Cisco AS5350XM and Cisco AS5400XM Universal Gateways Software Configuration Guide

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About Cisco IOS Software Documentation

This document describes the objectives, audience, conventions, and organization used in Cisco IOS software documentation. Also included are resources for obtaining technical assistance, additional documentation, and other information from Cisco. This document is organized into the following sections:

- Documentation Objectives, page ix
- Audience, page ix
- Documentation Conventions, page ix
- Documentation Organization, page xi
- Additional Resources and Documentation Feedback, page xviii

Documentation Objectives

Cisco IOS software documentation describes the tasks and commands available to configure and maintain Cisco networking devices.

Audience

The Cisco IOS software documentation set is intended for users who configure and maintain Cisco networking devices (such as routers and switches) but who may not be familiar with the configuration and maintenance tasks, the relationship among tasks, or the Cisco IOS software commands necessary to perform particular tasks. The Cisco IOS software documentation set is also intended for those users experienced with Cisco IOS software who need to know about new features, new configuration options, and new software characteristics in the current Cisco IOS software release.

Documentation Conventions

In Cisco IOS software documentation, the term *router* may be used to refer to various Cisco products; for example, routers, access servers, and switches. These and other networking devices that support Cisco IOS software are shown interchangeably in examples and are used only for illustrative purposes. An example that shows one product does not necessarily mean that other products are not supported.

This section includes the following topics:

- Typographic Conventions, page x
- Command Syntax Conventions, page x
- Software Conventions, page xi
- Reader Alert Conventions, page xi

Typographic Conventions

Cisco IOS documentation uses the following typographic conventions:

Convention	Description
^ or Ctrl	Both the ^ symbol and Ctrl represent the Control (Ctrl) key on a keyboard. For example, the key combination **^D** or **Ctrl-D** means that you hold down the Control key while you press the D key. (Keys are indicated in capital letters but are not case sensitive.)
string	A string is a nonquoted set of characters shown in italics. For example, when setting a Simple Network Management Protocol (SNMP) community string to *public*, do not use quotation marks around the string; otherwise, the string will include the quotation marks.

Command Syntax Conventions

Cisco IOS documentation uses the following command syntax conventions:

Convention	Description
bold	Bold text indicates commands and keywords that you enter as shown.
italic	Italic text indicates arguments for which you supply values.
[x]	Square brackets enclose an optional keyword or argument.
|	A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.
[x | y]	Square brackets enclosing keywords or arguments separated by a pipe indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a pipe indicate a required choice.
[x {y | z}]	Braces and a pipe within square brackets indicate a required choice within an optional element.

Software Conventions

Cisco IOS software uses the following program code conventions:

Convention	Description
`Courier font`	Courier font is used for information that is displayed on a PC or terminal screen.
`Bold Courier font`	Bold Courier font indicates text that the user must enter.
< >	Angle brackets enclose text that is not displayed, such as a password. Angle brackets also are used in contexts in which the italic font style is not supported; for example, ASCII text.
!	An exclamation point at the beginning of a line indicates that the text that follows is a comment, not a line of code. An exclamation point is also displayed by Cisco IOS software for certain processes.
[ ]	Square brackets enclose default responses to system prompts.

Reader Alert Conventions

The Cisco IOS documentation set uses the following conventions for reader alerts:

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

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Documentation Organization

This section describes the Cisco IOS documentation set, how it is organized, and how to access it on Cisco.com. Included are lists of configuration guides, command references, and supplementary references and resources that make up the documentation set. The following topics are included:

- Cisco IOS Documentation Set, page xii
- Cisco IOS Documentation on Cisco.com, page xii
- Configuration Guides, Command References, and Supplementary Resources, page xiii

Cisco IOS Documentation Set

Cisco IOS software documentation consists of the following:

- Release notes and caveats provide information about platform, technology, and feature support for a release and describe severity 1 (catastrophic), severity 2 (severe), and severity 3 (moderate) defects in released Cisco IOS software code. Review release notes before other documents to learn whether or not updates have been made to a feature.
- Sets of configuration guides and command references organized by technology and published for each standard Cisco IOS software release.
  - Configuration guides—Compilations of documents that provide informational and task-oriented descriptions of Cisco IOS software features.
  - Command references—Compilations of commands that provide detailed information about the commands used in the Cisco IOS features and processes that make up the related configuration guides.
- Lists of all the commands in a specific release and all commands that are new, modified, removed, or replaced in the release.
- Command reference book for **debug** commands. Commands are listed in alphabetical order.
- Reference book for system messages for all Cisco IOS releases.

Cisco IOS Documentation on Cisco.com

The following sections describe the documentation organization and how to access various document types.

Use Cisco Feature Navigator to find information about platform support and Cisco IOS and Catalyst OS software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

New Features List

The New Features List for each release provides a list of all features in the release with hyperlinks to the feature guides in which they are documented.

Feature Guides

Cisco IOS features are documented in feature guides. Feature guides describe one feature or a group of related features that are supported on many different software releases and platforms. Your Cisco IOS software release or platform may not support all the features documented in a feature guide. See the Feature Information table at the end of the feature guide for information about which features in that guide are supported in your software release.

Configuration Guides

Configuration guides are provided by technology and release and comprise a set of individual feature guides relevant to the release and technology.

Command References

Command reference books contain Cisco IOS commands that are supported in many different software releases and on many different platforms. The books are provided by technology. For information about Cisco IOS commands, see the Cisco IOS Master Commands List, or the Command Lookup Tool at http://tools.cisco.com/Support/CLILookup.

Cisco IOS Supplementary Documents and Resources

Supplementary documents and resources are listed in Table 2 on page xvii.

Configuration Guides, Command References, and Supplementary Resources

Table 1 lists in alphabetical order Cisco IOS software configuration guides and command references, including brief descriptions of the contents of the documents. The configuration guides and command references listed support many different software releases and platforms. Your Cisco IOS software release or platform may not support all these technologies.

For additional information about configuring and operating specific networking devices, go to the Product Support area of Cisco.com at http://www.cisco.com/web/psa/products/index.html.

Table 2 lists documents and resources that supplement the Cisco IOS software configuration guides and command references. These supplementary resources include release notes and caveats; master command lists; new, modified, removed, and replaced command lists; system messages; and the debug command reference.

Table 1 Cisco IOS Configuration Guides and Command References

Configuration Guide and Command Reference Titles	Features/Protocols/Technologies
Cisco IOS AppleTalk Configuration Guide *Cisco IOS AppleTalk Command Reference*	AppleTalk protocol.
Cisco IOS Asynchronous Transfer Mode Configuration Guide *Cisco IOS Asynchronous Transfer Mode Command Reference*	LAN ATM, multiprotocol over ATM (MPoA), and WAN ATM.
Cisco IOS Bridging and IBM Networking Configuration Guide *Cisco IOS Bridging Command Reference* *Cisco IOS IBM Networking Command Reference*	• Transparent and source-route transparent (SRT) bridging, source-route bridging (SRB), Token Ring Inter-Switch Link (TRISL), and token ring route switch module (TRRSM). • Data-link switching plus (DLSw+), serial tunnel (STUN), block serial tunnel (BSTUN); logical link control, type 2 (LLC2), synchronous data link control (SDLC); IBM Network Media Translation, including Synchronous Data Logical Link Control (SDLLC) and qualified LLC (QLLC); downstream physical unit (DSPU), Systems Network Architecture (SNA) service point, SNA frame relay access, advanced peer-to-peer networking (APPN), native client interface architecture (NCIA) client/server topologies, and IBM Channel Attach.
Cisco IOS Broadband and DSL Configuration Guide *Cisco IOS Broadband and DSL Command Reference*	Point-to-Point Protocol (PPP) over ATM (PPPoA) and PPP over Ethernet (PPPoE).
Cisco IOS Carrier Ethernet Configuration Guide *Cisco IOS Carrier Ethernet Command Reference*	Connectivity fault management (CFM), Ethernet Local Management Interface (ELMI), IEEE 802.3ad link bundling, Link Layer Discovery Protocol (LLDP), media endpoint discovery (MED), and operations, administration, and maintenance (OAM).

Table 1 Cisco IOS Configuration Guides and Command References (continued)

Configuration Guide and Command Reference Titles	Features/Protocols/Technologies
Cisco IOS Configuration Fundamentals Configuration Guide *Cisco IOS Configuration Fundamentals Command Reference*	Autoinstall, Setup, Cisco IOS command-line interface (CLI), Cisco IOS file system (IFS), Cisco IOS web browser user interface (UI), basic file transfer services, and file management.
Cisco IOS DECnet Configuration Guide *Cisco IOS DECnet Command Reference*	DECnet protocol.
Cisco IOS Flexible NetFlow Configuration Guide *Cisco IOS Flexible NetFlow Command Reference*	Flexible NetFlow.
Cisco IOS H.323 Configuration Guide	Gatekeeper enhancements for managed voice services, Gatekeeper Transaction Message Protocol, gateway codec order preservation and shutdown control, H.323 dual tone multifrequency relay, H.323 version 2 enhancements, Network Address Translation (NAT) support of H.323 v2 Registration, Admission, and Status (RAS) protocol, tokenless call authorization, and VoIP gateway trunk and carrier-based routing.
Cisco IOS High Availability Command Reference	A variety of High Availability (HA) features and technologies that are available for different network segments (from enterprise access to service provider core) to facilitate creation of end-to-end highly available networks. Cisco IOS HA features and technologies can be categorized in three key areas: system-level resiliency, network-level resiliency, and embedded management for resiliency.
Cisco IOS Intelligent Service Gateway Configuration Guide *Cisco IOS Intelligent Service Gateway Command Reference*	Subscriber identification, service and policy determination, session creation, session policy enforcement, session life-cycle management, accounting for access and service usage, session state monitoring.
Cisco IOS Interface and Hardware Component Configuration Guide *Cisco IOS Interface and Hardware Component Command Reference*	LAN interfaces, logical interfaces, serial interfaces, virtual interfaces, and interface configuration.
Cisco IOS IP Addressing Services Configuration Guide *Cisco IOS IP Addressing Services Command Reference*	Address Resolution Protocol (ARP), Network Address Translation (NAT), Domain Name System (DNS), Dynamic Host Configuration Protocol (DHCP), and Next Hop Address Resolution Protocol (NHRP).
Cisco IOS IP Application Services Configuration Guide *Cisco IOS IP Application Services Command Reference*	Enhanced Object Tracking (EOT), Gateway Load Balancing Protocol (GLBP), Hot Standby Router Protocol (HSRP), IP Services, Server Load Balancing (SLB), Stream Control Transmission Protocol (SCTP), TCP, Web Cache Communication Protocol (WCCP), User Datagram Protocol (UDP), and Virtual Router Redundancy Protocol (VRRP).
Cisco IOS IP Mobility Configuration Guide *Cisco IOS IP Mobility Command Reference*	Mobile ad hoc networks (MANet) and Cisco mobile networks.

Table 1 Cisco IOS Configuration Guides and Command References (continued)

Configuration Guide and Command Reference Titles	Features/Protocols/Technologies
Cisco IOS IP Multicast Configuration Guide *Cisco IOS IP Multicast Command Reference*	Protocol Independent Multicast (PIM) sparse mode (PIM-SM), bidirectional PIM (bidir-PIM), Source Specific Multicast (SSM), Multicast Source Discovery Protocol (MSDP), Internet Group Management Protocol (IGMP), and Multicast VPN (MVPN).
Cisco IOS IP Routing Protocols Configuration Guide *Cisco IOS IP Routing Protocols Command Reference*	Border Gateway Protocol (BGP), multiprotocol BGP, multiprotocol BGP extensions for IP multicast, bidirectional forwarding detection (BFD), Enhanced Interior Gateway Routing Protocol (EIGRP), Interior Gateway Routing Protocol (IGRP), Intermediate System-to-Intermediate System (IS-IS), on-demand routing (ODR), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP).
Cisco IOS IP SLAs Configuration Guide *Cisco IOS IP SLAs Command Reference*	Cisco IOS IP Service Level Agreements (IP SLAs).
Cisco IOS IP Switching Configuration Guide *Cisco IOS IP Switching Command Reference*	Cisco Express Forwarding, fast switching, and Multicast Distributed Switching (MDS).
Cisco IOS IPv6 Configuration Guide *Cisco IOS IPv6 Command Reference*	For IPv6 features, protocols, and technologies, go to the IPv6 "Start Here" document at http://www.cisco.com/en/US/docs/ios/ipv6/configuration/guide/ip6-roadmap.html
Cisco IOS ISO CLNS Configuration Guide *Cisco IOS ISO CLNS Command Reference*	ISO connectionless network service (CLNS).
Cisco IOS LAN Switching Configuration Guide *Cisco IOS LAN Switching Command Reference*	VLANs, Inter-Switch Link (ISL) encapsulation, IEEE 802.10 encapsulation, IEEE 802.1Q encapsulation, and multilayer switching (MLS).
Cisco IOS Mobile Wireless Gateway GPRS Support Node Configuration Guide *Cisco IOS Mobile Wireless Gateway GPRS Support Node Command Reference*	Cisco IOS Gateway GPRS Support Node (GGSN) in a 2.5-generation general packet radio service (GPRS) and 3-generation universal mobile telecommunication system (UMTS) network.
Cisco IOS Mobile Wireless Home Agent Configuration Guide *Cisco IOS Mobile Wireless Home Agent Command Reference*	Cisco Mobile Wireless Home Agent, an anchor point for mobile terminals for which mobile IP or proxy mobile IP services are provided.
Cisco IOS Mobile Wireless Packet Data Serving Node Configuration Guide *Cisco IOS Mobile Wireless Packet Data Serving Node Command Reference*	Cisco Packet Data Serving Node (PDSN), a wireless gateway that is between the mobile infrastructure and standard IP networks and that enables packet data services in a code division multiple access (CDMA) environment.
Cisco IOS Mobile Wireless Radio Access Networking Configuration Guide *Cisco IOS Mobile Wireless Radio Access Networking Command Reference*	Cisco IOS radio access network products.

Table 1 Cisco IOS Configuration Guides and Command References (continued)

Configuration Guide and Command Reference Titles	Features/Protocols/Technologies
Cisco IOS Multiprotocol Label Switching Configuration Guide *Cisco IOS Multiprotocol Label Switching Command Reference*	MPLS Label Distribution Protocol (LDP), MPLS Layer 2 VPNs, MPLS Layer 3 VPNs, MPLS Traffic Engineering (TE), and MPLS Embedded Management (EM) and MIBs.
Cisco IOS Multi-Topology Routing Configuration Guide *Cisco IOS Multi-Topology Routing Command Reference*	Unicast and multicast topology configurations, traffic classification, routing protocol support, and network management support.
Cisco IOS NetFlow Configuration Guide *Cisco IOS NetFlow Command Reference*	Network traffic data analysis, aggregation caches, export features.
Cisco IOS Network Management Configuration Guide *Cisco IOS Network Management Command Reference*	Basic system management; system monitoring and logging; troubleshooting, logging, and fault management; Cisco Discovery Protocol; Cisco IOS Scripting with Tool Control Language (Tcl); Cisco networking services (CNS); DistributedDirector; Embedded Event Manager (EEM); Embedded Resource Manager (ERM); Embedded Syslog Manager (ESM); HTTP; Remote Monitoring (RMON); SNMP; and VPN Device Manager Client for Cisco IOS Software (XSM Configuration).
Cisco IOS Novell IPX Configuration Guide *Cisco IOS Novell IPX Command Reference*	Novell Internetwork Packet Exchange (IPX) protocol.
Cisco IOS Optimized Edge Routing Configuration Guide *Cisco IOS Optimized Edge Routing Command Reference*	Optimized edge routing (OER) monitoring, policy configuration, routing control, logging and reporting, and VPN IPsec/generic routing encapsulation (GRE) tunnel interface optimization.
Cisco IOS Quality of Service Solutions Configuration Guide *Cisco IOS Quality of Service Solutions Command Reference*	Class-based weighted fair queuing (CBWFQ), custom queuing, distributed traffic shaping (DTS), generic traffic shaping (GTS), IP- to-ATM class of service (CoS), low latency queuing (LLQ), modular QoS CLI (MQC), Network-Based Application Recognition (NBAR), priority queuing, Security Device Manager (SDM), Multilink PPP (MLPPP) for QoS, header compression, AutoQoS, QoS features for voice, Resource Reservation Protocol (RSVP), weighted fair queuing (WFQ), and weighted random early detection (WRED).
Cisco IOS Security Configuration Guide *Cisco IOS Security Command Reference*	Access control lists (ACLs), authentication, authorization, and accounting (AAA), firewalls, IP security and encryption, neighbor router authentication, network access security, network data encryption with router authentication, public key infrastructure (PKI), RADIUS, TACACS+, terminal access security, and traffic filters.
Cisco IOS Service Selection Gateway Configuration Guide *Cisco IOS Service Selection Gateway Command Reference*	Subscriber authentication, service access, and accounting.

