Cisco AS5800 Operations, Administration, Maintenance, and Provisioning Guide

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Cisco AS5800 Operations, Administration, Maintenance, and Provisioning Guide

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Preface

This section discusses the following:

Document Objectives

This document serves as a software installation and configuration guide describing detailed configuration management alternatives for the Cisco AS5800 universal access server. The guide provides a conceptual framework for Cisco AS5800 network connectivity and covers five primary levels of network management: commissioning, operations, administration, maintenance and provisioning. Administrators can use this document as a reference and procedures manual and quickly commission the system to take a call and subsequently deploy diverse task-oriented protocol settings to engage all networking capabilities. This guide references features described in the Cisco IOS configuration guides and command references. Refer to those documents for additional information.

Audience

This publication includes basic software configuration to enable users to get their systems running as quickly as possible. However, this document does not include extensive software configuration instructions enabling users to customize their Cisco AS5800 access servers. For more inclusive software configuration, refer to the Cisco IOS configuration guides and command references, and in this guide to the documents listed in the “Related Documentation” section on page xii, and the “For More Information” section on page xiv.

This guide is intended primarily for the following audiences:

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

Document Organization

This document describes software installation, configuration, and troubleshooting instructions, which are included in the following chapters and appendices:

- Chapter 1, “Introduction” provides a functional profile of Cisco AS5800; a hardware and network topology review; Cisco IOS software fundamentals; basic startup, boot, and setup script previews; and deployment and operation strategies.
- Chapter 2, “Commissioning” provides formal functional inauguration of the equipment, through systematic software configurations, to initially engage the system for data/voice call processing.
- Chapter 3, “Operations” provides routine operations to configure router interfaces.
- Chapter 4, “Administration” describes management protocols and Network Access Server (NAS) security and control functionality with AAA and RADIUS servers.
- Chapter 5, “Maintenance” provides replacement, debugging, and troubleshooting procedures.
- Chapter 6, “Provisioning” describes basic hardware and service provision considerations such as system environment requirements, physical infrastructure checklists, IP service considerations, and system upgrade procedures.
- Appendix A, “Advanced Quick Reference” provides command line configurations for the advanced user and system administrator who need to rapidly modify system functionality or enhance system performance.
- The glossary at the end provides useful Cisco AS5800-related terminology definitions.

Document Conventions

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

Note The Cisco AS5800 universal access server uses a two-bar (/) command syntax to identify component (also known as “shelf”), interface, and port locations (*shelf/slot/port*). The shelf identification number is the first number identified in the two-bar command syntax.

Interactive examples showing prompts (`AS5800(config-line)#`) are used in procedures to show exactly what the prompt should look like when you enter a command, and what happens after you enter a command. Examples showing sample output from a **show running-config** or **show startup-config** (without prompts) command are included in the configuration sections.

Note Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

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

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

Tips Means the following information will help you solve a problem.

Safety Warnings

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may harm you. A warning symbol precedes each warning statement. To see translations of safety warnings pertaining to the Cisco AS5800, refer to *Cisco AS5800 Universal Access Server Regulatory Compliance and Safety Information*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/5800rcns.htm

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

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

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

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

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

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

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

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

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

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

Related Documentation

The Cisco AS5800 comprises the Cisco 5814 dial shelf, the Cisco 7206 router shelf, and an optional AC power supply. You might want to install multiple Cisco AS5800 Universal Access Servers at your site. To help you manage multiple systems, the Cisco 3640 system controller network management system is available to provide local data gathering and monitoring functions for multiple hardware platforms within a single point of presence (POP).

The Cisco 3640 system controller includes the Cisco 3640 router running Cisco IOS software. The system controller can be installed at a remote facility so users can access multiple systems through a console port or Web interface. System administrators can download software configurations to any Cisco AS5800 using Simple Network Management Protocol (SNMP) or Telnet. The system controller monitors Cisco equipment to provide performance data collection, accounting data collection, and logging.

Note An asynchronous card needs to be installed in the Cisco 3640 to use it as a remote console server.

The Cisco AS5800 and the Cisco 3640 system controller network management system are available to help you manage your dial POP site efficiently and effectively. Each of these products is supported by documentation available on the Cisco.com website.

Timesaver Verify that you have access to the documents listed in Table 1. These documents are available on the Cisco.com website.

Table 1 Cisco AS5800 Universal Access Server—Related Documents

Cisco Product	Document Title
Cisco AS5800	• *Read Me First* • *Cisco AS5800 Operations, Administration, Maintenance, and Provisioning Guide* (this book) • *Cisco AS5800 Universal Access Server Dial Shelf Card Guide* • *Cisco AS5800 Universal Access Server Hardware Installation Guide* • *Cisco AS5800 Universal Access Server Regulatory Compliance and Safety Information* • Configuration notes, updates, and release notes
Cisco 7206 router shelf	• *Cisco 7206 Installation and Configuration Guide* • *Cisco 7200 Series Port Adapter Hardware Configuration Guidelines* • *Regulatory Compliance and Safety Information for the Cisco 7200 Series Routers* • Configuration notes, updates, and release notes
Cisco 5814 dial shelf	• Configuration notes, updates, and release notes
System controller	• *Read Me First* • *Cisco 3640 System Controller Installation and Configuration Guide* • *Cisco 3640 Router Installation and Configuration Guide* • Configuration notes, updates, and release notes
Network management system	• Configuration notes, updates, and release notes
Cisco IOS software	Various documents available online at http://www.cisco.com/univercd/cc/td/doc/product/software/index.htm
Cisco marketing tools	• *Cisco Information Packet* • *Cisco Product Catalog*
Internetworking Solutions Guide	• *Cisco AS5x00 Case Study for Basic IP Modem Services* • *Cisco AAA Implementation Case Study*

For More Information

The Cisco IOS software running your Cisco AS5800 includes extensive features and functionality. For information about configuring Cisco AS5800, use the following resources:

- For Cisco AS5800 universal access server hardware installation and maintenance information, refer to the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/index.htm.
- For information about the trunk cards, modem cards, and Voice over IP cards used in the Cisco 5814 dial shelf, refer to the *Cisco AS5800 Universal Access Server Dial Shelf Card Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/index.htm.
- For international agency compliance, safety, and statutory information for wide-area network (WAN) interfaces for the Cisco AS5800 universal access server, refer to *Cisco AS5800 Universal Access Server Regulatory Compliance and Safety Information*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/5800rcns.htm.

Obtaining Documentation

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

World Wide Web

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

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

Documentation CD-ROM

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

Ordering Documentation

Cisco documentation is available in the following ways:

- Registered Cisco Direct Customers can order Cisco product documentation from the Networking Products MarketPlace at
  http://www.cisco.com/cgi-bin/order/order_root.pl
- Registered Cisco.com users can order the Documentation CD-ROM through the online Subscription Store at
  http://www.cisco.com/go/subscription
- Nonregistered CCO users can order documentation through a local account representative by calling Cisco corporate headquarters (California, USA) at 408 526-7208 or, in North America, by calling 800 553-NETS(6387).

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Obtaining Technical Assistance

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

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To access Cisco.com, go to the following website:
http://www.cisco.com

Technical Assistance Center

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

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:
http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

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

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

To register for Cisco.com, go to the following website:
http://www.cisco.com/register/

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

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:
http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

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

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CHAPTER 1

Introduction

The Cisco AS5800 universal access server is the latest entry into Cisco's award-winning AS5x00 series of universal access servers, and provides the highest concentration of modem and integrated services digital network (ISDN) terminations available in a single remote access concentrator product. The Cisco AS5800 is specifically designed to meet the demands of large service providers such as post, telephone, and telegraphs (PTTs), regional Bell operating companies (RBOCs), interexchange carriers (IXCs), and large Internet service providers (ISPs). The Cisco AS5800 complies with Network Equipment-Building System (NEBS) Level 3 requirements as defined by Telcordia Technologies SR-3580, and European requirements are defined by the European Telecommunication Standards Institute (ETSI). Cisco offers a full spectrum of lifecycle-focused support solutions that are complementary to the Cisco AS5800. Further, the Cisco AS5800 voice gateway enables highly scalable deployment of toll-quality voice and fax service over packet networks.

This introductory chapter provides a brief profile and review of the Cisco AS5800 hardware components and functionality, signal and data throughput logic, access server management flow, and Cisco IOS software, as well as an information map to this guide.

Cisco AS5800 Functional Profile

The Cisco AS5800 is a high-density, ISDN and modem WAN aggregation system that provides both digital and analog call termination. It is intended to be used in service-provider dial point-of-presence (PoP) or centralized-enterprise dial environments. The dial-shelf feature cards and the host router shelf communicate over a nonblocking interconnect that supports 100-Mbps full-duplex service.

The Cisco AS5800 supports high density dial aggregation and integrates with Cisco AS5200 and Cisco AS5300 access servers for scaling your service provider network. The Cisco AS5800 also supports high availability of service through online insertion and removal (OIR) capabilities, and redundant power supplies that are hot swappable. All active components within the dial-shelf chassis support OIR, which allows components to be removed or replaced while the system is powered on. Feature cards can be busied-out through the software to avoid loss of calls.

The Cisco AS5800 includes a Cisco 5814 dial shelf and a Cisco 7206 router shelf. If you are installing multiple access servers, a system controller is available, which provides a "single system" view of multiple POPs.

The system controller for the Cisco AS5800 includes the Cisco 3640 router running Cisco IOS software. The system controller can be installed at a remote facility so that you can access multiple systems through a console port or Web interface. It is also possible to download software configurations to any Cisco AS5800 using Simple Network Management Protocol (SNMP) or a Telnet connection using the TFTP protocols. The system controller also provides performance monitoring and accounting data collection and logging.

In addition to the system controller, a network management system (CiscoWorks) with a graphical user interface (GUI) runs on a UNIX SPARC station and includes a database management system, polling engine, trap management, and map integration.

The dial shelf contains ingress interfaces (CT1/CE1/PRI) that terminate ISDN and modem calls, and break out individual calls (DS0s) from the appropriate telco services. Digital or ISDN calls are terminated onboard the trunk card HDLC controllers, and analog calls are sent to modem resources on the modem cards. As a result, any DS0 can be mapped to any HDLC controller or modem module.You can install multiple ingress interface cards of similar or different types. This enables you to configure your systems as fully operative, port redundant, or card redundant, depending on your needs.

Trunk cards and modem cards are tied together across a time division multiplexing (TDM) bus on the dial-shelf backplane. The backplane TDM bus transmits and receives PCM-encoded analog data to and from the modem cards. Then the dial shelf and the router shelf exchange framed packets via a proprietary interconnect cable for further processing.

The dial shelf also contains a DSC card that provides clock and power control to the dial-shelf feature cards. Each dial-shelf controller card contains a block of logic referred to as the common logic and system clocks. This block generates the backplane Stratum-4 compliant 4-MHz and 8-KHz clocks used for interface timing and for the TDM bus data movement. The common logic can use a variety of sources to generate the system timing, including an E1 or T1 input signal from the BNC connector on the dial-shelf controller card front panel. The clock source can also be telco office timing units (BITS clocking) extracted from the network ingress interfaces.

On the DSC card, only one common logic is active at any one time, which is identified by the CLK (clock) LED on the DSC card front panel. The active common logic is user selectable and is independent from each dial-shelf controller card. This ensures that, if a DSC card needs replacing or if the slave DSC card becomes master, clocking remains stable. The selected common logic should not be changed during normal operation, unless related hardware failure is suspected or diagnosed.

Note Software support for redundant DSC cards will be available soon.

The Cisco 7206 router shelf supports call signaling for PRI interfaces; packet processing, and routing; and all commonly used high-speed LAN and WAN interfaces including Fast Ethernet (FE), Asynchronous Transfer Mode (ATM), High-Speed Serial Interface (HSSI), and Fiber Distributed Data Interface (FDDI). These interfaces are supported by common port adapters that are configured on the Cisco 7206 router shelf.

You can install and upgrade software remotely, without affecting current system operation. You can also upload and download configuration files remotely, without affecting current system operation. Remote access is enabled by using SNMP, a Telnet session to a console port on the router shelf, the World Wide Web (WWW) interface, or the optional system controller network management system.

The Cisco AS5800 can dynamically adjust any port to support any user configuration. Individual users can be authenticated as they connect to the system by use of one or more authentication servers using RADIUS and TACACS+ authentication protocols. Primary and backup authentication servers can define user authentication parameters via user domain and the number called. User profile information can also be configured to include time of day, number of simultaneous sessions, and number of B channels used.

A remote LAN user can connect to the Cisco AS5800 via an ISDN line or asynchronous serial connection, be authenticated, and establish a session. In addition to dynamic or static address assignments, this connection requires the traditional Cisco IOS software support for different routing protocols on different ports simultaneously, with virtually no impact on service provider routing tables.

A dial wholesale customer can connect to a Cisco AS5800, and tunnel PPP packet information to a retail service provider using dial virtual private network (dial VPN).

Cisco AS5800 Hardware Review

The Cisco AS5800 consists of two primary system components, the Cisco 5814 dial shelf (DS) and the Cisco 7206 router shelf (RS).

For detailed Cisco 7206 router-shelf hardware specifications and functionality, refer to the following documents:

- *Cisco 7200 VXR Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7200vx/72vxicg/
- *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

For detailed Cisco 5814 dial-shelf hardware specifications and functionality, refer to the following documents:

- *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/
- *Cisco AS5800 Universal Access Server Dial Shelf Card Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

Dial Shelf

The Cisco 5814 dial shelf (DS) houses three primary types of circuit cards or boards. Two of these circuit cards, commonly referred to as Feature Module (FM) are trunk cards and modems. They support online insertion and removal (OIR), a feature that permits dynamic replacement without interrupting system activity. These CE1/T1/T3 trunk cards and DMM modem carriers provide the ingress (signal input) interfaces for the Cisco AS5800. The third circuit card type is the dial-shelf controller (DSC) card that provides dial-shelf chassis control and management interfaces.

Dial-Shelf Controller

The Cisco AS5800 dial-shelf controller (DSC) card is located in slots 13 or 14 on the dial-shelf backplane interconnect bus (BIC). It manages all interfaces through the dial shelf, serves as the dial shelf's direct interface to the router shelf, and facilitates the TDM Bus Clock. The DSC card contains two PC card slots that hold the internal flash (bootflash).

Router Shelf

The Cisco 7206 serves as the host router for the Cisco AS5800 and conducts all route/packet route processing functionality of carrying data between the dial shelf and an external network. Full Cisco IOS software functionality is provided on the router shelf. Major components of the Cisco 7206 router shelf are the network processing engine (NPE), dial-shelf interconnect port adaptor (DSI-PA), and the egress interfaces (PAs).

The Cisco 7206 router shelf resides in a standard C7206 chassis, holds the Cisco AS5800's system configuration, performs all Cisco AS5800 routing functions, supports NPE-400, and provides the Cisco AS5800's egress (signal output) interfaces.

Note A virtual console can be opened from the RS to any feature card (including the DSC).

System Architecture

The Cisco AS5800 system architecture consists of backplane bus connections that provide communications between the dial shelf and the host router shelf, monitor system environment conditions, and transmit clock/frame pulses to feature/DS controller cards.

For detailed Cisco 7206 router-shelf functionality and hardware specifications refer to the following documents:

- *Cisco 7200 VXR Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7200vx/72vxicg/
- *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

ROM Monitor

This section describes the Cisco AS5800 ROM monitors on the Cisco 7206 router shelf and the Cisco 5814 dial shelf. ROM monitor is the first software to run when the Cisco AS5800 is powered-up or reset.

The router-shelf ROM monitor operates like a regular Cisco 7206 router ROM monitor. For more information on basic router usage, refer to the *Cisco 7206 Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/7206ig/.

The dial-shelf ROM monitor is located on dial-shelf controller cards installed in dial-shelf chassis slots 12 and 13. The dial-shelf ROM monitor is configured to autoboot during system power-up or reset. It always attempts to boot from the first image on Flash memory devices in the following sequence:

- PCMCIA slot 0
- PCMCIA slot 1
- Boot Flash memory

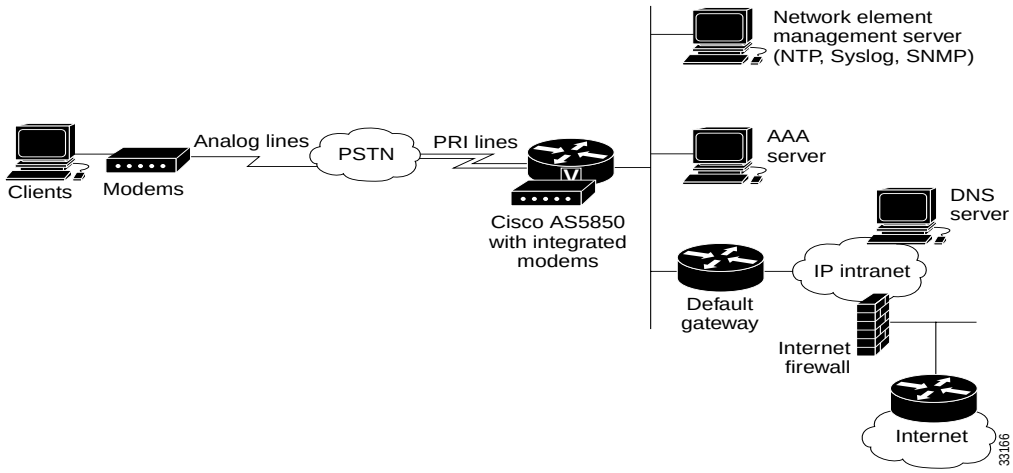
Note During a normal system boot, PCMCIA slots 0 and 1 should remain empty to allow the default image on the boot Flash memory to boot the system.

To boot the system from an image other than the default image, copy the image used to boot as the first file on a PCMCIA Flash memory card and insert the Flash memory card into PCMCIA slot 0 or 1. Reload the dial-shelf controller, which will cause the system to override the default image and reboot the system from the PCMCIA Flash memory card.

Network Topology and Equipment Selection

Figure 1-1 shows the topology devices used to build dialup access environments.

Figure 1-1 Network Topology Elements



Corporate users and ISPs may have identical network topologies:

- Remote clients use analog modems to access the IP backbone through the PSTN.
- A Cisco AS5800 NAS is used as a point-of-presence (POP) to terminate modem calls and Point-to-Point Protocol (PPP) sessions.
- PRI lines are used to provide high throughput (64K) for digital and analog calls. In general, T1 lines can be ISDN PRIs or channelized T1s.
- A network element management server maintains and monitors the Cisco AS5800 by using the Network Time Protocol (NTP), system logs (syslog), and the Simple Network Management Protocol (SNMP).
- A remote AAA server performs basic user authentication. Corporate users and ISPs can use TACACS+ or RADIUS.
- A default gateway forwards packets to the IP intranet and Internet.
- An Internet firewall is used to protect the IP intranet from intruders and hackers.
- A router provides connectivity between the access subnet and the IP backbone.
- For the latest Cisco IOS features and bug fixes, the Cisco AS5800 is upgraded to Cisco AS5800 12.0(4) XL or 12.0(5)T releases.

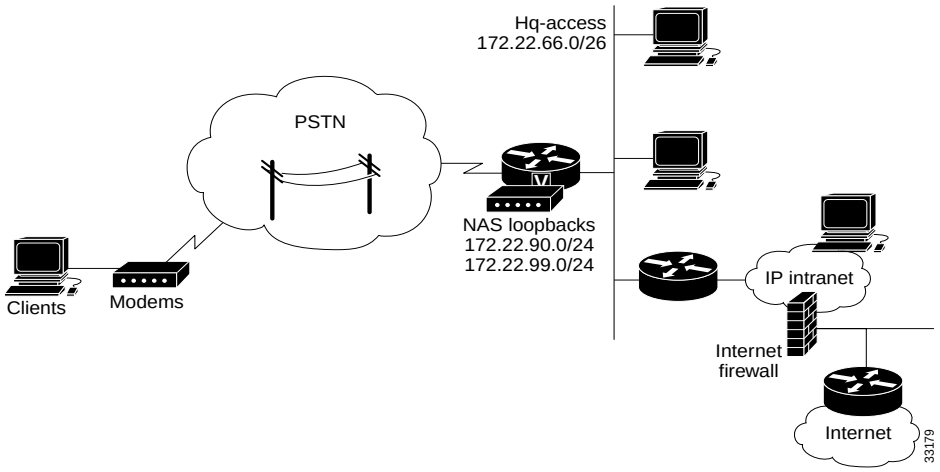
Note Use a mature Cisco IOS release whenever possible.

Configuration Design Parameters

Before Cisco AS5800 equipment is deployed at your site, define the following configuration design parameters:

- IP subnetting and address strategy
- Device parameters
- Network dial plan

Figure 1-2 IP Subnetting Diagram



Note Uses private RFC 1918 IP addresses. For more information, refer to the Best Current Practice memo available online at http://www.ietf.org/rfc/rfc1918.txt

IP Subnetting Plan

The following list describes IP subnetting plan considerations. Identify network names, assigned subnets, and descriptions.

1. Headquarters block (172.22.0.0/17)
   - The headquarters portion of the class-B IP address block for the corporate user or ISP.
   - The top half of 172.22.0.0 is the IP address pool for the incoming remote-node modem users. The lower half of 172.22.0.0 is reserved for the devices inside the corporate or ISP network.
2. Remotes block (172.22.128.0/17)
   - The upper half of 172.22.0.0 is reserved for remote networks.
3. Headquarters-access (172.22.66.0/26)
   - The headquarters access Ethernet subnet. All access devices are directly connected to this subnet.
   - If additional access servers and POP-management devices are needed, they are assigned to this IP subnet. This approach simplifies network design.

4. NAS loopback 0 (172.22.99.0/24)
   - Identifies with a unique and stable IP address. One unique IP address from a common block of addresses is assigned to each device in the IP network. This technique facilitates 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.
5. NAS loopback 1 (172.22.90.0/24)
   - Hosts a pool of IP addresses for the remote nodes. In this way, one route instead of 254 routes is summarized and propagated to the backbone.

Note Setting up Interior Gateway Protocols (IGP) such as OSPF and EIGRP is outside the scope of this document.

Device Parameters

The following list describes device parameter considerations.

1. Router host names
   - 5800-NAS
2. Interface Ethernet 0
   - 172.22.66.23 255.255.255.0
3. Interface loopback 0
   - 172.22.99.1 255.255.255.255
4. Interface loopback 1
   - 172.22.90.1 255.255.255.0
5. IP local address pool
   - 5800-NAS = 172.22.90.2 through 172.22.90.254
6. Primary and secondary name servers
   - 172.22.11.10
   - 172.22.12.11
7. Default gateway
   - 172.22.66.1
8. IP domain names
   - Corporate or ISP
9. Network element management server (NTP, SNMP, syslog)
   - 172.22.66.18
10. SNMP community strings
    - Read only (RO) = poptarts
    - Read write (RW) = pixysticks

Dial Plan

The following list describes dial plan setup considerations.

1. PRI telephone numbers assigned to the T1 trunks. One number is used for testing new modem firmware and the other for isolating debugs for specific users.
   - 4085551234
   - 4085556789
2. ISDN PRI switch type
   - 5ESS
3. Username and password for sending test calls into the NAS
   - username = user
   - password = user-pw

Cisco IOS Software Fundamentals

Cisco IOS software provides the capability to configure a Cisco AS5800 using command-line interface (CLI) commands.

Use the following helpful reminders when configuring your Cisco IOS software:

- Use the question mark (?) and arrow keys to help enter commands.
- Note that each command mode restricts you to a set of commands.
- Enter the keyword **no** before a command to disable a feature; for example, **no ip routing**.
- Save configuration changes to NVRAM so they are not lost in a system reload or power outage.
- Use the forward slash (/) command syntax to identify shelf components, interfaces, and port locations (shelf/slot/port). The shelf identification number is the first number identified in the two-bar command syntax.

Note Cisco IOS software is feature specific and licensed on an "as is" basis without warranty of any kind, either expressed or implied. The version of Cisco IOS software used in this manual varies depending on configuration requisites for presentation purposes, and should not be construed as the Cisco IOS software version of choice for your system or internetwork environment. Consult your Cisco sales representative regarding your Cisco IOS requirements.

User Interface Command Modes

Cisco routers are configured from user interfaces, known as ports, which provide hardware connectivity. They are accessed from the console port on a router or Telnet into a router interface from another host. Typical interfaces are Serial 0 (S0), Serial 1 (S1), and Ethernet 0 (E0). Token Ring interfaces are referenced as (T0) and FDDI interfaces use (F0).

Command Modes

When using the CLI, a command interpreter, called EXEC, is employed by the operating system to translate any command and execute its operation. This command interpreter has two access modes, user and privileged, which provide security to the respective command levels. Each command mode restricts you to a subset of mode-specific commands.

User mode provides restricted access and limits router configuration or troubleshooting. At this level, miscellaneous functionality is performed, such as viewing system information, obtaining basic router status, changing terminal settings, or establishing remote device connectivity.

Privileged mode includes user mode functionality and provides unrestricted access. It is used exclusively for router configuration, debugging, setting operating system (OS) parameters, and retrieving detailed router status information.

There are many modes of configuration within privileged mode that determine the type of configuration desired, such as interface configuration (`5800-1(config-if)#`), line configuration (`5800-1(config-line)#`), and controller configuration (`5800-1(config-controller)#`). Each configuration command mode restricts you to a subset of mode specific commands.

In the following command sequence, command prompts are automatically modified to reflect command mode changes. A manual carriage return is implied at the end of each line item.

```
5800-1> enable
5800-1# configure terminal
5800-1(config)# interface ethernet 0/0/0
5800-1(config-if)# line 0/0/0
5800-1(config-line)# controller t1 0/0/0
5800-1(config-controller)# exit
5800-1(config)# exit
5800-1#
%SYS-5-CONFIG_I: Configured from console by console
5800-1#
```

The last message is an example of a system response. Press **Enter** to get the `5800-1#` prompt.

Table 1-1 lists common configuration modes. Configure global parameters in global configuration mode, interface parameters in interface configuration mode, and line parameters in line configuration mode.

Table 1-1 Common Command Modes

Command Mode	Prompt	Access Method	Escape Method
User EXEC	`5800-1>`	Log in.	Use the **exit** or **logout** command to leave the command line interface.
Privileged EXEC	`5800-1#`	From user EXEC mode, enter the **enable** command.	Use the **disable** command to escape back to user EXEC mode. Use the **exit** or **logout** command to leave the command line interface.
Global configuration	`5800-1(config)#`	From privileged EXEC mode, enter the **configure terminal** command.	Use the **exit** or **end** (Ctrl-Z) command to escape to privileged EXEC mode.

Table 1-1 Common Command Modes (continued)

Command Mode	Prompt	Access Method	Escape Method
Interface configuration	`5800-1(config-if)#`	Enter the **interface** type and number command, such as **interface ethernet 0/0/0**.	Use the **exit** command to escape to global configuration mode. Use the **end** (Ctrl-Z) command to escape directly to privileged EXEC mode.
Line configuration	`5800-1(config-line)#`	Enter the **line** start-number end-number command, such as **line 0/0/1 0/0/48**.	Use the **exit** command to escape to global configuration mode. Use the **end** (Ctrl-Z) command to escape directly to privileged EXEC mode.
Controller configuration	`5800-1(config-control)#`	Enter the **controller** name and number command, such as **controller t1 0/0/0**.	Use the **exit** command to escape to global configuration mode. Use the **end** (Ctrl-Z) command to escape directly to privileged EXEC mode.

Context-Sensitive Help

Context-sensitive help is available at any command prompt. Enter a question mark (?) for a list of complete command names, semantics, and command mode command syntax. Use arrow keys at command prompts to scroll through previous mode-specific commands for display.

Note Cycle through mode-specific commands at a mode-specific prompt.

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

  `5800-1> ?`

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

  `5800-1> s?`

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

  `5800-1> show ?`

For more information about working with the user interface in the Cisco IOS software, refer to the document entitled *Configuration Fundamentals Configuration Guide* for your Cisco IOS software release, available from the Cisco.com website.

Note You can press **Ctrl-Z** in any mode to immediately return to enable mode (`5800#`), instead of entering **exit**, which returns you to the previous mode.

Saving Configurations

To prevent losing the Cisco AS5800 configuration, save it to NVRAM using the following steps.

Step 1 Enter the **enable** command and password. You are in privileged EXEC mode when the prompt changes to `5800-1#`.

```
5800-1> enable
Password: password
5800-1#
```

Note Press **Ctrl-Z** to return to privileged EXEC mode. Any subsequent system response message is normal and does not indicate an error.

Step 2 Execute the **copy running-config startup-config** command to save configuration changes to nonvolatile random-access memory (NVRAM) so configuration data will not be lost during a system reload, power cycle, or outage.

```
5800-1# copy running-config startup-config
Building configuration...
```

The following message and prompt appears after a successful configuration copy.

```
[OK]
5800-1#
```

Undoing a Command

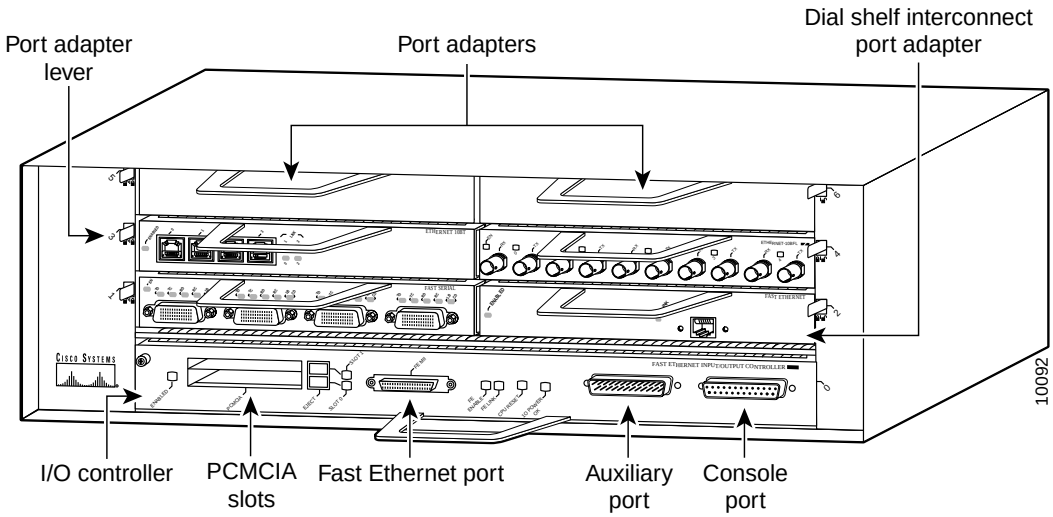
To undo a command or disable a feature, enter the keyword **no** before the command; for example, **no ip routing**.

Basic Cisco AS5800 Start Up

This section describes how to start up your Cisco AS5800 and configure it using the prompt-driven setup script.

All Cisco AS5800 interfaces are configured by connecting a terminal station or PC to the Cisco 7206 router-shelf console port. This console port is located on the I/O controller front panel, as shown in Figure 1-3.

Figure 1-3 Cisco 7206 Router-Shelf Console Port



To customize your Cisco AS5800 software configuration, you should be familiar with Cisco IOS software. Review the "Cisco IOS Software Fundamentals" section on page 1-8 to familiarize yourself with the command-line interface (CLI) commands, then continue with the "Commissioning"chapter for initial step-by-step configuration instructions.

Your Cisco AS5800 requires multiple Cisco IOS software images.

1. Router-shelf image—Cisco IOS software image (c5800-p4-mz) supporting Cisco AS5800 router-shelf functionality, and bundled trunk card and modem card images
2. Router-shelf boot image—Boot helper image (c7200-boot-mz) for Cisco 7206 router shelf
3. Dial-shelf controller image—With boot helper image (dsc-c5800-mz) for Cisco 5814 dial-shelf feature cards
4. Dial-shelf feature board image—Cisco 5814 dial-shelf feature card image (das-c5800-m.ucode) bundled into the router-shelf image

Although four Cisco IOS software images are required, only three software images (Items 1-3) require part numbers for ordering.

The dial-shelf controller image can be upgraded by copying the new image onto a Personal Computer Memory Card International Association (PCMCIA) Flash memory card on the dial-shelf controller card; however, you will soon be able to upgrade the dial-shelf controller image from the network.

Figure 1-4 and Figure 1-5 show a rack-mounted Cisco AS5800 hardware components that require configuration or software monitoring.

Figure 1-4 Cisco AS5800 Universal Access Server—Front View

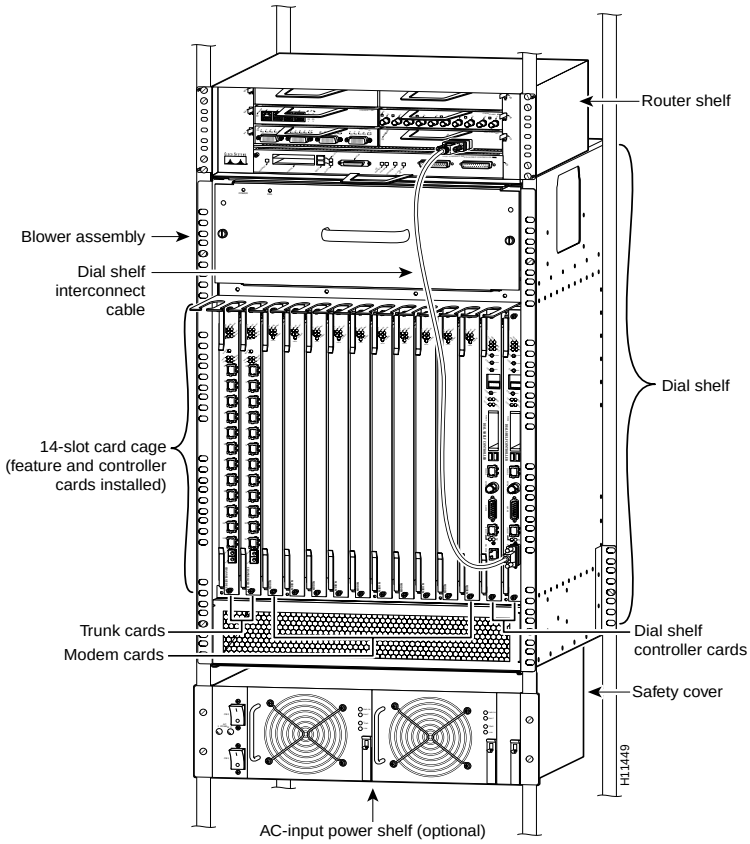
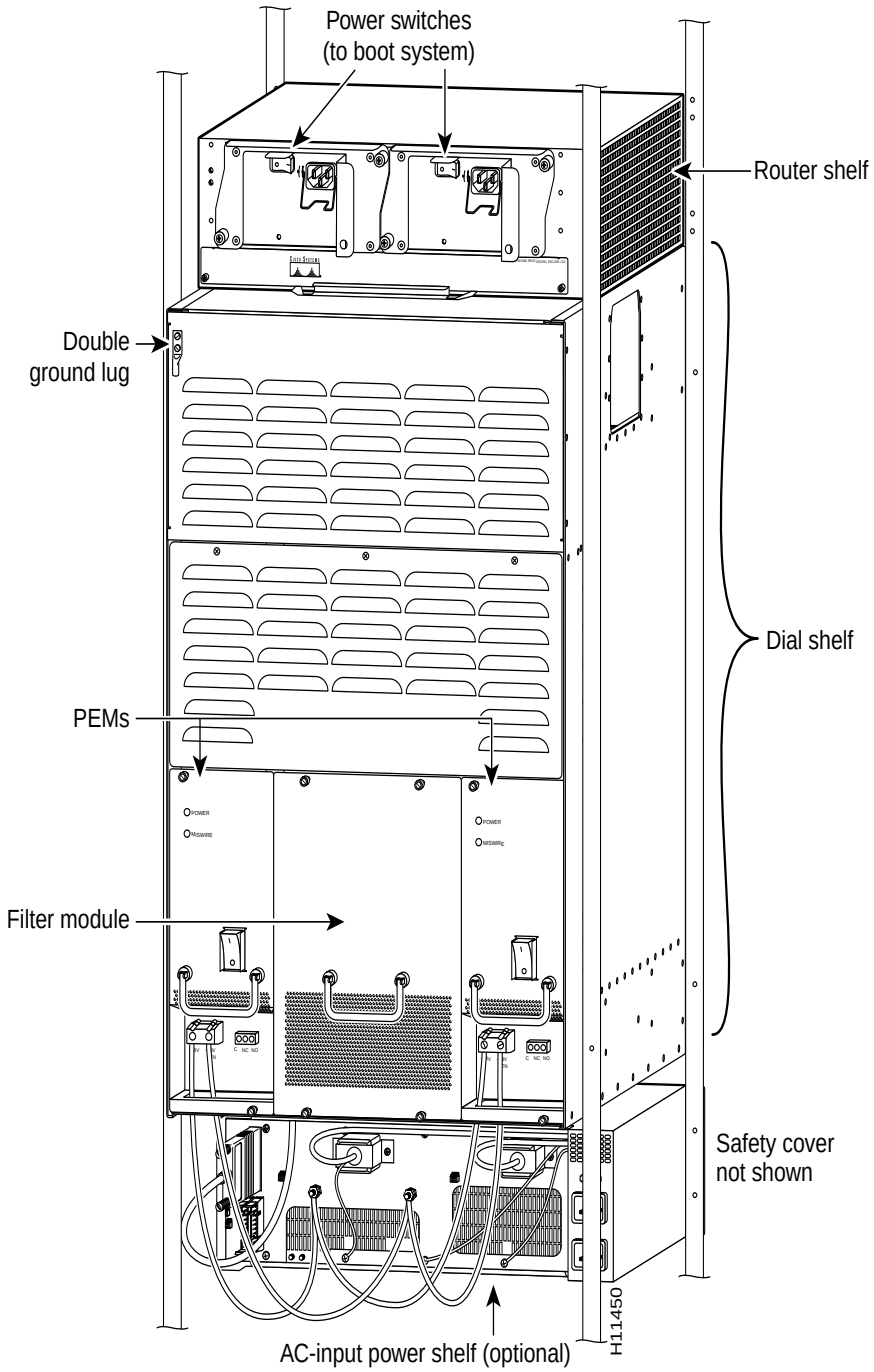


Figure 1-5 Cisco AS5800 Universal Access Server—Rear View



Cisco AS5800 First-Time Boot

When you power ON your Cisco AS5800, it goes through the following boot sequence:

1. A power-on self-test diagnostics program verifies basic operation of the CPU, memory, and interfaces.
2. The system bootstrap software executes and searches for a valid Cisco IOS software image. The Cisco IOS software source image is determined by the configuration register setting. The factory-default setting for the configuration register is 0x2102, which indicates that the router should attempt to load a Cisco IOS software image from Flash memory or over the network (depending on boot configuration commands).
3. If, after five attempts (if netbooting) or one attempt (for a Flash memory boot), a valid Cisco IOS software image is not found in Flash memory, the router reverts to boot the ROM mode, which is used to install or upgrade a Cisco IOS software image.
4. If a valid Cisco IOS software image is found, the router searches for a valid configuration file.
5. If a valid configuration file is not found in nonvolatile random-access memory (NVRAM), the router runs the setup script (also called the system configuration dialog), which enables you to configure your software manually. For normal router operation, you must have a valid Cisco IOS software image in Flash memory and a configuration file in NVRAM.

Cisco AS5800 Boot Process

The system boot process consists of two-stages. When the system is first powered on, the trunk cards and modem cards must receive a small image from the dial-shelf controller card, which is then launched by the ROM monitor. This allows the feature cards the ability to “talk” to the dial-shelf controller card and download the bootloader program. Communication is then made on the backplane, that allows each feature cards to talk with the router shelf the Cisco IOS software image. All cards download the bootloader image simultaneously, which then allows them to “talk” across the proprietary Fast Ethernet connection and request the image needed for each card. A hello message is exchanged between the router shelf and the dial shelf.

Because of this two-step boot process, when you first power ON your system, you might not see the feature card LEDs light immediately.

Dial-Shelf Booting

The dial shelf boots up independently from the router shelf. The dial-shelf controller card (DSC) is the first component to boot up. It is set for autobooting from internal Flash memory. If, however, a PCMCIA Flash memory card is present, the DSC tries to first boot from the card, beginning with slot 0.

Using the Setup Script

The setup script is designed to provide you with the minimum requirements needed to get your router running. The setup script enables your system controller to "talk" to the network. You can then configure your system using command-line interface (CLI) commands, or by downloading a predetermined site configuration file.

Before you power ON your Cisco AS5800 and begin using the setup script, verify that you have:

- Connected the console cable to the Cisco 7206 router-shelf console port, which is located on the I/O controller front panel
- Configured your PC terminal emulation program for 9600 baud, 8 data bits, no parity, and 2 stop bits
- Noted the IP address of your Ethernet interface
- Noted the set of available IP addresses to be assigned to dial-in IP clients
- Noted the host name
- Noted the ISDN switch types, framing types, and T1 or E1 line codes
- Noted passwords (see the "Passwords" section on page 1-17)

After you verify the information noted above, perform the configuration steps. Continue with the "Setup-Script Initial Configuration" section on page 1-17.

Running the Setup Script

You can run the setup script from the command line at any time using the **setup** command. The following commands help enable the **setup** command from the privileged EXEC mode.

Step 1 Enter the **enable** command.

```
5800> enable
```

Step 2 Enter your password. You are in privileged EXEC mode when the prompt changes to `5800#`.

```
Password: password
5800#
```

Step 3 Enter the **setup** command and press **Return**. This will initialize the system configuration dialog as described in the previous section "Setup-Script Initial Configuration."

```
5800# setup
```

Passwords

Several passwords are used when configuring your Cisco IOS software. Passwords are used to identify user authorization and permission rights, virtual terminal configuration, and network management software initialization. Most passwords can use the same notation.

You need the following types of passwords when configuring Cisco IOS software:

- Enable password—A nonencrypted and, therefore, less secure password.
- Enable secret password—A very secure, encrypted password that is used in place of the enable password. Because many privileged-level EXEC commands are used to set operating parameters, we recommend that you use the enable secret password to prevent unauthorized use.

Note The enable password and enable secret password should be different. In both cases, you cannot use a number as the first character. Spaces are valid characters, but only when following valid characters; lead spaces are ignored.

- Virtual console password—Enables terminal emulation.

Setup-Script Initial Configuration

When the system is booted for the first time, NVRAM is blank. Because of this, the system software will automatically ask if you want to enter the setup script (system configuration dialog). After you have a configuration, run the setup script again to change it.

The first step is to power ON your Cisco AS5800. The power switch is located on the Cisco 7206 router-shelf rear panel. Be sure to power on the power entry modules (PEMs), which can be accessed from the Cisco 5814 dial-shelf rear panel. If you are using the optional AC-input power shelf, you also need to power on the AC-input power supplies.

Note The messages vary, depending 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.x(19990210:195103) [12.0XE 105],
Copyright (c) 19xx-20xx by cisco Systems, Inc.
C7200 platform with 262144 Kbytes of main memory

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

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in subparagraph (c) of the Commercial Computer Software - Restricted Rights clause at FAR
sec. 52.227-19 and subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

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

Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-P4-M),
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Fri 21-Jan-00 07:57 by Image text-base: 0x60008900, data-base: 0x6150C000

cisco 7206VXR (NPE400) processor (revision B) with 253952K/40960K bytes of memory.
Processor board ID 15376291 R7000 CPU at 262Mhz, Implementation 39, Rev 1.0, 256KB L2,
2048KB L3 Cache6 slot VXR midplane, Version 2.0

Last reset from power-on
X.25 software, Version 3.0.0.
Bridging software.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
Primary Rate ISDN software, Version 1.1.
8 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
4 Serial network interface(s)
288 terminal line(s)
12 Channelized T1/PRI port(s)
125K bytes of non-volatile configuration memory.

16384K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Building configuration...
[OK]
Building configuration...

SETUP: new interface Ethernet0/3/0 placed in "shutdown" state
SETUP: new interface Ethernet0/3/1 placed in "shutdown" state
SETUP: new interface Ethernet0/3/2 placed in "shutdown" state
SETUP: new interface Ethernet0/3/3 placed in "shutdown" state
SETUP: new interface Ethernet0/3/4 placed in "shutdown" state
SETUP: new interface Ethernet0/3/5 placed in "shutdown" state
SETUP: new interface Ethernet0/3/6 placed in "shutdown" state
SETUP: new interface Ethernet0/3/7 placed in "shutdown" state
```

```
Press RETURN to get started!
```

The system then asks if you would like to enter the system configuration dialog. Answer **yes** and configure your software using the system configuration dialog.

Note If you make a mistake, you can exit and run the system configuration dialog again. Press **Ctrl-c**, and type **setup** at the enable mode prompt (`5800#`).

Step 1 Enter **yes** at the following prompt if you are ready to continue with the system configuration dialog. If you enter no at this prompt, the system software will return you to the router prompt.

```
Continue with configuration dialog? [yes/no]: yes
```

Step 2 Enter the router-shelf identification number, followed by a dial-shelf identification number. Substitute the default values shown with any numeric value between **0** and **9999**.

Basic management setup configures only enough connectivity for management of the system, extended setup will ask you to configure each interface on the system

```
Router Shelf-ID [0]:
Dial Shelf-ID   [1]:
```

Note The Cisco AS5800 uses a “two-bar” (/) command syntax to identify component (also known as “shelf”), interface, and port locations (shelf/slot/port). The shelf identification number will be the first number to be identified in the two-bar command syntax.

Step 3 Determine whether you want to enter basic management setup configuration and respond to the prompt.

```
Would you like to enter basic management setup? [yes/no]: yes
Configuring global parameters:
```

Note This example assumes you want to enter the basic management setup configuration. Extended configuration information is explained in Chapter 2 “Operations”.

Step 4 Enter the router host name. Substitute your own router host name for the one shown.

```
Enter host name: 5800-1
```

Step 5 Enter the enable secret password. The enable secret password is a one-way coded secret used instead of the enable password when it exists. Substitute your own enable secret password for the one shown.

```
Enter enable secret [<Use current secret>]: shhhh
```

Step 6 Enter the enable password. The enable password is used when there is no enable secret and when using older software and some boot images.

```
Enter enable password [public]: guesswho
```

Step 7 Enter the virtual terminal password. Substitute your own virtual terminal password for the one shown.

```
Enter virtual terminal password: shhhh1
```

Step 8 If you plan to use a system controller network management system through which you can administer your Cisco AS5800, enter **yes** to the following prompt, then enter substitute your own IP address and system controller password when prompted.

```
Configure System Management? [yes/no]: yes
System Controller IP address: 10.10.1.1
System Controller password: cisco
```

Step 9 The system controller supports the Simple Network Management Protocol (SNMP); enter **yes** at the prompt. The community string is used by the system controller to communicate with its managed shelves. You need to determine a password for this function; the default password is **public**.

```
Configure SNMP Network Management? [yes]:
Community string [public]:
```

Step 10 Enter the interface information used to connect to the system controller at the prompt.

```
Enter interface name used to connect to the management network from the above interface
summary: Ethernet0/1/0
```

Step 11 The system then displays current interface summary information, as shown in Table 1-1, that will help you configure your available egress interfaces.

```
Configuring interface Ethernet0/1/0:
Configure IP on this interface? [no]:
```

Table 1-2 Current Interface Summary

Interface	IP-Address	OK?[1]	Method	Status	Protocol
FastEthernet0/0/0	unassigned	NO	unset	down	down
Ethernet0/1/0	10.10.1.1[2]	YES	set	up	up
Ethernet0/1/1	unassigned	NO	unset	down	down
Ethernet0/1/2	unassigned	NO	unset	down	down
Ethernet0/1/3	unassigned	NO	unset	down	down

1. Any interface listed with OK? value “NO” does not have a valid configuration.
2. The IP address shown requires configuration by the user; it is not a default configuration.

Note If you change a shelf-ID number, you must perform a reload before the new shelf-ID is saved in NVRAM. Use the **show version** command after you have changed a shelf-ID and performed a reload.

After you enter the interface used to connect to the management network, the system software will automatically display the command script that was just created.

```
The following configuration command script was created:
hostname 5800-1
enable secret 5 $1$g74v$J87e3eDZdh0wWIR7m4ELy/
enable password shhhh
line vty 0 4
password alwaysup
syscon address 10.10.1.1 cisco
snmp-server community public
!
no ip routing

!
interface FastEthernet0/0/0
shutdown
no ip address
!
interface Ethernet0/1/0
no shutdown
no ip address
!
interface Ethernet0/1/1
shutdown
no ip address
!
interface Ethernet0/1/2
shutdown
no ip address
!
interface Ethernet0/1/3
shutdown
no ip address
!
end
```

Verify that the command script just created is correct and enter **yes** at the prompt if you want to save the configuration. If you enter **no** at the prompt, you will need to repeat the steps described in Table 1-1 until the desired configuration file is achieved.

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

Selecting choice number [2] builds the configuration into NVRAM as follows:

```
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.

5800#
*Dec 23 12:48:58: %LINK-3-UPDOWN: Interface Ethernet0/1/0, changed state to up
```

Press **Return** to display the privileged EXEC router prompt.

```
5800#
```

You have just completed a basic Cisco AS5800 startup configuration; however, you will probably need to customize this configuration to further meet your site's requirements.

Deployment and Operation Strategy

The following steps describe and suggest a recommended deployment and operation task strategy for the Cisco AS5800 that serves as a functional task flow for this Guide.

Step 1 Cisco AS5800 Introduction

- Network topology and equipment selection
- Configuration design parameters
- Subnetting plan
- Dial plan

Step 2 Cisco AS5800 Provisioning

- Setting up modem services
- Dial planning design
- Network service definition

Step 3 Cisco AS5800 Commissioning

- Cisco AS5800 basic hardware architecture and setup
- Supporting EXEC terminal shell services and login prompts for modem clients
- Enabling trunk controllers and IP setup
- Configuring Cisco IOS software, serial interfaces, modems and lines

Step 4 Cisco AS5800 Operations

- Understanding and troubleshooting basic modem connectivity
- Optimizing modem connect speeds

Step 5 Cisco AS5800 Administration

- Enabling the NTP, SNMP, and Syslog management protocols as part of commissioning a dial access service
- PPP authentication for local AAA.
- IP Control Protocol (IPCP) options
- Link Control Protocol (LCP) options
- PPP autoselect
- Testing asynchronous PPP connections.

Step 6 Cisco AS5800 Maintenance

- Managing modem firmware
- Configuring modems by using modem autoconfigure
- Gathering and viewing call statistics

Step 7 Advanced Operational Configurations of Functional Components.

- Egress interface
- Loopback interface
- Routing protocol
- Ingress interface

- Line signaling
- D-channels (ISDN)
- AAA
- Modem pools
- TTY line
- Async interface
- Dial interface
- IP address pools
- Virtual template
- SGBP
- VPDN
- SNMP
- Virtual profiles
- Multilink virtual templates
- V.120 support
- VoIP
- Global parameters
- Other configuration considerations

CHAPTER 2

Commissioning

Whether you are a corporate end user or a competitive Internet service provider (ISP), you have purchased a Cisco AS5800 network access server (NAS) to provide dialup services that facilitate accessibility for remote or roaming personnel, or Internet admission to consumers for e-mail, e-commerce, and web browsing.

This chapter details Cisco AS5800 commissioning, or the formal functional setup of the equipment, through systematic software configurations, to initially prepare the system for data/voice call processing.

In our discussion, local-based authentication is used. After the Cisco AS5800 hardware is commissioned, PPP is configured and tested as described in"Configuring PPP and Authentication" section on page 3-25.

Note A AAA RADIUS server is recommended. AAA Radius server discussions are available in the "Configuring RADIUS" section on page 4-14.

Commissioning the Cisco AS5800 Hardware

This section describes configuring the Cisco AS5800 hardware to support terminal EXEC shell services and log in prompts for client modems, and includes the following:

Note For a description of terminal EXEC shell services, see the "Task 7. Testing Asynchronous EXEC Shell Connections" section on page 2-36.

Understanding the Basic Hardware Architecture

To build an access network using the Cisco AS5800, it is necessary to understand:

- The Cisco 7206 router shelf
- The Cisco 5814 dial shelf
- Call-processing components

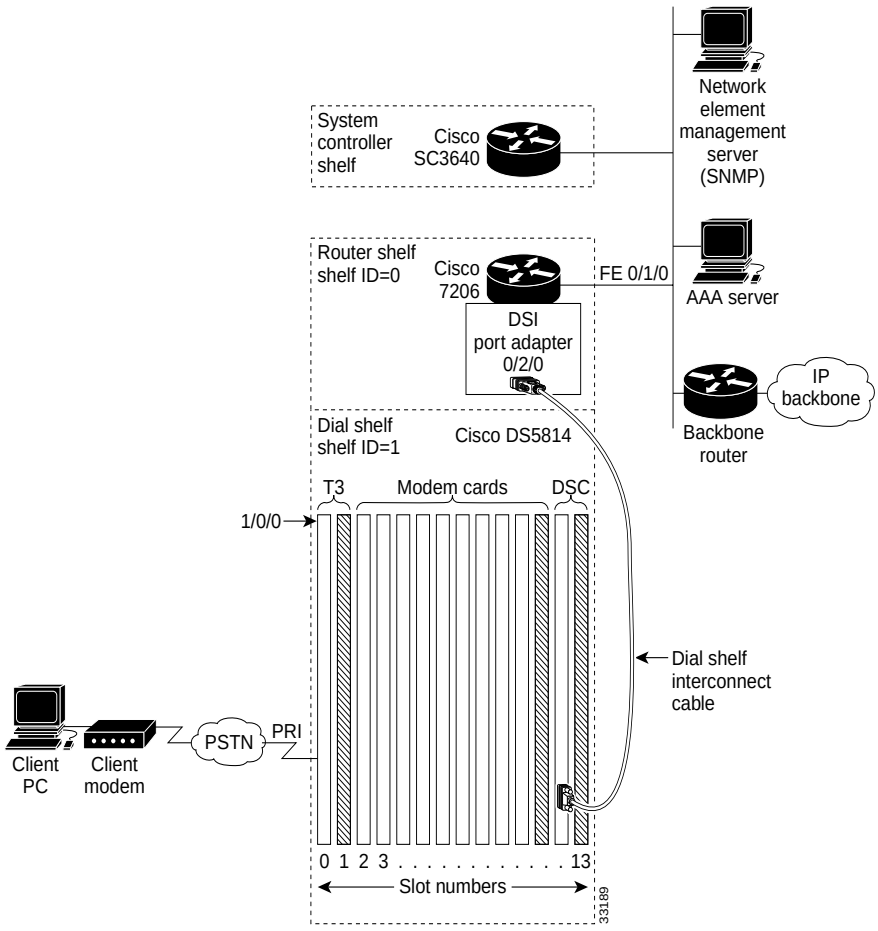
Cisco 7206 Router Shelf and Cisco 5814 Dial Shelf

The Cisco AS5800 access server contains:

- A Cisco 7206 router shelf (egress interface). It connects to the IP backbone.
- A Cisco 5814 dial shelf (ingress interface). It connects to the PSTN.

Figure 2-1 shows the Cisco AS5800 system architecture.

Figure 2-1 Cisco AS5800 System Architecture



Note The Cisco IOS software uses a three-element notation to specify interface and port locations: *shelf*/*slot*/*port*.

- The Cisco 7206 router shelf contains the following:
  - Port adapters. In the example, the Cisco 7206 uses Fast Ethernet (FE) 0/1/0 to connect to the IP backbone.
  - A dial-shelf interconnect (DSI) port adapter. In the example, the adapter is located at 0/2/0.

    The Cisco 7206 communicates with the Cisco 5814 dial shelf through an external dial-shelf interconnect cable. The cable connects from the DSI port adapter to the dial-shelf controller (DSC) card.

    The Dial Shelf Interconnect Protocol (DSIP) enables communication between the Cisco 7206 and the Cisco 5814.
  - Service adapters (for example, compression and encryption).
  - By default, a shelf ID of 0 is assigned to the router shelf.
- The Cisco 5814 dial shelf contains the following:
  - Dial-shelf controller (DSC) cards. They fit in slots 12 or 13 only. If you have one DSC card, slot 12 is recommended. One DSC card is used in the example.

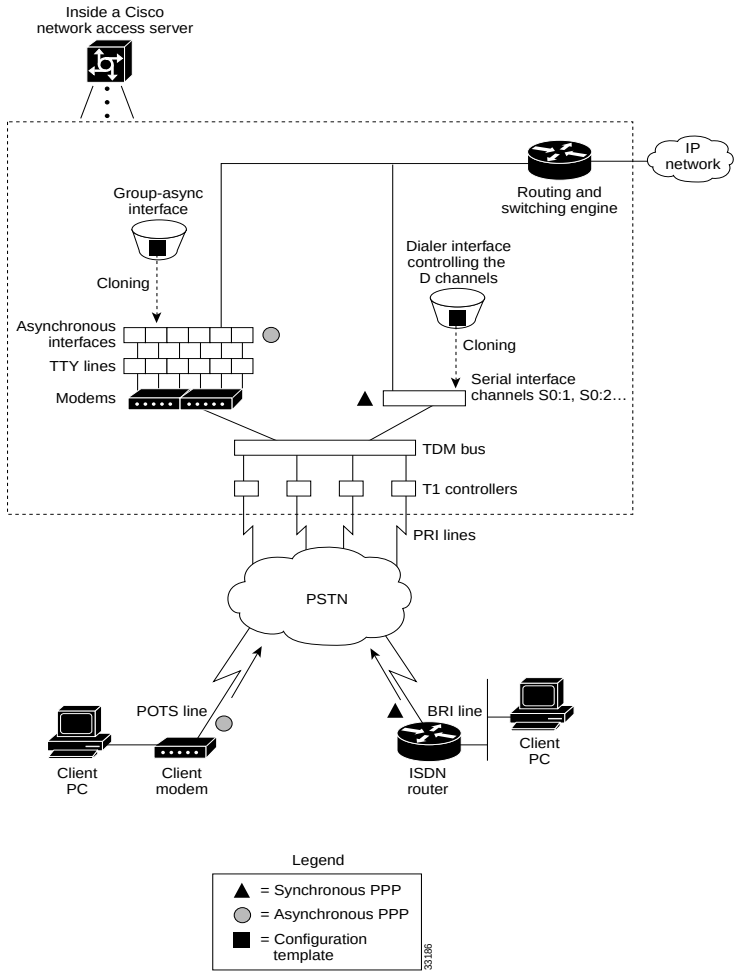
    The DSC card contains its own Cisco IOS software image. For maintenance purposes only, the card can be accessed through its console port and Ethernet interface. No IP packets originating from any trunk or modem cards go out this Ethernet interface.
  - T3/T1/E3/E1 cards. They connect to the PSTN and fit in slots 0 through 5 only. Slots 0 and 1 are recommended. In the example, one T3 trunk card is located at 1/0/0.
  - Modem/voice cards. They fit in slots 0 through 11. In the example, nine modem cards are installed. The first modem card is in slot 2. The line-modem range is 1/2/00 to 1/10/143.
  - By default, a shelf ID of 1 is assigned to the dial shelf.
- The Cisco SC3640 system controller is an external management subsystem. It interfaces with the Cisco 7206 and provides the following functions:
  - SNMP and syslog offloading
  - Out-of-band console access

Call-Processing Components

As shown in Figure 2-2, the following components process a call:

- Client modems and ISDN routers dial in to the access server through the PSTN.
- Asynchronous PPP calls (analog) connect to modems inside the access server.
- Each modem inside the access server 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 (digital) connect to serial interface channels (for example, S1/0/0:0:0 and S1/0/0:0:1).
- Synchronous interfaces clone their configurations from a dialer interface.

Figure 2-2 Cisco AS5800 Call-Processing Components



One asynchronous PPP call requires:

- (1) T1 DS0 channel
- (1) channel in a TDM bus
- (1) integrated modem
- (1) TTY line
- (1) asynchronous interface

One synchronous PPP call requires:

- (1) T1 DS0 channel
- (1) serial interface channel

Tips Synchronous PPP calls require HDLC resources. Each T3 trunk card is limited to 256 HDLC resources. T1 trunk cards do not have HDLC resource limitations.

Task 1. Verifying Basic Setup

Verify that basic system components are functioning:

Analyzing the System Boot Dialog

To view the boot sequence through a terminal session, you must have a console connection to the access server before it powers up.

Caution Always power up the dial shelf before the router shelf. The DSC card checks the dial shelf's inventory, which requires extra time. After two minutes, power up the router shelf. The router shelf depends on the DSC card for the dial shelf's inventory report.

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

```
System Bootstrap, Version x.x
Copyright (c) 20xx by cisco Systems, Inc.
C7200 processor with 131072 Kbytes of main memory

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

%PA-2-UNDEFPA: Undefined Port Adaptor type 106 in bay 2
%SYS-4-CONFIG_NEWER: Configurations from version 12.x may not be correctly understood.
%OIR-3-SEATED: Insert/removal failed (slot 2), check card seating
%OIR-3-SEATED: Insert/removal failed (slot 2), check card
seatingCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Read 7314384 bytes from file slot0:c5800-p4-mz.120-4.XL1.bin
Self decompressing the image :
##########################################################################################
##########################################################################################
##########################################################################################
##########################################################################################
####################################################### [OK]
```

- In the previous segment, the NAS decompresses the system boot image, tests the NVRAM for validity, and decompresses the Cisco IOS software image.

  Sometimes boot images do not support hardware cards. Sample error messages look like this:

```
%PA-2-UNDEFPA: Undefined Port Adapter
%OIR-3-SEATED: Insert/removal failed
```

  Ignore these messages and *do not* ignore error messages that appear after the Cisco IOS software image decompresses.

