 6000 with Newark gateway port 1/0:3.

When the San Jose caller at extension 5000 dials the digits 6000, the originating gateway in San Jose does the following:

1. Receives, through port 1/0:1 to which extension 5000 connects, the dialed digits 6000.
2. Searches its VoIP dial peers until it finds dial-peer 2, whose destination pattern best matches the dialed digits.
3. Sends the dialed digits through the IP network to the gateway specified by dial-peer 2's session target (172.16.1.1).

The destination gateway in Newark now does the following:

1. Receives the dialed digits through the IP network.
2. Searches its POTS dial peers until it finds dial-peer 4, whose destination pattern matches the dialed digits.
3. Sends the call out the port specified by that dial peer (port 1/0:3, which connects to extension 6000).

In this west-to-east scenario, dial peers 2 and 4 are used, in that order. If Newark extension 6000 were to call San Jose extension 5000, dial peers 3 and 1 would be used, in that order.

Configuring Basic VoIP

Configuring basic VoIP involves the following:

- Perform Preconfiguration Tasks, page 6-6
- Configure Signaling on Voice Ports, page 6-7
- Configure Dial Peers, page 6-8
- Configuring Nextport Echo Canceller Control (optional), page 6-12

Perform Preconfiguration Tasks

Before you configure your gateway for VoIP, complete the following tasks. See the earlier chapters in this book and the references at the end of this chapter for the additional information you need to do so.

Step 1 Establish a working IP network in which delay (as measured by ping tests) and jitter are minimized.

Step 2 Install a universal port card into the appropriate slot of your gateway. The number of ports or channels available for sending VoIP data depends on the capacity of the card. For more information, see Chapter 5, "Managing and Troubleshooting the Universal Port Card."

Step 3 Complete basic gateway configuration. For more information, see Chapter 3, "Basic Configuration Using the Command-Line Interface."

Step 4 Formulate the beginning of a dial plan that includes the following:

- Logical network diagram showing voice ports and components to which they connect, including phones, fax machines, PBX or key systems, other voice devices that require connection, and voice-enabled routers
- Connection details, including physical interfaces (T1, analog, etc.), relevant LAN and WAN ports, and all voice ports; for each WAN, type (Frame Relay, PPP, etc.); for Frame Relay, relevant PVCs and link-access rates
- Phone numbers or extensions for each voice port, logically laid out and consistent with existing private dial plans and external dialing schemes

Step 5 Establish a working telephony network based on that dial plan.

Step 6 Integrate the dial plan and telephony network into your existing IP network topology. The following is recommended:

- Make routing or dialing transparent to users by, for example, avoiding such inconveniences as secondary dial tones.
- Contact your PBX vendor to learn how to reconfigure PBX interfaces.

Configure Signaling on Voice Ports

The Cisco AS5350 and Cisco AS5400 gateways process and manage digital voice calls on the universal port card. They support voice configuration on channelized T1, E1, and T3 trunk interfaces.

Your universal port card supports ISDN PRI, E1 R2, and T1 CAS digital signaling. Configure your voice ports according to signaling type. Set parameters as needed for input gain, output attenuation, echo cancellation, various timeouts, and translation rules. Defaults are generally adequate, but may need to be tweaked for some networks.

Note For ISDN configurations, voice ports (with serial interfaces acting as D channels) are created automatically when you configure an ISDN PRI group. Before configuring your voice ports, configure both B and D channels as described in Chapter 3, "Basic Configuration Using the Command-Line Interface."

Tip For more information, see the following online references:

- *Voice over IP for the Cisco AS5300*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t3/voip5300/
- *Voice Over IP for the Cisco 3600 Series Commands*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113t/113t_1/voip/commands.htm
- *E1 R2 Signaling Configuration and Troubleshooting*, available online at http://www.cisco.com/warp/public/788/signalling/e1r2config.html

ISDN PRI Signaling

Signaling for ISDN PRI VoIP is handled by ISDN PRI group configuration. If you have ISDN PRI voice ports, be sure to complete these tasks:

- "Configuring ISDN PRI" section on page 3-13
- "Configuring the D Channels for ISDN Signaling" section on page 3-23
- "Configuring ISDN NFAS on CT1 PRI Groups" section on page 4-5

Ensure that multiframes are established on the serial interfaces (acting as D channel). Then set parameters as needed for input gain, output attenuation, echo cancellation, various timeouts, and translation rules.

E1 R2 Signaling

R2 is an international signaling standard for channelized E1 networks used in Europe, Asia, and South America, equivalent to channelized T1 signaling in North America. There are two elements to R2 signaling:

- Line signaling (supervision), including R2 digital, R2 analog, and R2 pulse
- R2 interregister signaling (call-setup control), including compelled, noncompelled, and semi-compelled

If you have ISDN PRI voice ports, be sure to complete "Configuring E1 R2 Signaling" section on page 4-6. Configure signaling types and, if necessary, set parameters unique to specific countries.

T1 CAS Signaling

Channel-associated signaling (CAS) occurs in-band within the data channel, rather than on a separate signaling channel as is the case (on the D channel) with ISDN PRI. For T1 CAS, specify parameters such as frame type and line code.

Configure Dial Peers

Your next step in preparing to set up dial peers is to determine the configurable options that you want to enable.

Configurable Options

Configurable options are the attributes to be applied to calls handled using that dial peer. These typically include, at a minimum, required quality of service, codec for voice encoding, and whether voice-activity detection is to be enabled. The following attributes, for example, are typical in a VoIP dial peer:

```
req-qos best-effort
codec g711ulaw
vad
```

You have many options and great flexibility in configuring dial peers. Table 6-5 and Table 6-6 show the most common configurable options that you can enable in POTS and VoIP dial peers, respectively, from config or config-dial-peer mode.

Table 6-5 POTS Dial-Peer Configuration Commands

Command	Purpose
`answer-address`	Sets call-destination number.
`application`	Sets selected application.
`calling-number`	Sets calling number (for fgd_eana signaling only).
`default`	Sets a command to its defaults.
`destination-pattern`	Sets full E.164 telephone number.
`digit-strip`	Strips digits from the POTS dialed number.
`direct-inward-dial`	Sets called number as final call destination.
`exit`	Exits dial-peer configuration mode.
`forward-digits`	Configures the destination digits forward of this dial peer.
`huntstop`	Stops hunting on dial peers.
`incoming`	Sets incoming called number.
`info-digits`	Prepends info digits to the calling number.
`information-type`	Sets information type for dial peer.
`max-conn`	Sets maximum connections per peer; “no” sets to unlimited.
`no`	Negates a command or sets its defaults.
`numbering-type`	Sets calling/called party numbering type.
`port`	Sets voice port associated with the peer.
`preference`	Configures preference order of the peer.
`prefix`	Sets prefix to be dialed before the dialed number.
`progress_ind`	Indicates call progress.
`register`	Registers E.164 number of this peer with gatekeeper.
`resource`	Sets resource allocation policy.
`session`	Sets session [target | protocol | transport] for this peer.
`shutdown`	Changes admin state of this peer to down (no->up).
`translate-outgoing`	Sets translation rule.

Table 6-6 VoIP Dial-Peer Configuration Commands

Command	Purpose
acc-qos	Sets minimally acceptable quality of service for calls to this peer.
answer-address	Sets call destination number.
application	Sets selected application.
clid_restrict	Restricts display of caller ID.
codec	Sets codec for calls to this peer.
default	Set a command to its defaults.
destination-pattern	Sets full E.164 telephone number.
dtmf-relay	Transports DTMF digits across IP link.
exit	Exits dial-peer configuration mode.
expect-factor	Sets expectation factor for voice quality.
fax	Configures fax service.
fax-relay	Sets fax-relay options.
huntstop	Stops hunting on dial peers.
icpif	Sets calculated planning-impairment factor.
incoming	Sets incoming called number.
information-type	Sets information type for dial peer.
ip	Sets IP packet options.
max-conn	Sets maximum connections per peer; “no” sets to unlimited.
max-redirects	Sets maximum redirects for this peer.
no	Negates a command or sets its defaults.
numbering-type	Sets calling/called party numbering type.
preference	Configures preference order of the peer.
req-qos	Sets required quality of service for calls to this peer.
roaming	Sets use of roaming server.
session	Sets session [target | protocol | transport] for this peer.
settle-call	Sets use of settlement server.
shutdown	Changes admin state of this peer to down (no->up).
snmp	Modifies SNMP voice-peer parameters.
tech-prefix	Sets H.323 gateway technology prefix.
translate-outgoing	Sets translation rule.
vad	Sets use of Voice Activity Detection.
voice-class	Sets dial-peer voice-class control parameters.

Here are just a few of the things that you can do with these commands (which, as mentioned previously, you set from config or config-dial-peer mode):

- Configure destination patterns with wildcards and other operators.

  Example: Use `6...` to denote a 4-digit number beginning with 6.

- Define fixed-length or variable-length destination patterns.

  Example: Use `6...` to denote a 4-digit number beginning with 6; use `9t` to denote a variable-length number beginning with 9.

- Specify that a prefix be added to calls on certain outgoing POTS call legs.

  Example: Prepend 9 to calls that pass through a PBX requiring 9 to access an outside line; replace prefixes that are stripped by a dial peer because they match the destination pattern.

- Specify that certain dialed digits be expanded.

  Example: Expand local 5-digit extensions beginning with 7 to the full E.164 number 1-408-7*xxx*.

- Create a hunt group to handle inbound calls.

  Example: Establish multiple dial peers, each for a different voice port, and each containing the same destination pattern; the gateway directs inbound calls to the voice ports in sequence until it reaches one that is not busy.

- Set up preferences for routing outbound calls.

  Example: Assign preference 1 to dial-peer voice 1, which directs outbound calls over the IP network; assign preference 2 to dial-peer voice 2, which directs calls over the PSTN; the gateway, looking for the longest exact match, finds both dial peers and then uses preference as a tie breaker among those matches.

Tip For more information, see *Voice over IP for the Cisco AS5300*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t3/voip5300/

Dial-Peer Configuration Table

The next step in creating dial peers is to create a dial-peer configuration table. Under the following headings, show data for all of your gateways and associated dial peers. Table 6-7 is for the simple gateway-to-gateway scenario described earlier; your own will be far more complex.

Table 6-7 Dial-Peer Configuration Table

Dial-Peer Tag	Extension	Destination Pattern	Type	Voice Port	Session Target	CODEC	QoS
San Jose Gateway							
1	5000	5000	pots	1/0:1	—	—	—
2	—	6...	voip	—	172.16.1.1	6.711	best effort
Newark Gateway							
3	—	5...	voip	—	172.19.1.1	6.711	best effort
4	6000	6000	pots	1/0:3	—	—	—

Tip Consult the references at the end of the chapter before you create a dial-peer configuration table. See also *Voice over IP for the Cisco AS5300*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t3/voip5300/

Configuring Nextport Echo Canceller Control (optional)

The AS5350, AS5400, and AS5400HPX Universal Gateways can detect 2100Hz tones, received in G.711 encoded VoIP packets. Customers can enable Nextport Voicecap to control the echo canceller when 2100Hz tones are received in G.711 encoded VoIP packets from either the PSTN or IP side of the network.

Note Nextport control over the echo canceller is only possible in G.711 codec modes.

Note It is not recommended that you enable Nextport control over the echo canceller in conjunction with modem-pass-through.

You enable IP tone detection and Nextport control over the echo canceller using CLI commands, but you must first set the following two Voicecap parameters to enable these features:

- v51 = 32769
  This setting enables IP side tone detection/notification and allows Nextport to disable the nonlinear processor (NLP) or the echo canceller upon reception of 2100Hz answer tones from the IP side. This setting is required in IOS Release 12.3T
- v2 = 512
  This setting enables the 250 millisecond silence detection. This setting is optional. When this setting is used in conjunction with the v51 = 32769 setting, Nextport restores the echo canceller to its original state after it detects the 250 millisecond silence.

The following example shows how to enable Nextport control over the echo canceller by creating a Voicecap entry and applying it to the voice-port.

1. Create Voicecap entries by entering the following CLI command:

   Syntax:

   ```
   router(config)#voicecap entry <name> <parameter list>
   ```

   Example:

   ```
   router(config)#voicecap entry npecho_ctrl v2=512 v51=32769
   ```

2. Apply the Voicecap entries to the voice port by entering the following CLI command:

   Syntax:

   ```
   router(config)#voicecap configure <name>
   ```

   Example:

   ```
   router(config)#voicecap configure npecho_ctrl
   ```

The following example shows the complete create and apply Voicecap procedure:

```
router(config)#voicecap entry npecho_ctrl v2=512 v51=32769
router(config)#voice-port 3/0
router(config-voiceport)#voicecap configure npecho_ctrl
router(config-voiceport)#end
```

Note The Voicecap must be applied to the voice-port.

The IOS CLI **show** command does not display the current echo state. However, you can display the EST trace messages that show the tone detections and the resultant echo operations if you enable *debug trace module f080 0010 x/y/z*. Nextport enables and disables the nonlinear processor (NLP) and the echo canceller based on reception of 2100Hz answer tones from the IP side or PSTN side and generates EST trace messages for each tone detected and its echo operation. Nextport also detects the 250 milliseconds of silence and generates EST trace messages to indicate such detection and to indicate that the echo state has been restored.

To display the EST trace messages, enable *debug trace module f080 0010 x/y/z* as follows:

```
router# debug trace module f080 0010 s/d/m
```

s/d/m is defined as follows:

- s = slot
- d = dfc
- m = module number

When the default configuration values for Index 51 and Index 52 are used, IP tone detection and notification are disabled, and all existing features continue to function as normal.