Table 1 Cisco IOS Configuration Guides and Command References (continued)

Configuration Guide and Command Reference Titles	Features/Protocols/Technologies
Cisco IOS Software Modularity Installation and Configuration Guide *Cisco IOS Software Modularity Command Reference*	Installation and basic configuration of software modularity images, including installations on single and dual route processors, installation rollbacks, software modularity binding, software modularity processes and patches.
Cisco IOS Terminal Services Configuration Guide *Cisco IOS Terminal Services Command Reference*	DEC, local-area transport (LAT), and X.25 packet assembler/disassembler (PAD).
Cisco IOS Virtual Switch Command Reference	**Note** For information about virtual switch configuration, refer to the product-specific software configuration information for the Cisco Catalyst 6500 series switch or for the Metro Ethernet 6500 series switch. Virtual switch redundancy, high availability, and packet handling; converting between standalone and virtual switch modes; virtual switch link (VSL); Virtual Switch Link Protocol (VSLP).
Cisco IOS Voice Configuration Library *Cisco IOS Voice Command Reference*	Cisco IOS support for voice call control protocols, interoperability, physical and virtual interface management, and troubleshooting. The library includes documentation for IP telephony applications.
Cisco IOS VPDN Configuration Guide *Cisco IOS VPDN Command Reference*	Layer 2 Tunneling Protocol (L2TP) dial-out load balancing and redundancy, L2TP extended failover, L2TP security VPDN, multihop by Dialed Number Identification Service (DNIS), timer and retry enhancements for L2TP and Layer 2 Forwarding (L2F), RADIUS Attribute 82: tunnel assignment ID, shell-based authentication of VPDN users, tunnel authentication via RADIUS on tunnel terminator.
Cisco IOS Wide-Area Networking Configuration Guide *Cisco IOS Wide-Area Networking Command Reference*	Frame Relay, Layer 2 Tunneling Protocol Version 3 (L2TPv3), Link Access Procedure, Balanced (LAPB), Switched Multimegabit Data Service (SMDS), and X.25.
Cisco IOS Wireless LAN Configuration Guide *Cisco IOS Wireless LAN Command Reference*	Broadcast key rotation, IEEE 802.11x support, IEEE 802.1x authenticator, IEEE 802.1x local authentication service for Extensible Authentication Protocol-Flexible Authentication via Secure Tunneling (EAP-FAST), Multiple Basic Service Set ID (BSSID), Wi-Fi Multimedia (WMM) required elements, and Wi-Fi Protected Access (WPA).

Table 2 Cisco IOS Supplementary Documents and Resources

Document Title	Description
Cisco IOS Master Commands List	Alphabetical list of all the commands documented in the Cisco IOS release.
Cisco IOS New, Modified, Removed, and Replaced Commands	List of all the new, modified, removed, and replaced commands for the Cisco IOS release.

Table 2 Cisco IOS Supplementary Documents and Resources (continued)

Document Title	Description
Cisco IOS Software System Messages	List of Cisco IOS system messages and descriptions. System messages may indicate problems with your system; be informational only; or may help diagnose problems with communications lines, internal hardware, or the system software.
Cisco IOS Debug Command Reference	Alphabetical list of **debug** commands including brief descriptions of use, command syntax, and usage guidelines.
Release Notes and Caveats	Information about new and changed features, system requirements, and other useful information about specific software releases; information about defects in specific Cisco IOS software releases.
MIBs	Files used for network monitoring. To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator at http://www.cisco.com/go/mibs
RFCs	Standards documents maintained by the Internet Engineering Task Force (IETF) that Cisco IOS software documentation references where applicable. The full text of referenced RFCs may be obtained at http://www.rfc-editor.org/

Additional Resources and Documentation Feedback

What's New in Cisco Product Documentation is published monthly and describes all new and revised Cisco technical documentation. The *What's New in Cisco Product Documentation* publication also provides information about obtaining the following resources:

- Technical documentation
- Cisco product security overview
- Product alerts and field notices
- Technical assistance

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Using the Command-Line Interface in Cisco IOS Software

This document provides basic information about the command-line interface (CLI) in Cisco IOS software and how you can use some of the CLI features. This document contains the following sections:

- Initially Configuring a Device, page xxi
- Using the CLI, page xxii
- Saving Changes to a Configuration, page xxx
- Additional Information, page xxxi

For more information about using the CLI, see the "Using the Cisco IOS Command-Line Interface (CLI)" section of the *Cisco IOS Configuration Fundamentals Configuration Guide*.

For information about the Cisco IOS software documentation set, see "About Cisco IOS Software Documentation."

Initially Configuring a Device

Initially configuring a device varies by platform. For information about performing an initial configuration, see the hardware installation documentation that is provided with the original packaging of the product or go to the Product Support area of Cisco.com at http://www.cisco.com/web/psa/products/index.html.

After you have performed the initial configuration and connected the device to your network, you can configure the device either by using the console port or Telnet to access the Cisco IOS CLI or by using the configuration method provided on the device, such as Security Device Manager.

Changing the Default Settings for a Console or AUX Port

There are only two changes that you can make to a console port and an AUX port:

- Change the port speed with the **config-register 0x** command. Changing the port speed is not recommended. The well-known default speed is 9600.
- Change the behavior of the port; for example, by adding a password or changing the timeout value.

Using the CLI

This section describes the following topics:

- Understanding Command Modes, page xxii
- Using the Interactive Help Feature, page xxiv
- Understanding Command Syntax, page xxv
- Understanding Enable and Enable Secret Passwords, page xxvi
- Using the Command History Feature, page xxvii
- Abbreviating Commands, page xxviii
- Using Aliases for CLI Commands, page xxviii
- Using the no and default Forms of Commands, page xxviii
- Using the debug Command, page xxix
- Filtering Output Using Output Modifiers, page xxix
- Understanding CLI Error Messages, page xxx

Understanding Command Modes

The CLI command mode structure is hierarchical, and each mode supports a set of specific commands. This section describes the most common of the many modes that exist.

Table 3 lists common command modes with associated CLI prompts, access and exit methods, and a brief description of how each mode is used.

Table 3 CLI Command Modes

Command Mode	Access Method	Prompt	Exit Method	Mode Usage
User EXEC	Log in.	`Router>`	Issue the **logout** or **exit** command.	• Change terminal settings. • Perform basic tests. • Display device status.
Privileged EXEC	From user EXEC mode, issue the **enable** command.	`Router#`	Issue the **disable** command or the **exit** command to return to user EXEC mode.	• Issue **show** and **debug** commands. • Copy images to the device. • Reload the device. • Manage device configuration files. • Manage device file systems.

Table 3 CLI Command Modes (continued)

Command Mode	Access Method	Prompt	Exit Method	Mode Usage
Global configuration	From privileged EXEC mode, issue the **configure terminal** command.	`Router(config)#`	Issue the **exit** command or the **end** command to return to privileged EXEC mode.	Configure the device.
Interface configuration	From global configuration mode, issue the **interface** command.	`Router(config-if)#`	Issue the **exit** command to return to global configuration mode or the **end** command to return to privileged EXEC mode.	Configure individual interfaces.
Line configuration	From global configuration mode, issue the **line vty** or **line console** command.	`Router(config-line)#`	Issue the **exit** command to return to global configuration mode or the **end** command to return to privileged EXEC mode.	Configure individual terminal lines.
ROM monitor	From privileged EXEC mode, issue the **reload** command. Press the **Break** key during the first 60 seconds while the system is booting.	`rommon # >` # is the line number and increments at each prompt.	Issue the **continue** command.	• Runs as the default operating mode when a valid Cisco IOS image cannot be loaded. • Access the fall-back procedure for loading a Cisco IOS image when the device lacks a valid Cisco IOS image and cannot be booted. • Perform password recovery when a CTRL-Break sequence is issued within 60 seconds of a power-on or reload event.

EXEC commands are not saved when the software reboots. Commands that you issue in a configuration mode can be saved to the startup configuration. If you save the running configuration to the startup configuration, these commands will execute when the software is rebooted. Global configuration mode is the highest level of configuration mode. From global configuration mode, you can enter a variety of other configuration modes, including protocol-specific modes.

ROM monitor mode is a separate mode that is used when the Cisco IOS software cannot load properly. If a valid software image is not found when the software boots or if the configuration file is corrupted at startup, the software might enter ROM monitor mode. Use the question symbol (?) to view the commands that you can use while the device is in ROM monitor mode.

```
rommon 1 > ?
alias              set and display aliases command
boot               boot up an external process
confreg            configuration register utility
```

```
cont                continue executing a downloaded image
context             display the context of a loaded image
cookie              display contents of cookie PROM in hex
.
.
.
rommon 2 >
```

The following example shows how the command prompt changes to indicate a different command mode:

```
Router> enable
Router# configure terminal
Router(config)# interface ethernet 1/1
Router(config-if)# ethernet
Router(config-line)# exit
Router(config)# end
Router#
```

Note A keyboard alternative to the **end** command is Ctrl-Z.

Using the Interactive Help Feature

The Cisco IOS CLI includes an interactive Help feature. Table 4 describes how to use the Help feature.

Table 4 CLI Interactive Help Commands

Command	Purpose
help	Provides a brief description of the help feature in any command mode.
?	Lists all commands available for a particular command mode.
*partial command***?**	Provides a list of commands that begin with the character string (no space between the command and the question mark).
partial command<**Tab**>	Completes a partial command name (no space between the command and <Tab>).
command **?**	Lists the keywords, arguments, or both associated with the command (space between the command and the question mark).
command keyword **?**	Lists the arguments that are associated with the keyword (space between the keyword and the question mark).

The following examples show how to use the help commands:

help

```
Router> help

Help may be requested at any point in a command by entering a question mark '?'.  If
nothing matches, the help list will be empty and you must backup until entering a '?'
shows the available options.

Two styles of help are provided:

1. Full help is available when you are ready to enter a command argument (e.g. 'show ?')
and describes each possible argument.

2. Partial help is provided when an abbreviated argument is entered and you want to know
what arguments match the input (e.g. 'show pr?'.)
```

?

```
Router# ?
Exec commands:
  access-enable        Create a temporary access-List entry
  access-profile       Apply user-profile to interface
  access-template      Create a temporary access-List entry
  alps                 ALPS exec commands
  archive              manage archive files
<snip>
```

***partial command*?**

```
Router(config)# zo?
zone  zone-pair
```

***partial command*<Tab>**

```
Router(config)# we<Tab> webvpn
```

***command* ?**

```
Router(config-if)# pppoe ?
  enable        Enable pppoe
  max-sessions  Maximum PPPOE sessions
```

***command keyword* ?**

```
Router(config-if)# pppoe enable ?
  group  attach a BBA group
  <cr>
```

Understanding Command Syntax

Command syntax is the format in which a command should be entered in the CLI. Commands include the name of the command, keywords, and arguments. Keywords are alphanumeric strings that are used literally. Arguments are placeholders for values that a user must supply. Keywords and arguments may be required or optional.

Specific conventions convey information about syntax and command elements. Table 5 describes these conventions.

Table 5 CLI Syntax Conventions

Symbol/Text	Function	Notes
< > (angle brackets)	Indicate that the option is an argument.	Sometimes arguments are displayed without angle brackets.
A.B.C.D.	Indicates that you must enter a dotted decimal IP address.	Angle brackets (< >) are not always used to indicate that an IP address is an argument.
WORD (all capital letters)	Indicates that you must enter one word.	Angle brackets (< >) are not always used to indicate that a WORD is an argument.

Table 5 CLI Syntax Conventions (continued)

Symbol/Text	Function	Notes
LINE (all capital letters)	Indicates that you must enter more than one word.	Angle brackets (< >) are not always used to indicate that a LINE is an argument.
<cr> (carriage return)	Indicates the end of the list of available keywords and arguments, and also indicates when keywords and arguments are optional. When <cr> is the only option, you have reached the end of the branch or the end of the command if the command has only one branch.	—

The following examples show syntax conventions:

```
Router(config)# ethernet cfm domain ?
  WORD  domain name
Router(config)# ethernet cfm domain dname ?
  level
Router(config)# ethernet cfm domain dname level ?
  <0-7>  maintenance level number
Router(config)# ethernet cfm domain dname level 7 ?
  <cr>
Router(config)# snmp-server file-transfer access-group 10 ?
  protocol  protocol options
  <cr>
Router(config)# logging host ?
  Hostname or A.B.C.D  IP address of the syslog server
  ipv6                 Configure IPv6 syslog server
Router(config)# snmp-server file-transfer access-group 10 ?
  protocol  protocol options
  <cr>
```

Understanding Enable and Enable Secret Passwords

Some privileged EXEC commands are used for actions that impact the system, and it is recommended that you set a password for these commands to prevent unauthorized use. Two types of passwords, enable (not encrypted) and enable secret (encrypted), can be set. The following commands set these passwords and are issued in global configuration mode:

- **enable** *password*
- **enable secret** *password*

Using an enable secret password is recommended because it is encrypted and more secure than the enable password. When you use an enable secret password, text is encrypted (unreadable) before it is written to the config.text file. When you use an enable password, the text is written as entered (readable) to the config.text file.

Each type of password is case sensitive, can contain from 1 to 25 uppercase and lowercase alphanumeric characters, and can start with a number. Spaces are also valid password characters; for example, “two words” is a valid password. Leading spaces are ignored, but trailing spaces are recognized.

Note Both password commands have numeric keywords that are single integer values. If you choose a number for the first character of your password followed by a space, the system will read the number as if it were the numeric keyword and not as part of your password.

When both passwords are set, the enable secret password takes precedence over the enable password.

To remove a password, use the **no** form of the commands: **no enable** *password* or **no enable secret** *password*.

For more information about password recovery procedures for Cisco products, see http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/products_tech_note09186a00801746e6.shtml.

Using the Command History Feature

The CLI command history feature saves the commands you enter during a session in a command history buffer. The default number of commands saved is 10, but the number is configurable within the range of 0 to 256. This command history feature is particularly useful for recalling long or complex commands.

To change the number of commands saved in the history buffer for a terminal session, issue the **terminal history size** command:

```
Router# terminal history size num
```

A command history buffer is also available in line configuration mode with the same default and configuration options. To set the command history buffer size for a terminal session in line configuration mode, issue the **history** command:

```
Router(config-line)# history [size num]
```

To recall commands from the history buffer, use the following methods:

- Press Ctrl-P or the up arrow key—Recalls commands beginning with the most recent command. Repeat the key sequence to recall successively older commands.
- Press Ctrl-N or the down arrow key—Recalls the most recent commands in the history buffer after they have been recalled using Ctrl-P or the up arrow key. Repeat the key sequence to recall successively more recent commands.

Note The arrow keys function only on ANSI-compatible terminals such as the VT100.

- Issue the **show history** command in user EXEC or privileged EXEC mode—Lists the most recent commands that you entered. The number of commands that are displayed is determined by the setting of the **terminal history size** and **history** commands.

  The CLI command history feature is enabled by default. To disable this feature for a terminal session, issue the **terminal no history** command in user EXEC or privileged EXEC mode or the **no history** command in line configuration mode.

Abbreviating Commands

Typing a complete command name is not always required for the command to execute. The Cisco IOS CLI recognizes an abbreviated command when the abbreviation contains enough characters to uniquely identify the command. For example, the **show version** command can be abbreviated as **sh ver**. It cannot be abbreviated as **s ver** because **s** could mean **show**, **set**, or **systat**. The **sh v** abbreviation also is not valid because the **show** command has **vrrp** as a keyword in addition to **version**. (Command and keyword examples from Cisco IOS Release 12.4(13)T.)

Using Aliases for CLI Commands

To save time and the repetition of entering the same command multiple times, you can use a command alias. An alias can be configured to do anything that can be done at the command line, but an alias cannot move between modes, type in passwords, or perform any interactive functions.

Table 6 shows the Cisco IOS software default command aliases.

Table 6 Default Command Aliases

Command Alias	Original Command
h	help
lo	logout
p	ping
s	show
u or **un**	undebug
w	where

To create a command alias, issue the **alias** command in global configuration mode. The syntax of the command is **alias** *mode command-alias original-command*. Following are some examples:

- Router(config)# **alias exec prt partition**—privileged EXEC mode
- Router(config)# **alias configure sb source-bridge**—global configuration mode
- Router(config)# **alias interface rl rate-limit**—interface configuration mode

To view both default and user-created aliases, issue the **show alias** command.

For more information about the **alias** command, see http://www.cisco.com/en/US/docs/ios/fundamentals/command/reference/cf_book.html.

Using the no and default Forms of Commands

Most configuration commands have a **no** form that is used to reset a command to its default value or disable a feature or function. For example, the **ip routing** command is enabled by default. To disable this command, you would issue the **no ip routing** command. To re-enable IP routing, you would issue the **ip routing** command.

Configuration commands may also have a **default** form, which returns the command settings to their default values. For commands that are disabled by default, using the **default** form has the same effect as using the **no** form of the command. For commands that are enabled by default and have default settings, the **default** form enables the command and returns the settings to their default values.

The **no** and **default** forms of commands are described in the command pages of Cisco IOS software command references.

Using the debug Command

A **debug** command produces extensive output that helps you troubleshoot problems in your network. These commands are available for many features and functions within Cisco IOS software. Some **debug** commands are **debug all**, **debug aaa accounting**, and **debug mpls packets**. To use **debug** commands during a Telnet session with a device, you must first enter the **terminal monitor** command. To turn off debugging completely, you must enter the **undebug all** command.