```
              Restricted Rights Legend

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

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

Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-P4-M),
Version 12.x
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 12-Aug-99 13:16 by ayeh
Image text-base: 0x60008900, data-base: 0x611A6000

cisco 7206 (NPE400) processor with 114688K/16384K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
6 slot midplane, Version x

Last reset from power-on
X.25 software, Version 3.0.0.
Bridging software.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
1 FastEthernet/IEEE 802.3 interface(s)
1296 terminal line(s)
1 Channelized T3 port(s)

125K bytes of non-volatile configuration memory.
4096K bytes of packet SRAM memory.
20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
```

- The following components are detected:
  - Cisco IOS release
  - Available memory
  - Available interfaces

Note If a hardware card 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

The following system message and prompt appears.

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

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

- Because the NAS has never been configured, the Cisco IOS software cannot find a startup-config file. In this example, the Cisco IOS software is configured manually. The automatic setup script is not used.

```
00:00:52: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 12 Succeeded
00:00:53: %DSC_REDUNDANCY-3-BICLINK: Switching to DSC 12
00:00:56: %DSC_REDUNDANCY-3-BICLINK: Link to active DSC up
00:02:05: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 0 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 2 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 3 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 4 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 5 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 6 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 7 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 8 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 9 Succeeded
00:02:06: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 10 Succeeded

Press RETURN to get started!

5800>
```

- By using DSIP, the router shelf detects the state of each card in the dial shelf.

  Depending on the number of cards in the dial shelf, there is a delay of 60 to 120 seconds before the "DSIP Hello" messages are displayed on your terminal session.

  After powering up the Cisco AS5800, enter the **show environment** command. Verify that there are no critical grounding, heating, or power problems. The following shows an operating environment.

```
5800-NAS> show environment
All measured values are normal
5800-NAS> show environment all
Power Supplies:
        Power supply 1 is empty.
        Power supply 2 is Zytek AC Power Supply. Unit is on.

Temperature readings:
        chassis inlet    measured at 25C/77F
        chassis outlet 1 measured at 27C/80F
        chassis outlet 2 measured at 33C/91F
        chassis outlet 3 measured at 41C/105F

Voltage readings:
        +3.45 V measured at +3.49 V
        +5.15 V measured at +5.21 V
        +12.15  measured at +12.34 V
        -11.95  measured at -11.81 V

Envm stats saved 1 time(s) since reload
5800-NAS>
```

Matching the Cisco IOS Software Images

The dial shelf and router shelf run separate Cisco IOS software images:

- Both images must be from the same Cisco IOS release. They *must* match. Cisco IOS Release 12.0(4)XL1 is used in this example.
- The router shelf's image is in the Cisco 7206s Flash memory. It begins with "c5800." The dial shelf's image is in the DSC card. It begins with "dsc."

On the router shelf, check the Cisco IOS software image, uptime, and restart reason:

```
5800# show version
Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-P4-M), Version
12.x
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 12-Aug-99 13:16 by ayeh
Image text-base: 0x60008900, data-base: 0x611A6000

ROM: System Bootstrap, Version xCA,
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version x

Router uptime is 2 minutes
System returned to ROM by reload
System image file is "slot0:c5800-p4-mz.120-4.XL1.bin"

cisco 7206 (NPE400) processor with 114688K/16384K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
6 slot midplane, Version x

Last reset from power-on
X.25 software, Version 3.0.0.
Bridging software.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
1 FastEthernet/IEEE 802.3 interface(s)
1296 terminal line(s)
1 Channelized T3 port(s)
125K bytes of non-volatile configuration memory.
4096K bytes of packet SRAM memory.

20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
```

Table 2-1 describes the significant output fields in the previous display:

Table 2-1 Show Version Command Field Descriptions

Field	Description
`5800 Software (C5800-P4-M), Version 12.x`	Cisco IOS software version.
`Router uptime is 2 minutes`	Reports the router's uptime. Watch for unscheduled reloads.
`System returned to ROM by reload`	Describes why the access server last reloaded. If the field displays "power-on," a power interruption caused the reload.
`System image file is "slot0:c5800-p4-mz.120-4.XL1.bin"`	The Cisco 7206 router shelf booted from the external PCMCIA Flash card at slot 0. The router shelf does not have internal Flash memory. If the PCMCIA Flash card is missing, the router shelf will not boot.

On the dial shelf, check the Cisco IOS software image, uptime, and restart reason. If you do not have a physical console connection to the dial shelf, enter the **execute-on slot** [**12** | **13**] **show version** command. The DSC can be in slot 12 or 13.

```
5800# execute-on slot 12 show version

DA-Slot12>
Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-DSC-M), Version
12.x
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 12-Aug-99 18:48 by ayeh
Image text-base: 0x600088F0, data-base: 0x60520000

ROM: System Bootstrap, Version xAA
ROM: 5800 Software (C5800-DSC-M), Version xAA2

DA-Slot12 uptime is 20 hours, 38 minutes
System returned to ROM by reload
System image file is "slot0:dsc-c5800-mz.120-4.XL1.bin"

cisco c5800 (R4K) processor with 24576K/8192K bytes of memory.
R4700 CPU at 150Mhz, Implementation 33, Rev 1.0, 512KB L2 Cache
Last reset from power-on
1 Ethernet/IEEE 802.3 interface(s)
2 Dial Shelf Interconnect(DSI) FE interface(s)
123K bytes of non-volatile configuration memory.

8192K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
```

Inspecting the Dial Shelf

Verify that feature cards are up (T3, T1, E3, E1, modem, or voice):

```
5800# show dial-shelf
Slot    Board     CPU       DRAM          I/O Memory   State         Elapsed
         Type     Util    Total (free)   Total (free)                Time
 0        CT3    0%/0%  21598976( 81%)  8388608( 41%)  Up           00:01:35
 2 Modem(DMM)  20%/20%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 3 Modem(DMM)    0%/0%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 4 Modem(DMM)  20%/20%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 5 Modem(DMM)  20%/20%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 6 Modem(DMM)  40%/40%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 7 Modem(DMM)  40%/40%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 8 Modem(DMM)  35%/35%  46764800( 86%) 16777216( 74%)  Up           00:01:35
 9 Modem(DMM)    0%/0%  46764800( 86%) 16777216( 74%)  Up           00:01:35
10 Modem(DMM)  20%/20%  46764800( 86%) 16777216( 74%)  Up           00:01:34
12        DSC    0%/0%  19097792( 79%)  8388608( 66%)  Up           00:02:49
Dial shelf set for auto boot
5800#
```

- Always power up the dial shelf before the router shelf. Allow two to three minutes for the DSC card to take an inventory of the dial shelf.
- If the DSC card goes down after the feature cards are up, the system will still function properly. This event will not bring down the system. However, online insertion and removal (OIR) will not work.
- Possible dial-shelf states include: unknown, down, resetting, booting, and up. The “Up” state means that the card can communicate with the router shelf.

- Each modem card contains its own DRAM memory. Double-density modem modules (DMM) require at least 64 MB of memory with Cisco IOS Release 12.0. Hex modem modules (HMM) require at least 32 MB with Cisco IOS Release 11.3. Each card performs its own call processing.
- A fully populated DMM card contains 144 modems. The dial shelf in the example contains 1296 modems.
- A normal CPU utilization range for modem cards is between 20 to 40 percent.

DSC Troubleshooting Tips

If the DSC card does not come up, perform the following troubleshooting steps. If the DSC card *never* comes up, the feature cards in the dial shelf cannot communicate with the router shelf.

Step 1 Look for LED lights on the DSC card. If the lights are off, try reseating the card.

Step 2 Verify that the DSI port adapter on the Cisco 7206 is inserted correctly.

Step 3 Verify that the cable between the DSI port adapter and the DSC card is connected correctly.

Step 4 From the Cisco 7206, verify that the DSI-Fast Ethernet interface and line protocol are up:

```
5800> show dsi
DSI-Fastethernet0/2/0 is up, line protocol is up
  Hardware is DEC21140A, address is 0030.f2f5.1438 (bia 0030.f2f5.1438)
  MTU 0 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:00, 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
```

Note The following example shows a dial-shelf interconnection that changes state to up after the DSC card reloads. Loss of DSIP Keepalive messages indicate no communication between the router shelf and dial shelf. After DSIP Hello messages succeed, the Fast Ethernet DSI-Tx 0 and DSI-Rx 1 change their state to up. Until these interfaces are up, the router shelf and dial shelf cannot communicate. No **debug** commands are used to create these console messages; however, the **terminal monitor** command is required to view messages.

```
5800#
00:04:29: %DSIPPF-5-DS_KEEPALIVE_LOSS: DSIP Keepalive Loss from shelf 1 slot 12
00:05:12: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 12 Succeeded
00:05:18: %DIAL12-3-MSG:
00:00:03: %LINK-3-UPDOWN: Interface DSI-Tx-FastEthernet0, changed state to up
00:00:03: %LINK-3-UPDOWN: Interface DSI-Rx-FastEthernet1, changed state to up
00:00:03: %LINK-3-UPDOWN: Interface Ethernet0, changed state to up
5800#
```

Note Verify that console logging is disabled. Enter the **show logging** command. If logging is enabled, the access server might intermittently freeze up as soon as the console port gets overloaded with log messages. Enter the **no logging console** command.

The following messages appear on the console-terminal session after the DSC card is physically removed from slot 12 and re-inserted. Approximately 120 seconds elapse before all these messages appear.

```
5800>
04:41:42: %DSC_REDUNDANCY-3-BICLINK: Link to active DSC down
04:42:13: %ISDN-6-LAYER2DOWN: Layer 2 for Interface Se1/0/0:4:23, TEI 0 changed to down
04:42:14: %DSC_REDUNDANCY-3-BICLINK: Link to active DSC up
04:42:36: %DSIPPF-5-DS_KEEPALIVE_LOSS: DSIP Keepalive Loss from shelf 1 slot 2
04:42:36: %DSIPPF-5-DS_KEEPALIVE_LOSS: DSIP Keepalive Loss from shelf 1 slot 3
04:42:46: %DSIPPF-5-DS_KEEPALIVE_LOSS: DSIP Keepalive Loss from shelf 1 slot 0
04:42:46: %DSIPPF-5-DS_KEEPALIVE_LOSS: DSIP Keepalive Loss from shelf 1 slot 12
04:42:53: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 12 Succeeded
04:44:59: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 0 Succeeded
04:45:02: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 2 Succeeded
04:45:03: %DSIPPF-5-DS_HELLO: DSIP Hello from shelf 1 slot 3 Succeeded
5800>
```

The following boot sequence occurs in the previous example:

a. The DSC card takes 32 seconds to boot up. Afterwards, the card checks the dial shelf's inventory.

b. The dial shelf exchanges hardware inventory information with the router shelf. After the exchange, the router shelf instructs the DSC card to load the appropriate boot images into the feature cards.

c. More than two minutes elapse before the DSC card detects the first "DSIP Hello" message from the first feature card (in shelf 1 slot 0). If the DSC card *never* comes up, the feature cards in the dial shelf cannot communicate with the router shelf.

d. The router shelf gives the feature cards the appropriate images.

Step 5 If the DSC card is still down, the card might have an incorrect Cisco IOS software image, or the Flash card is missing (ROM monitor mode). Open a physical console connection to the DSC card, copy an image into boot Flash memory, and re-initialize the system.

Step 6 For advanced troubleshooting measures after the DSC card is up, open a virtual-console session to the DSC card (DA-Slot12). To end the session, enter **Ctrl C** three times:

```
5800# dsip console slave 12
Trying Dial shelf slot 12 ...
Entering CONSOLE for slot 12
Type "^C^C^C" to end this session


DA-Slot12>
DA-Slot12#
DA-Slot12#
DA-Slot12#
Terminate NIP IO session? [confirm]

[Connection to Dial shelf slot 12 closed by local host]
5800#
```

Caution The router shelf provides the DSC card with the required configuration. Do not change the DSIP settings in the DSC card configuration.

Feature-Card Troubleshooting Tips

If the **show dial-shelf** command reports that feature cards are booting for extended periods of time, start debugging from the router shelf by using the following commands:

```
debug dsip transport
debug dsip trace
show dsi
```

- **Debug dsip transport** shows the registered MAC address sent from each feature board.
- **Debug dsip trace** displays detailed DSIP Hello and Keepalive messages.
- **Debug dsip boot** shows if the router shelf is sending the boot image to the feature cards.

Using DSIP

The router shelf communicates with the dial shelf using:

- Fast Ethernet interconnect cable
- Dial Shelf Interconnect Protocol (DSIP)

For the DSIP command reference and other system management functions, refer to *Dial and System Management Commands for the Cisco AS5800*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113aa/113aa_2/58cfeats/c5800uas.htm

To understand how DSIP functions, enter commands from the following bullet list:

- Verify that the connection between the router shelf and dial shelf is up. The DSI-Fast Ethernet interface is located at 0/2/0 in the Cisco 7206. Note that the output from the **show dsi** command is different from the **show dsip** command.

```
5800-NAS# show dsi
DSI-Fastethernet0/2/0 is up, line protocol is up
  Hardware is DEC21140A, address is 00d0.d342.4c38 (bia 00d0.d342.4c38)
  MTU 0 bytes, BW 100000 Kbit, DLY 100 usec,
        reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:00, 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
```

- Verify that each feature card's MAC address is registered by DSIP. Unregistered cards cannot communicate with the system. Shelf 0 is the router shelf (master). Shelf 1 is the dial shelf (slave).

```
5800# show dsip transport
DSIP transport statistics:
 IPC  : input msgs=4309, bytes=509139; output msgs=4308, bytes=291468
        total consumed ipc msgs=2133;  total freed ipc msgs = 2133
        transmit contexts in use = 13, free = 243, zombie = 0, invalid = 0
        ipc getmsg failures = 0, ipc timeouts=0
        core getbuffer failures=0, api getbuffer failures=0
        dsip test msgs rcvd = 0, sent = 0
 CNTL : input msgs=20927, bytes=738902; output msgs=20350, bytes=29816080
        getbuffer failures=0
 DATA : input msgs=1076, bytes=38736; output msgs=0, bytes=0
DSIP Private  Buffer Pool Hits  = 0
DSIP registered addresses:
 Shelf0 : Master: 00d0.d342.4c38, Status=local
 Shelf1 : Slot0 : 0090.bf52.4e00, Status=remote
 Shelf1 : Slot2 : 0090.bf52.4e10, Status=remote
 Shelf1 : Slot3 : 0090.bf52.4e18, Status=remote
 Shelf1 : Slot4 : 0090.bf52.4e20, Status=remote
 Shelf1 : Slot5 : 0090.bf52.4e28, Status=remote
 Shelf1 : Slot6 : 0090.bf52.4e30, Status=remote
 Shelf1 : Slot7 : 0090.bf52.4e38, Status=remote
 Shelf1 : Slot8 : 0090.bf52.4e40, Status=remote
 Shelf1 : Slot9 : 0090.bf52.4e48, Status=remote
 Shelf1 : Slot10: 0090.bf52.4e50, Status=remote
 Shelf1 : Slot12: 0090.bf52.4e60, Status=remote
5800#
```

- Verify that all feature cards are running DSIP versions that are compatible with the router shelf:

```
5800# show dsip version
DSIP version information:
------------------------
Local DSIP major version =  5,   minor version = 2
All feature cards are running DSIP versions compatible with router shelf
Local clients registered versions:
-----------------------------------
Client Name      Major Version   Minor Version
Console          5               2
Clock            2               1
Modem            0               0
Logger           No version      No version
TDM              No version      No version
Trunk            No version      No version
Async data       No version      No version
VOICE            0               0
Dial shelf       1               1
Environment      No version      No version
FILESYS          No version      No version
DSC Red. UI      0               1
Split DS         No version      No version
DSIP Test        No version      No version

Mismatched  remote client versions:
-----------------------------------
5800#
```

Note This command also reports mismatched Cisco IOS software versions. No mismatches exist in this example.

Checking the Initial Running-Config

The Cisco IOS software creates an initial running configuration. To familiarize yourself with default settings, inspect the software configuration as follows:

Step 1 Display the configuration on the Cisco 7206 router shelf:

```
5800# show running-config
Building configuration...

Current configuration:
!
version 12.x
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
!
shelf-id 0 router-shelf
shelf-id 1 dial-shelf
!
!
resource-pool disable
!
modem-pool Default
 pool-range 1/2/0-1/10/143
!
!
spe 1/2/0 1/10/11
 firmware ios-bundled default
modem recovery action none
ip subnet-zero
!
isdn voice-call-failure 0
!
!
controller T3 1/0/0
 cablelength 224
!
!
process-max-time 200
!
interface FastEthernet0/1/0
 no ip address
 no ip directed-broadcast
 shutdown
!
```

```
interface Group-Async0
 no ip address
 no ip directed-broadcast
 group-range 1/2/00 1/10/143
!
ip classless
no ip http server
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
line 1/2/00 1/10/143
 modem InOut
 no modem log rs232
!
end
```

Step 2 Without connecting to the DSC, display the configuration on the Cisco 5814 dial shelf:

```
5800# execute-on slot 12 show running-config

DA-Slot12#
Building configuration...

Current configuration:
!
version 12.x
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname DA-Slot12
!
!
ip subnet-zero
!
!
process-max-time 200
!
interface Ethernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
no ip http server
ip classless
!
!
line con 0
 transport input none
line vty 0 4
!
end
```

Exploring the Cisco IOS File System

Familiarize yourself with the file system and memory storage areas. The Cisco IOS file system provides a consolidated interface to:

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

Figure 2-3 shows the memory locations inside the Cisco AS5800.

Figure 2-3 Cisco AS5800 Memory Locations

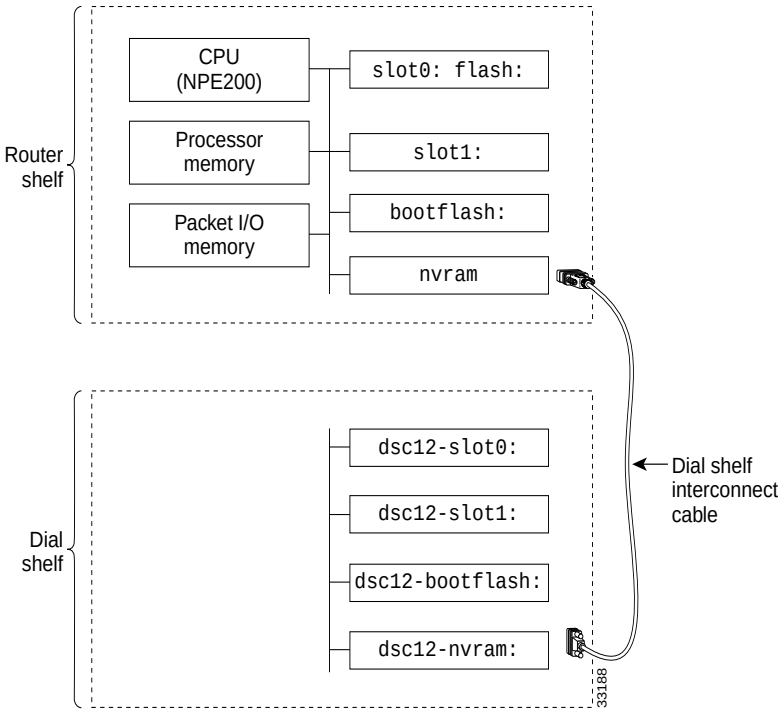


Table 2-2 describes the memory locations shown in Figure 2-3.

Table 2-2 Memory Location Descriptions

Component	Description
CPU (NPE400)	Central processing unit.
Processor memory	The Cisco IOS software image is initially read out of Flash memory, decompressed, and loaded into processor memory (also known as main memory). Routing tables, call control blocks, and other data structures are also stored here.
Packet I/O memory	Packets are temporarily stored in I/O memory.

Table 2-2 Memory Location Descriptions (continued)

Component	Description
slot0: flash: slot1:	PCMCIA Flash memory cards in the router shelf. They store Cisco IOS software images, modem firmware/portware, and custom web pages.
bootflash:	Flash memory on the Cisco 7206's motherboard.
nvram:	Nonvolatile configuration memory.
dsc12-slot0: dsc12-slot1:	PCMCIA Flash memory cards in the DSC card.
dsc12-bootflash:	Flash memory on DSC card's motherboard.
dsc12-nvram:	Nonvolatile configuration memory in the DSC card.

To verify the file system, enter commands from the following bullet list:

- View the different file storage areas and file management functions. Additionally, verify that you have everything you ordered from manufacturing, such as Flash memory. The asterisk (*) indicates the current directory.

```
5800# show file systems
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
           -           -     flash     rw   disk0:
           -           -     flash     rw   disk1:
           -           -    opaque     rw   null:
           -           -    opaque     rw   system:
           -           -   network     rw   tftp:
      129016      128277     nvram     rw   nvram:
*   20578304    13263792     flash     rw   slot0: flash:
           -           -     flash     rw   slot1:
     3407872     1286636     flash     rw   bootflash:
           -           -    opaque     wo   lex:
           -           -   network     rw   rcp:
           -           -   network     rw   pram:
           -           -   network     rw   ftp:
     7995392     5825440     flash     rw   dsc12-slot0:
           -           -     flash     rw   dsc12-slot1:
     3407872     1575412     flash     rw   dsc12-bootflash:
      126968      126968     nvram     rw   dsc12-nvram:
5800#
```

- Display the objects in the system memory directory:

```
5800# dir system:
Directory of system:/

  2  dr-x           0             <no date>  memory
  1  -rw-         787             <no date>  running-config

No space information available
5800#
```

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

- Inspect the Flash memory on the router and dial shelves. Both images must have matching Cisco IOS release number. In this example, both images are from Cisco IOS Release 12.0(4)XL1. As the chassis boots up, the images are copied, decompressed, and loaded into DRAM memory.

```
5800# pwd
slot0:
5800# dir
Directory of slot0:/

  1  -rw-     7314384   Sep 13 1999 20:03:41  c5800-p4-mz.120-4.XL1.bin
20578304 bytes total (13263792 bytes free)
5800#
5800# dir dsc12-slot0:
Directory of dsc12-slot0:/

  1  -rw-     2169824   Sep 13 1999 20:28:53  dsc-c5800-mz.120-4.XL1.bin
7995392 bytes total (5825440 bytes free)
5800#
```

- Inspect the bootFlash on both shelves:

```
5800# dir bootflash:
Directory of bootflash:/

  1  -rw-     2121108   Jan 01 2000 00:00:48  c7200-boot-mz.111-24.CC

3407872 bytes total (1286636 bytes free)
Router
5800# dir dsc12-bootflash:
Directory of dsc12-bootflash:/

  1  -rw-     2169824   Nov 18 1999 22:18:30  dsc-c5800-mz.120-4.XL1.bin

3407872 bytes total (1237920 bytes free)
```

Tips Keep a backup copy of the dial shelf's image in boot Flash. Someone may take PCMCIA Flash cards without notification. The dial shelf does not have its own connection to the IP backbone for image upgrade purposes.

The **squeeze** command is required to remove deleted files:

```
5800-NAS# pwd
dsc12-bootflash:/
5800-NAS# delete dsc-c5800-mz.113-9.AA2
Delete filename [dsc-c5800-mz.113-9.AA2]?
Delete dsc12-bootflash:dsc-c5800-mz.113-9.AA2? [confirm]
5800-NAS# squeeze dsc12-bootflash:
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]

DA-Slot12#
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]

Squeeze of bootflash complete
Squeeze of dsc12-bootflash complete
5800-NAS#
```

- Inspect the NVRAM memory on the router and dial shelves. Three files are present:
  - The initial boot or startup-config.
  - The private-config is a secure file that supports encryption technologies. It is not user accessible.
  - The underlying-config is the version of the startup-config that is stored in NVRAM.

```
5800# dir nvram:
Directory of nvram:/
  1  -rw-         739              <no date>  startup-config
  2  ----          24              <no date>  private-config
  3  -rw-         739              <no date>  underlying-config
129016 bytes total (128277 bytes free)
5800#

5800# dir dsc12-nvram:
Directory of dsc12-nvram:/
  1  -rw-           0              <no date>  startup-config
  2  ----           0              <no date>  private-config
  3  -rw-           0              <no date>  underlying-config
126968 bytes total (126968 bytes free)
5800#
```

Investigating Memory Usage

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

- Determine how memory is used for different processor and I/O memory processes.
- Identify memory fragmentation and memory leaks.
  - Memory leaks—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.
  - Memory fragmentation—Indicated by the largest block of memory not being equal to the free block. Fragmentation increases as the numbers grow further apart.

To inspect and calculate memory usage complete the following steps:

Step 1 Display the memory status report. Note that the largest-memory block is close to the free-memory block, which is good. There is no fragmentation.

```
5800-NAS# show memory summmary
               Head   Total(b)    Used(b)    Free(b)  Lowest(b) Largest(b)
 Processor  6164D4E0   94055200   42346480   51708720   50435436   51592056
       I/O   7000000   16777216    6433400   10343816   10343816   10343772
       PCI  4B000000    4194304     618584    3575720    3575720    3575676
```

Caution If you enter the **show memory summary** command with the **terminal length 0** command enabled you will produce many screens of output which might interrupt your session.

Table 2-3 describes the significant fields in the previous display:

Table 2-3 Show Memory Summary Output Field Descriptions

Field	Description
Processor	Processor memory. The Cisco IOS software image is initially read out of Flash memory, decompressed, and placed in main memory. Routing tables and call control blocks are also stored in main memory.
I/O	Packets are temporarily stored in I/O memory.
Head	Hexadecimal address of the head of the memory allocation chain.
Total(b)	Summary of used bytes plus free bytes.
Used(b)	Total number of bytes currently used for routing tables and call-processing components.
Free(b)	Total number of free bytes. The free memory size should be close to the largest block available.
Lowest(b)	Smallest amount of free memory since last boot.
Largest(b)	Size of largest available free block. Whenever the largest available block is equal to the free block, there is no fragmentation.

Step 2 Convert bytes to megabytes (MB):

- Total processor memory = 9,4055,200 bytes = 89.7 MB
- Used processor memory = 42,346,480 bytes = 40.4 MB
- Free processor memory = 51,708,720 bytes = 49.3 MB

Total memory (89.7 MB) = Used memory (40.4 MB) + free memory (49.3 MB)

Step 3 Do some useful memory calculations:

Total Processor = Total RAM - Cisco IOS software (use the **show version** command to get the MB assigned for all of Cisco IOS software + Processor)

```
cisco 7206 (NPE400) processor with 114688K/16384K bytes of memory.
```

114688 KB / (1024 KB / MB) = 112.0 MB

16384 KB = 16 MB

112 MB + 16 MB = 128 MB (what you purchased).

Note 112.0 MB - 89.7 MB = 22.3 MB. This means that 22.3 MB are not available for processor memory.

Verifying CPU Utilization

High utilization causes network performance problems. Knowing when the router is running at over 50% utilization is critical because the router might start dropping packets if an unexpected traffic burst comes through or if OSPF gets recalculated. Fast switching reduces CPU utilization.

```
5800# show processes cpu
CPU utilization for five seconds: 20%/6%; one minute: 31%; five minutes: 19%
 PID  Runtime(ms)  Invoked  uSecs    5Sec   1Min   5Min TTY Process
   1      144208   1526300     94   0.00%  0.00%  0.00%   0 Load Meter
   2      118732  19749060      6   0.24%  0.12%  0.08%   0 OSPF Hello
   3    42752544   2699659  15836   3.75%  0.87%  0.62%   0 Check heaps
   4        7260     30062    241   0.00%  0.00%  0.00%   0 Pool Manager
   5           0         2      0   0.00%  0.00%  0.00%   0 Timers
   6        1472    494101      2   0.00%  0.00%  0.00%   0 Serial Background
   7       49424   7631216      6   0.00%  0.00%  0.00%   0 EnvMon
   8           0         1      0   0.00%  0.00%  0.00%   0 OIR Handler
   9    13368616   3217631   4154   0.32%  0.57%  0.42%   0 ARP Input
  10       18932    533419     35   0.00%  0.00%  0.00%   0 DDR Timers
  11         116         4  29000   0.00%  0.00%  0.00%   0 Entity MIB API
```

Look at the top line of the output. If you see utilization at the top of the display over 50%, inspect the columns 5Sec, 1Min, and 5Min. Find the process that uses the most CPU power. For an idle chassis, numbers larger than two percent indicate a problem.

Table 2-4 describes the significant output fields in the previous example:

Table 2-4 CPU Utilization Display Fields

Field	Description
`CPU utilization for five seconds: 2%/0%;`	The first % number is the CPU utilization for the last 5.0 seconds. The second % number is the percentage of CPU time spent at the packet-based interrupt level.
`one minute: 1%;`	CPU utilization for the last minute.
`five minutes: 14%`	CPU utilization for the last 5.0 minutes.

Whenever memory cannot be allocated to a process request (a memory leak), a console error message appears:

```
Sep 14 11:30:33.339 EDT: %SYS-2-MALLOCFAIL: Memory allocation of 19960
bytes failed from 0x603D530C, pool Processor, alignment 0
 -Process= "Exec", ipl= 0, pid= 48
 -Traceback= 603D8610 603DAA70 603D5314 603D5AF0 60373054 60371474 603C33DC
603C3538 603C4378 60371934 603586B8 60358A10 6037C12C 6037C1E4 60372E9C
6037EDEC
```

To identify the problem, inspect the first few output lines of the **show memory summary** command and **show processor memory** command.

Task 2. Configuring Basic Cisco IOS Software

Apply a basic-running configuration to the NAS:

Tips Periodically save the configuration by using the **copy running-config startup-config** command.

Configuring the Host Name, Enable Secret Password, and Time Stamps

Assign a host name to the NAS, specify an enable secret password, and turn on time stamps:

- A host name allows you to distinguish between different network devices.
- A secret enable password allows you to prevent unauthorized configuration changes.
- Encrypted passwords in the configuration file add greater security to the NAS.
- Time stamps help you trace debug output for testing connections. Not knowing exactly when an event occurs prevents you from tracing debug output for testing conditions.

Step 1 Enter the following commands in global configuration mode:

```
hostname 5800-NAS
enable secret yourpassword
service password-encryption
service timestamps debug datetime msec
service timestamps log datetime msec
```

Note Do not use the **enable password** command.

Step 2 Log in with the enable secret password. The **show privilege** command shows the current security privilege level.

```
5800-NAS# disable
5800-NAS> enable
Password:
5800-NAS# show privilege
Current privilege level is 15
5800-NAS#
```

Configuring Local AAA Security

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

AAA is the Cisco IOS software security model used on all Cisco devices. AAA provides the primary framework through which you set up access control on the NAS.

In this basic discussion, the same authentication method is used on all interfaces. AAA is set up to use the local database configured on the NAS. 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 *dude*.

```
!
username admin password adminpasshere
username dude password passhere
!
```

Caution This prevents you from getting locked out of the NAS. 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.

```
!
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
!
```

Table 2-5 describes the configuration:

Table 2-5 Local AAA Commands

Command	Purpose
aaa new-model	Initiates the AAA access control system. This command immediately locks down **login** and PPP authentication.
aaa authentication login default local	Configures AAA to perform login authentication by using the local username database. The **login** keyword authenticates EXEC shell users.
aaa authentication ppp default if-needed local	Configures PPP authentication to use the local database if the session was not already authenticated by **login**.

Step 3 Log in with your username and password:

```
5800-NAS# login

User Access Verification

Username:admin
Password:

5800-NAS#
```

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.

Setting Up a Log In Banner

Create a login banner. However, do not tell users what device they are connecting to until after they log in. Providing device sensitive information can tempt unauthorized users to hack into the system.

Step 1 Create the banner:

```
5800-NAS(config)# banner login |
Enter TEXT message.  End with the character '|'.
This is a secured device.
Unauthorized use is prohibited by law.
|
5800-NAS(config)#^Z
5800-NAS#
```

Step 2 Test the banner:

```
5800-NAS#
5800-NAS# login

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

User Access Verification

Username: admin
Password:

5800-NAS#
```

Configuring Basic IP

To configure a basic dial access service:

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

Follow this procedure:

Step 1 Assign the IP addresses, and create an IP route to the default gateway.

```
!
interface Loopback0
 ip address 172.22.99.1 255.255.255.255
!
interface Loopback1
 ip address 172.22.90.1 255.255.255.0
!
interface FastEthernet0/1/0
 ip address 172.22.66.23 255.255.255.0
!
ip route 0.0.0.0 0.0.0.0 172.22.66.1
!
```

The loopback interfaces are used for the following reasons:

- Interface loopback 0:Identifies the router with a unique and stable IP address for network management purposes. One IP address from a common address block is assigned to each network device. This technique enables the network operations center (NOC) to more easily perform security filtering. One class C subnet, that was used to identify devices, can support 254 distinct nodes with unique loopback IP addresses.
- Interface loopback 1:Hosts a pool of IP addresses for the remote nodes. In this way, one route is summarized and propagated to the backbone instead of 254 host routes.

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

```
5800-NAS# ping 172.22.66.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.22.66.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/1 ms

5800-NAS#
```

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

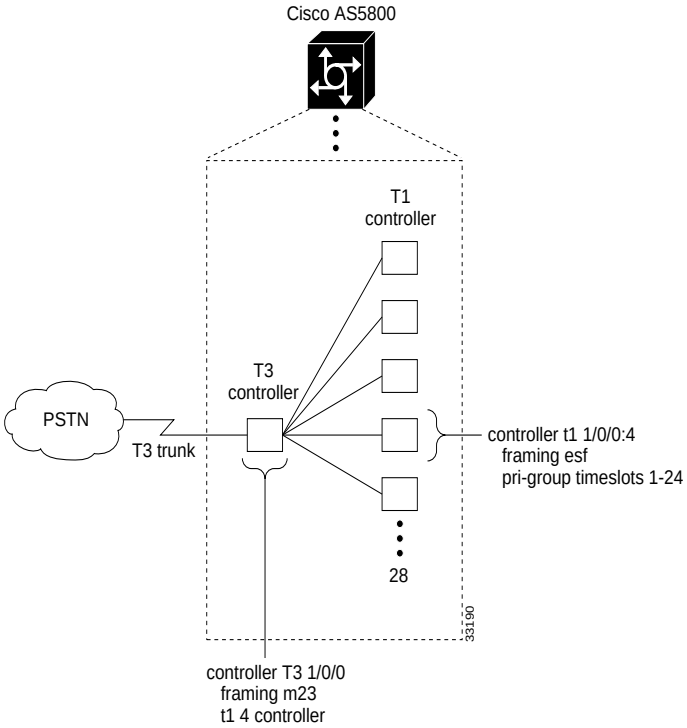
Note An 80% ping-success rate is normal for the first time you ping an external device. The NAS does not yet have an address resolution protocol (ARP) entry for the external device. A 100% success rate is achieved the next time you ping the device.

Task 3. Enabling the T3/T1 Controllers

Configure the settings for the T3/T1 controllers. They must match the telco's settings on the telephone switch. Mismatched settings cause problems; sometimes these problems are not detected for a long time.

Figure 2-4 displays the logical controller components inside a Cisco AS5800. The figure shows that a T3 trunk card requires T1 and T3 controller configuration settings. In the figure, only the fourth controller is configured. There are a total of 28 T1 controllers to configure.

Figure 2-4 Matching Controller Settings



Step 1 Define the ISDN PRI switch type. In the example, the T1 trunks are not using channel associated signaling (CAS).

```
!
isdn switch-type primary-ni
!
```

There are two ways to define the switch type:

- Under the individual serial-D channels. A different switch type can be defined for each PRI trunk. See the "Task 4. Configuring the Serial Interfaces" section on page 2-31.
- Globally across all PRI trunks. All trunks use the same switch type.

Note For T1 CAS trunks, no ISDN switch type is configured.

Step 2 Configure the T3 controller. There are 28 T1 controllers in one T3. In this example, only the fourth controller is configured. The **t1 4 controller** command automatically creates the logical controllers **controller t1 1/0/0:4**. The number of logical T1 controllers should match the number of TI PRI lines coming into your T3.

```
!
controller T3 1/0/0
 framing m23
 cablelength 0
 t1 4 controller
!
```

Step 3 Configure the corresponding T1 controllers:

```
!
controller t1 1/0/0:4
 framing esf
 pri-group timeslots 1-24
!
```

After the controllers are correctly configured, the following cards and interfaces change state:

```
00:01:59: %CONTROLLER-5-UPDOWN: Controller T3 1/0/0, changed state to up
00:02:01: %CONTROLLER-5-UPDOWN: Controller T1 1/0/0:4, changed state to up
00:02:02: %DIAL12-3-MSG:
07:08:54: %DSCCLOCK-3-SWITCH3: Clock moving to NORMAL from HOLDOVER, selected clock is on
slot 0 port 4 line 0
00:02:05: %ISDN-6-LAYER2DOWN: Layer 2 for Interface Se1/0/0:4:23, TEI 0 changedto down
00:02:21: %ISDN-6-LAYER2UP: Layer 2 for Interface Se1/0/0:4:23, TEI 0 changed to up
5800-NAS>
```

Table 2-6 describes some of the T3 and T1-controller concepts that are applied in the previous steps.

Table 2-6 Controller Terms and Descriptions

Concept	Description
Framing type	Defines the control bits and data bits. For T3s, Cisco supports: • M23—M23 multiplexer framing (default) • C-bit—C-bit parity framing For T1s, Cisco supports: • ESF—Extended super frame. Required for 64 KB operation on DS0s. ESF requires 2k-framing bits for synchronization. The remaining 6k is used for error detection, CRC, and data link monitoring. ESF is recommended for PRI configurations. • SF—Super frame. SF (D4) is used in channel bank robbed bit signalling (RBS) configurations. The in-band signaling occurs within the 6th and 12th frames. SF uses the framing bit for frame synchronization. SF is not recommended for PRI configurations.
Line code type	An encoding method used to allow synchronous data to be transmitted in a compatible format. Common line codes are RZ (return to zero), NRZ (non-return to zero), B8ZS, AMI, and HDB3. • AMI—Alternate mark inversion. Signal transitions are referenced by a binary 1 (mark). AMI is used on older T1 circuits. B8ZS is more reliable than AMI. • B8ZS—Most popular line-code scheme used in North America. To maintain clock synchronization, B8ZS replaces string 8 binary 0s with variations. B8ZS is more reliable than AMI, and it should be used with PRI configurations.
Clock source	Refers to both timing and synchronization of the T1 carrier. Timing is encoded within the transmitted data signal, and it ensures synchronization throughout the network. Clocks are prioritized by slot number (slot 0 to slot 5). The highest priority clock is selected from the card in slot 0. If this clock fails, the highest priority clock from the card in slot 1 becomes the default clock, and so forth.
Timeslot assignment	Timeslots are assigned to channels. For T1 PRI scenarios, all 24 T1 timeslots are assigned as ISDN PRI channels. After timeslots are assigned by the **pri-group** command, D-channel serial interfaces are automatically created in the configuration file (for example S1/0/0:0:23, S1/0/0:1:23, and so on).

Step 4 Verify that the controllers are up and no alarms or errors are detected. Error counters are recorded over a 24-hour period in 15-minute intervals. In the display output, focus on the data in the current interval.

```
5800-NAS# show controller t3
T3 1/0/0 is up.
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received: No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Internal
  Data in current interval (201 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 1 15 minute intervals):
     30664 Line Code Violations, 49191 P-bit Coding Violation,
     47967 C-bit Coding Violation, 0 P-bit Err Secs,
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
     2 Unavailable Secs, 0 Line Errored Secs,
     10 C-bit Errored Secs, 10 C-bit Severely Errored Secs
5800-NAS#
5800-NAS# show controller T1 1/0/0:4
T1 1/0/0:4 is up.
  Applique type is Channelized T1
  Cablelength is short
  No alarms detected.
  Framing is ESF, Line Code is AMI, Clock Source is Line.
  Data in current interval (240 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
  Data in Interval 1:
     0 Line Code Violations, 8 Path Code Violations
     11 Slip Secs, 26 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 26 Unavail Secs
  Total Data (last 1 15 minute intervals):
     0 Line Code Violations, 8 Path Code Violations,
     11 Slip Secs, 26 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 26 Unavail Secs
5800-NAS#
```

After each controller is correctly set up, clear the counters and look for ongoing line violations and errors. To do this, enter the **clear counters** command followed by the **show counters** command:

```
clear counters t1 1/0/0:4
show counters t1 1/0/0:4
```

Step 5 In the display output, focus on the data in the current interval. Error counters stop increasing when the controller is configured correctly.

Tips The **clear counters** command does not reset or bring down the controller. The T1 stays up. Only the counters are cleared.

From the reference point of the NAS, Table 2-7 provides a list of T1 alarm conditions and descriptions.

Table 2-7 Alarm Conditions

Alarm	Description
CRC Errors	Occur only in ESF format when a CRC bit has an error.
Excessive CRC Error Indication (ECRCEI)	Reported in ESF format when 32 of any 33 consecutive CRCs are in error.
Out of Frame (OOF)	Occurs when the framing pattern for a T1 line has been lost, and data cannot be extracted. This is a red alarm. In SF and ESF formats, OOF occurs when any two of four consecutive frame-synchronization bits are in error.
Loss of Signal (LOS)	Occurs when 175 consecutive 0s are detected in the MC. This is a red alarm. The signal is recovered if the density of 1s reaches 12.5%. The recovery happens when four 1s are received within a 32-bit period.
Remote Frame Alarm (RHEA)	Indicates that an OOF framing pattern occurred at the remote end. This is a yellow alarm.
Alarm Indication Signal (AIS)	Indicates to the remote end a loss of the received signal. This is a blue alarm. AIS occurs when a stream of 1s is received.
Loopback	Indicates that a remotely initiated loopback (from the network) is in progress.
Errored Seconds	Depending on the framing format, indicates OOF conditions, frame slip conditions, or error events. For SF, errored seconds reports the number of seconds the frame was in the OOF or slip condition. For ESF, errored seconds reports error events in seconds.
Bursty Errored Seconds	Reports CRC error conditions in seconds (ESF format only).
Severely Errored Seconds	Reports error events or frame slip conditions in seconds.

For more information about controllers, see the information on channelized E1 and channelized T1 setup commands in *Dial-In Port Setup*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/index.htm

Step 6 Verify that individual serial D channels are created. B channels S1/0/0:4:0 through S1/0/0:4:22 are rotary members (dialers) of the signaling D channel S1/0/0:4:23.

```
5800-NAS# show ip interface brief | inc :23
Serial1/0/0:4:23           unassigned      YES NVRAM  up       up

5800-NAS#
```

Step 7 Additionally, enter the **show interface S1/0/0:4:23** command to verify the serial interface.

Task 4. Configuring the Serial Interfaces

Configure the serial D channels to route incoming voice calls from the PSTN to the integrated modems. The behavior of the B channels is controlled by the D channels configuration instructions. The D channel is the signaling channel.

Table 2-8 describes the relationship between T1 controllers and serial interfaces.

- After timeslots are assigned by the **pri-group** command, D-channel serial interfaces are automatically created in the configuration file (for example, S1/0/0:0:23, S1/0/0:1:23, and so on).
- Individual B-channel serial interfaces are created as rotary members (dialers) of their signaling D-channels (for example, S1/0/0:0:0 through S1/0/0:0:22). The D-channel interface functions like a dialer for all the 23 B-channels using the controller.
- An ISDN switch type defined on the global level is automatically propagated to the serial D-channel interface level. However, a switch type defined on the serial-interface level overrides a switch type defined on the global level.

Table 2-8 Controller-to-Channel Relationships

T1 Controllers	D Channels	B Channels
Controller T1 1/0/0:0	Interface serial 1/0/0:0:23	S1/0/0:0:0 through S1/0/0:0:22
Controller T1 1/0/0:1	Interface serial 1/0/0:1:23	S1/0/0:1:0 through S1/0/0:1:22
Controller T1 1/0/0:2	Interface serial 1/0/0:2:23	S1/0/0:2:0 through S1/0/0:2:22
Controller T1 1/0/0:3	Interface serial 1/0/0:3:23	S1/0/0:3:0 through S1/0/0:3:22
Controller T1 1/0/0:4	Interface serial 1/0/0:4:23	S1/0/0:4:0 through S1/0/0:4:22
...	...	...

Step 1 Apply the **isdn incoming-voice modem** command to each D-channel serial interface. In this example, one interface is configured.

```
!
interface Serial1/0/0:4:23
 isdn incoming-voice modem
!
```

Step 2 Verify that ISDN is functioning properly, and the serial channels are up:

- Check the ISDN status. Confirm that Layer 1 reports ACTIVE, and the display field MULTIPLE_FRAME_ESTABLISHED appears at Layer 2. For PRI lines, the terminal endpoint identifier (TEI) is always 0. The Layer 3 status reports no active calls.

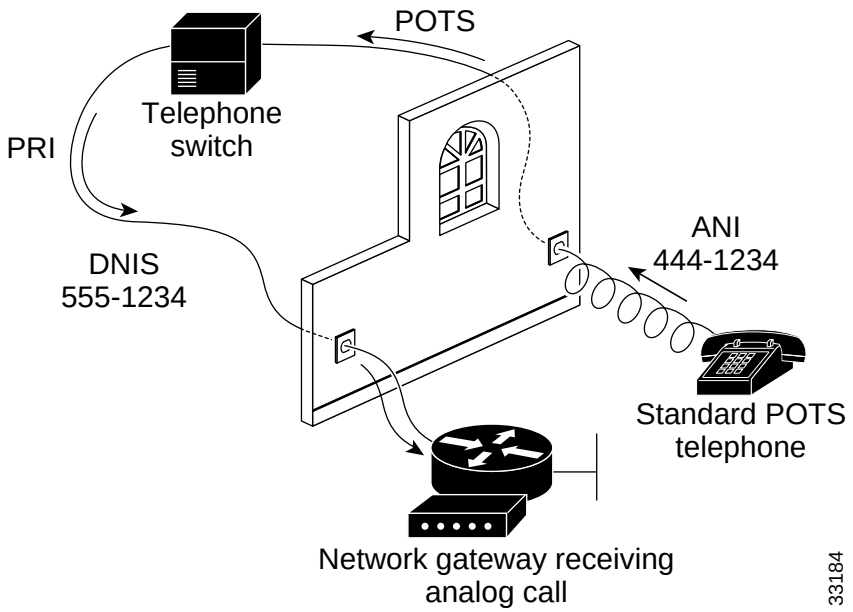
```
5800-NAS# show isdn status
Global ISDN Switchtype = primary-ni
ISDN Serial1/0/0:4:23 interface
        dsl 0, interface ISDN Switchtype = primary-ni
    Layer 1 Status:
        ACTIVE
    Layer 2 Status:
        TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
        0 Active Layer 3 Call(s)
    Activated dsl 0 CCBs = 0
    The Free Channel Mask:  0x807FFFFF
    Total Allocated ISDN CCBs = 0
```

- Look at the status of the DS0 channels. In this example, 23 DS0s are idle. The 24th channel is reserved for PRI D-channel signaling.

```
5800-NAS# show isdn service
PRI Channel Statistics:
ISDN Se1/0/0:4:23, Channel [1-24]
  Configured Isdn Interface (dsl) 0
  Channel State (0=Idle 1=Propose 2=Busy 3=Reserved 4=Restart 5=Maint_Pend)
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3
  Service State (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
5800-NAS#
```

Step 3 Test the configuration by sending a POTS call into the Cisco AS5800 network access server (NAS). If the modem answers (you hear modem squelch), the configuration works. In Figure 2-5, a different telephone number is associated with each end of the connection.

Figure 2-5 Sending a POTs Telephone Call to a NAS



Note The debug **ISDN q931** command (with **logging console** enabled) displays incoming call information on the monitor.

- In the called party number is the dial number identification service (DNIS). It identifies the directory number assigned to the Cisco AS5800's PRI trunks. In Figure 2-5, the telephone dialed 555-1234.
- In the calling part number is the automatic identification number (ANI). It identifies the directory number assigned to the device that initiates the call. In this example, the telephone line is assigned 444-1234.

Task 5. Configuring Modems and Lines

Modems and lines are configured after:

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

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

AAA security is applied to the lines by the **aaa new-model** command and **aaa authentication login default local** command. AAA performs login authentication by using the local username database. The **login** keyword authenticates EXEC shell users.

Note The modem speed (115200 bps) and hardware flow control are the defaults for integrated modems.

Step 1 Configure modem control (DCD/DTR) for incoming and outgoing modem calls:

```
!
line 1/2/00 1/10/143
 modem InOut
!
```

Note The **no modem log rs232** command limits the size of the **show modem log** command's output.

Step 2 Familiarize yourself with the modem-numbering scheme for the Cisco AS5800. Modems use the *shelf*/*slot*/*port* notation.

```
5800-NAS# show modem

  Codes:
  * - Modem has an active call
  T - Back-to-Back test in progress
  R - Modem is being Reset
  p - Download request is pending and modem cannot be used for taking calls
  D - Download in progress
  B - Modem is marked bad and cannot be used for taking calls
  b - Modem is either busied out or shut-down
  d - DSP software download is required for achieving K56flex connections
  ! - Upgrade request is pending

           Avg Hold     Inc calls     Out calls   Busied   Failed     No   Succ
  Mdm        Time      Succ   Fail   Succ   Fail   Out      Dial    Answer  Pct
  1/2/00   00:00:00       0      0      0      0       0        0       0    0%
  1/2/01   00:00:00       0      0      0      0       0        0       0    0%
  1/2/02   00:00:00       0      0      0      0       0        0       0    0%
  1/2/03   00:00:00       0      0      0      0       0        0       0    0%
  1/2/04   00:00:00       0      0      0      0       0        0       0    0%
```

Step 3 Choose a specific modem and inspect the modem-to-TTY line association. TTY lines are simulated EIA/TIA-232 ports. In this example, TTY 432 is associated with modem 1/2/00.

TTY line numbers map to specific slots. Each slot is hard coded with 144 TTY lines. In the example, the first modem card is in slot—that is, slot 0 and slot 1 do not contain modem cards.

```
5800-NAS# show modem 1/2/00
     Mdm  Typ     Status     Tx/Rx     G  Duration  RTS   CTS   DCD   DTR
     ---  ---     ------     -----     -  --------  ---   ---   ---   ---
   1/2/00 (n/a)   Idle        0/0      1  00:00:00  RTS   CTS   noDCD DTR

Modem 1/2/00, Cisco MICA modem (Managed), Async1/2/00, TTY432
Firmware Rev: 2.6.2.0
Modem config: Incoming and Outgoing
Protocol: (n/a), Compression: (n/a)
Management config: Status polling
RX signals: 0 dBm

  Last clearing of "show modem" counters never
    0 incoming completes, 0 incoming failures
    0 outgoing completes, 0 outgoing failures
    0 failed dial attempts, 0 ring no answers, 0 busied outs
    0 no dial tones, 0 dial timeouts, 0 watchdog timeouts
    0 no carriers, 0 link failures, 0 resets, 0 recover oob
    0 recover modem, 0 current fail count
    0 protocol timeouts, 0 protocol errors, 0 lost events
```

Task 6. Enabling IP Basic Setup

Tune IP routing behavior and domain-name services for EXEC shell users by completing the following steps:

Step 1 Optimize IP routing functions. Enter the following commands in global configuration mode:

```
ip subnet-zero
no ip source-route
ip classless
```

Table 2-9 describes the previous commands:

Table 2-9 IP Routing Commands

Command	Purpose
ip subnet-zero	Specifies that 172.22.0.0 is a valid subnet.
no ip source-route	Tightens security by ensuring that IP-header packets cannot define their own paths through the access server.
ip classless	Turns off traditional IP network class distinctions in the router [Class-A, Class-B, Class-C].

Step 2 Enter domain-name service global configuration commands to support EXEC shell users:

```
ip domain-lookup
ip host aurora 172.22.100.9
ip domain-name the.doc
ip name-server 172.22.11.10
ip name-server 172.22.12.10
```

Table 2-10 describes the previous commands:

Table 2-10 Domain-Name Commands

Command	Purpose
ip domain-lookup	Enables IP domain-name lookups.
ip host aurora 172.22.100.9	Creates a local name-to-address map. This map is useful when the NAS is not entered in a DNS server.
ip domain-name the.doc	Tells the NAS how to qualify DNS look ups. In this example, the.doc is appended to the end of each name that is looked up.
ip name-server 172.22.11.10 **ip name-server 172.22.12.10**	Specifies the primary and secondary name servers. They are used for mapping names to IP addresses.

Task 7. Testing Asynchronous EXEC Shell Connections

This task verifies that the following components are working:

- Physical asynchronous data path
- Basic modem links
- Basic IP functionality to support EXEC shell sessions

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

The EXEC:

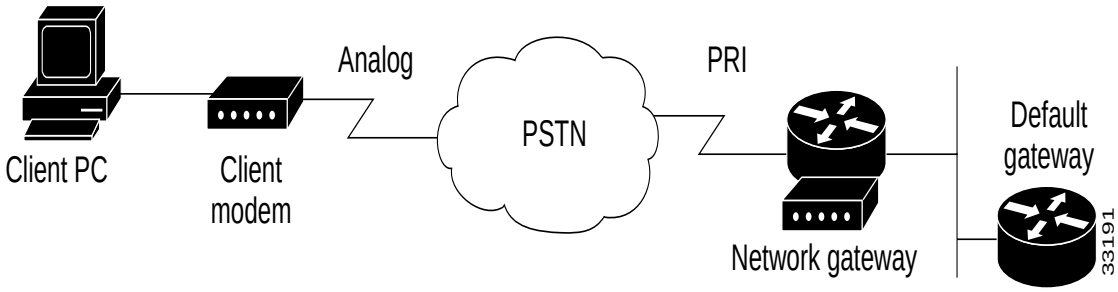
- Can be accessed by dialing in with a modem
- Provides access to terminal EXEC shell services (no PPP) to do the following:
  - Modify configuration files
  - Change passwords
  - Troubleshoot possible problems including modem connections
  - Access other network resources by using Telnet

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 need to be configured (for example, PPP and IPCP). The asynchronous-shell test ensures that the EXECs log in prompt can be accessed by a client modem. Taking a layered approach to building a network isolates problems and saves time.

Note The Cisco AS5800 is designed to process PPP sessions. To support high ratios of EXEC-shell users or V.120 users, work with your support team.

Step 1 Locate a client PC, client modem, and analog line. From the client PC, open a terminal emulation program (such as Hyper Terminal, not dialup networking) and connect to the client modem. Figure 2-6 shows the network environment for this test.

Figure 2-6 Test Environment



Step 2 From a terminal-emulation program, test the EIA/TIA-232 connection to the client modem. Enter the **at** command. The modem sends an OK return message.

```
at
OK
```

Step 3 Dial the PRI telephone number assigned to the NAS (5551234). After the modem successfully connects, a connect message appears.

```
atdt5551234
CONNECT 28800 V42bis
```

Tips 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 into the EXEC session:

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

User Access Verification

Username: theuser
Password:

5800-NAS>
```

Step 5 Determine upon which line the call landed. The following example shows that TTY line 436 accepted the call. The call has been up and active for 20 seconds.

```
5800-NAS# show caller
                                                 Active    Idle
  Line         User               Service       Time      Time
  con 0        admin              TTY           00:13:43  00:00:00
  tty 436      theuser            TTY           00:00:20  00:00:08

5800-NAS# show caller user theuser

  User: dude, line tty 436, service TTY
        Active time 00:00:34, Idle time 00:00:09
  Timeouts:            Absolute  Idle      Idle
                                 Session   Exec
      Limits:          -         -         00:10:00
      Disconnect in:   -         -         00:09:50
  TTY: Line 1/2/04
  DS0: (slot/unit/channel)=0/4/2
  Status: Ready, Active, No Exit Banner
  Capabilities: Hardware Flowcontrol In, Hardware Flowcontrol Out
                Modem Callout, Modem RI is CD
  Modem State: Ready

5800-NAS#
```

Note The **show caller** command is added to Cisco IOS Release 11.3 AA and 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 NAS, Telnet to another device in your network.

```
5800-NAS> telnet 172.22.66.26
Trying 172.22.66.26 ... Open

User Access Verification

Username: admin
Password:

5800-NAS>
5800-NAS> telnet aurora
Translating "aurora"...domain server (172.22.11.10) [OK]
Trying aurora.cisco.com (172.22.2.2)... Open

SunOS 5.6

login: theuser
Password:
Last login: Wed Oct  6 08:57:46 from dhcp-aus-163-236
Sun Microsystems Inc.   SunOS 5.6       Generic August 1997
aurora%
```

Task 8. Confirming the Final Running Configuration

After you complete the tasks in this section, the final running configuration looks like this:

```
5800-NAS# show running-config

Building configuration...

Current configuration:
!
version 12.x
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname 5800-NAS
!
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
enable secret 5 $1$gq.d$nZwr.ElnV/O0nE9U.wZ3D/
!
username admin password 7 105B1D1A0A12
username dude password 7 111C0D061817
!
!
!
!
shelf-id 0 router-shelf
shelf-id 1 dial-shelf
!
!
!
resource-pool disable
!
modem-pool Default
 pool-range 1/2/0-1/10/143
!
!
spe 1/2/0 1/10/11
 firmware ios-bundled default
modem recovery action none
ip subnet-zero
no ip source-route
ip host aurora 172.22.100.9
ip domain-name the.doc
ip name-server 172.22.11.10
ip name-server 172.22.12.11
!
isdn switch-type primary-ni
isdn voice-call-failure 0
!
!
controller T3 1/0/0
 framing m23
 cablelength 0
 t1 4 controller
!
controller T1 1/0/0:4
 framing esf
 pri-group timeslots 1-24
!
!
```

```
voice-port 1/0/0:4:D
!
!
process-max-time 200
!
interface Loopback0
 ip address 172.22.99.1 255.255.255.255
 no ip directed-broadcast
!
interface Loopback1
 ip address 172.22.90.1 255.255.255.0
 no ip directed-broadcast
!
interface FastEthernet0/1/0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial1/0/0:4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-ni
 isdn incoming-voice modem
 no cdp enable
!
interface Group-Async0
 no ip address
 no ip directed-broadcast
 group-range 1/2/00 1/10/143
!
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
no ip http server
!
!
banner login ^C
This is a secured device.
Unauthorized use is prohibited by law.
^C
!
line con 0
 transport input none
line aux 0
line vty 0 4
line 1/2/00 1/10/143
 modem InOut
 no modem log rs232
!
end
```

CHAPTER 3

Operations

This chapter details Cisco AS5800 routine operations performed on a daily basis to configure router interfaces.