The following example shows EST trace messages collected from the IOS console:

```
5350-torpedo#
*Apr 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:      Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:51.735:      Data Len   : 56
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received Early ANS tone 0x01 from
IP side
*Apr 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:
5350-torpedo#  Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:51.735:      Data Len   : 63
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received Tone Off ntf for code 0x01
from IP side
*Apr 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:      Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
5350-torpedo#*Apr 26 21:40:51.735:      Data Len   : 45
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received ANS tone 0x03 from IP
*Apr 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:      Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
```

```
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:51.735:      Data Len   : 47
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Non-linear Processor Is Disabled
*Apr
5350-torpedo# 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:      Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:51.735:      Data Len   : 63
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received Tone Off ntf for code 0x03
from IP side
*Apr 26 21:40:51.735:   00:00:14: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:
5350-torpedo#   Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:51.735:      Data Len   : 47
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received ANSam tone 0x07 from IP
*Apr 26 21:40:51.735:   00:00:13: Port Trace Event:
*Apr 26 21:40:51.735:      Port       : 3/00
*Apr 26 21:40:51.735:      Address    : 0x3000000
*Apr 26 21:40:51.735:      Trace Event: 0x2
*Apr 26 21:40:51.735:      Data Format: ASCII
*Apr 26 21:40:5
5350-torpedo#1.735:      Data Len   : 63
*Apr 26 21:40:51.735:      Data       : Session 0x0144 Received Tone Off ntf for code 0x07
from IP side
*Apr 26 21:40:51.739:   00:00:13: Port Trace Event:
*Apr 26 21:40:51.739:      Port       : 3/00
*Apr 26 21:40:51.739:      Address    : 0x3000000
*Apr 26 21:40:51.739:      Trace Event: 0x2
*Apr 26 21:40:51.739:      Data Format: ASCII
*Apr 26 21:40:51.739:      Data Len   : 48
*Apr 26 21:40:51.739:      Data       : Session 0x0144 Received /ANSam tone 0x0f from IP
5350-torpedo#*Apr 26 21:40:51.739:   00:00:13: Port Trace Event:
*Apr 26 21:40:51.739:      Port       : 3/00
*Apr 26 21:40:51.739:      Address    : 0x3000000
*Apr 26 21:40:51.739:      Trace Event: 0x2
*Apr 26 21:40:51.739:      Data Format: ASCII
*Apr 26 21:40:51.739:      Data Len   : 31
*Apr 26 21:40:51.739:      Data       : Session 0x0144 ECAN Is Disabled
*Apr 26 21:40:51.739:   00:00:04: Port Trace Event:
*Apr 26 21:40:51.739:      Port       : 3/00
*Apr 26 21:40:51.739:      Address    : 0x3000000
5350-torpedo#*Apr 26 21:40:51.739:      Trace Event: 0x2
*Apr 26 21:40:51.739:      Data Format: ASCII
*Apr 26 21:40:51.739:      Data Len   : 63
*Apr 26 21:40:51.739:      Data       : Session 0x0144 Received Tone Off ntf for code 0x0f
from IP side

*Apr 26 21:46:36.431:   00:00:08: Port Trace Event:
*Apr 26 21:46:36.431:      Port       : 3/00
*Apr 26 21:46:36.431:      Address    : 0x3000000
*Apr 26 21:46:36.431:      Trace Event: 0x2
*Apr 26 21:46:36.431:      Data Format: ASCII
*Apr 26 21:46:36.431:      Data Len   : 43
*Apr 26 21:46:36.431:      Data       : Session 0x0144 detected 250 msec of silence
*Apr 26 21:46:36.431:   00:00:08: Port Trace Event:
*Apr 26 21:46:36.431:      Port       : 3/00
*Apr 26 21:46:36.431:      Address    : 0x3000000
*Apr 26 21:46:36.435:      Trace Event: 0x2
*Apr 26 21:46:36.435:      Data Format: ASCII
```

```
*Apr 26 21:46:36.435:      Data Len   : 41
*Apr 26 21:46:36.435:      Data       : Session 0x0144 Ecan State 0x0007 Restored
```

Voice QoS Basics

Quality of service refers to the ability of a network to provide differentiated service to selected network traffic over various underlying technologies. QoS is not inherent in a network infrastructure. Rather, you institute QoS by strategically enabling appropriate QoS features throughout an intranetwork or internetwork.

Voice traffic differs from data traffic in a number of ways:

- Data is often bursty by nature; voice is deterministic (smooth).
- Data applications resend dropped packets; voice applications can only conceal dropped packets.
- Data applications can usually tolerate some delay; voice applications must minimize delay, so that the recipient does not hear clips in the transmission.

All of these mandate use of QoS strategies to give strict priority to voice traffic, ensuring reliable delivery and minimal delay for networks that carry both voice and data.

Note The ITU-T G.114 recommendation specifies, for good voice quality, that no more than 150 ms of one-way, end-to-end delay should occur. In many situations, 200 ms may be acceptable.

QoS features for voice focus on two things—reliability and predictability. Reliability ensures delivery without packet loss. Predictability ensures delivery without excessive delay. Together, they serve to eliminate poor-quality voice transmission, including crackles and missing syllables that render a call unsatisfactory or even incoherent to the recipient.

Voice traffic requires real-time service, with steady and predictable throughput and low delay. In the presence of bursty, delay-tolerant data traffic, you must provide for voice traffic a differentiated—that is, higher-priority—level of service. Because networking equipment and devices that carry both data and voice cannot differentiate traffic that requires high-priority service from traffic that does not, your only means for ensuring that voice traffic is expedited or that it receives constant, predictable transmission across a backbone shared by data traffic is by enabling QoS features.

Effective end-to-end QoS throughout a network must serve disparate users, applications, organizations, and technologies, all at reasonable cost and effort. QoS features enable you to balance service levels for user satisfaction, granting priority service to voice while servicing data transmission to the degree of fairness that you require. In addition, other benefits can accrue: Internet service providers (ISPs), for example, can selectively enable QoS features so as to offer their customers differentiated services with different associated costs, as well as a spectrum of new applications and additional services based on these levels of service.

Cisco IOS software provides many features for optimizing QoS. Fine-tuning your network to adequately support VoIP almost certainly involves enabling some of these features. Be sure to read the sited references as you enable features, as the details of wide-scale QoS deployment are beyond the scope of this document. Also, keep in mind that you must configure QoS throughout your network, not just on the devices running VoIP, to optimize voice performance.

Not all QoS features are appropriate for all network devices and topologies. Edge devices and backbone devices do not necessarily perform the same operations. Briefly, edge devices handle packet classification, fragmentation, queuing, bandwidth management, and policing; backbone devices handle

switching and transport, congestion management, and queue management. Thus, the QoS tasks that they perform might differ. Consider the functions of both edge and backbone devices in your network, and enable QoS features for each type as appropriate.

Enabling QoS Features for VoIP

The following text briefly overviews some of the most important QoS features that you can enable, and cites references that you need to make informed decisions about the use and optimization of those features. Features discussed include the following:

- Congestion Management, page 6-16
  - Weighted Fair Queuing
  - Low-Latency Queuing
  - IP RTP Priority and Frame Relay IP RTP Priority
  - Resource Reservation
- Fragmentation and Interleaving, page 6-19
- Traffic Shaping for Frame Relay, page 6-19
- Other Bandwidth-Reduction Features, page 6-20
  - Voice Encoding
  - RTP Packet-Header Compression
  - Serialization Delay
  - Voice-Activity Detection
  - Jitter Buffering

References in Additional Resources, page 6-23 provide more information.

Tip Should you have problems with QoS, try adding the following commands to your configuration:

- At the top-level configuration level:

```
io-cache enable
voice-fastpath enable
```

- Under the Fast Ethernet interface:

```
ip route-cache
```

Congestion Management

Weighted Fair Queuing

You need to avoid congestion on backbone gateways serving high-traffic, high-speed networks. A weighted-fair-queuing methodology called WRED (Weighted Random Early Detection) queues traffic according to priority values that you set (you set voice traffic to critical, for example), sets different

packet-drop thresholds for each queue, and drops packets in lower-priority queues as necessary so that higher-priority queues can be adequately served. This ensures that low-bandwidth conversations get through, even in the presence of other high-bandwidth applications.

Tip For more information and configuration options, see the following:

- *Weighted Fair Queueing (WFQ)*, available online at http://www.cisco.com/warp/public/732/Tech/quality.shtml
- *Configuring Weighted Fair Queuing*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/qos_c/qcpart2/

Low-Latency Queuing

If you need to give voice packets priority but cannot allow them to starve other applications, the recommended queuing methodology is LLQ (Low-Latency Queuing), used in conjunction with IP RTP Priority. LLQ directs voice traffic into a priority queue, but allows you to place limits on the amount of traffic serviced at this and each other priority level before the next-lower priority level is serviced.

Tip For more information and configuration options, see *Low-Latency Queuing*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t7/

IP RTP Priority and Frame Relay IP RTP Priority

IP RTP Priority creates a strict-priority queue for VoIP calls. Only when the priority queue empties does the gateway process the other queues. The feature becomes active only when congestion exists on the interface.

Configure IP RTP Priority when you configure dial peers. Set an IP priority level to specify, in the packet header, that a voice call be accorded class-5 (critical) priority. Other queuing and traffic-management functions such as RSVP detect this information and provide priority service.

If your voice traffic passes through a Frame Relay network, the same argument holds, but the feature is called Frame Relay IP RTP Priority (described in the third reference below).

Tip For more information and configuration options, see the following:

- *Voice over IP Quality of Service for Low-Speed PPP Links*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html
- *IP RTP Priority*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t5/iprtp.htm
- *Frame Relay IP RTP Priority*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t7/friprtp.htm

Resource Reservation

You can set things up so that your and any other similarly-set-up sending or receiving system can reserve bandwidth, on a call-by-call basis, along a router path by enabling RSVP (Resource Reservation Protocol) on all WAN links that transport voice traffic.

Configure RSVP when you configure dial peers. Do not enable RSVP in conjunction with Frame Relay traffic shaping.

Tip For more information and configuration options, see *Voice over IP for the Cisco AS5300*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t3/voip5300/

Call-Admission Control

You can gracefully prevent calls from entering your Cisco AS5850 from the PSTN when certain resources—such as CPU, memory, and interfaces—are not available to process those calls. Such intervention is called call-admission control.

If your system experiences high CPU usage, large call volumes, or occasional large numbers of simultaneous calls, you need to control two specific aspects of call-admission control: call spikes and call thresholds. Doing so is especially important if you handle transactions involving debit cards, which require AAA and similar types of support.

Configure call spikes to limit the number of incoming calls over a short period of time. Configure call thresholds to define under which circumstances system resources should be enabled.

Tips For more information and configuration options, including how to configure limits on call spikes and call thresholds, refer to the following document:

- *Call Admission Control for H.323 VoIP Gateways*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122limit/122x/122xa/122xa_2/ft_pfavb.htm

Fragmentation and Interleaving

Transmission of voice packets, usually small (60 to 240 bytes) in size, can be unduly delayed in networks that also transmit large data packets. Fragmenting large data packets into smaller ones and interleaving voice packets among the fragments reduces jitter and delay. Use fragmentation and interleaving in conjunction with a congestion-management technique such as IP RTP Priority and/or RSVP if you have a low-bandwidth (<1.5 Mbps) WAN circuit, but not if you have a high-bandwidth (>1.5 Mbps) WAN circuit. The recommended fragmentation and interleaving methodology is FRF.12 for Voice over Frame Relay, Multilink PPP for VoIP-over-PPP leased lines.

Tip For more information and configuration options, see the following:

- For FRF.12, *Frame Relay Fragmentation for Voice*, available online at http://www.cisco.com/warp/public/788/vofr/fr_frag.html
- For Multilink PPP, *Voice over IP Quality of Service for Low-Speed PPP Links*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html

Traffic Shaping for Frame Relay

You must regulate traffic flow so that packets arrive at their destination only as fast as the destination can handle them. You do so by buffering packets that are generated faster than a configured value, and releasing them at that value. It is especially important that you enable traffic shaping in Frame Relay networks, but not in conjunction with RSVP. Do not enable traffic shaping with PPP leased lines.

Tip For more information and configuration options, see the following:

- *VoIP over Frame Relay with Quality of Service (Fragmentation, Traffic Shaping, IP RTP Priority*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-ov-fr-qos.html
- *Frame Relay Traffic Shaping for Voice*, available online at http://www-vdtl/SPUniv/Vofr/FR_traffic.htm

Note Successful traffic shaping on a Frame Relay network requires that you set not just this but many other QoS features. Refer to these references and the “Additional Resources” section for more information.

Other Bandwidth-Reduction Features

Voice Encoding

The Cisco AS5350 and Cisco AS5400 gateways offer the following codec (coders/decoder) methodologies for encoding (digitizing and, optionally, compressing) voice:

- G.711/PCM (pulse-code modulation): Digitizes, does not compress
- G.729a/CS-ACELP (conjucate structure - algebraic code excited linear prediction): Digitizes and compresses
- G.723.1/MP-MLQ (multipulse multilevel quantization), 6.3 or 5.3 kbps: Digitizes and compresses

Choosing a coding methodology is a matter of balancing trade-offs among several factors, principal among them those listed for various methodologies in Table 6-8.

Table 6-8 Trade-Offs Among Codec Methodologies

Methodology	Bit Rate (kbps)[1]	Frame Size (ms) (low is optimal)	Processing Required (mips) (low is optimal)	Perceived Quality (1=bad, 5=excellent) (high is optimal)[2]
G.711 PCM	64 (very high)	0.125 (low)	0.34 (low)	4.1 (high)
G.729a CS-ACELP	8 (low)	10 (med)	10 (med)	3.7 (med)
G.723.1 MP-MLQ	6.3/5.3 (low)	30 (high)	16 (med-high)	3.9 (med)

1. High bit rate is optimal for voice quality, because the original voice signal is better represented; low bit rate is optimal for network performance, because packets are less apt to be delayed or dropped.
2. Perceived quality is measured in standardized mean-opinion-score (MOS) studies.

Note Tandem switching (also called dual encodings or dual compressions) can cause additional problems. Digital calls routed to a tandem (toll) office are converted there to analog form for processing, and then reconverted to digital form for further transmission. Converting and reconverting in this way more than about twice distorts signals irreparably. If your calls are subject to significant toll-office processing, choose PCM if you have sufficient bandwidth. It is also recommended that you employ a Cisco IOS Multimedia Conference Manager (H.323 gatekeeper) or management application such as Cisco Voice Manager to help manage these types of processes.

Other factors that might enter into your decision, or that you can use to tweak performance, include the likelihood of multiple tandem encodings and how you handle packet fragmentation.

Tip For more information and configuration options, see *Voice over IP Quality of Service for Low-Speed PPP Links*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html

RTP Packet-Header Compression

Because of the repetitive nature of subsequent IP/UDP/RTP (network/transport/session-layer) headers, you can compress them significantly. A recommended methodology is cRTP (Compressed Real-Time Transfer Protocol), which, by tracking first-order and second-order differences between headers on subsequent packets, compresses the 40-byte header to just 2 or 4 (without or with UDP checksum) bytes. Other methodologies may be preferable if cRTP's high CPU usage causes delay. Employ a compression methodology on both ends of low-bandwidth (<1.5 Mbps) WAN circuits, but not at all on high-speed (>1.5 Mbps) WANs.

Tip For more information and configuration options, see *Voice over IP Quality of Service for Low-Speed PPP Links*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html

Serialization Delay

You can control packet (payload) size—which, in turn, controls how long one packet takes to be placed on the system interface. Set this in bytes, ideally equating to no greater than 20 ms (typically equivalent to two 10-ms voice samples per packet). Increasing serialization delay increases end-to-end delay. You want to incur no more than 150-to-200 ms of 1-way, end-to-end delay.