For more information about **debug** commands, see the *Cisco IOS Debug Command Reference* at http://www.cisco.com/en/US/docs/ios/debug/command/reference/db_book.html.

Caution Debugging is a high priority and high CPU utilization process that can render your device unusable. Use **debug** commands only to troubleshoot specific problems. The best times to run debugging are during periods of low network traffic and when few users are interacting with the network. Debugging during these periods decreases the likelihood that the **debug** command processing overhead will affect network performance or user access or response times.

Filtering Output Using Output Modifiers

Many Cisco IOS commands produce lengthy output that may use several screens to display. Using output modifiers, you can filter this output to show only the information that you want to see.

Three output modifiers are available and are described as follows:

- **begin** *regular expression*—Displays the first line in which a match of the regular expression is found and all lines that follow.
- **include** *regular expression*—Displays all lines in which a match of the regular expression is found.
- **exclude** *regular expression*—Displays all lines except those in which a match of the regular expression is found.

To use one of these output modifiers, type the command followed by the pipe symbol (|), the modifier, and the regular expression that you want to search for or filter. A regular expression is a case-sensitive alphanumeric pattern. It can be a single character or number, a phrase, or a more complex string.

The following example illustrates how to filter output of the **show interface** command to display only lines that include the expression “protocol.”

```
Router# show interface | include protocol

FastEthernet0/0 is up, line protocol is up
Serial4/0 is up, line protocol is up
Serial4/1 is up, line protocol is up
Serial4/2 is administratively down, line protocol is down
Serial4/3 is administratively down, line protocol is down
```

Understanding CLI Error Messages

You may encounter some error messages while using the CLI. Table 7 shows the common CLI error messages.

Table 7 Common CLI Error Messages

Error Message	Meaning	How to Get Help
% Ambiguous command: "show con"	You did not enter enough characters for the command to be recognized.	R-enter the command followed by a space and a question mark (?). The keywords that you are allowed to enter for the command appear.
% Incomplete command.	You did not enter all the keywords or values required by the command.	Reenter the command followed by a space and a question mark (?). The keywords that you are allowed to enter for the command appear.
% Invalid input detected at "^" marker.	You entered the command incorrectly. The caret (^) marks the point of the error.	Enter a question mark (?) to display all the commands that are available in this command mode. The keywords that you are allowed to enter for the command appear.

For more system error messages, see the following documents:

- *Cisco IOS Release 12.2SR System Message Guide*
- *Cisco IOS System Messages, Volume 1 of 2* (Cisco IOS Release 12.4)
- *Cisco IOS System Messages, Volume 2 of 2* (Cisco IOS Release 12.4)

Saving Changes to a Configuration

To save changes that you made to the configuration of a device, you must issue the **copy running-config startup-config** command or the **copy system:running-config nvram:startup-config** command. When you issue these commands, the configuration changes that you made are saved to the startup configuration and saved when the software reloads or power to the device is turned off or interrupted. The following example shows the syntax of the **copy running-config startup-config** command:

```
Router# copy running-config startup-config
Destination filename [startup-config]?
```

You press Enter to accept the startup-config filename (the default), or type a new filename and then press Enter to accept that name. The following output is displayed indicating that the configuration was saved:

```
Building configuration...
[OK]
Router#
```

On most platforms, the configuration is saved to NVRAM. On platforms with a Class A flash file system, the configuration is saved to the location specified by the CONFIG_FILE environment variable. The CONFIG_FILE variable defaults to NVRAM.

Additional Information

- "Using the Cisco IOS Command-Line Interface (CLI)" section of the *Cisco IOS Configuration Fundamentals Configuration Guide*.

  http://www.cisco.com/en/US/docs/ios/fundamentals/configuration/guide/cf_cli-basics.html

- Cisco Product Support Resources

  http://www.cisco.com/web/psa/products/index.html

- Support area on Cisco.com (also search for documentation by task or product)

  http://www.cisco.com/en/US/support/index.html

- *White Paper: Cisco IOS Reference Guide*

  http://www.cisco.com/en/US/products/sw/iosswrel/ps1828/products_white_paper09186a008018305e.shtml

- Software Download Center (downloads; tools; licensing, registration, advisory, and general information) (requires Cisco.com User ID and password)

  http://www.cisco.com/kobayashi/sw-center/

- Error Message Decoder, a tool to help you research and resolve error messages for Cisco IOS software

  http://www.cisco.com/pcgi-bin/Support/Errordecoder/index.cgi

- Command Lookup Tool, a tool to help you find detailed descriptions of Cisco IOS commands (requires Cisco.com User ID and password)

  http://tools.cisco.com/Support/CLILookup/cltSearchAction.do

- Output Interpreter, a troubleshooting tool that analyzes command output of supported **show** commands

  https://www.cisco.com/pcgi-bin/Support/OutputInterpreter/home.pl\

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Understanding Basic Hardware Architecture and Cisco IOS Software

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways. This chapter provides a brief profile of the Cisco AS5350XM and Cisco AS5400XM universal gateway hardware components and functionality, explains how to use the Cisco IOS command-line interface (CLI), and describes how to upgrade your Cisco IOS software:

- Basic Hardware Architecture, page 1
- Exploring the Cisco IOS File System, page 3
- Exploring Cisco IOS Software, page 6
- Upgrading to a New Cisco IOS Release, page 10
- Upgrade the ROM Monitor Image, page 13
- Where to Go Next, page 15

The Cisco AS5350XM and Cisco AS5400XM 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 Cisco AS5350XM and Cisco AS5400XM chassis are of two types: trunk feature cards, which provide an T1, E1, or channelized T3 interface, and universal port, dial-only, and voice feature cards, which host the universal digital signal processors (DSPs) that dynamically handle voice, dial, or fax calls.

Figure 1 shows the logical and physical system architecture for the Cisco AS5350XM and Cisco AS5400XM universal gateways, and illustrates the components used to process a call.

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Figure 1 Cisco AS5350XM and Cisco AS5400XM Basic System Architecture

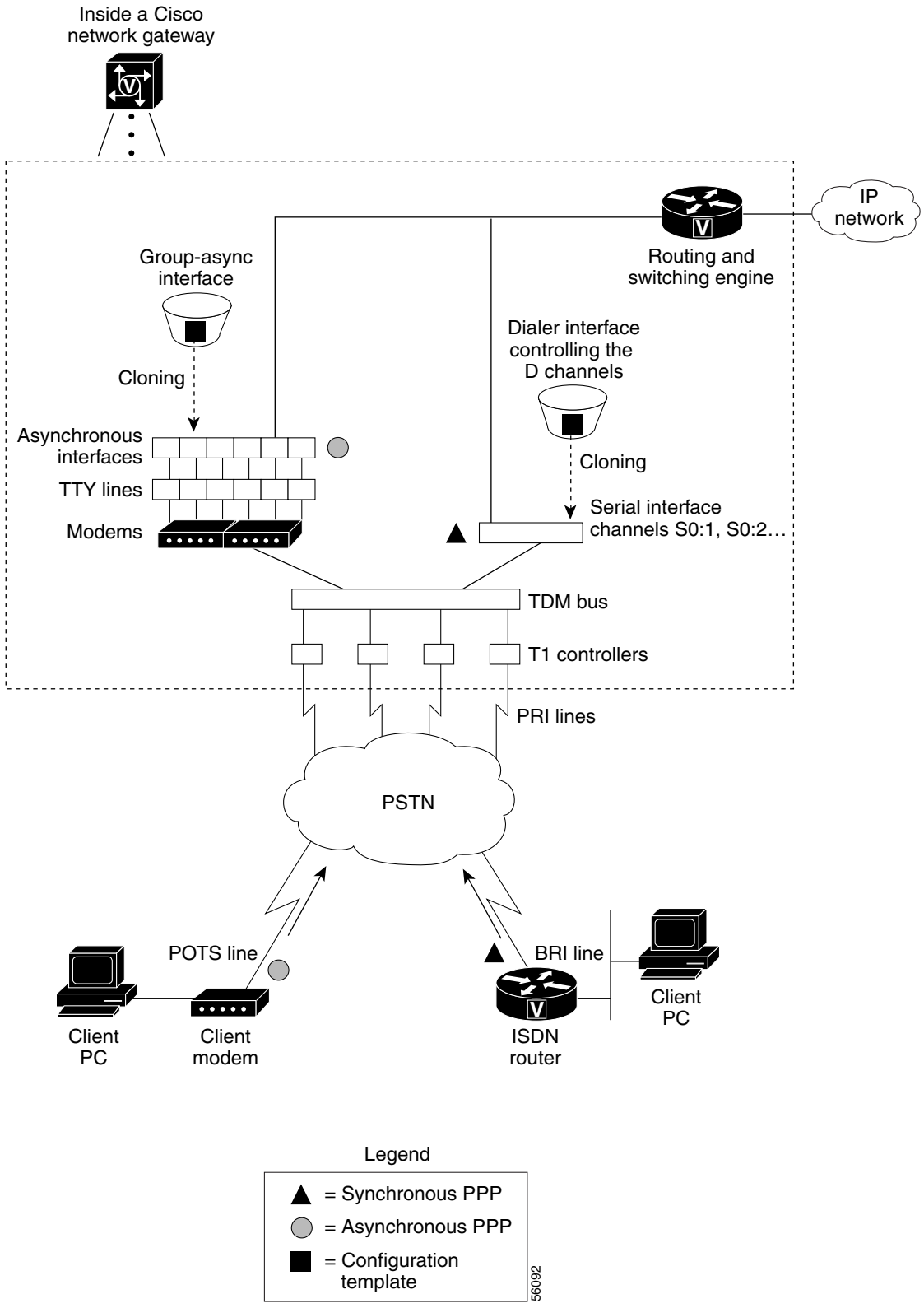

Figure 1 shows the following:

- 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 time-division multiplexing (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 and flash load helper log)

Note The Cisco AS5350XM and Cisco AS5400XM universal gateways use a Class C Flash File System.

IFS first appeared in Cisco IOS Releases 11.3 AA and 12.0. For more information about IFS, see the chapter "Using the Cisco IOS File System" in the *Cisco IOS Configuration Fundamentals Configuration Guide* for your software release.

Figure 2 illustrates the memory locations and Table 8 describes the memory locations.

Figure 2 Cisco AS5350XM and Cisco AS5400XM Memory Locations

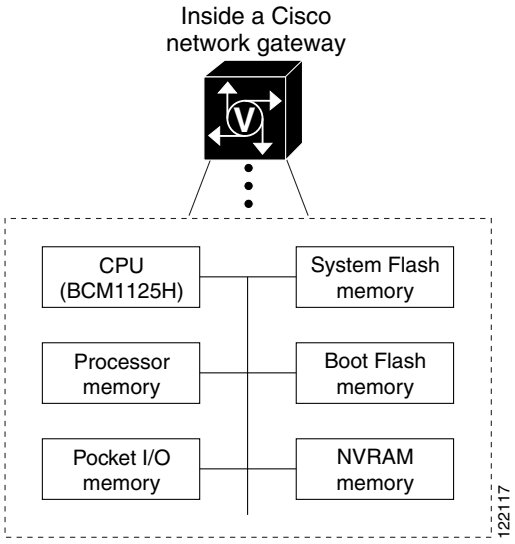

Table 8 Memory Location Descriptions

Component	Description
CPU	750 MHz (Cisco AS5350XM and Cisco AS5400XM)
Processor memory	Stores the Cisco IOS image after it is initially read out of flash memory and decompressed (also known as main memory or DRAM). Also stores routing tables, call control blocks, and other data structures.
Packet I/O memory	Temporarily stores packets in transit.
System flash and flash memory	Stores Cisco IOS images, modem firmware/portware, and custom web pages.
NVRAM memory	Stores configurations in nonvolatile memory, which 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   flash:
           -           -    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 flash memory:

```
Router# dir flash:
Directory of flash:/
1 -rw- 18442404 Oct 11 2004 16:52:54 +00:00 c5400-js-mz
2 -rw- 11978    Sep 13 2004 13:27:22 +00:00 tb3-2-nemo-sip-stress.conf
3 -rw- 18373376 Oct 05 2004 14:34:42 +00:00 c5400-js-mz-nm51520ef
4 -rw- 18446620 Oct 06 2004 13:47:46 +00:00 c5400-js-mz.nemo.Sep30
```

In the example, the flash image is c5350-js-mz. The compressed file size is 1962796 bytes. The total 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 system flash or flash memory.

Note For more information on crashinfo files, see the *Retrieving Information from the Crashinfo File* document, 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.

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 AS5350XM or Cisco AS5400XM universal gateway.

Note The examples in this guide show prompts for either a Cisco AS5350XM or a Cisco AS5400XM universal 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 gigabitethernet 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.

	Command	Purpose

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**.
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 time slot range of values from 1 to 24. You can specify time slot ranges (for example, 1-24), individual time slots separated by commas (for example 1, 3, 5), or a combination of the two (for example 1-3, 8, 17-24). The 16th time slot is not specified in the command line, because it is reserved for transmitting the channel signaling.

	Command	Purpose

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 time slots.

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 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.

```
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 GigabitEthernet0/0): !!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

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 alternative 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, see the *Cisco IOS File System* document, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113aa/113aa_2/allplats/ifs.htm

Note The Cisco AS5350XM and Cisco AS5400XM universal gateways use a Class C Flash File System.

Step 4 To specify the alternative 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.

Note The configuration register must be set to 0xXXX2, where 2 tells the system to use the "boot system" command. If the configuration register is set to 0xXXX1, the system will ignore the boot system command and will load the first image on flash memory.

Step 5 Reload the Cisco AS5350XM or Cisco AS5400XM universal gateway 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 filename; otherwise, the gateway becomes 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.
AS5400XM platform with 524288 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, see the *Loading and Maintaining System Images and Microcode* document, 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 the cable and reload the 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 the console session, install the console jumper on the motherboard to set your default console port speed to 9600 bps.

Changing Console Line Speed

Caution Changing your console line speed on an active Cisco AS5350XM or Cisco AS5400XM universal gateway 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 AS5350XM or Cisco AS5400XM 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 in to the Cisco AS5350XM or Cisco AS5400XM universal gateway through the AUX port or telnet in through a VTY session. Change the console line speed and the related terminal server speed, and then reconnect the console cable.

Log in to your Cisco AS5350XM or Cisco AS5400XM universal gateway through the AUX port or Telnet VTY session. Enter the **show running-config** command and determine the speed your line console is set for. 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 8, "ROM Monitor."

Changing Gateway Line Speed

The following example shows how to configure line speed on a Cisco AS5350XM or Cisco AS5400XM universal gateway, beginning in global configuration mode:

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

Upgrade the ROM Monitor Image

Use the **upgrade rom-monitor** command to upgrade the ROM monitor to a new version. The Cisco AS5350XM and Cisco AS5400XM universal gateways have two ROM monitor images. The original image shipped with your system is a read-only image that cannot be erased or altered in the field; the second image is read-and-write upgradable by the field. This eliminates or reduces the need to physically replace the hardware in order to get a new image.

The **upgrade rom-monitor** commands allow you to:

- Load the upgrade ROM monitor image.
- Configure your system to point to the upgrade ROM monitor image at the next reboot of your router.
- Select the read-only ROM monitor image for execution on the next reboot.
- Display both ROM monitor image versions and which ROM monitor image is currently selected.

Note If the upgrade ROM monitor image fails to boot, the router will mark this ROM monitor image as invalid and revert to the read-only image.

The first time a new ROM monitor image is loaded, you must allow the system to boot ROM monitor before doing any additional resets or power cycling. If the ROM monitor-loading process is interrupted, the system interprets this as a bootup failure of the new ROMmon image and reverts to the read-only image.

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**upgrade rom-monitor file** {**archive:** [*file-path*] | **cns:** [*file-path*] | **flash:** [*file-path*] | **ftp:** [*file-path*] | **http:** [*file-path*] | **null:** [*file-path*] | **nvram:** [*file-path*] | **pram:** [*file-path*] | **rcp:** [*file-path*] | **system:** [*file-path*] | **tftp:** [*file-path*]} **Example:** `Router# upgrade rom-monitor file tftp: //00.0.00.0/biff/AS5350_RMFUR.srec`	Loads the upgrade ROM monitor image from a specified source directory filename. In the example, you are loading the ROM monitor image from a TFTP server using a TFTP path name.

Selecting a ROM Monitor Image for Execution

This section contains the procedure to select a ROM monitor image for execution on the next reboot. Use this procedure if you want to replace the upgrade ROM monitor image, which has been selected, with the read-only ROM monitor image. The read-only ROM monitor image will then be booted on the next reload of the gateway.

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables Privileged EXEC mode. • Enter your password if prompted.
Step 2	**upgrade rom-monitor preference** [**readonly** | **upgrade**] **Example:** `Router# upgrade rom-monitor preference readonly`	When in Cisco IOS, this command in Privileged EXEC mode selects either the read-only or upgrade ROM monitor image as the image to be booted on the next reload. • In this example, you are selecting the read-only ROM monitor image. One reason could be that the upgrade image has features or side effects you do not like.

Verifying the ROM Monitor Image

To verify whether the upgrade ROM monitor or the read-only ROM monitor image has been installed, perform the following steps.

Step 1 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

```
Router> enable
```

Step 2 **show rom-monitor**

When in Cisco IOS, this command in privileged EXEC mode shows both the read-only and the upgrade ROM monitor image versions, as well as which ROM monitor image is running.