In our discussion, local-based authentication is used. After the Cisco AS5800 hardware is commissioned, PPP is configured and tested as described in the section "Configuring PPP and Authentication" on page 25.

Verifying Modem Performance

This section describes how to verify and test modem performance on a Cisco AS5800 by using an EXEC terminal shell service.

The following sections are provided:

- Background on Asynchronous Data Communications, page 3-1
- Understanding Modem Modulation Standards, page 3-7
- Initiating a Modem Loopback Test Call, page 3-9
- Initiating and Inspecting a V.90 Test Call, page 3-17

An EXEC terminal shell service tests modem performance (lower layers) independently of PPP (and higher layers). A terminal-shell service test gets quick test results in a simple environment.

For information on how to manage modem pools and collect call statistics, see the "Modem Management Operations" section on page 3-40.

Background on Asynchronous Data Communications

Understanding how EIA/TIA-232 states function with the Cisco IOS software helps you test and troubleshoot modem connections:

- Async DataComm Model, page 3-2
- Logical Packet and Circuit Components of a NAS, page 3-2
- EIA/TIA-232 in Cisco IOS Software, page 3-4
- Cisco IOS Line-Side Inspection, page 3-6

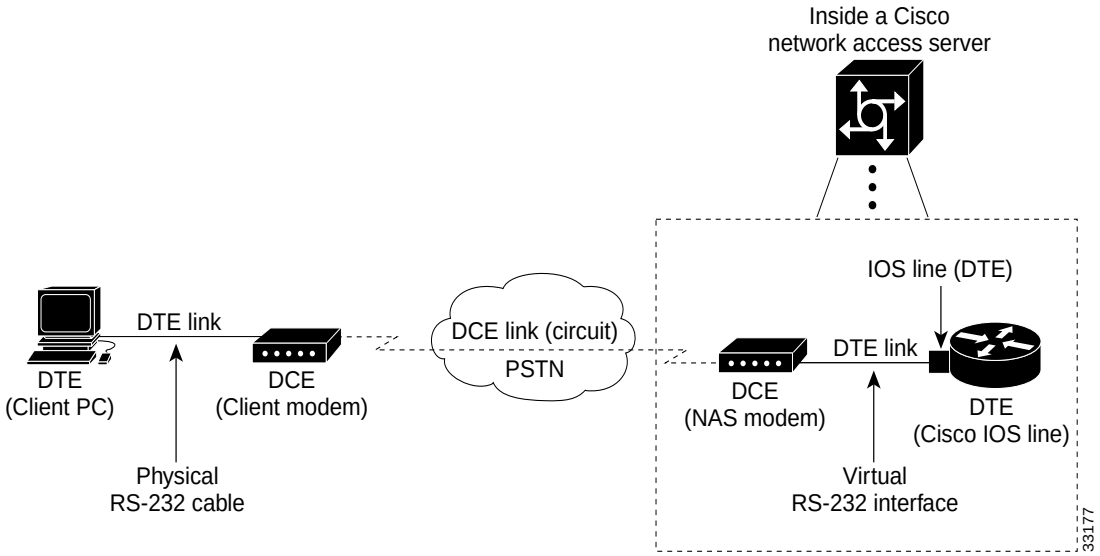
Async DataComm Model

Figure 3-1 shows how traditional DTE-to-DCE relationships map to a Cisco network access server (NAS). Data terminal equipment (DTE) uses data communication equipment (DCE) to send data over the PSTN.

In the context of EIA/TIA-232 and Cisco IOS software:

- The DTE is the client PC and the Cisco IOS TTY lines.
- The DCE is the client modem and the modem inside the NAS.
- The dashed line between the DCEs is the modem carrier running on top of the voiceband circuit through the PSTN. EIA/TIA-232 (whether physical or logical) is used on the DTE lines, not on the DCE link.
- The PSTN circuit runs through the circuit-switched half of the NAS.

Figure 3-1 A Standard Dialup Connection



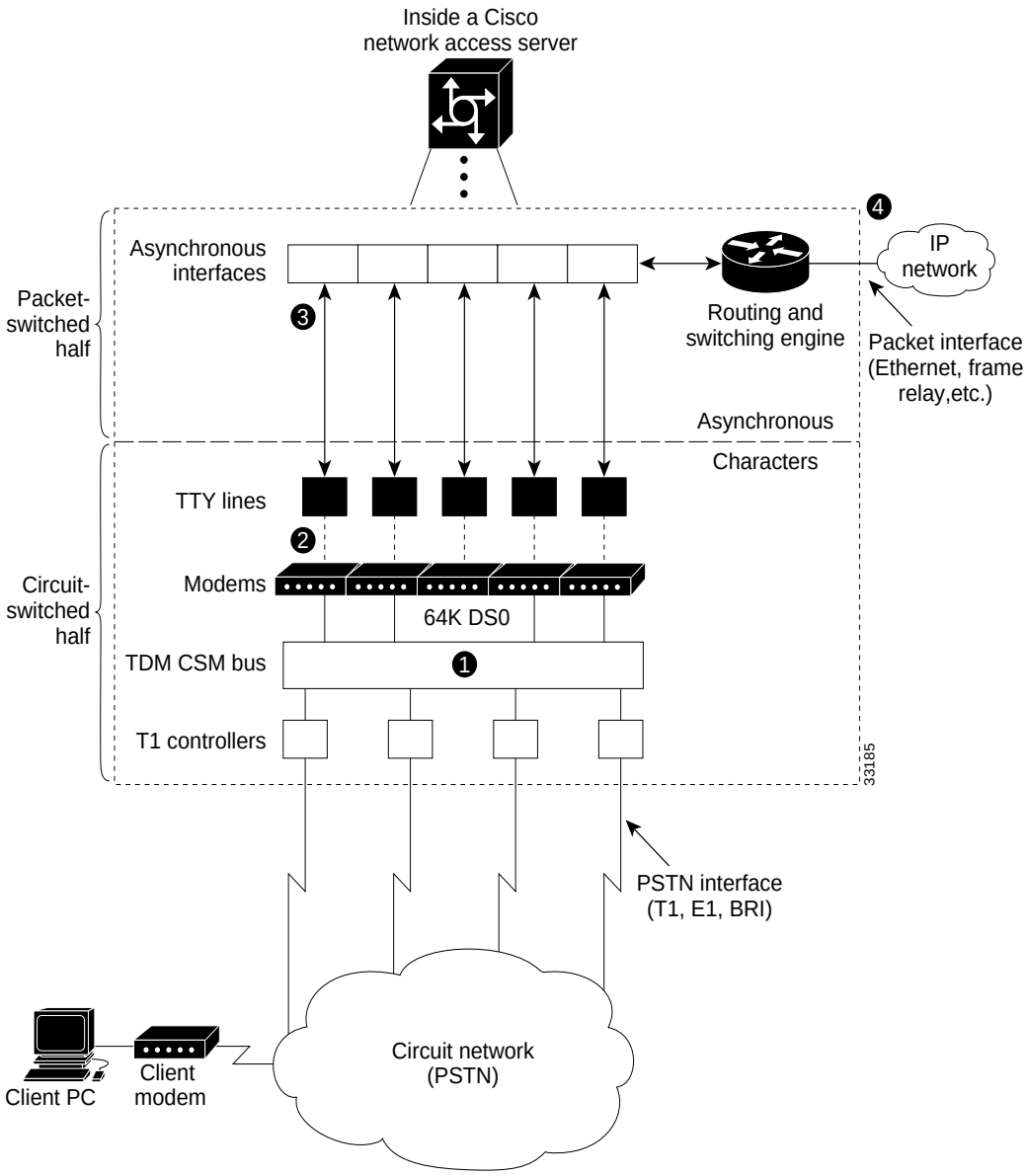
Logical Packet and Circuit Components of a NAS

The NAS functions as a gateway between two different networks:

- A circuit-switched network (for example, the PSTN)
- A packet-switched network (for example, the Internet)

The NAS is half a circuit switch and half a packet switch (router). EIA/TIA-232 signaling on the line is displayed by the **show line** command and **debug modem** command. Figure 3-2 shows the modem access connectivity path.

Figure 3-2 Modem Access Connectivity Path



To understand the general call-processing sequence, match the following numbered list with the numbers shown in Figure 3-2:

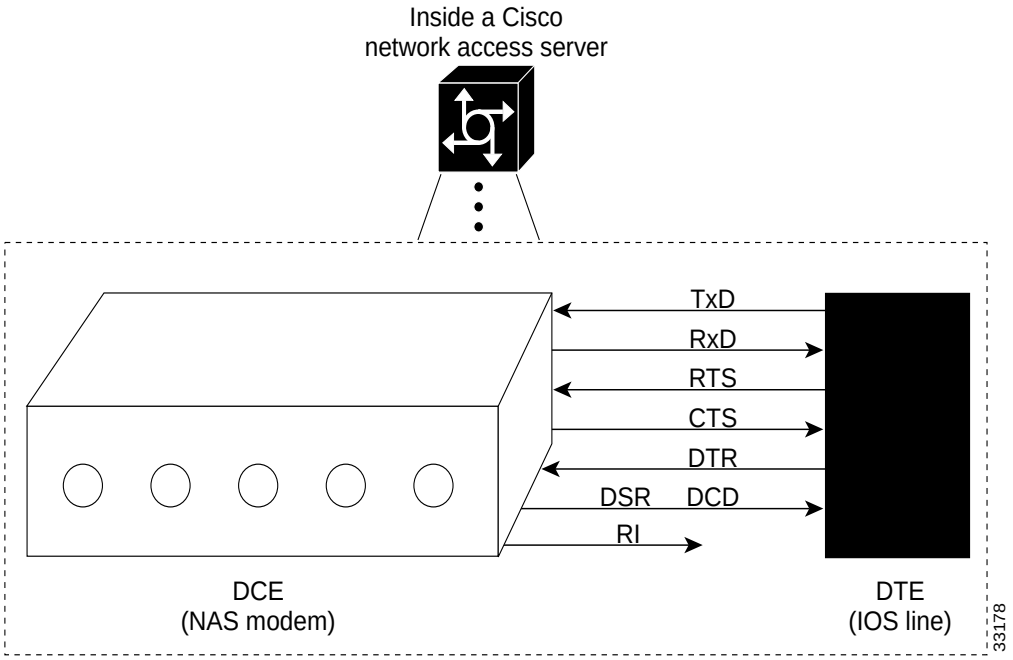
1. 64K DS0 circuits extend from the NAS modems, through the internal TDM CSM bus, and through the circuit network (PSTN).
2. The NAS modems demodulate digital streams into analog-voiceband modulation. The virtual EIA/TIA-232 interface connects the modems (DCE) to the TTY lines.
3. The TTY lines are mapped into asynchronous interfaces. Interfaces are Cisco IOS software objects that move packets. TTY lines function at Layer 1. Interfaces function at Layer 2 and Layer 3.
4. The packets are delivered into the IP network.

EIA/TIA-232 in Cisco IOS Software

The Cisco IOS software variation of asynchronous EIA/TIA-232 is shown in Figure 3-3. The variation exists between the Cisco IOS line (DTE) and the NAS modem (DCE).

- Six EIA/TIA-232 pins exist between each NAS modem and Cisco IOS line. One or more grounding wires also exist on physical EIA/TIA-232 lines; however, these wires do not convey signaling.
- Each pin controls a different EIA/TIA-232 signal.
- The arrows in Figure 3-3 indicate the signal transmission direction.

Figure 3-3 Cisco IOS EIA/TIA-232



Tips In Figure 3-3, notice that the DSR signal is the DCD signal for the modem. In the scheme of Cisco IOS software, the DCD pin on the DCE is strapped to the DSR pin on the Cisco IOS DTE side. What the Cisco IOS software calls DSR is not DSR; it is DCD. The DCE's actual DSR pin and ring ignore (RI) pin are ignored by the Cisco IOS software.

Table 3-1 describes how Cisco uses its EIA/TIA-232 pins. The signal direction in the table is from the perspective of the DTE (IOS line):

- Data signals (TxD, RxD)
- Hardware flow control signals (RTS, CTS)
- Modem signals (DTR, DSR, DCD, RI)

Table 3-1 EIA/TIA-232 Signal State Behavior

Signal	Signal Direction	Purpose
Transmit Data (TxD)	——> (Output)	DTE transmits data to DCE.
Receive Data (RxD)	<—— (Input)	DCE transmits received data to DTE.
Request To Send (RTS)	——> (Output)	DTE uses the RTS output signal to indicate if it can receive characters into the Rx input buffer[1]. The DCE should not send data to the DTE when DTR input is low (no RTS).
Clear To Send (CTS)	<—— (Input)	DCE signals to DTE that it can continue to accept data into its buffers. DCE asserts CTS only if the DCE is able to accept data.
Data Terminal Ready (DTR)	——> (Output)	DTE signals to DCE that it can continue to accept data into its buffers. DTE asserts RTS only if the DTE is able to accept data.
Data Carrier Detect (DCD)	<—— (Input)	DCE indicates to DTE that a call is established with a remote modem. Dropping DCD terminates the session. DCD will be up on the DCE only if the DCE has achieved data mode with its peer DCE (client modem).

1. The name RTS is illogical with the function (able to receive) due to historical reasons.

Cisco IOS Line-Side Inspection

To display the current modem-hardware states applied to a specific Cisco IOS line, enter the **show line tty** *number* command. The states of each logical EIA/TIA-232 pin change according to line conditions and modem events.

The following shows a line-side inspection of the idle state for TTY line 1:

```
5800-NAS#show line tty 1
   Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
I    1 TTY              - inout     -    -    -      2       0     0/0       -

Line 1, Location:"", Type:""
Length:24 lines, Width:80 columns
Status:No Exit Banner
Capabilities:Hardware Flowcontrol In, Hardware Flowcontrol Out
  Modem Callout, Modem RI is CD, Line usable as async interface
  Integrated Modem
Modem state:Idle
  modem(slot/port)=1/0, state=IDLE
  dsx1(slot/unit/channel)=NONE, status=VDEV_STATUS_UNLOCKED
Modem hardware state:CTS noDSR  DTR RTS
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
                            00:00:30
                           Autoselect Initial Wait
                             not set
Modem type is unknown.
Session limit is not set.
Time since activation:never
Editing is enabled.
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed transports are pad telnet rlogin v120 lapb-ta.  Preferred is telnet.
No output characters are padded
No special data dispatching characters
```

Table 3-2 describes some of the significant fields shown in the previous example:

Table 3-2 Show TTY Line Field Descriptions

Field	Description
`Capabilities`	Describes different aspects of the line: • The **flowcontrol hardware** command displays as "Hardware Flowcontrol In, Hardware Flowcontrol Out." • The **modem inout** command displays as "modem callout." • The text "Line usable as async interface" means there is an "interface async N" that corresponds to "line N." • The text "Modem RI is CD" displays for historical reasons.
`Modem state`	Displays the current status of the modem. Possible values include: • `Idle`—Modem is ready for incoming and outgoing calls. • `Conn`—Modem is connected to a remote host. • `Busy`—Modem is out of service and not available for calls. • `D/L`—Modem is downloading firmware. • `Bad`—Modem is in an inoperable state, which is manually configured by the **modem bad** command. • `Bad*`—During initial power-up testing, the **modem startup-test** command automatically put the modem in an inoperable state. • `Reset`—Modem is in reset mode. • `Bad FW`—The downloaded modem firmware is not usable.
`Modem Hardware state`	Displays the EIA/TIA-232 signal state status. CTS and no DSR are incoming signals. DTR and RTS are outgoing signals. NoDSR means that no call is currently connected.

Understanding Modem Modulation Standards

To optimize modem connect speeds, you must understand the basic modem modulation standards. This section provides the basic rules for achieving maximum V.34 and V.90 modulation speeds:

• V.34 Basic Rules, page 3-7
• V.90 Basic Rules, page 3-8

V.34 Basic Rules

V.34 modulation should work on any land-line voiceband circuit. V.34 supports speeds ranging from 2400 to 33600 bps.

Speed is a function of:

- The amount of usable spectrum across the channel (for example, 2400 to 3429 Hz)
- The signal to noise ratio (SNR)

To achieve 33600 bps, the channel must deliver:

- A response from 244 to 3674 Hz
- A SNR of 38 dB or better

In practice, toll-quality voiceband circuits support V.34 at speeds of 21600 to 33600 bps.

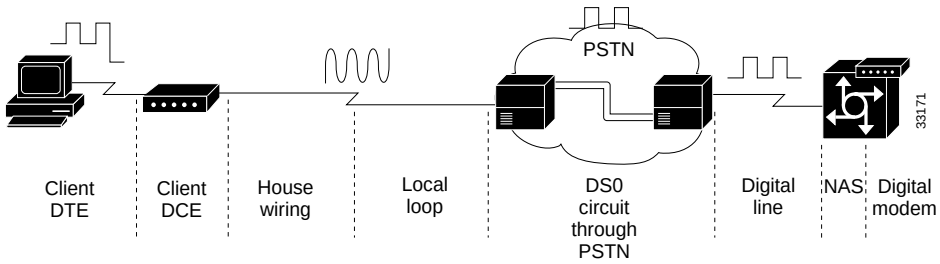
The following six items reduce the achieved V.34 speed:

1. Robbed-bit signaling links in the circuit, which reduce SNR.
2. Extra analog-to-digital conversions. For example, nonintegrated or universal subscriber line concentrators (SLCs) reduce bandwidth and SNR.
3. Load coils on the local loop, which reduce bandwidth.
4. Long local loops, which reduce bandwidth and SNR.
5. The following electrical disturbances in the house wiring, which reduce SNR:
   - Cross talk from two lines in the same quad cable
   - Corroded connectors
   - Bridge-tapped lines running parallel to fluorescent lights
   - Flat silver-satin cables running parallel to power cables
   - Extra electrical equipment sharing the same power jack as the modem
6. Voiceband circuits that pass through sub-64k coding, such as a cellular or 32K ADPCM link. With 32k ADMCM, the speed is typically 9600 to 16800 bps.

V.90 Basic Rules

Many circuit components work together to deliver V.90 modulation. See Figure 3-4.

Figure 3-4 V.90 Network Components



Here are the V.90 basic rules:

- Select recommended modem code. The following are reliable V.90 releases at the time of this publication:
  - MICA Portware Version 2.6.2.0
  - Microcom Firmware Version 5.2.1.0

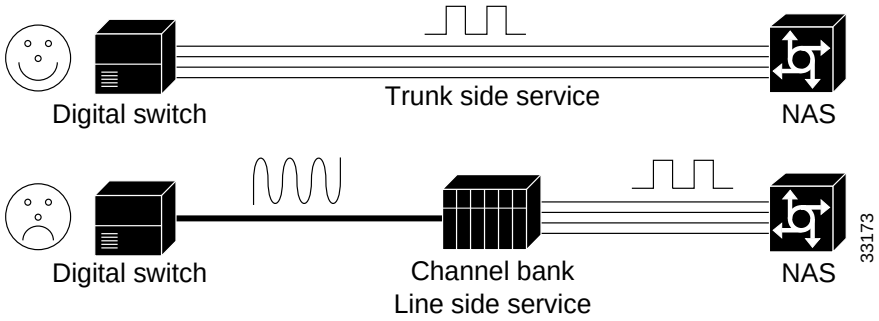
  The latest modem code is posted on CCO at the following URL:
  http://www.cisco.com/kobayashi/sw-center/sw-access.shtml
- Run a Cisco IOS release that is compatible with V.90. Table 3-3 shows the V.90 supported Cisco IOS releases at the time of this publication.

Table 3-3 V.90 Supported Cisco IOS Releases

Chassis	Modem Type	Cisco IOS Release
Cisco AS5800	MICA	11.3(6+)AA 12.0(1+)T

- Exactly one digital to analog conversion must exist in the circuit. The digital line must connect into a digital switch, *not* a channel bank. V.90 requires PRI (64k clear-channel DS0s). Channel banks destroy V.90 by adding additional analog-to-digital conversions. Telcos occasionally refer to channel banks as line-side services. Digital switches are sometimes referred to as trunk-side services. Figure 3-5 shows this.

Figure 3-5 No Channel Banks for V.90



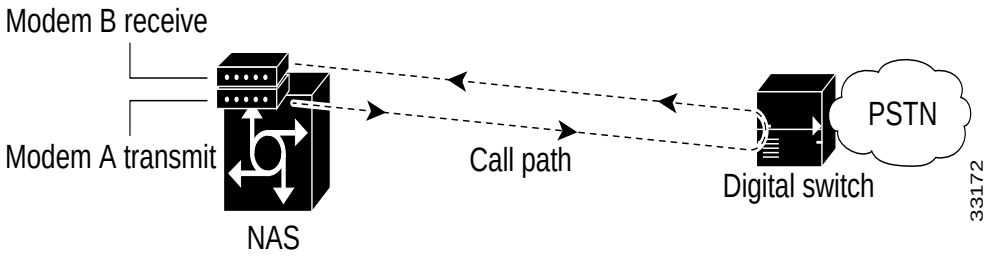
- In the local loop, less than three miles of twisted-pair copper line with no load coils is ideal. Load coils limit frequencies (passband). V.90 requires a 3000 Hz passband. A circuit that does not deliver a 3200 Hz passband will most likely not deliver V.90. Load coils are common in long loops in North America (at the 3.5 mile mark).
- Sometimes the PSTN switch fabric is extended by a digital carrier. It is then converted to analog by a SLC. This setup complies with V.90. The digital-to-analog conversion is moved closer to the subscriber. However, non-integrated or universal SLCs do not comply to V.90.
- Use a recommended V.90 client modem.
- Electrical house wiring sometimes causes V.90 trainup to fail. For details, see the "V.34 Basic Rules" section on page 3-7.

Initiating a Modem Loopback Test Call

Test the access server's ability to initiate and terminate a modem call. Similar to sending a ping to the next-hop router, this test verifies basic connectivity for modem operations. Successfully performing this test gives you a strong indication that remote clients should be able to dial into the NAS. Figure 3-6 shows this test.

After completing this test, dial into the EXEC from a client PC and a client modem (no PPP).

Figure 3-6 Initiating and Terminating a Modem Call on the Same NAS



Note When calling between two digital modems, you will not achieve V.90. V.90 requires one digital and one analog modem.

Step 1 From a workstation, open two Telnet sessions into the NAS. One Telnet session is used to simulate the client. The other session is used to administer and run the debugs. In this way, the debug messages will not be scrambled into the loopback screen display.

Step 2 Configure the lines to support dial in, dial out, and outbound Telnet connections:

```
!
line 1/2/00 1/3/143
 modem inout
 transport input telnet
!
```

Step 3 From the administrative Telnet session, turn on the appropriate debug commands. Older software might require the **debug modem csm** command.

```
5800-NAS#debug isdn q931
ISDN Q931 packets debugging is on
5800-NAS#debug csm modem
Modem Management Call Switching Module debugging is on
5800-NAS#debug modem
Modem control/process activation debugging is on
5800-NAS#show debug
General OS:
  Modem control/process activation debugging is on
CSM Modem:
  Modem Management Call Switching Module debugging is on
ISDN:
  ISDN Q931 packets debugging is on
  ISDN Q931 packets debug DSLs. (On/Off/No DSL:1/0/-)
  DSL  0 --> 31
  1 - - - - - - -  - - - - - - - - -  - - - - - - - - -  - - - - - - - - -
  DSL 32 --> 55
  - - - - - - - -  - - - - - - - - -  - - - - - - - - -
Modem Management:
  Modem Management Call Switching Module debugging is on

5800-NAS#
```

Tips For channel associated signaling (CAS), robbed bit signaling (RBS), and R2, use the **debug cas** command. If this command is not included in your software, use the **modem-mgmt csm debug-rbs** command; however, the **service internal** command is required.

```
5800-NAS(config)#service internal
5800-NAS(config)#end
5800-NAS#modem-mgmt csm debug-rbs
```

At the time of this publication, the Cisco AS5800 does not support the **debug cas** command or **modem-mgmt csm debug-rbs** command. As a workaround, complete the following steps:

a. Determine the slot positions of each card. Enter the **show dial-shelf** command.

b. Access the trunk card's console port. Enter the **dsip console slave** *X* command where *X* is the slot of the card that you want to perform debugging on.

c. Enter the command **debug trunk cas port** *port-number* **timeslots** *range.*

Step 4 Ensure that your EXEC session receives logging and debug output from the NAS:

```
5800-NAS#logging console
```

Step 5 From the client Telnet session, Telnet into one of the idle modems (not in use). To do this, Telnet to an IP address on the NAS (Ethernet or Loopback) followed by 2000 plus a TTY line number. This example Telnets to TTY line 1 (2001).

```
5800-NAS#telnet 172.22.66.23 2001
Trying 172.22.66.23, 2001 ... Open
```

Note This step is also known as a reverse Telnet.

For a Cisco AS5800, create an arbitrary IP host followed by a reverse Telnet. Use the **show modem** *shelf/slot/port* command to determine which modem is associated with which TTY line. The following example Telnets to TTY 500, which maps to modem 1/2/68.

```
5800-NAS#show modem 1/2/68
     Mdm  Typ     Status     Tx/Rx     G  Duration  RTS   CTS   DCD   DTR
     ---  ---     ------     -----     -  --------  ---   ---   ---   ---
   1/2/68 V.90    Idle    37333/31200  1  00:01:05  RTS   CTS   noDCD DTR

Modem 1/2/68, Cisco MICA modem (Managed), Async1/2/68, TTY500
Firmware Rev: 2.6.2.0

5800-NAS(config)#ip host mod500 2500 172.22.66.23
5800-NAS(config)#^Z
5800-NAS#telnet mod500
Trying mod500 (172.22.66.23, 2500)... Open
```

Step 6 Log in from the client Telnet session. The Cisco IOS software sends out a username-password prompt.

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


User Access Verification

Username:admin
Password:

Sep 23 05:04:58.047: TTY0: pause timer type 1 (OK)
Sep 23 05:04:58.051: TTY1: asserting DTR
Sep 23 05:04:58.051: TTY1: set timer type 10, 30 seconds
Sep 23 05:05:03.583: TTY1: set timer type 10, 30 seconds
```

Step 7 Enter the **at** command to test connectivity to the NAS modem. The modem reports an "OK" return message.

```
at
OK
```

Step 8 Dial the PRI phone number assigned to the NAS (in this example, 5551234). A connect string appears when the modem connects.

```
atdt5551234
CONNECT 33600 /V.42/V.42bis
```

In this example:

- Modulation connect speed = 33600 bps. Expect to get a maximum of 33600 bps if you use a PRI line. If you use RBS, expect to get a maximum of 31200 bps.
- Error correction = V.42
- Data compression = V.42bis

Step 9 From the administrative Telnet session, inspect the debug output:

```
000434: *May  2 23:01:39.507 UTC: ISDN Se1/0/0:23: RX <-  SETUP pd = 8  callrefB
000435: *May  2 23:01:39.507 UTC:         Bearer Capability i = 0x9090A2
000436: *May  2 23:01:39.507 UTC:         Channel ID i = 0xA98381
000437: *May  2 23:01:39.507 UTC:         Progress Ind i = 0x8083 - Origination
000438: *May  2 23:01:39.507 UTC:         Calling Party Number i = 0x2183, '408'
000439: *May  2 23:01:39.507 UTC:         Called Party Number i = 0xC1, '324193'
000440: *May  2 23:01:39.511 UTC: allocate slot 2 and port 12 is allocated

000441: *May  2 23:01:39.511 UTC: ISDN Se1/0/0:23: TX ->  CALL_PROC pd = 8  calB
000442: *May  2 23:01:39.511 UTC:         Channel ID i = 0xA98381
000443: *May  2 23:01:39.511 UTC: CSM v(2/12) c(T1 1/0/0:0): CSM_EVENT_FROM_ISD.
000444: *May  2 23:01:39.511 UTC: CSM v(2/12) c(T1 1/0/0:0): CSM_PROC_IDLE:  ev.
000445: *May  2 23:01:39.511 UTC: ISDN Se1/0/0:23: TX ->  ALERTING pd = 8  callB
000446: *May  2 23:01:39.539 UTC: CSM v(2/12) c(T1 1/0/0:0): CSM_PROC_IC2_RING:.
000447: *May  2 23:01:39.539 UTC: ISDN Se1/0/0:23: TX ->  CONNECT pd = 8  callrB
000448: *May  2 23:01:39.563 UTC: ISDN Se1/0/0:23: RX <-  CONNECT_ACK pd = 8  cB
000449: *May  2 23:01:39.563 UTC: ISDN Se1/0/0:23: CALL_PROGRESS: CALL_CONNECTE0
000450: *May  2 23:01:39.563 UTC: CSM v(2/12) c(T1 1/0/0:0): CSM_EVENT_FROM_ISD.
000451: *May  2 23:01:39.563 UTC: CSM v(2/12) c(T1 1/0/0:0): CSM_PROC_IC6_WAIT_.
000452: *May  2 23:01:57.778 UTC: TTY1/2/12: DSR came up
000453: *May  2 23:01:57.778 UTC: tty1/2/12: Modem: IDLE->(unknown)
000454: *May  2 23:01:57.778 UTC: TTY1/2/12: EXEC creation
000455: *May  2 23:01:57.778 UTC: TTY1/2/12: create timer type 1, 600 seconds
000456: *May  2 23:02:05.462 UTC: TTY1/2/12: set timer type 10, 30 seconds
```

Note You must have the logging console feature turned on to view this output on the screen.

The bearer capability 0x8090A2 indicates an analog voice call. Alternative bearer services include 64K data calls, which are indicated by 0x8890. The calling party number is 408 (also known as ANI). The called party number is 5551234 (also known as DNIS). The **debug q931** command shows the call coming into the NAS over ISDN.

```
*Jan  1 00:34:47.867:VDEV_ALLOCATE:1/2 is allocated from pool System-def-Mpool
*Jan  1 00:34:47.867:csm_get_vdev_for_isdn_call:fax_call=0
*Jan  1 00:34:47.867:EVENT_FROM_ISDN:(001A):DEV_INCALL at slot 1 and port 2
*Jan  1 00:34:47.867:CSM_PROC_IDLE:CSM_EVENT_ISDN_CALL at slot 1, port 2
*Jan  1 00:34:47.867:Mica Modem(1/2):Configure(0x1 = 0x0)
*Jan  1 00:34:47.867:Mica Modem(1/2):Configure(0x23 = 0x0)
*Jan  1 00:34:47.867:Mica Modem(1/2):Call Setup
*Jan  1 00:34:47.867: Enter csm_connect_pri_vdev function
*Jan  1 00:34:47.867:csm_connect_pri_vdev:tdm_allocate_bp_ts() call.
BP TS allocated at bp_stream0, bp_Ch5,vdev_common 0x610378B0
*Jan  1 00:34:47.883:ISDN Se0:23:RX <-  ALERTING pd = 8  callref = 0x8004
*Jan  1 00:34:47.883:        Progress Ind i = 0x8288 - In-band info or appropriate now
available
*Jan  1 00:34:48.019:Mica Modem(1/2):State Transition to Call Setup
*Jan  1 00:34:48.019:Mica Modem(1/2):Went offhook
*Jan  1 00:34:48.019:CSM_PROC_IC2_RING:CSM_EVENT_MODEM_OFFHOOK at slot 1, port 2
*Jan  1 00:34:48.019:ISDN Se0:23:TX ->  CONNECT pd = 8  callref = 0x8053
*Jan  1 00:34:48.047:ISDN Se0:23:RX <-  CONNECT_ACK pd = 8  callref = 0x0053
*Jan  1 00:34:48.047:EVENT_FROM_ISDN::dchan_idb=0x6149A144, call_id=0x1A,
ces=0x1 bchan=0x0, event=0x4, cause=0x0
*Jan  1 00:34:48.047:EVENT_FROM_ISDN:(001A):DEV_CONNECTED at slot 1 and port 2
*Jan  1 00:34:48.047:CSM_PROC_IC4_WAIT_FOR_CARRIER:CSM_EVENT_ISDN_CONNECTED at slot 1,
port 2
*Jan  1 00:34:48.047:Mica Modem(1/2):Link Initiate
*Jan  1 00:34:48.047:ISDN Se0:23:RX <-  CONNECT pd = 8  callref = 0x8004
*Jan  1 00:34:48.047:EVENT_FROM_ISDN::dchan_idb=0x6149A144, call_id=0x8005, ces=0x1
bchan=0x16, event=0x4, cause=0x0
*Jan  1 00:34:48.047:EVENT_FROM_ISDN:(8005):DEV_CONNECTED at slot 1 and port 0
*Jan  1 00:34:48.047:CSM_PROC_OC5_WAIT_FOR_CARRIER:CSM_EVENT_ISDN_CONNECTED at slot 1,
port 0
*Jan  1 00:34:48.051:ISDN Se0:23:TX ->  CONNECT_ACK pd = 8  callref = 0x0004
```

MICA modem 1/2 goes offhook and receives the call. The **debug modem csm** command shows the call getting switched over to a modem.

```
*Jan  1 00:34:49.159:Mica Modem(1/2):State Transition to Connect
*Jan  1 00:34:53.903:Mica Modem(1/2):State Transition to Link
*Jan  1 00:35:02.851:Mica Modem(1/2):State Transition to Trainup
*Jan  1 00:35:04.531:Mica Modem(1/2):State Transition to EC Negotiating
*Jan  1 00:35:04.711:Mica Modem(1/2):State Transition to Steady State
*Jan  1 00:35:04.755:TTY3:DSR came up
*Jan  1 00:35:04.755:tty3:Modem:IDLE->(unknown)
```

Inspect the different modem trainup phases. The modem goes from Connect to Steady State in 15 seconds. The **debug modem csm** command displays the trainup phases. The **debug modem** command displays the logical EIA/TIA-232 transition message "DSR came up."

```
*Jan  1 00:35:04.759:TTY3:EXEC creation
*Jan  1 00:35:04.759:TTY3:set timer type 10, 30 seconds
*Jan  1 00:35:08.915:TTY3:Autoselect(2) sample 61 <------------------- a
*Jan  1 00:35:09.187:TTY3:Autoselect(2) sample 6164 <----------------- d
*Jan  1 00:35:09.459:TTY3:Autoselect(2) sample 61646D <--------------- m
*Jan  1 00:35:09.459:TTY3:Autoselect(2) sample 61646D69 <------------- i
*Jan  1 00:35:09.715:TTY3:Autoselect(2) sample 646D696E <------------- n
*Jan  1 00:35:09.715:TTY3:Autoselect(2) sample 6D696E0D <------------- <cr>
```

Decode the incoming character-byte stream for an EXEC shell login (no PPP). In this example, match the username "admin" to the character stream: 616D696E0D = admin carriage return.

The Cisco IOS samples four packets at a time. It searches for a header that matches one of your autoselect styles. The **debug modem** command generates the autoselect debug output.

```
*Jan  1 00:35:09.715:TTY3:set timer type 10, 30 seconds
*Jan  1 00:35:11.331:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:11.667:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:11.987:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:11.987:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:11.987:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:12.339:TTY3:Autoselect(2) sample [suppressed--line is not echoing]
*Jan  1 00:35:12.391:TTY3:create timer type 1, 600 seconds
5800-NAS>
```

Type 10 is the login timer. The timeout is 30 seconds. The user's EXEC-shell login password is suppressed.

Step 10 Identify who is logged in. TTY line 3 corresponds to modem 1/2. Use the **show terminal** command to see which modem is assigned to the TTY line.

```
5800-NAS> show user
    Line     User      Host(s)                 Idle Location
   3 tty 3   admin     idle                    0
* 98 vty 0   joe       172.22.66.1             0 leftfield.corporate.com

  Interface  User      Mode                    Idle Peer Address
```

d. Program the terminal window not to pause in the middle of a screen display. To adjust the display output on a Cisco AS5800, enter the **terminal length 0** command instead.

```
5800-NAS> terminal length 0
```

Step 11 Generate traffic across the modem link. Force the answering modem (in the NAS) to send a data stream to the client modem. The data stream generated by the **show modem log** command is about 1 MB. The data should scroll freely for one or two minutes.

```
5800-NAS> show modem log
doc-rtr58-01#sh modem log
Modem 1/2/00 Events Log:
  3w2d    :Startup event:MICA Hex modem (Managed)
           Modem firmware = 0.7.3.7
  2w2d    :Modem State event:
           State:Terminate
  2w2d    :Modem State event:
           State:Idle
Modem 1/2/01 Events Log:
  3w2d    :Startup event:MICA Hex modem (Managed)
           Modem firmware = 0.7.3.7
  2w2d    :Modem State event:
           State:Terminate
  2w2d    :Modem State event:
           State:Idle
Modem 1/2/02 Events Log:
  3w2d    :Startup event:MICA Hex modem (Managed)
           Modem firmware = 0.7.3.7
  2w2d    :Modem State event:
           State:Terminate
  2w2d    :Modem State event:
           State:Idle
```

Step 12 Look at the modem's operational statistics and verify that you have acceptable speed, line shape, and throughput. In this example, modem 1/2 accepts the call.

If you do not have a scroll bar in your Telnet application, limit terminal length to 24 lines to see all the command output.

If you are using Microcom modems, enter the **modem at-mode** *slot*/*port* command followed by the **at@e1** command.

```
5800-NAS> show modem operational-status 1/2/00
Modem(1/2/00) Operational-Status:

 Parameter #0  Disconnect Reason Info: (0x0)
       Type (=0 ): <unknown>
      Class (=0 ): Other
     Reason (=0 ): no disconnect has yet occurred
 Parameter #1  Connect Protocol: LAP-M
 Parameter #2  Compression: V.42bis both
 Parameter #3  EC Retransmission Count: 0
 Parameter #4  Self Test Error Count: 0
 Parameter #5  Call Timer: 597 secs
 Parameter #6  Total Retrains: 0
 Parameter #7  Sq Value: 4
 Parameter #8  Connected Standard: V.34+
 Parameter #9  TX,RX Bit Rate: 33600, 33600
 Parameter #11 TX,RX Symbol Rate: 3429, 3429
 Parameter #13 TX,RX Carrier Frequency: 1959, 1959
 Parameter #15 TX,RX Trellis Coding: 16, 16
 Parameter #16 TX,RX Preemphasis Index: 0, 0
 Parameter #17 TX,RX Constellation Shaping: Off, Off
 Parameter #18 TX,RX Nonlinear Encoding: Off, Off
 Parameter #19 TX,RX Precoding: Off, Off
 Parameter #20 TX,RX Xmit Level Reduction: 0, 0 dBm
 Parameter #21 Signal Noise Ratio: 41 dB
```

```
 Parameter #22 Receive Level: -12 dBm
 Parameter #23 Frequency Offset: 0 Hz
 Parameter #24 Phase Jitter Frequency: 0 Hz
 Parameter #25 Phase Jitter Level: 0 degrees
 Parameter #26 Far End Echo Level: -52 dBm
 Parameter #27 Phase Roll: 31 degrees
 Parameter #28 Round Trip Delay: 1 msecs
 Parameter #30 Characters transmitted, received: 70966, 80
 Parameter #32 Characters received BAD: 2
 Parameter #33 PPP/SLIP packets transmitted, received: 0, 0
 Parameter #35 PPP/SLIP packets received (BAD/ABORTED): 0
 Parameter #36 EC packets transmitted, received OK: 269, 61
 Parameter #38 EC packets (Received BAD/ABORTED): 0
 Parameter #39 Robbed Bit Signalling (RBS) pattern: 0
 Parameter #40 Digital Pad: None,  Digital Pad Compensation:None
Line Shape:
.............................*
..............................*
...............................*
..............................*
..............................*
...............................*
...............................*
...............................*
..............................*
...............................*
...............................*
..............................*
..............................*
..............................*
..............................*
..............................*
..............................*
..............................*
...............................*
```

Table 3-4 describes the significant parameters in the previous example. For a complete command reference description, refer to *Modem Management Commands*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/

Table 3-4 Operational Parameter Descriptions for a Loopback Test Call

Parameter	Description
`Parameter #1  Connect Protocol: LAP-M`	LAP-M is the connection protocol.
`Parameter #6  Total Retrains: 0`	The modem has no retrain counts.
`Parameter #8  Connected Standard: V.34+`	The modem connects at V.34.
`Parameter #9  TX,RX Bit Rate: 33600, 33600`	The receive and transmit bit rate is 33600 bps, which is the fastest possible V.34 speed. You will never attain V.90 with this test. MICA-to-MICA calls default to V.34 modulation. V.90 requires one analog modem.
`Parameter #11 TX,RX Symbol Rate: 3429, 3429`	The transmit and receive symbol rate is 3429. To achieve 33600 bps, you must have a 3429 Hz passband.
`Parameter #21 Signal Noise Ratio: 41 dB`	The signal to noise ratio is 41 dB.

Table 3-4 Operational Parameter Descriptions for a Loopback Test Call (continued)

Parameter	Description
Parameter #26 Far End Echo Level: -52 dBm	Use this field to detect a near-end digital-to-analog conversion. For this test, an acceptable value is less than -55 dB. If you see a high level of far end echo (-55 or higher), a digital-to-analog conversion probably exists between the NAS and the switch. This conversion severely impairs modem performance.
Parameter #30 Characters transmitted, received: 70966, 80	The number of characters transmitted and received by the modem.
Line shape: .....* .....* .....* .....* .....* .....* .....* .....* .....* .....*	A line shape is the frequency-response graph of the channel. For this modem loopback test call, there should be no rolloff (even at the highest frequency). High-end rolloff is characteristic of an analog-to-digital conversion (not good). A flat vertical line shape is an ideal V.90 line shape. ISDN uses a 64KB clear channel. No statistical roll off should exist at the low end or the high end of the spectrum. The spectrum has a Y and X axis. The Y axis (vertical) represents frequencies from 150 Hz (top of chart) to 3750 Hz (bottom of chart) in 150 Hz steps. A flat spectrum plot is best, it is available for V.34, V.90, and K56Flex. The X axis (horizontal) represents a normal amplitude. The graph identifies nulls, bandwidth, and distortion (irregular shape).

Step 13 Turn off all debug commands:

```
5800-NAS# undebug all
All possible debugging has been turned off
```

Initiating and Inspecting a V.90 Test Call

Before you let users dial in to the NAS, initiate and inspect a V.90 test call. V.90 call performance is heavily dependent upon the telco's network topology. There are many variables.

Most modem manufactures have unique AT command sets. The AT commands used in the following procedure may not be supported by your modem. For more information, refer to the following:

- Modem manuals, available online at http://56k.com/links/Modem_Manuals/
- Modemsite.com's troubleshooting website, available at http://808hi.com/56k/trouble1.htm

Step 1 Locate a client PC, client modem, and an analog line.

Step 2 Test your EIA/TIA-232 connection to the client modem:

```
at
OK
```

Step 3 Verify that the modem is running the recommended firmware version. The following example shows a U.S. Robotics 56K fax external modem running V.4.11.2. Compare the firmware version with the version that is posted on the modem vendor's website.

The ati3 and **ati7** modem firmware commands are commonly used and are shown below:

```
ati3
U.S. Robotics 56K FAX EXT V4.11.2

OK

ati7
Configuration Profile...

Product type           US/Canada External
Product ID:            00568602
Options                V32bis,V.34+,x2,V.90
Fax Options            Class 1/Class 2.0
Line Options           Caller ID, Distinctive Ring
Clock Freq             92.0Mhz
EPROM                  256k
RAM                    32k

FLASH date             6/3/98
FLASH rev              4.11.2

DSP date               6/3/98
DSP rev                4.11.2

OK
```

Step 4 Verify that the modem is configured correctly. Enter the **ati4** (USR) or **at&v** (Conexant) command. To reset the modem to the factory defaults, enter the **at&f**, **at&f1**, or **at&f2** command.

```
ati4
U.S. Robotics 56K FAX EXT Settings...

   B0  E1  F1  M1  Q0  V1  X1  Y0
   BAUD=38400  PARITY=N  WORDLEN=8
   DIAL=TONE    ON HOOK   CID=0

   &A1  &B1  &C1  &D2  &G0  &H0  &I0  &K0
   &M4  &N0  &P0  &R1  &S0  &T5  &U0  &Y1

   S00=000  S01=000  S02=043  S03=013  S04=010  S05=008  S06=002
   S07=060  S08=002  S09=006  S10=014  S11=070  S12=050  S13=000
   S15=000  S16=000  S18=000  S19=000  S21=010  S22=017  S23=019
   S25=005  S27=000  S28=008  S29=020  S30=000  S31=128  S32=002
   S33=000  S34=000  S35=000  S36=014S38=000  S39=000  S40=001
   S41=000  S42=000

   LAST DIALED #: T14085551234

OK
```

Step 5 Dial the access server's telephone number, log in, and access the EXEC shell. The client modem is connected at 48000 bps in this example.

```
atdt14085551234
CONNECT 48000/ARQ

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

User Access Verification

Username:user
Password:

5800-NAS>
```

Step 6 Inspect your call on the access server. In the example, the call landed on TTY line 1. The call has been up for 36 seconds.

```
5800-NAS> show caller
                                              Active    Idle
  Line         User               Service      Time      Time
  vty 0        -                  VTY          00:07:46  00:00:00

5800-NAS> show caller
```

Note The **show caller** command is supported in Cisco IOS Release 11.3 AA and 12.0 T. Use the **show user** command if your software does not support the **show caller** command.

Step 7 Inspect the physical terminal line that received the call. In the example, the call landed on modem 1/0.

```
5800-NAS> show terminal
Line 1/2/10, Location: "", Type: ""
Length: 24 lines, Width: 80 columns
Status: PSI Enabled, Ready, Active, No Exit Banner
Capabilities: Hardware Flowcontrol In, Hardware Flowcontrol Out
  Modem Callout, Modem RI is CD
Modem state: Ready
Modem hardware state: CTS DSR  DTR RTS
modem=1/2/10, vdev_state(0x00000000)=CSM_OC_STATE, bchan_num=(T1 1/0/0:0)
vdev_status(0x00000001): VDEV_STATUS_ACTIVE_CALL.

Group codes:    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
                             00:00:30
                            Autoselect Initial Wait
                              not set
```

```
Modem type is unknown.
Session limit is not set.
Time since activation: 00:12:24
Editing is enabled.
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed transports are lat pad v120 telnet rlogin dsipcon.  Preferred is lat.
No output characters are padded
No special data dispatching characters
```

Step 8 Program the display window so it does not pause in the middle of a screen display:

```
5800-NAS> terminal length 0
```

Step 9 Generate traffic across the modem link. Perform a lightweight stress test between the modems to generate meaningful modem-performance statistics.

```
5800-NAS> show modem log
Modem 1/2/00 Events Log:
  3w4d    :Startup event:MICA Hex modem (Managed)
           Modem firmware = 2.7.1.0
  3w4d    :RS232 event:  noRTS, noDTR, CTS, noDCD
  3w4d    :RS232 event:  noRTS, DTR, CTS, noDCD
```

The output generated by the **show modem log** command sends a large data stream across the modem link - about 1 MB of data. The data should scroll freely for one or two minutes.

Step 10 Inspect the NAS modem that answered the call, and verify that it has acceptable connect speed, throughput, and line shape. This example examines MICA modem 1/0. If you have Microcom modems, enter the **modem at-mode** *slot*/*port* command followed by the **at@e1** command.

```
5800-NAS> show modem operational-status 1/2/00
Modem(1/2/00) Operational-Status:

 Parameter #0  Disconnect Reason Info: (0x0)
       Type (=0 ): <unknown>
      Class (=0 ): Other
     Reason (=0 ): no disconnect has yet occurred
 Parameter #1  Connect Protocol: LAP-M
 Parameter #2  Compression: None
 Parameter #3  EC Retransmission Count: 2
 Parameter #4  Self Test Error Count: 0
 Parameter #5  Call Timer: 118 secs
 Parameter #6  Total Retrains: 0
 Parameter #7  Sq Value: 3
 Parameter #8  Connected Standard: V.90
 Parameter #9  TX,RX Bit Rate: 48000, 28800
 Parameter #11 TX,RX Symbol Rate: 8000, 3200
 Parameter #13 TX,RX Carrier Frequency: 0, 1920
 Parameter #15 TX,RX Trellis Coding: 0, 16
 Parameter #16 TX,RX Preemphasis Index: 0, 6
 Parameter #17 TX,RX Constellation Shaping: Off, Off
 Parameter #18 TX,RX Nonlinear Encoding: Off, Off
 Parameter #19 TX,RX Precoding: Off, Off
 Parameter #20 TX,RX Xmit Level Reduction: 0, 0 dBm
 Parameter #21 Signal Noise Ratio: 36 dB
 Parameter #22 Receive Level: -19 dBm
 Parameter #23 Frequency Offset: 0 Hz
 Parameter #24 Phase Jitter Frequency: 0 Hz
 Parameter #25 Phase Jitter Level: 0 degrees
```

```
 Parameter #26 Far End Echo Level: -37 dBm
 Parameter #27 Phase Roll: 0 degrees
 Parameter #28 Round Trip Delay: 23 msecs
 Parameter #30 Characters transmitted, received: 67109, 43
 Parameter #32 Characters received BAD: 0
 Parameter #33 PPP/SLIP packets transmitted, received: 0, 0
 Parameter #35 PPP/SLIP packets received (BAD/ABORTED): 0
 Parameter #36 EC packets transmitted, received OK: 565, 43
 Parameter #38 EC packets (Received BAD/ABORTED): 2
 Parameter #39 Robbed Bit Signalling (RBS) pattern: 0
 Parameter #40 Digital Pad: 6.0   dB,  Digital Pad Compensation:None
Line Shape:
.......................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
.............................*
```

Table 3-5 describes the significant output fields (**bold** font) in the previous example:

Table 3-5 Show Modem Operational-Status Field Descriptions

Parameter	Description
`Parameter #6 Total Retrains: 0`	Total retrains and speed shifts for the current connection. There are no retrains.
`Parameter #8 Connected Standard: V.90`	V.90 modulation is negotiated. Standard connect protocol which can be V.21, Bell03, V.22, V.22bis, Bell212, V.23, V.32, V.32bis, V.32terbo, V.34, V.34+, K56Flex, or V.90.
`Parameter #9 TX, RX Bit Rate: 48000, 28800`	The transmit speed (TX) is 48000 bps. The receive speed (RX) is 28800 bps. TX is the bit rate from the local DCE (NAS modem) to the remote DCE (client modem). RX is the bit rate from the remote DCE to the local DCE. V.90 uplink speed tends to be lower than V.34 uplink speed.
`Parameter #21 Signal Noise Ratio: 36 dB`	The signal to noise ratio (SNR) is 36 dB. (40 dB is a perfect SNR. MICA measures the SNR in the signal band. The SNR value ranges from 0 to 70 dB, and it changes in 1 dB steps. A 28.8 kbps connection requires a SNR of about 37 dB. SNRs lower than 37 dB reduce the quality of the connection. A 33.6 kbps connection requires a SNR of about 38 to 39 dB.

Table 3-5 Show Modem Operational-Status Field Descriptions (continued)

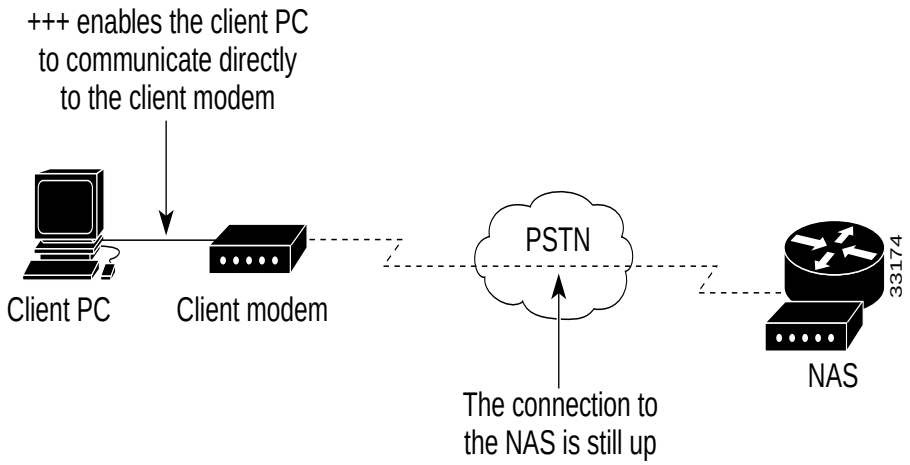
Parameter	Description
Parameter 30 Characters transmitted, received: 67109, 43	67109 characters are transmitted by the NAS modem to the client modem over the synchronous/asynchronous connection.
Line shape: .....* .....* .....* .....* .....* .....* .....* .....* .....* .....* .....* .....* .....*	A line shape is the frequency-response graph of the channel. A flat vertical line shape is an ideal V.90 line shape. ISDN uses a 64-kb clear channel. No statistical roll off should exist at the low end or the high end of the spectrum. The spectrum has a Y and X axis. The Y axis (vertical) represents frequencies from 150 Hz (top of chart) to 3750 Hz (bottom of chart) in 150 Hz steps. A flat spectrum plot is best, it is available for V.34, V.90, and K56Flex. The X axis (horizontal) represents a normal amplitude. The graph identifies nulls, bandwidth, and distortion (irregular shape).

Step 11 Enter the +++ command to jump back to the client modem and examine client-side performance statistics. The modem connection to the NAS is not dropped.

```
5800-NAS>+++
OK
at
OK
```

In the example, the client modem reports both "OK" messages. The +++ modem-escape sequence is similar to a router's Telnet-escape mode (Shift + Ctrl + 6 + x). See Figure 3-7.

Figure 3-7 Using Modem-Escape Mode to View Client-Side Modem Statistics



Step 12 Enter the **ati6** command to display, among other things, the receive and transmit-carrier speeds. Compare the displayed information with the output from the **show modem operational-status** command.

If **ati6** is not supported by your modem, try **at&v1**. For additional client report statistics, enable Windows modemlog.txt or ppplog.txt files.

```
ati6
U.S. Robotics 56K FAX EXT Link Diagnostics...

Chars sent                  98      Chars Received          104701
Chars lost                   0
Octets sent                354      Octets Received         104701
Blocks sent                 95      Blocks Received            914
Blocks resent                4

Retrains Requested           0      Retrains Granted             0
Line Reversals               0      Blers                        0
Link Timeouts                0      Link Naks                    1

Data Compression       NONE
Equalization           Long
Fallback               Enabled
Protocol               LAPM
Speed                  48000/28800
V.90 Peak Speed        48000
Current Call           00:04:46

Online

OK
```

Tips For a detailed explanation of this command, refer to Modemsite.com's website at http://808hi.com/56k/diag3com.htm

Step 13 Inspect frequency levels (dB) and other diagnostic functions. The following AT commands display the client modem's view of the frequency response. The display is a companion to the output of the **show modem operational-status** command (see Step 9).

```
aty11

Freq         Level (dB)

150           24
300           23
450           22
600           22
750           22
900           22
1050          22
1200          22
1350          22
1500          22
1650          22
1800          23
1950          23
2100          23
2250          23
2400          23
2550          23
2700          23
2850          23
3000          23
3150          23
3300          24
3450          25
3600          27
3750          31

ati11
U.S. Robotics 56K FAX EXT Link Diagnostics...


Modulation                  V.90
Carrier Freq     (Hz)       None/1920
Symbol Rate                 8000/3200
Trellis Code                None/64S-4D
Nonlinear Encoding          None/ON
Precoding                   None/ON
Shaping                     ON/ON
Preemphasis      (-dB)      6/2
Recv/Xmit Level  (-dBm)     19/10
Near Echo Loss   (dB)       7
Far Echo Loss    (dB)       0
Carrier Offset   (Hz)       NONE
Round Trip Delay (msec)     24
Timing Offset    (ppm)      1638
SNR              (dB)       48.1
Speed Shifts Up/Down        0/0
Status :                    uu,5,13Y,19.4,-15,1N,0,51.1,7.3
OK
```

Step 14 (Optional) To return to online mode and the router prompt, enter the **ato** command. After your enter this command, however, the +++ escape sequence is still in the EXEC session's input buffer. If you press the carriage return (<CR>), you will receive an error about +++ being an unknown command. To clear the input buffer, type Ctrl U after the **ato** command.

```
ato
% Unknown command or computer name, or unable to find computer address
5800-NAS>
```

Configuring PPP and Authentication

This section describes how to configure the Cisco AS5800 for PPP and local authentication.

The following sections are provided:

- Configuring PPP Authentication for Local AAA, page 3-25
- Configuring IPCP Options, page 3-26
- Configuring LCP Options, page 3-27
- Enabling PPP Autoselect, page 3-28
- Testing Asynchronous PPP Connections, page 3-29
- Inspecting Active Call States, page 3-34
- Confirming the Final Running Configuration, page 3-38

After local authentication is verified, use TACACS+ and a remote authentication server or RADIUS.

Configuring PPP Authentication for Local AAA

Configure AAA to perform log in authentication by using the local username database. The **login** keyword authenticates EXEC terminal shell users. Additionally, configure PPP authentication to use the local database if the session was not already authenticated by **login**.

Step 1 Create a local log in username database in global configuration mode. In this example, admin is used for the administrator and the remote client's login password is user.

```
!
username admin password adminpass
username theuser password theuserpass
!
```

Warning **This step also prevents you from getting locked out of the NAS. 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.

```
!
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
!
```

Step 3 Log in with your username and password:

```
5800-NAS# login

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


User Access Verification
Username: theuser
Password:

5800-NAS#
```

Caution A successful login means that your local username will work on any TTY or VTY line. Do not disconnect your session until you can log in. (If you get locked out, you will need to perform password recovery by rebooting the device.)

Configuring IPCP Options

Create a pool of IP addresses to assign to the PC clients dialing in. As the clients connect, they request IP addresses from the NAS.

Tips Remote ISDN LANs and remote nodes are primarily differentiated by an IP addressing scheme. Remote LANs can appear as remote nodes by using port address translation (PAT).

Step 1 Define the local IP address pool and DNS servers:

```
!
ip local pool addr-pool 172.22.90.2 172.22.90.254
!
async-bootp dns-server 172.30.10.1 172.30.10.2
!
```

For clients using server-assigned addressing (if there are any) you must specify primary and secondary DNS servers. The clients send config-requests to the NAS if the clients are configured to receive NAS assigned WINS and DNS servers.

Note RFC 1877 describes DNS and NBNS servers. The domain name must also be configured on the client.

Step 2 Verify that the IP address pool was created:

```
5800-NAS# show ip local pool
 Pool                    Begin           End             Free  In use
 addr-pool               172.22.90.2     172.22.90.254    253       0
5800-NAS#
```

Configuring LCP Options

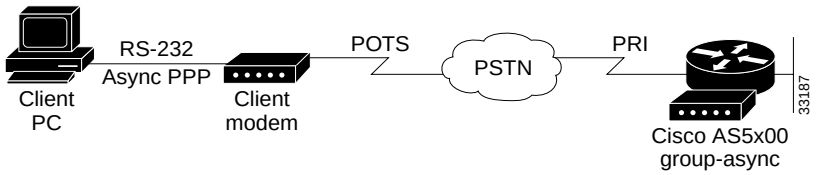
The group-async interface is a template that controls the configuration of all the asynchronous interfaces in the NAS.

Asynchronous interfaces:

- Are lines that can run in PPP mode
- Use the same number as its corresponding line
- Save you time and configuration file size by configuring the asynchronous interfaces as a group-async

The client PPP framing must match the Cisco IOS interface. Figure 3-8 shows this concept.

Figure 3-8 Modem Dialup PPP Framing



The following group-async configuration applies to asynchronous interfaces 1/2/00 through 1/10/143:

```
!
interface Group-Async0
 ip unnumbered FastEthernet0/1/0
 encapsulation ppp
 async mode interactive
 ppp authentication chap pap
 peer default ip address pool addr-pool
 no cdp enable
 no ip directed-broadcast
 group-range 1/2/00 1/10/143
!
```

Table 3-6 describes the previous configuration snippet in more detail:

Table 3-6 Interface Group Async Command Descriptions

Command	Purpose
`ip unnumbered FastEthernet0/1/0`	Conserves IP address space by configuring the asynchronous interfaces as unnumbered.
`encapsulation ppp`	Enables PPP.
`async mode interactive`	Configures interactive mode on the asynchronous interfaces. Interactive means that users can dial in and get to a shell or PPP session on that line.
`ppp authentication chap pap`	Enables CHAP and PAP authentication on the interface during LCP negotiation. The NAS first requests to authenticate with CHAP. If CHAP is rejected by the remote client (modem), then PAP authentication is requested.

Table 3-6 Interface Group Async Command Descriptions (continued)

Command	Purpose
`peer default ip address pool addr-pool`	Assigns dial-in client IP addresses from the pool named addr-pool.
`no cdp enable`	Disables the Cisco discovery protocol.
`no ip directed-broadcast`	Prevents IP directed broadcasts.
`group-range 1/2/00 1/10/143`	Specifies the range of asynchronous interfaces to include in the group, which is usually equal to the number of modems you have in the NAS. (The session may pause for several seconds when you issue this command.)

Enabling PPP Autoselect

Enable remote PPP users to dial in, bypass the EXEC facility, and automatically start PPP on the line.