Note Take care when you assign a payload size for your chosen codec. To assign a codec and payload size, you use the **codec** *codec* **bytes** *payload_size* command under the **dial-peer voip** command. Although the **codec** command permits a wide range of payload sizes, the universal port card permits a much smaller range of sizes, to help ensure that end-to-end delay for voice signals does not exceed 200 ms. For the (default) g729r8 codec, these sizes are just 10ms, 20ms (recommended), and 30ms, which correspond to 10 bytes, 20 bytes, and 30 bytes of payload. If your network uses a variety of gateway and router types, you may need to ensure that payload sizes are set both optimally (so as not to incur excessive end-to-end delay) and consistently.

Tip For more information and configuration options, see *Voice over IP—Per Call Bandwidth Consumption*, available online at http://www.cisco.com/warp/public/788/pkt-voice-general/bwidth_consume.html

Voice-Activity Detection

Because telephone users generally speak in turn, a typical voice conversation contains up to 50 percent silence. A feature called VAD (Voice Activity Detection) causes the gateway to transmit when speech starts and cease transmitting when speech stops. During silences, it generates white noise so that callers do not mistake silence for a disconnected call. By suppressing packets of silence, VAD enables you to handle more calls. For VoIP bandwidth planning, assume that VAD reduces bandwidth by 35 percent. Enable VAD if you wish to allocate more bandwidth to other types of traffic.

A possible problem with VAD is that it tends to clip the start and end of speech. To avoid activation during very short pauses and to compensate for clipping, VAD waits approximately 200 ms after speech stops before stopping transmission. Upon restarting transmission, it includes the previous 5 ms of speech along with the current speech.

VAD disables itself on a call automatically if ambient noise prevents it from distinguishing between speech and background noise.

Tip For more information and configuration options, see *Voice over IP Quality of Service for Low-Speed PPP Links*, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html

Jitter Buffering

Jitter occurs when there is a variation between when a voice packet is expected to arrive and when it actually arrives, causing discontinuity in the voice stream. Cisco devices handle jitter by buffering received data and playing it back smoothly.

Default jitter-buffer settings are sufficient in most networks under normal situations. If you experience choppy voice signals or poor voice quality, increase the size of the buffer. If you experience significant overall network delay, decrease the size. If your network is noisy and you use jitter-prone applications such as unified messaging server or interactive voice response, select fixed mode and a relatively high nominal value. Note that the trade-off for increasing jitter-buffer size is a corresponding increase in delay.

Cisco's jitter buffers are normally sized dynamically, and adaptive mode plus default buffer size should suffice. But adjust mode and size as needed.

Additional Resources

In configuring VoIP and setting QoS parameters for your network, you will have to wrestle with a large number of decisions and parameters. This chapter provides a brief overview on this very complex subject. The following sources provide more information:

- Cisco documents on IP telephony solutions: http://www.cisco.com/univercd/cc/td/doc/product/voice/ip_tele/index.htm
- Cisco feature modules: http://www.cisco.com/univercd/cc/td/doc/product/software/, under listings for your Cisco IOS release
- Cisco IOS documents:
  - *Cisco IOS Quality of Service Solutions Configuration Guide*
  - *Cisco IOS Multiservice Applications Command Reference*
  - *Cisco IOS Voice, Video, and Fax Configuration Guide*
  - *Cisco IOS Voice, Video, and Fax Command Reference*

Note Start your search at http://www.cisco.com/univercd/cc/td/doc/product/software/ and then go to your Cisco IOS release.

- Commercially available books:
  - *Voice Over IP Fundamentals*, Jonathan Davidson & James Peters, Cisco Press, 2000
  - *Cisco Packetized Voice & Data Integration*, Robert Caputo, McGraw-Hill, 2000
- VoIP references for Cisco devices:
  - *Cisco IP Telephony Network Design Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/ip_tele/network/index.htm
  - *Cisco AVVID QoS Design Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/ip_tele/avvidqos/index.htm
  - *Voice-over-IP Quick Start Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/1750/voipqsg/voipqsg.htm
  - *Configuring H.323 VoIP Gateway for Cisco Access Platforms*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/5300/cfios/cfselfea/0044gw.htm
  - *Monitoring Voice and Fax Services on the Cisco AS5400 Universal Gateway*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/; select your Cisco IOS release and search for this title
  - *Voice over IP for the Cisco AS5300*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t3/voip5300/voip53_1.htm
  - *Voice over IP for the Cisco AS5800*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip5800/
  - *(Cisco 2600 Series) Software Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/software/voice.htm

  - *Configuring Voice over IP for the Cisco 3600 Series*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/voice_c/vcprt1/vcvoip.htm
  - *Voice over IP for the Cisco 2600/3600 Series*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip3600/index.htm
- Other websites:
  - *Voice over IP Technology Tutorial and First Approach*: http://www.comsoc.org.mx/standard/voip.thm
  - *Voice over Packet Tutorial*: http://www.webproforum.com/voice_packet/index.html
  - Tutorials on various telecommunications topics: http://www.iec.org/tutorials/
  - VoIP references: http://www.netlab.ohio-state.edu/~jain/refs/ref_voip.htm

Using the Setup Script

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

This appendix describes how to power ON the Cisco AS5350 and Cisco AS5400 universal gateways and configure them using the prompt-driven setup script (also called the System Configuration dialog).

If you prefer to configure the gateway manually, go to the "Exploring Cisco IOS Software" section on page 1-6 to familiarize yourself with the command-line interface (CLI) and then go to Chapter 3, "Basic Configuration Using the Command-Line Interface" for step-by-step instructions.

The setup script in this appendix is a typical example using a version of Cisco IOS software that may not exactly match your newly loaded software; however, message prompts are similar.

Getting Started

Before you power on the gateway and begin to use the setup script in the System Configuration dialog, make sure you have already connected the cables to the gateway and configured your PC terminal emulation program for 9600 baud, 8 data bits, no parity, and 2 stop bits. Connect to the gateway through the console port; the AUX port is not active. All configuration must be performed from your PC terminal emulation program window.

The prompts and resulting messages vary depending on your responses. For most configurations, you can press **Enter** to accept the default entries displayed in square ([]) brackets.

This section provides the setup scripts for the following hardware configurations:

- Cisco AS5350 or Cisco AS5400 with AS54-DFC-CT3 and AS54-DFC-108NP, page A-2
- Cisco AS5350 or Cisco AS5400 with AS54-DFC-8CT1 and AS54-DFC-108NP, page A-7
- Cisco AS5350 or Cisco AS5400 with AS54-DFC-8CE1 and AS54-DFC-108NP, page A-11

Note Information that you enter is in **`boldface`** font. Also note that if you make a mistake during the configuration, exit and run the System Configuration dialog again by pressing **Ctrl-c**, and then type **setup** at the privileged EXEC, also called enable, mode prompt (`AS5350#` or `AS5400#`).

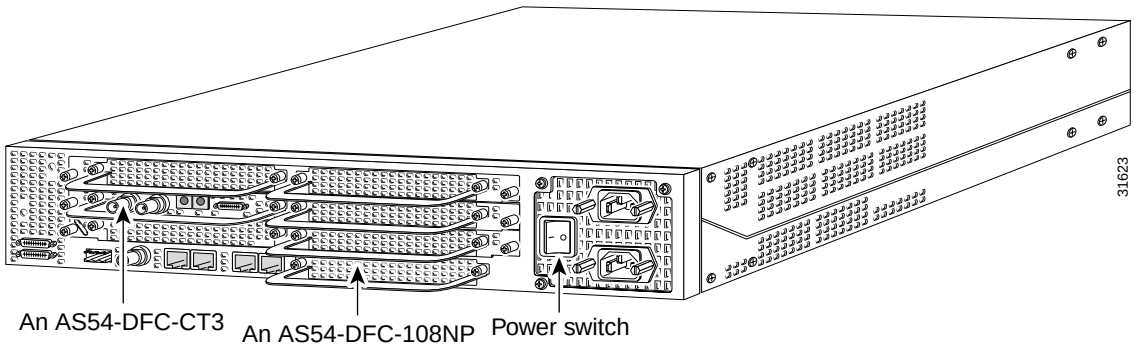
Cisco AS5350 or Cisco AS5400 with AS54-DFC-CT3 and AS54-DFC-108NP

To use the setup script on the gateway configuring an AS54-DFC-CT3 trunk card and five AS54-DFC-108NP universal port cards, take the following steps.

Step 1 Power ON the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure A-1.

Messages begin to appear in your terminal emulation program window.

Figure A-1 Power Switch Location



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 you to power cycle the gateway and start over. It takes a few minutes for the messages to stop.

The messages look similar to the following display:

Note The displayed messages depend on the Cisco IOS software release and feature set you selected. The screen displays in this section are for reference only and might not exactly reflect the messages on your console.

```
System Bootstrap, Version 12.0(20000223:202419) RELEASE SOFTWARE
Copyright (c) 1994-2000 by cisco Systems, Inc.
AS5400 platform with 65536 Kbytes of main memory

rommon 1>b flash:

Self decompressing the image :######################### [OK]

              Restricted Rights Legend

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

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



Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(0.2.0)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 23-Feb-00 22:35 by beliu
Image text-base:0x60008908, data-base:0x61200000

cisco AS5400 (R7K) processor (revision L) with 65536K/131072K bytes of
memory.
Processor board ID JAB034608LW
R7000 CPU at 250Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3
Cache
Last reset from unexpected value
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x31,
 Board Hardware Version 3.22, Item Number 800-5171-01,
 Board Revision 017, Serial Number JAB034608LW,
 PLD/ISP Version 0.0, Manufacture Date 4-Jan-2000.
Processor 0xFF, MAC Address 0x03096F808E
Backplane HW Revision 17.43
2 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
108 terminal line(s)
512K bytes of non-volatile configuration memory.
32768K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)

Press RETURN to get started!
```

Step 2 When the following message appears, enter **yes** to continue:

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

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 3 When the following message appears, enter **no** to configure all interfaces. Note that, if you enter **yes**, your system will not be configured correctly:

```
Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no
```

Step 4 When the following message appears, enter **yes** to see the current interface summary:

```
First, would you like to see the current interface summary? [yes]: 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
Serial0/0                  unassigned      NO  unset  down                  down
Serial0/1                  unassigned      NO  unset  down                  down    .
.
.
```

Step 5 Enter a host name for the gateway.

```
Enter host name [Router]: AS5400
```

Step 6 Enter an enable secret password. This password is encrypted (more secure) and cannot be seen when viewing the configuration.

```
Enter enable secret: lab
```

Step 7 Enter an enable password. This password is *not* encrypted (less secure) and can be seen when viewing the configuration.

```
Enter enable password: guessme
```

Step 8 Enter the virtual terminal password, which is used for remote console access.

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

Step 9 Respond to the following prompts as appropriate for your network:

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

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

Step 10 Enter the letter corresponding to the ISDN switch type that matches your telco switch type or press **Enter** to accept the default.

```
Do you want to configure ISDN switch type? [yes]:
  The following ISDN switch types are available:
   [a] primary-4ess
   [b] primary-5ess
   [c] primary-dms100
   [d] primary-net5
   [e] primary-ntt
   [f] primary-ts014
  Enter the switch type [b]:
```

Step 11 Enter **yes** to create T1 controllers, then enter the number of T1 controllers you want to create or press **Enter** to create all the controllers.

```
Do you want to create t1 controllers? [yes]: yes
 Enter # of t1 controllers, you want to create under t3 controller [28]:

Configuring controller T3 3/0:
Next, you will be prompted to configure controllers.
These controllers enable users to dial in via ISDN or analog modems.
```

Step 12 Enter **yes** to allow users to dial in via ISDN or analog modems.

```
Do you intend to allow users to dial in? [yes]: yes
```

```
There are 10 controllers on this access server. If you want to use
the full capacity of the access server configure all controllers.

Controller CT3 0,1...etc  in software corresponds to Port 0,1...etc
on the back of the access server.

PRI configuration can be configured to controllers all at once
based on your PRI controllers selection. Whereas CAS configuration
will be configured individually for each controller.
```

Step 13 Enter the number of controllers you will be using for the PRI configuration or press **Enter** to configure all controllers.

```
Enter # of controllers, you will be using for PRI configuration [28]:

Configuring controller parameters:
```

Step 14 Press **Enter** for every slot, port, and channel.

```
Configuring controller t1 3/0:1
 Configuring PRI on this controller.
.
.
.
.
Configuring controller t1 3/0:28
```

Step 15 Enter **yes** to use robbed bit signaling on the controller.

```
  Will you be using CT1 (robbed-bit signaling) on this controller? [yes]: yes
```

Step 16 Enter your telco framing type.

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

Step 17 Enter your telco line code type.

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

Step 18 Enter the letter corresponding to the signaling type to support modem pooling over the T1 lines or press **Enter** to accept the default.

```
The following line signaling types are available
    [a] e&m-fgb
    [b] e&m-fgd
    [c] e&m-immediate-start
    [d] fgd-eana
    [e] fgd-os
    [f] fxs-ground-start
    [g] fxs-loop-start
    [h] none
    [i] r1-itu
    [j] r1-modified
    [k] r1-turkey
    [l] sas-ground-start
    [m] sas-loop-start
```

Step 19 Enter the tone signaling type.

```
The following tone signaling types are available:
                dtmf | mf
  Enter the tone signal type [dtmf]:
```

Step 20 Enter **yes** to configure digital number identification service (DNIS).

```
Do you want to provision DNIS address information? [yes]: yes
```

Step 21 Repeat Step 15 to Step 20 to configure the remaining controllers.

Step 22 Enter **yes** to configure the FastEthernet0/0 interface to connect the gateway to a LAN, then respond to the remaining questions to configure the FastEthernet port.

```
Do you want to configure FastEthernet0/0  interface? [yes]: yes
  Use the 100 Base-TX (RJ-45) connector? [yes]:
```

Note Full duplex mode enables simultaneous data transfer between a sending and a receiving station.

```
Operate in full-duplex mode? [no]:
Operate at 100 Mbps speed? [yes]:
Configure IP on this interface? [yes]:
  IP address for this interface [X.X.X.X]: 172.22.50.10
  Subnet mask for this interface [255.255.0.0] :
  Class B network is 172.22.0.0, 16 subnet bits; mask is /16
```

Step 23 Repeat Step 22 to configure any other FastEthernet ports, if necessary.

Step 24 Configure your serial interfaces by responding to the following prompts:

```
Do you want to configure Serial0/0  interface? [no]: yes
Configure IP on this interface? [no]: yes
Configure IP unnumbered on this interface? [no]:
    Assign to which interface [FastEthernet0/0]:
```

Step 25 Repeat Step 24 to configure any other serial interfaces, if necessary.

After you complete the configuration script, the setup script displays the configuration command script.

Step 26 Go to the "Save the Configuration File" section on page A-15.