```
Router# show rom-monitor

ReadOnly ROMMON version is:
System Bootstrap, Version 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.

Upgrade ROMMON version is:
System Bootstrap, Version 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.

Currently running ROMMON from ReadOnly region
ROMMON from ReadOnly region is selected for next boot
```

Where to Go Next

At this point you should go to these references:

- Chapter 2, "Verifying Basic Setup," to analyze your system and execute basic tasks and system configuration before configuring the Cisco AS5350XM or Cisco AS5400XM universal gateway using the CLI to prepare your system for data call processing.

Tip The following publications are available on the Documentation DVD, 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, see the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- For troubleshooting information, see the *System Error Messages* and *Debug Command Reference* publications.

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Verifying Basic Setup

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways. This chapter details the tasks required to verify that your basic system components are functioning normally:

- Gigabit Ethernet Configuration, page 17
- Analyzing the System Boot Dialog, page 18
- Checking the Initial Running Configuration, page 21
- Investigating Memory Usage, page 23
- Inspecting CPU Utilization, page 24
- Displaying Component Status Using the Health Monitor, page 26
- Using the Interface Queue Wedge Monitor, page 27
- Where to Go Next, page 30

Gigabit Ethernet Configuration

The Cisco AS5350XM and AS5400XM universal gateway Ethernet ports are Gigabit Ethernet ports (labeled GE0 and GE1 on the chassis). The Cisco IOS firmware and software is designed so that configurations for Fast Ethernet will work on the Cisco AS5350XM and AS5400XM universal gateways without requiring any modification by the user.

If the Cisco IOS commands, **write** or **copy running-config startup-config** have been used to save the configuration to NVRAM, then all references to Ethernet interfaces will now be GigabitEther, and the IOS commands, **write terminal** and **show running configuration** will always show GigabitEther.

If you must have FastEther available as a searchable word for any scripts you are using, you can use the ROMMON command, **ethertype fe** to change GigabitEther to FastEther. Once you enter **ethertype fe**, the IOS image will only recognize FastEther. It will *not* recognize GigabitEther.

Analyzing the System Boot Dialog

The Cisco AS5350XM and Cisco AS5400XM universal gateways 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, verify that the baud rate is configured correctly. The Cisco AS5350XM and Cisco AS5400XM 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 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.
AS5400XM platform with 524288 Kbytes of main memory

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

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

Note If a feature 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

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Software clause at DFARS sec. 252.227-7013.

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

Cisco IOS Software, 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Sat 29-Jan-05 02:10 by yiyan
Image text-base: 0x60011068, data-base: 0x61F80000

Cisco AS5400XM (BCM) processor (revision 0x21) with 393215K/131072K bytes of memory.
Processor board ID JAB082904P4
SB-1 CPU at 750MHz, Implementation 1025, Rev 0.3, 256KB L2 Cache
Last reset from IOS reload
Manufacture Cookie Info:
 EEPROM Version 0x4, Board ID 0x4BD,
```

```
 Board Hardware Version 1.11, Item Number 800-6572289-01,
 Board Revision 02, Serial Number JAB082904P4.
Processor 0x0, MAC Address badb.adba.d044
2 Gigabit Ethernet interfaces
6 Serial interfaces
648 terminal lines
1 Channelized T3 port
512K bytes of NVRAM.
125184K bytes of ATA External CompactFlash (Read/Write)
```

Step 3 Because the gateway has never been configured, it cannot find a startup configuration 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 feature cards are not inserted. The universal port feature 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 T1 trunks 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 GigabitEthernet0/0, changed state to up
00:00:19: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, 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 GigabitEthernet0/0, changed
state to up
00:00:20: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, 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 GigabitEthernet0/0, changed state to administratively
down
00:01:05: %LINK-5-CHANGED: Interface GigabitEthernet0/1, 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 GigabitEthernet0/0, changed
state to down
00:01:10: %SYS-5-RESTART: System restarted --
Cisco Internetwork Operating System Software
IOS (tm) 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 2004 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) 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
Copyright (c) 2004 by cisco Systems, Inc.
Compiled Mon 19-Feb-04 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 GigabitEthernet/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 9 describes the significant output fields in the previous example.

Table 9 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....`	This line 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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 AS5350XM or Cisco AS5400XM universal gateway 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 38.

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 interface saves you time and configuration file size.

Investigating Memory Usage

Use the **show memory summary** command to perform these tasks:

- 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—Memory that is 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 percent 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
.
```

.
.

The **show processes cpu history** command displays in ASCII graphical form the total CPU usage on the router over a period of time: one minute, one hour, and 72 hours, displayed in increments of one second, one minute, and one hour, respectively. Maximum usage is measured and recorded every second; average usage is calculated on periods over one second.

```
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 percent, inspect the columns 5Sec, 1Min, and 5Min. Find the process that uses the most CPU power.

Displaying Component Status Using the Health Monitor

The health monitor allows you to see the status of different components of your universal gateway.

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

- Chassis: Power supply, temperature, fans
- Memory: Processor, I/O memory
- Feature cards

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

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

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
```

Using the 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 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 GigabitEthernet0/0 output queue is already wedged, the following message is displayed on the console, syslog, and buffer:

```
Eg:  00:39:15: %HHM-3-INTFWEDGE: GigabitEthernet0/0 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# configure terminal
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# show 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
GigabitEthernet0/0            00:24:35
GigabitEthernet0/1            00:24:50
Virtual-Access2            00:38:19
Virtual-Access3            00:38:19
AS5400#
```

Step 3 Show the 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 the interface monitor.

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

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

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

Step 6 Show the 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# configure terminal
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: GigabitEthernet0/0 Output Queue Wedged
00:39:18: %HHM-3-INTFWEDGE: GigabitEthernet0/1 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# show wedge output
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
GigabitEthernet0/0          00:26:29
GigabitEthernet0/1          00:26:44
Virtual-Access2             00:40:12
Virtual-Access3             00:40:12
AS5400#
```

Step 9 Show the 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# show 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
GigabitEthernet0/0          11:58:28
GigabitEthernet0/1          11:58:46
Virtual-Access2             00:08:46
Virtual-Access3             00:08:46
AS5400#
AS5400#
```

Step 2 Show the interface wedge process running.

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

Step 3 Disable the interface monitor.

```
AS5400# configure terminal
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 the interface wedge process running again. (No process is running now.)

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

Step 5 Show the 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# configure terminal
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: GigabitEthernet0/0 Input Queue Wedge
12:01:05: %HHM-3-INTFWEDGE: GigabitEthernet0/1 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 the interface wedge process running again. (The process is running now.)

```
AS5400# show proc cpu | i Intf
  39           8       110         72  0.00%  0.00%  0.00%   0 Intf Wedge Monit
AS5400#
```

Step 8 Show the wedge input.

```
AS5400# show 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
GigabitEthernet0/0         12:00:44
GigabitEthernet0/1         12:01:01
Virtual-Access2            00:11:02
Virtual-Access3            00:11:02
```

Where to Go Next

At this point you should go to these references:

- Chapter 3, "Basic Configuration Using the Command-Line Interface," to commission your Cisco AS5350XM or Cisco AS5400XM universal gateway.
- For additional basic configuration information, see the *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference* publications for your Cisco IOS software release, available online at Cisco.com. For more advanced configuration topics, see the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.

- For troubleshooting information, see the *System Error Messages* and *Debug Command Reference* publications for your Cisco IOS software release.

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Basic Configuration Using the Command-Line Interface

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways. After you have verified your basic setup, you are ready to begin performing 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 AS5350XM or Cisco AS5400XM universal gateway and includes the following tasks:

- Configuring the Hostname, Password, and Time Stamps, page 34
- Configuring Local AAA Security, page 35
- Creating a Login Banner, page 37
- Configuring Loopback Interfaces, Gigabit Ethernet Interfaces, and IP Route, page 37
- Configuring the Asynchronous Group Interface, page 38
- Configuring T1 and E1 Feature Cards, page 40
- Configuring a Channelized T3 Feature Card, page 43
- Configuring ISDN PRI, page 44
- Configuring DS0 Trunk Group Dial Out, page 51
- Configuring the D Channels for ISDN Signaling, page 54
- Configuring the Universal Port and Dial-Only Feature Cards, page 56
- Configuring the Voice Feature Card, page 61
- Configuring Clocking, page 62
- Enabling IP Basic Setup, page 66
- Testing Asynchronous Shell Connections, page 67
- Verifying the Final Running Configuration, page 70
- Saving Configuration Changes, page 72
- Where to Go Next, page 72

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Tip If you are experienced using the Cisco IOS software, you might find the "Where to Go Next" section on page 72 a useful reference for configuration.

Configuring the Hostname, Password, and Time Stamps

The first configuration tasks you might want to execute are assign a hostname to your Cisco AS5350XM or Cisco AS5400XM, set an encrypted password, and turn on time stamps for these reasons:

- Assigning a hostname 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 hostname 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 password for *guessme*.
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 time-stamp debugging messages to include milliseconds in the date and time stamp.
Step 7	`AS5400(config)# service timestamps log datetime msec`	Enters time-stamp logging messages to include milliseconds in the date and time stamp.

	Command	Purpose
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 hostname and passwords, use these commands:

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

- Exit global configuration mode and attempt to log in 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 the **login** keyword.

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 AS5350XM or Cisco AS5400XM universal gateway.

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 10 explains the preceding configuration example.

Table 10 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.
`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 the **login** keyword.

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 the *Cisco AAA Implementation Case Study* document, 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, Gigabit Ethernet Interfaces, and IP Route

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

- Create two loopback interfaces.
- Bring up the Gigabit 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 GigabitEthernet 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 the universal gateway 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, 1 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 Gigabit 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 to the default gateway succeeds, 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 percent ping-success rate is normal for the first time you ping an external device. The Cisco AS5350XM and Cisco AS5400XM universal gateways do not have an Address Resolution Protocol (ARP) entry for the external device. A 100 percent 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 interface. 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 21, 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)#`	Enters interface configuration mode, and 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 whether 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
```

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 T1 and E1 Feature Cards

On a Cisco AS5350XM or Cisco AS5400XM universal gateway, you can allocate the available channels for channelized T1 and E1 lines in the following ways:

- Configure all channels to support ISDN PRI.
- If you are not running ISDN PRI, configure all channels to support robbed-bit signaling (also known as channel-associated signaling).
- Configure all channels 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 Configuration Fundamentals Configuration Guide* for your software release.

Note You can install a maximum of two T1 feature cards, two E1 feature cards, or one channelized T3 (CT3) feature card in a single Cisco AS5350XM or Cisco AS5400XM chassis.

Controller Numbering

The T1 and E1 controller numbering convention is *slot/port* in CLI commands. Feature card slot numbering starts from the motherboard and works up from left to right. Slot 0 is reserved for the motherboard. T1 or E1 feature 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)#`.

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 the telco framing type: **esf** or **sf**.
Step 5	`AS5400(config-controller)# linecode b8zs`	Enters the telco 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, see the Cisco IOS software configuration guide and command reference publications. These publications are available on the Documentation DVD and on the World Wide Web from the Cisco home page, or you can order printed copies.

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 44.)
- 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 62.)

Configuring a Channelized T3 Feature Card

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

Additionally, you can allocate your T1 channels as described in the "Configuring T1 and E1 Feature Cards" section on page 40.

Controller Numbering

The channelized T3 controller numbering convention is *slot/port* in CLI commands. Feature card slot numbering starts from the motherboard and works up from left to right. Slot 0 is reserved for the motherboard. Feature card slots are numbered sequentially from 1 to 7. Port number value is always 0.

Under the channelized T3, the T1 controller numbering convention is *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 the telco framing type: **c-bit** or **m23**.
Step 5	`AS5400(config-controller)# clock source line`	Enters line clock source: **internal** or **line**.
Step 6	`AS5400(config-controller)# cablelength 450`	Enters your cable length: values range from 0 to 450 feet.

	Command	Purpose

Step 7	`AS5400(config-controller)# t1 1-28 controller`
	
	or
	
	`AS5400(config-controller)# t1 1-10,15-20,23 controller`
		Configures your T1 controllers. Values range from 1 to 28. In this instance, all 28 T1 channels 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 that the **show controller** command output is not reporting alarms or violations. Also, see the "Configuring T1 and E1 Feature Cards" section on page 40.

Configuring ISDN PRI

ISDN PRI interfaces can be configured on the 8-port T1 or E1 feature cards, or the CT3 feature card. 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 section, refer to the *Cisco IOS Dial Technologies Command Reference* for your software release.

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 11 provides a sample of the channelized T1 configuration attributes you might request for a PRI switch.

Table 11 Channelized T1 Configuration Attributes

Attribute	Value
Line format	Extended super frame (ESF) format
Line coding	Binary 8-zero substitution (B8ZS)
Call type	23 incoming channels and 23 outgoing channels
Speed	64 kbps
Call-by-call capability	Enabled
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 T1 or E1 controller numbering convention is *slot/port* in CLI commands. Feature card slot numbering starts from the motherboard and works up from left to right. Slot 0 is reserved for the motherboard. T1 or E1 feature card slots are numbered sequentially from 1 to 7. Port numbering is from 0 to 7.

The channelized T3 controller numbering convention is *slot/port* in CLI commands. Feature card slot numbering starts from the motherboard and works up from left to right. Slot 0 is reserved for the motherboard. Feature card slots are numbered sequentially from 1 to 7. Port number value is always 0.

Under the channelized T3 controller, the T1 controller numbering convention is *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. (See Table 12 for a list of supported switch type keywords.)

Step 4	`AS5400(config)# controller t1 1/0`
	
	`or`
	
	`AS5400(config)# controller e1 1/0`
		Specifies T1 feature card slot, port number, and channel. On the CT3 feature card, port-number values range from **1** to **28**. On the T1 feature card, port-number values range from **0** to **7**.
		
		or
		
		Specifies E1 feature card slot, port number, and channel. On the E1 feature card, port number values range from **0** to **7**.
		
		Note After you configure the T1or E1 controller, a corresponding D-channel serial interface is created instantly. See the "Configuring the D Channels for ISDN Signaling" section on page 54 to learn how to configure your D channel.

Step 5	`AS5400(config-controller)# framing esf`
	
	`or`
	
	`AS5400(config-controller)# framing crc4`
		Enters framing type for the T1 or CT3 feature card.
		
		or
		
		Enters framing type for the E1 feature card.

Step 6	`AS5400(config-controller)# linecode b8zs`
	
	`or`
	
	`AS5400(config-controller)# linecode hdb3`
		Defines the line code as binary 8 zero substitution (B8ZS) for the T1 or CT3 feature card.
		
		or
		
		Defines the line code as high-density bipolar 3 (HDB3) for the E1 feature card.

	Command	Purpose
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. For T1, 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 channelized T1 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 channelized E1 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 12 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, use the following commands:

- 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 displays 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 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 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 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 0 2 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 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 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 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 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 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 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 2 0 0 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 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 2 0 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 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 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 2 2 2 2 2 2 2 2
```

Note Your Cisco AS5350XM or Cisco AS5400XM universal gateway supports a total of 248 ISDN channels per ingress trunk feature card. If you are configuring individual T1 channels of your channelized T3 line for backup links or serial backhaul connections, the T1 channels must be configured into channel groups—each channel group using 24 time slots or channels. For example, to configure 6 T1 channels (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 44.

In the following **show running-config** example, six T1 channels 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
```

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 those of your telco. 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 DS0 lines for outbound calls. Previous to this feature, outbound DS0 lines could not be configured separately from DS1 lines. The dial out capabilities of a DS1 line applied to all DS0 lines under that DS1 line.

Currently, the aggregation of DS1 lines into trunk groups is done through the Trunk Group Resource Manager (TGRM). The DS0 Trunk Group Dial Out feature enables the TGRM subsystem to aggregate DS0 lines into trunk groups also. The dial out capabilities of these DS0 trunk groups can then be configured directly at the DS0 level through the TGRM CLI and by setting the authentication authorization and accounting (AAA) attributes.

The configuration of DS0 lines 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 ISDN PRI and Non-Facility Associated Signaling (NFAS) circuits.

A trunk group is a logical grouping of multiple T1 or E1 interfaces with the same signaling characteristics. A single trunk group can contain up to 64 trunks. Each trunk group can consist of DS0 lines from different circuits, but each individual DS0 line can belong to only one trunk group.

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 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 line or a group of DS0 lines 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 DS0 lines from a signaling circuit. Fractional trunk groups are configured from the controller configuration mode only (because 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 DS0 lines 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 DS0 lines 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 signaling circuit to be added to the trunk group. The range is 1 to 64.
preference	Priority of the trunk group member in a trunk group. The range is from 1 (highest priority) to 64 (lowest priority). The *preference* variable can be used to sort a list of trunks in order. A trunk with no *preference* variable is given the highest preference.

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

PRI Trunk Configuration

Step 1 Configure framing, clock source, DS0 group, and so forth.