```
!
line 1/2/00 1/10/143
 autoselect during-login
 autoselect ppp
!
```

These two autoselect commands:

- Provide the transparent launching of shell and PPP services on the same lines.
- Circumvent the need to alert the NAS by pressing the **return** key. Older versions of Cisco IOS software did not have this feature and required the peer to hit return before the username was displayed.

Note The **autoselect during-login** command displays the username:password prompt after modems connect.

Testing Asynchronous PPP Connections

Before you troubleshoot PPP negotiation or AAA authentication, you need to understand what a successful PPP and AAA debug sequence looks like. In this way, you can save time and effort when comparing a successful debug session against a faulty completed debug sequence.

Successful PPP Negotiation Debug

The following steps describe how to initiate a PPP test call and interpret a successful debug sequence.

Step 1 Enter the appropriate debug commands:

```
5800-NAS# debug ppp authentication
PPP authentication debugging is on
5800-NAS# debug aaa authentication
AAA Authentication debugging is on
5800-NAS# show debug
General OS:
  AAA Authentication debugging is on
PPP:
  PPP authentication debugging is on
```

Step 2 Make sure that your EXEC session receives logging and debug output:

```
5800-NAS# logging console
```

Step 3 From the client, send a test call into the NAS by using dialup networking. Figure 3-9 shows an example Windows dialup networking display.

Figure 3-9 Windows Dialup Networking

Step 4 Go to the NAS terminal screen to observe and interpret the debug output messages. As the call enters the NAS, debug output is created.

When examining PPP between two remote peers:

a. First check to see if DSR came up.

b. Verify that both sides get through LCP negotiation. If they do, check authentication.

c. After authentication succeeds, check IPCP negotiation.

d. If no debug output appears, troubleshoot ISDN Q.931. Use the **debug isdn q931** command.

Given the debug commands entered in Step 1, the following debug output should be generated by the call:

```
*Sep 24 13:05:49.052: AAA: parse name=tty1/2/09 idb type=10 tty=441
*Sep 24 13:05:49.052: AAA: name=tty1/2/09 flags=0x1D type=4 shelf=0 slot=1 adapter=2
port=9 channel=0
*Sep 24 13:05:49.052: AAA: parse name=Serial1/0/0:4:21 idb type=12 tty=-1
*Sep 24 13:05:49.052: AAA: name=Serial1/0/0:4:21 flags=0x5D type=1 shelf=0 slot=1
adapter=0 port=4 channel=21
```

In this example, the call enters the NAS on channel 1/0/0:4:21. This channel maps to the 21st DS0 channel of the 4th PRI line of a CT3 card. Eventually the call terminates on modem 441.

```
*Sep 24 13:05:49.052: AAA/MEMORY: create_user (0x63E8FB70) user='' ruser='' port
='tty1/2/09' rem_addr='4089548211/51121' authen_type=ASCII service=LOGIN priv=1
*Sep 24 13:05:49.052: AAA/AUTHEN/START (1586904428): port='tty1/2/09' list='' ac
tion=LOGIN service=LOGIN
*Sep 24 13:05:49.052: AAA/AUTHEN/START (1586904428): using "default" list
*Sep 24 13:05:49.052: AAA/AUTHEN/START (1586904428): Method=LOCAL*Sep 24 13:05:49.052:
AAA/AUTHEN (1586904428): status = GETUSER
*Sep 24 13:05:49.072: AAA/AUTHEN/ABORT: (1586904428) because Autoselected.
*Sep 24 13:05:49.072: AAA/MEMORY: free_user (0x63E8FB70) user='' ruser='' port='
```

An authentication start packet is sent by AAA, and it searches the local username database as the default authentication method.

```
tty1/2/09' rem_addr='4089548211/51121' authen_type=ASCII service=LOGIN priv=1
*Sep 24 13:05:51.076: As1/2/09 PPP: Treating connection as a dedicated line
*Sep 24 13:05:55.272: As1/2/09 PPP: Phase is AUTHENTICATING, by this end
*Sep 24 13:05:55.404: As1/2/09 PAP: I AUTH-REQ id 1 len 20 from "theuser"
*Sep 24 13:05:55.404: As1/2/09 PAP: Authenticating peer theuser
```

PPP is allowed to start on the interface. The client sends an authentication request called *theuser*. PAP authentication is used.

```
*Sep 24 13:05:55.404: AAA: parse name=Async1/2/09 idb type=10 tty=441
*Sep 24 13:05:55.404: AAA: name=Async1/2/09 flags=0x1D type=4 shelf=0 slot=1 adapter=2
port=9 channel=0
*Sep 24 13:05:55.404: AAA: parse name=Serial1/0/0:4:21 idb type=12 tty=-1
*Sep 24 13:05:55.404: AAA: name=Serial1/0/0:4:21 flags=0x5D type=1 shelf=0 slot=1
adapter=0 port=4 channel=21
*Sep 24 13:05:55.404: AAA/MEMORY: create_user (0x63E8FB70) user='theuser'
ruser=''port='Async1/2/09' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
*Sep 24 13:05:55.404: AAA/AUTHEN/START (693233173): port='Async1/2/09' list=''
action=LOGIN service=PPP
*Sep 24 13:05:55.404: AAA/AUTHEN/START (693233173): using "default" list
*Sep 24 13:05:55.404: AAA/AUTHEN (693233173): status = UNKNOWN
*Sep 24 13:05:55.404: AAA/AUTHEN/START (693233173): Method=LOCAL
*Sep 24 13:05:55.404: AAA/AUTHEN (693233173): status = PASS
*Sep 24 13:05:55.404: As1/2/09 PAP: O AUTH-ACK id 1 len 5
```

The example above shows that local authentication was successful.

Failed PPP Negotiation Debugging and Troubleshooting

Failed authentication is a common occurrence. Misconfigured or mismatched user names and passwords create error messages in debug output.

The following example shows that the username *maddog* does not have permission to dial into the NAS. The NAS does not have a local username configured for this user. To fix the problem, use the **username** *name* **password** *password* command to add the username to the local AAA database in the NAS:

```
*Sep 24 13:11:28.964: AAA/MEMORY: create_user (0x63E43558) user='maddog' ruser=''
port='Async1/2/10' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
*Sep 24 13:11:28.964: AAA/AUTHEN/START (3281080218): port='Async1/2/10'
list=''action=LOGIN service=PPP
*Sep 24 13:11:28.964: AAA/AUTHEN/START (3281080218): using "default" list
*Sep 24 13:11:28.964: AAA/AUTHEN (3281080218): status = UNKNOWN
*Sep 24 13:11:28.964: AAA/AUTHEN/START (3281080218): Method=LOCAL
*Sep 24 13:11:28.964: AAA/AUTHEN (3281080218): User not found, end of method list
*Sep 24 13:11:28.964: AAA/AUTHEN (3281080218): status = FAIL
*Sep 24 13:11:28.964: As1/2/10 PAP: O AUTH-NAK id 1 len 32 msg is "Password validation
failure"
*Sep 24 13:11:28.964: AAA/MEMORY: free_user (0x63E43558) user='maddog'
ruser=''port='Async1/2/10' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
```

The following example shows an invalid password. Notice that the same error messages are used for username failure—"Password validation failure."

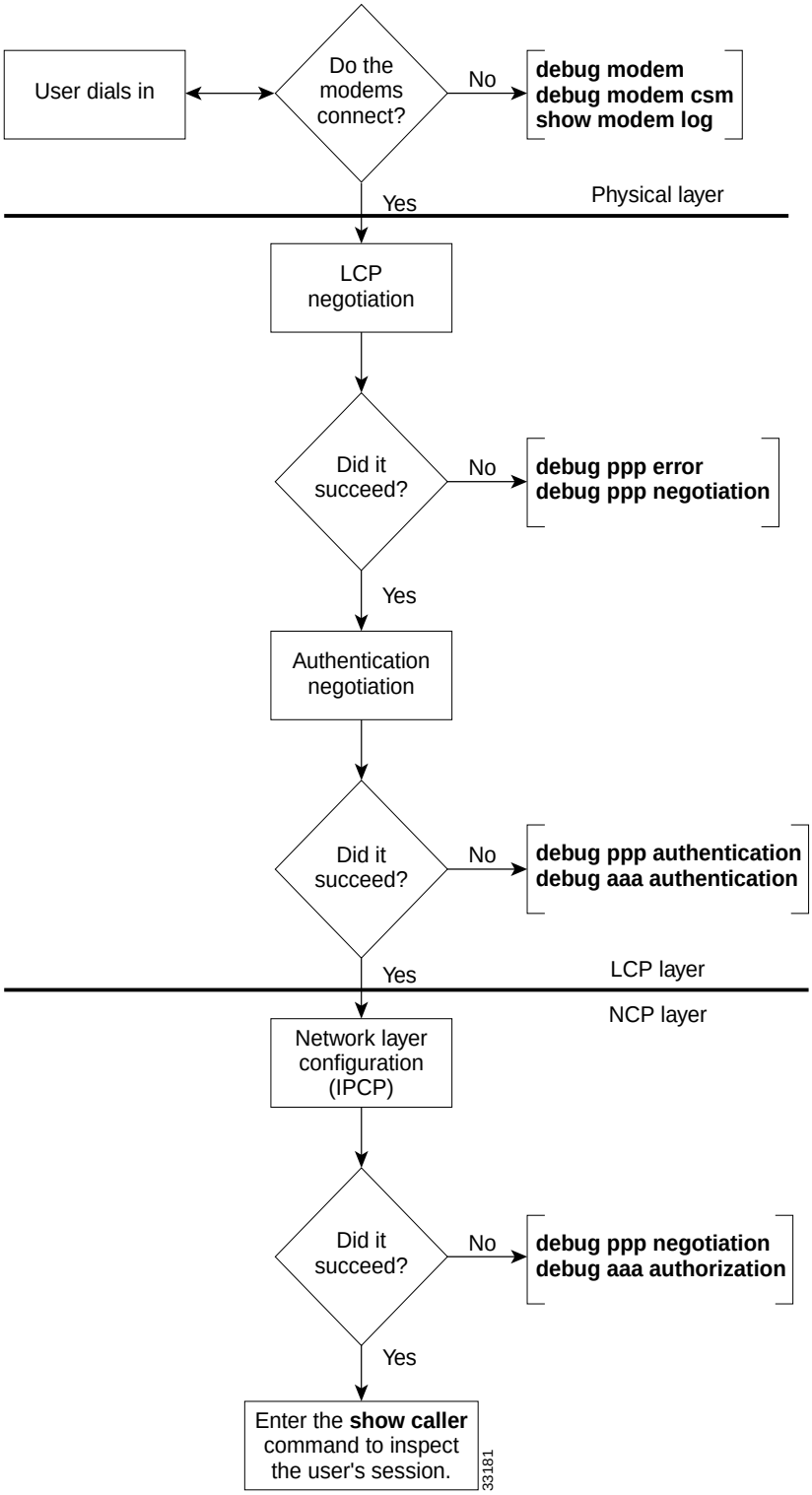
```
*Sep 24 13:13:59.032: AAA/MEMORY: create_user (0x63E9846C) user='user'
ruser=''port='Async1/2/11' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
*Sep 24 13:13:59.032: AAA/AUTHEN/START (3032205297): port='Async1/2/11'
list=''action=LOGIN service=PPP
*Sep 24 13:13:59.032: AAA/AUTHEN/START (3032205297): using "default" list
*Sep 24 13:13:59.032: AAA/AUTHEN (3032205297): status = UNKNOWN
*Sep 24 13:13:59.032: AAA/AUTHEN/START (3032205297): Method=LOCAL
*Sep 24 13:13:59.032: AAA/AUTHEN (3032205297): status = FAIL
*Sep 24 13:13:59.032: As1/2/11 PAP: O AUTH-NAK id 1 len 32 msg is "Password validation
failure"
*Sep 24 13:13:59.036: AAA/MEMORY: free_user (0x63E9846C) user='user' ruser=''
port='Async1/2/11' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
```

Troubleshooting Flow Diagrams

Figure 3-10 provides a flowchart for troubleshooting the following three PPP layers:

- Physical layer
- Link Control Protocol (LCP) and authentication layer
- Network Control Protocol (NCP) layer

Figure 3-10 Troubleshooting Flow Chart for PPP and Authentication



LCP negotiation is a series of LCP packets exchanged between PPP peers to negotiate a set of options and option values when sending data. The LCP negotiation is actually two separate dialogs between two PPP peers (Peer1 and Peer 2):

Peer 1 and Peer 2 do not have to use the same set of LCP options. When a PPP peer sends its initial Configure-Request, the response is any of the following:

- A Configure-Nack because one or more options have unacceptable values.
- A Configure-Reject because one or more of the options are unknown or not negotiable.
- A Configure-Ack because all of the options have acceptable values.

When a PPP peer receives a Configure-Nack or Configure-Reject in response to its Configure-Request, it sends a new Configure-Request with modified options or option values. When a Configure-Ack is received, the PPP peer is ready to send data.

Figure 3-11 shows an example LCP negotiation process for Peer 1 using the fictional options W, X, Y, Z. Additionally, Figure 3-11 shows Peer 1 sending data to Peer 2 only. Separate LCP negotiation must be configured so that Peer 2 can send data back to Peer 1. Very often, the LCP packets for both Peer 1 and Peer 2 are intermixed during the connection process (that is, Peer 1 is configuring the way it sends data at the same time as Peer 2.).

Figure 3-11 LCP Layer Negotiations

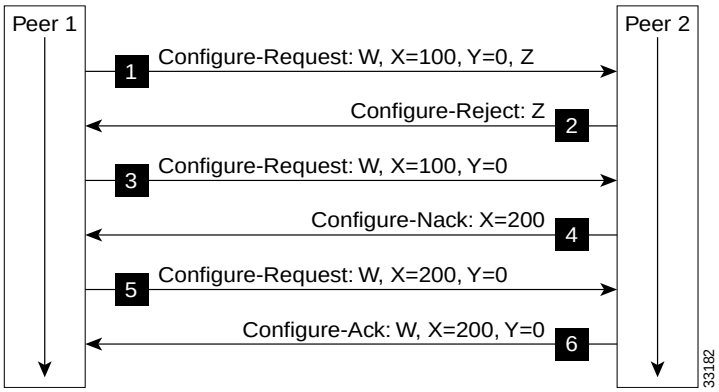


Figure 3-11 shows that:

- Peer 1 sends a Configure-Request requesting option W, option X set to 100, option Y set to 0, and option Z. (Options W and Z are flag options.)
- Peer 2 does not understand option Z so it sends a Configure-Reject containing option Z.
- Peer 1 sends a new Configure-Request packet requesting option W, option X set to 100, and option Y set to 0.
- Peer 2 prefers that option X be set to 200 so it sends a Configure-Nack containing option X and its preferred value.
- Peer 1 sends a new Configure-Request packet requesting option W, option X set to 200, and option Y set to 0.
- Peer 2 sends a Configure-Ack.

Each time Peer 1 sends a new Configure-Request, it changes the Identifier value in the LCP header so that Configure-Requests can be matched with their responses.

Inspecting Active Call States

After a basic PPP modem call comes into the NAS, you should use some **show** commands to inspect several active call statistics. If you try to use the client's web browser after the modems connect, you will test DNS, IP, and other functions. If your test fails, try pinging the DNS server from the device that dialed in.

Show Caller Statistics

The **show caller** command is used to:

- View individual users and consumed resources on the NAS.
- Inspect active call statistics for large pools of connections. (Debug commands produce too much output and tax the CPU too heavily.)
- Display the absolute and idle times for each user. The current values for both of these settings are displayed on the TTY line and the asynchronous interface. Users that have been idle for unacceptably long periods of time can be easily identified. By using this information, you can define timeout policies and multiple grades of services for different users.

The **show caller** command has many options:

```
5800-NAS# show caller ?
  full       Provide expanded caller information
  interface  Provide information on one interface
  ip         Display IP information
  line       Provide information on one line
  timeouts   Display session and idle limits and disconnect time
  user       Display information for a particular user
  |          Output modifiers
  <cr>

5800-NAS# show caller
                                                 Active    Idle
  Line         User              Service       Time      Time
  vty 0        admin             VTY           00:54:39  00:00:00
  tty 441      theuser           Async         00:00:15  00:00:00
  As1/2/09     theuser           PPP           00:00:08  00:00:00
```

```
5800-NAS# show caller user theuser

  User: theuser, line tty 441, service Async
        Active time 00:01:24, Idle time 00:01:05
  Timeouts:            Absolute  Idle      Idle
                                 Session   Exec
      Limits:          -         -         00:10:00
      Disconnect in:   -         -         -
  TTY: Line 1/2/09, running PPP on As1/2/09
  Location: PPP: 192.168.10.4
  DS0: (slot/unit/channel)=0/4/21
  Status: Ready, Active, No Exit Banner, Async Interface Active
          HW PPP Support Active, Modem Detected
  Capabilities: Hardware Flowcontrol In, Hardware Flowcontrol Out
                Modem Callout, Modem RI is CD,
                Line usable as async interface, Modem Autoconfigure
  Modem State: Ready, Modem Configured

  User: theuser, line As1/2/09, service PPP
        Active time 00:01:17, Idle time 00:01:05
  Timeouts:            Absolute  Idle
      Limits:          -         -
      Disconnect in:   -         -
  PPP: LCP Open, PAP (<- AAA), IPCP
  IP: Local 172.22.66.23, remote 172.22.90.2
  Counts: 30 packets input, 1640 bytes, 0 no buffer
          1 input errors, 1 CRC, 0 frame, 0 overrun
          14 packets output, 290 bytes, 0 underruns
          0 output errors, 0 collisions, 0 interface resets
```

In the previous example, notice that one call uses the following system resources:

- TTY line 441
- Asynchronous interface 1/2/09 (shelf/slot/port)
- DS0 channel number 0/4/21
- Modem 1/2/09

Note Different data is presented at each layer of the connection. Understanding the roles of the layers is very useful for troubleshooting purposes. The **show caller user "username" detailed** command displays detailed LCP negotiated parameters.

Table 3-7 describes some of the significant display output fields of the **show caller user** command:

Table 3-7 Show Caller User Command Descriptions

Field	Description
`User: theuser, line tty 441, service Async`	Active user on line TTY 441. The output fields are very similar to the **show line** command.
`DS0: (slot/unit/channel)=0/4/21`	The DS0 channel used by the call.
`User: admin, line As1/2/09, service PPP`	Active user on asynchronous interface 1/2/09. The timeouts working on the PPP layer are displayed, which are different from the TTY line timeouts.

Table 3-7 Show Caller User Command Descriptions (continued)

Field	Description
`PPP: LCP Open, CHAP (<- AAA), IPCP`	Superficial information about what is open in PPP. The field "(<- AAA)" is somewhat misleading. Local authentication is also from AAA. For more detailed IPCP information, enter the **show caller user detail** command.
`IP: Local 172.22.66.23, remote 172.22.90.2`	The IP addresses on each end of the link. These values are only displayed on the output for the asynchronous interface.
`Counts:`	Counters from the **show interface async 1/2/09** command output.

Fast Switching and Route Caching Statistics

Inspect fast-switching and route-caching performance statistics for the call. Incoming asynchronous calls can be fast switched. However, some features disable fast switching.

Step 1 Inspect the queuing characteristics of the asynchronous interface. Notice that the queuing strategy is first-in-first-out (fifo).

```
5800-NAS# show interface async 1/2/02
Async1/2/02 is up, line protocol is up
modem=1/2/02, vdev_state(0x00000000)=CSM_OC_STATE, bchan_num=(T1 1/0/0:4:6)
vdev_status(0x00000001): VDEV_STATUS_ACTIVE_CALL.

  Hardware is Async Serial
  Interface is unnumbered. Using address of FastEthernet0/1/0 (172.22.66.23)
  MTU 1500 bytes, BW 9 Kbit, DLY 100000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set, keepalive not set
  DTR is pulsed for 5 seconds on reset
  LCP Open
  Open: IPCP
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/10, 0 drops; input queue 1/10, 0 drops
  5 minute input rate 0 bits/sec, 1 packets/sec
  5 minute output rate 0 bits/sec, 1 packets/sec
     1683 packets input, 112764 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     1 input errors, 1 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1626 packets output, 108235 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Step 2 Inspect the IP settings of the interface. Notice that IP fast switching is disabled, because TCP/IP header compression is enabled. Turn off TCP/IP header compress to enable fast switching. Enter the **no ip tcp header-compression** command on the asynchronous interface.

```
5800-NAS# show ip int async 1/2/02
Async1/2/02 is up, line protocol is up
  Interface is unnumbered. Using address of FastEthernet0/1/0 (172.22.66.23)
  Broadcast address is 255.255.255.255
  Peer address is 172.22.90.2
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is enabled
  Outgoing access list is not set
  Inbound  access list is not set
  Proxy ARP is enabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are never sent
  IP fast switching is disabled
  IP fast switching on the same interface is disabled
  IP multicast fast switching is enabled
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is enabled and compressing
  RTP/IP header compression is disabled
  Probe proxy name replies are disabled
  Gateway Discovery is disabled
  Policy routing is disabled
  Network address translation is disabled
```

Step 3 Look at the fast-switching cache in action. Notice that only packets destined to the Fast Ethernet interface are currently cached.

```
5800-NAS# show ip cache
IP routing cache 3 entries, 560 bytes
   109 adds, 106 invalidates, 3 refcounts
Minimum invalidation interval 2 seconds, maximum interval 5 seconds,
   quiet interval 3 seconds, threshold 0 requests
Invalidation rate 0 in last second, 0 in last 3 seconds
Last full cache invalidation occurred 22:17:01 ago

Prefix/Length         Age       Interface       Next Hop
172.61.0.0/16         15:13:22  FastEthernet0/1 172.22.66.1
172.22.67.67/32       00:06:10  FastEthernet0/1 172.22.67.2
172.22.68.67/32       00:06:09  FastEthernet0/1 172.22.68.3

5800-NAS# show interface async 1/2/02 stat
Async1/2/02
          Switching path    Pkts In   Chars In   Pkts Out  Chars Out
               Processor        909      57050       1022      67918
            Route cache         155      14260          0          0
                  Total        1064      71310       1022      6791
```

Timesaver For more information on this command, refer to *Cisco IOS Switching Commands*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/switch_r/

Confirming the Final Running Configuration

After you complete the tasks in this section, the Cisco AS5800 final running configuration looks like the following example:

```
5800-NAS# show running-config
Building configuration...

Current configuration:
!
version 12.x
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname 5800-NAS
!
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
enable secret 5 $1$LKgL$tgi19XvWn7fld7JGt55p01
!
username theuser password 7 045802150C2E
username admin password 7 044E1F050024
!
!
!
!
!
!
shelf-id 0 router-shelf
shelf-id 1 dial-shelf
!
!
!
resource-pool disable
!
modem-pool Default
 pool-range 1/2/0-1/10/143
!
!
spe 1/2/0 1/10/11
 firmware ios-bundled default
modem recovery action none
ip subnet-zero
no ip source-route
ip host aurora 172.22.100.9
ip domain-name the.doc
ip name-server 172.22.11.10
ip name-server 172.22.12.11
!
```

```
async-bootp dns-server 172.30.10.1 172.30.10.2
isdn switch-type primary-ni
isdn voice-call-failure 0
!
!
controller T3 1/0/0
 framing m23
 cablelength 0
 t1 4 controller
!
controller T1 1/0/0:4
 framing esf
 pri-group timeslots 1-24
!
!
voice-port 1/0/0:4:D
!
!
process-max-time 200
!
interface Loopback0
 ip address 172.22.99.1 255.255.255.255
 no ip directed-broadcast
!
interface Loopback1
 ip address 172.22.90.1 255.255.255.0
 no ip directed-broadcast
!
interface FastEthernet0/1/0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial1/0/0:4:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-ni
 isdn incoming-voice modem
 no cdp enable
!
interface Group-Async0
 ip unnumbered FastEthernet0/1/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 peer default ip address pool addr-pool
 no cdp enable
 ppp authentication chap pap
 group-range 1/2/00 1/10/143
!
ip local pool addr-pool 172.22.90.2 172.22.90.254
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
no ip http server
!
!
banner login ^C
AS5800 Austin
ISP's Dial Access Server
^C
!
line con 0
 transport input none
line aux 0
 transport input telnet
```

```
line vty 0 4
line 1/2/00 1/10/143
 autoselect during-login
 autoselect ppp
 modem InOut
 no modem log rs232
!
end
```

Modem Management Operations

This section describes how to manage the modems on a Cisco AS5800 by using the Cisco IOS software.

The following sections are provided:

- Managing Modem Firmware, page 3-41
- Configuring Modems Using Modem Autoconfigure, page 3-48
- Gathering and Viewing Call Statistics, page 3-49

In this discussion relative tasks are performed to manage modem operations of network access servers (NAS).

For information on how to verify modem performance, see the "Verifying Modem Performance" section on page 3-1.

Table 3-8 provides a list of terms for this section.

Table 3-8 List of Terms

Term	Description
DSP	Digital Signal Processor (DSP). The processor that does the modulating and demodulating. The modem modulation protocols, such as V.34 and V.90, that run in the DSP.
Firmware[1]	Name for Microcom modem code.
MICA module	MICA modem card containing 6 (HMM) or 12 (DMM) modems.
Portware	Name for MICA modem code.
SPE	Service Processing Element (SPE). A SPE unit is defined as the smallest software downloadable unit. For Microcom, an SPE is an individual modem. For MICA, SPE is either 6 or 12 modems, depending on whether the MICA module is single or double density.
ucode	Short for microcode. Microcode in a Cisco NAS is code that gets loaded into a card, and it is typically bundled with the Cisco IOS software image. (In general, Cisco does not refer to modem code microcode.)

1. Examples and text that refer to both MICA and Microcom modems use the term firmware (not portware).

The following documents are related to modem management operations:

- *Cisco IOS Release 12.0 Dial Solutions Configuration Guide*, chapter on managing modems, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/
- *Cisco IOS Release 12.0 Dial Solutions Command Reference*, dialer on dial-in port setup and, within that, on modem-management commands, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/
- *Firmware and Portware Information*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/fwpwinfo/index.htm

Managing Modem Firmware

Inspecting and upgrading modem firmware is a fundamental part of commissioning a NAS. Cisco posts new firmware versions on CCO for you to download via FTP. For more information, go to the Cisco Software Center at the following URL:
http://www.cisco.com/kobayashi/sw-center/sw-access.shtml

A specific architecture surrounds integrated modem technology. Integrated modems get their modem firmware from a file that is stored in one of three places:

- Bundled into the Cisco IOS software
- Stored in Flash memory
- Stored in bootFlash memory

The modem looks first for its firmware inside the bundled Cisco IOS software image. The modem does not look outside the bundled image unless you manually change the configuration settings by using the **copy** *source* **modem** command or **spe** command.

Inspecting Modem Firmware

Before you upgrade modem firmware for MICA or Microcom modems, you should perform the following tasks:

Step 1 Determine the version of firmware that is currently loaded in each modem (for example, 2.6.2.0).

```
5800-NAS# show modem version
Modem Range          Module   Firmware Rev    Upgrade
    1/2/00 1/2/11         0      2.6.2.0            -
    1/2/12 1/2/23         1      2.6.2.0            -
    1/2/24 1/2/35         2      2.6.2.0            -
    1/2/36 1/2/47         3      2.6.2.0            -
    1/2/48 1/2/59         4      2.6.2.0            -
    1/2/60 1/2/71         5      2.6.2.0            -
    1/2/72 1/2/83         6      2.6.2.0            -
    1/2/84 1/2/95         7      2.6.2.0            -
    1/2/96 1/2/107        8      2.6.2.0            -
   1/2/108 1/2/119        9      2.6.2.0            -
   1/2/120 1/2/131       10      2.6.2.0            -
   1/2/132 1/2/143       11      2.6.2.0            -
    1/3/00 1/3/11         0      2.6.2.0            -
    1/3/12 1/3/23         1      2.6.2.0            -
    1/3/24 1/3/35         2      2.6.2.0            -
    1/3/36 1/3/47         3      2.6.2.0            -
    1/3/48 1/3/59         4      2.6.2.0            -
    1/3/60 1/3/71         5      2.6.2.0            -
    1/3/72 1/3/83         6      2.6.2.0            -
    1/3/84 1/3/95         7      2.6.2.0            -
    1/3/96 1/3/107        8      2.6.2.0
```

Step 2 Find the version of firmware that is bundled with the Cisco IOS software. The Cisco AS5800 supports the **show modem bundled-firmware** command which replaces the **show modem map** command that displays the region of NVRAM that identifies where the modems get their firmware at bootup.

```
as5800-RS-1# show modem bundled-firmware
List of bundled modem firmware images by slot
  Slot 4
    2.6.2.0
  Slot 5
    2.6.2.0
  Slot 6
    2.6.2.0
  Slot 7
    2.6.2.0
  Slot 8
    2.6.2.0
```

Step 3 Inspect the directory that stores the bundled firmware files. The files are loaded into the system main memory through the system:/ucode directory.

In the following example, two versions of firmware are found: mica_port_firmware and microcom_firmware. The file mica_board_firmware is not user upgradeable.

```
5800-NAS# dir system:ucode
Directory of system:/ucode/

 14  -r--      516060              <no date>  mica_board_firmware
 15  -r--      375525              <no date>  mica_port_firmware
 16  -r--      381284              <no date>  microcom_firmware

No space information available
```

Step 4 Look at the existing contents of Flash/bootFlash for the following reasons:

- Determine what firmware versions you already have.
- Determine if your Flash/bootFlash is read-only or read/write.
- Determine if you have enough free space.

The commands **show flash** and **show bootflash** are supported in any version of Cisco IOS software. The commands **dir flash:** and **dir bootflash:** are supported in Cisco IOS Release 12.0T.

```
AS5800-1# show flash

System flash directory:
File  Length   Name/status
  1   6436752  c5800-is-mz.120-5.5.T
  2   392241   mica-modem-pw.2.7.1.0.bin
[6829124 bytes used, 9948092 available, 16777216 total]
16384K bytes of processor board System flash (Read/Write)

AS5800-1# show bootflash

Boot flash directory:
File  Length   Name/status
  1   1220196  c5800-boot-mz.120-3.bin
  2   375525   mica-modem-pw.2.6.1.0.bin
  3   381540   mica-modem-pw.2.6.2.0.bin
[1977456 bytes used, 2216848 available, 4194304 total]
4096K bytes of processor board Boot flash (Read/Write)
```

Filenames are arbitrary and are not necessarily indicative of their contents. If there is not enough free space on Flash or bootFlash to store the desired file, then you need to:

a. Copy the existing files that you want to keep onto a TFTP server.

b. Erase the Flash memory.

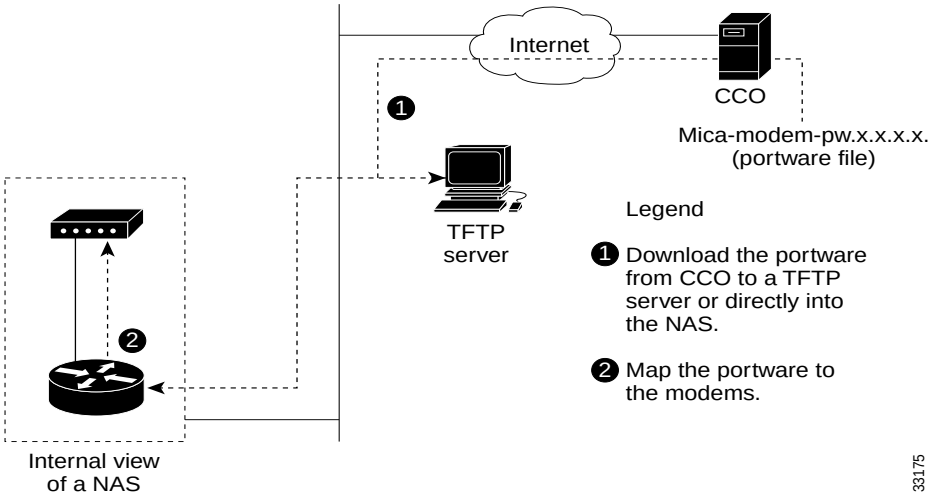
c. Copy the desired files into Flash memory.

Upgrading Modem Firmware

Cisco regularly enhances modem DSP code to improve modem performance. To obtain the latest DSP code, upgrade the NAS modem firmware.

Figure 3-12 summarizes the firmware upgrade procedure.

Figure 3-12 Modem Firmware Download Operation Example



Step 1 Read the latest modem release notes about modem and firmware information on CCO. Understand the latest enhancements and bug fixes before you download code. Refer to the latest release notes, available online at
http://www.cisco.com/univercd/cc/td/doc/product/access/fwpwinfo/index.htm

Step 2 Download the latest firmware from CCO to the NAS Flash or bootFlash memory. Depending on which Cisco IOS software you are running, there are two ways you can get the latest firmware from CCO into the NAS Flash or bootFlash. Table 3-8 describes these two methods.

Table 3-9 Firmware Copy Commands

Cisco IOS Software Release	Command	Purpose
12.0T and later	**copy ftp**	Copy a file directly from CCO into Flash memory, without staging it at a local TFTP server.
11.3 and later	**copy tftp: {flash: | bootflash:}**	Copy from a TFTP server.

The following example uses the **copy ftp** command. The file mica-modem-pw.2.7.1.0.bin is copied from ftp.cisco.com to the bootFlash. Be sure to specify your own CCO username and password in the command line (as indicated in the example).

```
5800-NAS# ping ftp.cisco.com

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.31.7.171, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/4 ms
5800-NAS#
5800-NAS#copy ftp://CCOUSERNAME:CCOPASSWORD@ftp.doc.com/cisco/access/modems/mica/
mica-modem-pw.2.7.1.0.bin bootflash:
Destination filename [mica-modem-pw.2.7.1.0.bin]? <cr>
Accessing ftp:// CCOUSERNAME:CCOPASSWORD@ftp.doc.com/cisco/access/modems/mica/
mica-modem-pw.2.7.1.0.bin...Translating "ftp.cisco.com"...domain
 server (171.70.24.56) [OK]

Erase bootflash: before copying? [confirm]n
Loading cisco/access/modems/mica/mica-modem-pw.2.7.1.0.bin
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 392241/1024 bytes]

Verifying checksum...  OK (0x6638)
392241 bytes copied in 5.940 secs (78448 bytes/sec)
5800-NAS#
```

Step 3 Verify that the new firmware is in Flash or bootFlash memory. The *unbundled* firmware file is mica-modem-pw.2.7.1.0.bin in this example.

```
5800-NAS# dir flash:
Directory of flash:/

  1  -rw-     4583276             <no date>  C5800-IS-MZ.113-9_AA
  2  -rw-     4675992             <no date>  c5800-js-mz.112-18.P.bin
  3  -rw-      392241             <no date>  mica-modem-pw.2.7.1.0.bin
  4  -rw-     5947548             <no date>  c5800-is-mz.120-4.XI1
  5  -rw-        4339             <no date>  startup-config.12.0(4)XI1

16777216 bytes total (1173496 bytes free)
```

Step 4 (Optional) Enable the **modem firmware-download** command to watch the modem mapping operation take place:

```
5800-NAS# modem firmware-download
Modem Firmware-Download debugging is on
```

Step 5 Map the new firmware to the modems.

For MICA modems, firmware is mapped to entire modem modules (6 or 12 modem-module boundaries; not individual modems). For Microcom modems, firmware is mapped to one or more individual modems. The rule requiring that all modems in a MICA module run the same code is an architectural requirement.

Depending on which Cisco IOS release is loaded in the NAS, there are two commands that you can use. Table 3-10 describes these two commands.

Table 3-10 Modem Mapping Commands

Cisco IOS Software Release	Command	Notes
12.0(5)T and later	**spe**	An SPE unit is defined as the smallest software downloadable unit. For Microcom, an SPE is an individual modem. For MICA, an SPE is either 6 or 12 modems, depending on whether the MICA module is single or double density.
Before Release 12.0(5)T	**copy source modem**	Replace the *source* variable with either **flash** or **bootflash**.

The following MICA example uses the **spe** command. The numbers 1/0 1/7 refer to modem *module numbers* 0 through 7 in slot 1. These numbers do not refer to specific *modem numbers* (for example, slot/port for Microcom modems). In this example, 48 modems are upgraded (8 SPE x 6 modems per module = 48 modems).

```
5800-NAS# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5800-NAS(config)# spe 1/0 1/7
5800-NAS(config-spe)# firmware location flash:mica-modem-pw.2.7.1.0.bin
5800-NAS(config-spe)#
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/0) started firmware download
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/1) started firmware download
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/2) started firmware download
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/3) started firmware download
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/4) started firmware download
*Jan 23 11:14:48.702: %MODEM-5-DL_START: Modem (1/5) started firmware download
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/0) completed firmware download:
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/1) completed firmware download:
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/2) completed firmware download:
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/3) completed firmware download:
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/4) completed firmware download:
*Jan 23 11:15:03.042: %MODEM-5-DL_GOOD: Modem (1/5) completed firmware download:
*Jan 23 11:15:03.046: %MODEM-5-DL_START: Modem (1/6) started firmware download
*Jan 23 11:15:03.046: %MODEM-5-DL_START: Modem (1/7) started firmware download
*Jan 23 11:15:03.046: %MODEM-5-DL_START: Modem (1/8) started firmware download
*Jan 23 11:15:03.050: %MODEM-5-DL_START: Modem (1/9) started firmware download
*Jan 23 11:15:03.050: %MODEM-5-DL_START: Modem (1/10) started firmware download
*Jan 23 11:15:03.050: %MODEM-5-DL_START: Modem (1/11) started firmware download
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/6) completed firmware download:
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/7) completed firmware download:
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/8) completed firmware download:
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/9) completed firmware download:
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/10) completed firmware download
*Jan 23 11:15:17.394: %MODEM-5-DL_GOOD: Modem (1/11) completed firmware download
.
.
.
*Jan 23 11:16:43.482: %MODEM-5-DL_GOOD: Modem (1/47) completed firmware download
```

In this example, the specified SPE range gets updated with new firmware in batches of six modems at a time. If double density modems were installed, batches of 12 modems would be updated.

Note The SPE range 1/0 to 1/7 is mapped to firmware 2.7.1.0. However, SPE range 2/0 through 2/7 is still mapped to the firmware that is bundled with the Cisco IOS software.

```
!
spe 1/0 1/7
 firmware location flash:mica-modem-pw.2.7.1.0.bin
spe 2/0 2/7
 firmware location system:/ucode/mica_port_firmware
!
```

The following MICA example is for the **copy** *source* **modem** command. Unlike the **spe** command, the numbers 1/0-1/5 refer to specific *modem numbers* (slot/port). The **busyout** keyword will gracefully busy out the modems if the modems are off hook.

```
cisco# copy bootflash modem
Source filename []? mica-modem-pw.2.6.2.0.bin
Modem Numbers (<slot>/<port> | group <number> | all)? 1/0-1/5
Type of service [busyout/reboot/recovery] busyout
Allow copy of "bootflash:mica-modem-pw.2.6.2.0.bin" to modems? [yes/no]yes
5800#
2d05h: %MODEM-5-DL_START: Modem (1/0) started firmware download
2d05h: %MODEM-5-DL_START: Modem (1/1) started firmware download
2d05h: %MODEM-5-DL_START: Modem (1/2) started firmware download
2d05h: %MODEM-5-DL_START: Modem (1/3) started firmware download
2d05h: %MODEM-5-DL_START: Modem (1/4) started firmware download
2d05h: %MODEM-5-DL_START: Modem (1/5) started firmware download
2d05h: %MODEM-5-DL_GOOD: Modem (1/0) completed firmware download:
2d05h: %MODEM-5-DL_GOOD: Modem (1/1) completed firmware download:
2d05h: %MODEM-5-DL_GOOD: Modem (1/2) completed firmware download:
2d05h: %MODEM-5-DL_GOOD: Modem (1/3) completed firmware download:
2d05h: %MODEM-5-DL_GOOD: Modem (1/4) completed firmware download:
2d05h: %MODEM-5-DL_GOOD: Modem (1/5) completed firmware download:
```

Step 6 Verify that the new firmware was successfully mapped to the modems.

In the following example:

- SPE 1/0 applies to modems 1/0 through 1/5.
- SPE 1/1 applies to modem 1/6 through 1/11, and so on.
- The MICA modules 0 through 7 in slot 1 are running Version 2.7.1.0 (not 2.6.2.0).
- All the modems in slot 2 are still running version 2.6.2.0, which is bundled into the Cisco IOS software image (see the field IOS-Default).

```
as5800-RS-1# show modem bundled-firmware
List of bundled modem firmware images by slot
  Slot 4
    2.6.2.0
  Slot 5
    2.6.2.0
  Slot 6
    2.6.2.0
  Slot 7
    2.6.2.0
  Slot 8
    2.6.2.0
```

Configuring Modems Using Modem Autoconfigure

This section describes how to apply a new modem capability (modemcap) to an integrated modem. A modemcap is a database of setup strings that is used by the modem autoconfigure function to change a modem's default settings.

Modemcaps have many applications:

- A modem's default settings are not optimal. For example, a modem function that you want is not enabled by default.
- Two separate modem pools need to be set up in the NAS to perform two different tasks. For example, one pool supports V.90. The other pool has a maximum speed set at 26400 bps to support older modems.
- A specialized application is required. For example, a NAS supporting a point-of-sale (POS) application such as a charge card reader. A modemcap is required that will tune the modem for a fast trainup time at the expense of having a slower connect speed.

Always use a modemcap (even if you only want the modem's default settings). To display the modemcaps that are built into the Cisco IOS software, enter the **show modemcap** command. Modemcaps are configured on a per modem basis. They are not configured on a per modem module or service processing element (SPE) basis.

Basic Rules for Modem Autoconfigure

The following list describes the basic rules:

- Never use the **modem autoconfigure discovery** command. Applying specific modemcaps reduces the risk of error.
- Always use the **modem autoconfigure type** *modem-name* command. This command improves your modem's performance.
- The **modem autoconfigure type mica** command can be used to reset any integrated modem (not only MICA), back to its factory defaults. The keyword **mica** is a built-in modemcap that only functions as &F (return to defaults).
- When you use the **modem autoconfigure** command, be sure that any script reset function is removed. A script reset is redundant and possibly harmful.
- A script reset is a chat script that is applied to a line when the line resets. The modem autoconfigure function is applied when the system starts up, not just when the line resets.
- When creating a modemcap, ignore all the strange and confusing fields. Put your modem init string into the MSC (Miscellaneous) field:
  - Always start your init string with &F (or, for third party modems, with the preferred &F1, &F2, etc.)
  - Never put an &W into an init string. An &W can wear out the EPROM on modems where this is not a no op (that is, a statement or operation that does nothing).
  - For MICA modems, always be sure that &D2 (not &D3) is in effect.

Modem Autoconfigure K56Flex Example

The following modem-autoconfigure string disables V.8bis/K56Flex. The string &F&D2s53=0 is applied to two MICA modems. Disabling V.8bis reduces trainup time by about two seconds, and it prevents trainup problems with older client modems.

Step 1 Watch the modem autoconfigure function run, so you can see if there are any typos in the modem string:

```
5800-NAS# debug confmodem
Modem Configuration Database debugging is on
5800-NAS# show debug
Modem Autoconfig:
  Modem Configuration Database debugging is on
5800-NAS# terminal monitor
```

Step 2 Remove any previous modem autoconfigure entry:

```
5800-NAS# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5800-NAS(config)# no modemcap entry mica-noKflex
% Modemcap entry 'mica-noKflex' does not exist
```

Step 3 Add the new entry:

```
5800-NAS(config)# modemcap edit mica-noKflex misc &F&D2s53=0
```

Step 4 Apply the new entry to the specified lines. Re-enter the **modem autoconfigure** command each time you change a modemcap. Modem-autoconfigure strings are not applied to busy modems. Modem strings are applied after modems disconnect.

```
5800-NAS(config)# line 1 2
5800-NAS(config-line)# modem autoconfigure type mica-noKflex
5800-NAS(config-line)#
Oct 25 19:46:06.960 PDT: TTY1: detection speed (115200) response ---OK---
Oct 25 19:46:06.960 PDT: TTY1: Modem command:  --AT&F&D2s53=0--
Oct 25 19:46:06.960 PDT: TTY2: detection speed (115200) response ---OK---
Oct 25 19:46:06.960 PDT: TTY2: Modem command:  --AT&F&D2s53=0--
Oct 25 19:46:09.520 PDT: TTY1: Modem configuration succeeded
Oct 25 19:46:09.520 PDT: TTY1: Detected modem speed 115200
Oct 25 19:46:09.520 PDT: TTY1: Done with modem configuration
Oct 25 19:46:09.520 PDT: TTY2: Modem configuration succeeded
Oct 25 19:46:09.520 PDT: TTY
5800-NAS(config-line)#
```

If you want to reset the modem to its factory defaults, do not simply remove the **modem autoconfigure** command. Rather, replace it with another **modem autoconfigure type** *name* command where *name* is a modemcap whose only action is &F. (In recent Cisco IOS software releases, the built-in **mica** modemcap entry will do this.)

Gathering and Viewing Call Statistics

Making sure that your modems are connecting at the correct connections speeds is an important aspect of managing modems. This section details the following methods for gathering and viewing modem performance statistics:

- Using the Cisco IOS EXEC (CLI)
- Using Modem Call-Record Terse
- Using SNMP

Note If you detect low connection speeds across all the modems, you may have a faulty channelized T1/E1 or ISDN PRI line connection.

Using the Cisco IOS EXEC (CLI)

The Cisco IOS software command line interface (CLI) contains many modem management **show** commands. Use these commands to gather and view modem statistics. This section provides a bulleted list detailing some of the most useful commands.

Step 1 List **show modem** command options:

```
AS5800-1# show modem ?
  <0-1439>            First Modem TTY Number
  bundled-firmware    Bundled modem firmware information for all modem slots
  call-stats          Calling statistics for all system modems
  calltracker         CallTracker modem information
  config              Modem configuration
  connect-speeds      Connection speeds for all system modems
  csm                 CSM modem information
  group               Modem group information
  log                 Modem event log
  operational-status  Modem operational status
  summary             Summary statistics for all system modems
  test                Modem test log
  version             Version information for all system modems
  x/y/z               First Shelf/Slot/Port for Internal Modems
  |                   Output modifiers
  <cr>
```

Step 2 Display a summary of the modem call statistics:

```
5800-NAS# show modem summary
         Incoming calls       Outgoing calls      Busied   Failed   No    Succ
Usage  Succ   Fail  Avail   Succ   Fail  Avail    Out      Dial     Ans   Pct.
  43% 60005   4678     25      3     11      0        0       13     8     92%
```

Table 3-11 describes some of the significant fields in the previous example.

Table 3-11 Show Modem Summary Field Descriptions

Field	Description
`Succ 60005`	60,005 calls successfully trained up. The Cisco IOS software saw “DSR” go high (still does not mean that PPP negotiated successfully).
`Fail 4678`	4,678 calls came into the modem, the modem went offhook, but the modem did not train up.
`Succ Pct. 92%`	The overall success percentage is 92%.
`No Ans 8`	Eight calls came into the modem but the modem did not go offhook (CPU was too busy). Unless you misconfigured the NAS, this counter should be very low (under 1% of the total calls).

Step 3 Display the disconnect reasons for the modems that trained up:

```
5800-NAS# show modem call-stats 0

dial-in/dial-out call statistics

       compress  retrain lostCarr userHgup  rmtLink  trainup hostDrop wdogTimr
  Mdm     #   %    #   %    #   %    #   %    #   %    #   %    #   %    #   %
 Total  237      916      413      124     9999     1064     8496        0

  dial-out call statistics

         noCarr noDitone     busy    abort dialStrg autoLgon dialTout  rmtHgup
  Mdm     #   %    #   %    #   %    #   %    #   %    #   %    #   %    #   %
 Total 1715        0        0        0        0        0        0        0
```

Table 3-12 describes some of the significant fields in the previous example.

Table 3-12 Show Modem Call-Status Field Descriptions

Field	Description
`rmtLink 9999`	RmtLink is the most common disconnect reason. RmtLink means that the modem trained up, error correction was negotiated, and the client DTE decided to hang up. All the call-stat counters do not go higher than 9999.
`hostDrop`	HostDrop (or dtrDrop) means the Cisco IOS software (DTE) informed the modem to terminate the call. For example: • Idle timeouts • Absolute timeouts • Authentication failures • PPP negotiation failures • The Cisco IOS software learns from the telephone switch that the DS0 was disconnected.

Besides the “hostDrop” message, all other disconnect reasons are not good. If the call trained up without EC, then the peer modem will probably not communicate an orderly disconnect with the Cisco IOS software. For example, the messages “lostCarr” or “retrain” might be displayed even though the peer DTE voluntarily disconnected. The collective total of disconnect reasons should be less than 10% of the total number of calls.

Step 4 Look at detailed disconnect reasons for individual modems:

```
5800-NAS# show modem call-stats
dial-in/dial-out call statistics

       compress  retrain lostCarr userHgup  rmtLink  trainup hostDrop wdogTimr
  Mdm     #   %    #   %    #   %    #   %    #   %    #   %    #   %    #   %
  1/0     5   2   23   2    7   1    2   1  971   2   20   1  176   2    0   0
* 1/1     8   3   18   1   12   2    6   4  949   2   29   2  167   1    0   0
  1/2     3   1   14   1    8   1    2   1  954   2   26   2  180   2    0   0
* 1/3     4   1   19   2    9   2    1   0  927   2   21   1  202   2    0   0
* 1/4     1   0   20   2   10   2    2   1  961   2   23   2  192   2    0   0
  1/5     2   0   19   2   10   2    4   3  893   1   30   2  182   2    0   0
  1/6     4   1   20   2   10   2    3   2  778   1   21   1  140   1    0   0
* 1/7     6   2   21   2    7   1    1   0  915   2   25   2  176   2    0   0
* 1/8     5   2   21   2    7   1    2   1 1019   2   28   2  159   1    0   0
  1/9     3   1   10   1    8   1    2   1  939   2   22   2  191   2    0   0
  1/10    1   0   29   3    9   2    1   0  918   2   28   2  194   2    0   0
  1/11    2   0   27   2    9   2    4   3  981   2   27   2  174   2    0   0
* 1/12    7   2   21   2   10   2    5   4  966   2   24   2  182   2    0   0
  1/13    6   2   21   2   10   2    1   0  977   2   32   3  168   1    0   0
```

Step 5 Display a summary of the range of connect speeds. Specify the top speed of interest followed by a 0. This example displays the initial connect speeds in each direction (transmit and receive) for the range of speeds that go up to 56K. No connections happened at 56000 bps. The transmit speed with the highest hit counter is 48K (9161 hits). The receive-connect speeds are all zeros because V.90 is a transmit only speed.

```
5800-NAS# show modem connect-speeds 56000 0
transmit connect speeds

  Mdm   48000  49333  50000  50667  52000  53333  54000  54667  56000 TotCnt
 Tot     9161   5047   1454   3291    813   1427      0     25      0  60012
 Tot %     15      8      2      5      1      2      0      0      0

  receive connect speeds

  Mdm   48000  49333  50000  50667  52000  53333  54000  54667  56000 TotCnt
 Tot        0      0      0      0      0      0      0      0      0  60012
 Tot %      0      0      0      0      0      0      0      0      0
```

Step 6 Inspect the range of speeds below 56000 bps (38667 to 46667). This is the distribution of speeds of PCM users (Kflex users and V.90 users). Compare this output with the previous example. The peak speed is at 48K, which had 9,161 hits—15% of all callers.

```
5800-NAS# show modem connect-speeds 46666 0
transmit connect speeds

  Mdm   38667  40000  41333  42000  42667  44000  45333  46000  46667 TotCnt
 Tot      349    192    700    221    780   2188   1123    804    693  60011
 Tot %      0      0      1      0      1      3      1      1      1

  receive connect speeds

  Mdm   38667  40000  41333  42000  42667  44000  45333  46000  46667 TotCnt
 Tot        0      0      0      0      0      0      0      0      0  60011
 Tot %      0      0      0      0      0      0      0      0      0
```

Step 7 Examine the DS0 timeslots on each T1 that are used to carry the modem calls. The following example shows that the telco is distributing calls into this hunt group evenly across the T1s. There are a total of 29 (20+9) DS0s currently active.

The high-water mark reports the highest number of DS0s that were in use at one time. However, be sure to inspect the entire dial pool. Entire T1s have been known to remain idle in some hunt groups.

```
5800-NAS# show controllers t1 call-counters
T1 0:
  DS0's Active: 20
  DS0's Active High Water Mark: 23
  TimeSlot   Type   TotalCalls   TotalDuration
      1       pri        6536       3w1d
      2       pri        6701       2w3d
      3       pri        5789       2w0d
      4       pri        5498       1w2d
      5       pri        5497       3d02h
      6       pri        5126       7w0d
      7       pri        4525       6w1d
      8       pri        4401       5w3d
      9       pri        4096       4w4d
     10       pri        3961       3w3d
     11       pri        3320       3w0d
     12       pri        3138       1w3d
     13       pri        2912       4d05h
     14       pri        2486       6w4d
     15       pri        2042       5w5d
     16       pri        1644       4w5d
     17       pri        1413       4w1d
     18       pri        1071       3w3d
     19       pri         884       2w4d
     20       pri         675       2w0d
     21       pri         507       1w3d
     22       pri         380       1w1d
     23       pri         263       5d17h

T1 1:
  DS0's Active: 9
  DS0's Active High Water Mark: 23
  TimeSlot   Type   TotalCalls   TotalDuration
      1       pri        8985       3w2d
      2       pri        8650       2w4d
      3       pri        8594       1w3d
      4       pri        7813       4d03h
      5       pri        7671       6w3d
      6       pri        6955       5w5d
      7       pri        6492       4w3d
      8       pri        6343       3w4d
      9       pri        5668       2w3d
     10       pri        5398       6d09h
     11       pri        4842       6w6d
     12       pri        4413       5w3d
     13       pri        4050       4w1d
     14       pri        3339       2w6d
     15       pri        3019       1w2d
     16       pri        2493       1d14h
```

```
     17       pri        2104       6w0d
     18       pri        1664       5w1d
     19       pri        1395       3w6d
     20       pri        1094       3w3d
     21       pri         811       2w6d
     22       pri         688       2w0d
     23       pri         482       1w3d

Total DS0's Active High Water Mark: 46
```

Using Modem Call-Record Terse

Starting with Cisco IOS Releases 11.3AA and 12.0T, modem call records can be sent to syslog and examined to perform statistical analysis.

For example, you can monitor:

- Modulation trends such as V.90 verses V.34
- Call time durations (consistent short connection times on a modem, regular Lost Carrier counts)
- Unavailable user IDs
- PPP negotiation or authentication failures

The following example enables modem call-records and sends the logs to wherever your syslog output goes, for example:

- To the console—If you do not have the **no logging console** command enabled.
- To the terminal line—If you have the **terminal monitor** command enabled.
- To a syslog host—If you have one configured.

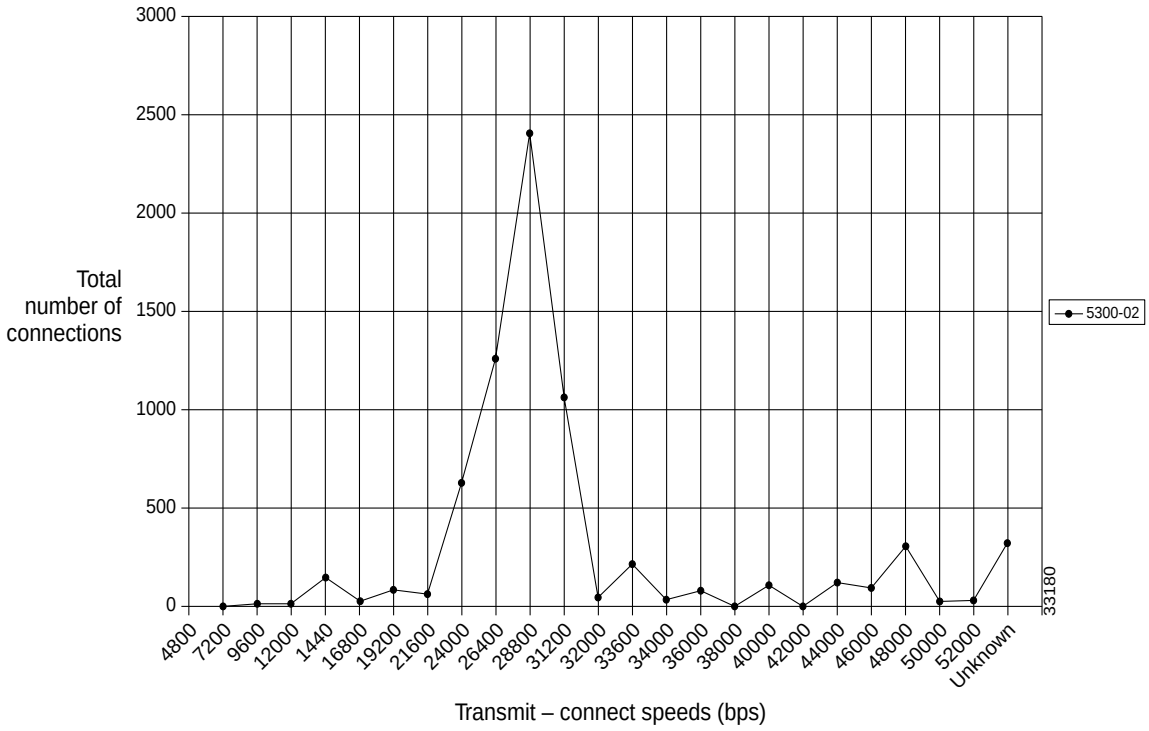
```
5800-NAS# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5800-NAS(config)# modem call-record terse

*Jan  1 04:19:50.262: %CALLRECORD-3-MICA_TERSE_CALL_REC: DS0 slot/contr/chan=0/0/0,
slot/port=2/0, call_id=18, userid=(n/a), ip=0.0.0.0, calling=4082329440,
called=5710945, std=V.34+, prot=LAP-M, comp=V.42bis both, init-rx/tx
b-rate=26400/26400, finl-rx/tx b-rate=26400/26400, rbs=0, d-pad=None, retr=2, sq=3,
snr=25, rx/tx chars=79/94701, bad=0, rx/tx ec=60/204, bad=521, time=698,
finl-state=Steady, disc(radius)=(n/a)/(n/a), disc(modem)=A220 Rx (line to host) data
flushing - not OK/EC condition - locally detected/received DISC frame -- normal LAPM
termination
```

Using SNMP

Modem connect speeds can be graphed using SNMP MIBs. The graph shown in Figure 3-13 was created with Cisco Access Manager (CAM). The graph describes the modem connect-speed performance activity of one NAS for one month. The following connect speeds are transmitted by the NAS and received by the client modem. Most of the calls performed between 28000 and 31200 bps. This NAS is one member of an access stack.

For discussions on enabling management protocols such as NTP, SNMP, and Syslog, refer to Chapter 4, “Administration.”

Figure 3-13 Graphed Modem-Connect Speeds for One Month



CHAPTER 4

Administration

This chapter describes management protocols and Network Access Server (NAS) security and control functionality with AAA and RADIUS servers.