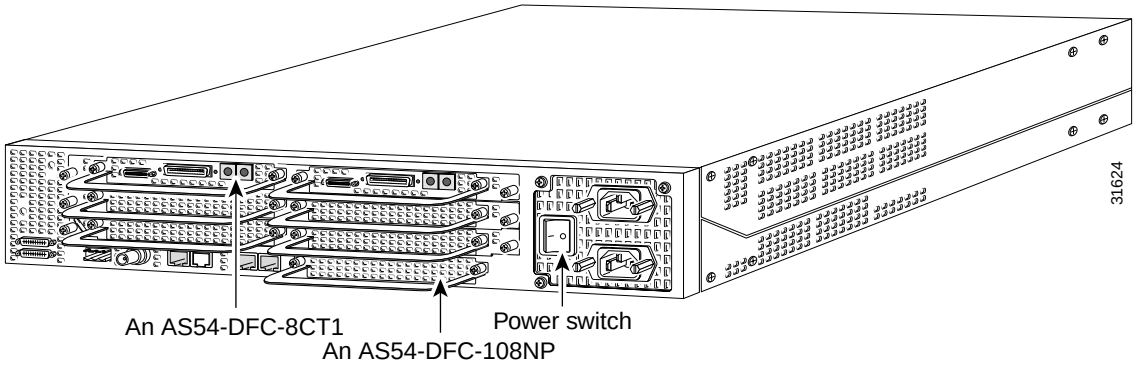
Cisco AS5350 or Cisco AS5400 with AS54-DFC-8CT1 and AS54-DFC-108NP

To use the setup script on the gateway configuring two AS54-DFC-8CT1 trunk cards and five AS54-DFC-108NP universal port cards, take the following steps.

Step 1 Power ON the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure A-2.

Messages begin to appear in your terminal emulation program window.

Figure A-2 Power Switch Location



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 you to power cycle the gateway and start over. It takes a few minutes for the messages to stop.

The messages look similar to the following display:

Note The displayed messages depend on the Cisco IOS software release and feature set you selected. The screen displays in this section are for reference only and might not exactly reflect the messages on your console.

```
System Bootstrap, Version 12.0(20000223:202419) RELEASE SOFTWARE
Copyright (c) 1994-2000 by cisco Systems, Inc.
AS5400 platform with 65536 Kbytes of main memory

rommon 1>b flash:

Self decompressing the image :######################### [OK]

              Restricted Rights Legend

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

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

Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(0.2.0)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 23-Feb-00 22:35 by beliu
Image text-base:0x60008908, data-base:0x61200000

cisco AS5400 (R7K) processor (revision L) with 65536K/131072K bytes of
memory.
Processor board ID JAB034608LW
R7000 CPU at 250Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3
Cache
Last reset from unexpected value
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x31,
 Board Hardware Version 3.22, Item Number 800-5171-01,
 Board Revision 017, Serial Number JAB034608LW,
 PLD/ISP Version 0.0, Manufacture Date 4-Jan-2000.
Processor 0xFF, MAC Address 0x03096F808E
Backplane HW Revision 17.43
2 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
108 terminal line(s)
512K bytes of non-volatile configuration memory.
32768K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)

Press RETURN to get started!
```

Step 2 When the following message appears, enter **yes** to continue:

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

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 3 When the following message appears, enter **no** to configure all interfaces. Note that, if you enter **yes**, your system will not be configured correctly.

```
Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no
```

Step 4 When the following message appears, enter **no** to bypass the current interface summary:

```
First, would you like to see the current interface summary? [yes]: no
```

Step 5 Enter a host name for the gateway.

```
Configuring global parameters:

  Enter host name [Router]: AS5400

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

```
  Enter enable secret: lab

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

Step 7 Enter an enable 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 8 Enter the virtual terminal password, which is used for remote console access.

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

Step 9 Respond to the following prompts as appropriate for your network:

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

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

Step 10 Enter the letter corresponding to the ISDN switch type that matches your telco switch type or press **Enter** to accept the default.

```
Do you want to configure ISDN switch type? [yes]:
  The following ISDN switch types are available:
   [a] primary-4ess
   [b] primary-5ess
   [c] primary-dms100
   [d] primary-net5
   [e] primary-ntt
   [f] primary-ts014
  Enter the switch type [b]:
```

Step 11 Enter **yes** to allow users to dial in via ISDN or analog modems.

```
Do you intend to allow users to dial in? [yes]: yes

There are 16 controllers on this access server. If you want to use
the full capacity of the access server configure all controllers.

Controller CT1 0,1,...etc  in software corresponds to Port 0,1,..etc
on the back of the access server.

PRI configuration can be configured to controllers all at once
based on your PRI controllers selection. Where as CAS configuration
will be configured individually for each controller.
```

Step 12 Enter the number of controllers you will be using for the PRI configuration or press **Enter** to configure all controllers.

```
Enter # of controllers, you will be using for PRI configuration [16]:

Configuring controller parameters:
```

Step 13 Press **Enter** for every slot, port, and channel.

```
Configuring controller T1 1/0:
 Configuring PRI on this controller.


Configuring controller T1 1/1:
 Configuring PRI on this controller.


Configuring controller T1 1/2:
 Configuring PRI on this controller.


Configuring controller T1 1/3:
 Configuring PRI on this controller.
.
.
.
.
Configuring controller T1 2/6:
 Configuring PRI on this controller.


Configuring controller T1 2/7:
 Configuring PRI on this controller.

Configuring interface parameters:
```

Step 14 Enter **yes** to configure the FastEthernet0/0 interface to connect the gateway to a LAN, then respond to the remaining questions to configure the FastEthernet port.

```
Do you want to configure FastEthernet0/0  interface? [yes]: yes

  Use the 100 Base-TX (RJ-45) connector? [yes]:
```

Note Full duplex mode enables simultaneous data transfer between a sending and a receiving station.

```
Operate in full-duplex mode? [no]:
Operate at 100 Mbps speed? [yes]:
Configure IP on this interface? [yes]:
  IP address for this interface [X.X.X.X]: 172.22.50.10
  Subnet mask for this interface [255.255.0.0] :
  Class B network is 172.22.0.0, 16 subnet bits; mask is /16
```

Step 15 Repeat Step 14 to configure any other FastEthernet ports, if necessary.

Step 16 Configure your serial interfaces by responding to the following prompts:

```
Do you want to configure Serial0/0  interface? [no]: yes
Configure IP on this interface? [no]: yes
Configure IP unnumbered on this interface? [no]:
    Assign to which interface [FastEthernet0/0]:
```

Step 17 Repeat Step 16 to configure any other serial interfaces, if necessary.

After you complete the configuration script, the setup script displays the configuration command script.

Step 18 Go to "Save the Configuration File" section on page A-15.

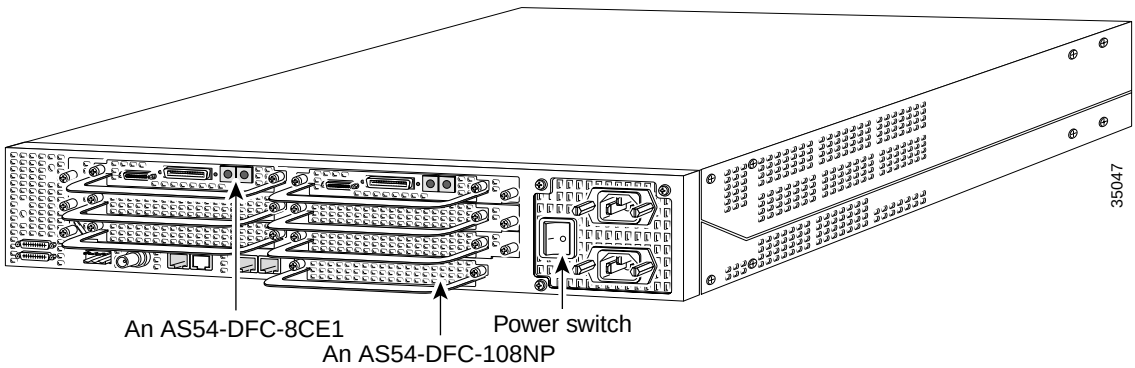
Cisco AS5350 or Cisco AS5400 with AS54-DFC-8CE1 and AS54-DFC-108NP

To use the setup script on the gateway configuring two AS54-DFC-8CE1 trunk cards and five AS54-DFC-108NP universal port cards, take the following steps.

Step 1 Power ON the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure A-3.

Messages begin to appear in your terminal emulation program window.

Figure A-3 Power Switch Location



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 you to power cycle the gateway and start over. It will take a few minutes for the messages to stop.

The messages look similar to the following display:

Note The displayed messages depend on the Cisco IOS software release and feature set you selected. The screen displays in this section are for reference only and probably will not exactly reflect the messages on your console.

```
System Bootstrap, Version 12.0(20000223:202419) RELEASE SOFTWARE
Copyright (c) 1994-2000 by cisco Systems, Inc.
AS5400 platform with 65536 Kbytes of main memory

rommon 1>b flash:

Self decompressing the image :######################### [OK]

              Restricted Rights Legend

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

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


Cisco Internetwork Operating System Software
IOS (tm) 5350 Software (C5350-JS-M), Version 12.1(0.2.0)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 23-Feb-00 22:35 by beliu
Image text-base:0x60008908, data-base:0x61200000

cisco AS5400 (R7K) processor (revision L) with 65536K/131072K bytes of
memory.
Processor board ID JAB034608LW
R7000 CPU at 250Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3
Cache
Last reset from unexpected value
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x31,
 Board Hardware Version 3.22, Item Number 800-5171-01,
 Board Revision 017, Serial Number JAB034608LW,
 PLD/ISP Version 0.0, Manufacture Date 4-Jan-2000.
Processor 0xFF, MAC Address 0x03096F808E
Backplane HW Revision 17.43
2 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
108 terminal line(s)
512K bytes of non-volatile configuration memory.
32768K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)

Press RETURN to get started!
```

Step 2 When the following message appears, enter **yes** to continue:

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

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 3 When the following message appears, enter **no** to configure all interfaces. Note that, if you enter **yes**, your system will not be configured correctly.

```
Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no
```

Step 4 When the following message appears, press enter **yes** to see the current interface summary:

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

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

FastEthernet0/0            unassigned      NO  unset  up                    up
FastEthernet0/1            unassigned      NO  unset  up                    up
Group-Async0               unassigned      NO  unset  down                  down
Serial0/0                  unassigned      NO  unset  down                  down
Serial0/1                  unassigned      NO  unset  down                  down    .
```

Step 5 Enter a host name for the gateway.

```
Configuring global parameters:

Enter host name [Router]: AS5400

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

```
Enter enable secret: lab

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

Step 7 Enter an enable 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 8 Enter the virtual terminal password, which is used for remote console access.

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

Step 9 Respond to the following prompts as appropriate for your network:

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

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

Step 10 Enter the letter corresponding to the ISDN switch type that matches your telco switch type or press **Enter** to accept the default.

```
Do you want to configure ISDN switch type? [yes]:
  The following ISDN switch types are available:
   [a] primary-4ess
   [b] primary-5ess
   [c] primary-dms100
   [d] primary-net5
   [e] primary-ntt
   [f] primary-ts014
  Enter the switch type [d]:
```

Step 11 Enter **yes** to allow users to dial in via ISDN or analog modems.

```
Do you intend to allow users to dial in? [yes]: yes

There are 16 controllers on this access server. If you want to use
the full capacity of the access server configure all controllers.

Controller E1 0,1,..etc  in software corresponds to Port 0,1,..etc
on the back of the access server.

PRI configuration can be configured to controllers all at once
based on your PRI controllers selection. Where as CAS configuration
will be configured individually for each controller.
```

Step 12 Enter the number of controllers you will be using for the PRI configuration or press **Enter** to configure all controllers.

```
Enter # of controllers, you will be using for PRI configuration [16]:

Configuring controller parameters:
```

Step 13 Press **Enter** for every slot, port, and channel.

```
Configuring controller E1 1/0:
 Configuring PRI on this controller.


Configuring controller E1 1/1:
 Configuring PRI on this controller.
.
.
.
.
Configuring controller E1 2/6:
 Configuring PRI on this controller.


Configuring controller E1 2/7:
 Configuring PRI on this controller.
```

Step 14 Enter **yes** to configure the FastEthernet0/0 interface to connect the gateway to a LAN, then respond to the remaining questions to configure the FastEthernet port (you can also press **Enter** to accept the default):

```
Do you want to configure FastEthernet0/0  interface? [yes]: yes
  Use the 100 Base-TX (RJ-45) connector? [yes]:
```

Note Full duplex mode enables simultaneous data transfer between a sending and a receiving station.

```
Operate in full-duplex mode? [no]:
Operate at 100 Mbps speed? [yes]:
Configure IP on this interface? [yes]:
  IP address for this interface [X.X.X.X]: 172.22.50.10
  Subnet mask for this interface [255.255.0.0] :
  Class B network is 172.22.0.0, 16 subnet bits; mask is /16
```

Step 15 Repeat Step 14 to configure any other FastEthernet ports, if necessary.

Step 16 Configure your serial interfaces by responding to the following prompts:

```
Do you want to configure Serial0/0  interface? [no]: yes
Configure IP on this interface? [no]: yes
Configure IP unnumbered on this interface? [no]:
    Assign to which interface [FastEthernet0/0]:
```

Step 17 Repeat Step 16 to configure any other serial interfaces, if necessary.

After you complete the configuration script, the setup script displays the configuration command script.

Step 18 Go to the next section "Save the Configuration File."

Save the Configuration File

Step 1 Enter 0, 1, or 2 when the following prompt is displayed:

```
[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.

Enter your selection [2]:

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

Press RETURN to get started!