```
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 the 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, because 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 or NFAS trunk is fractionally added to a trunk group, the **timeslots** keyword is compulsory.

Verify

Use the **show trunk group** command to display the DS0 lines that belong to a particular trunk group. A trunk group can be a group of DS0 lines from various signaling channels.

```
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 time slots 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 whether the call is a circuit-switched digital call or an analog modem call. Analog modem calls are decoded and then sent off to the onboard modems. Circuit-switched digital calls are directly relayed to the ISDN processor in the gateway.

When you configured ISDN PRI on the T1 or E1 controller, you automatically created a serial interface that corresponds to the PRI group time slots. 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 (time slots) for that PRI group.

Figure 3 shows the logical contents of an ISDN PRI interface used in a T1 network configuration. The logical contents include 23 B channels, 1 D channel, 24 time slots, and 24 virtual serial interfaces (total number of B + D channels).

Figure 3 Logical Relationship of ISDN PRI Components for T1

Channel type		Time slot number	Virtual serial interface number
B	(data channel)	1	S0:0
B	(data channel)	2	S0:1
B	(data channel)	3	S0:2
B	(data channel)	4	S0:3
•		•	•
•		•	•
•		•	•
•		•	•
•		•	•
B	(data channel)	21	S0:20
B	(data channel)	22	S0:21
B	(data channel)	23	S0:22
Ⓓ	(signaling channel)	24	S0:23

Logical contents of a PRI interface

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Note When you configure your T1 controller for an NFAS backup D channel, a serial interface is automatically created only when your primary D channel fails.

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 you configure the T1 controller, a corresponding D channel serial interface is automatically created. For example, serial interface 1/0:23 is the D channel for T1 controller 1. You must configure each serial interface to receive incoming and send outgoing signaling. **Note** On a channelized E1 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.
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#
```

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 and Dial-Only Feature Cards

The universal port and dial-only feature cards support all modem standards and features. Rather than the more traditional line-to-modem mapping, lines are mapped to a system processing engine (SPE) that resides on the universal port and dial-only feature cards. Associated SPE firmware serves a function similar to modem code on a modem ISDN channel aggregation (MICA) technologies modem.

Note The dial-only feature card only supports dial services. Dial services include modem calls (all modulations), ISDN digital calls, V.110 data calls, and V.120 data calls. Modem pass-through calls are not included in dial services.

One SPE provides services for six ports, with additional ports per SPE. Busyout and shutdown can be configured at the SPE or port level.

The universal port and dial-only feature cards perform 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, see Chapter 5, "Managing and Troubleshooting the Universal Port and Dial-Only Feature Cards."

For detailed information about CLI commands supported on the universal port and dial-only feature cards, see the *Monitoring Voice and Fax Services on the Cisco AS5350 and Cisco AS5400 Universal Gateways* publication, available online at http://www.cisco.com/en/US/products/sw/iosswrel/ps1839/products_feature_guide09186a0080080e60.html.

SPE Firmware

SPE firmware is automatically downloaded to a universal port or dial-only feature card from the Cisco AS5350XM or Cisco AS5400XM universal gateway when you boot the system for the first time or when you insert a universal port or dial-only feature card while the system is operating. When you insert feature cards while the system is operating, the Cisco IOS image recognizes the feature cards and downloads the required firmware to the feature cards.

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

The universal port and dial-only feature cards support the modem standards and features listed in Table 13.

Table 13 Modem Standards and Supported Features

Feature	Description
Carrier protocols	ITU V.23 at 75/1200 bps Telcordia Technologies 103 at 300 bps ITU V.21 at 300 bps ITU V.22 at 1200 bps Telcordia 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 33,600 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
In-band signaling or 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)#`.

	Command	Purpose
Step 3	`AS5400(config)# spe country country name`	Specifies the country for the feature card parameters (including country code and encoding). This setting is applied at the system level. All universal port or dial-only feature 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 **usa**. **Note** All sessions on all universal port or dial-only feature 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**. 108 ports will be configured on each slot.
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.
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 and POTS telephone calls have been 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 using 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 35.

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 the modem to default settings for country codes, enter the **no spe country** command in global configuration mode.

Verify

To verify your SPE configuration, use these commands.

- 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
```

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

Configuring the Voice Feature Card

A voice feature card with one to six PVDM2-64 modules supports different port densities depending on codec complexity.

Note For detailed information about the voice feature card CLI commands, see the *High-Density Packet Voice Feature Card for Cisco AS5350XM and AS5400XM Universal Gateways* document, available online at the following URL:

http://www.cisco.com/en/US/products/ps6706/products_feature_guide09186a008060df15.html

Configure

The voice feature card should work without specific modifications to the software configuration on these platforms. However, you might need to upgrade the firmware on the voice feature card, depending on the software release you are using.

To upgrade the firmware of the voice feature card, follow these steps:

	Command or Action	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)# voice dsp slot [/dsp] [slot [/dsp]]`	Enters voice dsp config mode and specifies the slot/dsp location or a range of slots/dsps. • For the *slot* argument, specify a value from 1 to 7 to specify the location of the VFC. • For the *dsp* argument, specify a value from 1 to 24 to specify the location of the DSP. • To specify a range, the first two arguments specify the first slot/dsp in the range. The second two arguments specify the last slot/dsp in the range. • Where slash marks appear in the command syntax, they are required.
Step 4	`AS5400(config-voice-dsp)# firmware location flash:filename`	Specifies that the firmware is in flash memory and identifies the file name.

	Command or Action	Purpose
Step 5	`AS5400(config-voice-dsp)# end`	Exits config-voicedsp mode and returns to global configuration mode.
Step 6	`AS5400(config-voice-dsp)# Ctrl-Z` `AS5400#`	Returns to enable mode.

Verifying

To verify your firmware upgrade, use the **show voice dsp version** command.

```
AS5400#show voice dsp version ?

IOS-Bundled Default                Version     Firmware-Type
==========================         =======     =============
system:/bundled_fw_image           4.4.5       c5510

On-Flash Dspware-Filename          Version     Firmware-Type
=========================          =======     =============
flash:dsp_c5510_flex.rbf           4.5.9051    c5510
flash:new_flex.rbf                 4.4.5       c5510
flash:big.rbf                      4.5.985x    c5510

  DSP#     Type       Version     Filename
  3/1      C5510      4.5.9051    flash:dsp_c5510_flex.rbf
  3/2      C5510      4.4.5       system:/bundled_fw_image
  3/3      C5510      4.4.5       system:/bundled_fw_image
  3/4      C5510      4.4.5       system:/bundled_fw_image
  3/5      C5510      4.4.5       system:/bundled_fw_image
  3/6      C5510      4.4.5       system:/bundled_fw_image
  3/7      C5510      4.4.5       system:/bundled_fw_image
  3/8      C5510      4.4.5       system:/bundled_fw_image
  3/9      C5510      4.4.5       system:/bundled_fw_image
  3/10     C5510      4.4.5       system:/bundled_fw_image
  3/11     C5510      4.4.5       system:/bundled_fw_image
```

Configuring Clocking

The time-division multiplexing (TDM) bus on the Cisco AS5350XM and Cisco AS5400XM universal gateway backplane can receive an input clock from one of these basic sources on the gateway:

- T1, E1, and CT3 feature cards
- An external T1 or 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 BITS is a single building master timing supply. BITS generally supplies DS1 and DS0 level timing throughout an office. In North America, BITS is the clock that provides and distributes timing to a wireline network's lower levels.

Trunk Feature Card Ports

The TDM bus can be synchronized with any trunk cards. On the T1 or E1 feature card, each port receives the clock from the T1 or E1 line. The CT3 feature card uses an M13 multiplexer to receive the DS1 clock. Each port on each trunk feature 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 or E1 clock (using 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 feature card or an external clock source, then choose 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		Enter one of the bulleted commands, depending on your configuration.
•	`AS5400(config)# dial-tdm-clock priority priority# {external | freerun | slot/ds1 port}`	Configures the T1 or E1 feature card clock priority, slot, and port that are providing the clocking source. Priority range is a value between 1 and 99. Feature 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.

	Command	Purpose
•	`AS5400(config)# dial-tdm-clock priority priority# {external | freerun | slot/ds3 port:ds1 port}`	Configures the CT3 feature card clock priority, slot, and port that is providing the clocking source. Priority range is a value between 1 and 99. Feature 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, the BITS clock is set to priority 1.

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

In the following example, a trunk clock from a T1 feature 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 feature 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 and the status of all trunk feature card controller clocks. You can also view information about and the history of the 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 or 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 channelized T3):

```
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 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 the **dial-tdm-clock priority** parameter from free-running clock to a setting that matches your system requirements.

Enabling IP Basic Setup

To fine-tune the IP routing functions and domain-name services for EXEC shell users, follow these 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 14 describes the commands in the example.

Table 14 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 15 describes the commands in the example.

Table 15 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 that can be accessed by dialing in with a modem. The EXEC provides access to terminal-shell services (no PPP) to do the following:

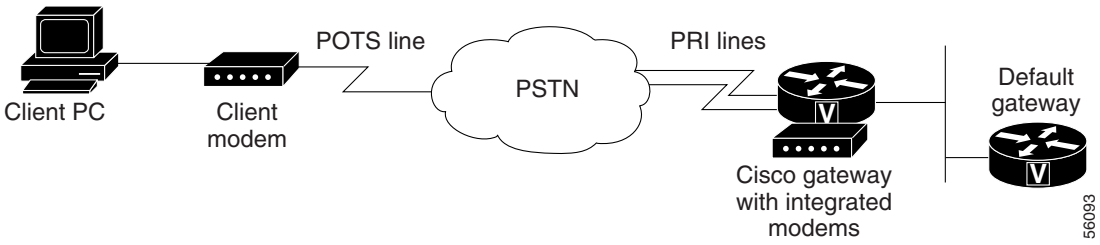
- Modify configuration files
- Change passwords
- Troubleshoot possible problems including modem connections
- Access other network resources by using Telnet

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 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 HyperTerminal, not dial-up networking) and connect to the client modem. Figure 4 shows the network environment for this test.

Figure 4 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 was 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, use Telnet to access 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 GigabitEthernet0/0
 ip address 172.21.101.21 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 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 enters 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 these references:

- Chapter 4, "Continuing Configuration Using the Command-Line Interface," to continue system configuration of basic features.
- Chapter 5, "Managing and Troubleshooting the Universal Port and Dial-Only Feature Cards," to configure, manage, and troubleshoot universal-port and dial-only feature card connections on your gateway.
- Chapter 5, "Managing and Troubleshooting the Voice Feature Card," to configure, manage, and troubleshoot voice feature card connections on your gateway.
- Appendix 9, "Comprehensive Configuration Examples."

- The *Monitoring Voice and Fax Services on the Cisco AS5350 and Cisco AS5400 Universal Gateways* publication, available online at http://www.cisco.com/en/US/products/sw/iosswrel/ps1839/products_feature_guide09186a0080080e60.html.
- The *High-Density Packet Voice Feature Card for Cisco AS5350XM and AS5400XM Universal Gateways* document, available online at: http://www.cisco.com/en/US/products/ps6706/products_feature_guide09186a008060df15.html
- For additional basic configuration information, see the *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference* publication. For more advanced configuration topics, see the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- For Cisco AAA-based security information, see the *Cisco AAA Implementation Case Study* publication, available online at http://www.cisco.com/univercd/cc/td/doc/cisintwk/intsolns/secsols/aaasols/
- For troubleshooting information, see the *System Error Messages* and *Debug Command Reference* publications.

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Continuing Configuration Using the Command-Line Interface

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways. This chapter continues where the "Basic Configuration Using the Command-Line Interface" chapter ends. After you have commissioned your Cisco AS5350XM or Cisco AS5400XM universal gateway, you might want to configure other features that include serial interface support, T1 channel groups, and signaling.

Proceed to the following sections:

- Configuring Synchronous Serial Interfaces for WAN Support, page 75
- Configuring T1 Channel Groups, page 77
- Configuring ISDN NFAS on Channelized T1 PRI Groups, page 78
- Configuring E1 R2 Signaling, page 79
- Configuring Alarms, page 83
- Saving Configuration Changes, page 84
- Where to Go Next, page 85

Tip 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 or 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.

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Configure

	Command	Purpose
Step 1	AS5350> **enable** Password: *password* AS5350#	Enters enable mode (also called privileged EXEC 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)#.
Step 3	AS5350(config)# **interface serial 0/0**	Enters interface configuration mode and 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 that you have configured the interfaces correctly, use these commands:

- 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 that the network interface is properly connected and terminated.

Configuring T1 Channel Groups

You can configure up to 24 channel groups for each T1 controller for backup links or serial backhaul connections.

First, you must define the time slots that belong with each channel group. Channel groups are numbered 0 to 23, and time slots 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 channelized T1 controller can be arbitrarily assigned.

Configure

To define the channel groups, time slots, and (if needed) circuit speed, enter the following command in controller configuration mode:

```
AS5350(config-controller)# channel-group number timeslots range [speed {48 | 56 | 64}]
```

In the United States, channel-group speeds can be either 56 or 64 kbps. If 64 kbps is used, we recommend that you use the ESF framing type and a linecode of B8ZS. Working with your local service provider, you can create channel groups with from 1 to 24 time slots. These time slots can be in any order, contiguous or noncontiguous.

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

To define the serial interface that corresponds to a T1 channel group, enter the following command in global configuration mode to enter interface configuration mode:

```
AS5350(config)# interface serial slot/port:channel-group
```

Verify

The following example shows a T1 controller configured for channel groups and an ISDN PRI group. The **pri-group** command and the **channel-group** command cannot have overlapping time slots; note the correct time slot 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 Channelized T1 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 T1 controllers configured for ISDN, you use an extended version of the ISDN **pri-group** command to specify the following:

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

Note Your Cisco AS5350XM or Cisco AS5400XM universal gateway must connect to a Primary-4ESS, Primary-DMS 100, or Primary-NI switch (see Table 12 on page 47) 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 on 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 sets 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 dialed number identification support (DNIS) turned on by default. If you enable the automatic number identification (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, and the ANI number is assigned to gateway A. Also, note that ANI is similar to caller ID.

Configure

To configure E1 R2 signaling, 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 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)#.
Step 3	AS5350(config)# **controller e1 0/0** AS5350(config-controller)#	Enters controller configuration mode to configure your E1 controller port. Specifies E1 feature card slot, port number, and channel. On the E1 feature 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 time slots 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 ANI to address information 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 the "Country Codes for R2 Signaling" section on page 82 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 6. CAS custom commands include **caller-digits**, **category**, **country**, **unused-abcd**, **invert-abcd**, **metering**, **ka**, **kd**, **dnis-digits**, **answer-signal**, and **nc-congestion**
	`[or]` `AS5350(config-ctrl-cas)# default answer-signal group-b 6`	Sets answer-signal group-b to the default ITU value.
	`[or]` `AS5350(config-ctrl-cas)# no answer-signal group-b 6`	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.

	`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}`	Sets the SPE country code or uses 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 AS5350XM and Cisco AS5400XM universal gateway, 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)#`	Enters voice port mode for the port you want to configure.
Step 10	`AS5350(config-voiceport)# cptone` *contry-code*	Enters the 2-digit country code to configure the regional ring tone.
Step 11	`AS5350(config-voiceport)# Ctrl-Z` `AS5350#`	Returns to enable mode.

Country Codes for R2 Signaling

Table 16 lists the country codes supported for R2 signaling.

Table 16 Country Codes for R2 Signaling

argentina	greece	paraguay
australia	guatemala	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** *#* command 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
```

If the connection does not come 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
- T1, E1, or T3 controller down
- Modem board failure
- Redundant power supply (RPS) failure
- Thermal failure
- Fan failure

Cisco IOS software polls every second to detect the failure events that you have configured and turns on an 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)#`.

Step 3	`AS5350(config)# facility-alarm detect interface [interface type] [slot/port]`	Turns on the facility alarm when an interface goes down. Enters the interface type and slot/port designation.

	Command	Purpose
Step 4	`AS5350(config)# facility-alarm detect controller [t1 | e1 | t3] [slot/port]`	Turns on an alarm when the controller goes down. The slot values range from 1 to 7. The port values range from 0 to 7 for T1 and E1. The port value is always 0 for T3.
Step 5	`AS5350(config)# facility-alarm detect modem-board [slot]`	Turns on an alarm when the modem board present in the specified 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: • Input power voltage failure • Output power voltage failure • Overvoltage condition • Multiple failures
Step 7	`AS5350(config)# facility-alarm detect temperature`	Turns on an alarm if a thermal failure event is detected.
Step 8	`AS5350(config)# facility-alarm detect fan`	Turns on an alarm if a 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
    ------            -----

  gigabitethernet 0/0 UP
  Modem Card 4        UP

 Facility Alarm is ON
```

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 enters 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 these references:

- Chapter 5, "Managing and Troubleshooting the Universal Port and Dial-Only Feature Cards," to configure, manage, and troubleshoot universal port and dial-only feature card connections on your gateway.
- Chapter 5, "Managing and Troubleshooting the Voice Feature Card," to configure, manage, and troubleshoot voice feature card connections on your gateway.
- Appendix 9, "Comprehensive Configuration Examples."