Remote Monitor (RMON)

Remote Monitoring (RMON) is an Internet Engineering Task Force (IETF) monitoring standard (RFC 1757) that allows console systems and network monitors to exchange statistical and functional monitoring data, through RMON-compliant console managers and network probes. RMON provides network administrators with flexibility to satisfy networking demands through console and network monitoring probes to obtain fault diagnostics, planning, and performance information.

RMON delivers information in nine unique monitoring element groups that provide specific types of data, which satisfies common network-monitoring requirements. Some RMON groups are dependent upon others for support, but each is optional so that it is not necessary for vendors to support all groups within the management information base (MIB). See Table 4-1 for RMON group functions.

Table 4-1 RMON Groups

RMON Group	Description
Alarm	Periodic statistical sampling from event generated variables in the probe that compares configured thresholds.
Events	Controls the generation and notification of events from this device.
Filters	Enables packet matching by equation filtering to form data streams that may be captured or generate events.
History	Records and stores periodic statistical samples, number of samples, and items sampled from a network.
Host	Contains statistics associated with each discovered network host.
HostTopN	Creates tables describing hosts that top a list ordered by one of their rate-based statistics.
Matrix	Stores new conversation statistics detected on source and destination device.
Packet Capture	Enables packet capturing after it flows through a channel.
Statistics	Contains probe calculated statistics for each interface monitored on device.

Enabling Management Protocols: NTP, SNMP, and Syslog

This section describes how to enable basic management protocols on a Cisco AS5800 as part of a dial access service. It does not however, describe how to integrate the Cisco IOS software with NT or UNIX servers. Management protocols are described only from the perspective of the Cisco IOS software.

Understanding Network Management Basics

Figure 4-1 shows a logical perspective of how management protocols interact between the Cisco IOS software (client) and a network element management server. Dashed lines represent different protocols and functions.

- NTP synchronizes time between network devices.
- The SNMP element manager (EM) receives SNMP traps from the Cisco IOS software. The SNMP manager uses SNMP to query variables and set configurations.
- The Cisco IOS software sends logging messages to a syslog daemon.

Figure 4-1 NTP, SNMP, and Syslog Interactions

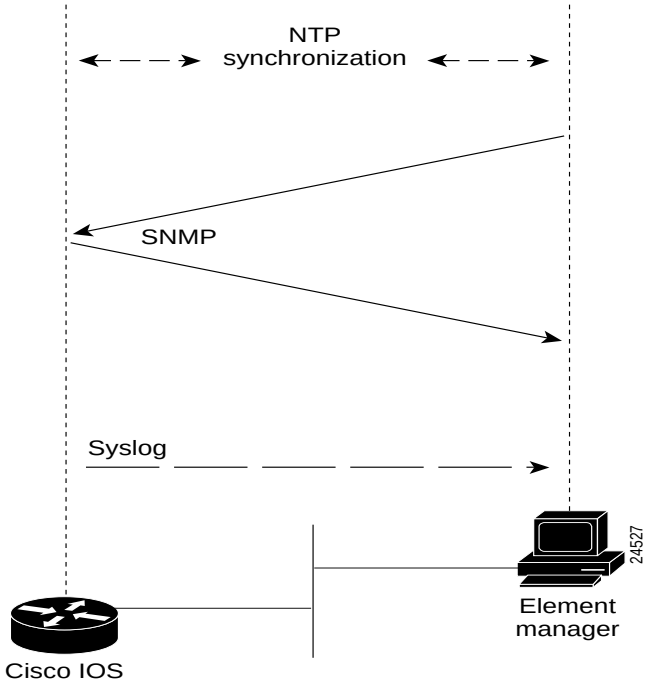


Table 4-2 provides the RFCs and URLs for the management protocols described in this section.

Table 4-2 Management Protocol RFCs

Management Protocol	RFC	URL
NTP	RFC 1305	http://www.ietf.org/rfc/rfc1305.txt
SNMP	RFC 1157	http://www.ietf.org/rfc/rfc1157.txt

For more information about system management, refer to Cisco IOS Release 12.0 *Configuration Fundamentals Configuration Guide* and *Command Reference*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/index.htm

Enabling the Network Time Protocol

The Network Time Protocol (NTP) provides a common time base for networked routers, servers, and other devices. A synchronized time enables you to correlate syslog and Cisco IOS debug output to specific events. For example, you can find call records for specific users within one millisecond.

Comparing logs from various networks is essential for:

- Troubleshooting
- Fault analysis
- Security incident tracking

Without precise time synchronization between all the various logging, management, and AAA functions, time comparisons are not possible.

An NTP enabled network usually gets its time from an authoritative time source, such as a Cisco router, radio clock, or an atomic clock attached to a timeserver. NTP then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two machines to within a millisecond of each another. NTP runs over UDP, which in turn runs over IP.

Step 1 Locate an authoritative clock source. For example, you can use a Cisco router or an atomic clock that is attached to a time server.

Step 2 Specify the primary NTP server IP address and automatic calendar updates as shown below:

```
!
ntp update-calendar
ntp server 172.22.66.18 prefer
!
```

Step 3 Verify that the clock is synchronized to the NTP server. Inspect the status and time association. Clock sources are identified by their stratum levels. The following example shows a stratum level five clock.

```
5800-NAS# show ntp status
Clock is synchronized, stratum 5, reference is 172.22.66.18
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**24
reference time is BB944312.4451C9E7 (23:11:30.266 PDT Wed Sep 22 1999)
clock offset is 0.5343 msec, root delay is 13.26 msec
root dispersion is 18.02 msec, peer dispersion is 0.09 msec
5800-NAS#
```

The following command identifies how often the NAS is polling and updating to the stratum clock. An asterisk (*) next to the NTP servers IP address indicates successful synchronization with the stratum clock.

```
5800-NAS# show ntp association

address         ref clock     st  when  poll reach  delay  offset    disp
*~172.22.66.18      172.60.8.1       16    46    64  377     1.0    0.53     0.1
 * master (synced), # master (unsynced), + selected, - candidate, ~ configured
5800-NAS#
```

Enabling Syslog

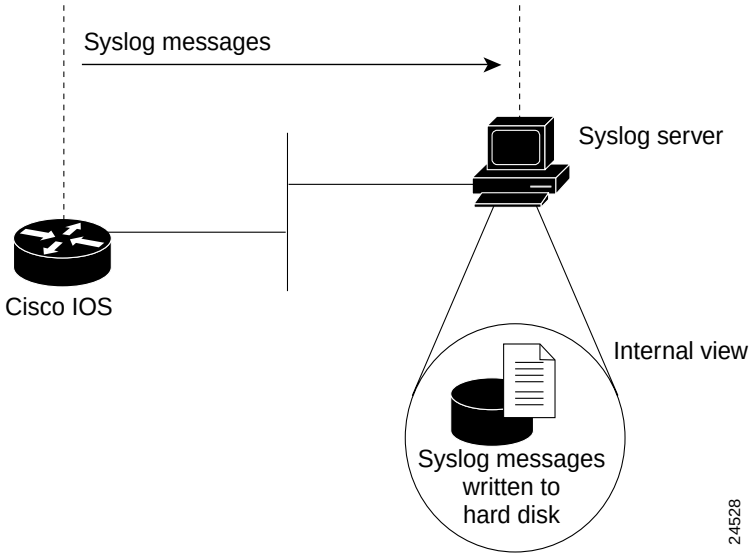
The Cisco IOS software can send syslog messages to one or more element manager servers. Syslog messages are then collected by a standard UNIX or NT type syslog daemon.

Syslog enables you to:

- Centrally log and analyze configuration events and system error messages such as interface status, security alerts, environmental conditions, and CPU process overloads.
- Capture client debug output sessions in a real-time scenario.
- Reserve Telnet sessions for making configurations changes and using **show** commands. This prevents Telnet sessions from getting cluttered up with debug output.

Figure 4-2 shows the Cisco IOS software sending syslog data to an element manager. Syslog data either stays in the Cisco IOS software buffer, or is pushed out and written to the element managers hard disk.

Figure 4-2 Syslog Messages Written to Hard Disk



Note Cisco System's UNIX syslog format is compatible with 4.3 BSD UNIX.

Step 1 Enable debug timestamps and include date, time, and milliseconds relative to the local time zone:

```
!
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
!
```

Step 2 Verify that console logging is disabled. If it is enabled, the NAS will intermittently freeze up as soon as the console port is overloaded with log messages. See the field "1 flushes." Increments on this number represents bad logging behavior.

```
5800-NAS# show logging
Syslog logging: enabled (0 messages dropped, 1 flushes, 0 overruns)
    Console logging: level debugging, 1523 messages logged
    Monitor logging: level debugging, 0 messages logged
    Buffer logging: level debugging, 911 messages logged
    Trap logging: level informational, 44 message lines logged

5800-NAS(config)# no logging console
5800-NAS(config)# ^Z
5800-NAS# show logging
Syslog logging: enabled (0 messages dropped, 1 flushes, 0 overruns)
    Console logging: disabled
    Monitor logging: level debugging, 0 messages logged
    Buffer logging: level debugging, 912 messages logged
    Trap logging: level informational, 45 message lines logged
```

Caution Not entering the **no logging console** command might cause CPU interrupts, dropped packets, denial of service events, and router lock up.

Step 3 Specify the logging configuration:

```
!
logging 172.22.66.18
logging buffered 10000 debugging
logging trap debugging
!
```

Table 4-3 describes the commands in the previous configuration fragment.

Table 4-3 Syslog Commands

Command	Purpose
`logging 172.22.66.18`	Specifies the syslog servers IP address.
`logging buffered 10000 debugging`	Sets the internal log buffer to 10,000 bytes for debug output (newer messages overwrite older messages).
`logging trap debugging`	Allows logging up to the debug level (all 8 levels) for all messages sent to the syslog server.

If you are working with multiple network access servers, assign a different logging facility tag to each server. Syslog information can be collected and sorted into different files on the syslog server.

For example:

- Assign local1 to NAS1
- Assign local2 to NAS2
- Assign local3 to NAS3

Assigning a different tag to each device enables you to intelligently sort and view syslog messages:

```
!
logging facility local7
!
```

Step 4 Verify that local buffered logging is working:

```
5800-NAS# show logging
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
    Console logging: disabled
    Monitor logging: level debugging, 0 messages logged
    Buffer logging: level debugging, 2 messages logged
    Trap logging: level debugging, 53 message lines logged
        Logging to 172.22.66.18, 2 message lines logged

Log Buffer (10000 bytes):

Sep 26 16:32:02.848 PDT: %SYS-5-CONFIG_I: Configured from console by admin on console
Sep 26 16:33:16.069 PDT: %SYS-5-CONFIG_I: Configured from console by admin on console
5800-NAS#
```

Enabling SNMP

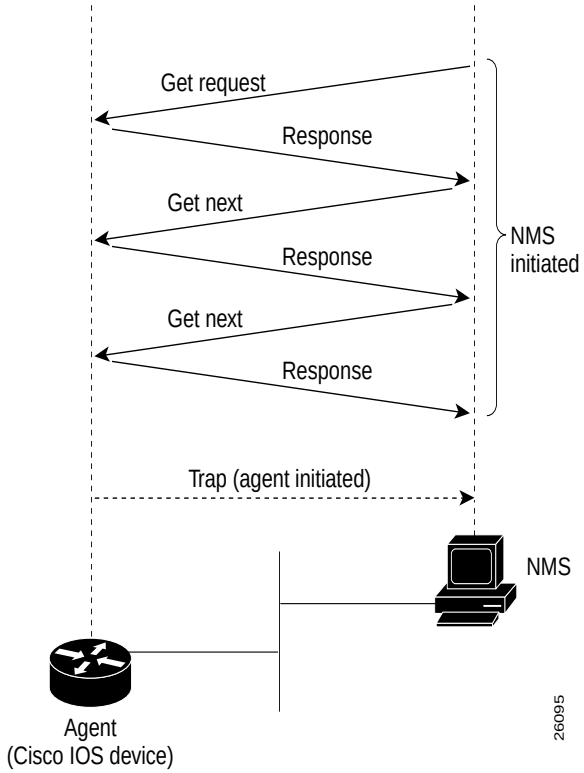
The SNMP traps generated by Cisco routers provide:

- Potentially harmful environmental conditions
- Processor status
- Port status
- Security issues

The Cisco IOS software generates SNMP traps based on the features that the Cisco IOS software supports.

Figure 4-3 shows the interactions and timing of the SNMP protocol between the EM (SNMP manager) and the NAS (SNMP agent). Traps are unsolicited messages sent from the NAS to the EM. Four functions of SNMP include: trap, get request, get next, and set request.

Figure 4-3 SNMP Event Interaction and Timing



Note For a listing of all SNMP traps supported by Cisco, refer to *Cisco IOS SNMP Traps Supported and How to Configure Them*, available online at http://www.cisco.com/warp/public/477/SNMP/snmp_traps.html

Step 1 Configure the Cisco IOS software to support basic SNMP functions. Access lists 5 and 8 are used for SNMP community strings:

- The read only (RO) community string is called “poptarts.” It uses access list 8 as a filter.
- The read write (RW) community string is called “pixysticks.” It uses access list 5 as a filter.

```
!
snmp-server contact admin user@the.doc
snmp-server location 5800-NAS-corporate
snmp-server community poptarts RO 8
snmp-server community pixysticks RW 5
snmp-server host 172.22.66.18 maddog
snmp-server trap-source Loopback0
snmp-server enable traps snmp
!
access-list 5 permit 172.22.67.1
access-list 5 permit 0.0.0.1 172.22.68.20
access-list 8 permit 172.22.67.1
access-list 8 permit 0.0.0.1 172.22.68.20
!
```

Table 4-4 describes commands in the previous configuration fragment.

Table 4-4 SNMP Commands

Command	Purpose
`snmp-server contact admin user@the.doc`	Specifies a contact name to notify whenever a MIB problems occurs.
`snmp-server location 5800-NAS-corporate`	Specifies a geographic location name for the router.
`snmp-server community poptarts RO 8`	Assigns a read only (RO) community string. Only queries and get requests can be performed. The community string (poptarts) allows polling but no configuration changes. Without the correct community string on both machines, SNMP will not let you do the authorization to get or set the request.
`snmp-server community pixysticks RW 5`	Assigns a read write (RW) community string. This community string (pixysticks) enables configuration changes to be performed. For example, you can shut down an interface, download a configuration file, or change a password.
`snmp-server host 172.22.66.18 maddog`	Identifies the IP address of the SNMP host followed by a password.
`snmp-server trap-source Loopback0`	Associates SNMP traps with a loopback interface. In this way, an Ethernet shutdown will not disrupt SNMP management flow.
`snmp-server enable traps`	Enables traps for unsolicited notifications for configuration changes, environmental variables, and device conditions.
`access-list 5 permit 172.22.67.1` `access-list 8 permit 172.22.67.1`	Permits access from a single element management server.
`access-list 5 permit 0.0.0.1 172.22.68.20` `access-list 8 permit 0.0.0.1 172.22.68.20`	Permits access from a block of addresses at your network operations center.

Caution If you are not using SNMP, make sure to turn it off. Never use a configuration that uses "public" or "private" as community strings—these strings are well known in the industry and are common defaults on hardware. These strings are open invitations to attacks, regardless if you use filters.

Step 2 Monitor SNMP input and output statistics. For example, display a real-time view of who is polling the NAS for statistics and how often.

Excessive polling will:

- Consume much of the CPU resources
- Cause packets to be dropped
- Crash the NAS

```
5800-NAS# show snmp
Chassis: 11811596
Contact: admin user@the.doc
Location: 5800-NAS-corporate
0 SNMP packets input
    0 Bad SNMP version errors
    0 Unknown community name
    0 Illegal operation for community name supplied
    0 Encoding errors
    0 Number of requested variables
    0 Number of altered variables
    0 Get-request PDUs
    0 Get-next PDUs
    0 Set-request PDUs
0 SNMP packets output
    0 Too big errors (Maximum packet size 1500)
    0 No such name errors
    0 Bad values errors
    0 General errors
    0 Response PDUs
    0 Trap PDUs

SNMP logging: enabled
    Logging to 172.22.66.18.162, 0/10, 0 sent, 0 dropped.
5800-NAS#
```

Disabling the Logging of Access Interfaces

Limit the amount of output logged from the group-async interface and ISDN D channels. Carefully choose the data sources for system management purposes. AAA accounting and the modem-call record terse feature provides the best data set for analyzing ISDN remote node device activity.

Link status up-down events and SNMP trap signals:

- Occur regularly on access interfaces. Dialer interfaces going up and down is normal behavior and does not indicate a problem.
- Should not be logged or sent to a management server.

The following configuration fragment disables logging on access interfaces:

```
!
interface Serial 0:23
 no logging event link-status
 no snmp trap link-status
!
interface Serial 1:23
 no logging event link-status
 no snmp trap link-status
!
interface Serial 2:23
 no logging event link-status
 no snmp trap link-status
!
interface Serial 3:23
 no logging event link-status
 no snmp trap link-status
!
interface Group-Async 1
 no logging event link-status
 no snmp trap link-status
!
```

Confirming the Final Running Configuration

The following is an example of the Cisco AS5800 running configuration with Cisco IOS Release 12.0(4) XL1 installed.

```
5800-NAS# show running-config
Building configuration...

Current configuration:
!
version 12.x
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
hostname 5800-NAS
!
logging buffered 10000 debugging
no logging console
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
enable secret 5 $1$LKgL$tgi19XvWn7fld7JGt55p01
!
username dude password 7 045802150C2E
username admin password 7 044E1F050024
!
!
!
shelf-id 0 router-shelf
shelf-id 1 dial-shelf
!
!
!
```

```
resource-pool disable
!
modem-pool Default
 pool-range 1/2/0-1/10/143
!
!
spe 1/2/0 1/10/11
 firmware ios-bundled default
modem recovery action none
ip subnet-zero
no ip source-route
ip host guessme 172.22.100.9
ip domain-name the.net
ip name-server 172.22.11.10
ip name-server 172.22.12.11
!
async-bootp dns-server 172.30.10.1 172.30.10.2
isdn switch-type primary-ni
isdn voice-call-failure 0
!
!
controller T3 1/0/0
 framing m23
 cablelength 0
 t1 4 controller
!
controller T1 1/0/0:4
 framing esf
 pri-group timeslots 1-24
!
!
voice-port 1/0/0:4:D
!
!
process-max-time 200
!
interface Loopback0
 ip address 172.22.99.1 255.255.255.255
 no ip directed-broadcast
!
interface Loopback1
 ip address 172.22.90.1 255.255.255.0
 no ip directed-broadcast
!
interface FastEthernet0/1/0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial1/0/0:4:23
 no ip address
 no ip directed-broadcast
 no snmp trap link-status
 isdn switch-type primary-ni
 isdn incoming-voice modem
 no cdp enable
!
interface Group-Async0
 ip unnumbered FastEthernet0/1/0
 no ip directed-broadcast
 encapsulation ppp
 async mode interactive
 no snmp trap link-status
 peer default ip address pool addr-pool
 no cdp enable
```

```
 ppp authentication chap pap
 group-range 1/2/00 1/10/143
!
ip local pool addr-pool 172.22.90.2 172.22.90.254
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
no ip http server
!
logging trap debugging
logging 172.22.66.18
access-list 5 permit 172.22.67.1
access-list 5 permit 0.0.0.1 172.22.68.20
access-list 8 permit 172.22.67.1
access-list 8 permit 0.0.0.1 172.22.68.20
snmp-server engineID local 00000009020000D0D3424C1C
snmp-server community poptarts RO 8
snmp-server community pixysticks RW 5
snmp-server community maddog view v1default RO
snmp-server trap-source Loopback0
snmp-server location 5800-NAS-Austin
snmp-server contact admin dude@the.net
snmp-server enable traps snmp
snmp-server enable traps isdn call-information
snmp-server enable traps hsrp
snmp-server enable traps config
snmp-server enable traps entity
snmp-server enable traps envmon
snmp-server enable traps syslog
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
snmp-server enable traps dial
snmp-server enable traps dsp card-status
snmp-server enable traps bgp
snmp-server enable traps voice poor-qov
snmp-server host 172.22.66.18 maddog
!
banner login ^C
This is a secured device.
Unauthorized use is prohibited by law.
^C
!
line con 0
 transport input none
line aux 0
 transport input telnet
line vty 0 4
line 1/2/00 1/10/143
 autoselect during-login
 autoselect ppp
 modem InOut
 no modem log rs232
!
ntp update-calendar
ntp server 172.22.66.18 prefer
end
```

Access Service Security

The Cisco AS5800 is designed to support a security paradigm providing authentication, authorization, and accounting (AAA) security measures using RADIUS and TACACS+.

- Authentication—requires dial-in users to identify themselves and prove their identity, thus preventing wrongful access to lines on your Cisco AS5800, or connecting through the lines directly to network resources.
- Authorization—prevents users from gaining access to particular services and devices on the network.
- Accounting—provides records for billing and other needs to determine who is connected to the network and how long they have been connected. It does not describe how to configure accounting.

This section describes how to configure security using a local database resident on your Cisco AS5800 or using a remote security database for Terminal Access Controller Access Control System with Cisco proprietary enhancements (TACACS+) and Remote Authentication Dial-In User Service (RADIUS). Refer to the "Local and Remote Server Authentication" section on page 4-13 for local and remote authentication definitions.

Note This section does not provide a comprehensive security overview. It does not describe how to completely configure TACACS, Extended TACACS, access lists or RADIUS. It presents the most commonly used security mechanisms to prevent unauthenticated and unauthorized access to network resources through a Cisco AS5800. For a comprehensive overview of Cisco security tools, refer to the security configuration guide in the Cisco IOS configuration guides and command references documentation.

This section describes the following topics:

- Local and Remote Server Authentication
- Configuring RADIUS
- Configuring TACACS+

Local and Remote Server Authentication

This section describes the differences between local and remote security databases and the basic authentication process for each. Remote security databases described in this section include Terminal Access Controller Access Control System with Cisco proprietary enhancements (TACACS+) and Remote Authentication Dial-In User Service (RADIUS).

Generally the size of the network and type of corporate security policies and control determine whether you use a local or remote security database.

Local Security Database

If you have one or two Cisco AS5800 providing access to your network, store username and password security information on your Cisco AS5800. This is referred to as local authentication.

Remote Security Database

As your network expands, you need a centralized security database that provides username and password information each access server in the network. This centralized security database resides in a security server.

A centralized security database helps establish consistent remote access policies throughout a corporation. An example of a remote security database server is the CiscoSecure product from Cisco Systems. CiscoSecure is a UNIX security daemon, with which the administrator creates a database that defines the network users and their privileges. CiscoSecure uses a central database that stores user and group profiles with authentication and authorization information.

The Cisco AS5800 exchanges user authentication information with a TACACS+ or RADIUS database on the security server by transmitting encrypted TACACS+ or RADIUS packets across the network.

For specific information about the interaction between the security server and the Cisco AS5800, refer to the security configuration guide in the Cisco IOS configuration guides and command references documentation.

Configuring RADIUS

This section describes the Remote Authentication Dial-In User (RADIUS) security system, defines its operation, and identifies appropriate and inappropriate network environments for using RADIUS technology. RADIUS Configuration Task List, page 4-16 describes how to configure RADIUS with the authentication, authorization, and accounting (AAA) command set. RADIUS Configuration Examples, page 4-20 offers two possible implementation scenarios.

This section includes the following topics:

- RADIUS Overview, page 4-14
- RADIUS Operation, page 4-15
- RADIUS Configuration Task List, page 4-16

For a complete description of the commands used in this section, refer to information on RADIUS commands in the security command reference for your Cisco IOS release. To locate documentation of other commands that appear in this section, use the command reference master index or search online.

RADIUS Overview

RADIUS is a distributed client/server system that secures networks against unauthorized access. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a central RADIUS server. The server contains all user authentication and network service access information.

RADIUS is a fully open protocol, distributed in source code format, that can be modified to work with any security system currently available on the market.

Cisco supports RADIUS under its AAA security paradigm. RADIUS can be used with other AAA security protocols, such as TACACS+, Kerberos, or local username lookup. RADIUS is supported on all Cisco platforms.

RADIUS has been implemented in a variety of network environments that require high levels of security while maintaining network access for remote users.

Use RADIUS in the following network environments that require access security:

- Networks with multiple-vendor access servers, each supporting RADIUS. For example, access servers from several vendors use a single RADIUS server-based security database. In an IP-based network with multiple vendors access servers, dial-in users are authenticated through a RADIUS server that has been customized to work with the Kerberos security system.
- Turnkey network security environments in which applications support the RADIUS protocol, such as in an access environment that uses a "smart card" access control system. In one case, RADIUS has been used with Enigmas security cards to validate users and grant access to network resources.
- Networks already using RADIUS. You can add a Cisco router with RADIUS to the network. This might be the first step when you make a transition to a Terminal Access Controller Access Control System (TACACS+) server.
- Networks in which a user must only access a single service. Using RADIUS, you can control user access to a single host, to a single utility such as Telnet, or to a single protocol such as Point-to-Point Protocol (PPP). For example, when a user logs in, RADIUS identifies this user as having authorization to run PPP using IP address10.2.3.4 and the defined access list is started.
- Networks that require resource accounting. You can use RADIUS accounting independent of RADIUS authentication or authorization. The RADIUS accounting functions allow data to be sent at the start and end of services, indicating the amount of resources (such as time, packets, and bytes used during the session.
- An Internet service provider (ISP) might use a freeware-based version of RADIUS access control and accounting software to meet special security and billing needs.

RADIUS is not suitable in the following network security situations:

- Multiprotocol access environments. RADIUS does not support the following protocols:
  - AppleTalk Remote Access Protocol (ARAP)
  - NetBIOS Frame Protocol Control Protocol (NBFCP)
  - NetWare Asynchronous Services Interface (NASI)
  - X.25 PAD connections
- Router-to-router situations. RADIUS does not provide two-way authentication. RADIUS can be used to authenticate from one Cisco router to a third party router if, other company's router requires RADIUS authentication.
- Networks using a variety of services. RADIUS generally binds a user to one service model.

RADIUS Operation

When attempting to log in and authenticate to Cisco AS5800 using RADIUS, the following steps occur:

1. The user enters a username and password at the corresponding prompts.
2. The username and encrypted password are sent over the network to the RADIUS server.
3. The user receives one of the following responses from the RADIUS server:
   - ACCEPT - The user is authenticated.
   - REJECT - The user is not authenticated and is prompted to reenter the username and password, or access is denied.
   - CHALLENGE - A challenge is issued by the RADIUS server. The challenge collects additional data from the user.

– CHANGE PASSWORD - A request is issued by the RADIUS server, asking the user to select a new password.

The ACCEPT or REJECT response is bundled with additional data that is used for EXEC or network authorization. You must first complete RADIUS authentication before using RADIUS authorization. The additional data included with the ACCEPT or REJECT packets consists of the following:

- Services that the user can access, including Telnet, rlogin, local-area transport (LAT) connections, and PPP, Serial Line Internet Protocol (SLIP), or EXEC services.
- Connection parameters, including the host or client IP address, access list, and user timeouts.

RADIUS Configuration Task List

To configure RADIUS on your Cisco AS5800, you must perform the following tasks:

- Use the **aaa new-model** global configuration command to enable AAA. AAA must be configured if you plan to use RADIUS. For more information about using the **aaa new-model** command, refer to the "AAA Commands" section on page 4-23.
- Use the **aaa authentication** global configuration command to define method lists for RADIUS authentication. For more information about using the **aaa authentication** command, refer to the "Specify RADIUS Authentication" section on page 4-20.
- Use **line** and **interface** commands to enable the defined method lists to be used. For more information, refer to the "Specify RADIUS Authentication" section on page 4-20.

The following configuration tasks are optional:

- Use the **aaa authorization** global command to authorize specific user functions. For more information about using the **aaa authorization** command, refer to the "Specify RADIUS Authorization" section on page 4-20.
- Use the **aaa accounting** command to enable accounting for RADIUS connections. For more information about using the **aaa accounting** command, refer to the "Specify RADIUS Accounting" section on page 4-20.

This section describes how to set up RADIUS for authentication, authorization, and accounting on your network, and includes the following sections:

Configure Router to RADIUS Server Communication

The RADIUS host is normally a multi-user system running RADIUS server software from Livingston, Merit, Microsoft, or another software provider. A RADIUS server and a Cisco router use a shared secret text string to encrypt passwords and exchange responses.

To configure RADIUS to use the AAA security commands, you must specify the host running the RADIUS server daemon, and a secret text string that it shares with the router. Use the radius-server commands to specify the RADIUS server host and a secret text string.

To specify a RADIUS server host and shared secret text string, perform the following tasks in global configuration mode:

- Specify the IP address or host name of the remote RADIUS server host, and assign authentication and accounting destination port numbers.

  ```
  radius-server host {hostname | ip-address}
  [auth-port port-number] [acct-port port-number]
  ```

- Specify the shared secret text string used between the router and the RADIUS server.

  ```
  radius-server key string
  ```

To customize communication between the router and the RADIUS server, use the following optional radius-server global configuration commands:

- Specify the number of times the router transmits each RADIUS request to the server before giving up (default is three).

  ```
  radius-server retransmit retries
  ```

- Specify the number of seconds a router waits for a reply to a RADIUS request before retransmitting the request.

  ```
  radius-server timeout seconds
  ```

- Specify the number of minutes a RADIUS server, which is not responding to authentication requests, is passed over by requests for RADIUS authentication.

  ```
  radius-server deadtime minutes
  ```

Configure Router to Use Vendor-Specific RADIUS Attributes

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific information between the network Cisco AS5800 and the RADIUS server, by using the vendor-specific attribute (Attribute 26). Vendor-specific attributes (VSAs) allow vendors to support their own extended attributes not suitable for general use. The Cisco RADIUS implementation supports one vendor-specific option using the format recommended in the specification. The Cisco vendor-ID is 9, and the supported option has vendor-type 1, which is named “cisco-avpair.” The value is a string of the format:

```
protocol : attribute sep value *
```

- “Protocol” is a value of the Cisco “protocol” attribute for a particular type of authorization.
- “Attribute” and “value” are an appropriate attribute/value (AV) pair defined in the Cisco TACACS+ specification
- “sep” is “=” for mandatory attributes and “*” for optional attributes.

This allows the full set of features available for TACACS+ authorization to also be used for RADIUS.

For example, the following AV pair causes the Cisco “multiple named ip address pools” feature to be activated during IP authorization (during PPP's IPCP address assignment).

```
cisco-avpair= “ip:addr-pool=first”
```

The following example causes a “NAS Prompt” user to have immediate access to EXEC commands.

```
cisco-avpair= “shell:priv-lvl=15”
```

Other vendors have their own vendor-IDs, options, and associated VSAs. For more information about vendor-IDs and VSAs, refer to the RADIUS specification RFC 2138, “Remote Authentication Dial-In User Service (RADIUS),” described in *How Does RADIUS Work?*, available online at http://www.cisco.com/warp/public/707/32.html

To configure the NAS to recognize and use VSAs, perform the following task in global configuration mode:

Enable the network Cisco AS5800 to recognize and use VSAs as defined by RADIUS IETF attribute 26.

```
radius-server vsa send [accounting|authentication]
```

For a complete list of RADIUS attributes or more information about vendor-specific Attribute 26, refer to the RADIUS Attributes appendix.

Configure Router for Vendor-Proprietary RADIUS Server Communication

Although the IETF draft standard for RADIUS specifies a method for communicating vendor-specific information between the network Cisco AS5800 and the RADIUS server, some vendors have extended the RADIUS attribute set in a unique way. Cisco IOS software supports a subset of vendor-proprietary RADIUS attributes.

To configure RADIUS (whether vendor-proprietary or IETF draft-compliant), you must specify the host running the RADIUS server daemon and the secret text string it shares with the Cisco device. You specify the RADIUS host and secret text string by using the radius-server commands. To identify that the RADIUS server is using a vendor-proprietary implementation of RADIUS, use the radius-server host nonstandard command.

Vendor-proprietary attributes will not be supported unless you use the radius-server host non-standard command.

To specify a vendor-proprietary RADIUS server host and a shared secret text string, perform the following tasks in global configuration mode.

Specify the IP address or host name of the remote RADIUS server host and identify that it is using a vendor-proprietary implementation of RADIUS.

```
radius-server host {hostname |ip-address} non-standard
```

Specify the shared secret text string used between the router and the vendor-proprietary RADIUS server. The router and the RADIUS server use this text string to encrypt passwords and exchange responses.

```
radius-server key string
```

Configure Router to Query RADIUS Server for Static Routes and IP Addresses

Some vendor-proprietary implementations of RADIUS let the user define static routes and IP pool definitions on the RADIUS server, instead of on each individual Cisco AS5800 in the network. Each network Cisco AS5800 then queries the RADIUS server for static route and IP pool information.

To have the Cisco AS5800 query the RADIUS server for static routes and IP pool definitions when the device first starts up, use the following commands in global configuration mode:

```
radius-server configure-nas
```

Note Because the **radius-server configure-nas** command is performed when the Cisco router starts up, it will not take effect until you enter a **copy running-config startup-config** command.

Configure Router to Expand Network Cisco AS5800 Port Information

In some situations, PPP or login authentication occurs on an interface different from the interface on which the call itself comes in. For example, in a V.120 ISDN call, login or PPP authentication occurs on a virtual asynchronous interface “ttt” but the call itself occurs on one of the channels of the ISDN interface.

The **radius-server attribute nas-port extended** command configures RADIUS to expand the size of the NAS-Port attribute (RADIUS IETF Attribute 5) field to 32 bits. The upper 16 bits of the NAS-Port attribute display the type and number of the controlling interface; the lower 16 bits indicate the interface undergoing authentication.

To display expanded interface information in the NAS-Port attribute field, perform the following task in global configuration mode.

Expand the NAS-Port attribute size from 16 to 32 bits to display extended interface information.

```
radius-server attribute nas-port extended
```

Note This command replaces the deprecated **radius-server extended-portnames** command.

On platforms with multiple interfaces (ports) per slot, the Cisco RADIUS implementation will not provide a unique NAS-Port attribute that permits distinguishing between the interfaces. For example, if a dual PRI interface is in slot 1, calls on both Serial1/0:1 and Serial1/1:1 will appear as NAS-Port = 20101. This is due to the 16-bit field size limitation associated with RADIUS IETF NAS-port attribute. In this case, replace the NAS-port attribute with a vendor-specific attribute (RADIUS IETF Attribute 26). The Cisco vendor-ID is 9, and the Cisco-NAS-Port attribute is subtype 2. Vendor-specific attributes (VSAs) can be turned on by entering the **radius-server vsa send** command. The port information in this attribute is provided and configured using the **aaa nas port extended** command.

To replace the NAS-Port attribute with RADIUS IETF Attribute 26 and to display extended field information, use the following commands in global configuration mode.

Enable the network Cisco AS5800 to recognize and use vendor-specific attributes as defined by RADIUS IETF Attribute 26.

```
radius-server vsa send [accounting | authentication]
```

Expand the size of the VSA NAS-Port field from 16 to 32 bits to display extended interface information.

```
aaa nas-port extended
```

The standard NAS-Port attribute (RADIUS IETF Attribute 5) will continue to be sent. If you do not want this information to be sent, you can suppress it by using the **no radius-server attribute nas-port** command. When this command is configured, the standard NAS-Port attribute will no longer be sent.

Specify RADIUS Authentication

After you have identified the RADIUS server and defined the RADIUS authentication key, you need to define method lists for RADIUS authentication. Because RADIUS authentication is facilitated through AAA, you need to enter the **aaa authentication** command, and specify RADIUS as the authentication method. For more information, refer to information on configuring authentication in the security configuration guide for your Cisco IOS release.

Specify RADIUS Authorization

AAA authorization lets you set parameters that restrict users network access. Authorization using RADIUS provides one method for remote access control, including one-time authorization or authorization for each service, per-user account list and profile, user group support, and support of IP, IPX, ARA, and Telnet. Because RADIUS authorization is facilitated through AAA, you need to issue the **aaa authorization** command, specifying RADIUS as the authorization method.

Specify RADIUS Accounting

The AAA accounting feature enables you to track the services users access and the amount of network resources they consume. Because RADIUS accounting is facilitated through AAA, you need to issue the **aaa accounting** command, specifying RADIUS as the accounting method.

RADIUS Attributes

The network Cisco AS5800 monitors the RADIUS authorization and accounting functions defined by RADIUS attributes in each user-profile.

Vendor-Proprietary RADIUS Attributes

An Internet Engineering Task Force (IETF) draft standard for RADIUS specifies a method for communicating vendor-proprietary information between the network Cisco AS5800 and the RADIUS server. Some vendors, nevertheless, have extended the RADIUS attribute set in a unique way. Cisco IOS software supports a subset of vendor-proprietary RADIUS attributes.

RADIUS Configuration Examples

RADIUS configuration examples in this section include the following:

RADIUS Authentication and Authorization Example

The following example shows a router configuration to authenticate and authorize using RADIUS.

```
aaa authentication login use-radius radius local
aaa authentication ppp user-radius if-needed radius
aaa authorization exec radius
aaa authorization network radius
```

These RADIUS authentication and authorization configuration commands are defined as follows:

- The **aaa authentication login use-radius radius local** command configures the router to use RADIUS for authentication at the login prompt. If RADIUS returns an error, the user is authenticated using the local database. In this example, use-radius is the name of the method list, which specifies RADIUS and then local authentication.
- The **aaa authentication ppp user-radius if-needed radius** command configures the Cisco IOS software to use RADIUS authentication for lines using Point-to-Point Protocol (PPP) with CHAP or PAP if the user has not already been authorized. If the EXEC facility has authenticated the user, RADIUS authentication is not performed. In this example, user-radius is the name of the method list defining RADIUS as the if-needed authentication method.
- The **aaa authorization exec radius** command sets the RADIUS information that is used for EXEC authorization, autocommands, and access lists.
- The **aaa authorization network radius** command sets RADIUS for network authorization, address assignment, and access lists.

RADIUS Authentication, Authorization, and Accounting Example

The following sample is a general configuration using RADIUS with the AAA command set.

```
radius-server host 123.45.1.2
radius-server key myRaDiUSpassWoRd
username root password ALongPassword
aaa authentication ppp dialins radius local
aaa authorization network radius local
aaa accounting network start-stop radius
aaa authentication login admins local
aaa authorization exec local
line 1 16
 autoselect ppp
 autoselect during-login
 login authentication admins
 modem ri-is-cd
interface group-async 1
 encaps ppp
 ppp authentication pap dialins
```

The lines in this sample RADIUS authentication, authorization, and accounting configuration are defined as follows:

- **radius-server host** defines the IP address of the RADIUS server host.
- **radius-server key** defines the shared secret text string between the network Cisco AS5800 and the RADIUS server host.
- **aaa authentication ppp dialins radius local** defines the authentication method list “dialins,” which specifies that RADIUS authentication, then (if the RADIUS server does not respond) local authentication will be used on serial lines using PPP.
- **ppp authentication pap dialins** applies the “dialins” method list to the lines specified.

- **aaa authorization network radius local** is used to assign an address and other network parameters to the RADIUS user.
- **aaa accounting network start-stop radius** tracks PPP usage.
- **aaa authentication login admins local** defines another method list, "admins," for login authentication.
- **login authentication admins** applies the "admins" method list for login authentication.

Vendor-Proprietary RADIUS Configuration Example

The following example is a general configuration using vendor-proprietary RADIUS with the AAA command set.

```
radius-server host alcatraz non-standard
radius-server key myRaDiUSpassWoRd
radius-server configure-nas
username root password ALongPassword
aaa authentication ppp dialins radius local
aaa authorization network radius local
aaa accounting network start-stop radius
aaa authentication login admins local
aaa authorization exec local
line 1 16
autoselect ppp
autoselect during-login
login authentication admins
modem ri-is-cd
interface group-async 1
encaps ppp
ppp authentication pap dialins
```

The lines in this example RADIUS AAA configurations are defined as follows:

- **radius-server host non-standard** defines the name of the RADIUS server host, and identifies that this RADIUS host uses a vendor-proprietary version of RADIUS.
- **radius-server key** defines the shared secret text string between the network Cisco AS5800 and the RADIUS server host.
- **radius-server configure-nas** defines that the Cisco AS5800 will query the RADIUS server for static routes and IP pool definitions when the device first starts up.
- **aaa authentication ppp dialins radius local** defines the authentication method list "dialins," which specifies that RADIUS authentication, then (if the RADIUS server does not respond) local authentication will be used on serial lines using PPP.
- **ppp authentication pap dialins** applies the "dialins" method list to the lines specified.
- **aaa authorization network radius local** is used to assign an address and other network parameters to the RADIUS user.
- **aaa accounting network start-stop radius** tracks PPP usage.
- **aaa authentication login admins local** defines another method list, "admins," for login authentication.
- **login authentication admins** applies the "admins" method list for login authentication.

RADIUS Cisco IOS Software Support

The following Cisco IOS software support is available for RADIUS.

1. AAA commands
2. RADIUS commands
3. RADIUS & AAA debug commands

AAA Commands

```
aaa new-model
aaa authentication login CONSOLE none
aaa authentication login RADIUS_LIST radius
aaa authentication login TAC_PLUS tacacs+ enable
aaa authentication login V.120 none
aaa authentication enable default enable tacacs+
aaa authentication ppp RADIUS_LIST if-needed radius
aaa authorization exec RADIUS_LIST radius if-authenticated
aaa authorization exec V.120 none
aaa authorization network default radius if-authenticated
aaa authorization network V.120 radius if-authenticated
aaa authorization network RADIUS_LIST if-authenticated radius
aaa accounting suppress null-username
aaa accounting delay-start
aaa accounting exec default start-stop radius
aaa accounting commands 0 default start-stop radius
aaa accounting network default start-stop radius
aaa accounting connection default start-stop radius
aaa accounting system default start-stop radius
aaa nas port extended
```

RADIUS Commands

```
ip radius source-interface subinterface-name
radius-server configure-nas
radius-server dead-time minutes
radius-server extended-portnames (*deprecated)
radius-server attribute nas-port extended  (old)
radius-server attribute nas-port format {a | b | c}  (new)
radius-server host {hostname | ip} [auth-port port#] [acct-port port#]
radius-server host {hostname | ip} non-standard
radius-server host {hostname | ip} ignore
radius-server host {hostname | ip}
radius-server key {string}
radius-server retransmit retries
radius-server timeout seconds
```

RADIUS & AAA Debug Commands

```
debug radius
debug aaa authorization
debug aaa authentication
debug aaa peruser
debug ppp negotiation
debug ppp authentication
debug isdn q931
```

Configuring TACACS+

The following global configuration commands provide basic security and local database configuration.

Step 1 Enable the AAA access control modem that includes TACACS+.

```
5800-1(config)# aaa new-model
```

Step 2 Enable AAA authentication method during login.

```
5800-1(config)# aaa authentication login default local
```

Step 3 Enable AAA authentication method during login using a methods list.

```
5800-1(config)# aaa authentication login console none
```

Step 4 Enable AAA authentication method for use on serial interfaces running PPP when TACACS+ is used.

```
5800-1(config)# aaa authentication ppp default if-needed local
```

Step 5 Enter authorization for username and password.

```
5800-1(config)# username username password password
```

TACACS+ Authentication

Use the AAA facility to authenticate users with either a local or remote security database. For more information about a local and remote security database, refer to the “Local and Remote Server Authentication” section on page 4-13.

Whether you maintain a local or remote security database, or use TACACS+ or RADIUS authentication and authorization, the process of configuring the Cisco AS5800 for these different databases and protocols is similar. The basic process of configuring the Cisco IOS software for authentication requires the following tasks:

1. Securing Access to Privileged EXEC and Configuration Mode
2. Communicating Between the Access and Security Servers
3. Enabling AAA Globally
4. Defining Authentication Method Lists
   - Issue the aaa authentication Command, page 4-30
   - Specify Protocol or Login Authentication, page 4-30
   - Identify a List Name, page 4-30
   - Specify the Authentication Method, page 4-31
   - Populate the Local Username Database if Necessary, page 4-32
5. Applying Authentication Method Lists, page 4-33

Securing Access to Privileged EXEC and Configuration Mode

The first step is to secure access to privileged EXEC (enable) mode. Enable mode provides access to configuration mode, which enables any type of configuration change to the Cisco AS5800. To secure privileged EXEC mode access, use one of the following commands.

- The **enable password** *password* command requires that network administrators enter a password to access privileged EXEC mode. Do not provide access to users who are not administrators.
- The **enable secret** *password* command specifies a secret password that is encrypted, so that the password cannot be read when crossing a network. After you issue this command, the encryption cannot be reversed.

The enable secret password takes precedence over the enable password when it exists. The same password cannot be used for both commands. You can view the encrypted version of the enable secret password using the **show running-config** or **show startup-config** commands. (The encrypted version of the password is noted with ***** in the following example.)

```
5800-1(config)# show running-config
Using 1899 out of 126968 bytes
!
Version x AA
.
.
.
!
hostname 5800-1
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1lo0/w8/*
.
.
.
```

Note For more information about the enable password and enable secret commands and their complete syntax, refer to the security command reference for your Cisco IOS release in the Cisco IOS configuration guides and command references documentation.

Caution If you use the **enable secret** command and specify an encryption type, you *must* enter the *encrypted version* of a specific password. Do not enter the cleartext version of the password after specifying an encryption type, otherwise you will be locked out of privileged EXEC (enable) mode. To regain access to privileged EXEC mode, erase the contents of NVRAM and your entire configuration, and reconfigure the Cisco AS5800.

Note The enable secret password overrides the enable password.

The following global configuration commands provide an encrypted password using **enable secret**.

Step 1 Enter the cleartext password used to gain access to privileged EXEC mode. Do not specify an encryption type.

```
5800-1(config)# enable secret password
5800-1(config)#
```

Step 2 Type the **exit** command to exit out of global configuration mode.

```
5800-1(config)# exit
5800-1#
```

Step 3 Enter the **show running-config** command to view the encrypted version of the cleartext password that was entered in Step 1. The encrypted password is noted with ******.

```
5800-1# show running-config
Building configuration...

Current configuration:
!
version x AA
! some of the configuration skipped
enable secret 5 $1$h7dd$VTNs4.BAfQMUU0Lrvw6570**
! the rest of the configuration skipped
```

Note Encryption type **5** is the only valid encryption type for enable secret.

Step 4 Type **Ctrl-Z** to return to privileged EXEC mode.

```
5800-1(config)# Ctrl-Z
5800-1#
```

Step 5 Save changes.

```
5800-1# copy running-config startup-config
```

You can also specify additional protection for privileged EXEC mode, including the following:

- Privilege levels for Cisco IOS software commands
- Privileged EXEC passwords for different privilege levels
- Privilege levels for specific lines on the Cisco AS5800
- Encrypt passwords using **service password-encryption**

For more information about these security tools, refer to the security configuration guide for your Cisco IOS release in the Cisco IOS configuration guides and command references documentation.

Communicating Between the Access and Security Servers

This section describes the Cisco IOS software commands that enable the Cisco AS5800 to communicate with a security server. This procedure is similar for communicating with TACACS+ and RADIUS servers, and the following sections describe the process.

If you are using a remote security server for authentication and authorization, you must configure the security server before performing the tasks described in this section. TACACS+ Security Examples, page 4-38 shows typical TACACS+ and RADIUS server entries corresponding to the Cisco AS5800 security configurations.

Communicating with a TACACS+ Server

The following global configuration commands enable communication between the TACACS+ security (database) server and the Cisco AS5800.

Step 1 Specify the IP address or the host name of the remote TACACS+ server host. This host is typically a UNIX or NT system running TACACS+ software.

```
5800-1(config)# tacacs-server host {hostname | ip-address}
```

Step 2 Specify a shared secret text string used between the Cisco AS5800 and the TACACS+ server. The Cisco AS5800 and TACACS+ server use this text string to encrypt passwords and exchange responses.

```
5800-1(config)# tacacs-server key shared-secret-text-string
```

Step 3 Type **Ctrl-Z** to return to privileged EXEC mode.

```
5800-1(config)# Ctrl-Z
5800-1#
```

Step 4 Save your changes when ready.

```
5800-1# copy running-config startup-config
```

For example, to enable the remote TACACS+ server to communicate with the Cisco AS5800, enter the commands as follows:

```
5800-1# configure terminal
5800-1(config)# tacacs-server host alcatraz
5800-1(config)# tacacs-server key abra2cad
```

The host name of the TACACS+ server in the previous example is alcatraz. The key in the previous example (abra2cad) is the encryption key shared between the TACACS+ server and the Cisco AS5800. Substitute your own TACACS+ server host name and password for those shown.

For more information about these commands, refer to the security command reference for your Cisco IOS release, which is part of the Cisco IOS configuration guides and command references documentation.

Configuring Authentication on a TACACS+ Server

On most TACACS+ security servers, there are three ways to authenticate a user for login:

- Include a cleartext (DES) password for a user or for a users group (each user can belong to only one group). Note that CHAP and global user authentication must be specified in cleartext.

  The following is the configuration for global authentication:

  ```
  user = birdman {global = cleartext "birdman global password"}
  ```

  To assign different passwords for CHAP, and a normal login, you must enter a string for each user. Each string must specify the security protocols, state whether the password is cleartext, and specify if the authentication is performed with a DES card. The following example shows a user aaaa, who has authentication configured for CHAP and login. The users CHAP password, "chap password," is shown in cleartext and the login password has been encrypted.

  ```
  user = aaaa
     chap  = cleartext "chap password"
     login = des XQj4892fjk}
  ```

- Use password (5) files instead of entering the password into the configuration file directly.

  The default authentication is to deny authentication. You can change this at the top level of the configuration file to have the default use passwd(5) file, by issuing the following command:

  ```
  default authentication = /etc/passwd
  ```

- Authenticate using an s/key. If you have built and linked in an s/key library and compiled TACACS+ to use the s/key, you can specify that a user be authenticated using the s/key, as shown in the following example:

  ```
  user= bbbb {login = skey}
  ```

  On the Cisco AS5800, configure authentication on all lines including the VTY and Console lines by entering the following commands:

  ```
  5800-1# configure terminal
  5800-1(config)# aaa new-model
  5800-1(config)# aaa authentication login default tacacs+ enable
  ```

Caution When you issue the **aaa authentication login default tacacs+ enable** command, you are specifying that if your TACACS+ server fails to respond (because it is set up incorrectly), you can log in to the Cisco AS5800 by using your enable password. If you do not have an enable password set on the Cisco AS5800, you will not be able to log in until you have a functioning TACACS+ daemon configured with user names and passwords. The enable password in this case is a last-resort authentication method. You can also specify **none** as the last-resort method, which means that no authentication is required if all other methods have failed.

Enabling AAA Globally

To use the AAA security facility in the Cisco IOS software, you must issue the **aaa new-model** command from global configuration mode.

When you issue the **aaa new-model** command, all lines on the Cisco AS5800 receive the implicit **login authentication default** method list, and all interfaces with PPP enabled have an implicit **ppp authentication pap default** method list applied.

Caution If you authenticate users by a security server, do not inadvertently lock yourself out of the Cisco AS5800 ports after you issue the **aaa new-model** command. Enter line configuration mode and issue the **aaa authentication login default tacacs+ enable** global configuration command. This command specifies that if your TACACS+ (or RADIUS) server is not functioning properly, you can enter your enable password to log in to the Cisco AS5800. In general, verify that you have a last-resort access method before you are certain that your security server is set up and functioning properly. For more information about the **aaa authentication** command, refer to the "Defining Authentication Method Lists" section on page 4-29.

Note Cisco recommends that you use CHAP authentication with PPP, rather than PAP. CHAP passwords are encrypted when they cross the network, whereas PAP passwords are cleartext when they cross the network. The Cisco IOS software selects PAP as the default, so you must manually select CHAP. The process for specifying CHAP is described in Applying Authentication Method Lists, page 4-33.

```
5800-1# configure terminal
5800-1(config)# aaa new-model
```

Defining Authentication Method Lists

After you enable AAA globally on the Cisco AS5800, you need to define authentication method lists, which you then apply to lines and interfaces. These authentication method lists are security profiles that indicate the protocol (PPP) or login and authentication method (TACACS+, RADIUS, or local authentication).

To define an authentication method list:

1. Issue the **aaa authentication** command.
2. Specify protocol (PPP) or login authentication.
3. Identify a list name or **default**. A list name is any alphanumeric string you choose. You assign different authentication methods to different named lists.
4. Specify the authentication method. You can specify multiple methods, such as **tacacs+**, followed by **local** if a TACACS+ server is not available on the network.
5. Populate the local username database if you specified **local** as the authentication method (or one of the authentication methods). To use a local username database, you must issue the **username** global configuration command. Refer to the "Populate the Local Username Database if Necessary" section on page 4-32.

After defining these authentication method lists, apply them to your interfaces (synchronous or asynchronous) configured for PPP.

Refer to the "Applying Authentication Method Lists" section on page 4-33 for information about applying these lists.

Issue the aaa authentication Command

To define an authentication method list, enter the **aaa authentication** global configuration command, as shown in the following example:

```
5800-1# configure terminal
5800-1(config)# aaa authentication
```

Specify Protocol or Login Authentication

After you enter **aaa authentication**, you must specify one of the following dial-in protocols as applicable for your network:

- If you are enabling dial-in PPP access, specify **ppp.**
- If you are enabling users to connect to the EXEC facility, specify **login.**

You can specify only one dial-in protocol per authentication method list; however, you can create multiple authentication method lists with each of these options. You must give each list a different name, as described in Identify a List Name, page 4-30.

If you specify the **ppp** option, the default authentication method for PPP is PAP. For greater security, specify CHAP. The full command is **aaa authentication ppp chap**.

For example, if you specify PPP authentication, the configuration looks like this:

```
5800-1# configure terminal
5800-1(config)# aaa authentication ppp
```

Identify a List Name

A list name identifies each authentication list. You can choose either to use the keyword **default**, or choose any other name that describes the authentication list. For example, you name it ppp-radius if you intend to apply it to interfaces configured for PPP and RADIUS authentication. The list name can be any alphanumeric string. Use **default** as the list name for most lines and interfaces, and use different names on an exception basis.

You can create different authentication method lists and apply them to lines and interfaces selectively. You can even create a named authentication method list that you do not apply to a line or interface, but which you intend to apply at some later point, such as when you deploy a new log-in method for users.

After you define a list name, you must identify additional security attributes (such as local authentication versus TACACS+ or RADIUS).

In the following example, the default authentication method list for PPP dial-in clients uses the local security database:

```
5800-1# configure terminal
5800-1(config)# aaa authentication ppp default
```

In the following example, the PPP authentication method list name is insecure:

```
5800-1# configure terminal
5800-1(config)# aaa authentication ppp insecure
```

In the following example, the login authentication method list name is **deveng**:

```
5800-1# configure terminal
5800-1(config)# aaa authentication login deveng
```

Specify the Authentication Method

After you identify a list name, you must specify an authentication method to identify how users will be authenticated. Authentication methods are defined with optional keywords in the **aaa authentication** command.

The following global configuration commands configure authentication methods for PPP.

Step 1 Configure for AAA.

```
5800-1(config)# aaa new-model
```

Step 2 Create a local authentication list. Methods include **if-needed, krb5, local, none, radius, tacacs+.**

```
5800-1(config)# aaa authentication ppp {default | list-name} method1 [method2]
```

Step 3 Apply the authentication list to a line or set of lines.

```
5800-1(config)# ppp authentication {chap | pap | chap pap | pap chap} [if-needed]
{default | list-name} [callin]
```

Step 4 Type **Ctrl-Z** to return to privileged EXEC mode.

```
5800-1(config)# Ctrl-Z
5800-1#
```

Step 5 Save your changes when ready.

```
5800-1# copy running-config startup-config
```

The keyword *list-name* is any character string used to name the list you are creating. The *keyword* method refers to the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify **none** as the final method in the command line.

Timesaver If you are not sure whether you should use TACACS+ or RADIUS, consider the following: TACACS+ encrypts the entire payload of packets passed across the network, whereas RADIUS only encrypts the password when it crosses the network. TACACS+ can query the security server multiple times, whereas a RADIUS server gives one response only and is not as flexible regarding per-user authentication and authorization attempts.

You can specify multiple authentication methods for each authentication list. The following authentication method example for PPP first queries a TACACS+ server, then a RADIUS server, then the local security database. Multiple authentication methods can be useful if you have multiple types of security servers on the network, and one or more types of security server do not respond.

```
5800-1(config)# aaa authentication ppp testbed tacacs+ radius local
```

If you specify more than one authentication method and the first method (TACACS+ in the previous example) is not available, the Cisco IOS software attempts to authenticate using the next method (such as RADIUS). If, in the previous example, the RADIUS server has no information about the user, or if no RADIUS server can be found, the user is authenticated using the local username database that was populated with the **username** command.

If authentication *fails* using the first method listed, the Cisco IOS software does *not* permit access. It does not attempt to authenticate using the subsequent security methods if the user entered the incorrect password.

Populate the Local Username Database if Necessary

If you specify **local** as the security method, you must specify username profiles for each user who might log in. An example of specifying local authentication is as follows:

```
5800-1(config)# aaa authentication login deveng local
```

This command specifies that anytime a user attempts to log in to a line on an Cisco AS5800, the Cisco IOS software checks the username database. To create a local username database, define username profiles using the **username** global configuration command.

The following example shows how to use the **username** command and password:

```
5800-1(config)# username username password password
```

The **show running-config** command shows the encrypted version of the password, as follows:

```
5800-1# show running-config
Building configuration...

Current configuration:
!
version x AA
! most of config omitted
username xxx password 7 0215055500070C294D
```

Note The Cisco IOS software adds the encryption type of 7 automatically for passwords. If you were to manually enter the number 7 to represent an encryption type, you must follow the 7 with the *encrypted* version of the password. If you specify the number 7, enter a cleartext password, the user will not have access to the line, interface, or the network the user is trying to access, and you must reconfigure the users authentication profile.

Authentication Method List Examples

This section includes authentication method list examples for:

- Users Logging In to the Cisco AS5800
- Users Dialing In Using PPP

Users Logging In to the Cisco AS5800

The following example creates a local authentication list for users logging in to any line on the Cisco AS5800:

```
5800-1(config)# aaa authentication login default local
```

The following example specifies login authentication using RADIUS (the RADIUS daemon is polled for authentication profiles):

```
5800-1(config)# aaa authentication login default radius
```

The following example specifies login authentication using TACACS+ (the TACACS+ daemon is polled for authentication profiles):

```
5800-1(config)# aaa authentication login default tacacs+
```

Users Dialing In Using PPP

The following example creates a TACACS+ authentication list for users connecting to interfaces configured for dial-in using PPP. The name of the list is marketing. This example specifies that a remote TACACS+ daemon be used as the security database. If this security database is not available, the Cisco IOS software then polls the RADIUS daemon. Users are not authenticated if they are already authenticated on a TTY line.

```
5800-1(config)# aaa authentication ppp marketing if-needed tacacs+ radius
```

In this example, **default** can be substituted for **marketing** if the administrator wants this list to be the default list.

Applying Authentication Method Lists

As described in Defining Authentication Method Lists, page 4-29, the **aaa authentication** global configuration command creates authentication method lists or profiles. You apply these authentication method lists to lines or interfaces by issuing the **login authentication** or **ppp authentication** command, as described in Table 4-5.

Table 4-5 Line and Interface Authentication Method Lists

Interface and Line Command	Action	Port to Which List Is Applied	Corresponding Global Configuration Command
login authentication	Logs directly in to the Cisco AS5800	Console port or VTY lines	**aaa authentication login**
ppp authentication[1]	Uses PPP to access IP or IPX network resources	Interface	**aaa authentication ppp**

1. If you issued the **ppp authentication** command, you must specify either CHAP or PAP authentication. PAP is enabled by default, but Cisco recommends that you use CHAP because CHAP is more secure. For more information, refer to the security configuration guide for your Cisco IOS release, which is part of the Cisco IOS configuration guides and command references documentation.