%LINK-3-UPDOWN: Interface Ethernet0, changed state to up
%LINK-3-UPDOWN: Interface Serial0, changed state to down
%LINK-3-UPDOWN: Interface Serial1, changed state to down

<Additional messages omitted.>
```

Step 2 When the messages stop displaying on your screen, press **Enter** to get the following prompt:

```
AS5400>
%AT-6-ONLYROUTER: Ethernet0: AppleTalk port enabled; no neighbors found
```

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

Step 3 The `AS5350>` or `AS5400>` prompt indicates that you are now at the command-line interface (CLI) and you have just completed the basic gateway configuration. However, this is not a complete configuration. At this point you have two options:

- Run the setup script in the System Configuration dialog again and create another configuration. Enter the following commands to repeat the setup script:

```
AS5400> enable
Password: password
AS5400# setup
```

- Modify the existing configuration or configure additional features with the CLI as described in the *Dial Solutions Configuration Guide*, the *Dial Solutions Command Reference Guide*, the Cisco IOS software configuration guide, and command reference publications. See "Obtaining Documentation" on page xvi.

Where to Go Next

At this point you can go to:

- Chapter 2, "Verifying Basic Setup" for step-by-step instructions to configure the gateway manually.

You can also refer to the following documents for more advanced configuration topics:

- Cisco IOS software configuration guide
- Command-reference publications
- *Dial Solutions Configuration Guide*
- *Dial Solutions Command Reference*
- *Configuring Selected 12.1 Cisco IOS Software Features*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5400/index.htm

These publications are available on the Documentation CD-ROM that arrived with your gateway, or on the World Wide Web from the Cisco home page.

ROM Monitor

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

the first software to run when the gateway is powered-up or reset. The ROM monitor can help you isolate or rule out hardware problems encountered when installing your gateway. This appendix describes the following:

Entering the ROM Monitor Program

The ROM monitor diagnostics help initialize the processor hardware and boot the main operating system software. If you set the software configuration register (bits 3, 2, 1, and 0) to zero, you can start the gateway in the standalone ROM monitor. An example of the ROM monitor prompt follows:

```
rommon 1 >
```

To enable the Break key, and to default to booting at the ROM monitor while running the system software, reset the configuration register to 0x0 by entering configuration mode, and enter the following configuration command:

```
confreg 0x0
```

The new configuration register value, 0x0, takes effect after the gateway is rebooted with the **reload** command. If you set the configuration to 0x0, you will have to manually boot the system from the console each time you reload the gateway.

Timesaver Break (system interrupt) is always enabled for 60 seconds after rebooting the system, regardless of whether break is configured to be off by setting the configuration register. During the 60-second window, you can break to the ROM monitor prompt.

ROM Monitor Command Conventions

Following are ROM monitor command conventions:

- Brackets [ ] denote an optional field. If a minus option is followed by a colon (for example: [-*s*:]), you must provide an argument for the option.
- A word in italics means that you must fill in the appropriate information.
- All address and size arguments to the memory-related commands are assumed to be hexadecimal (no “0x” prefix or ‘h’ suffix needed).
- The options [-*bwl*] for the memory-related commands provide for byte, word, and longword operations. The default is *word*.
- You can invoke the memory-related commands by entering the command with no arguments. This causes the utility to prompt you for parameters. This option is available for the commands marked as prompting.
- All the built-in commands can be aborted (user interrupt signal) by pressing the **Break** key at the console.
- You can place more than one command (except the repeat command) on a line by using the semicolon delimiter.

Command Aliasing

The ROM monitor supports command aliasing modeled on the aliasing function built into the Korn shell. The alias command is used to set and view aliased names. This allows you to alias command names to a letter or word. Aliasing is often used to shorten command names or automatically invoke command options.

Aliases are stored in NVRAM and remain intact across periods of no power. These are some of the set aliases:

```
b=boot
h=history
i=reset
r=repeat
k=stack
?=help
```

ROM Monitor Commands

At the ROM monitor prompt, enter **?** or **help** at the `rommon n >` prompt to display a list of available commands and options, as follows:

```
rommon 12 > help
alias               set and display aliases command
boot                boot up an external process
break               set/show/clear the breakpoint
confreg             configuration register utility
cont                continue executing a downloaded image
context             display the context of a loaded image
cookie              display contents of cookie PROM in hex
dev                 list the device table
dir                 list files in file system
dis                 disassemble instruction stream
dnld                serial download a program module
dram                verify DRAM
frame               print out a selected stack frame
hardware_info       display hardware information
help                monitor builtin command help
history             monitor command history
meminfo             memory information (-spd dumps SDRAM cookie)
repeat              repeat a monitor command
reset               system reset
set                 show all monitor variables
show_spd            show all SPD data
sleep               millisecond sleep command
stack               produce a stack trace
sync                write monitor environment to NVRAM
sysret              print out info from last system return
unalias             unset an alias
unset               unset a monitor variable
```

Note You can display additional details for a command by entering the command name with a ***-?*** option, which prints the command usage message.

The commands are listed and described in alphabetical order. Note that the ROM monitor commands are case sensitive.

- **alias** [*name=value*]—Aliases a name to a value. If the value contains white space or other special (shell) characters, it must be quoted. If the value has a space as the last character the next command-line word is also checked for an alias (normally only the first word on the command line is checked). Without an argument, this command prints a list of all aliased names with their values.

  For example:

  ```
  rommon 1 > alias
  r=repeat
  h=history
  ?=help
  b=boot
  ls=dir
  ```

- **boot** or **b**—Boots an image. The **boot** command with no arguments boots the first image in boot Flash memory. You can include an argument, *filename*, to specify a file to be booted over the network using the Trivial File Transfer Protocol (TFTP). The local device (see the description of **b** *device* following) can be specified by entering the device specifier (*devid*). If the specified device name is not recognized by the ROM monitor, the system attempts to boot the image (*imagename*) from a network TFTP server. Do not insert a space between *devid* and *imagename*. Options to the **boot** command are *-x*, load image but do not execute, and *-v*, verbose. The form of the **boot** command follows:

  boot [-xv] [devid] [imagename]

  b—Boots the default system software from ROM.

  b *filename* **[***host***]**—Boots using a network TFTP server. When a host is specified, either by name or IP address, the **boot** command boots from that source.

  b flash:—Boots the first file in Flash memory.

  b *device:*—Boots the first file found in the Flash memory device. The Flash memory device specified can be either *flash*:, to boot the Cisco IOS software, or *bootflash*:, to boot the boot image in Flash memory.

  b *device:name*—An extension of the above command, allows you to specify a particular filename in the Flash memory bank.

- **confreg** [*hexnum*]—Executing the **confreg** command with the argument *hexnum* changes the virtual configuration register to match the hex number specified. Without the argument, **confreg** dumps the contents of the virtual configuration register in English and allows you to alter the contents. You are prompted to change or keep the information held in each bit of the virtual configuration register. In either case, the new virtual configuration register value is written into NVRAM and does not take effect until you reset or power cycle the gateway.

  The configuration register resides in NVRAM. The configuration register is identical in operation to other Cisco gateways. Enter **confreg** for the menu-driven system, or enter the new value of the register in hexadecimal.

  Note The value is always interpreted as hex. The **confreg** utility prints a before and after view of the configuration register when used in menu-driven mode.

  For example:

```
rommon 2 > confreg

Configuration Summary
   (Virtual Configuration Register:0x0)
enabled are:
break/abort has effect
console baud:9600
boot:the ROM Monitor

do you wish to change the configuration? y/n  [n]: y
enable  "diagnostic mode"? y/n  [n]:
enable  "use net in IP bcast address"? y/n  [n]:
enable  "load rom after netboot fails"? y/n  [n]:
enable  "use all zero broadcast"? y/n  [n]:
disable "break/abort has effect"? y/n  [n]:
enable  "ignore system config info"? y/n  [n]:
change console baud rate? y/n  [n]: y
```

```
enter rate:0 = 9600,  1 = 4800,  2 = 1200,  3 = 2400
4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200  [0]:
change the boot characteristics? y/n  [n]:


          Configuration Summary
   (Virtual Configuration Register:0x0)
enabled are:
break/abort has effect
console baud:9600
boot:the ROM Monitor

do you wish to change the configuration? y/n  [n]:
```

- **cont** [-*b*]—Continues a loaded image that has stopped. The -*b* option sets the requested break points before continuing.

  For example:

```
reboot >
monitor: command “launch” aborted due to user interrupt
diagmon 7 > cont

reboot>
```

- **context**—Displays the CPU context at the time of the fault. The context from kernel mode and process mode of a booted image is displayed, if available.

  For example:

```
rommon 6 > context

CPU Context:
d0 - 0x00000028      a0 - 0x0ff00420
d1 - 0x00000007      a1 - 0x0ff00000
d2 - 0x00000007      a2 - 0x02004088
d3 - 0x00000000      a3 - 0x020039e6
d4 - 0x00000000      a4 - 0x02002a70
d5 - 0x02003e8a      a5 - 0x02003f17
d6 - 0x00000000      a6 - 0x02003938
d7 - 0x00000001      a7 - 0x0200392c
pc - 0x02004adc     vbr - 0x02000000
```

- **cookie**—Displays the contents of the cookie PROM in hexadecimal format.

  For example:

```
rommon 1 > cookie

cookie:
00 01 01 31 03 15 03 20 00 14 33 01 30 11 4a 41
42 30 33 35 31 30 37 38 32 00 00 00 00 00 13 63
0c 1d 00 00 00 00 11 11 22 22 33 33 44 44 55 55
66 66 77 77 88 88 99 99 00 00 11 11 22 22 33 33
ff 00 30 96 f8 00 7a ff ff ff ff ff ff ff ff ff
ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```

- **dev**—Lists boot device identifications on the gateway.

  For example:

```
rommon 10 > dev

Devices in device table:
        id  name
    flash: flash
bootflash: boot flash
```

- **dir** *devid*—Lists the files on the named device.

  For example:

```
rommon 11 > dir flash:

File size           Checksum   File name
   9474676 bytes (0x909274)   0x54322421    c5350-js-mz.Jan6
```

- **dlnd** [*-xv:*] [*args*]—Downloads in binary format through the console and executes. The -x option downloads but does not execute. The -v option allows you to specify the verbose level. The optional arguments are passed to the downloaded program via the argc/argv mechanism (only when -x is not used). The exit value is the return value from the downloaded routine or the status of the download operation (success or failure) if the -x option is used.
- **frame** [*number*]—Displays an entire individual stack frame. Enter a number to indicate which frame to display. You can also specify a number to indicate which stack frame to display. Note that the default is 0 (zero), which is the youngest frame.

  For example:

```
rommon 6 > frame 2

Frame 02: FP = 0x02003960    RA = 0x020050ee
at 0x02003968 (fp + 0x08) = 0x02004f8d
at 0x0200396c (fp + 0x0c) = 0x0200f390
at 0x02003970 (fp + 0x10) = 0x02006afc
at 0x02003974 (fp + 0x14) = 0xc0a82983
at 0x02003978 (fp + 0x18) = 0x02003a7e
at 0x0200397c (fp + 0x1c) = 0x02002630
at 0x02003980 (fp + 0x20) = 0x00000000
at 0x02003984 (fp + 0x24) = 0x02000000
at 0x02003988 (fp + 0x28) = 0x0200c4a4
at 0x0200398c (fp + 0x2c) = 0x0200f448
```

- **help**—Prints a summary of the ROM monitor commands to the console screen. This is the same output as entering **?**

  For example:

```
rommon 11 > help

alias               set and display aliases command
boot                boot up an external process
break               set/show/clear the breakpoint
confreg             configuration register utility
cont                continue executing a downloaded image
context             display the context of a loaded image
cookie              display contents of cookie PROM in hex
dev                 list the device table
dir                 list files in file system
dis                 disassemble instruction stream
dnld                serial download a program module
dram                verify DRAM
```

```
frame               print out a selected stack frame
hardware_info       display hardware information
help                monitor builtin command help
history             monitor command history
meminfo             memory information (-spd dumps SDRAM cookie)
repeat              repeat a monitor command
reset               system reset
set                 show all monitor variables
show_spd            show all SPD data
sleep               millisecond sleep command
stack               produce a stack trace
sync                write monitor environment to NVRAM
sysret              print out info from last system return
unalias             unset an alias
unset               unset a monitor variable
```

- **history** or **h**—Displays the command history, that is, the last 16 commands executed in the monitor environment.
- **meminfo**—Displays the size (in bytes) the starting address, the available range of the main memory, the starting point and size of packet memory, and the size of nonvolatile memory (NVRAM).

  For example:

```
rommon 9 > meminfo

Main memory size:128 MB. Packet memory size:64 MB
Available main memory starts at 0xa000e000, size 0x7ff2000
Packet memory starts at 0xa8000000
NVRAM size:0x80000
Main memory control register:0xbe9022f4
Shared memory control register:0x00000202
```

- **repeat** [*number or string*] [*count*] or **r**—Repeats the specified command. Without an argument, repeats the last command. The optional command number (from the history list) or match string specifies which command to repeat. In the case of the match string, the most recent command to begin with the specified string will be re-executed. If the string includes spaces, you must define it using quotes. The *count* option allows you to repeat the command more than once.
- **reset** or **i**—Resets and initializes the system, similar to power-on.
- **set**—Displays all the monitor variables and their values.
- **stack** [*num*]—Produces a stack trace of the num frames. The default is 5. The command dumps from the kernel stack and the process stack (if one is available) of a booted image.

  For example:

```
rommon 5 > stack 8

Stack trace:
PC = 0x02004adc
Frame 00: FP = 0x02003938    RA = 0x02005f2a
Frame 01: FP = 0x02003948    RA = 0x02005df0
Frame 02: FP = 0x02003960    RA = 0x020050ee
Frame 03: FP = 0x02003994    RA = 0x02004034
Frame 04: FP = 0x02003b00    RA = 0x00012ca6
```

- **sync**—Writes the working in-core copy of the environment variables and aliases to NVRAM so that they are read on the next reset.