Tip The following publications are available on the Documentation DVD, on the World Wide Web from the Cisco home page, or you can order printed copies.

- For additional basic configuration information, see the *Cisco IOS Dial Technologies Configuration Guide* and *Cisco IOS Dial Technologies Command Reference* publications for your software release. For more advanced configuration topics, see the Cisco IOS software configuration guide, feature modules, and command reference publications that pertain to your Cisco IOS software release.
- For troubleshooting information, see the *System Error Messages* and *Debug Command Reference* publications.

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Managing and Troubleshooting the Voice Feature Card

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways, and includes the following sections:

- Viewing DSP Performance Statistics, page 88
- Managing DSPs, page 88
- Troubleshooting, page 89
- Upgrading DSP Firmware, page 90
- Using the AMR-NB Codec, page 97
- Where to Go Next, page 99

The high-density packet voice and fax feature card (AS5X-FC) supports up to six high-density packet voice and fax digital signal processor (DSP) modules (AS5X-PVDM2-64), providing scalability from 64 to 384 channels. The voice feature card converts voice and fax calls into IP packets or frames that can be transmitted as voice over IP (VoIP) over a variety of transport technologies on the Cisco AS5350XM or Cisco AS5400XM universal gateways.

You can manage the voice feature card at the slot level, digital signal processor (DSP) level, or channel level by using monitoring and troubleshooting commands. On the Cisco AS5350XM and Cisco AS5400XM universal gateways, the hierarchy designation is *slot/dsp* and *slot/channel*.

You can perform the following functions on a voice feature card:

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

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Viewing DSP Performance Statistics

You can view DSP statistics by using the Cisco IOS software with the universal gateway. To view performance statistics for the voice feature cards, enter one or more of the following commands in privileged EXEC mode (at the `AS5350XM#` prompt).

show voice dsp Commands

- **show voice dsp active**—Displays the statistics for DSPs with active calls.
- **show voice dsp summary**—Displays summary information about the state, call types, and total calls for all the DSPs in a particular slot, a specified DSP, or a specified range of DSPs.

show voice dsp channel Commands

- **show voice dsp channel operational-status**—Displays operational status of a channel or a range of channels. The channels should have active calls at the time the command is executed.
- **show voice dsp channel statistics**—Displays error statistics for a channel or a range of channels. The channels should have active calls at the time the command is executed.
- **show voice dsp channel traffic**—Displays traffic information for a channel or a range of channels. The channels should have active calls at the time the command is executed.

Managing DSPs

This section describes how to manage DSPs by entering DSP configuration mode, including upgrading the DSP firmware, performing busyout on DSPs, and clearing active calls on the DSPs.

DSP Configuration Mode

DSP configuration mode allows you to configure DSPs. You can configure a DSP by specifying a slot and a DSP associated with the slot or, you can choose to configure a range of DSPs by specifying the first and last DSP in the range.

The following example demonstrates how to enter DSP configuration mode:

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

DSP Configuration Mode Commands

Use the following commands in DSP configuration mode:

- **firmware location**—Allows you to transfer a specified version of DSP firmware from system flash memory to the DSPs named upon entering DSP configuration mode. For further information on firmware upgrades, see the "Upgrading DSP Firmware" section on page 90.
- **firmware upgrade** *busyout* | *reboot*—Allows you to specify the upgrade method. Two methods of upgrade are available.
  - *Busyout* (the default) upgrades when all calls are terminated on an DSP.
  - *Reboot* upgrades at the next DSP reset or system reboot.
- **busyout**—Gracefully disables a DSP by waiting for all the active services on the specified DSP to terminate. If there are active calls on the specified DSP, the state of the DSP is changed to *Busiedout*. The DSP is temporarily disabled. Use the **no** form of this command to reenable the DSP.
- **shutdown**—Clears all active calls on the DSP. Calls can no longer be placed on the DSP because the DSP state is changed to *Out-of-Service*. The state of the DSP is reflected in the **show voice dsp** command display. Use the **no** form of the **shutdown** command to reenable the channels on the DSP.

Troubleshooting

This section provides troubleshooting information for your voice feature card. You can view debug information, set automatic recovery options, and upgrade the DSP firmware.

Debugging Commands

Use the following **debug** commands in privileged EXEC mode:

- **debug voice dsp crash-dump**—Displays debugging information for the crash dump feature details. No debug output is displayed until there is one DSP crash. When the crash dump feature is turned on, the detailed debug messages are displayed.
- **debug dsp-resource-manager flex**—Displays debugging information about errors downloading the DSP firmware to the DSP, and DSP allocation statistics, errors, and functions.
- **debug voice hpi**—Displays debugging information for Host Port Interface (HPI) message events, which are used to communicate with DSPs.

DSP Recovery

Automatic recovery (removal from service and reloading of DSP firmware) is enabled by default for the voice feature card.

You can disable automatic recovery using the **voice dsp recovery disabled** command in configuration mode.

Clear a DSP

Use the **clear voice dsp** command in privileged EXEC mode to manually restart a DSP. This command can be used to reset a DSP. This command causes the firmware that is configured for that DSP to be downloaded to the specified DSP or range of DSPs. This command can be executed regardless of the state of the DSPs. All active channels running on the DSP are prematurely terminated.

The following example shows a cold start on DSP 1 on slot 1:

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

Upgrading DSP Firmware

With new systems, Cisco loads a Cisco IOS software-compatible version of DSP firmware into each DSP. A map of the version or versions of DSP firmware copied to RAM for each DSP is stored in NVRAM so that it is retained over power cycles.

Note You do not have to take any action to use the bundled version of DSP firmware with new systems.

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

- **Bundled** in regular Cisco IOS releases. See the "Using DSP Firmware Bundled with Cisco IOS Software" section on page 96 for details.
- **Unbundled** from Cisco.com. This is a more up-to-date version of DSP firmware released before the next Cisco IOS release, or a special version of DSP firmware shipped with a new board. See the "Using Unbundled DSP Firmware" section on page 95 for details.

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

Note Do not store more than nine DSP firmware images in system flash memory. If you store more than nine DSP firmware images in system flash memory, the **firmware upgrade** command will fail. You will need to delete at least one firmware image from the system flash memory and reboot the gateway to use one of the remaining unbundled DSP firmware images.

Important Upgrade Commands

There are several commands you use to upgrade DSP firmware. For examples on using the commands, see the "Using Unbundled DSP Firmware" section on page 95 and the "Using DSP Firmware Bundled with Cisco IOS Software" section on page 96.

- Use the **copy tftp flash** *filename* command to copy any version of DSP firmware (no matter how it is obtained) into system flash memory. You can store several versions of the DSP firmware in system flash memory under different filenames.
- Use the **firmware location** command in DSP configuration mode to transfer a specified version of DSP firmware from system flash memory to the DSPs specified in DSP configuration mode.

- Use the **firmware upgrade** *busyout* | *reboot* command in DSP configuration mode to configure when the file named in the **firmware location** command will be loaded to the DSPs. Two methods of upgrade are available:
  - *Busyout* (the default) upgrades when all calls are terminated on an DSP.
  - *Reboot* upgrades at the next DSP reset or system reboot.

Note The **copy ios-bundled** command is not necessary with the voice feature card. By default, the version of DSP firmware bundled with the Cisco IOS software release is transferred to all DSPs that are not specifically configured for a different DSP firmware file.

Displaying DSP Firmware Versions

Use the **show voice dsp version** command to list the versions of DSP firmware running on the DSPs, residing in system flash memory, and bundled with Cisco IOS software. This helps you decide whether you need to change the version running on the DSPs.

Note The version number displayed may not match the filename for a short period of time while a range of DSPs is in the process of downloading new firmware. The version number is updated at the beginning of the upgrade process, whereas the filename is updated upon completion of the process. This is done intentionally to enable you to recognize the upgrade process from the **show voice dsp version** output.

```
AS5400# show voice dsp version

IOS-Bundled Default               Version     Firmware-Type
==========================        =======     =============
system:/bundled_fw_image          7.3.0       c5510

On-Flash Dspware-Filename         Version     Firmware-Type
=========================         =======     =============
flash:dsp_c5510_flex.rbf          4.4.5       c5510
flash:big.rbf                     4.5.985x    c5510

  DSP#      Type        Version     Filename
  5/1       C5510       4.4.5       flash:dsp_c5510_flex.rbf
  5/2       C5510       7.3.0       system:/bundled_fw_image
  5/3       C5510       7.3.0       system:/bundled_fw_image
  5/4       C5510       7.3.0       system:/bundled_fw_image
  5/5       C5510       7.3.0       system:/bundled_fw_image
```

Upgrading DSP Firmware from Cisco.com

Upgrading DSP firmware from the Cisco.com website is a three-step process:

1. Download the DSP firmware from the Cisco.com website to a local TFTP server.
2. Copy the DSP firmware file to the gateway and the DSPs (which may also involve removing old firmware).
3. Configure the DSPs to use an upgraded firmware file.

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

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

You can download software from the Cisco.com website by 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 voice feature card DSP firmware folder to view available images.

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

Step 7 Once the download is complete, transfer the file using a terminal emulation software application to a TFTP server that can be accessed by the universal gateway.

Using an FTP Application

Note The directory path leading to the DSP firmware files on ftp.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/kobayashi/sw-center/

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

```
terminal> ftp ftp.cisco.com

Connected to ftp.cisco.com.
220-  <}======[+]> FTP.CISCO.COM <[+]======={>
220-
220-  Welcome to the Cisco Systems FTP server.
220-
220-  Local time is Fri Jan 06 14:53:39 2006.
220-
220-  This server has a number of restrictions.  If you are not familiar
220-  with these, please first get and read the /README or /README.TXT file.
220-
220-  If you have any odd problems, try logging in with a minus sign (-) as
220-  the first character of your password.  This will turn off a feature that
220-  may be confusing your ftp client program.
220-
220-  Please send any questions, comments, or problem reports about this
220-  server to cco-team@cisco.com.
220-
220-  NOTE:
220-  o To upload or download files from ftp.cisco.com, you must be running a
*passive-mode*
220-    capable FTP client.
```

```
220-
220-  o To upload files on this system, you must cd to the /incoming directory.
220-    Uploads are available on ftp-sj.cisco.com only.
220-
220-  Cisco.com                     |        |      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-  You may login with:
220-         + Your Cisco.com username and password, or
220-         + "anonymous" followed by your e-mail address for guest access.
220 ftp-sj-4.cisco.com FTP Server (Apache Aug  8 2005 12:16:13) ready.
```

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

```
User (ftp.cisco.com:(none)): harry
331 Password required for harry.
Password: letmein
```

Step 3 Specify the directory path that holds the DSP firmware you want to download. For example, the directory path for the Cisco AS5400 DSP firmware is /cisco/access/5350:

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

250 CWD command successful.
```

Step 4 View the contents of the directory by using 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 vfc-dsp-upw-7.0.1.2.bin
-r--r--r-- 1 ftpadmin ftpint 635 Jul 10 18:08 vfc-dsp-upw-7.0.1.2.readme
226 Transfer complete.
```

Step 5 Specify a binary image transfer:

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

Step 6 Copy the DSP 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 vfc-dsp-upw-7.0.1.2.bin
server% pwd
/auto/tftpboot
```

Step 9 Transfer these files to a local TFTP or remote copy protocol (RCP) server that your gateway or router can access.

Copy the DSP Firmware File from the Local TFTP Server to the DSP

The procedure for copying the DSP firmware file from your local TFTP server to a voice feature card is a two-step process:

1. Transfer the DSP firmware to the universal gateway's flash memory.
2. Configure the DSPs 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 DSP firmware file into flash memory for the first time, you should not have to perform these steps again. Because the DSP firmware is configurable for individual DSPs or ranges of DSPs, the Cisco IOS software automatically copies the DSP firmware to each DSP each time the gateway restarts.

Transfer DSP Firmware to Flash Memory

Follow these steps to download the DSP 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 hostname.

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

If you do not have available space to copy the DSP 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 GigabitEthernet0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[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 universal gateway's flash memory:

```
AS5400# show flash

-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1 .. unknown 12375B0E 92704 6 337539 Feb 21 2005 22:46:51 vfc-dsp-upw-7.0.1.2.bin
2 .. image 1A58C7EA AA7F9C 20 10573848 Feb 21 2005 23:11:59 c5350-js-mz.xm.Feb16
5079140 bytes available (10911644 bytes used)
```

Configure DSPs to Use an Upgraded Firmware File

Using Unbundled DSP Firmware

Use this procedure to configure DSPs to use unbundled DSP firmware. For more information about unbundled DSP firmware releases for the voice feature card, see the "Using the AMR-NB Codec" section on page 97.

Note By default, the version of DSP firmware bundled with the Cisco IOS software release is transferred to all DSPs that are not specifically configured for a different DSP firmware file. This procedure is only necessary if you are using DSP firmware that is not bundled with the Cisco IOS software release.

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 DSP firmware versions to obtain the filename of the firmware on flash memory.

Note The version number and filename may not match until the upgrade is complete.

```
AS5400# show voice dsp version

IOS-Bundled Default              Version     Firmware-Type
=========================        =======     =============
system:/bundled_fw_image         7.0.200x    c5510

On-Flash Dspware-Filename        Version     Firmware-Type
=========================        =======     =============
No voice dsp in the slot range 1 to 7
```

Step 4 Enter global configuration mode by typing the **configure terminal** command.

```
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 DSP configuration mode. You can choose to configure a single DSP or range of DSPs by specifying the first and last DSP in the range.

```
AS5400(config)# voice dsp slot/dsp
```

or

```
AS5400(config)# voice dsp slot/dsp slot/dsp
```

You are in DSP configuration mode when the prompt changes to `AS5350(config-voicedsp)#`.

Step 6 Specify the DSP firmware file in flash memory to use for the selected DSPs. This is the firmware filename that you obtained in Step 3.

```
AS5400(config-voicedsp)# firmware location vfc-dsp-upw-7.0.1.2.bin
```

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

```
AS5400(config-voicedsp)# firmware upgrade busyout | reboot
```

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

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

Step 9 Press the **Enter** key to make the changes, and then type **Ctrl-Z** to return to privileged EXEC mode.

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

Step 10 Save your changes.

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

Using DSP Firmware Bundled with Cisco IOS Software

Use this procedure to update DSP firmware on the DSPs in your gateway if the DSPs are currently configured with any non-bundled DSP firmware version.

Note This process does not delete any existing DSP 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 DSP firmware as the old one, no new code is downloaded to the DSPs.

To set the DSP firmware to the DSP 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 terminal** command.

```
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 DSP configuration mode. You can either delete the configuration for a single DSP, or a range of DSPs by specifying the first and last DSP in the range. The DSP firmware used by the DSPs automatically reverts to the version bundled with the current Cisco IOS image.