You can create more than one authentication list or profile for login and protocol authentication and apply them to different lines or interfaces. The following examples show the line or interface authentication commands that correspond to the **aaa authentication** global configuration command.

Login Authentication Example

The following example shows the default log-in authentication list applied to the console port and the default virtual terminal (VTY) lines on the Cisco AS5800:

```
5800-1(config)# aaa authentication login default local
5800-1(config)# line console 0
5800-1(config-line)# login authentication default
5800-1(config-line)# line vty 0 69
5800-1(config-line)# login authentication default
```

In the following example, the login authentication list named rtp2-office, which uses RADIUS authentication, is created. It is applied to all 54 lines on an configured with a channelized T1 PRI card, including the console (CTY) port, the 48 physical asynchronous (TTY) lines, the auxiliary (AUX) port, and 69 virtual terminal (VTY) lines:

```
5800-1(config)# aaa authentication login rtp2-office radius
5800-1(config)# line 0 118
5800-1(config-line)# login authentication rtp2-office
```

The following sample output shows lines and their status on the Cisco AS5800.

```
5800-1# show line
Tty Typ     Tx/Rx     A Modem  Roty AccO AccI  Uses    Noise   Overruns
*  0 CTY               -    -      -    -    -     0        0        0/0
I  1 TTY  115200/115200  - inout   -    -    -     0        0        0/0
I  2 TTY  115200/115200  - inout   -    -    -     0        0        0/0
...
I 48 TTY  115200/115200  - inout   -    -    -     0        0        0/0
  49 AUX   9600/9600   -    -      -    -    -     0        0        0/0
  50 VTY               -    -      -    -    -     0        0        0/0
  51 VTY               -    -      -    -    -     0        0        0/0
  52 VTY               -    -      -    -    -     0        0        0/0
  53 VTY               -    -      -    -    -     0        0        0/0
  54 VTY               -    -      -    -    -     0        0        0/0
```

PPP Authentication Example

The following example creates the PPP authentication list marketing, which uses TACACS+, and RADIUS authentication. The list marketing requires authentication only if the user has not been authenticated on another line. It is then applied to asynchronous lines 1-48 on a Cisco AS5800 and uses CHAP authentication, instead of the default of PAP.

```
5800-1(config)# aaa authentication ppp marketing if-needed tacacs+ radius
5800-1(config)# line shelf/slot/1 shelf/slot/48
5800-1(config-line)# ppp authentication chap marketing
```

TACACS+ Authorization

You can configure the Cisco AS5800 to restrict user access to the network so that users can only perform certain functions after successful authentication. As with authentication, authorization can be used with either a local or remote security database. This guide describes only remote security server authorization.

A typical configuration often uses the EXEC facility and network authorization. EXEC authorization restricts access to the EXEC, and network authorization restricts access to network services, including PPP.

Authorization must be configured on both the Cisco AS5800 and the security daemon. The default authorization is different on the Cisco AS5800 and the security server:

- By default, the Cisco AS5800 *permits* access for every user until you configure the system to make authorization requests to the daemon.
- By default, the daemon *denies* authorization of anything that is not explicitly permitted. Therefore, you have to explicitly allow all per-user attributes on the security server.

Timesaver If authentication has not been set up for a user, per-user authorization attributes are not enabled for that user. That is, if you want a user to obtain authorization before gaining access to network resources, you must first require that the user provide authentication. For example, if you want to specify the **aaa authorization network tacacs+** (or **radius**) command, you must first specify the **aaa authentication** {**ppp**} **default if-needed tacacs+** (or **radius**) command.

Configuring Authorization on the Security Server

You typically have the three following methods for configuring default authorization on the security server:

- To override the default denial or authorization from a nonexistent user, specify authorization at the top level of the configuration file:

  ```
  default authorization = permit
  ```

- At the user level, inside the braces of the user declaration, the default for a user who does not have a service or command explicitly authorized is to deny that service or command. To permit it:

  ```
  default service = permit
  ```

- At the service authorization level, arguments are processed according to the following algorithm: For each AV pair sent from the Cisco AS5800, the following process occurs:

  a. If the AV pair from the Cisco AS5800 is mandatory, look for an exact match in the daemons mandatory list. If found, add the AV pair to the output.

  b. If an exact match does not exist, look in the daemons optional list for the first attribute match. If found, add the Cisco AS5800 AV pair to the output.

  c. If no attribute match exists, deny the command if the default is to deny. If the default is permit, add the Cisco AS5800 AV pair to the output.

  d. If the AV pair from the Cisco AS5800 is optional, look for an exact attribute, value match in the mandatory list. If found, add the daemons AV pair to output.

  e. If not found, look for the first attribute match in the mandatory list. If found, add daemons AV pair to output.

  f. If no mandatory match exists, look for an exact attribute, value pair match among the daemons optional AV pairs. If found, add the daemons matching AV pair to the output.

  g. If no exact match exists, locate the first attribute match among the daemons optional AV pairs. If found, add the daemons matching AV pair to the output.

  h. If no match is found, delete the AV pair if default is deny. If the default is permit, add the Cisco AS5800 AV pair to the output.

  i. If there is no attribute match already in the output list after all AV pairs have been processed for each mandatory daemon AV pair, add the AV pair. Add only one AV pair for each mandatory attribute.

Configuring Authorization (Network or EXEC)

The following global configuration commands configure network and EXEC authorization.

Step 1 Prevents unauthorized users from accessing network resources.

```
5800-1(config)# aaa authorization network
```

Step 2 Prevents users from logging in to the privileged EXEC facility.

```
5800-1(config)# aaa authorization exec
```

Step 3 Type **Ctrl-Z** to return to privileged EXEC mode.

```
5800-1(config)# Ctrl-Z
5800-1#
```

Step 4 Save your changes when ready.

```
5800-1# copy running-config startup-config
```

Note You can also require authorization before a user can issue specific commands by using the **aaa authorization** command. For more information, refer to the security configuration guide for your Cisco IOS release, which is part of the Cisco IOS configuration guides and command references.

Specifying an Authorization Method

Authorization methods are defined as optional keywords in the **aaa authorization** command. The following global configuration command configure both network and EXEC AAA authorization. Table 4-5 defines authorization methods.

Step 1 Prevents unauthorized users from accessing network resources.

```
5800-1(config)# aaa authorization {if-authenticated | local | none | radius | tacacs+}
```

Step 2 Type **Ctrl-Z** to return to privileged EXEC mode.

```
5800-1(config)# Ctrl-Z
5800-1#
```

Step 3 Save your changes when ready.

```
5800-1# copy running-config startup-config
```

Table 4-6 Authorization Methods

Authorization Methods	Purpose
if-authenticated	User is authorized if already authenticated.
local	Uses the local database for authorization. The local database is created using the **username privilege** command to assign users to a privilege level from 0 to 15, and the **privilege level** command to assign commands to these different levels.
none	Authorization always succeeds.
radius	Uses RADIUS authorization as defined on a RADIUS server.
tacacs+	Uses TACACS+ authorization as defined on a TACACS+ server.

Specifying Authorization Parameters on a TACACS+ Server

When you configure authorization, you must ensure that the parameters established on the Cisco AS5800 correspond with those set on the TACACS+ server.

Authorization Examples

The following example uses a TACACS+ server to authorize the use of network services, including PPP. If the TACACS+ server is not available or has no information about a user, no authorization is performed, and the user can use all network services.

```
5800-1(config)# aaa authorization network tacacs+ none
```

The following example permits the user to run the EXEC process if the user is authenticated. If the user is not authenticated, the Cisco IOS software defers to a RADIUS server for authorization information.

```
5800-1(config)# aaa authorization exec if-authenticated radius
```

The following example configures network authorization. If the TACACS+ server does not respond or has no information about the username being authorized, the RADIUS server is polled for authorization information for the user. If the RADIUS server does not respond, the user still can access all network resources without authorization requirements.

```
5800-1(config)# aaa authorization network tacacs+ radius none
```

TACACS+ Security Examples

The following examples show complete security configuration components of a configuration file on a Cisco AS5800. Each example shows authentication and authorization.

Local TACACS+ Security Example

The following sample configuration uses AAA to configure default authentication using a local security database on the Cisco AS5800. All lines and interfaces have the default authentication lists applied. Users aaaa, bbbb, and cccc have been assigned privilege level 7. This prevents them from issuing **ppp** and **slip** commands because these commands have been assigned to privilege level 8.

```
aaa new-model
aaa authentication login default local
aaa authentication arap default local
aaa authentication ppp default local
aaa authorization exec local
aaa authorization network local
aaa authorization
!
username aaaa privilege exec level 7 privilege network level 8 password 7 095E470B1110
username bbbb privilege network level 7 password 7 0215055500070C294D
username cccc privilege network level 7 password 7 095E4F10140A1916
!
privilege exec level 8 ppp
privilege exec level 8 slip

line console 0
login authentication default
!
line 2/2/0 2/2/47
interface Group-Async1
ppp authentication chap default
group-range 2/2/0 2/2/47
```

The following configuration displays the sign-on dialog from a remote PC:

```
atdt5551234
CONNECT 14400/ARQ/V32/LAPM/V42BIS
User Access Verification
Username: username
Password: password
5800-1> enable
Password: password
5800-1#
```

TACACS+ Security Example for Login and PPP

The following example shows how to create and apply the following authentication lists:

- A TACACS+ server named AAA is polled for authentication information (so you do not need to define a local username database). The shared key between the Cisco AS5800 and the TACACS+ security server is 007.
- A login authentication list named rtp-office is created, then applied to the console port.
- A PPP authentication list named marketing is created, and applied to group async interface 0, which includes asynchronous interfaces 2/2/0 to 2/2/47.

Note The authentication method lists used in this example use names other than **default**. However, you generally specify **default** as the list name for most lines and interfaces, and apply different named lists on an exception basis. These names are used only for illustrative purposes.

```
hostname 5800-1
!
tacacs-server host aaa
tacacs-server key 007
!
aaa authentication login rtp-office tacacs+
aaa authentication ppp marketing if-needed tacacs+
!
line console0
login authentication rtp-office
!
tacacs-server host aaa
tacacs-server key 007
!
aaa authentication login rtp-office tacacs+
aaa authentication ppp marketing if-needed tacacs+
!
line console0
login authentication rtp-office
!
interface group-async0
ppp authentication chap marketing
group-range 2/2/0 2/2/47
!
line 2/2/0 2/2/47
```

The following example shows how to create the following authentication lists:

- A RADIUS server named AAA is polled for authentication information (so you do not need to define a local username database). The shared key between the Cisco AS5800 and the RADIUS security server is 007.
- A login authentication list named fly is created, then applied to all lines that users can log in to, except the console port. In this example, the console port is physically secure and does not need password protection. The Cisco AS5800 is locked in a closet and secured behind a deadbolt lock.

- A PPP authentication list itsme is created, then applied to group async interface 6, that includes asynchronous interfaces 2/2/0 to 2/2/47. The more secure CHAP authentication is used over PAP.

```
radius-server host aaa
radius-server key 007
!
privilege exec level 14 configure
privilege exec level 14 reload
privilege exec level 8 ppp
!
aaa authentication login fly radius
aaa authentication ppp itsme if-needed radius
aaa authorization network radius
aaa authorization exec radius
!
line 2/1/0 2/1/53
login authentication fly
!
interface group-async6
ppp authentication chap itsme
group-range 2/2/0 2/2/47
```

CHAPTER 5

Maintenance

This chapter provides hardware replacement, system debugging, and troubleshooting procedures.

Replacement Procedures

This section provides detailed replacement procedures for the Cisco AS5800 field-replaceable units (FRUs) and covers the following areas:

Note Instructions for replacing the router-shelf components are included in the *Cisco 7206 Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/t

Instructions for rack-mounting the AC-input power shelf and for replacing an AC-input power supply are included in the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/.

Powering Off the Access Server

Some procedures in this section require you to power off the access server. See this section when appropriate.

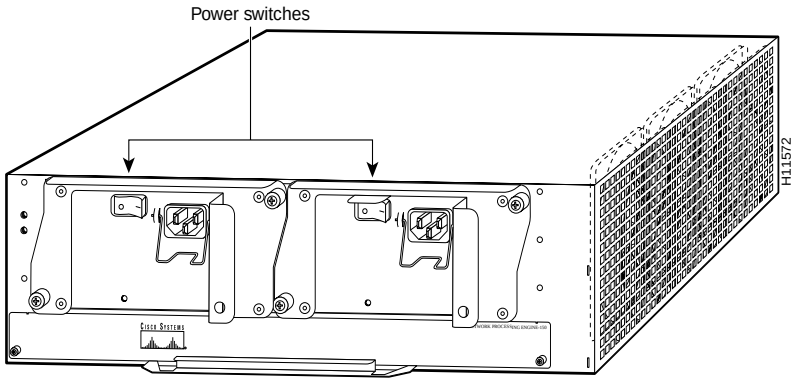
Powering off the access server involves removing power from the following components:

- Router shelf
- Dial shelf
- AC-input power shelf, if applicable

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.**

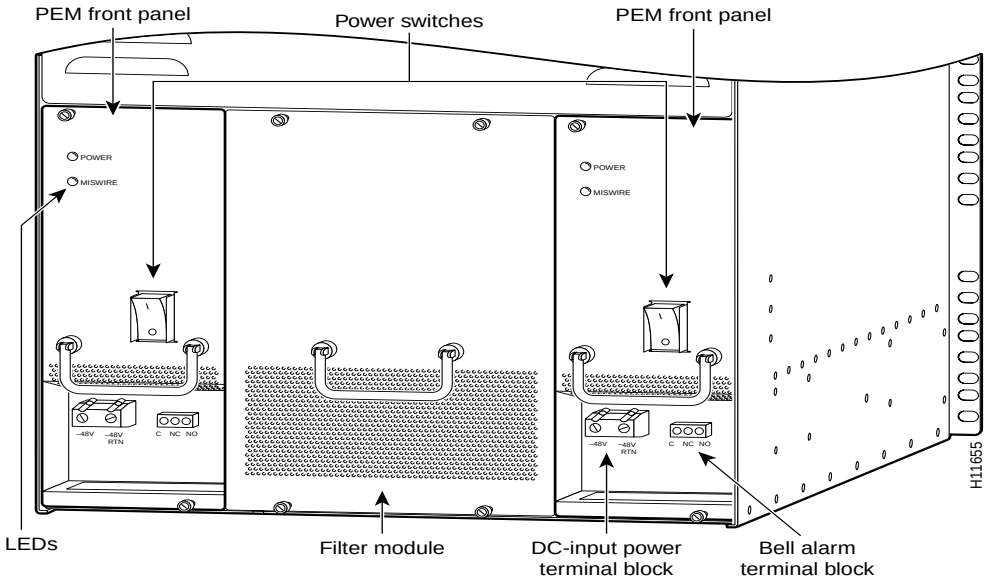
Step 1 Power OFF (O) the power switches located on the router-shelf rear panel.

Figure 5-1 Router-Shelf Power Switches



Step 2 Power OFF (O) the power switches located on each dial-shelf PEM front panel. (See Figure 5-2.)

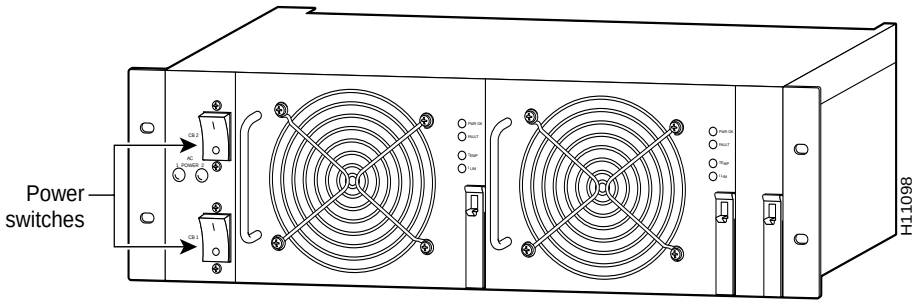
Figure 5-2 Dial-Shelf Power Switches on the PEMs



Step 3 If you are using the optional AC-input power shelf, power OFF (O) the power switches located on the AC-input power shelf front panel. (See Figure 5-3.)

Step 4 Power OFF the central office main circuit breaker for the chassis.

Figure 5-3 AC-Input Power Shelf



Replacing a DC Power Entry Module

This section explains how to remove and replace the power entry modules (PEMs) in the dial-shelf chassis.

Note The color coding of the DC-input power supply leads depends on the color coding of the DC power source at your site. Typically, green or green/yellow is used for ground, black is used for +48V (return), and red or white is used for –48V. Verify that the lead color coding for the DC-input power supply matches the color coding at the DC power source.

Tools and Parts Required

To replace a PEM you need the following items:

- New PEM (DS5814-DC-PEM=)
- 6 American Wire Gauge (AWG), or 10 mm^2, cable rated for at least 140^o F (60^o C) (for new DC-input power supply installations)
- Standard wire stripper
- No. 2 Phillips screwdriver
- 1/4-in. flat-blade screwdriver
- ESD-preventive wrist strap

Removing a Power Entry Module

This section explains how to remove and replace the PEMs in the dial-shelf chassis.

Warning **Before completing any of the following steps, and to prevent short-circuit or shock hazards, ensure that power is removed from the DC-input or optional AC-input circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC-input or optional AC-input circuit, switch the circuit breaker to the OFF (O) position, and tape the switch handle of the circuit breaker in the OFF (O) position.**

Warning **When installing the unit, the ground connection must always be made first and disconnected last.**

Caution If your system requires the AC-input power shelf for AC-to-DC conversion, you should schedule a time for system maintenance and replace the PEM at that time.

The following procedure for hot-swapping a PEM assumes you are *not* using the optional AC-input power shelf, and that each PEM in your dial shelf is connected to a separate DC power source. If you are removing and replacing a PEM in an AC-configured system, you must perform the replacement during a scheduled maintenance time and *power off the entire system*.

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.**

To remove a PEM, complete the following steps:

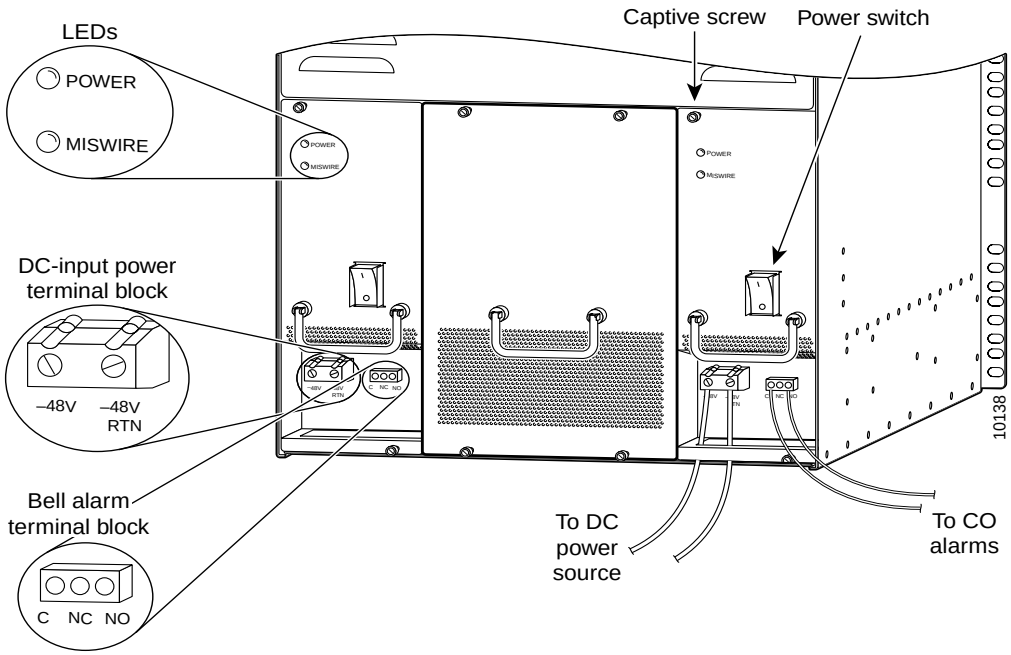
Step 1 Power OFF the central office circuit breaker connected to the PEM you are removing and tape the switch in the OFF position.

Step 2 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 3 Power OFF the power switch located on the PEM front panel. (See Figure 5-4.)

Caution Terminal blocks may be energized. Ensure that the power source circuit breaker is disconnected and the PEM power switch is in the OFF (O) position before accessing terminals.

Figure 5-4 PEM Front Panel



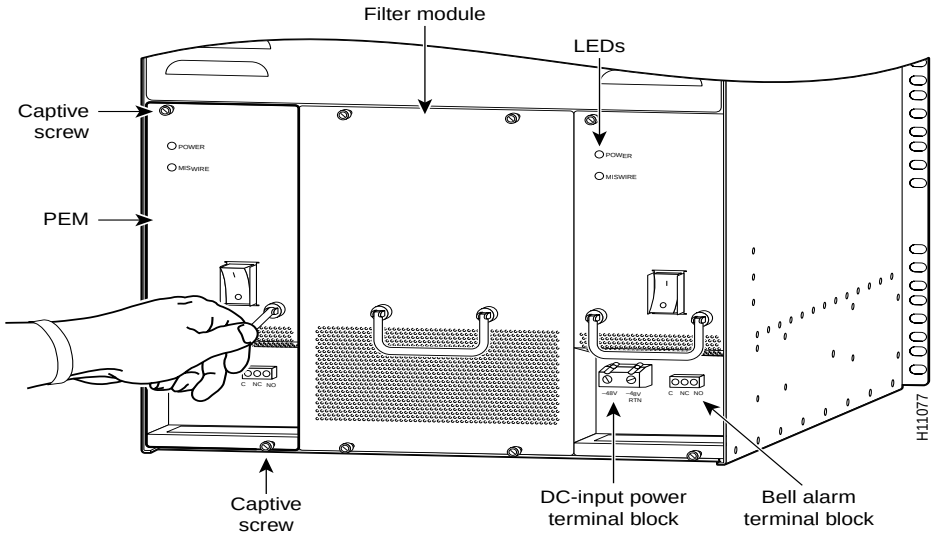
Step 4 Using a 1/4-in. flat-blade screwdriver, disconnect the DC cables from the DC-input power terminal block. (See Figure 5-4.)

Step 5 Unplug the alarm cable from the bell alarm terminal block. (See Figure 5-4.)

Step 6 Using a 1/4-in. flat-blade screwdriver, loosen the captive screws on the PEM front panel.

Step 7 Grasp the handle and carefully pull the PEM from the backplane connectors using a gentle rocking motion; then remove the PEM from the DC power supply chassis. (See Figure 5-5.)

Figure 5-5 Removing and Replacing a PEM



This completes the PEM removal process. Continue with Replacing the Power Entry Module, page 5-6.

Replacing the Power Entry Module

To install a new PEM, complete the following steps. (See Figure 5-5 to locate the PEMs in the dial shelf.)

Step 1 Grasp the PEM handle and carefully align the PEM with the DC-input power supply bay.

Step 2 Slide the PEM into the power supply bay until it is fully seated and connected to the backplane connectors.

Step 3 Using a 1/4-in. flat-blade screwdriver, tighten the captive screws on the PEM front panel.

Step 4 Plug the alarm cables into the bell alarm terminal block. (See Figure 5-5.)

This completes the procedure for replacing a PEM in the dial shelf. To connect the PEM power cables and power on the PEM, continue with section "Connecting to Your DC Power Source."

Note If you are connecting to an AC power source, continue with section "Connecting to an AC Power Source."

Connecting to Your DC Power Source

If your site has access to a DC power source, you need to provide your own DC power cables. In the United States you need to use 6 AWG stranded or solid copper wire; elsewhere use 16 mm^2 solid or 10 mm^2 stranded copper wire.

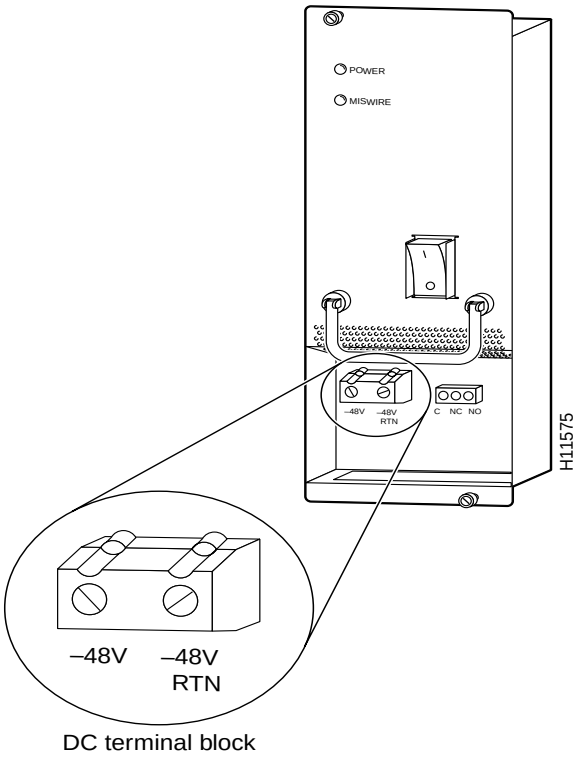
To reconnect the PEM to your DC-input power source, complete the following steps:

Step 1 Locate the DC terminal block located on the dial-shelf PEM front panel and loosen the connector screws using a 1/4-in. flat-blade screwdriver. (See Figure 5-6.)

Step 2 Strip the DC power cable of its outer insulation to expose about 1/2-in. of copper wire.

Step 3 Connect the power cable stripped wires to the DC terminal block on the PEM and securely tighten the terminal block connector screws. (See Figure 5-6.)

Figure 5-6 Power Entry Module (PEM) DC Terminal Block



Step 4 Connect the other end of your DC power cables to your DC power source.

Step 5 Repeat Step 1 through Step 4 to connect your DC power cables to the second PEM.

Note If the two DC conductors entering the PEM terminal block are reversed, a yellow warning LED on the PEM lights to indicate a miswire. No damage will occur; however, you must power OFF the power at the source and reverse the connections.

Step 6 Power ON the central office circuit breaker connected to the PEM you are replacing.

Step 7 Power ON (|) the power switch located on the PEM front panel. (See Figure 5-4.)

This completes the procedure for replacing a PEM and connecting to your DC power source. Continue with section "Verifying and Troubleshooting the Installation" on page 8 for installation troubleshooting tips.

Connecting to an AC Power Source

If you are using the optional AC-input power shelf, you *cannot* remove and replace a PEM while the system is powered on.

Caution If your system requires the AC-input power shelf for AC-to-DC conversion, you should schedule a time for system maintenance and replace the PEM at that time. See the "Replacing an AC-Input Power Supply" section on page 5-13 for installation and replacement instructions.

Verifying and Troubleshooting the Installation

To complete the installation, verify that the power supply LEDs operate properly and that you have wired the DC-input connections correctly. Each PEM contains two LEDs on the front panel - POWER and MISWIRE. (See Figure 5-4.)

- Verify that the power LED is on.

  If neither the power nor the miswire LED is on, check the voltage at the DC-input terminal block. If the voltage reading falls between –40 and –60 VDC, replace the PEM.

- Verify that the miswire LED remains off.

  If the miswire LED is on, the two DC conductors entering the PEM DC-input terminal block are reversed. Power OFF power at the source and reverse the connections.

This completes the procedures for installing and troubleshooting a power entry module. To verify that the PEM is properly installed, refer to the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

Replacing a Filter Module

The Cisco AS5800 is equipped with a passive DC power filter, which contains a broadband electromagnetic interference (EMI) filter and circuitry for monitoring power coming into the Cisco 5814 dial shelf. The DC power filter is housed in the filter module, which resides in the dial shelf between the two power entry modules (PEMs).

Tools and Parts Required

To remove and replace the filter module you need the following parts and tools:

- A new filter module (DS5814-DC-FLT=)
- 1/4-in. flat-blade screwdriver
- ESD-preventive wrist strap
- An antistatic bag to return the old filter module

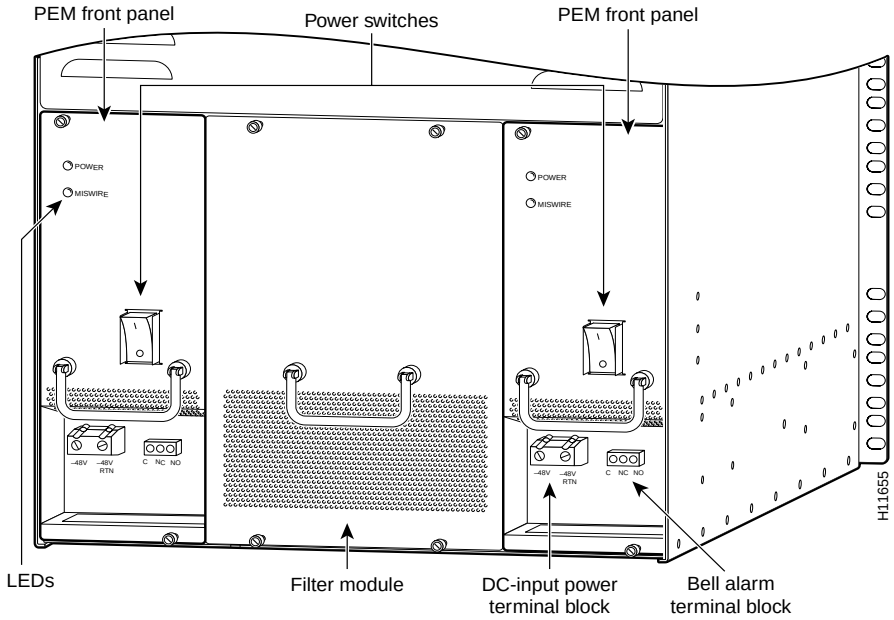
For additional equipment, contact a service representative for ordering information.

Removing a Filter Module

This procedure is ideally performed during a scheduled maintenance time. If not, you must first power off the dial shelf as follows:

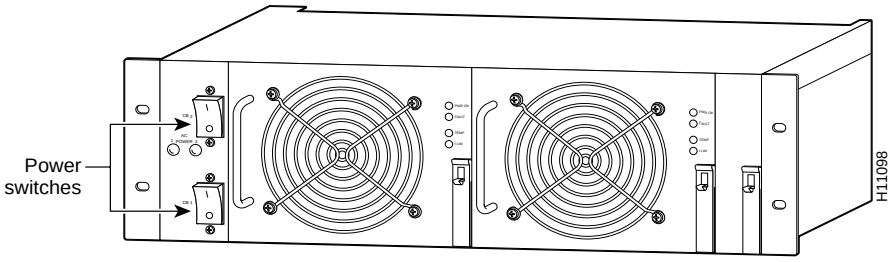
Step 1 Power OFF (O) the power switch located on each dial-shelf PEM front panel. (See Figure 5-7.)

Figure 5-7 Dial-Shelf Power Switches on the PEMS



Step 2 If you are using the optional AC-input power shelf, power OFF (O) the power switches on the AC-input power shelf front panel. (See Figure 5-8.)

Figure 5-8 AC-Input Power Shelf Power Switches



To remove the filter module from the dial shelf, complete the following steps:

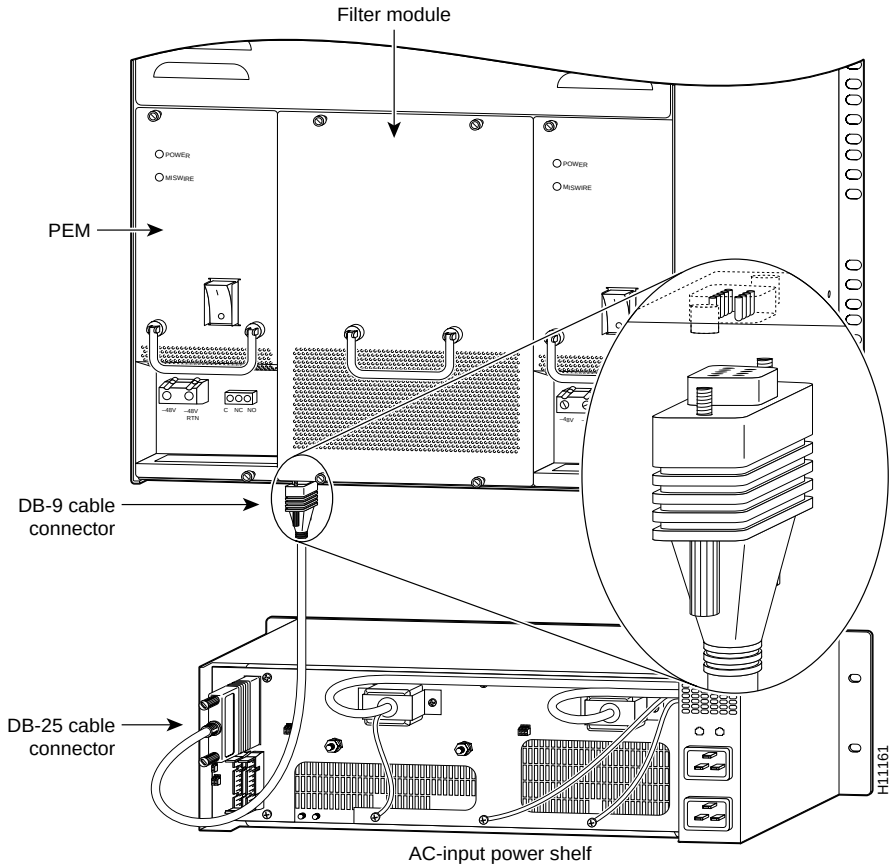
Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Ensure that both PEM power LEDs are off.

Step 3 Using a 1/4-in. flat-blade screwdriver, loosen the captive screws on the filter module front panel.

Step 4 If you are using the optional AC-input power shelf, disconnect the monitor cable DB-9 connector from the base of the filter module, as shown in Figure 5-9.

Figure 5-9 Filter Module Monitor Cable Connections

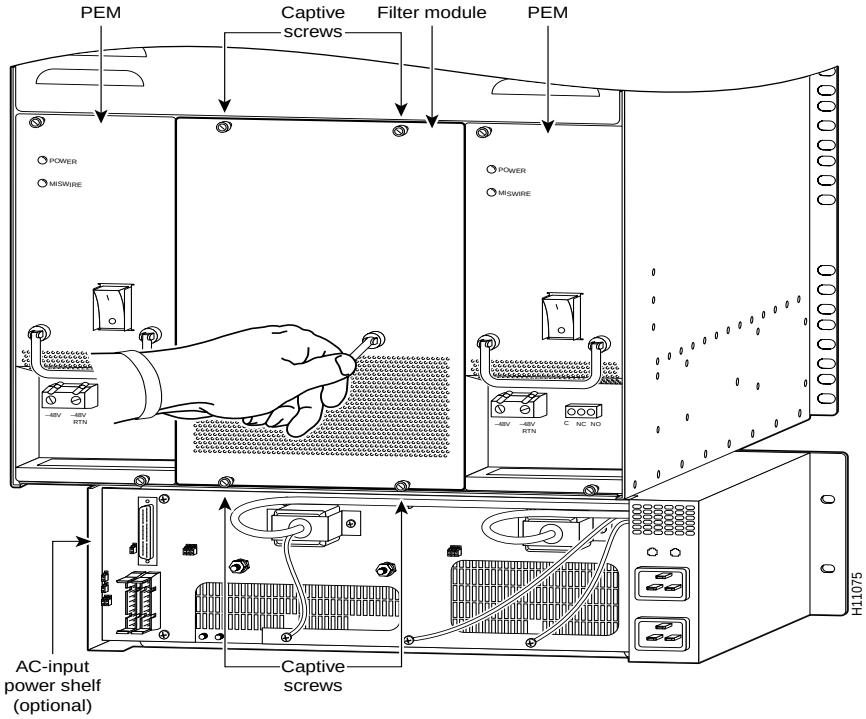


Note Figure 5-9 shows the location of the DB-9 connector, which is at the base of the filter module. The safety cover normally covering the AC-input power shelf rear panel has been removed to show the DB-25 connector, which you use to connect the monitor cable from the filter module to the AC-input power shelf.

Caution The filter module weighs 5.5 lb (2.5 kg). Use both hands when removing or replacing the filter module.

Step 5 Grasp the filter module handle and gently pull the filter module about halfway out of the dial-shelf chassis. (See Figure 5-10.)

Figure 5-10 Removing and Replacing the Filter Module



Step 6 Holding the filter module handle with one hand, place your other hand under the module for support.

Step 7 Pull the filter module from the dial-shelf chassis and place it in an antistatic bag to return to the factory.

This completes the filter module removal process. Continue with Replacing the Filter Module.

Replacing the Filter Module

To replace the filter module, complete the following steps. When you are finished, use a Site Log sheet to record service maintenance.

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Using both hands, gently push the new filter module into the dial-shelf chassis until it connects firmly with the backplane.

Caution When inserting the filter module, avoid unnecessary force, which can damage the connectors.

Step 3 Using a 1/4-in. flat-blade screwdriver, tighten the captive screws.

Step 4 If you are using the optional AC-input power shelf, connect the monitor cable DB-9 connector at the base of the filter module and tighten the jackscrews. Verify that the DB-25 connector at the other end of the cable is connected to the AC-input power shelf (see Figure 5-9). Power ON the AC-input power shelf.

Step 5 Power ON (|) the power switches located on each dial-shelf PEM front panel.

Step 6 Note the service maintenance on your Site Log sheet.

This completes the procedure for removing and replacing the filter module.

Replacing an AC-Input Power Supply

The AC-input power shelf is an optional component of the Cisco AS5800 and is used to convert AC-input power into DC-output power for the DC-powered Cisco 5814 dial shelf. The AC-input power shelf contains two AC-input power supplies.

This section explains how to remove and replace an individual power supply in the power shelf.

Tools and Parts Required

To remove and replace an individual power supply you need the following tools and parts:

- AC power supply (DS58-AC-PWR=)
- ESD-preventive wrist strap
- If access to the power supply bays is partially blocked by a power strip or other permanent rack fixture, you need a 1/4-in., flat-blade screwdriver to temporarily detach the fixture from the equipment rack-mounting strips.

Removing and Replacing a Power Supply

Use the following procedure if you are replacing a faulty power supply, or if you want to reduce the weight of the power shelf before you install it in a rack. If you do not want to remove power supplies prior to rack-mounting the AC-input power shelf, skip this section and continue with the “Replacing a Dial-Shelf Controller Card” section on page 5-15.

The AC-input power shelf is configured with two power supplies. You can remove or replace one of the power supplies without affecting system operation. When power is removed from one supply, the redundant power feature causes the second power supply to ramp up to full power and maintain uninterrupted system operation.

To remove a power supply, perform the following steps:

Caution A single power supply weighs 14.5 lb (6.6 kg). Use both hands when removing or replacing a power supply.

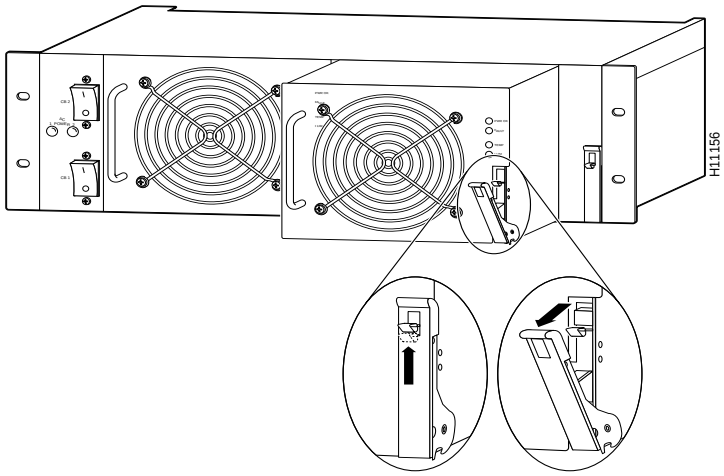
Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Ensure that the power switch for the power supply you are removing is in the OFF (O) position.

Note Power supplies are numbered 1 and 2 from left to right in the power shelf.

Step 3 Lift the metal spring-clip in the center of the ejector lever to release the lock. (The power supplies are secured by self-locking ejector levers. (See Figure 5-11.)

Figure 5-11 Removing and Replacing a Power Supply



Step 4 Apply downward pressure to the ejector lever to disconnect the power supply from the power backplane.

Step 5 Grasp the power supply handle and pull the power supply halfway out of the bay. Then with your other hand under the power supply to support it, pull the power supply completely out of the bay.

To replace the power supply, follow these steps:

Step 1 Slide the power supply into the power supply bay. Push the power supply fully into the power shelf until the front is flush against the power shelf frame. To prevent damage to the backplane connector, do not jam the power supply into the bay.

Step 2 Push the self-locking ejector lever upward until the metal spring-clip locks into place (listen for the click). (See Figure 5-11.)

This completes the power supply replacement procedure.

Replacing a Dial-Shelf Controller Card

The dial-shelf controller (DSC) card serves as the interface between the dial shelf and the Cisco 7206 router shelf. This section lists tools and parts you need, and explains how to remove and replace a DSC card in the Cisco 5814 dial-shelf chassis.

Tools and Parts Required

The following parts and tools are required to remove and replace the dial-shelf controller card. If you need additional equipment, contact a service representative for ordering information.

- New DSC card (DS58-DSC=)
- Proprietary interconnect cable (CAB-DSIC-5= or CAB-DSIC-20=)
- No. 2 Phillips screwdriver
- T1/E1 input cable (customer supplied)
- Console cable (customer supplied)
- Alarm cable (customer supplied)
- ESD-preventive wrist strap

Removing a Dial-Shelf Controller Card

Caution DSC cards weigh 8.5 lb (3.8 kg) each. Use both hands when removing or replacing a DSC card (see Figure 5-13).

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.**

Caution If your system is equipped with dual DSCs, Cisco recommends that you perform DSC card replacements during low traffic periods.

Use the **hw-module** <*shelf-id*>/<*slot-num*> **stop** command to stop the backup DSC **before** you remove the **backup** (slave) DSC.

To remove a DSC, complete the following steps:

Note The power LED and MBus LED on the DSC card remain on until the card is disconnected from the backplane.

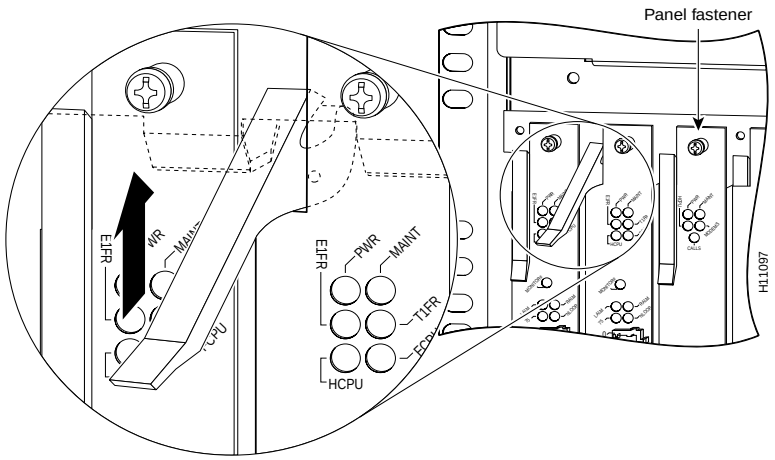
Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Caution To prevent ESD damage, handle dial-shelf controller cards by ejector levers and carrier edges only and use an ESD-preventive wrist strap or other grounding device.

Step 2 Disconnect all cables connected to the DSC card front panel.

Step 3 Using a No. 2 Phillips screwdriver, loosen the two panel fasteners on the top and bottom of the DSC card front panel. (See Figure 5-12.)

Figure 5-12 Using the Ejector Levers

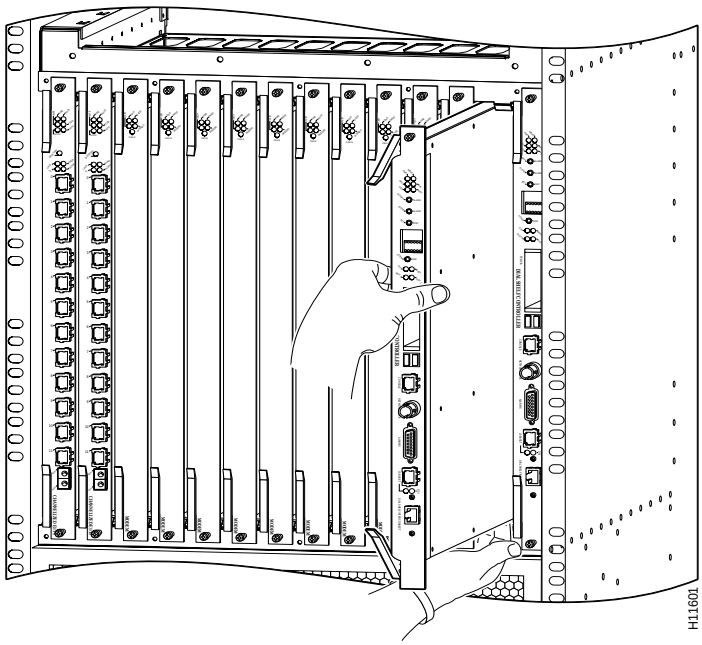


Step 4 Grasp the top and bottom ejector levers (see Figure 5-12) and pull them away from the front panel to disengage the DSC card from the backplane connectors.

Caution Do not use the ejector levers as handles to carry the card. They are not designed to support the weight of the card.

Step 5 Carefully slide the DSC card partially out of the slot, until you can grasp the card front panel with one hand. Place your other hand under the card to support it. (See Figure 5-13.)

Figure 5-13 Removing or Replacing a Dial-Shelf Controller Card



Note Use care when removing and installing feature cards and DSC cards to avoid damage to the pin connectors. Only the feature cards and DSC cards should make contact with the backplane connectors.

Step 6 Pull the DSC card straight out of the slot. Avoid touching the circuitry or any connector pins.

Caution When inserting or removing the DSC card, avoid unnecessary force, which can damage the backplane connectors.

Caution Never allow anything other than the feature card or dial-shelf controller card connectors to make contact with the backplane pins.

Caution Never insert any foreign or metallic object into the dial-shelf chassis. Also, remove all jewelry and watches prior to placing your hands inside the dial-shelf chassis.

Replacing a Dial-Shelf Controller Card

Caution DSC cards weigh 8.5 lb (3.8 kg) each. Use two hands when removing or replacing a DSC card. (See Figure 5-13.)

Caution If your system is equipped with dual DSCs, Cisco recommends that you perform DSC card replacements during low traffic periods.

Use the **hw-module** <*shelf-id*>/<*slot-num*> **stop** command to stop the backup DSC before you remove the backup (slave) DSC.

To replace a dial-shelf controller card, complete the following steps:

Note The dial-shelf controller card can be installed in either slot 12 or slot 13; however, if you install the replacement dial-shelf controller card in the slot that held the former DSC card, this will accelerate the installation process.

Caution Insertion or removal of a second DSC while there is already an active DSC may result in loss of calls.

Step 1 Attach your ESD-preventive wrist strap between you and an unpainted chassis surface.

Caution To prevent ESD damage, handle DSC cards by ejector levers and carrier edges only and use an ESD-preventive wrist strap or other grounding device.

Step 2 Carefully align the DSC card carrier guides with the top and bottom grooves in the dial-shelf slot. Avoid touching the circuitry or any connector pins.

Step 3 Slide the replacement DSC card into the dial-shelf slot until the ejector levers make contact with the chassis frame. (See Figure 5-13.)

Caution When inserting or removing the DSC card, avoid unnecessary force, which can damage the backplane connectors.

Step 4 Seat the DSC card in the backplane by pushing the card firmly until the ejector levers fold in toward the card front panel and the front panel is flush with the chassis frame.

Step 5 Using a No. 2 Phillips screwdriver, tighten the panel fasteners. This secures the backplane connection and ensures proper EMI shielding.

Caution Always tighten the panel fasteners on DSC cards. These fasteners prevent accidental removal and provide proper grounding for the system.

Step 6 Install a blank filler card (part number DS58-BLANK=) in all empty dial-shelf card slots to keep the chassis dust-free and to maintain proper airflow.

Caution To prevent the overheating of internal components and maintain the proper flow of cooling air across the cards, always install blank filler cards in empty slots.

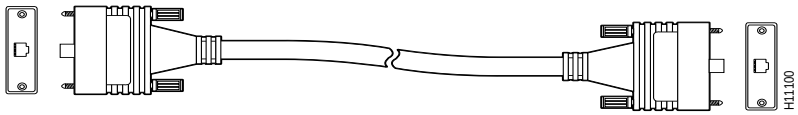
This completes the steps for removing and replacing a dial-shelf controller card. For information on reconnecting the cables, see the "Connecting the Cables" section on page 5-19.

Note If you install a replacement DSC card into the same dial-shelf slot as the card you just removed, the system recognizes the existing hardware configuration. There is no need to reconfigure the hardware. If you install the replacement DSC card in a different dial-shelf slot, you must configure the hardware. See the "Configuring the Dial-Shelf Controller Card" section on page 5-21.

Connecting the Cables

The DSC card includes a dial-shelf interconnect cable that connects the card to the dial-shelf interconnect port adapter in the Cisco 7206 router shelf. The connection between the DSC card and the dial-shelf interconnect port adapter uses a single full-duplex interconnect cable. (See Figure 5-14.)

Figure 5-14 Dial-Shelf Interconnect Cable



Attaching the Dial-Shelf Interconnect Cable

To connect the dial-shelf interconnect cable, complete the following steps:

Warning **Hazardous network voltages are present in WAN ports regardless of whether power to the router is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the router first.**

Step 1 Attach one end of your interconnect cable to the port labeled Dial Shelf Interconnect on the dial-shelf controller card front panel.

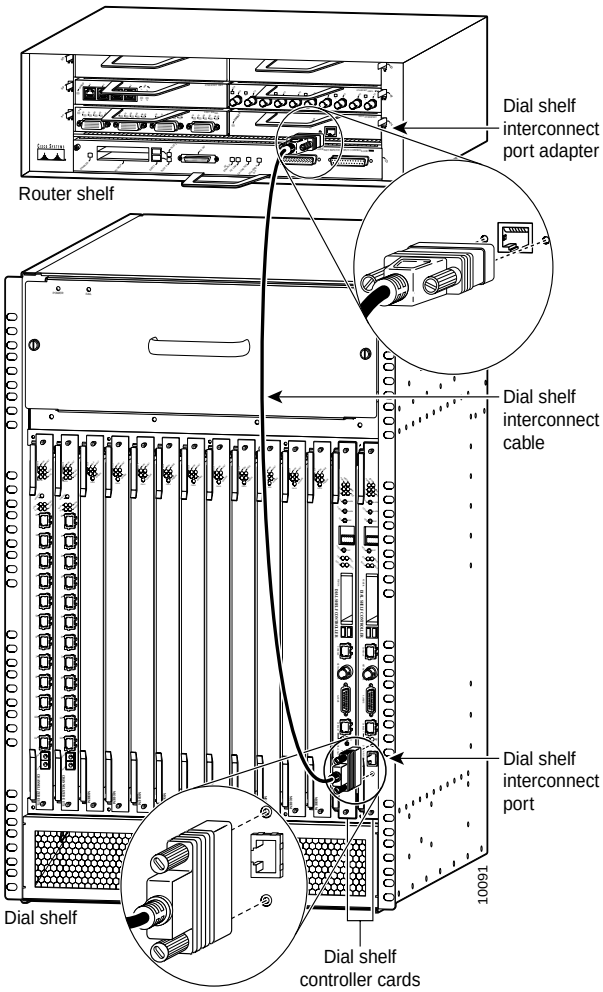
Step 2 Tighten the jackscrews on either side of the connector.

Step 3 Attach the other end of your cable to the RJ-45 port on the interconnect port adapter in the Cisco 7206 router shelf.

Step 4 Tighten the jackscrews on either side of the connector.

Caution Never disconnect the interconnect cable while the system is operating (except when replacing a redundant DSC card) because you will lose all calls.

Figure 5-15 Connecting the Dial-Shelf Interconnect Cable



Warning **The ports labeled Network clock, 10BaseT, Dial Shelf Interconnect, Console, and Alarms are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the E1/T1 circuits are treated like telephone network voltage, avoid connecting the SELV circuit to the telephone network voltage circuits.**

For more information about the dial-shelf interconnect cable and dial-shelf interconnect port adapter, see the "Replacing a Dial-Shelf Interconnect Port Adapter" section on page 5-27.

Verifying and Troubleshooting the Installation

Verify that your new DSC card is properly installed and operative by observing the card LEDs as follows:

- Verify that the power LED and MBus LED light after the DSC card has been installed in the dial shelf and the system is powered on.
  - If both the MBus and power LEDs are on, the card should boot normally. During the boot sequence, the four alarm LEDs momentarily flash and then turn off. In addition, the two four-character alphanumeric displays will show status messages.

    After the boot sequence completes, the alphanumeric display should read:

    ```
    MSTR
    ```

    If the boot sequence does not complete, contact a service representative for assistance.
  - If either the power or MBus LED remains off, try removing and reinserting the card. If the problem persists, contact your service representative. You may need to replace the card.

    If the problem persists with a new card installed, remove the dial-shelf controller card from the dial-shelf slot and examine the backplane for bent connector pins.

    To inspect the backplane pins, first power OFF the system to avoid hazards caused by high voltages present on the backplane connectors. Next, remove cards in neighboring slots to allow an unimpeded view of the backplane connectors. Then, using a flashlight, verify that the backplane connectors are in good condition. If you discover bent pins, you need a new backplane. The backplane is an FRU. Contact your service representative to order a new backplane, and see the "Replacing the Backplane Module" section on page 5-32.
- You can also use the **show** command to diagnose a problem with the dial-shelf controller card. Enter the following command:

  ```
  5800> enable
  enter password <password>
  5800# show diag <type {shelf | slot}>
  Ctrl-Z
  ```

Configuring the Dial-Shelf Controller Card

The Cisco 5814 dial shelf is designed to recognize DSC cards in specific slots within the dial-shelf chassis. Backplane slots 12 and 13 are the designated DSC card slots. This design supports redundancy features to eliminate dropped calls.

Caution **Do not configure the Ethernet interface on the DSC to be available on the network.** Users could connect to the system via Telnet (VTY line) without using a password. System security could be seriously compromised if unauthorized users were to gain access to the Ethernet interface on the DSC in this way.

Commands for Dual-DSC-Equipped Systems

Table 5-1 shows new or modified commands have been added to support redundant-DSC-equipped systems.

Table 5-1 New of Modified Commands

Command Level	Command	Description
User	**show redundancy [history]**	The **show redundancy** command displays the current status of the DSCs. The **show redundancy hist** command displays a table of the last 5 redundancy events for each redundant component on the DSCs.
	show tech-support	The show-tech-support command displays the output of the **show redundancy** and **show redundancy history** commands.
	show debug	The **show debug** command displays the debug section for DSC Redundancy if any debugging is on.
User Exec	**hw-module** <*shelf-id*>/<*slot-num*> {**start** | **stop**}	The **hw-module** command is used to start or stop the DSC cards. The **stop** option requires confirmation before execution.
	[**no**] **debug redundancy** {**all** | **clk** | **hub** | **ui**}	The **debug redundancy** command turns debugging on or off for the selected components. The components are • **clk** - DS clock • **hub** - DSI hub • **ui** - user interface • **all** - all of the above. The **no** option turns debug redundancy off.
	[**no**] **debug all**	The **debug all** command affects all DSC Redundancy debugging. The **no** option turns debugging off.

Replacing a Flash Memory Card

Both the router shelf and the dial shelf contain PCMCIA slots for Flash memory cards. The router-shelf PCMCIA slots are located on the I/O controller and are oriented horizontally. The dial-shelf PCMCIA slots are located on the dial-shelf controller card and are oriented vertically. Except for the orientation of the slots, the installation procedures are the same for both shelves.

This section describes inserting and removing a Flash memory card in the dial shelf. For procedures specific to the router shelf, refer to the *Cisco 7206 Installation and Configuration Guide*, available online at
http://www.cisco.com/univercd/cc/td/doc/product/core/7206/

The dial-shelf controller card has two PCMCIA slots for Flash memory cards. The slots are numbered left to right, slot 0 and slot 1, respectively.

Note To avoid potential problems when inserting spare Flash memory cards in your DSC cards, we recommend that you reformat your Flash memory cards on a Cisco 7206 router shelf running Cisco IOS Release 11.3AA or later during your regularly scheduled service times. For instructions on formatting a Flash memory card, refer to the *Cisco 7206 Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/

To install a Flash memory card, complete the following steps:

Step 1 Orient the Flash memory card so that the connector end faces the appropriate slot. (See Figure 5-16.)

Step 2 Carefully insert the card in the slot until it mates with the slot connector at the back of the slot and the eject button for the slot pops out toward you.

Note Flash memory cards do not insert completely flush with the DSC card front panel; a portion of the card remains outside of the slot. Do not attempt to force the card past this point.

Removing a Flash Memory Card

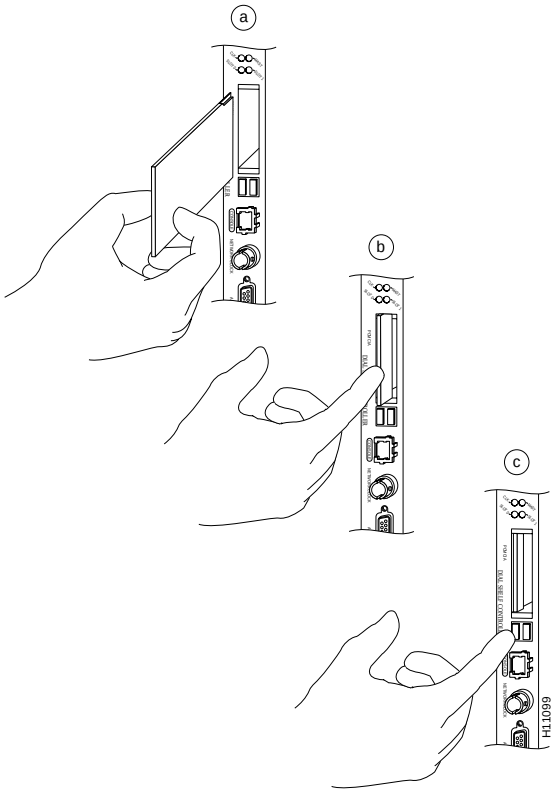
To remove a Flash memory card from the PCMCIA slot, complete the following steps (see Figure 5-16):

Step 1 Press the ejector button on the slot.

Step 2 Grasp the card and pull it from the slot.

Step 3 Place the card in an antistatic bag.

Figure 5-16 Inserting and Removing a PCMCIA Flash Card



This completes the dial-shelf controller card and Flash memory installation procedures.

Replacing the Blower Assembly

The Cisco AS5800 is equipped with a blower assembly, which is designed to monitor system internal operating temperatures and maintain acceptable cooling parameters.

This section explains how to remove and replace the blower assembly in the dial-shelf chassis.

Tools and Parts Required

You need the following tools and parts to remove and replace the blower assembly. If you need additional equipment, contact a service representative for ordering information.

- New blower assembly (DS58-FAN=)
- 1/4-in. flat-blade screwdriver
- ESD-preventive wrist strap
- Antistatic mat or packaging

Removing the Blower Assembly

Caution The system shuts down cards approximately 2.0 minutes after the system temperature threshold has been reached. Although normal blower assembly replacement is estimated not to exceed 30 sec., if you expect the replacement process to exceed 1.0 minutes, we recommend shutting down the system prior to the removal and replacement process.

Caution The blower assembly weighs 27.5 lb (12.5 kg). Use both hands when removing or replacing the blower assembly.