- **sysret**—Displays the return information from the last booted system image. This 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:0x60043754,  error address: 0x0
Stack Trace:
FP: 0x80007e78, PC: 0x60043754
FP: 0x80007ed8, PC: 0x6001540c
FP: 0x80007ef8, PC: 0x600087f0
FP: 0x80007f18, PC: 0x80008734
```

- **unalias** *name*—Removes *name* and its associated value from the alias list.
- **unset** *varname*—Removes the variable name from the variable list.
- **xmodem** [- *yc*] *destination_file_name*—Downloads a system image to the boot Flash memory over the console port. The -y option performs the download. The -c option performs the download using 16-bit CRC error checking. The xmodem transfer protocol supports a 128-byte block size and the transfer begins with a block number starting at 1, which contains file data. This is the default transfer protocol.

Comprehensive Configuration Examples

Note The information herein applies to the Cisco AS5350, Cisco AS5400, and Cisco AS5400HPX universal gateways. Note that the latter requires use of Cisco IOS release 12.2(2)XB or later.

This appendix includes sample outputs of the **show config** command after completing the procedures in "Chapter 2, "Verifying Basic Setup"" and configuring various advanced features.

The following examples are useful references for you only if you are experienced with the Cisco IOS software:

CT3 CAS/ISDN with RADIUS

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service internal
```

```
!
hostname CT3-Mixed-UUT
!
no boot startup-test
logging buffered 32000 debugging
aaa new-model
aaa group server radius aaa.router
 server 192.168.1.137 auth-port 1645 acct-port 1646
 server 192.168.1.138 auth-port 1645 acct-port 1646
!
aaa authentication ppp default group aaa.router local
aaa authorization network default group aaa.router local
aaa authorization network no-author none
aaa accounting update newinfo periodic 30
aaa accounting network default start-stop group aaa.router
enable password lab
!
username cisco password password
!
!
resource-pool disable
!
!
!
!
dial-tdm-clock  priority 1 1/0:1
!
!
!
!
ip subnet-zero
no ip domain-lookup
ip host tftpboot 172.22.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn switch-type primary-5ess
isdn voice-call-failure 0
modemcap entry factory:MSC=&f
modemcap entry test:MSC=s30=28800
cns event-service server
mta receive maximum-recipients 0
!
!
controller T3 1/0
 framing m23
 clock source line
 t1 1 controller
 t1 2 controller
 t1 3 controller
 t1 4 controller
 t1 5 controller
 t1 6 controller
 t1 7 controller
 t1 8 controller
 t1 9 controller
 t1 10 controller
 t1 11 controller
 t1 12 controller
 t1 13 controller
 t1 14 controller
 t1 15 controller
 t1 16 controller
 t1 17 controller
```

```
 t1 18 controller
 t1 19 controller
 t1 20 controller
 t1 21 controller
 t1 22 controller
 t1 23 controller
 t1 24 controller
 t1 25 controller
 t1 26 controller
 t1 27 controller
 t1 28 controller
!
controller T1 1/0:1
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:2
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:3
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:4
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:5
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:6
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:7
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:8
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:9
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:10
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:11
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:12
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:13
 framing esf
 pri-group timeslots 1-24
!
```

```
controller T1 1/0:14
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:15
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:16
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:17
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:18
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:19
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:20
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:21
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:22
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:23
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:24
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:25
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:26
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
```

```
controller T1 1/0:27
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:28
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
!
!
!
!
interface FastEthernet0/0
 description VLAN 6
 ip address 192.168.6.100 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
 duplex auto
 speed auto
!
interface FastEthernet0/1
 description VLAN 7
 ip address 172.22.36.36 255.255.254.0
 no ip directed-broadcast
 no ip mroute-cache
 duplex auto
 speed auto
!
interface Serial0/0
 ip address 172.22.123.2 255.255.255.0
 no ip directed-broadcast
 clockrate 8000000
!
interface Serial0/1
 ip address 172.22.124.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ppp authorization no-author
!
interface Serial1/0:1:23
 ip address 10.1.0.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:2:23
 ip address 10.1.1.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
```

```
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 isdn T203 10000
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:3:23
 ip address 10.1.2.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:4:23
 ip address 10.1.3.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:5:23
 ip address 10.1.4.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:6:23
 ip address 10.1.5.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
```

```
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:7:23
 ip address 10.1.6.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:8:23
 ip address 10.1.7.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:9:23
 ip address 10.1.8.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:10:23
 ip address 10.1.9.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
```

```
interface Serial1/0:11:23
 ip address 10.1.10.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:12:23
 ip address 10.1.11.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:13:23
 ip address 10.1.12.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:14:23
 ip address 10.1.13.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:15:23
 ip address 10.1.14.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
```

```
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:16:23
 ip address 10.1.15.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
interface Group-Async0
 ip address 192.168.253.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 async default routing
 async mode interactive
 peer default ip address pool one
 no fair-queue
 ppp authentication chap
 group-range 2/00 7/107
!
router eigrp 100
 network 192.168.6.0
 network 192.168.7.0
!
ip local pool one 192.168.253.2 192.168.253.254
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 10.2.1.0 255.255.255.0 172.22.123.1
ip route 10.55.55.55 255.255.255.255 172.22.123.1
ip route 10.1.0.0 255.255.0.0 192.168.6.10
ip route 10.2.0.0 255.255.0.0 192.168.6.10
ip route 10.3.0.0 255.255.0.0 192.168.6.10
ip route 10.66.66.66 255.255.255.255 172.22.124.1
ip route 171.0.0.0 255.0.0.0 172.22.36.1
ip route 172.0.0.0 255.0.0.0 172.22.36.1
ip route 192.168.173.0 255.255.255.0 172.22.36.1
ip route 192.168.243.0 255.255.255.0 172.22.36.1
no ip http server
!
logging facility local5
logging 192.168.1.137
```

```
dialer-list 1 protocol ip permit
!
snmp-server engineID local 00000009020000E01E6B2FBE
snmp-server view public-view internet included
snmp-server community public RO
snmp-server community Public RO
snmp-server community junk RW
snmp-server community v2c view v1default RO
snmp-server community liang view v1default RO
snmp-server contact Test123456
snmp-server chassis-id 'router for AS5400 ct3'
!
radius-server host 192.168.1.137 auth-port 1645 acct-port 1646
radius-server host 192.168.1.138 auth-port 1645 acct-port 1646
radius-server retransmit 2
radius-server timeout 9
radius-server deadtime 30
radius-server key lab
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 exec-timeout 0 0
 password password
 logging synchronous
line vty 0 4
 no exec
 no logging synchronous
line 2/00 7/107
 autoselect ppp
 autoselect timeout 10
 logging synchronous
 modem InOut
 transport input all
!
ntp clock-period 17179742
ntp server 192.168.6.1
scheduler allocate 10000 400
end
```

CT3 CAS/ISDN Without RADIUS

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service internal
!
hostname CT3-Mixed-UUT
!
no boot startup-test
logging buffered 32000 debugging
!
enable password password
!
username cisco password password
!
!
resource-pool disable
!
!
!
!
dial-tdm-clock  priority 1 1/0:1
!
!
!
!
ip subnet-zero
no ip domain-lookup
ip host tftpboot 172.22.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn switch-type primary-5ess
isdn voice-call-failure 0
modemcap entry factory:MSC=&f
modemcap entry test:MSC=s30=28800
cns event-service server
mta receive maximum-recipients 0
!
!
controller T3 1/0
 framing m23
 clock source line
 t1 1 controller
 t1 2 controller
 t1 3 controller
 t1 4 controller
 t1 5 controller
 t1 6 controller
 t1 7 controller
 t1 8 controller
 t1 9 controller
 t1 10 controller
 t1 11 controller
```

```
 t1 12 controller
 t1 13 controller
 t1 14 controller
 t1 15 controller
 t1 16 controller
 t1 17 controller
 t1 18 controller
 t1 19 controller
 t1 20 controller
 t1 21 controller
 t1 22 controller
 t1 23 controller
 t1 24 controller
 t1 25 controller
 t1 26 controller
 t1 27 controller
 t1 28 controller
!
controller T1 1/0:1
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:2
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:3
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:4
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:5
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:6
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:7
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:8
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:9
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:10
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:11
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:12
 framing esf
```

```
 pri-group timeslots 1-24
!
controller T1 1/0:13
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:14
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:15
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:16
 framing esf
 pri-group timeslots 1-24
!
controller T1 1/0:17
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:18
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:19
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:20
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:21
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:22
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:23
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:24
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:25
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:26
```

```
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:27
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 1/0:28
 framing esf
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
!
!
!
!
interface FastEthernet0/0
 description VLAN 6
 ip address 192.168.6.100 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
 duplex auto
 speed auto
!
interface FastEthernet0/1
 description VLAN 7
 ip address 172.22.36.36 255.255.254.0
 no ip directed-broadcast
 no ip mroute-cache
 duplex auto
 speed auto
!
interface Serial0/0
 ip address 172.22.123.2 255.255.255.0
 no ip directed-broadcast
 clockrate 8000000
!
interface Serial0/1
 ip address 172.22.124.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ppp authorization no-author
!
interface Serial1/0:1:23
 ip address 10.1.0.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:2:23
 ip address 10.1.1.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
```

```
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 isdn T203 10000
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:3:23
 ip address 10.1.2.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:4:23
 ip address 10.1.3.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:5:23
 ip address 10.1.4.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:6:23
 ip address 10.1.5.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
```

```
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:7:23
 ip address 10.1.6.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:8:23
 ip address 10.1.7.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:9:23
 ip address 10.1.8.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:10:23
 ip address 10.1.9.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice data
```

```
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:11:23
 ip address 10.1.10.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:12:23
 ip address 10.1.11.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:13:23
 ip address 10.1.12.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 no fair-queue
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:14:23
 ip address 10.1.13.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
```

```
interface Serial1/0:15:23
 ip address 10.1.14.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
interface Serial1/0:16:23
 ip address 10.1.15.2 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 ip mroute-cache
 logging event link-status
 no keepalive
 dialer idle-timeout 72000 either
 dialer-group 1
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
 ppp authentication chap
!
interface Group-Async0
 ip address 192.168.253.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 async default routing
 async mode interactive
 peer default ip address pool one
 no fair-queue
 ppp authentication chap
 group-range 2/00 7/107
!
router eigrp 100
 network 192.168.6.0
 network 192.168.7.0
!
ip local pool one 192.168.253.2 192.168.253.254
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 10.2.1.0 255.255.255.0 123.123.123.1
ip route 10.55.55.55 255.255.255.255 123.123.123.1
ip route 10.1.0.0 255.255.0.0 192.168.6.10
ip route 10.2.0.0 255.255.0.0 192.168.6.10
ip route 10.3.0.0 255.255.0.0 192.168.6.10
ip route 10.66.66.66 255.255.255.255 124.124.124.1
ip route 171.0.0.0 255.0.0.0 172.22.36.1
ip route 172.0.0.0 255.0.0.0 172.22.36.1
ip route 192.168.173.0 255.255.255.0 172.22.36.1
ip route 192.168.243.0 255.255.255.0 172.22.36.1
```

```
no ip http server
!
logging facility local5
logging 192.168.1.137
dialer-list 1 protocol ip permit
!
snmp-server engineID local 00000009020000E01E6B2FBE
snmp-server view public-view internet included
snmp-server community public RO
snmp-server community Public RO
snmp-server community junk RW
snmp-server community v2c view v1default RO
snmp-server community liang view v1default RO
snmp-server contact Test123456
snmp-server chassis-id 'router for AS5400 ct3'
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 exec-timeout 0 0
 password lab
 logging synchronous
line vty 0 4
 no exec
 no logging synchronous
line 2/00 7/107
 autoselect ppp
 autoselect timeout 10
 logging synchronous
 modem InOut
 transport input all
!
ntp clock-period 17179742
ntp server 192.168.6.1
scheduler allocate 10000 400
end
```

CT3 Without Resource Pooling

```
AS5400# show config

Building configuration ...

Current configuration:
!!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CT3-CAS-UUT
!
no boot startup-test
no logging console
!
<text omitted>
!
resource-pool enable
resource-pool call treatment resource busy
resource-pool call treatment profile no-answer
!
resource-pool group resource 4700
 range port 1/0 1/107
 range port 2/0 2/1
!
resource-pool group resource 5300
 range port 2/2 2/107
 range port 3/0 3/107
 range port 4/0 4/107
 range port 5/0 5/107
 range port 6/0 6/107
!
resource-pool profile customer 4700
 limit base-size 110
 limit overflow-size 18
 resource 4700 speech
 dnis group default
!
resource-pool profile customer 5300
 limit base-size 538
 limit overflow-size 18
 resource 5300 speech
 dnis group elnino
!
resource-pool profile service gold
 modem min-speed 33200 max-speed 56000
resource-pool aaa protocol local
!
!
!
!
dial-tdm-clock  priority 1 7/0:1
!
!
!
!
ip subnet-zero
no ip domain-lookup
ip host jurai 172.23.254.253
!
```

```
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
!
controller T3 7/0
 clock source line
 t1 1 controller
 t1 2 controller
 t1 3 controller
 t1 4 controller
 t1 5 controller
 t1 6 controller
 t1 7 controller
 t1 8 controller
 t1 9 controller
 t1 10 controller
 t1 11 controller
 t1 12 controller
 t1 13 controller
 t1 14 controller
 t1 15 controller
 t1 16 controller
 t1 17 controller
 t1 18 controller
 t1 19 controller
 t1 20 controller
 t1 21 controller
 t1 22 controller
 t1 23 controller
 t1 24 controller
 t1 25 controller
 t1 26 controller
 t1 27 controller
 t1 28 controller
!
controller T1 7/0:1
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:2
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:3
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:4
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:5
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:6
```

```
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:7
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:8
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:9
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:10
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:11
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:12
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:13
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:14
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:15
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:16
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:17
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:18
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
```

```
controller T1 7/0:19
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:20
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:21
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:22
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:23
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:24
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:25
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:26
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:27
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:28
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.18.100 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
 no keepalive
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 192.168.19.100 255.255.255.0
 no ip directed-broadcast
```

```
 no ip mroute-cache
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 shutdown
 clockrate 2000000
!
interface Group-Async0
 no ip address
 no ip directed-broadcast
 no group-range
!
interface Group-Async1
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 group-range 1/00 6/107
!
router eigrp 100
 network 192.168.18.0
 network 192.168.19.0
!
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 60.1.14.0 255.255.255.0 192.168.21.10
ip route 70.1.14.0 255.255.255.0 192.168.21.10
ip route 80.1.14.0 255.255.255.0 192.168.21.10
ip route 100.1.1.0 255.255.255.0 192.168.21.10
ip route 110.1.1.0 255.255.255.0 192.168.21.10
ip route 120.1.1.0 255.255.255.0 192.168.21.10
ip route 130.1.1.0 255.255.255.0 192.168.21.10
ip route 172.22.254.253 255.255.255.255 FastEthernet0/0
no ip http server
!
snmp-server engineID local 0000000902000003096F80084
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 exec-timeout 0 0
 logging synchronous
 transport input all
line vty 0 4
```