```
AS5400(config)# voice dsp slot/dsp
```

or

```
AS5400(config)# voice dsp slot/dsp slot/dsp
```

You are in DSP configuration mode when the prompt changes to `AS5400(config-voicedsp)#`.

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 DSP firmware:

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

Step 6 Type the **exit** command to exit DSP configuration mode.

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

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

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

Step 8 Save your changes.

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

Using the AMR-NB Codec

Note You must buy a license to access the DSPWare that supports the AMR-NB codec. It is recommended that you purchase a Cisco SMARTnet contract in order to streamline the process of getting the AMR-NB codec DSPWare. When obtaining your license, use the following part numbers:
FR535XM-AMR-LIC for the Cisco AS5350XM
FR54XM-AMR-LIC for the Cisco AS5400XM
For more information, contact your Cisco representative or visit the following Cisco.com website to

obtain a Cisco SMARTnet contract:
http://www.cisco.com/en/US/partner/products/svcs/ps3034/ps2827/ps2978/serv_datasheet09186a0080092491.html

The Adaptive Multirate Narrow Band (AMR-NB) codec is a high complexity multimode codec that supports eight narrowband speech encoding modes with bit rates between 4.75 and 12.2 kbps. The sampling frequency used in AMR-NB is 8000 Hz and the speech encoding is performed on 20 ms speech frames. Therefore, each encoded AMR-NB speech frame represents 160 samples of the original speech.

The AMR-NB codec was originally developed and standardized by the European Telecommunications Standards Institute (ETSI) for Groupe Speciale Mobile (GSM) cellular systems. and chosen by the Third Generation Partnership Project (3GPP) as the mandatory codec for third generation (3G) cellular systems.

Table 17 contains codec mode and bit rate information for the AMR codec.

Table 17 AMR Codec Modes and Bit Rates

Codec Mode	Bit Rate (kbps)
0	4.75
1	5.15
2	5.90
3	6.70
4	7.40
5	7.95
6	10.2
7	12.2
8[1]	1.80

1. Used for Silence Indication Detection(SID) frames.

How the AMR-NB Codec Works

The multirate encoding (or multimode) capability of AMR-NB is designed for preserving high speech quality under a wide range of transmission conditions. Unlike other codecs, the AMR-NB codec can adapt to different bit rates (see Table 17) based on channel conditions during the call.

To perform mode adaptation, the decoder (speech receiver) sends a signal to the encoder (speech sender) to indicate which new mode it prefers. This mode-change signal is called codec mode request (CMR). Because speech is sent in both directions between the two ends in most sessions, the mode requests from the decoder at one end to the encoder at the other end are sent in a piggyback form over the speech frames in the reverse direction; there is no out-of-band signaling needed for sending CMRs. The Cisco AS5400XM and Cisco AS5350XM cannot initiate CMRs and received CMRs can be processed. For more information about AMR-NB codecs, see RFC3267.

Restrictions for the AMR-NB Codec

The following message is displayed when an upgrade takes place if a version of DSPWare other than the recommended version is uploaded:

```
WARNING: Recommended GSM AMR-NB supported DSPWare for this Cisco IOS image is X.Y.Z Where
X.Y.Z changes depending on the Cisco IOS image that is used by the customer.
```

This warning has no impact on the firmware upgrade and calls can be brought up with a version of DSPWare that is not the recommended version.

Where to Go Next

At this point you can go to these references:

- Chapter 6, “Configuring Voice over IP,” to learn how to configure voice and fax traffic over an IP network.
- Appendix 9, “Comprehensive Configuration Examples”

Tip The following publications are available on the Documentation DVD, or on the World Wide Web from the Cisco home page.

- The *High-Density Packet Voice Feature Card for Cisco AS5350XM and AS5400XM Universal Gateways* document, available online at: http://www.cisco.com/en/US/products/ps6706/products_feature_guide09186a008060df15.html
- 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.

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Configuring Voice over IP

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways.

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 AS5350XM and Cisco AS5400XM 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

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This chapter briefly introduces the subject of configuring VoIP and describes 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.

This chapter describes the following topics:

- VoIP Basics, page 102
- Configuring Basic VoIP, page 106
- Voice QoS Basics, page 115
- Enabling QoS Features for VoIP, page 116
- Additional Resources, page 121

Tip It is critical that you consult the additional references cited 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.

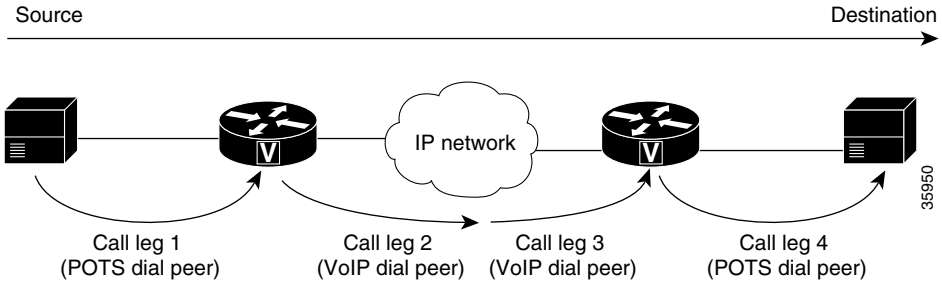
Note Although VoIP technology is primarily software-based, it requires that you install a universal port or voice feature card into the appropriate slot of your Cisco AS5350XM or Cisco AS5400XM universal gateway. The number of ports or channels available for sending VoIP data depends on the capacity of your card. For more information, see Chapter 5, "Managing and Troubleshooting the Universal Port and Dial-Only Feature Cards" or Chapter 5, "Managing and Troubleshooting the Voice Feature 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. (See Figure 5.) 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 5 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 18 describes the different types of call legs.

Table 18 Call Legs

Call Leg Source	Call Leg Destination	Call Leg 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 uses 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 19 and Table 20 detail the general call flow from the perspective of an originating and destination gateway respectively.

Table 19 VoIP Call Flow, Originating Gateway View

Event	Leg Type
User sends dialed digits using public switched telephone network to gateway.	Inbound POTS
Gateway does the following: • Processes information (maps dialed digits, according to 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 20 VoIP Call Flow, Destination Gateway View

Event	Leg Type
Gateway receives dialed digits.	Inbound VoIP
Gateway does the following: • Processes information (maps dialed digits, according to 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 the address to which 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 chooses 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 chooses 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. Table 21 shows the dial peers needed to make this connection:

Table 21 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
- Configure Signaling on Voice Ports
- Configure Dial Peers
- Configuring Echo Cancellation on the Voice Feature Card
- Configuring Nextport Echo Canceller Control (optional)

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 or voice feature 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 and Dial-Only Feature Cards" or Chapter 5, "Managing and Troubleshooting the Voice Feature 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, and so forth), relevant LAN and WAN ports, and all voice ports; for each WAN, type (Frame Relay, PPP, and so forth); 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 AS5350XM and Cisco AS5400XM universal gateways process and manage digital voice calls on the universal port or voice feature card. They support voice configuration on channelized T1, E1, and T3 trunk interfaces.

Your universal gateway 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 44
- "Configuring the D Channels for ISDN Signaling" section on page 54
- "Configuring ISDN NFAS on Channelized T1 PRI Groups" section on page 78

Ensure that multiframes are established on the serial interfaces (acting as the 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 the "Configuring E1 R2 Signaling" section on page 79. 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 22 and Table 23 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 22 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 ahead 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.

Table 22 POTS Dial-Peer Configuration Commands (continued)

Command	Purpose
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 administrator state of this peer to down.
translate-outgoing	Sets translation rule.

Table 23 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 or called party numbering type.
preference	Configures preference order of the peer.

Table 23 VoIP Dial-Peer Configuration Commands (continued)

Command	Purpose
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 24 is for the simple gateway-to-gateway scenario described earlier; your own will be far more complex.

Table 24 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 Echo Cancellation on the Voice Feature Card

The **echo-cancel enable** command enables cancellation of voice that is sent out the interface and received back on the same interface; sound that is received back in this manner is perceived by the listener as an echo. Disabling echo cancellation might cause the remote side of a connection to hear an echo. Because echo cancellation is an invasive process that can minimally degrade voice quality, this command should be disabled if it is not needed.

For the voice feature card, software echo cancellation is the default configuration—G.168-compliant echo cancellation is enabled by default with a coverage of 64 milliseconds. Hardware echo cancellation is not available.

Configure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**voice-port** *slot/port* **Example:** `Router(config)# voice-port 2/1`	Enters voice-port configuration mode and identifies a slot and port for configuration parameters.
Step 4	**echo-cancel enable** **Example:** `Router(config-voiceport)# echo-cancel enable`	Enables the cancellation of voice that is sent out the interface and received back on the same interface.
Step 5	**echo-cancel coverage** {**24** | **32** | **48** | **64**} **Example:** `Router (config-voiceport)# echo-cancel coverage 24`	Adjusts the echo canceller by the specified number of milliseconds. • The default is 64.
Step 6	**exit** **Example:** `Router(config-voiceport)# exit`	Exits voice-port configuration mode and returns to global configuration mode.

Configuring Nextport Echo Canceller Control (optional)

The AS5350XM and AS5400XM universal gateways can detect 2100Hz tones, received in G.711 encoded VoIP packets. Customers can enable Nextport Voicecap to control the echo canceller when 2100-Hz 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 We do not recommend 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 2100-Hz answer tones from the IP side. This setting is required in Cisco IOS Release 12.3T and later.
- v2 = 512
  This setting enables detection of the 250 millisecond silence . 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 procedure for creating and applying Voicecap:

```
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 Cisco 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 issue *debug trace module f080 0010 x/y/z*. Nextport enables and disables the nonlinear processor (NLP) and the echo canceller based on reception of 2100-Hz 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, issue *debug trace module f080 0010 x/y/z* as follows:

```
router# debug trace module f080 0010 s/d/m
```

where:

- s = slot
- d = dial feature card
- 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 cited references as you enable features, because 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 describes 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
  - Weighted Fair Queuing
  - Low-Latency Queuing
  - IP RTP Priority and Frame Relay IP RTP Priority
  - Resource Reservation
- Fragmentation and Interleaving
- Traffic Shaping for Frame Relay
- Other Bandwidth-Reduction Features
  - Voice Encoding
  - RTP Packet-Header Compression
  - Serialization Delay
  - Voice Activity Detection
  - Jitter Buffering

References in the "Additional Resources" section on page 121 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 Gigabit 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 *Configuring Weighted Fair Queuing* document, 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 the *Low-Latency Queuing* document, 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:

- *VoIP over PPP Links with Quality of Service (LLQ / IP RTP Priority, LFI, cRTP)*, 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 AS5350XM or Cisco AS5400XM universal gateway 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.

Tip 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, RSVP, or both 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, *VoIP over PPP Links with Quality of Service (LLQ / IP RTP Priority, LFI, cRTP)*, 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 *VoIP over Frame Relay with Quality of Service (Fragmentation, Traffic Shaping, IP RTP Priority* document, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-ov-fr-qos.html

Note Successful traffic shaping on a Frame Relay network requires that you set not just this but many other QoS features. See these references and the "Additional Resources" section for more information.

Other Bandwidth-Reduction Features

Voice Encoding

The Cisco AS5350XM and Cisco AS5400XM universal gateways offer multiple codec (coders/decoder) methodologies for encoding (digitizing and, optionally, compressing) voice:

- G.711
- G.723.1
- G.726
- G.729
- G.729a
- G.729ab
- G.729b
- GSMAMR-NB

- GSMFR
- G.Clear

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. We also recommend 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 the *VoIP over PPP Links with Quality of Service (LLQ / IP RTP Priority, LFI, cRTP)* document, 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 the cRTP high CPU usage causes delay. Use 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 the *VoIP over PPP Links with Quality of Service (LLQ / IP RTP Priority, LFI, cRTP)* document, 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 equaling no more 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 150–200 ms of one-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 and voice feature cards permit a much smaller range of sizes, to help ensure that end-to-end delay for voice signals does not exceed 200 ms. 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 the *VoIP over PPP Links with Quality of Service (LLQ / IP RTP Priority, LFI, cRTP)* document, available online at http://www.cisco.com/warp/public/788/voice-qos/voip-mlppp.html

Jitter Buffering

Jitter occurs when there is a discrepancy 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, choose 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 jitter buffers are normally sized dynamically, and adaptive mode plus default buffer size should suffice, but you can 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:
  - Davidson, J. Peters, J. and Gracely, B. *Voice Over IP Fundamentals*, Indianapolis, Indiana: Cisco Press; 2000.
  - Caputo, R. *Cisco Packetized Voice & Data Integration*, New York, New York: McGraw-Hill; 2000.
- VoIP references for Cisco devices:
  - *Voice-over-IP Quick Start Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/1700/voipqsg.htm
  - Cisco IOS Voice Configuration Library, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/voice_c/vcl.htm
- Other websites:
  - Tutorials on various telecommunications topics: http://www.iec.org/tutorials/

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Using the Setup Script

This chapter describes how to power up the Cisco AS5350XM and Cisco AS5400XM 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 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 chapter 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 up 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 AS5350XM or Cisco AS5400XM with AS54-DFC-CT3, page 124
- Cisco AS5350XM or Cisco AS5400XM with AS54-DFC-8CT1, page 128
- Cisco AS5350XM or Cisco AS5400XM with AS54-DFC-8CE1, page 132

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#`).

Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

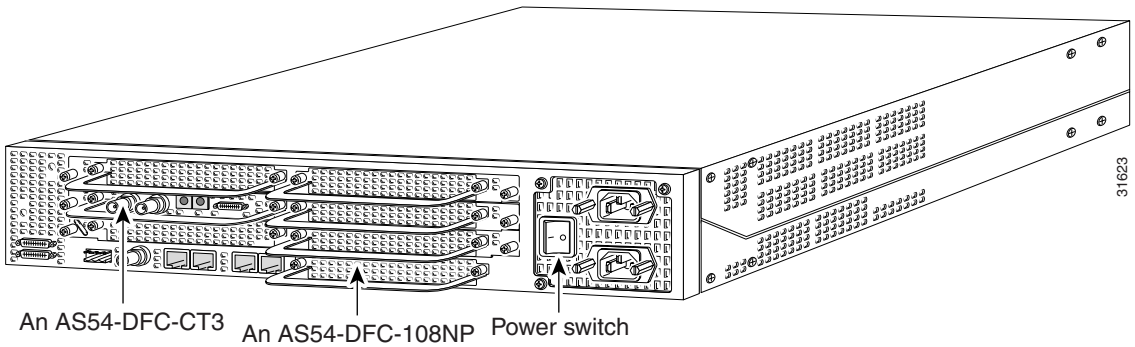
Cisco AS5350XM or Cisco AS5400XM with AS54-DFC-CT3

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 up the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure 6.

Messages begin to appear in your terminal emulation program window.

Figure 6 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 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.
AS5400XM platform with 524288 Kbytes of main memory


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 IOS Software, 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Sat 29-Jan-05 02:10 by yiyan
Image text-base: 0x60011068, data-base: 0x61F80000

Cisco AS5400XM (BCM) processor (revision 0x21) with 393215K/131072K bytes of memory.
Processor board ID JAB082904P4
SB-1 CPU at 750MHz, Implementation 1025, Rev 0.3, 256KB L2 Cache
Last reset from IOS reload
Manufacture Cookie Info:
 EEPROM Version 0x4, Board ID 0x4BD,
 Board Hardware Version 1.11, Item Number 800-6572289-01,
 Board Revision 02, Serial Number JAB082904P4.
Processor 0x0, MAC Address badb.adba.d044
2 Gigabit Ethernet interfaces
6 Serial interfaces
648 terminal lines
1 Channelized T3 port
512K bytes of NVRAM.
125184K bytes of ATA External CompactFlash (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
GigabitEthernet0/0         unassigned      NO  unset  up                    up
GigabitEthernet0/1         unassigned      NO  unset  up                    down
Serial0/0                  unassigned      NO  unset  down                  down
Serial0/1                  unassigned      NO  unset  down                  down
.
.
.
```

Step 5 Enter a hostname 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 you view the configuration.

```
Enter enable secret: lab
```

Step 7 Enter an enable password. This password is *not* encrypted (less secure) and can be seen when you view 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 using 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
```

Note Signaling type R1-ITU is not supported on the Cisco AS5400 platform.

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 GigabitEthernet0/0 interface to connect the gateway to a LAN, and then respond to the remaining questions to configure the Gigabit Ethernet port.

```
Do you want to configure GigabitEthernet0/0  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 Gigabit Ethernet 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 [GigabitEthernet0/0]:
```

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 136.

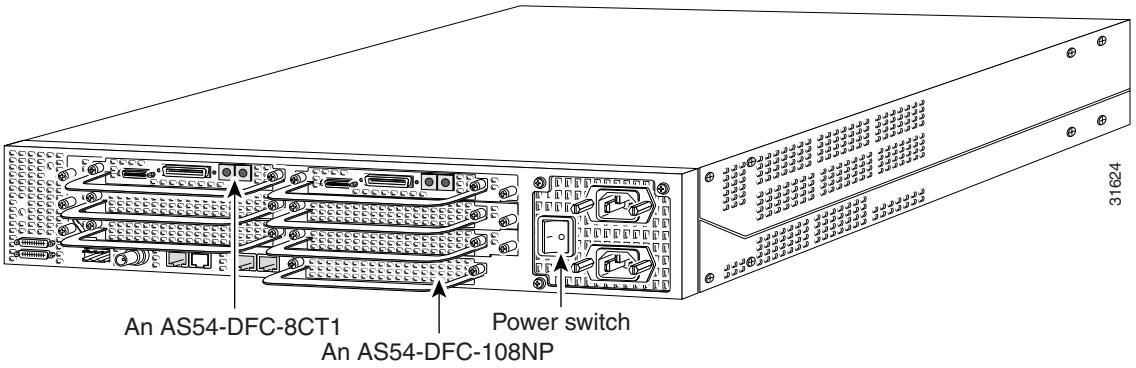
Cisco AS5350XM or Cisco AS5400XM with AS54-DFC-8CT1

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 up the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure 7.

Messages begin to appear in your terminal emulation program window.

Figure 7 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 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.
AS5400XM platform with 524288 Kbytes of main memory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########################################################################################################
########################################################################################################
################################ [OK]

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Software clause at DFARS sec. 252.227-7013.

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



Cisco IOS Software, 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Sat 29-Jan-05 02:10 by yiyan
Image text-base: 0x60011068, data-base: 0x61F80000
```

```
Cisco AS5400XM (BCM) processor (revision 0x21) with 393215K/131072K bytes of memory.
Processor board ID JAB082904P4
SB-1 CPU at 750MHz, Implementation 1025, Rev 0.3, 256KB L2 Cache
Last reset from IOS reload
Manufacture Cookie Info:
 EEPROM Version 0x4, Board ID 0x4BD,
 Board Hardware Version 1.11, Item Number 800-6572289-01,
 Board Revision 02, Serial Number JAB082904P4.
Processor 0x0, MAC Address badb.adba.d044
2 Gigabit Ethernet interfaces
6 Serial interfaces
648 terminal lines
1 Channelized T3 port
512K bytes of NVRAM.
125184K bytes of ATA External CompactFlash (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 hostname 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 you view 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 you view 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 using 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 GigabitEthernet0/0 interface to connect the gateway to a LAN. Then respond to the remaining questions to configure the Gigabit Ethernet port.

```
Do you want to configure GigabitEthernet0/0  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 Gigabit Ethernet 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 [GigabitEthernet0/0]:
```

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 "Save the Configuration File" section on page 136.