To remove the blower assembly, complete the following steps:

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

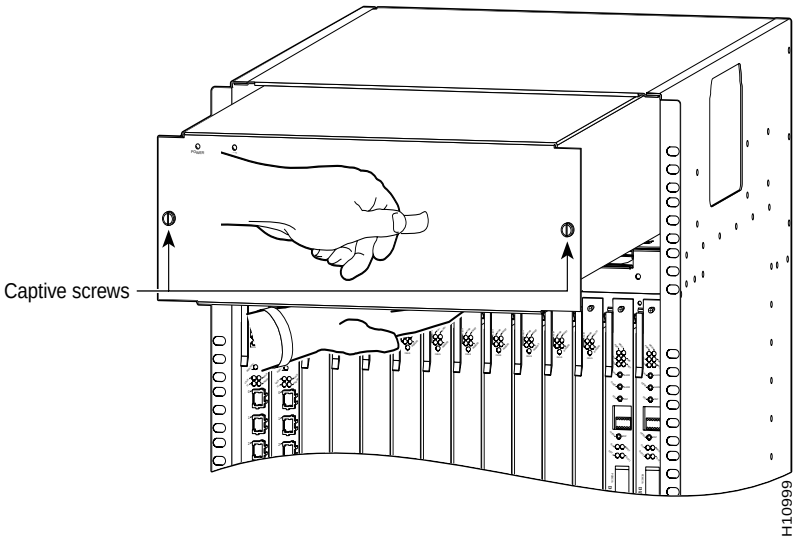
Step 2 Loosen the two captive screws on the blower assembly front panel. (See Figure 5-17.)

Step 3 Grasp the blower assembly handle with one hand and pull the blower assembly straight toward you, about halfway out of the slot.

Step 4 Place your other hand under the blower assembly as it extends from the dial-shelf chassis to support the blower and prevent it from falling.

Step 5 Slowly pull the blower assembly all the way out of the slot and place it on an antistatic mat or in packaging to return it to the factory.

Figure 5-17 Blower Assembly Removal and Replacement



This completes the blower assembly removal process. Continue with the "Replacing the Blower Assembly" section on page 5-26.

Replacing the Blower Assembly

To replace the blower assembly in the dial shelf, complete the following steps.

Caution The blower assembly weighs 27.5 lb (12.5 kg). Use both hands when removing or replacing the blower assembly.

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Place one hand on the blower assembly handle and place your other hand under the blower assembly to support the weight.

Step 3 Position the blower assembly in the opening and slide it fully into the chassis until the backplane connectors mate. (See Figure 5-17.)

Note All electrical connections are fully operative when the backplane connectors mate. The blower assembly will immediately power up if the system is powered on.

Step 4 Using a 1/4-in. flat-blade screwdriver, tighten the two captive screws on the blower assembly front panel.

Step 5 Note service maintenance on your Site Log sheet.

This completes the blower assembly installation procedure. Continue with the "Verifying and Troubleshooting the Installation" section on page 5-27 to verify your installation.

Verifying and Troubleshooting the Installation

To verify that the blower assembly is properly installed and operational, complete the following steps:

Step 1 Listen to verify that the fans are operative. In noisy environments, you may want to place your hand to the rear of the blower assembly and feel for airflow from the exhaust vent.

Step 2 Verify that the green power LED on the blower assembly front panel lights.

- If the power LED remains off, verify that the blower assembly is fully installed in the dial shelf, the connector is firmly connected to the backplane, and the captive screws are adequately tightened.

Step 3 Verify that the yellow fault LED on the blower assembly front panel remains off.

- If the fault LED lights, the newly installed blower assembly may be faulty, or the chassis connector may be damaged. Shut OFF system power; remove the blower assembly from the dial shelf, and check the connectors. If the connectors are in good condition, reinstall the blower assembly in the dial shelf and power ON the system.
- If the fault LED is still on, assume that the blower assembly is faulty. Install another blower assembly and return the faulty blower assembly to the factory.

Replacing a Dial-Shelf Interconnect Port Adapter

The Cisco AS5800 is equipped with a dial-shelf interconnect port adapter that provides the connection between the Cisco 7206 router shelf and the Cisco 5814 dial shelf. The interconnect port adapter installs in the router shelf and connects to the dial shelf via a full-duplex 100-Mbps interconnect cable. No installation tools are necessary; the dial-shelf interconnect port adapter connects directly to the router midplane and locks into position by a port adapter lever. The dial-shelf interconnect port adapter has no configurable ports.

The Cisco 7206 router shelf supports OIR; however, unless you have installed a second dial-shelf interconnect port adapter and established a redundant connection to the dial shelf, you must either reload the system software after removing and replacing a dial-shelf interconnect port adapter in an operating system, or you must power off the system during the replacement procedure.

You reload the system software at the router-shelf console using the **reload** command. For a detailed description of the **reload** command, refer to the configuration fundamentals command reference for your Cisco IOS release.

Note When you reload the software, all active calls are lost. New incoming calls are not accepted during the reload process.

If you power OFF and restart the system, the system software automatically reboots. For instructions on powering OFF and powering ON the access server, refer to the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

Tools and Parts Required

You need the following equipment and parts to install the dial-shelf interconnect port adapter. If you need additional equipment, contact a service representative for ordering information.

- Dial-shelf interconnect port adapter (PA-DSIC=)
- Dial-shelf interconnect cables (CAB-DSIC-5= or CAB-DSIC-20=)
- Blank port adapter, if needed, for unoccupied slots (MAS-72BLANK=)
- Your own ESD-prevention equipment or the disposable grounding wrist strap included with all upgrade kits, FRUs, and spares
- An antistatic mat or an antistatic shipping container or both

Note When an adapter slot is not in use, a blank adapter must fill the empty slot to allow the router shelf to conform to EMI emissions requirements and to allow proper air flow across the adapters.

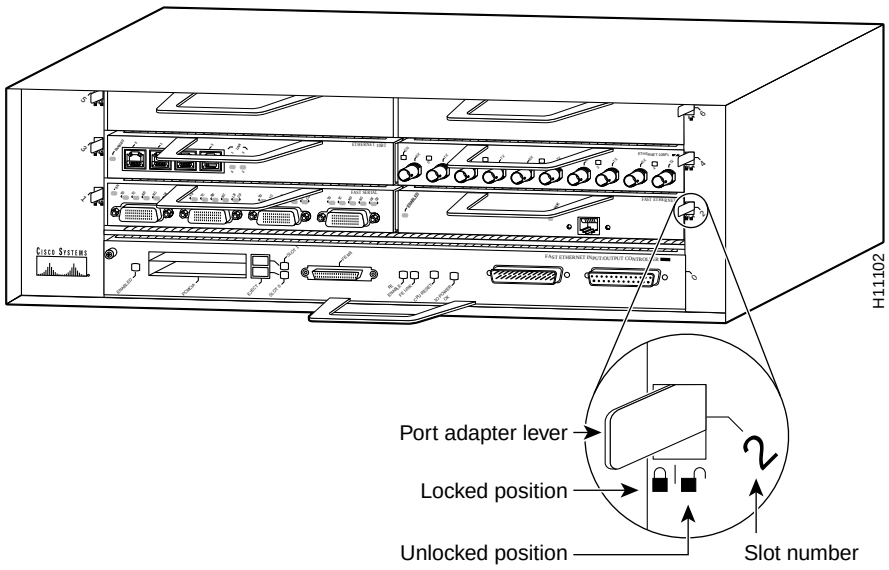
Removing the Dial-Shelf Interconnect Port Adapter

Use the following procedure to remove the dial-shelf interconnect port adapter from the router shelf:

Step 1 Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2 Place the adapter lever for the desired adapter slot in the unlocked position. (See Figure 5-18.)

Figure 5-18 Unlocked and Locked Port Adapter Lever Positions

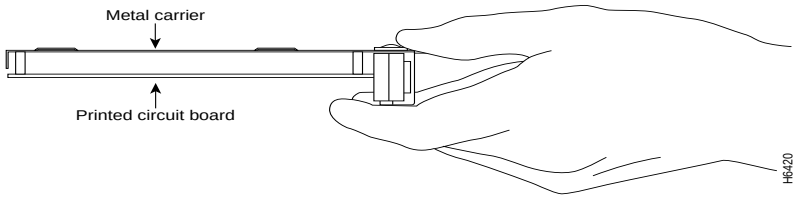


Step 3 Disconnect the dial-shelf interconnect cable from the interconnect port adapter.

Step 4 Grasp the handle and pull the interconnect port adapter out of its slot, disconnecting it from the router-shelf midplane.

Caution Always handle adapters by the metal carrier edges and handle; never touch the adapter components or connector pins.

Figure 5-19 Port Adapter Handling—Side View



Step 5 Place the interconnect port adapter on an antistatic surface with its components facing upward. If you are returning the port adapter to the factory, immediately place it in a static shielding bag.

This completes the procedure for removing the dial-shelf interconnect port adapter from the router shelf. Continue with Replacing the Dial-Shelf Interconnect Port Adapter, page 5-29.

Replacing the Dial-Shelf Interconnect Port Adapter

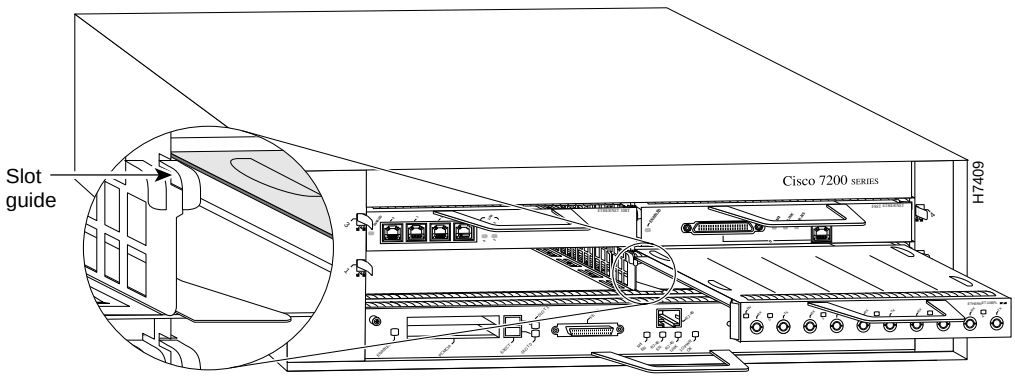
Use the following procedure to install a new dial-shelf interconnect port adapter in the router shelf:

Step 1 Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2 Hold the interconnect port adapter with the component side facing downward.

Step 3 Align the left and right edges of the interconnect port adapter's metal carrier between the guides in the slot. (See Figure 5-20.)

Figure 5-20 Aligning the Port Adapter Metal Carrier Between the Slot Guides



Note: this adapter alignment applies to any port or service adapter.

Step 4 Slide the interconnect port adapter into the slot until the connectors are properly seated in the midplane.

Step 5 Place the adapter lever in the locked position, as shown in Figure 5-18.

Note If the adapter lever does not move to the locked position, the adapter is not completely seated in the midplane. Carefully pull the adapter halfway out of the slot, reinsert it, and place the lever in the locked position.

This completes the procedure for installing a new dial-shelf interconnect port adapter in the router shelf. Continue with the "Attaching the Dial-Shelf Interconnect Cable" section on page 5-30.

Attaching the Dial-Shelf Interconnect Cable

The interconnect port adapter includes a single dial-shelf interconnect receptacle. For a redundant connection to the dial shelf, you need to install a second port adapter.

Caution Do *not* use the dial-shelf interconnect port adapter for outgoing WAN connections.

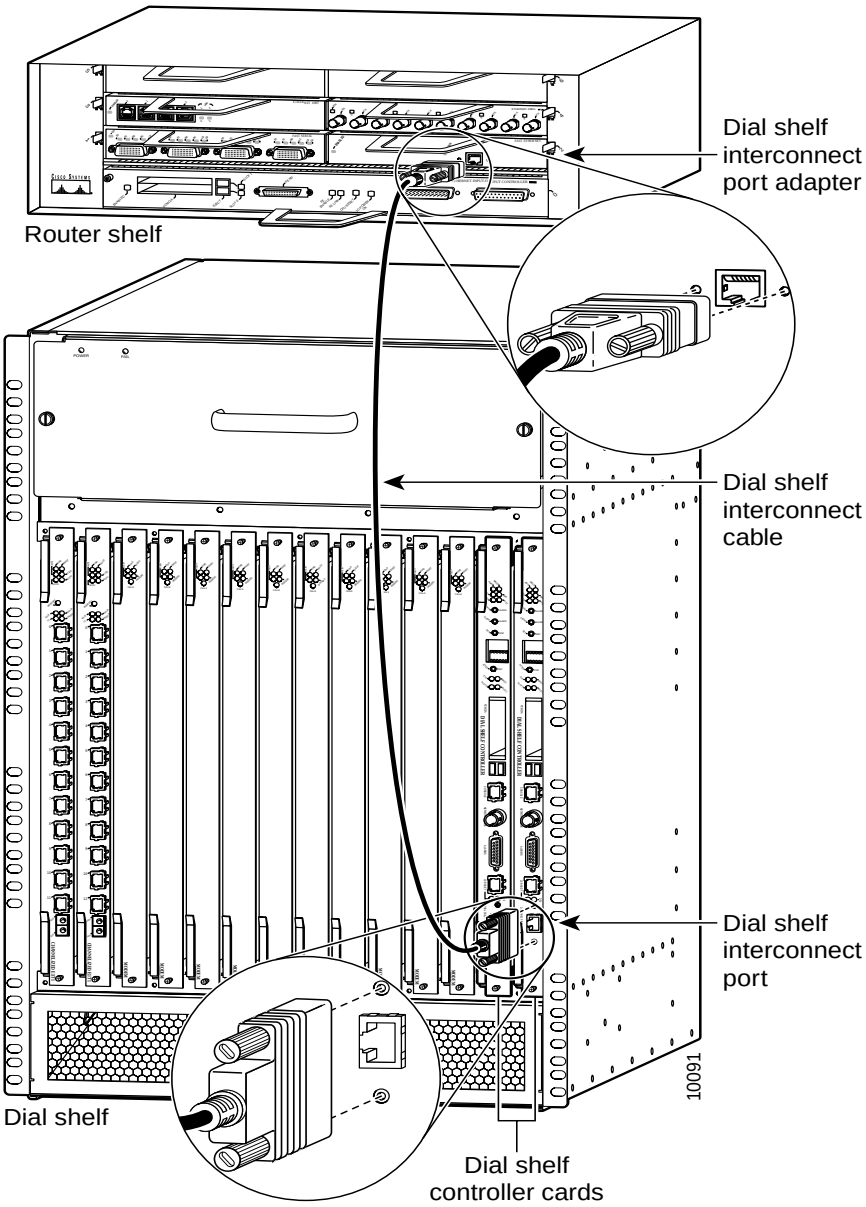
Connect the dial-shelf interconnect cable as follows:

Step 1 Attach the interconnect cable directly to the RJ-45 port on the interconnect port adapter.

Step 2 Tighten the jackscrews on either side of the connector.

Step 3 Attach the other end of your interconnect cable to the port labeled Dial Shelf Interconnect on the Cisco 5814 dial-shelf controller card.

Figure 5-21 Connecting the Dial-Shelf Interconnect Cable



Warning **The ports labeled Network clock, 10BaseT, Dial Shelf Interconnect, Console, and Alarms are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the E1/T1 circuits are treated like telephone network voltage, avoid connecting the SELV circuit to the telephone network voltage circuits.**

Step 4 Tighten the jackscrews on either side of the connector.

Step 5 Reload the system software using the **reload** command in EXEC mode, or restart the access server to reboot the system software.

This completes the dial-shelf interconnect cable installation procedure. To verify the installation, continue with the "Verifying and Troubleshooting the Installation" section on page 5-32.

Verifying and Troubleshooting the Installation

To complete the installation, verify that the LEDs operate properly by observing the following LED states on the dial-shelf interconnect port adapter:

- The power enabled LED is on.

  If the enabled LED is off, the interconnect port adapter may have pulled away from the midplane. Reseat the interconnect port adapter in its slot.

  If the enabled LED remains off, contact a service representative for assistance.

- The link LED is on.

  If the link LED is off, check the interconnect cable connection and tighten the jackscrews.

- You can also use the **show dsi** command in EXEC mode to display information about the dial-shelf interconnect port adapter.

This completes the dial-shelf interconnect port adapter installation. For hardware troubleshooting procedures, refer to the *Cisco 7206 Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/

Replacing the Backplane Module

The Cisco AS5800 includes a *passive* backplane in the Cisco 5814 dial shelf that can be ordered as a spare. This section explains how to remove and replace the backplane in the Cisco 5814 dial-shelf chassis.

In most cases, the Cisco 5814 dial-shelf chassis will be fully installed to include the dial-shelf controller card and feature cards. As part of the backplane removal, unseat all cards from the dial-shelf backplane.

Warning **Before completing any of the following steps, and to prevent short-circuit or shock hazards, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF (O) position, and tape the switch handle of the circuit breaker in the OFF (O) position.**

Warning **When installing the unit, the ground connection must always be made first and disconnected last.**

In this section you will be instructed to perform the following actions:

1. Power off the router shelf and the dial shelf.
2. Disconnect power and alarm cables to the PEMs.
3. Unseat the dial-shelf controller cards and feature cards from the backplane.
4. Remove the PEMs, filter module, and dial-shelf back panel.
5. Disconnect the blower assembly backplane cable.
6. Unscrew the backplane and remove it from the dial shelf.

Note You need access to both the front and rear of the Cisco AS5800 universal access server. Some of the procedures are performed from the front and some are performed from the rear.

Tools and Parts Required

The following parts and tools are required to remove and replace the backplane module. If you need additional equipment, contact a service representative for ordering information.

- New backplane module (MAS-5814BP=)
- 1/4-in. flat-blade screwdriver
- No. 2 Phillips screwdriver
- ESD-preventive wrist strap
- Site Log sheet to record service maintenance
- Cable ties (optional)
- ESD shielding bag

Removing the Backplane

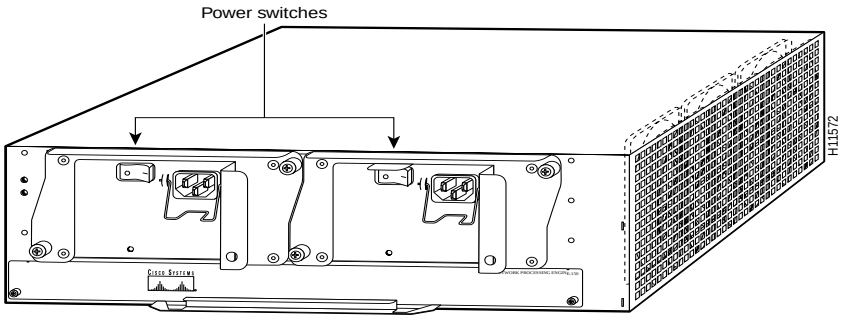
The backplane cannot be removed while the system is powered on. This procedure is ideally performed during a scheduled maintenance time. If not, you must first power OFF the system.

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.**

To remove the backplane:

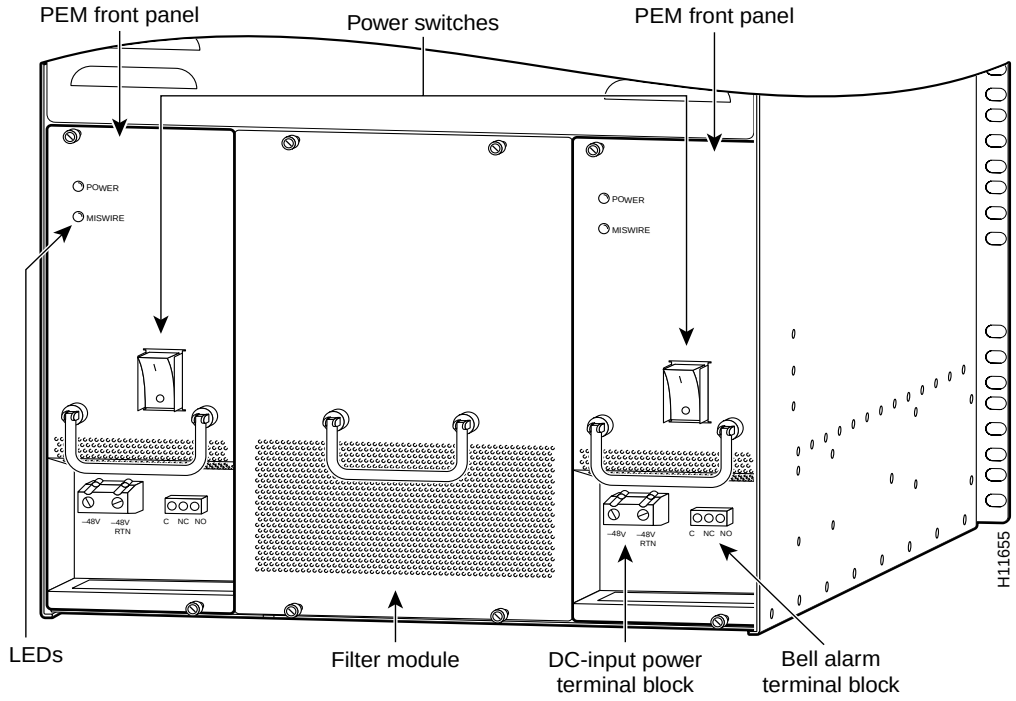
Step 1 Power OFF (O) the Cisco 7206 router shelf using the power switches located on the router-shelf rear panel. (See Figure 5-22.)

Figure 5-22 Router-Shelf Power Switches



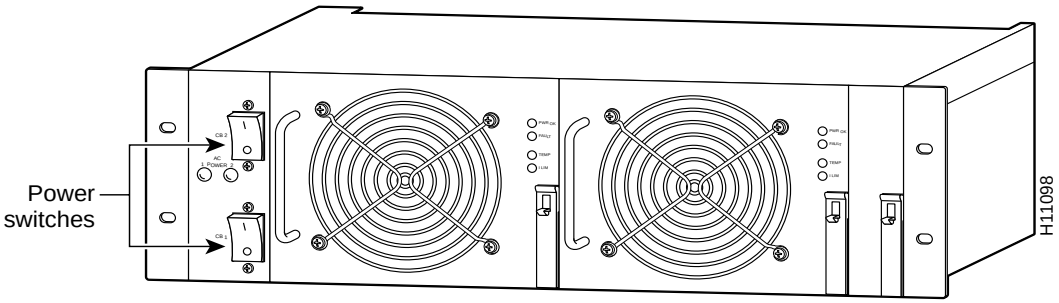
Step 2 Power OFF (O) the dial shelf at the power entry modules (PEMs) using the power switches located on the PEM front panels. (See Figure 5-23.)

Figure 5-23 Dial-Shelf Power Switches on the PEMS



Step 3 If you are using the optional AC-input power shelf, power OFF (O) the AC-input power supplies using the power switches located on the power shelf front panel. (See Figure 5-24.)

Figure 5-24 AC-Input Power Shelf

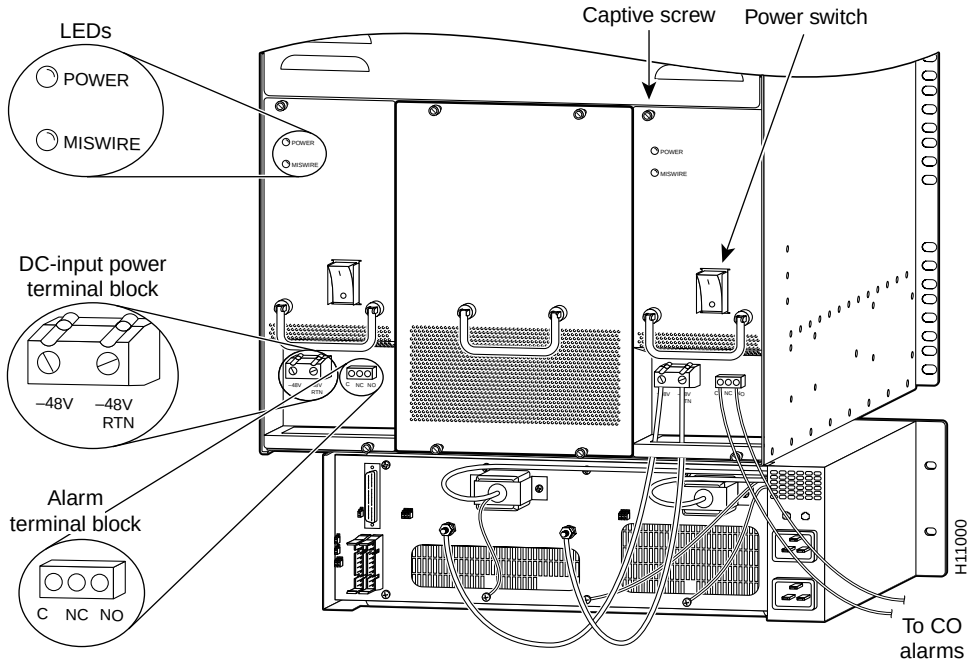


Step 4 Power OFF the central office main circuit breaker.

To continue, you must next disconnect power cables and alarm cables to the dial-shelf PEMs.

Step 1 Loosen the screws in the DC-input power terminal blocks and the alarm terminal blocks using a 1/4-in. flat-blade screwdriver, and disconnect power cables and alarm cables to the dial-shelf PEMs. Figure 5-25 shows the location of the terminal blocks.

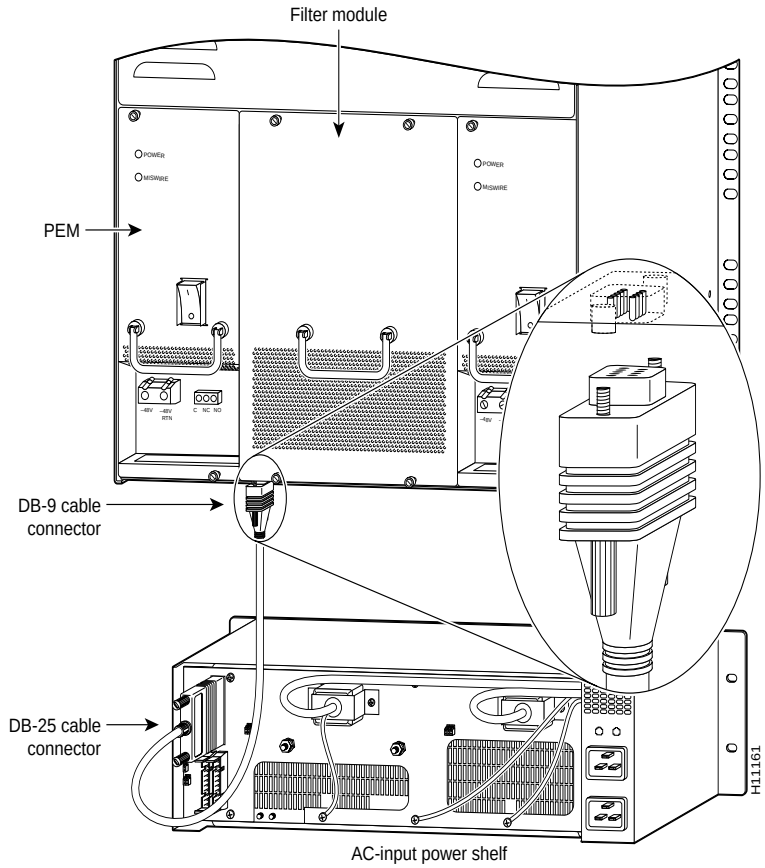
Figure 5-25 PEM Cable and Alarm Terminal Blocks



The following steps refer to the optional AC-input power shelf. If you are using a DC power source, you can skip Step 2 and Step 3.

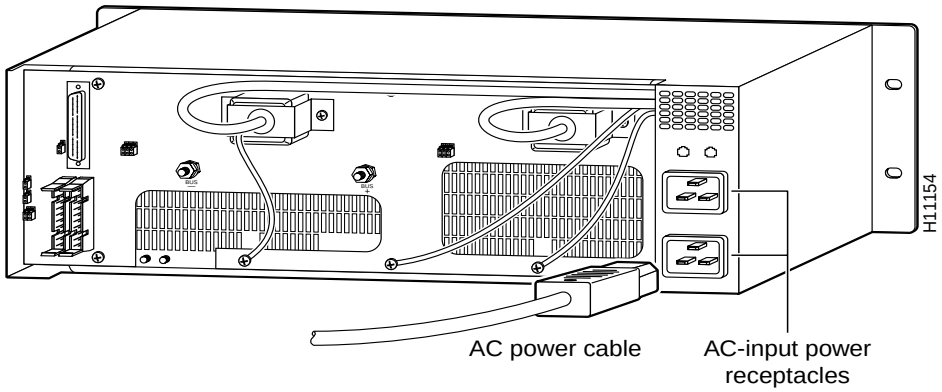
Step 2 Disconnect the monitor cable DB-9 connector from the base of the filter module. (See Figure 5-26.)

Figure 5-26 Filter Module Monitor Cable DB-9 Connector



Step 3 Disconnect power cables to the optional AC-input power shelf. (See Figure 5-27.)

Figure 5-27 AC-Input Power Shelf Cable Connections



After you disconnect the cables, you must disconnect the dial-shelf controller cards and feature cards from the backplane connectors. You do not need to remove the cards completely from the dial-shelf chassis; however, you must disconnect incoming CE1/CT1 trunk line cables.

To disconnect the feature cards and dial-shelf controller cards from the backplane, follow these steps:

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

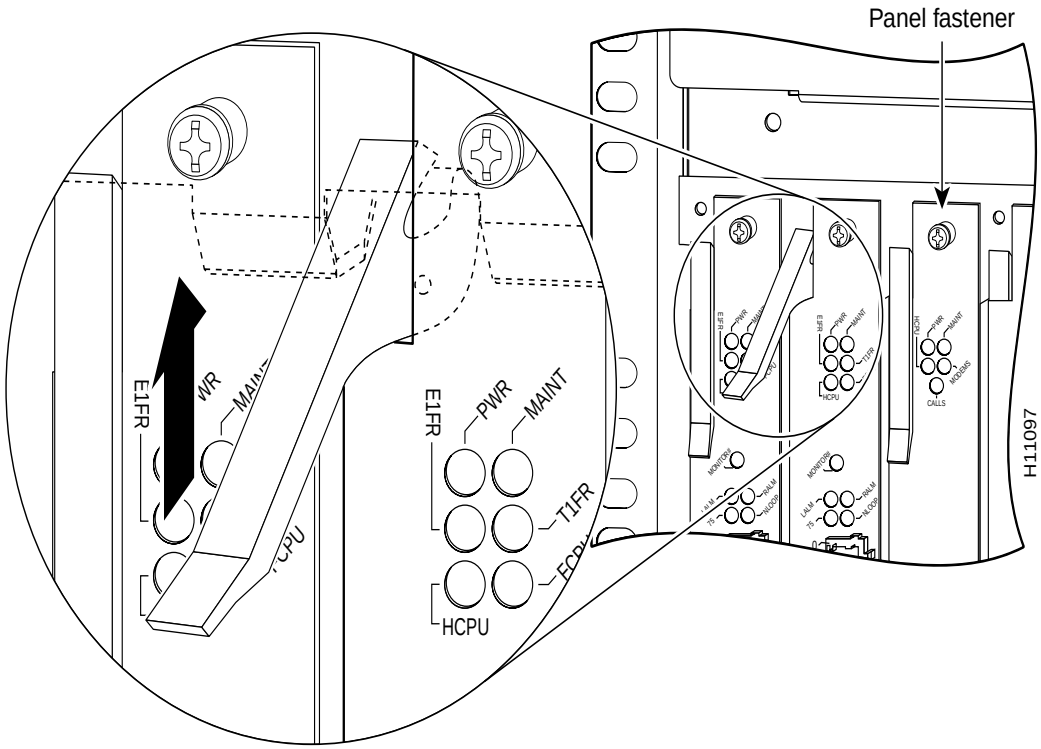
Step 2 Disconnect incoming CE1/CT1 trunk line cables and secure them out of the way using cable ties, if necessary. On the dial-shelf controller card, disconnect the dial-shelf interconnect cable and the 10BaseT connection, if applicable.

Warning **Before opening the chassis, disconnect the telephone network cables to avoid contact with telephone-network voltages.**

Step 3 Using a number 2 Phillips screwdriver, loosen the panel fasteners at the top and bottom of the card front panel.

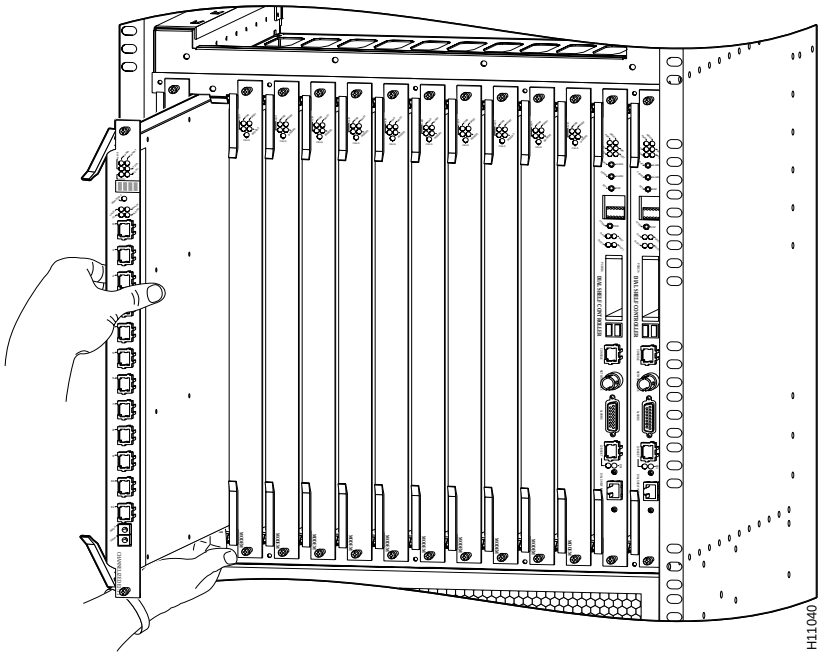
Step 4 Pull either the upper or lower ejector lever away from the card front panel to disengage the card from the backplane connector. (See Figure 5-28.)

Figure 5-28 Ejector Lever Enlarged



Step 5 Grasp the ejector levers and pull the card partially out of the dial-shelf slot. (See Figure 5-29.)

Figure 5-29 Removing Feature Cards and Dial-Shelf Controller Cards

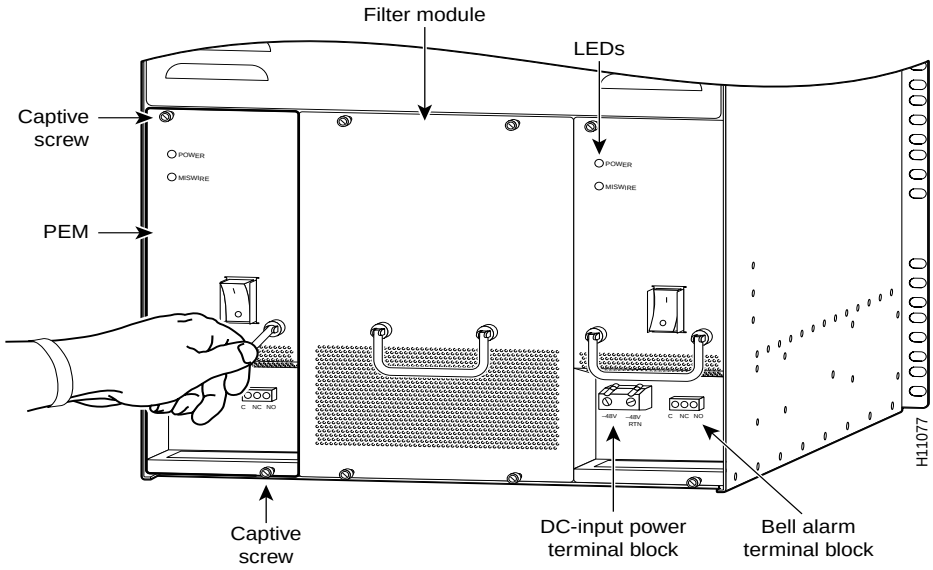


Return to the rear of the dial shelf and continue by removing the PEMs, the filter module, and the back cover. You also need to remove the horizontal bar that attaches the bottom of the back cover and the tops of the PEMs and filter module to the chassis.

Step 1 Using a 1/4-in. flat-blade screwdriver, loosen the two captive screws on each PEM front panel.

Step 2 Remove the PEMs from the dial shelf and set them aside until you are ready to reinstall them. (See Figure 5-30.)

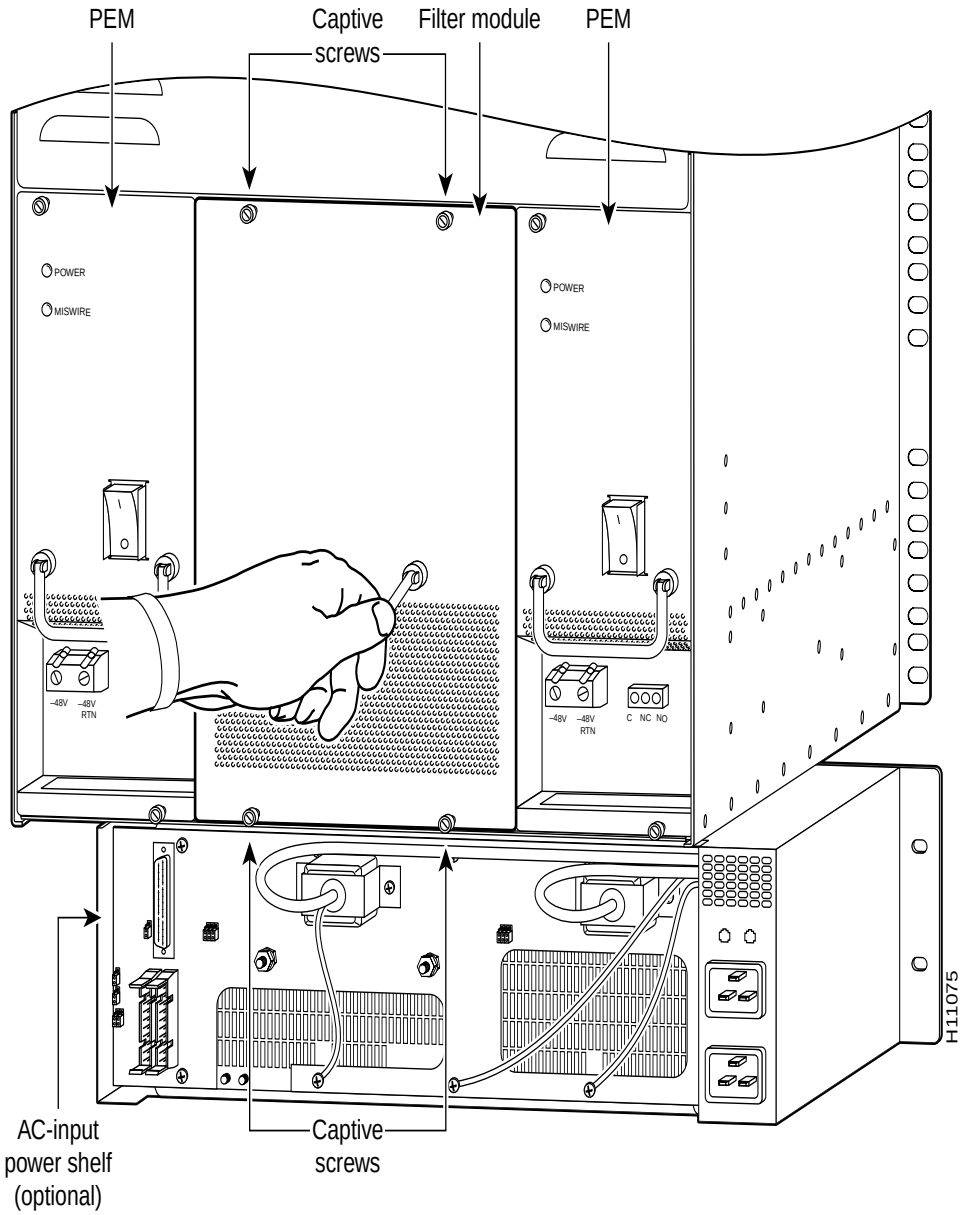
Figure 5-30 PEM Removal



Step 3 Using a 1/4-in. flat-blade screwdriver, loosen the captive screws on the filter module front panel.

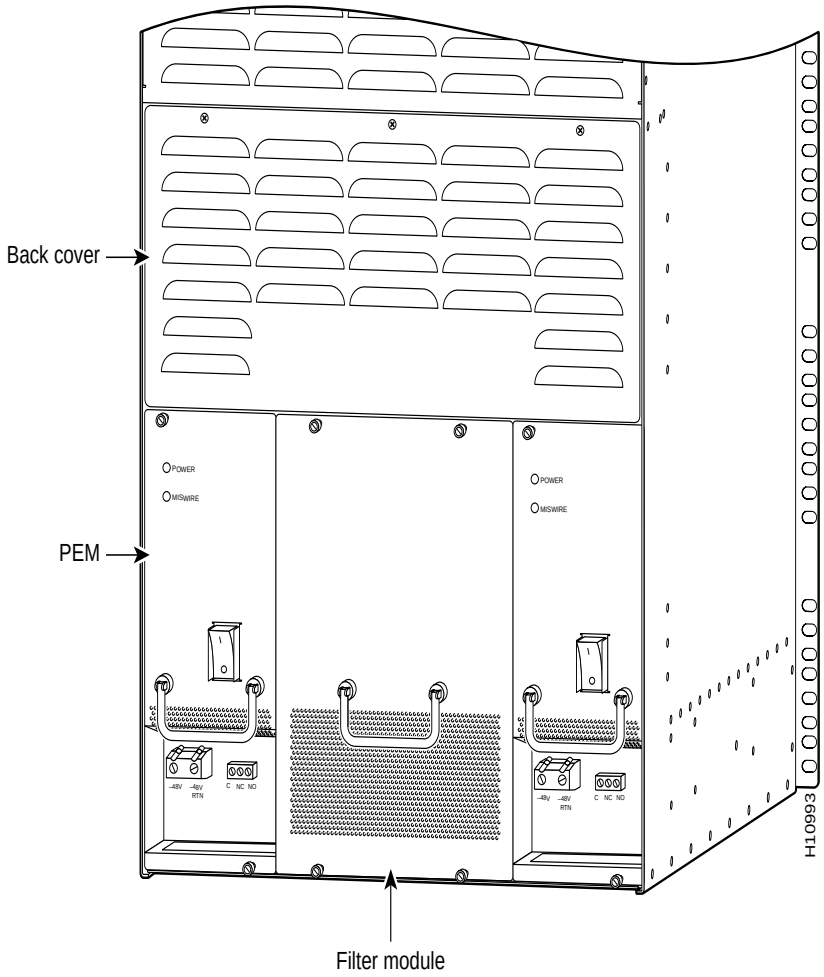
Step 4 Remove the filter module from the dial shelf and set it aside until you are ready to reinstall it. (See Figure 5-31.)

Figure 5-31 Filter Module Removal



Step 5 Remove the back cover using a number 2 Phillips screwdriver. Remove the screws located on the dial-shelf back cover grill. (See Figure 5-32.) Save the screws.

Figure 5-32 Dial-Shelf Chassis Back Cover

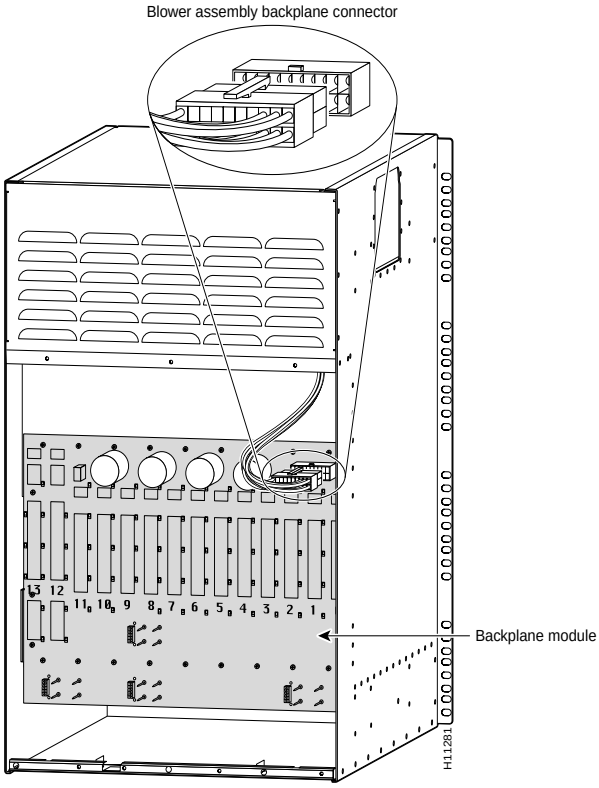


Step 6 Locate the horizontal bar that spans the width of the dial-shelf chassis rear (see Figure 5-32) and remove the four screws (two on each side of the dial-shelf outer chassis) using a No. 2 Phillips screwdriver. Save the screws.

To complete the backplane removal procedure, complete the following steps:

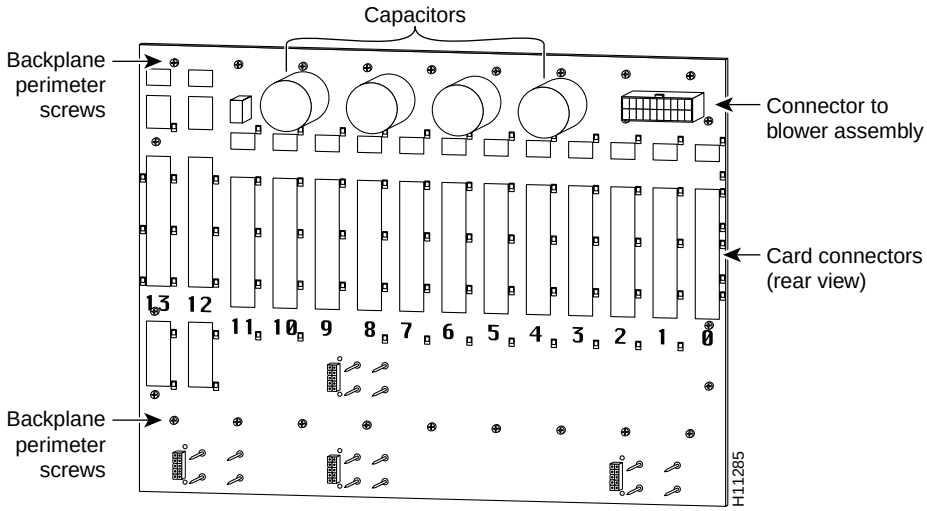
Step 1 Disconnect the cable connection to the dial-shelf blower assembly. (See Figure 5-33.)

Figure 5-33 Blower Assembly Backplane Connector



Step 2 Remove the 26 M3 x 8-mm screws around the backplane perimeter using a No. 2 Phillips screwdriver. (See Figure 5-34.) Save the screws.

Figure 5-34 Backplane Module—Rear View



Step 3 Remove the backplane and place it in an ESD shielding bag. Use the replacement backplane carton to return the faulty backplane to the factory, if necessary.

Replacing the Backplane

To replace the backplane complete the following steps and reverse the procedures used to remove cables and components. When you finish, use a Site Log sheet to record service maintenance.

Step 1 Unpack the new backplane module (MAS-5814BP=) from the ESD shielding bag and install the backplane in the same position as the one you just removed.

Step 2 Reuse the screws used to secure the old backplane and tighten the screws using a No. 2 Phillips screwdriver. (See Figure 5-34.)

Step 3 Connect the cable connection to the dial-shelf blower assembly. (See Figure 5-33.)

Step 4 Replace the back cover. Reuse the screws used to secure the back cover and tighten the screws using a No. 2 Phillips screwdriver. (See Figure 5-32.)

Step 5 Replace the dial-shelf filter module and tighten the captive screws on the front panel using a 1/4-in. flat-blade screwdriver. If using the AC-input power shelf, connect the monitor cable. The DB-9 connector connects to the filter module; the DB-25 connector connects to the optional AC-input power shelf. (See Figure 5-26.)

Step 6 Replace the dial-shelf PEMs and tighten the captive screws on the front panels using a 1/4-in. flat-blade screwdriver. Then reconnect the power cables.

Step 7 From the front of the dial shelf, reseat the dial-shelf controller cards and the feature cards using the ejector levers and tighten the panel fasteners with a number 2 Phillips screwdriver. (See Figure 5-28 and Figure 5-29.)

Step 8 Power ON the main power source circuits for the Cisco AS5800.

Step 9 Power ON (|) the dial shelf using the power switches located on each PEM front panel.

Step 10 If using the optional AC-input power shelf, power ON (|) the power supplies using the power switches on the power shelf front panel.

Step 11 Power ON (|) the router shelf using the power switches located on the Cisco 7206 router-shelf rear panel.

Step 12 Note the service maintenance on your Site Log sheet.

This completes the backplane removal and replacement procedure. The backplane is a passive design. Specific verification and troubleshooting instructions are considered unnecessary.

Troubleshooting

This section describes possible causes for specific symptom related to Cisco AS5800 hardware components and software configurations.

For system startup and subsystem troubleshooting, refer to the chapter on troubleshooting in the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

Common Misconfigurations

- Incorrect ISDN switch-type
- Orphan async interfaces
- Encapsulation PPP missing
- ISDN incoming-voice missing
- Dialer group/dialer-list missing
- Async mode interactive missing
- Multilink bundle-name both not configured

AS5800 Router Shelf

Symptom

- Cisco AS5800 RS boots up with “boot” prompt.

Possible Cause

- Invalid *boot system* statement in the config.
- No/wrong image on flash card for the platform.
- Image downloaded in-correctly.

AS5800 Dial Shelf

Symptom

- Dial-shelf controller shows “down” state.
- OIR not detected.

Possible Cause

- DSIC is not connected securely.
- DSC has the incorrect image.
- Faulty DSC.

Feature Cards

Symptom

- Feature Cards not coming up.

Possible Cause

- DSC is in the down state.
- FB not seated properly.
- FB not in the correct slot.
- FB is broken.

Controller T1

Symptom

- Slips on T1 controllers.

Possible Cause

- T1’s from multiple switches (clocking problem).
- Problematic T1 is used for clocking.
- DSC is in free-running mode.

General Configuration

Symptom

- The NAS was working okay, then it does not do what is expected.

Possible Cause

- Configuration changed, do "diff.".
- Equipment failure (modem).
- Telco line provision changed.

Symptom

- Call does not authenticate.

Possible Cause

- Incorrect AAA authentication.
- Login/ppp authentication method not defined or not applied for dialer/group-async/virtual-template.
- Misconfigured radius-server.

Symptom

- Call connects and authenticates, but can not seem to get traffic across.

Possible Cause

- *Dialer-list* not defined or not installed.
- Route/data filter installed.
- Modem is in retrain constantly.
- Incoming connection became part of an existing MLP bundle because account is shared.

Symptom

- User has idle-timer/session timer installed but never disconnects.

Possible Cause

- Make sure correct timer is installed.
- Multicast traffic/routing update is resetting idle-timers.

Async Calls

Symptom

- Async user gets fast busy.

Possible Cause

- ISDN PRI layer 2 is not up/channel busied out.
- *ISDN incoming-voice mode* not configured.
- Modem can not be allocated (busied out, firmware download in progress).
- DNIS screening is enabled and access-rejected.
- *ISDN switch-type* reconfigured, NAS needs reload.

Symptom

- Some users can connect but some can not.

Possible Cause

- Incorrect password/modem problem.
- *Dialer caller xxxxxxxxxx* configured and user does not deliver caller-id.
- Telco provision problem.

Symptom

- Async user modem will not train-up or connect at low speed and retrains often.

Possible Cause

- Check for slip seconds on the T1 controller.
- Check for A/u-law, modemcap.
- Check for client modem firmware version.
- Check for client modem compatibility issues.

Interactive Async User

Symptom

- Interactive Async user does not get Username Prompt.

Possible Cause

- Need to hit return after connect.
- *Async-mode interactive* not configured.

Interactive Users

Symptom

- Interactive users can not authenticate.

Possible Cause

- Incorrect method under AAA or method-list under line configuration.
- Back-end authentication rejected (RADIUS/TACACS).

Symptom

- Interactive user authenticates but PPP does not/cannot start (even after “ppp default”).

Possible Cause

- User is not authorized to start PPP based on RADIUS/TACACS profile.
- Unable to assign an IP address.

Symptom

- User authenticates and PPP appears to start but fails eventually.

Possible Cause

- User is double authenticated.
  - AAA authen PPP login if-needed radius
- IP address allocation/PPP negotiation failure.

Dedicated-PPP Users

Symptom

- Interactive async user can connect and authenticate, but dedicated PPP user can not authenticate.

Possible Cause

- AAA authentication PPP not defined.
- Autoselect PPP not defined under line.
- Autoselect during-login not defined under line.
- Back-end authentication rejected.

Symptom

- User authenticates but gets disconnected.

Possible Cause

- IP address could not be allocated - pool/dhcp.
- PPP negotiation failed due to incompatible parameters.
- MLP call but PPP multilink not enabled.

PPP Users

Symptom

- User authenticated and successfully logged in but cannot get to anywhere.

Possible Cause

- Modem is in retrain.
- User is treated as part of a multilink bundle.
- Incorrectly defined data-filters.
- Dialer-list *x* protocol ip permit is not defined.

Sync Calls

Symptom

- Sync user gets “no answer” or “busy.”

Possible Cause

- Controller T1 / isdn layer 2 is down, channels busied out.
- *ISDN switch-type* reconfigured. NAS as need reload.
- DNIS screening is enabled and call is rejected due to radius server access-reject.
- Telco provisioning problem.

MMPPP

Symptom

- First channel/modem dial-in and connect fine, but second channel/modem does not connect to the same NAS.

Possible Cause

- First channel/modem not negotiated as a MLP call.
- *PPP multilink* not configured.

Symptom

- First channel/modem dial-in and connect fine, but second channel/modem does not connect to the different NAS.

Possible Cause

- SGBP not configured.
- SGBP not succeeding.

RADIUS

Symptom

- No response for Access/Accounting-Requests generated by NAS.

Possible Cause

- Radius server/ports not reachable from NAS.
- NAS not configured/recognized by RADIUS server.
- Shared secret does not match.
- Unreliable connection between NAS and RADIUS.

Symptom

- Getting Access-Reject for Access-Request.

Possible Cause

- User is not in the radius database. Database needs reload.
- Incorrectly formatted/configured radius user profile.
- One of the check-items in profile does not match the corresponding value in Access-Request.

Symptom

- Idle/Session timeout defined in RADIUS but not installed (MLP or PPP w/ 1-channel ISDN).

Possible Cause

- Virtual-profile aaa not configured.

SGBP Troubleshooting

Debug Commands

- **debug sgbp hellos**
- **debug sgbp errors**

CHAPTER 6

Provisioning

This chapter describes basic hardware and service provision considerations such as system environment requirements, physical infrastructure checklists, IP service considerations, and system upgrade procedures for the Cisco AS5800.

For details on the following, refer to the information on preparing for installation in the *Cisco AS5800 Access Server Hardware Installation Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/as5800/hw_inst/

- Safety recommendations
- Site requirements such as shelf specifications, space, chassis heights, rack types, mounting options, power and plant wiring
- Site logs for monitoring installation progress, or recording upgrade history

Note House the Cisco AS5800 in an area with constant temperature and humidity. Cooler environments are ideal for stabilizing hardware temperatures. Humidity should be high enough to prevent accumulation of static electricity, yet low enough to prevent condensation. Relative humidity up to 90% is acceptable.

Setting Up Basic IP Modem Services

This section describes how to set up and provision basic modem IP services using a Cisco AS5800 network access server. It is tailored for network engineers who work with dialup access technologies, and assumes the reader is Cisco certified or familiar with Cisco IOS routers and technologies.

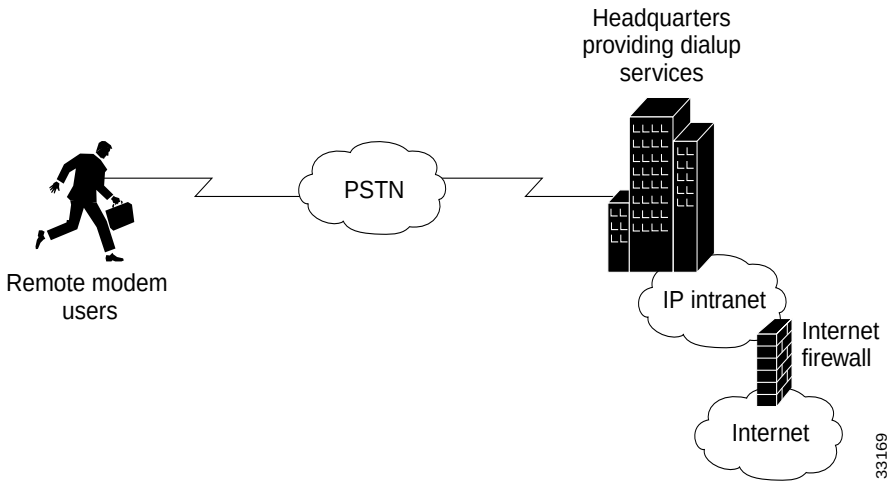
Corporate users and Internet service providers (ISP) install dialup services to facilitate e-mail, e-commerce, and application/database access for employees, roaming sales personnel, household consumers, and students. As a corporate user or ISP, you want to:

- Enable remote modem users to access IP backbone resources through the Public Switched Telephone Network (PSTN).
- Build an access network foundation that scales to support larger dial implementations for the future.

The following section discusses:

- Planning and designing a basic IP modem dialup network
- Deploying networking equipment by configuring, verifying, and troubleshooting the Cisco IOS software
- Preparing for operations by inspecting modem call statistics and enabling basic management protocols

Figure 6-1 Business Scenario



Network-Service Considerations

The network-service definition for a corporate user generally differs from that for an ISP, as shown in Table 6-1.

Table 6-1 Network-Service-Definition Perspectives

Attribute	Corporate-User Perspective	ISP Perspective
Scaling projections	Have smaller projections.	Have larger projections, and require higher-density network gateways such as the Cisco AS5850.
Line requirements	Have lower requirements.	Have higher requirements.
Client types and Internet access	Control the client types used by their employees.	Offer Internet access to all client types.
Security and billing	Care more about security and less about billing.	Care more about billing and less about security.
V.90	Have lower V.90 priority and spend less time fine-tuning V.90. Revenue streams do not depend on high modem-connect speeds, and so will most likely deploy dialup service for employees.	Have higher V.90 priority and spend more time fine-tuning V.90. Primary objective is to enable 56K modem connections, because higher connect speeds equate to increased sales.
AAA design	Consider to be important, because a defined security policy protects enterprise network resources.	Consider to be less important.
Multilink PPP support for remote dialin	Generally do not need.	Need in a stacked solution for future deployment.
Password changes	Enable network administrators to change their own passwords using an EXEC shell login.	Allow users to change their own passwords using a website interface.
Password security	For the short term, store user passwords in a local username database inside the route switch controller (RSC). In the long term, may scale to remote TACACS+ security for storing user passwords; users can change passwords using the EXEC shell.	For the short term, store user passwords in a local username database inside the RSC. In the long term, scale to remote AAA RADIUS security for storing user passwords; users can change passwords using the Cisco Secure website.
Per-user attribute definitions (authorization)	Support; enable vendors to dial in, pass through filters, and access specific devices.	Do not support; provide Internet access only.

Establishing a Network-Service Definition

Begin your implementation of basic IP UPC services by establishing a network service definition. Use the perspectives described in Table 6-1 preceding and in the following list of design and configuration considerations as a guide. A conservative approach is to project your current deployment and design into a three-month, one-year, and five-year timeline.

Step 1 Project user growth and resulting line requirements (lines=users/busy-hour ratio) over the following intervals:

- 3 months (example: 25 lines)
- 1 year (example: 50 lines)
- 5 years (example: 100 lines)

Step 2 Determine user-to-line ratio during busy hours.

Step 3 Determine access media to be used for dial services:

- Analog lines
- ISDN BRI lines

Step 4 Determine types of remote devices to support:

- Analog modems
- Remote LANs
- PCBUS ISDN terminal adaptors
- V.110
- V.120

Step 5 Determine operating systems to support:

- Windows 95
- Windows 98
- Windows NT
- UNIX
- Mac OS

Step 6 Determine if dial-in modem services will be supported.