```
 password password
 no logging synchronous
line 1/00 6/107
 autoselect ppp
 autoselect timeout 10
 logging synchronous
 modem InOut
 transport input all
!
ntp clock-period 17179843
ntp server 192.168.18.1
scheduler allocate 40000 200
end
```

CT3 CAS with Resource Pooling

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CT3-CAS-UUT
!
no boot startup-test
no logging console
aaa new-model
aaa group server radius aaa.router
 server 192.168.1.137 auth-port 1645 acct-port 1646
 server 192.168.1.138 auth-port 1645 acct-port 1646
!
aaa authentication ppp default group aaa.router local
aaa authorization network default group aaa.router local
aaa accounting update newinfo periodic 30
aaa accounting network default start-stop group aaa.router
enable password password
!
<text omitted>
!
resource-pool enable
resource-pool call treatment resource busy
resource-pool call treatment profile no-answer
!
resource-pool group resource 4700
 range port 1/0 1/107
 range port 2/0 2/1
!
resource-pool group resource 5300
 range port 2/2 2/107
 range port 3/0 3/107
 range port 4/0 4/107
 range port 5/0 5/107
 range port 6/0 6/107
!
resource-pool profile customer 4700
 limit base-size 110
 limit overflow-size 18
 resource 4700 speech
 dnis group default
!
resource-pool profile customer 5300
 limit base-size 538
 limit overflow-size 18
 resource 5300 speech
 dnis group elnino
!
resource-pool profile service gold
 modem min-speed 33200 max-speed 56000
resource-pool aaa protocol local
!
!
!
```

```
!
dial-tdm-clock  priority 1 7/0:1
!
!
!
!
ip subnet-zero
no ip domain-lookup
ip host jurai 172.23.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
!
controller T3 7/0
 clock source line
 t1 1 controller
 t1 2 controller
 t1 3 controller
 t1 4 controller
 t1 5 controller
 t1 6 controller
 t1 7 controller
 t1 8 controller
 t1 9 controller
 t1 10 controller
 t1 11 controller
 t1 12 controller
 t1 13 controller
 t1 14 controller
 t1 15 controller
 t1 16 controller
 t1 17 controller
 t1 18 controller
 t1 19 controller
 t1 20 controller
 t1 21 controller
 t1 22 controller
 t1 23 controller
 t1 24 controller
 t1 25 controller
 t1 26 controller
 t1 27 controller
 t1 28 controller
!
controller T1 7/0:1
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:2
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:3
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:4
```

```
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:5
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:6
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:7
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:8
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:9
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:10
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:11
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:12
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:13
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:14
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:15
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis cas-custom 1
!
controller T1 7/0:16
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:17
```

```
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:18
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:19
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:20
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:21
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:22
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:23
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:24
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:25
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:26
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:27
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
controller T1 7/0:28
 framing esf
 ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
 cas-custom 1
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.18.100 255.255.255.0
```

```
 no ip directed-broadcast
 no ip mroute-cache
 no keepalive
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 192.168.19.100 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 shutdown
 clockrate 2000000
!
interface Group-Async0
 no ip address
 no ip directed-broadcast
 no group-range
!
interface Group-Async1
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 group-range 1/00 6/107
!
router eigrp 100
 network 192.168.18.0
 network 192.168.19.0
!
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 60.1.14.0 255.255.255.0 192.168.21.10
ip route 70.1.14.0 255.255.255.0 192.168.21.10
ip route 80.1.14.0 255.255.255.0 192.168.21.10
ip route 100.1.1.0 255.255.255.0 192.168.21.10
ip route 110.1.1.0 255.255.255.0 192.168.21.10
ip route 120.1.1.0 255.255.255.0 192.168.21.10
ip route 130.1.1.0 255.255.255.0 192.168.21.10
ip route 172.22.254.253 255.255.255.255 FastEthernet0/0
no ip http server
!
!
dialer dnis group callblock
```

```
 number 5555
!
dialer dnis group v90
 number 815.............
!
dialer dnis group elnino
 number 915.....
!
snmp-server engineID local 0000000902000003096F80084
!
radius-server host 192.168.1.137 auth-port 1645 acct-port 1646
radius-server host 192.168.1.138 auth-port 1645 acct-port 1646
radius-server retransmit 2
radius-server timeout 9
radius-server deadtime 30
radius-server key lab
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 exec-timeout 0 0
 logging synchronous
 transport input all
line vty 0 4
 password password
 no logging synchronous
line 1/00 6/107
 autoselect ppp
 autoselect timeout 10
 logging synchronous
 modem InOut
 transport input all
!
ntp clock-period 17179843
ntp server 192.168.18.1
scheduler allocate 40000 200
end
```

Two 8 T1/PRI ISDN with Modems

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname AS5400-T1-PRI-UUT
!
no boot startup-test
logging rate-limit 5
no logging console
enable password password
!
resource-pool disable
!
!dial-tdm-clock  priority 1 2/4
!
!ip subnet-zero
ip ftp source-interface FastEthernet0/0
ip ftp username hanif
ip ftp password 7 060F022C4D1D0
no ip domain-lookup
ip host greenbug 172.22.43.28
ip host jurai 172.23.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn switch-type primary-5ess
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
!
controller T1 2/0
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/1
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/2
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/3
 framing esf
 linecode b8zs
 cablelength short 133
```

```
 pri-group timeslots 1-24
!
controller T1 2/4
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/5
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/6
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/7
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/0
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/1
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/2
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/3
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/4
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/5
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/6
 framing esf
```

```
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/7
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.10.102 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 no keepalive
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue 64 256 0
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Serial2/0:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/1:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
```

```
!
interface Serial2/2:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/3:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/5:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/6:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/7:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/0:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/1:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
```

```
!
interface Serial5/2:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/3:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/5:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/6:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/7:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Async1/00
 ip address 10.5.97.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 6151300001
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
```

```
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/01
 ip address 10.5.98.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100001
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/02
 ip address 10.5.99.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100002
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/03
 ip address 10.5.100.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100003
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/04
 ip address 10.5.101.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
```

```
 dialer idle-timeout 2000000
 dialer string 7150100004
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/05
 ip address 10.5.102.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100005
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/06
 ip address 10.5.103.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100006
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/07
 ip address 10.5.104.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100007
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/08
 ip address 10.5.105.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100008
```

```
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/09
 ip address 10.5.106.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100009
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/10
 ip address 10.5.107.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100010
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/11
 ip address 10.5.108.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100011
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/12
 ip address 10.5.109.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100012
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/13
 ip address 10.5.110.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
```

```
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100013
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/14
 ip address 10.5.111.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100014
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/15
 ip address 10.5.112.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100015
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/16
 ip address 10.5.113.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100016
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/17
 ip address 10.5.114.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
```

```
 dialer string 7150100017
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/18
 ip address 10.5.115.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100018
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/19
 ip address 10.5.116.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100019
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/20
 ip address 10.5.117.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100020
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Group-Async0
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 async mode interactive
 no peer default ip address
 ppp authentication chap
 group-range 1/21 7/107
!
router eigrp 100
 network 192.168.10.0
!
ip local pool ip-pool 10.4.1.1 10.4.1.250
ip default-gateway 192.168.10.1
```

```
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 10.5.1.97 255.255.255.255 Async1/00
ip route 10.5.1.98 255.255.255.255 Async1/01
ip route 10.5.1.99 255.255.255.255 Async1/02
ip route 10.5.1.100 255.255.255.255 Async1/03
ip route 10.5.1.101 255.255.255.255 Async1/04
ip route 10.5.1.102 255.255.255.255 Async1/05
ip route 10.5.1.103 255.255.255.255 Async1/06
ip route 10.5.1.104 255.255.255.255 Async1/07
ip route 10.5.1.105 255.255.255.255 Async1/08
ip route 10.5.1.106 255.255.255.255 Async1/09
ip route 10.5.1.107 255.255.255.255 Async1/10
ip route 10.5.1.108 255.255.255.255 Async1/11
ip route 10.5.1.109 255.255.255.255 Async1/12
ip route 10.5.1.110 255.255.255.255 Async1/13
ip route 10.5.1.111 255.255.255.255 Async1/14
ip route 10.5.1.112 255.255.255.255 Async1/15
ip route 10.5.1.113 255.255.255.255 Async1/16
ip route 10.5.1.114 255.255.255.255 Async1/17
ip route 10.5.1.115 255.255.255.255 Async1/18
ip route 10.5.1.116 255.255.255.255 Async1/19
ip route 10.5.1.117 255.255.255.255 Async1/20
no ip http server
!
dialer-list 1 protocol ip permit
!
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password 7 1042081B
 no logging synchronous
 login
line 1/00 1/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 3/00 4/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 6/00 7/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
!
```

```
exception core-file coredump
exception protocol ftp
exception dump 172.23.254.253
ntp clock-period 17179873
ntp server 192.168.10.1
scheduler allocate 4000 200
end
```

Two 8 E1/PRI ISDN with Modems

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
service internal
!
hostname AS5400-E1-PRI-UUT
!
enable password password
!
<test omitted>
!
!
resource-pool disable
!
!
spe country united-kingdom
!
!
ntp server 192.168.10.1
!
!
!
ip subnet-zero
no ip domain-lookup
ip host jurai 172.23.254.253
!
isdn switch-type primary-net5
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
xgcp snmp sgcp
!
controller E1 6/0
pri-group timeslots 1-31
!
controller E1 6/1
pri-group timeslots 1-31
!
controller E1 6/2
pri-group timeslots 1-31
!
controller E1 6/3
pri-group timeslots 1-31
!
controller E1 6/4
pri-group timeslots 1-31
!
controller E1 6/5
pri-group timeslots 1-31
!
controller E1 6/6
pri-group timeslots 1-31
```

```
!
controller E1 6/7
pri-group timeslots 1-31
!
controller E1 7/0
pri-group timeslots 1-31
!
controller E1 7/1
pri-group timeslots 1-31
!
controller E1 7/2
pri-group timeslots 1-31
!
controller E1 7/3
pri-group timeslots 1-31
!
controller E1 7/4
pri-group timeslots 1-31
!
controller E1 7/5
pri-group timeslots 1-31
!
controller E1 7/6
pri-group timeslots 1-31
!
controller E1 7/7
pri-group timeslots 1-31
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.10.103 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue 64 256 0
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Serial6/0:15
 no ip address
 no ip directed-broadcast
```

```
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/1:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/2:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/3:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/4:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/5:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/6:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial6/7:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/0:15
 no ip address
 no ip directed-broadcast
```

```
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/1:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/2:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/3:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/4:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/5:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/6:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial7/7:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Async1/00
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
```

```
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async1/01
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async1/02
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
.
.
<information deleted>
.
.
!

interface Async5/106
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async5/107
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Group-Async0
 no ip address
 no ip directed-broadcast
 no group-range
!
router eigrp 100
 network 192.168.13.0
!
ip default-gateway 192.168.13.1
ip classless
no ip http server
!
!
!
line con 0
 exec-timeout 0 0
```

Two 8 T1/PRI CAS with Modems

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname AS5400-T1-CAS-UUT
!
no boot startup-test
enable password password
!
<text omitted>
!
!
resource-pool disable
!
!
dial-tdm-clock  priority 1 2/0
!
!
ip subnet-zero
ip ftp source-interface FastEthernet0/0
ip ftp username hanif
ip ftp password 7 000D1E0B0508
no ip domain-lookup
ip host jurai 172.23.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn voice-call-failure 0
chat-script dial ABORT ERROR ABORT BUSY ABORT "NO CARRIER" TIMEOUT 120 "" at OK
"\datd,,\T" CONNECT
cns event-service server
mta receive maximum-recipients 0
!
!
controller T1 2/0
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/1
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/2
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
```

```
 cas-custom 0
!
controller T1 2/3
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/4
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/5
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/6
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/7
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/0
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/1
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/2
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/3
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
```

```
!
controller T1 3/4
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/5
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/6
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/7
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
!
interface FastEthernet0/0
 mac-address 000b.7264.9173
 ip address 192.168.10.100 255.255.255.0
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Async1/00
```

```
 ip address 10.1.1.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 dialer in-band
 dialer idle-timeout 30 either
 dialer string 10000
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Group-Async0
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
 group-range 1/01 7/107
!
router eigrp 100
 network 192.168.10.0
!
ip default-gateway 192.168.10.1
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 10.1.1.1 255.255.255.255 Async1/00
ip route 60.1.1.0 255.255.255.255 192.168.10.10
ip route 60.2.1.0 255.255.255.255 192.168.10.10
ip route 60.3.1.0 255.255.255.255 192.168.10.10
ip route 70.11.1.0 255.255.255.255 192.168.10.10
no ip http server
!
dialer-list 1 protocol ip permit
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password 7 13091610
 no logging synchronous
 login
line 1/00 1/107
 exec-timeout 0 0
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 4/00 7/107
 exec-timeout 0 0
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
```

```
!
exception core-file coredump
exception protocol ftp
exception dump 223.255.254.253
ntp clock-period 17179726
ntp server 192.168.10.1
scheduler allocate 40000 400
end
```

Two 8 T1/PRI CAS with RADIUS (AAA) and Resource Pooling

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname AS5400-T1-CAS-UUT
!
no boot startup-test
enable password password
!
<text omitted>
!
!
resource-pool enable
resource-pool call treatment resource channel-not-available
resource-pool call treatment profile no-answer
!
resource-pool group resource group1
 range port 1/0 1/107
!
resource-pool group resource group2
 range port 4/0 4/107
 range port 5/0 5/107
!
resource-pool group resource group3
 range port 6/0 6/107
 range port 7/0 7/107
!
resource-pool profile customer bell_atlantic
 limit base-size all
 limit overflow-size 0
 resource group2 speech
 dnis group group2
!
resource-pool profile customer us_west
 limit base-size 60
 limit overflow-size 100
 resource group1 speech
 dnis group group1
!
resource-pool profile customer all
 limit base-size all
 limit overflow-size 0
 resource group3 speech
 dnis group default
!
resource-pool profile discriminator not_allowed
 call-type speech
 dnis group not_allowed
!
!
!dial-tdm-clock  priority 1 2/0
!
!ip subnet-zero
```

```
ip ftp source-interface FastEthernet0/0
ip ftp username hanif
ip ftp password 7 000D1E0B0508
no ip domain-lookup
ip host jurai 172.23.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn voice-call-failure 0
chat-script dial ABORT ERROR ABORT BUSY ABORT "NO CARRIER" TIMEOUT 120 "" at OK
"\datd,,\T" CONNECT
cns event-service server
mta receive maximum-recipients 0
!
!
controller T1 2/0
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/1
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/2
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/3
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/4
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/5
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 2/6
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
```

```
controller T1 2/7
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/0
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/1
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/2
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/3
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/4
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/5
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/6
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
controller T1 3/7
 framing esf
 linecode b8zs
 cablelength short 133
 ds0-group 0 timeslots 1-24 type e&m-fgb
 cas-custom 0
!
!
```

```
interface FastEthernet0/0
 mac-address 000b.7264.9173
 ip address 192.168.10.100 255.255.255.0
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Async1/00
 ip address 10.1.1.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 dialer in-band
 dialer idle-timeout 30 either
 dialer string 10000
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Group-Async0
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
 group-range 1/01 7/107
!
router eigrp 100
 network 192.168.10.0
!
ip default-gateway 192.168.10.1
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
```

```
ip route 10.1.1.1 255.255.255.255 Async1/00
ip route 60.1.1.0 255.255.255.255 192.168.10.10
ip route 60.2.1.0 255.255.255.255 192.168.10.10
ip route 60.3.1.0 255.255.255.255 192.168.10.10
ip route 70.11.1.0 255.255.255.255 192.168.10.10
no ip http server
!
dialer dnis group group1
 number 10000
 call-type cas speech
!
dialer dnis group group2
 number 10001
 call-type cas speech
!
dialer dnis group not_allowed
 number 66666
dialer-list 1 protocol ip permit
!
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password 7 13091610
 no logging synchronous
 login
line 1/00 1/107
 exec-timeout 0 0
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 4/00 7/107
 exec-timeout 0 0
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
!
exception core-file coredump
exception protocol ftp
exception dump 172.23.254.253
ntp clock-period 17179726
ntp server 192.168.10.1
scheduler allocate 40000 400
end
```