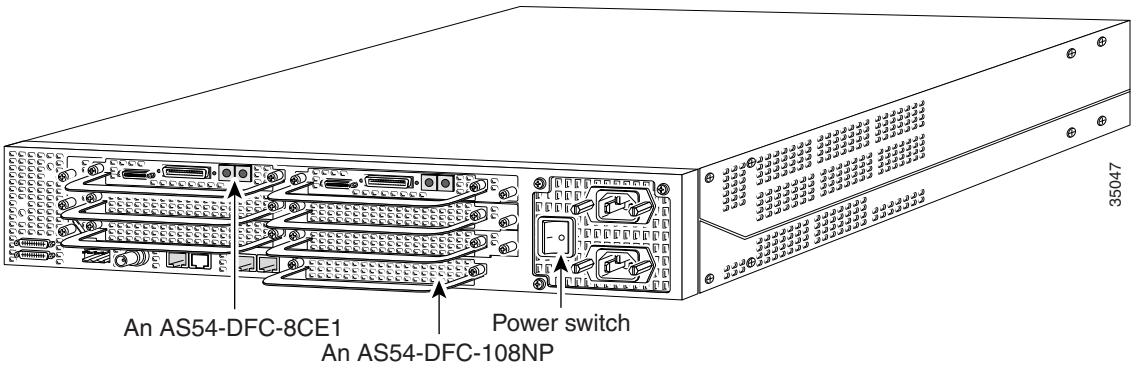
Cisco AS5350XM or Cisco AS5400XM with AS54-DFC-8CE1

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 up the gateway. The power switch is on the rear panel, at the upper right corner near the power cord, as shown in Figure 8.

Messages begin to appear in your terminal emulation program window.

Figure 8 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 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.
AS5400XM platform with 524288 Kbytes of main memory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Software clause at DFARS sec. 252.227-7013.

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           170 West Tasman Drive
           San Jose, California 95134-1706



Cisco IOS Software, 5400 Software (C5400-JS-M), Version 12.3(14)T,  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
```

```
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Sat 29-Jan-05 02:10 by yiyan
Image text-base: 0x60011068, data-base: 0x61F80000

Cisco AS5400XM (BCM) processor (revision 0x21) with 393215K/131072K bytes of memory.
Processor board ID JAB082904P4
SB-1 CPU at 750MHz, Implementation 1025, Rev 0.3, 256KB L2 Cache
Last reset from IOS reload
Manufacture Cookie Info:
 EEPROM Version 0x4, Board ID 0x4BD,
 Board Hardware Version 1.11, Item Number 800-6572289-01,
 Board Revision 02, Serial Number JAB082904P4.
Processor 0x0, MAC Address badb.adba.d044
2 Gigabit Ethernet interfaces
6 Serial interfaces
648 terminal lines
1 Channelized T3 port
512K bytes of NVRAM.
125184K bytes of ATA External CompactFlash (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

GigabitEthernet0/0         unassigned      NO  unset  up                    up
GigabitEthernet0/1         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 hostname 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 you view 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 you view 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 using 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 GigabitEthernet0/0 interface to connect the gateway to a LAN. Then respond to the remaining questions to configure the Gigabit Ethernet port (you can also press **Enter** to accept the default):

```
Do you want to configure GigabitEthernet0/0  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 Gigabit Ethernet 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 [GigabitEthernet0/0]:
```

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

To save the configuration file, follow these steps:

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 appearing on your screen, press **Enter** to access 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.

Where to Go Next

At this point you can go to 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*

These publications are available on the Documentation DVD, or on the World Wide Web from the Cisco home page.

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ROM Monitor

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways.

This chapter describes the Cisco AS5350XM and Cisco AS5400XM ROM monitor, 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, page 139
- ROM Monitor Command Conventions, page 140
- Command Aliasing, page 140
- ROM Monitor Commands, page 140

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 2 > help
        alias               set and display aliases command
        boot                boot up an external process
        confreg             configuration register utility
        cont                continue executing a downloaded image
        context             display the context of a loaded image
        cookie              display contents of cookie PROM in hex
        dev                 list the device table
        dir                 list files in file system
        dis                 disassemble instruction stream
        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)
reset               system reset
rommon-pref         select ROMMON
set                 show all monitor variables
showmon             display currently selected ROM monitor
stack               produce a stack trace
sync                write monitor environment to NVRAM
sysret              print out info from last system return
tftpdnld            tftp image download
unalias             unset an alias
unset               unset a monitor variable
```

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 enclosed in quotation marks. 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:

  The Cisco AS5350XM and Cisco AS5400XM universal gateways support the following three boot commands at the ROM monitor level:

  boot [-xv] [devid] [imagename]

  b—load/run the first XM image on flash.

  b *flash:filename*—Load or run the image pointed to by flash:filename.

- **confreg** [*hexnum*]—When executed with the argument *hexnum*, changes the virtual configuration register to match the hex number specified. Without the argument, the **confreg** command 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 the **confreg** command 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
flash:  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
```

- **ethertype** [**fe** | **ge**]—The Cisco AS5350XM and AS5400XM universal gateway Ethernet ports are Gigabit Ethernet ports (labeled GE0 and GE1 on the chassis). The Cisco IOS firmware and software is designed so that configurations for Fast Ethernet will work on the Cisco AS5350XM and AS5400XM universal gateways without requiring any modification by the user.

  If the Cisco IOS commands, **write** or **copy running-config startup-config** have been used to save the configuration to NVRAM, then all references to Ethernet interfaces will now be GigabitEther, and the IOS commands, **write terminal** and **show running configuration** will always show GigabitEther.

  If you must have FastEther available as a searchable word for any scripts you are using, you can use the ROMMON command, **ethertype fe** to change GigabitEther to FastEther. Once you enter **ethertype fe**, the IOS image will only recognize FastEther. It will *not* recognize GigabitEther.

  For example:

```
rommon 6 > ethertype fe
```

- **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
    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
    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)
    reset               system reset
    rommon-pref         Select ROMMON
    set                 show all monitor variables
    showmon             display currently selected ROM monitor
    stack               produce a stack trace
    sync                write monitor environment to NVRAM
    sysret              print out info from last system return
    tftpdnld            tftp image download
    unalias             unset an alias
    unset               unset a monitor variable
```

- **history** or **h**—Displays the command history, that is, the last 16 commands executed in the ROM 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
```

- **reset** or **i**—Resets and initializes the system, similar to power up.
- **rommon-pref** [**readonly | upgrade**]—Selects the ROM monitor image to be booted on the next reload.
- **set**—Displays all the monitor variables and their values.
- **showmon**—Displays both ROM monitor images and verifies which image is running.

  For example:

```
rommon 1 > showmon

ReadOnly ROMMON version is:
System Bootstrap, Version 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.

Upgrade ROMMON version is:
System Bootstrap, Version 12.3(12r)PI6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2004 by cisco Systems, Inc.

Upgrade ROMMON currently running
Upgrade ROMMON is selected for next boot
```

- **stack** [*num*]—Produces a stack trace of the number of frames, specified by *num*. 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 them 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
```

- **tftpdnld** *-r*—Loads the image from the TFTP server pointed to by TFTP_FILE as shown below:

```
rommon 1 > set
TFTP_SERVER=1.6.1.2
IP_SUBNET_MASK=255.0.0.0
DEFAULT_GATEWAY=1.2.0.1
IP_ADDRESS=1.2.65.10
TFTP_FILE=hyeh/c5400-js-mz.nemo.Sep20
```

  The user must set up the preceding five environmental variables (*variable* = *new.value*)above to boot from the TFTP server as follows:

```
rommon 2> TFTP_FILE=user/newimage.ios
```

- **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 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.

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Comprehensive Configuration Examples

The information in this chapter applies to the Cisco AS5350XM and Cisco AS5400XM universal gateways.

This chapter includes sample outputs of the **show config** command after you have completed the procedures in Chapter 2, "Verifying Basic Setup," and have configured 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, page 147
- CT3 CAS/ISDN Without RADIUS, page 156
- CT3 Without Resource Pooling, page 165
- CT3 CAS with Resource Pooling, page 170
- Two 8 T1/PRI ISDN with Modems, page 176
- Two 8 E1/PRI ISDN with Modems, page 187
- Two 8 T1/PRI CAS with Modems, page 192
- Two 8 T1/PRI CAS with RADIUS (AAA) and Resource Pooling, page 196
- Two 8 T1/PRI ISDN with RADIUS (AAA) and Resource Pooling, page 201
- Two 8 E1/PRI ISDN with RADIUS (AAA) and Resource Pooling, page 213
- CT3 with Resource Pooling, AAA, and Modem, page 216

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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 172.16.0.0 255.0.0.0 172.22.36.1
ip route 172.16.0.0 255.0.0.0 172.22.36.1
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 v3c 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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 172.16.0.0 255.0.0.0 172.22.36.1
ip route 172.16.0.0 255.0.0.0 172.22.36.1
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 v3c 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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 GigabitEthernet0/0
 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 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
```

```
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 172.21.1.0 255.255.255.0 192.168.21.10
ip route 172.22.1.0 255.255.255.0 192.168.21.10
ip route 172.22.254.253 255.255.255.255 GigabitEthernet0/0
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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 GigabitEthernet0/0
 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 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 172.21.1.0 255.255.255.0 192.168.21.10
ip route 172.22.1.0 255.255.255.0 192.168.21.10
ip route 172.22.254.253 255.255.255.255 GigabitEthernet0/0
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 GigabitEthernet0/0
ip ftp username frank
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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 172.16.97.1 255.255.255.0
```

```
 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 172.16.98.1 255.255.255.0
 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 172.16.99.1 255.255.255.0
 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 172.16.100.1 255.255.255.0
 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 172.16.101.1 255.255.255.0
 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 172.16.102.1 255.255.255.0
 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 172.16.103.1 255.255.255.0
 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 172.16.104.1 255.255.255.0
 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 172.16.105.1 255.255.255.0
 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 172.16.106.1 255.255.255.0
 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 172.16.107.1 255.255.255.0
 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 172.16.108.1 255.255.255.0
 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 172.16.109.1 255.255.255.0
 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 172.16.110.1 255.255.255.0
 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 172.16.111.1 255.255.255.0
 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 172.16.112.1 255.255.255.0
 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 172.16.113.1 255.255.255.0
 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 172.16.114.1 255.255.255.0
 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 172.16.115.1 255.255.255.0
 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 172.16.116.1 255.255.255.0
 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 172.16.117.1 255.255.255.0
 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 GigabitEthernet0/0
 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 172.16.1.97 255.255.255.255 Async1/00
ip route 172.16.1.98 255.255.255.255 Async1/01
ip route 172.16.1.99 255.255.255.255 Async1/02
ip route 172.16.1.100 255.255.255.255 Async1/03
ip route 172.16.1.101 255.255.255.255 Async1/04
ip route 172.16.1.102 255.255.255.255 Async1/05
ip route 172.16.1.103 255.255.255.255 Async1/06
ip route 172.16.1.104 255.255.255.255 Async1/07
ip route 172.16.1.105 255.255.255.255 Async1/08
ip route 172.16.1.106 255.255.255.255 Async1/09
ip route 172.16.1.107 255.255.255.255 Async1/10
ip route 172.16.1.108 255.255.255.255 Async1/11
ip route 172.16.1.109 255.255.255.255 Async1/12
ip route 172.16.1.110 255.255.255.255 Async1/13
ip route 172.16.1.111 255.255.255.255 Async1/14
ip route 172.16.1.112 255.255.255.255 Async1/15
ip route 172.16.1.113 255.255.255.255 Async1/16
ip route 172.16.1.114 255.255.255.255 Async1/17
ip route 172.16.1.115 255.255.255.255 Async1/18
ip route 172.16.1.116 255.255.255.255 Async1/19
ip route 172.16.1.117 255.255.255.255 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 GigabitEthernet0/0
 ip address 192.168.10.103 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface GigabitEthernet0/1
 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 GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async1/01
 ip unnumbered GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async1/02
 ip unnumbered GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
.
.
<information deleted>
.
.
!

interface Async5/106
 ip unnumbered GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async5/107
 ip unnumbered GigabitEthernet0/0
 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 GigabitEthernet0/0
ip ftp username frank
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 GigabitEthernet0/0
 mac-address 000b.7264.9173
 ip address 192.168.10.100 255.255.255.0
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 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 GigabitEthernet0/0
 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 192.168.21.1 255.255.255.255 Async1/00
ip route 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 172.21.1.0 255.255.255.0 192.168.21.10
ip route 172.22.1.0 255.255.255.0 192.168.21.10
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 telco1
 limit base-size all
 limit overflow-size 0
 resource group2 speech
 dnis group group2
!
resource-pool profile customer telco2
 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 GigabitEthernet0/0
ip ftp username frank
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 GigabitEthernet0/0
 mac-address 000b.7264.9173
 ip address 192.168.10.100 255.255.255.0
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 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 GigabitEthernet0/0
 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 192.168.1.1 255.255.255.255 Async1/00
ip route 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
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 GigabitEthernet0/0
ip ftp username frank
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 GigabitEthernet0/0
 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 GigabitEthernet0/1
 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 172.16.97.1 255.255.255.0
 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 172.16.98.1 255.255.255.0
 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 172.16.99.1 255.255.255.0
 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 172.16.100.1 255.255.255.0
 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 172.16.101.1 255.255.255.0
 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 172.16.102.1 255.255.255.0
 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 172.16.103.1 255.255.255.0
 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 172.16.104.1 255.255.255.0
 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 172.16.105.1 255.255.255.0
 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 172.16.106.1 255.255.255.0
```

```
 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 172.16.107.1 255.255.255.0
 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 172.16.108.1 255.255.255.0
 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 172.16.109.1 255.255.255.0
 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 172.16.110.1 255.255.255.0
 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 172.16.111.1 255.255.255.0
 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 172.16.112.1 255.255.255.0
 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 172.16.113.1 255.255.255.0
 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 172.16.114.1 255.255.255.0
 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 172.16.115.1 255.255.255.0
 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 172.16.116.1 255.255.255.0
 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 172.16.117.1 255.255.255.0
 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 GigabitEthernet0/0
 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 172.16.1.97 255.255.255.255 Async1/00
ip route 172.16.1.98 255.255.255.255 Async1/01
ip route 172.16.1.99 255.255.255.255 Async1/02
ip route 172.16.1.100 255.255.255.255 Async1/03
ip route 172.16.1.101 255.255.255.255 Async1/04
ip route 172.16.1.102 255.255.255.255 Async1/05
ip route 172.16.1.103 255.255.255.255 Async1/06
ip route 172.16.1.104 255.255.255.255 Async1/07
ip route 172.16.1.105 255.255.255.255 Async1/08
ip route 172.16.1.106 255.255.255.255 Async1/09
ip route 172.16.1.107 255.255.255.255 Async1/10
ip route 172.16.1.108 255.255.255.255 Async1/11
ip route 172.16.1.109 255.255.255.255 Async1/12
ip route 172.16.1.110 255.255.255.255 Async1/13
ip route 172.16.1.111 255.255.255.255 Async1/14
ip route 172.16.1.112 255.255.255.255 Async1/15
ip route 172.16.1.113 255.255.255.255 Async1/16
ip route 172.16.1.114 255.255.255.255 Async1/17
ip route 172.16.1.115 255.255.255.255 Async1/18
ip route 172.16.1.116 255.255.255.255 Async1/19
ip route 172.16.1.117 255.255.255.255 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 GigabitEthernet0/0
 ip address 192.168.10.103 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface GigabitEthernet0/1
 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 GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
```

```
!
interface Async1/01
 ip unnumbered GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
<text omitted>
!
interface Async5/106
 ip unnumbered GigabitEthernet0/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 ppp authentication chap
!
interface Async5/107
 ip unnumbered GigabitEthernet0/0
 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 GigabitEthernet0/0
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 GigabitEthernet0/0
ip address 192.168.18.100 255.255.255.0
no keepalive
duplex auto
speed auto
hold-queue 4000 out
!
interface GigabitEthernet0/1
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 GigabitEthernet0/0
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 172.16.14.0 255.255.255.0 192.168.21.10
ip route 172.17.14.0 255.255.255.0 192.168.21.10
ip route 172.18.14.0 255.255.255.0 192.168.21.10
ip route 172.19.1.0 255.255.255.0 192.168.21.10
ip route 172.20.1.0 255.255.255.0 192.168.21.10
ip route 192.168.0.0 255.0.0.0 GigabitEthernet0/1
ip route 192.168.173.18 255.255.255.255 GigabitEthernet0/1
ip route 223.255.254.253 255.255.255.255 GigabitEthernet0/0
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
!
```

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