Two 8 T1/PRI ISDN with RADIUS (AAA) and Resource Pooling

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname AS5400-T1-PRI-UUT
!
no boot startup-test
logging rate-limit 5
no logging console
enable password password
!
<text omitted>
!
resource-pool enable
resource-pool call treatment resource channel-not-available
resource-pool call treatment profile no-answer
!
resource-pool group resource group1
 range port 1/0 1/107
!
resource-pool group resource group2
 range port 4/0 4/107
 range port 5/0 5/107
!
resource-pool group resource group3
 range port 6/0 6/107
 range port 7/0 7/107
!
resource-pool profile customer bell_atlantic
 limit base-size all
 limit overflow-size 0
 resource group2 speech
 dnis group group2
!
resource-pool profile customer us_west
 limit base-size 60
 limit overflow-size 100
 resource group1 speech
 dnis group group1
!
resource-pool profile customer all
 limit base-size all
 limit overflow-size 0
 resource group3 speech
 dnis group default
!
resource-pool profile discriminator not_allowed
 call-type speech
 dnis group not_allowed
!
! dial-tdm-clock  priority 1 2/4
!
! ip subnet-zero
```

```
ip ftp source-interface FastEthernet0/0
ip ftp username hanif
ip ftp password password
no ip domain-lookup
ip host greenbug 172.22.43.28
ip host jurai 172.23.254.253
!
mgcp package-capability trunk-package
mgcp default-package trunk-package
isdn switch-type primary-5ess
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
!
controller T1 2/0
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/1
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/2
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/3
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/4
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/5
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/6
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 2/7
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/0
```

```
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/1
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/2
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/3
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/4
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/5
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/6
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
controller T1 5/7
 framing esf
 linecode b8zs
 cablelength short 133
 pri-group timeslots 1-24
!
!
interface FastEthernet0/0
 ip address 192.168.10.102 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 no keepalive
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 duplex auto
```

```
 speed auto
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue 64 256 0
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
interface Serial2/0:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/1:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/2:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/3:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/5:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
```

```
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/6:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2/7:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/0:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/1:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/2:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/3:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/5:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
```

```
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/6:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial5/7:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Async1/00
 ip address 10.5.97.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 6151300001
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/01
 ip address 10.5.98.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100001
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/02
 ip address 10.5.99.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100002
```

```
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/03
 ip address 10.5.100.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100003
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/04
 ip address 10.5.101.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100004
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/05
 ip address 10.5.102.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout 2000000
 dialer string 7150100005
 dialer-group 1
 async default routing
 async mode interactive
 no peer default ip address
 no fair-queue
 ppp authentication chap
 hold-queue 1000 in
 hold-queue 1000 out
!
interface Async1/06
```

```
 ip address 10.5.103.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100006
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/07
 ip address 10.5.104.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100007
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/08
 ip address 10.5.105.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100008
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/09
 ip address 10.5.106.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100009
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
interface Async1/10
 ip address 10.5.107.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100010
 dialer-group 1
 async mode interactive
 ppp authentication chap
!
```

```
interface Async1/11
 ip address 10.5.108.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100011
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/12
 ip address 10.5.109.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100012
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/13
 ip address 10.5.110.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100013
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/14
 ip address 10.5.111.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100014
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/15
 ip address 10.5.112.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
```

```
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100015
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/16
 ip address 10.5.113.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100016
 dialer-group 1
 async mode interactive
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
interface Async1/17
 ip address 10.5.114.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100017
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/18
 ip address 10.5.115.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100018
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/19
 ip address 10.5.116.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100019
 dialer-group 1
```

```
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Async1/20
 ip address 10.5.117.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 dialer in-band
 dialer idle-timeout AS5400
 dialer string 7150100020
 dialer-group 1
 async mode interactive
 no peer default ip address
 ppp authentication chap
!
interface Group-Async0
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 no ip mroute-cache
 async mode interactive
 no peer default ip address
 ppp authentication chap
 group-range 1/21 7/107
!
router eigrp 100
 network 192.168.10.0
!
ip local pool ip-pool 10.4.1.1 10.4.1.250
ip default-gateway 192.168.10.1
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 10.5.1.97 255.255.255.255 Async1/00
ip route 10.5.1.98 255.255.255.255 Async1/01
ip route 10.5.1.99 255.255.255.255 Async1/02
ip route 10.5.1.100 255.255.255.255 Async1/03
ip route 10.5.1.101 255.255.255.255 Async1/04
ip route 10.5.1.102 255.255.255.255 Async1/05
ip route 10.5.1.103 255.255.255.255 Async1/06
ip route 10.5.1.104 255.255.255.255 Async1/07
ip route 10.5.1.105 255.255.255.255 Async1/08
ip route 10.5.1.106 255.255.255.255 Async1/09
ip route 10.5.1.107 255.255.255.255 Async1/10
ip route 10.5.1.108 255.255.255.255 Async1/11
ip route 10.5.1.109 255.255.255.255 Async1/12
ip route 10.5.1.110 255.255.255.255 Async1/13
ip route 10.5.1.111 255.255.255.255 Async1/14
ip route 10.5.1.112 255.255.255.255 Async1/15
ip route 10.5.1.113 255.255.255.255 Async1/16
ip route 10.5.1.114 255.255.255.255 Async1/17
ip route 10.5.1.115 255.255.255.255 Async1/18
ip route 10.5.1.116 255.255.255.255 Async1/19
ip route 10.5.1.117 255.255.255.255 Async1/20
no ip http server
```

```
!
dialer dnis group group1
 number 10000
 call-type cas speech
!
dialer dnis group group2
 number 10001
 call-type cas speech
!
dialer dnis group not_allowed
 number 66666
dialer-list 1 protocol ip permit
!
dialer-list 1 protocol ip permit
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
line aux 0
 logging synchronous
line vty 0 4
 password password
 no logging synchronous
 login
line 1/00 1/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 3/00 4/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
line 6/00 7/107
 autoselect ppp
 script dialer dial
 logging synchronous
 modem InOut
 transport input all
!
exception core-file coredump
exception protocol ftp
exception dump 223.255.254.253
ntp clock-period 17179873
ntp server 192.168.10.1
scheduler allocate 4000 200
end
```

Two 8 E1/PRI ISDN with RADIUS (AAA) and Resource Pooling

```
AS5400# show config

Building configuration ...

Current configuration:
!
version 12.1
no service pad
service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
service internal
!
hostname AS5400-E1-PRI-UUT
!
enable password password
!

username AS5400-E1-PRI-UUT password password
!
<text omitted>
!
resource-pool enable
resource-pool call treatment resource channel-not-available
resource-pool call treatment profile no-answer
!
resource-pool group resource group1
 range port 1/0 1/107
!
resource-pool group resource group2
 range port 4/0 4/107
 range port 5/0 5/107
!
resource-pool group resource group3
 range port 2/0 2/107
 range port 3/0 3/107
!
resource-pool profile customer bell_atlantic
 limit base-size all
 limit overflow-size 0
 resource group2 speech
 dnis group group2
!
resource-pool profile customer us_west
 limit base-size 60
 limit overflow-size 100
 resource group1 speech
 dnis group group1
!
resource-pool profile customer all
 limit base-size all
 limit overflow-size 0
 resource group3 speech
 dnis group default
!
resource-pool profile discriminator not_allowed
 call-type speech
 dnis group not_allowed
!
!
spe country united-kingdom
```

```
!
!
ntp server 192.168.10.1
!
!
!
ip subnet-zero
no ip domain-lookup
ip host jurai 172.23.254.253
!
isdn switch-type primary-net5
isdn voice-call-failure 0
cns event-service server
mta receive maximum-recipients 0
!
xgcp snmp sgcp
!
controller E1 6/0
pri-group timeslots 1-31
!
controller E1 6/1
pri-group timeslots 1-31
!
controller E1 6/2
pri-group timeslots 1-31
!
controller E1 6/3
pri-group timeslots 1-31
!
controller E1 6/4
pri-group timeslots 1-31
!
controller E1 6/5
pri-group timeslots 1-31
!
controller E1 6/6
pri-group timeslots 1-31
!
controller E1 6/7
pri-group timeslots 1-31
!
controller E1 7/0
pri-group timeslots 1-31
!
controller E1 7/1
pri-group timeslots 1-31
!
controller E1 7/2
pri-group timeslots 1-31
!
controller E1 7/3
pri-group timeslots 1-31
!
controller E1 7/4
pri-group timeslots 1-31
!
controller E1 7/5
pri-group timeslots 1-31
!
controller E1 7/6
pri-group timeslots 1-31
!
controller E1 7/7
pri-group timeslots 1-31
```

```
!
!
!
interface FastEthernet0/0
 ip address 192.168.10.103 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 fair-queue 64 256 0
 clockrate 2000000
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
 clockrate 2000000
!
<text omitted>
!
interface Serial7/7:15
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-net5
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Async1/00
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async1/01
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
<text omitted>
!
interface Async5/106
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
```

```
 ppp authentication chap
!
interface Async5/107
 ip unnumbered FastEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Group-Async0
 no ip address
 no ip directed-broadcast
 no group-range
!
router eigrp 100
 network 192.168.13.0
!
ip default-gateway 192.168.13.1
ip classless
no ip http server
!
dialer dnis group group1
 number 10000
 call-type cas speech
!
dialer dnis group group2
 number 10001
 call-type cas speech
!
dialer dnis group not_allowed
 number 66666
dialer-list 1 protocol ip permit
!
!
line con 0
 exec-timeout 0 0
 transport input none
 speed 9600
line aux 0
line vty 0 4
 login
```

CT3 with Resource Pooling, AAA, and Modem

```
AS5400# show config

Building configuration . . .
Current configuration:
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CT3-CAS-UUT
!
no boot startup-test
logging buffered 10000000 debugging
no logging console
aaa new-model
aaa group server radius aaa.router
server 192.168.1.137 auth-port 1645 acct-port 1646
server 192.168.1.138 auth-port 1645 acct-port 1646
!
aaa authentication ppp default group aaa.router local
aaa authorization network default group aaa.router local
aaa accounting update newinfo periodic 30
aaa accounting network default start-stop group aaa.router
enable password lab
!
username cisco password 0 lab
username 4700-F8 password 0 lab
username 4700-F13 password 0 lab
username 4700-I4 password 0 lab
username ELNINO-N3 password 0 lab
username ELNINO-N4 password 0 lab
username ELNINO-N5 password 0 lab
username NAS password 0 lab
username HGW password 0 lab
username all
!
!
resource-pool enable
resource-pool call treatment resource busy
!
resource-pool group resource 4700
range port 1/0 1/107
!
resource-pool group resource 5300
range port 2/0 2/107
range port 4/0 4/107
range port 5/0 5/107
range port 6/0 6/107
!
resource-pool profile customer 4700
limit base-size 110
limit overflow-size 18
resource 4700 speech
!
resource-pool profile customer 5300
limit base-size 538
limit overflow-size 18
resource 5300 speech
dnis group elnino
!
```

```
resource-pool profile service gold
modem min-speed 33200 max-speed 56000
!
!
!
!
dial-tdm-clock priority 1 freerun
calltracker enable
!
!
!
!
ip subnet-zero
ip ftp source-interface FastEthernet0/0
ip ftp username router
ip ftp password lab
no ip domain-lookup
ip host jurai 223.255.254.253
!
isdn voice-call-failure 0
cns event-service server
!
!
!
mta receive maximum-recipients 0
!
!
controller T3 7/0
clock source line
t1 1-28 controller
!
controller T1 7/0:1
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:2
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:3
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:4
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:5
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:6
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:7
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
```

```
cas-custom 1
!
controller T1 7/0:8
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:9
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:10
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:11
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:12
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:13
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:14
raming esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:15
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
ontroller T1 7/0:16
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:17
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:18
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:19
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:20
framing esf
```

```
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:21
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:22
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:23
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:24
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:25
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:26
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:27
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
controller T1 7/0:28
framing esf
ds0-group 1 timeslots 1-24 type e&m-fgb dtmf dnis
cas-custom 1
!
!
!
interface Loopback0
no ip address
!
interface FastEthernet0/0
ip address 192.168.18.100 255.255.255.0
no keepalive
duplex auto
speed auto
hold-queue 4000 out
!
interface FastEthernet0/1
ip address 172.22.35.71 255.255.0.0
shutdown
duplex auto
speed auto
!
interface Serial0/0
no ip address
shutdown
```

```
clockrate 2000000
!
interface Serial0/1
no ip address
hutdown
lockrate 2000000
!
interface Group-Async0
no ip address
no group-range
!
interface Group-Async1
ip unnumbered FastEthernet0/0
encapsulation ppp
async default routing
async mode interactive
no peer default ip address
fair-queue
ppp authentication chap
group-range 1/00 6/107
!
router eigrp 100
network 192.168.18.0
network 192.168.19.0
!
ip nat translation timeout never
ip nat translation tcp-timeout never
ip nat translation udp-timeout never
ip nat translation finrst-timeout never
ip nat translation syn-timeout never
ip nat translation dns-timeout never
ip nat translation icmp-timeout never
ip classless
ip route 60.1.14.0 255.255.255.0 192.168.18.10
ip route 70.1.14.0 255.255.255.0 192.168.18.10
ip route 80.1.14.0 255.255.255.0 192.168.18.10
ip route 100.1.1.0 255.255.255.0 192.168.18.10
ip route 110.1.1.0 255.255.255.0 192.168.18.10
ip route 120.1.1.0 255.255.255.0 192.168.18.10
ip route 130.1.1.0 255.255.255.0 192.168.18.10
ip route 192.0.0.0 255.0.0.0 FastEthernet0/1
ip route 192.122.173.18 255.255.255.255 FastEthernet0/1
ip route 223.255.254.253 255.255.255.255 FastEthernet0/0
no ip http server
!
logging facility local2
logging 192.168.1.131
!
dialer dnis group callblock
number 5555
!
dialer dnis group v90
number 815..............
!
dialer dnis group elnino
number 915.....
!
snmp-server engineID local 0000000902000003096F80084
snmp-server community public RW
!
radius-server host 192.168.1.137 auth-port 1645 acct-port 1646
radius-server host 192.168.1.138 auth-port 1645 acct-port 1646
radius-server retransmit 2
radius-server timeout 9
```

```
radius-server deadtime 30
radius-server key lab
!
!
line con 0
exec-timeout 0 0
logging synchronous
transport input none
line aux 0
exec-timeout 0 0
logging synchronous
transport input all
line vty 0 4
password lab
no logging synchronous
line 1/00 6/107
autoselect ppp
autoselect timeout 10
logging synchronous
modem InOut
transport input all
!
```

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X