Step 7 Rank technology priorities:

- AAA design
- IP design
- V.90 modem performance

Step 8 Determine which access service will be used for connecting to modems:

- EXEC shell sessions
- PPP sessions
- SLIP sessions

Step 9 Determine if multilink will be supported. If yes, indicate whether you will scale to a stacked multichassis solution.

Step 10 Determine if PPP timeouts (accounting) will be supported.

Step 11 Determine where user passwords will be stored in the short term:

- Local AAA database in the router
- Remote AAA database in a server

Step 12 Determine if an AAA server will be used in the long term. If yes, specify which protocol will be used:

- TACACS+
- RADIUS

Step 13 Determine if users will be allowed to change their own passwords. If yes, specify how:

- EXEC shell
- CiscoSecure website

Step 14 Determine if the access network will use an external authentication database such as SecureID, Windows NT, or Novell NDS.

Step 15 Determine if per-user attribute definitions (authorization) will be supported.

Step 16 Indicate whether an existing accounting system to monitor call-detail records is in place.

Step 17 Indicate whether you are running an existing network-management system. If no, determine whether a network-element management server is needed

Cisco IOS Upgrades

This section describes Cisco IOS upgrade procedures for the Cisco AS5800. The following tasks are detailed.

- Installing a TFTP (Trivial File Transfer Protocol) server for telnet purposes
- Determining memory requirements
- Obtaining a new Cisco IOS software version
- Backing up existing Cisco IOS software images and configurations
- Upgrading the Cisco IOS image for the Cisco 5814 dial shelf (DS)
- Upgrading the Cisco IOS image for the Cisco 7206 router shelf (RS)
- Upgrading the Bootflash boot image for the Cisco 7206 router shelf (RS)

A Cisco IOS upgrade requires a compatible Cisco IOS image upgrade on both the dial-shelf controller (DSC) cards and router-shelf (RS) components of the system. Two distinct upgrade procedures are necessary, one for each component.

Note Sufficient memory (available bytes) is required to accommodate any new image file size on the RS and DSC! Contact your Cisco Sales Representative for memory upgrades.

Note Cisco IOS software is feature specific and licensed on an “as is” basis without warranty of any kind, either expressed or implied. The version of Cisco IOS software used in this manual varies depending on configuration requisites for presentation purposes, and should not be construed as the Cisco IOS software version of choice for your system or internetwork environment. Consult your Cisco Sales Representative regarding your Cisco IOS requirements.

Software Upgrade Requisites

To upgrade a Cisco IOS software image you need the following:

- An established network connection between the PC you are designating as your TFTP server and your access server
- Access to the Cisco website (CCO) for downloading the Cisco IOS software

Memory Requirements

Before installing new software, first determine the amount of available memory in RAM and Flash.

Note You must have sufficient memory available on your Access Server to accommodate the file size memory requirements for new software you want to load.

Step 1 Determine the amount of available random access memory (RAM) for processing purposes.

```
AS5800#show version
Cisco Internetwork Operating System Software
IOS (tm) 5800 Software (C5800-P4-M), Version 12.x
...
ROM: System Bootstrap, Version 12.x
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version 12.x
...
cisco 7206VXR (NPE400) processor with 253952K/40960K bytes of memory.
...
16384K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
...
AS5800#
```

Step 2 Determine the amount of available flash memory for storage purposes.

```
AS5800# show flash
-#- ED --type-- -- --- -seek-- nlen -length- -----date/time------ name
1   .. image    AAD4004B  719C50   25  7314384 May 02 2000 13:55:04
c5800-p4-mz_120-4_XL1.bin
9069488 bytes available (7314512 bytes used)
```

Step 3 Record this memory values for future reference.

Obtaining a New Cisco IOS Version

To obtain a recent version of the Cisco IOS software, you need access to the Cisco.com website.

Cisco IOS software is version specific bundled software that includes the following compatible components:

- Router-shelf (or system) image (c5800-p4-mz.XXX)
- Dial-shelf controller (DSC) image (dsc-c5800-mz.XXX)
- Boot image (c7200-boot-mz.XXX)

Step 1 Log onto the Cisco.com website at the following URL to enter your AS5800 image selection criteria: http://www.cisco.com/cgi-bin/Software/Iosplanner/Planner-tool/iosplanner.cgi

Note Images much match the specific version of Cisco IOS software being installed. Example: If attempting to run 12.0.7T, you must run the 12.0.7T dial-shelf (DSC) image (dsc-c5800-mz.XXX) and the 12.0.7T router-shelf image (C5800-p4-mz.XXX) to secure proper system functionality.

Step 2 After verifying that you have sufficient memory, download the router shelf, dial shelf, and boot image to your TFTP server.

Backing Up Your AS5800 Configuration

Cisco recommends backing up all existing Cisco IOS images and configurations from privileged exec mode.

Note Back up current Cisco IOS images (boot, router-shelf, dial-shelf) and configurations to your TFTP server before upgrading. By default, files are copied to and from the Cisco TFTP root directory.

Step 1 Back up your existing startup configuration. Use a distinct file name for the startup configuration. This makes it easy to distinguish from other startup configurations previously saved on your TFTP Server.

```
AS5800# copy startup-config tftp
Address or name of remote host []? 171.71.219.167
Destination filename [startup-config]? AS5800-startup
!!
3449 bytes copied in 0.136 secs
```

Step 2 Back up your existing running configuration. Use a distinct file name for the running configuration. This makes it easy to distinguish from other running configurations previously saved on your TFTP Server.

```
AS5800# copy running-config tftp
Address or name of remote host []? 171.71.219.167
Destination filename [running-config]? AS5800-running-config
!!
3312 bytes copied in 0.140 secs
```

Step 3 Save your running-configuration to your startup configuration in NVRAM.

```
Router# copy running-configuration start-up configuration
```

Note Do not modify your running configuration during the Cisco IOS upgrade process.

Step 4 Determine the current boot image.

```
AS5800# show bootflash:
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    AC05EDDF  37A6B8   22  3384888 Dec 31 1999 18:08:09 c7200-boot-mz.120-4.XE
```

Step 5 Back up the boot image (c7200-boot-mz.XXX) from bootflash to your TFTP server. Use the file name obtained in Step 4.

```
AS5800# copy bootflash: tftp
Source filename [c]? c7200-boot-mz.120-4.XE
Address or name of remote host []? 171.71.219.167
Destination filename [c7200-boot-mz.120-4.XE]?
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
3384888 bytes copied in 89.920 secs (38032 bytes/sec)
```

Step 6 Determine the router shelf's current flash image.

```
AS5800# show flash
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    AAD4004B  719C50   25  7314384 May 02 2000 13:55:04
c5800-p4-mz_120-4_XL1.bin
```

Step 7 Back up the current router-shelf Cisco IOS image (C5800-p4-mz.XXX) stored in flash memory. Use the file name obtained in Step 6.

```
AS5800# copy flash tftp
Source filename []? c5800-p4-mz_120-4_XL1.bin
Address or name of remote host []? 171.71.219.167
Destination filename [c5800-p4-mz_120-4_XL1.bin]?
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
7314384 bytes copied in 218.684 secs (33552 bytes/sec)
```

Step 8 On your TFTP Server, verify that files were copied (backed up).

Note By default, files are copied to and from the Cisco TFTP root directory.

Installing New IOS Software

A Cisco IOS upgrade requires a compatible Cisco IOS image upgrade on both the dial-shelf controller (DSC) cards and router-shelf (RS) components of the system. Two distinct upgrade procedures are necessary, one for each component.

Note Cisco recommends upgrading the dial-shelf controllers first, since all upgrades are performed through the router shelf. Once DSCs are upgraded, the router shelf is not be able to communicate with the DSCs until a compatible Cisco IOS image is installed on the RS.

Note Do not modify your running configuration during the Cisco IOS upgrade process.

Note Upgrade verifications are performed after all necessary upgrades are complete, and all system components are reloaded.

Upgrading the DSC Software

The following procedure outlines commands used to perform a Cisco 5814 dial-shelf controller (DSC) software upgrade from the router shelf.

Step 1 Log in to the Cisco AS5800 router shelf and enter Enable (privileged exec) mode.

Step 2 Identify Cisco IOS images in the DSC bootflash.

```
AS5800# execute-on slot 12 show bootflash:
DA-Slot12#
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    BC8CA85F  251C60   26  2169824 Nov 18 1999 22:12:15
dsc-c5800-mz.120-4.XL1.bin
```

Step 3 Delete the current Cisco IOS images from bootflash.

```
AS5800# execute-on slot 12 delete bootflash:dsc-c5800-mz.120-4.XL1.bin
DA-Slot12#
Delete filename [dsc-c5800-mz.120-4.XL1.bin]?
Delete bootflash:dsc-c5800-mz.120-4.XL1.bin? [confirm]
AS5800#
```

Step 4 Squeeze the DSC bootflash.

```
AS5800# execute-on slot 12 squeeze bootflash

DA-Slot12#
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]

Squeeze of bootflash complete
```

Step 5 Identify Cisco IOS images in the DSC flash.

```
AS5800# execute-on slot 12 show flash

DA-Slot12#
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    BC8CA85F  231C60   26  2169824 Sep 16 1999 18:10:32
dsc-c5800-mz.120-4.XL1.bin
2   .D image    8FDE1F61  45FEC8   18  2286056 Jan 25 2000 18:28:57 dsc-c5800-mz.Jan21
```

Note Remember, sufficient memory (available bytes) is required to accommodate any new image file size on the RS and DSC! Compare memory size obtained in "Memory Requirements".

Step 6 Delete images or files no longer required.

```
AS5800# execute-on slot 12 delete flash:dsc-c5800-mz.120-4.XL1.bin
DA-Slot12#
Delete filename [dsc-c5800-mz.120-4.XL1.bin]?
Delete slot0:dsc-c5800-mz.120-4.XL1.bin? [confirm]
AS5800#
```

Step 7 Squeeze the DSC flash to remove deleted files.

```
AS5800# execute-on slot 12 squeeze flash:
DA-Slot12#
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]
Writing sector: 1
Squeeze of slot0 complete
```

Step 8 Download the new DSC image from your TFTP server to the DSC flash.

Note By default, files are copied to and from the Cisco TFTP root directory.

```
AS5800# copy tftp:dsc-c5800-mz.120-7.T.bin dsc12-slot0
Address or name of remote host [171.71.219.167]?
Source filename [dsc-c5800-mz.120-7.T.bin ]?
Destination filename [dsc12-slot0]?
Accessing tftp://171.71.219.167/dsc-c5800-mz.120-7.T.bin ...
%Warning: File not a valid executable for this system
Abort Copy? [confirm]n
Loading dsc-c5800-mz.120-7.T.bin from 171.71.219.167 (via FastEthernet0/0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

The following Warning message appears.

```
%Warning: File not a valid executable for this system
Abort Copy? [confirm]
```

Note **Do not abort the copy process.** This message implies that the file being downloaded is not router-shelf compatible, which is true. However, the router assumes the file being downloaded will be executed on the router shelf, when, in fact, the file is a dial-shelf controller file, being downloaded to the dial shelf through the router, that will ultimately be executed on the dial shelf.

Step 9 Enter **n** to proceed with the download.

Step 10 Copy the new DSC image to the DSC bootflash:

```
AS5800# execute-on slot 12 copy slot0:dsc-c5800-mz.120-7.T.bin
bootflash:
DA-Slot12#
Destination filename [dsc-c5800-mz.120-7.T.bin ]?
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
2169824 bytes copied in 24.464 secs (90409 bytes/sec)
```

Step 11 Reload the DSC to load the new image.

```
Router# execute-on slot 12 reload
```

Step 12 Repeat this procedure if you have a second DSC card to ensure both cards are running the same software release. The only change to the commands will be the slot number (“13” instead of “12”).

Note At this juncture, the DSCs and router shelf are not running the same Cisco IOS image, so you will not be able to communicate with the DSC through the router shelf.

Upgrading the Router-Shelf Software

The following procedure outlines commands used to perform a Cisco 7206 router-shelf (RS) software upgrade from the router shelf.

Note Unless you installed new port adapters in the router shelf, do not upgrade the boot image. See the "Upgrading the Router-Shelf Boot Image" section on page 6-12.

Step 1 Identify Cisco IOS images in the RS flash.

```
AS5800# show flash
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    AAD4004B  719C50   25  7314384 May 02 2000 13:55:04
c5800-p4-mz_120-4_XL1.bin
9069488 bytes available (7314512 bytes used)
```

Note Remember, sufficient memory (available bytes) is required to accommodate any new image file size on the RS and DSC! Compare memory size obtained in "Memory Requirements".

Step 2 Delete images or files no longer required.

```
AS5800# delete slot0:c5800-p4-mz_120-4_XL1.bin
Delete filename [c5800-p4-mz_120-4_XL1.bin]?
Delete slot0:c5800-p4-mz_120-4_XL1.bin? [confirm]
```

Step 3 Squeeze the flash to remove all deleted files.

```
AS5800# squeeze slot0:
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]
Squeeze of slot0 complete
```

Step 4 Download the new image from your TFTP server to the RS flash.

Note By default, files are copied to and from the Cisco TFTP root directory.

```
AS5800# copy tftp:c5800-p4-mz.120-7.T.bin slot0:
Address or name of remote host [171.71.219.167]?
Source filename [c5800-p4-mz.120-7.T.bin ]?
Destination filename [c5800-p4-mz.120-7.T.bin ]?
Accessing tftp://171.71.219.167/c5800-p4-mz.120-7.T.bin ...
Loading c5800-p4-mz.120-7.T.bin from 171.71.219.167 (via
FastEthernet0/0/0):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

Step 5 Upgrade the bootflash, if applicable. See the "Upgrading the Router-Shelf Boot Image" section on page 6-12.

Note Unless you are installing new port adapters in the router shelf, do not upgrade the boot image. See the "Upgrading the Router-Shelf Boot Image" section on page 6-12.

Step 6 Reload the router shelf to load the new image.

```
Router# reload
```

Upgrading the Router-Shelf Boot Image

The following procedure outlines commands used to perform a Cisco 7206 router-shelf (RS) boot image software upgrade from the router shelf.

Note Unless you installed new port adapters in the router shelf, do not upgrade the boot image.

Step 1 Identify the current bootflash image.

```
AS5800# show bootflash
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    AC05EDDF  37A6B8   22  3384888 Dec 31 1999 18:08:09 c7200-boot-mz.120-4.XE

1 bytes available (3407872 bytes used)
```

Step 2 Delete the current boot image from bootflash.

```
AS5800# delete bootflash:
Delete filename []? c7200-boot-mz.120-4.XE
Delete bootflash:c7200-boot-mz.120-4.XE? [confirm]
```

Step 3 Squeeze the bootflash to remove all deleted files.

```
AS5800# squeeze bootflash:
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]

Squeeze of bootflash complete
```

Step 4 Copy the boot image from your TFTP server (c7200-boot-mz.XXX) to bootflash.

```
AS5800# copy tftp bootflash:
Address or name of remote host []? 171.71.219.167
Source filename []? c7200-boot-mz.120-7.T.bin
Destination filename [c7200-boot-mz.120-7.T.bin]?
Accessing tftp://171.71.219.167/c7200-boot-mz.120-7.T.bin...
Loading c7200-boot-mz.120-7.T.bin from 171.71.219.167 (via FastEthernet0/0/0):!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 3384888/6769664 bytes]

3384888 bytes copied in 65.112 secs (52075 bytes/sec)
```

Software Upgrade Verification

Perform the following steps to verify that the router shelf and DSCs are running new Cisco IOS images, and the Bootflash is running a new boot image.

Step 1 Check the dial-shelf controllers for a new Cisco IOS image.

```
AS5800# execute-on slot 12 show version

DA-Slot12>
Cisco Internetwork Operating System Software
IOS (tm) 5800 Software (C5800-DSC-M), Version 12.x
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 12-Aug-99 18:48 by ayeh
Image text-base: 0x600088F0, data-base: 0x60520000

ROM: System Bootstrap, Version x AA, ROM: 5800 Software (C5800-DSC-M),Version 12.x

DA-Slot12 uptime is 41 minutes
System returned to ROM by reload
System image file is "slot0:dsc-c5800-mz.120-7.T.bin "

Router# execute-on slot 13 show version (IF APPLICABLE)
```

Step 2 Check the router shelf for a new Cisco IOS image.

```
AS5800# show version
Cisco Internetwork Operating System Software
IOS (tm) 5800 Software (C5800-P4-M), Version 12.x, TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 12-Aug-99 13:16 by ayeh
Image text-base: 0x60008900, data-base: 0x611A6000

ROM: System Bootstrap, Version 12.x
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version 12.x

doc-rtr58-01 uptime is 9 minutes
System returned to ROM by reload at 16:04:24 CST Fri Jun 9 2000
System restarted at 16:05:39 CST Fri Jun 9 2000
System image file is "slot0:c5800-p4-mz.120-7.T.bin"
```

Step 3 Check the Bootflash for a new boot image.

```
AS5800#sh bootflash:
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    AC05EDDF  37A6B8   22  3384888 Jun 12 200014:00:23
c7200-boot-mz.120-7.T.bin

22856 bytes available (3385016 bytes used)
```

Modem Upgrading

Compatible modem firmware is included in each Cisco IOS bundled software version and upgraded as part of the installation process.

Note Do not install a separate version of modem firmware independent of the Cisco IOS software it accompanies. See the “Modem Upgrades” section on page 6-14.

Modem Upgrades

This section describes basic debugging and modem commands used for upgrading modem module firmware as well as modem activation considerations. The **show modem version** command output is displayed to verify a successful download.

Debugging a Modem

Use the following commands for debugging a modem or group of modems.

From the Cisco IOS privileged mode `AS5800-1#` .

- Debug a modem's out-of-band port that is used to poll modem events.

  debug modem oob *shelf/slot/port* **group** *group_number*

- Debug a call-switching module that is used to connect calls.

  debug csm *shelf/slot/port* **group** *group_number*

- Debug the call trace, which determines why calls are terminated. Use this keyword only with manageable modems. Upload the call trace on **normal**, **abnormal**, or **all** call terminations.

  debug modem trace {**normal** | **abnormal** | **all**} *shelf/slot/port* **group** *group_number*

Upgrading Modem Firmware

Each modem card installed in your Cisco AS5800 access server contains 12 MICA modems, each with six modem SIMMs. This allows you to upgrade firmware for each group of six modem SIMMs.

The default firmware image is loaded on the modem card during system boot-up. Normally, you do not need to change the firmware image; however, you can override the default image with another firmware image.

A valid pool range must exist (that is, the **pool-range** modem pool configuration command must have been configured) for modem overrides to occur. Modem pooling allows you to define, select, and use separate modem pools within a single access server or router to enable different dial-in services for different customers. In this case, the modem pool specifies which modems are loaded with the new firmware image.

The specified firmware image is loaded on every modem for every slot specified in the pool range. If the modem is busy, the firmware change is deferred until the modem is available. When the modem is available, the firmware change takes place immediately.If you specify a firmware image that does not exist, the information is stored so that, in the event that the modem card is updated with that firmware image, it will be loaded when the modem card image boots.

At boot-up time, the default firmware image is loaded first. If there is a firmware image specified by the **firmware** command, it is then loaded onto the modem card.

Table 6-2 lists modem firmware upgrade commands to override the default modem firmware image with another specified firmware image.

Table 6-2 Modem Firmware Upgrade Commands

Step	Command	Description
1.	AS5800-1> **enable** Password: ***password*** AS5800-1#	Enter the **enable** command. Enter your password. You are in privileged EXEC mode when the prompt changes to AS5800-1#.
2.	AS5800-1# show modem version	Determine the firmware version currently running on the modem card.
3.	AS5800-1# show modem bundled-firmware	Determine the available bundled modem firmware images per slot.
4.	AS5800-1# **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. AS5800-1(config)#	Enter global configuration mode by entering the **configure** command. The example is using the terminal configuration option. You are in global configuration mode when the prompt changes to AS5800-1(config)#.
5.	AS5800-1(config)# **modem-pool** *pool-name*	Create a modem pool and enter modem pool configuration mode.
6.	AS5800-1(config-modem-pool)# **pool-range** *shelf/slot/port shelf/slot/port*	Create the range of modems on which you want to override the modem firmware. Modem range must allow for all six modems on a modem SIMM. Thus, numbering range examples include *shelf/slot/***0** *shelf/slot/***5**; *shelf/slot/***0** *shelf/slot/***11**; *shelf/slot/***6** *shelf/slot/***23**; etc.
7.	AS5800-1(config-modem-pool)# **firmware** *version*	Enter the firmware version you want the modem pool to use. Currently, the default version is **2.2.2.2**
8.	AS5800-1(config-modem-pool)# **exit** AS5800-1(config)# [or] AS5800-1(config)# **Ctrl-Z** AS5800-1# %SYS-5-CONFIG_I: Configured from console by console	Type **exit** to exit out of modem-pool configuration mode [or] Press **Return** to verify your command registers, then type **Ctrl-Z** to return to privileged EXEC mode. This message is normal and does not indicate an error
9.	AS5800-1# **copy running-config startup-config**	Save your configuration when ready.

To deactivate a modem command, type **no** before the command:

```
AS5800-1(config)# modem-pool test
AS5800-1(config-modem-pool)# no firmware 2.2.2.2
```

To verify that a download has succeeded, use the **show modem version** command.

```
AS5800-1> show modem version
 Modem Range             Module   Firmware Rev
    1/6/00 1/6/05          0      2.2.2.2
    1/6/06 1/6/11          1      2.2.2.2
    1/6/12 1/6/17          2      2.2.2.2
    1/6/18 1/6/23          3      2.2.2.2
    1/6/24 1/6/29          4      2.2.2.2
    1/6/30 1/6/35          5      2.2.2.2
    1/6/36 1/6/41          6      2.2.1.7
    1/6/42 1/6/47          7      2.2.1.7
    1/6/48 1/6/53          8      2.2.1.7
    1/6/54 1/6/59          9      2.2.1.7
    1/6/60 1/6/65         10      2.2.1.7
    1/6/66 1/6/71         11      2.2.1.7

Modem board HW version info:

Modem Range:    1/6/00 1/6/05         Modem Module:  0
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298557,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/06 1/6/11         Modem Module:  1
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298553,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/12 1/6/17         Modem Module:  2
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298017,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/18 1/6/23         Modem Module:  3
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298019,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/24 1/6/29         Modem Module:  4
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298200,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/30 1/6/35         Modem Module:  5
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298590,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/36 1/6/41         Modem Module:  6
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
```

```
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298446,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/42 1/6/47         Modem Module:  7
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298593,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/48 1/6/53         Modem Module:  8
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298233,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/54 1/6/59         Modem Module:  9
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298309,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/60 1/6/65         Modem Module: 10
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06297954,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.

Modem Range:    1/6/66 1/6/71         Modem Module: 11
Manufacture Cookie Info:
 EEPROM Type 0x0101, EEPROM Version 0x01, Board ID 0x06,
 Board Hardware Version 1.0, Item Number 73-2522-2,
 Board Revision 051, Serial Number 06298008,
 PLD/ISP Version 255.255, Manufacture Date 17-Jul-1997.
```

Modem Operation at Bootup

When the Cisco 7206 router shelf boots up and parses its NVRAM, the modem cards will not be up. As a result, the override firmware name is stored in the modem pool structures and no action is taken.

When a modem card becomes active, it sends a startup message to the router shelf. The router shelf then triggers a search in the various modem pools to see if any modem modules on the modem card have a specified firmware override. If yes, the firmware override request is relayed to the modem card, which will load the specified override firmware image on the indicated modem modules.

As a result, the modem modules that are destined to run an override firmware image will experience two firmware downloads at bootup time. The default modem firmware image is loaded first, followed by the override modem firmware image.

Error messages result if the following circumstances exist:

- If you issue a firmware command on a modem pool that has no pool range already specified, an error message will result.
- If you issue a firmware command on a modem pool that is neither constrained nor constraint-capable, an error message will result.

- If the firmware specified is not part of the firmware list, a message is printed to the console. The firmware name is stored in the modem pool structures until that modem card is updated with the specified firmware image. The firmware upgrade then occurs when that modem card is rebooted.
- If any modem module has an active call on it, the firmware upgrade request is queued and deferred until the modem module becomes free.

Split Dial Shelves

The split mode is intended to support two router shelves connected to a single dial shelf. To use this arrangement as intended, both router shelves need a split dial shelf configured. However, a second router is not required; a single router can run in split mode with all slots owned by that router.

Split-Dial-Shelf Configuration

Split-dial-shelf configuration is implemented by connecting two router shelves to a single dial shelf. You allocate the slots in the dial shelf between the two router shelves to achieve the desired configuration. The two router shelves are configured to run in split mode by a new top-level router configuration command:

dial-shelf split slots {*slot-numbers***}**

where *slot-numbers* is a list of the dial-shelf slot numbers (from 0 to 11) that the router owns, with the slot numbers separated by spaces. Slot ownership for each of the two router shelves is configured individually using the **dial-shelf split slots** command.

- While a router is in split mode, additional slots can be added to the set that the router owns by entering a **dial-shelf split slots** command listing the new slots. The effect of entering two (or more) **dial-shelf split slots** commands with different slot numbers is cumulative.
- Slots must be explicitly removed from a router's list of owned slots with the remove command: **dial-shelf split slots remove** {*slot-numbers*}.
- A single router can also be configured in split mode but with no slots owned, by using the keyword **none** instead of slot numbers in the command (**dial-shelf split slots none).**

When you configure a Cisco AS5800 to operate in split mode, it is the same as having two Cisco AS5800s, each having a separate set of feature boards assigned to its router that happen to be sharing a single dial shelf. Modem pooling, for example, is the same as if you had two separate Cisco AS5800s. Router shelf 1 has a modem pool that consists of all the modem cards that reside in slots owned by router shelf 1. The same situation applies to router shelf 2.

Changing to Split Mode

This section describes the procedure required to transition a router from normal mode to split mode, and change the set of slots a router owns while it is in split mode. The process of switching the ownership of a slot from one router to the other is potentially disruptive. When a feature board is restarted, all calls through that card are lost. Therefore, a router shelf cannot take over a slot until ownership is relinquished by the router that currently claims ownership, either by reconfiguring the router or disconnecting that router or its associated DSC.

The dial shelf is split by dividing the ownership of the feature boards between the two router shelves. You must configure the division of the dial-shelf slots between the two router shelves so that each router controls an appropriate mix of trunk and modem cards. Each router shelf controls its set of feature boards as if those were the only boards present. There is no interaction between feature boards owned by either router.

Split mode is entered when the **dial-shelf split slots** command is parsed on the router shelf. This can occur when the router is starting up and parsing the stored configuration or when the command is entered when the router is already up. On parsing the **dial-shelf split slots** command, the router frees any resources associated with cards in the slots that it no longer owns, as specified by exclusion of slot numbers from the *slot-numbers* argument. The router should be in the same state as if the card had been removed from the slot; all calls through that card will be terminated. The configured router then informs its connected DSCs that it is in split mode, and which slots it claims to own.

In split mode, a router shelf uses only half of the 1,792 available TDM timeslots. (See the "TDM Resource Allocation" section on page 6-19.) If a **dial-shelf split slots** command is entered when the calls using timeslots exceed the number that would be available to the router in split mode, the command is rejected. (This should occur only when a change to split mode is attempted where the dial shelf has more than 896 calls in progress, or more than half of the 1,792 available timeslots. Otherwise, a transition from normal mode to split mode can be made without disturbing the cards in the slots that remain owned, and calls going through those cards will stay up.)

TDM Resource Allocation

Trunk cards and modem cards are tied together across a time-division multiplexing (TDM) bus on the dial-shelf backplane. Timeslots for the TDM bus are allocated by the router shelf on a call-by-call basis. This is implemented by initializing a queue at start-up with one element for each usable timeslot (currently 14*128 = 1,792 timeslots are used). Timeslots for a call are allocated from the front of the queue and replaced at the end of the queue when the call is completed. For split-dial-shelf operation, timeslots are added to the queue dynamically, as needed. When a TDM slot is required and the queue is empty, a chunk of TDM slots is allocated to the queue.

In normal mode, the router shelf connected to the DSC in slot 12 allocates timeslots starting from 0 going up, and the router shelf connected to the DSC in slot 13 allocates timeslots starting from 1,791 going down. For split-dial-shelf operation each router is assigned half of the usable set of timeslots. The router shelf connected to the DSC in slot 12 controls the first half of the timeslots (0 to 895). The router shelf connected to the DSC in slot 13 controls the second half of the timeslots (896 to 1791).

Transition Procedure for Split Mode

To transition from normal mode to split mode, complete the following steps:

Step 1 Ensure that both DSCs and both router shelves are running the same Cisco IOS image.

Having the same version of Cisco IOS software running on both DSCs and both router shelves is not mandatory; however, it is a good idea. There is no automatic check to ensure that the versions are the same.

Step 2 Schedule a time when the Cisco AS5800 universal access server can be taken out of service without unnecessarily terminating calls in progress.

The entire procedure for transitioning from normal mode to split mode should require approximately one hour if the hardware is already installed.

Step 3 Busy out all feature boards and wait for your customers to log off.

Step 4 Reconfigure the existing router shelf to operate in split mode.

Enter the **dial-shelf split slots {*slot-numbers*}** command, specifying the slot numbers that are to be owned by the existing router shelf.

Step 5 Configure the new router shelf to operate in split mode on other feature boards.

Enter the **dial-shelf split slots {*slot-numbers*}** command, specifying the slot numbers that are to be owned by the new router shelf. Do not specify any of the slot numbers that you specified in Step 4. The range of valid slot numbers is 0 to 11.

Step 6 Install the second DSC, if it has not already been installed.

Step 7 Connect the dial-shelf interconnect cable from the second DSC to the new router shelf.

Step 8 Ensure that split mode is operating properly.

Enter the **show dial-shelf** command for each router. This command has been extended so that the response indicates that the router shelf is running in split mode, and which slots the router shelf owns. The status of any cards in any owned slots is shown, just as they are in the present **show dial-shelf** command.

Step 9 Enable all feature boards to accept calls again.

Changing Slot Sets

You can change the sets of slots owned by the two router shelves while they are in split mode. First remove slots from the set owned by one router, then add them to the slot set owned by the other router. The changed slot-set information is sent to the respective DSCs, and the DSCs determine which slots have been removed and which added. Moving a slot in this manner will disconnect all calls that were going through the card in that slot.

To move a slot from one router shelf's control to the others, first modify the router releasing the slot by entering the **dial-shelf split slots remove** command specifying the slot numbers to be released. The released slots can then be added to the slot set of the other router by entering the **dial-shelf split slots** command including the new slot numbers.

When a slot is removed, the router shelf that is losing the slot frees any resources and clears any state associated with the card in the slot it is relinquishing. The DSC reconfigures its hub to ignore traffic from that slot, and if there is a card in the slot it will be reset. This ensures that the card frees up any TDM resources it might be using, and allows it to restart under control of the router shelf that is subsequently configured to own the slot.

When a slot is added, if there are no configuration conflicts, and there is a card present in the added slot, a dial-shelf OIR insertion event is sent to the router shelf. The router shelf processes the event as a normal event. The card in the added slot is reset by the DSC to ensure a clean state, and the card downloads its image from the router shelf that now owns it. If the other router shelf (and the other DSC) claim ownership of the same slot, the command adding the slot should be rejected. However, should a configuration conflict exist, error messages are sent to both routers. The card is not reset until one of the other router shelves and its DSC stop claiming ownership of the slot. Normally this will not happen until you issue a **dial-shelf split slots remove** command surrendering the ownership claim on the slot by one of the routers.

Leaving Split Mode

Split mode is exited when the dial-shelf configuration is changed by a **no dial-shelf split slots** command. When the split dial-shelf line is removed, the router shelf will start using all of the TDM timeslots. Feature boards that were not owned in split mode and are not owned by the other router will be reset. Cards in slots that are owned by the other router will be reset, but only after the other DSC has been removed or is no longer claiming the slots. The split-dial-shelf configuration should not be removed while the second router shelf is still connected to the dial shelf.

When a router configured in split mode fails, all calls associated with the failed router are lost. Users cannot connect back in until the failed router recovers and is available to accept new incoming calls. However, the other split mode router shelf will continue to operate normally.

Potential Split-Dial-Shelf Problems

The system will behave as configured as soon as the configuration is changed. The exception is when there is a misconfiguration, such as when one router is configured in split mode and the other router is configured in normal mode, or when both routers are configured in split mode and both claim ownership of the same slots.

Problems can arise if one of the two routers connected to a dial shelf is not configured in split mode, or if both are configured in split mode and both claim ownership of the same slots. If the state of the second router is known when the **dial-shelf split slots** command is entered and the command would result in a conflict, the command is rejected.

If a conflict in slot ownership does arise, both routers receive warning messages until the conflict is resolved. Any card in a slot that is claimed by both routers remains under the control of the router that claimed it first, until you resolve the conflict by correcting the configuration of one or both routers.

Note that there can be slots that are not owned by either router (orphan slots). Cards in orphan slots cannot boot up until one of the two routers claims ownership of the slot, because neither DSC will download bootstrap images to cards in orphan slots.

Split-Dial-Shelf Show Commands

In normal mode, all **show** commands look and behave as they do in the current system. In split mode, most **show** commands look and behave as they would in the current system *if there were no cards in the slots for which the other router has configured ownership.* This is consistent with the view of a split-dial-shelf configuration being basically two separate Cisco AS5800 universal access servers. A router shelf cannot manage or even recognize cards in slots that it does not own. For example, **DSIP** console and **execute-on** commands work only in owned slots.

There are, however, the following exceptions:

- The **show dial-shelf clocks** command still shows all configured clock sources, even those from non-owned trunk cards. This is because only one DSC can provide the master clock, and it may need to have backup clock sources configured from all trunk cards present (regardless of which DSC owns them).
- To avoid confusion, the **show dial-shelf** command is extended so that when the router is in split mode, **show dial-shelf** indicates both the router shelf is running in split mode and which slots the router shelf owns. The status of any cards in any owned slots is shown, exactly as it is in the present command. Thus, when in normal mode, **show dial-shelf** is unchanged from the current version.

When in split mode, the **show dial-shelf** output is extended. For example:

```
5800# show dial-shelf
System is in split dial shelf mode.
Slots owned: 0 2 3 4 5 6 (connected to DSC in slot 13)
Slot    Board     CPU       DRAM          I/O Memory   State   Elapsed
         Type     Util    Total (free)   Total (free)          Time
 0        CE1    0%/0%  21341728( 87%)  8388608( 45%)  Up      01:11:37
 2        CE1    0%/0%  21341728( 87%)  8388608( 45%)  Up      01:11:37
 4 Modem(HMM)  20%/20%   6661664( 47%)  6291456( 33%)  Up      01:11:37
 5 Modem(DMM)    0%/0%   6661664( 31%)  6291456( 32%)  Up      01:11:37
 6 Modem(DMM)    0%/0%   6661664( 31%)  6291456( 32%)  Up      01:11:37
13        DSC    0%/0%  20451808( 91%)  8388608( 66%)  Up      01:16:31
Dial shelf set for auto boot
```

Note that only the first two lines of output are new. The remaining information is exactly the same as what would currently be displayed if there were no cards in the slots that are not owned (1 and 7 to 12).

- A new command, **show dial-shelf split**, has been added to provide some minimal information about the types of cards in non-owned slots. For example:

```
5800# show dial-shelf split
System is in split dial shelf mode, connected to DSC in slot 13.
Slots owned: 0 2 3 4 5 6
Non owned slots:
Slot    Board Type
 1      CE1
 7      Modem(DMM)
 8      Modem(DMM)
 9      Modem(DMM)
10      Slot Empty
11      Slot Empty
12      DSC
```

Note Note that the **show dial-shelf split command** also shows the slots and corresponding feature boards for orphan slots (those slots not owned by either router shelf). This means that OIR events on all slots in the dial shelf are detected by both DSCs, and the feature boards are added to or deleted from the list of boards physically present in the dial shelf. When a feature board is inserted into an orphan slot, a message is sent to both router shelves indicating that a feature board was just inserted. This message differs from an OIR event message, OIR event processing is done only for owned slots.

- The **show context** command works only for owned slots. However, **show context all** displays all information available about any slot. This is intended to cover the case where ownership of a feature board is moved from one router shelf to the other after a crash.

Managing a Split Dial Shelf

If you are installing split-dial-shelf systems, a system controller is available that provides a single system view of multiple POPs. The system controller for the Cisco AS5800 includes the Cisco 3640 router running Cisco IOS software. The system controller can be installed at a remote facility so that you can access multiple systems through a console port or Web interface.

There are no new Management Information Bases (MIBs) or MIB variables required for the split-dial-shelf configuration. A split dial shelf appears to Simple Network Management Protocol (SNMP) management applications as two separate Cisco AS5800s. You cannot use one console to manage the whole system—you must have a console session for each router shelf (two console sessions) to configure each split. The system controller must manage a split-dial-shelf configuration as two separate Cisco AS5800 universal access servers.

The normal mode configuration of the Cisco AS5800 requires the dial-shelf and router-shelf IDs to be different. In a split system, four unique shelf IDs are desirable; one for each router shelf and one for each of the slot sets. However, a split system will function satisfactorily if the router-shelf IDs are the same. If a system controller is used to manage a split-dial-shelf configuration, then the two routers must have distinct shelf IDs, just as they must when each router has its own dial shelf.

You can download software configurations to any Cisco AS5800 using SNMP or a Telnet connection. The system controller also provides performance monitoring and accounting data collection and logging.

In addition to the system controller, a network management system with a graphical user interface (GUI) runs on a UNIX SPARC station and includes a database management system, polling engine, trap management, and map integration.

Configuring Split-Dial-Shelf Routers

To configure a router for split-dial-shelf operation, use the following commands in global configuration mode 5800(config)#

dial-shelf split slots {*slot_numbers*}

Normal mode: This command changes the router shelf to split mode with ownership of the slots listed.

In case of conflicting slot assignments, the command is rejected and a warning message is issued. Issue a **show dial-shelf split slots** command to the other router shelf to display its list of owned dial-shelf slots.

OIR events on all slots are detected by both DSCs and added to the list of feature boards physically present in the dial shelf. However, OIR event processing is done only for assigned slots.

Split mode: This command adds the dial-shelf slots listed to the router shelf's list of owned slots.

show dial-shelf split

Normal mode: This command is invalid.

Split mode: This command displays the slots assigned to each of the router shelves and the corresponding feature boards in orphan slots (slots not currently assigned to either router).

dial-shelf split slots none

Normal mode: This command puts the router shelf in split mode; however, it does not assign ownership of any dial-shelf slots.

To prevent accidentally entering the **dial-shelf split slots** command, at least one valid dial-shelf slot number (0–11) or the keyword **none** must be specified.

If the **dial-shelf split slots** command is entered in normal mode without valid slot numbers or the keyword **none**, the command is rejected.

Split mode: This command will change dial-shelf slot ownership. The router will no longer have ownership of any dial-shelf slots.

no dial-shelf split slots

Normal mode: This command has no effect. If the router shelf is in normal mode, it stays that way.

Split mode: This command changes the router shelf to normal mode if it is in split mode, and the other router shelf has already relinquished control of all dial-shelf slots or is switched off.

dial-shelf split slots {*slot_numbers*}

Normal mode: This command changes the router shelf to split mode with ownership of the slots listed. Valid slot numbers are 0 through 11.

- In case of conflicting slot assignments, the command is rejected and a warning message is issued.
- OIR events on all slots are detected by both DSCs and added to the list of feature boards physically present in the dial shelf. However, OIR event processing is done only for assigned slots.

Split mode: This command adds the dial-shelf slots listed to the router shelf's list of owned dial-shelf slots. The effect of multiple commands is cumulative.

dial-shelf split slots remove {*slot_numbers*}

Normal mode: This command has no effect.

Split mode: This command removes the dial-shelf slots listed from the router shelf's list of owned dial-shelf slots. The effect of multiple commands is cumulative.

Split-Dial-Shelf Error Messages

New error messages for various split-dial-shelf conditions include:

```
Duplicate priority clock source configured on other router shelf.
```

Explanation The configuration commands for the master clock specify the clock sources and a priority for each source. Together, these commands define a prioritized list of the clock sources used to generate the master clock. This list, configured on the router shelf, is passed to and stored by the DSC providing the active clock. In the event of failure of the highest priority clock source, the DSC switches to the source with the next highest priority.

With a split dial shelf, clock sources can be configured on either of the router shelves from the slots that each shelf owns. All valid clock source configurations are known to the DSC providing the clock, including the clock sources configured on the other router or DSC.

This error condition results when a clock source input on one router is configured to have the same priority as one configured on the other router. The original configuration command is not rejected; however, these error messages are issued to both routers. The two inputs, with identical priorities, both go into the ordered list of clock sources, but the one received first by the DSC providing the active clock is assigned a higher priority.

Action Reconfigure the clock sources on the two routers so that they have different priorities.

`Other router shelf is in split mode when this one is not.`

Explanation Split mode is intended to support two router shelves connected to a single dial shelf. To use this arrangement, both connected router shelves should be configured for split dial shelves. Problems can arise if two routers are connected to the dial shelf, but one router is not configured in split mode.

Action Issue a **dial-shelf split slots** command to this router or a **no-dial-shelf split slots** command to the other router.

`Other router shelf is not in split mode when this one is.`

Explanation Split mode is intended to support two router shelves connected to a single dial shelf. To use this arrangement, both connected router shelves should be configured for split dial shelves. Problems can arise if two routers are connected to the dial shelf, but one router is not configured in split mode.

Action Issue a **dial-shelf split slots** command to this router or a **no-dial-shelf split slots** command to the other router.

`Other router shelf has overlapping slot ownership specified in its split dial shelf configuration.`

Explanation Each router shelf connects to one of the DSCs in the dial shelf. The dial-shelf feature boards are divided between the two router shelves. Each router controls its own set of feature boards as if those were the only boards present. There is no interaction between the routers or between feature boards owned by one router and feature boards owned by the other router.

This error message indicates that both routers are configured in split mode, but there is an overlap in the set of slots each router claims. While the conflict in slot ownership continues, both router shelves will periodically receive this error message.

Action Correct the configuration of one of the routers by issuing a **dial-shelf split slots** command with a list of slot numbers that does not include the slot that is reporting as having overlapping ownership. You must configure the division of the dial-shelf slots between the two router shelves so that each router controls an appropriate mix of trunk and modem cards. Any card in a slot that is claimed by both routers remains under the control of the router that claimed it first until you resolve the conflict by correcting the configuration.

Verifying and Troubleshooting Split-Dial-Shelf Installation

Your Cisco 7206 router went through extensive testing before leaving the factory. However, if you encounter problems starting the routers, do the following:

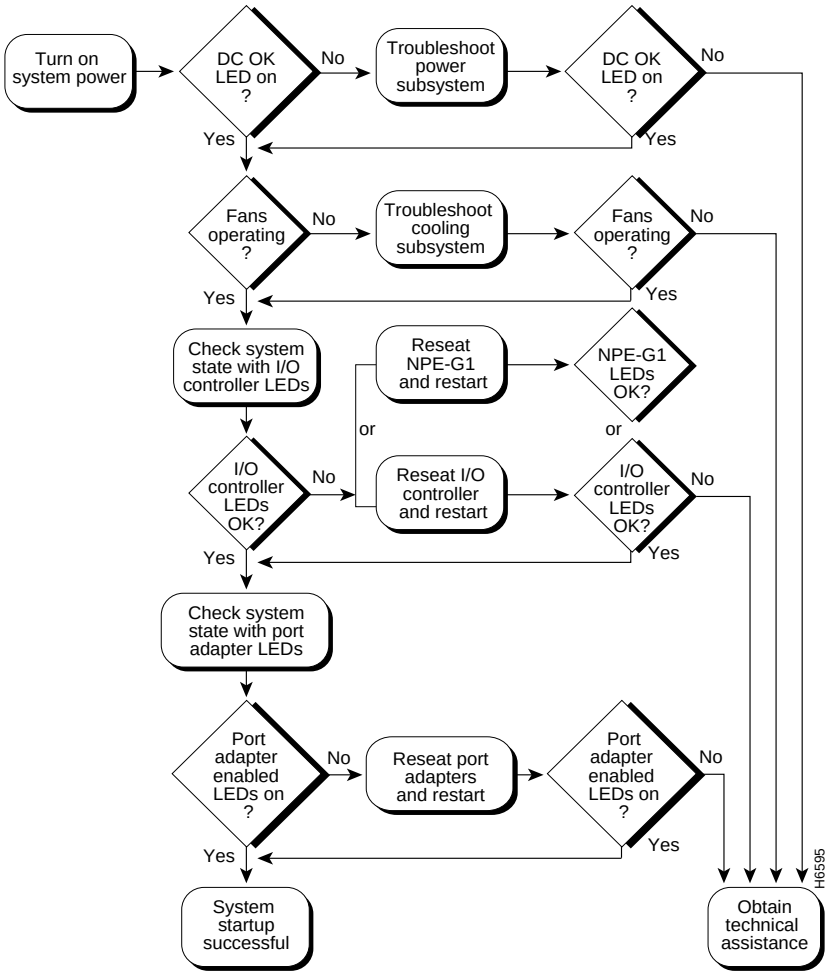
- Review the safety warnings in *Cisco 7200 Regulatory Compliance and Safety Information*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/
- Review the troubleshooting information in the *Cisco 7200 VXR Installation and Configuration Guide*, available online at http://www.cisco.com/univercd/cc/td/doc/product/core/7200vx/

If you are unable to solve the problem, contact a customer service representative for assistance and further instructions. Be prepared to provide the representative with the following information:

- Date you received the router
- Chassis serial number
- Type of software and release number
- Brief description of the problem
- Brief explanation of the steps taken to isolate and resolve the problem
- Maintenance agreement or warranty information

Figure 6-2 shows the general troubleshooting strategy for Cisco 7206 routers. Refer to this chart to isolate problems to a specific subsystem; then attempt to resolve the problem.

Figure 6-2 Troubleshooting Strategy for Start-Up Problems



Router-Shelf Redundancy

When an active router shelf in a Cisco AS5800 loses communication with the dial shelf, a backup router shelf can be automatically invoked to take over dial-shelf resources controlled by the lost router shelf. This backup method, called redundancy, is provided on the Cisco AS5800 to prevent a single point of failure, subsequent downtime, and user intervention to resolve unrecoverable hardware faults.

Router-shelf redundancy uses a second router shelf that automatically assumes resource responsibility (dial-shelf card and traffic control) of the primary, or active router, if it fails. This disruptive failover makes no attempt to retain established calls on the failed router. All calls are dropped when dial-shelf cards, controlled by the failing router, are automatically restarted by the secondary or backup router, which becomes the controlling router after restart.

Failover Operation

Redundancy on a Cisco AS5800 is two router shelves connected, in parallel, to a single dial shelf (as in split-dial-shelf mode), except only one router is active, or engaged, at any given time. Each router shelf contains user specific configurations for normal mode operations, as opposed to split mode. The active router controls all the dial-shelf cards, while the secondary router functions purely as a standby backup. In the event the active router fails, all dial-shelf cards are restarted by the backup router that automatically assumes active router functionality.

External interfaces do not share the same IP address between redundant routers or duplicate IP address errors occur. One (active) router shelf maintains control of dial-shelf cards at a time. However unsuccessful, it does not interfere with the operation of the primary active router. If the active router shelf crashes, the link between it and it's DSC will go down, relinquishing control of all dial-shelf cards to the other DSC which is connected to the secondary or backup router shelf. This surviving router shelf restarts the cards and commences normal operations. If the router shelf that crashed recovers, or is restarted, it will not regain control of the cards, but becomes the backup, serving as the standby router shelf for the new active router, should it fail.

Note A failover is triggered if the active DSC (i.e. the DSC connected to the active router) goes down and doesn't recover within ninety seconds. Any router-shelf failure that does not result in the DSC link going down would not cause a failover (for example, the active router's egress interface going down would not trigger failover). Conversely any temporary loss of the link between the active router and its DSC would cause a failover, even if the router shelf itself had not crashed and connectivity was quickly re-established (for example, if the BIC cable was knocked out and then quickly replaced).

Load-Sharing

There is no load sharing between routers. Calls can not be routed through the active and backup routers simultaneously. Consequently, you cannot split the load between the routers to reduce granularity of failure, or the number of calls that are lost, when a router crashes. Conversely, failover conditions, that would otherwise occur, such as overwhelming traffic volume on the surviving router after failover, under load sharing, will not degrade service.

Hitless Redundancy

Hitless redundancy is not supported. When a router-shelf failover occurs, all calls associated with that router shelf are lost. Cisco AS5800 redundancy ensures that resources (particularly trunk lines) do not remain unusable while the controlling router is down.

Network Management

Redundancy management via SNMP is not supported. However, an SNMP trap will be issued by the backup router when the router failover event occurs. The trap "ccrSwitchStatusChange" defined in the CISCO-C8500-REDUNDANCY-MIB as well as the SNMP variables "ccrCpuMode" and "ccrCpuStatus" are used for issuing a failover.

Failover Performance

Enabling failover has no significant (greater than 1%) impact on system performance, both before and after failover has occurred. With a redundant router, of the same model as the active router, acting purely as a standby, the load capacity threshold is unchanged, thereby not affecting performance.

External Services

A single active router is conceptually simpler, and makes it easier to support failover when dealing with external servers, such as signalling controllers for RPMS server, SS7.

Note RPMS server must be configured with the same information for both router shelves to ensure full functionality before and after a switchover.

SS7 Setup

In an SS7 environment, call signalling comes via an external SC2200 rather than directly from the switch over the trunk line (as for CAS and ISDN). After a switchover has occurred, both routers must be connected to the SC2200. Use SS7's redundant link manager (RLM) to provide redundant links between a single router and the signalling controller. Configure RLM links from both the active and standby routers so a change of routers will look like a change from one redundant link to another.

Configuring Redundancy

Router-shelf failover is a simple configuration command on the two router shelves in split-dial-shelf configuration mode. The command is issued in "redundancy" configuration submode:

```
router(config)# redundancy
router(config-r)# failover group-number <group-code>
```

This command must be configured on both routers. The parameter *group-code* is used by the system controller and must be the same for both routers forming the redundant pair. It identifies both routers as the same set of dial-shelf resources.

For successful failover to occur, both router-shelf configurations need to be synchronized. Configure each router separately, as active and backup, respectively, with the same configuration, except for the IP address on egress interfaces.

Note Test the backup router's configuration for errors discovery before production environment deployment.

Redundancy Show Commands

The **show redundancy** command indicates when failover is enabled. The **show redundancy history** command logs failover events (where the router has changed from ACTIVE to BACKUP or vice-versa).

Advanced Quick Reference

This appendix provides quick reference configurations for the advanced Cisco AS5800 user and system administrator who need to rapidly modify system functionality or enhance system performance. Interface and/or protocol configurations addressed in this section are listed categorically and sequenced logically by operation.

Remember, Cisco routers are configured using a command line interface (CLI) from a user interface, known as a port, that provides hardware connectivity. Routers are accessed from the routers console port or by Telnetting into the routers interface from another host. A command interpreter, called EXEC, is employed by the operating system to translate and execute Cisco IOS commands. This command interpreter provide the user with privileged mode of access that promotes security to the respective command levels, restricting users to a subset of mode-specific commands.

- User EXEC mode `(5800>)` provides restricted access and limits router configuration or troubleshooting. At this level, miscellaneous functionality is performed, such as viewing system information, obtaining basic router status, changing terminal settings, or establishing remote device connectivity.
- Privileged EXEC mode `(5800#)` includes user mode functionality and provides unrestricted access. It is used exclusively for router configuration, debugging, setting operating system (OS) parameters, and retrieving detailed router status information.
  - Global configuration mode `[5800(config)#]` is a preliminary configuration mode that recognizes commands affecting the whole router. Some of these commands cause the router to enter other configuration modes that recognize even more detailed commands.
- There are many modes of configuration within global configuration mode that determine the type of configuration desired, such as interface configuration `[5800(config-if)#]`. Each configuration command mode restricts the user to a subset of mode-specific commands that individualize and secure a router.
- ROM monitor mode `(> or rommon>)` is a CLI allowing router configuration if the router does not find a valid system image or if the bootup sequence is interrupted during startup.

The **end** (Ctrl-Z) command provides an escape from any configuration command mode: Terminal `[5800(config)#]`, Interface `[5800(config-if)#]`, Line `[5800(config-line)#]`, Controller `[5800(config-controll)#]`, Router `[5800(config-router)#]`, `etc.`, to privileged EXEC mode `(5800#)`. The **exit** command provides an escape from any configuration command mode to one command prompt level higher, or completely out of the command line interface if you are in privileged EXEC or user EXEC mode. The **disable** command provides an escape from privileged EXEC mode to user EXEC mode. The **logout** command provides a complete escape out of the command line interface if you are in privileged EXEC or user EXEC mode.

Advanced Quick Reference Configurations

This section provides abridged interface and/or protocol configurations listed categorically and sequenced logically by operation. Each functional component is dependent on previous component configurations and includes the following reference information:

- Basic operational summary
- List of operational prerequisites
- Configuration summary with:
  - a sample configuration script
  - a detailed line item description of the configuration script
  - a convenient list of the configuration commands for purposes of editing, copying, and pasting into your router
- Other configuration considerations include:
  - access lists
  - route summarization
  - basic show commands
  - useful debug commands

Functional Components

Cisco AS5800 operational configurations are provided for the following functional components.

Egress Interface

Egress interfaces are network connections, or ports, used for outbound traffic flow.

Egress Requisites

The following requisites are significant considerations to identify before configuring an egress interface:

- Interface type
- IP configuration
- Interface specific parameters (Duplex, Speed, PVC, Encapsulation, etc.)

Egress Configuration

The following Cisco IOS CLI script serves as a sample egress interface configuration or setup.

Sample Configuration

```
5800(config)# interface FastEthernet0/0/0
5800(config-if)# ip address 1.1.1.1 255.255.255.0
5800(config-if)# no ip directed broadcast
5800(config-if)# no ip mroute-cache
5800(config-if)# no cdp enable
5800(config-if)# exit
5800(config)#
```

Command Line Description

`5800(config)# interface FastEthernet0/0/0`
Defines the interface type.

`5800(config-if)# ip address 1.1.1.1 255.255.255.0`
Assigns a primary IP address and subnet mask to the interface.

`5800(config-if)# no ip directed broadcast`
Disables the translation of directed broadcast to physical broadcasts. It drops the directed broadcasts destined for this subnet.

`5800(config-if)# no ip mroute-cache`
Turns off IP multicast fast switching.

`5800(config-if)# no cdp enable`
Disables CDP (Cisco Discovery Protocol).

`5800(config-if)# exit`
Exits interface configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
interface FastEthernet0/0/0
ip address 1.1.1.1 255.255.255.0
no ip directed broadcast
no ip mroute-cache
no cdp enable
exit
```

Loopback Interface

Loopback interface is a logical interface on the router that can be used for diagnostics and troubleshooting purposes. It is also used to conserve address space so other physical interfaces can be unnumbered to this interface. The state of the Loopback interface is always UP/UP.

Loopback Requisites

The following requisite is significant consideration to identify before configuring a loopback interface:

- IP configuration

Loopback Configuration

The following Cisco IOS CLI script serves as a sample loopback configuration or setup.

Sample Configuration

```
5800(config)# interface loopback0
5800(config-if)# ip address 2.2.2.2 255.255.255.255
5800(config-if)# no ip directed broadcast
5800(config-if)# exit
5800(config)#
```

Command Line Description

`5800(config)# interface loopback0`
Defines the interface type.

`5800(config-if)# ip address 2.2.2.2 255.255.255.255`
Assigns an IP address to the interface.

`5800(config-if)# no ip directed broadcast`
Disables the translation of directed broadcast to physical broadcasts.

`5800(config-if)# exit`
Exits this interface configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
interface loopback0
ip address 2.2.2.2 255.255.255.255
no ip directed broadcast
exit
```

Routing Protocol

Routing protocol that accomplishes routing through the implementation of a specific routing algorithm. Examples of routing protocols include: RIP, IGRP, EIGRP, OSPF, and BGP.

Routing Protocol Requisites

The following requisites are significant considerations to identify before configuring routing protocols:

- Routing protocol for egress network
- Networks to advertise
- IP summarization if supported
- Interfaces to advertise routing on

Routing Protocol Configuration

The following Cisco IOS CLI script serves as a sample routing protocol configuration or setup.

Sample Configuration

```
5800(config)# router rip
5800(config-router)# version 2
5800(config-router)# redistribute static
5800(config-router)# passive-interface Group-Async0
5800(config-router)# passive-interface Virtual-Template1
5800(config-router)# passive-interface Dialer0
5800(config-router)# passive-interface Loopback0
5800(config-router)# network 10.0.0.0
5800(config-router)# network 172.16.0.0
5800(config-router)# no auto-summary
5800(config-router)# exit
5800(config)# ip route 0.0.0.0 0.0.0.0 172.16.1.1
```

Command Line Description

`5800(config)# router rip`
Defines the routing protocol used on the router and initiates the routing protocol processes.

`5800(config-router)# version 2`
Defines the protocol version used. Enables sending and receiving of Version 2 RIP packets.

`5800(config-router)# redistribute static`
Enables the redistribution of static routes in routing updates. Advertises static routes (including per-user static routes downloaded from RADIUS or TACACS+).

`5800(config-router)# passive-interface Group-Async0`
Defines the Group-Async interface as a passive interface so no routing updates are sent out of these interfaces. Disables sending of updates across the interface and places the interface in listen mode.

`5800(config-router)# passive-interface Virtual-Template1`
Defines the Virtual-Template as a passive interface so no routing updates are send out the Virtual-Access interfaces that are cloned off the Virtual-Template.

`5800(config-router)# passive-interface Dialer0`
Defines the Dialer interface as a passive interface.

`5800(config-router)#` **`passive-interface Loopback0`**
Defines the Loopback interface as a passive interface.

`5800(config-router)#` **`network 10.0.0.0`**
Enables advertisement of interfaces in this network. Defines 10.0.0.0 network as part of the RIP routing process. The router exchanges routing updates about the 10.0.0.0 network dynamically.

`5800(config-router)#` **`network 172.16.0.0`**
Defines 172.16.0.0 network as part of the RIP routing process. Updates regarding this network are exchanged dynamically between this router and its neighbors.

`5800(config-router)#` **`no auto-summary`**
Turns off route summarization, so updates are not summarized to classful boundaries.

`5800(config-router)#` **`exit`**
Exits the router configuration mode to global configuration mode.

`5800(config)#` **`ip route 0.0.0.0 0.0.0.0 172.16.1.1`**
Defines a default route for this router. If the router does not have an address in its routing table, the table forwards the packets to this IP address. Default route for destinations are not learned through the routing protocol.

To Modify, Copy, & Paste

```
router rip
version 2
redistribute static
passive-interface Group-Async0
passive-interface Virtual-Template1
passive-interface Dialer0
passive-interface Loopback0
network 10.0.0.0
network 172.16.0.0
no auto-summary
exit
ip route 0.0.0.0 0.0.0.0 172.16.1.1
```

Ingress Interface

Interfaces used for inbound traffic flow.

Ingress Requisites

The following requisites are significant considerations to identify before configuring ingress interfaces:

- Facilities (T1 / T3 / E1 / E3)
- Circuit type (ISDN CAS)
- Telco parameters
- ISDN switch type
- CAS signaling
- Dial-shelf slots

T3 Ingress Configuration

The following Cisco IOS CLI script serves as a sample T3 ingress interface configuration or setup.

Sample Configuration

```
5800(config)# isdn switch-type primary-ni (ISDN)
5800(config)# controller t3 1/0/0
5800(config-controller)# framing m23
5800(config-controller)# cablelength 224
5800(config-controller)# t1 1 controller
5800(config-controller)# t1 2 controller
5800(config-controller)# . . .
5800(config-controller)# exit
5800(config)#
```

Command Line Description

`5800(config)# isdn switch-type primary-ni (ISDN)`
Defines the ISDN switch-type to be used on the router. This is a global command but can also be configured under the D-channel in later versions of Cisco IOS software.

`5800(config)# controller t3 1/0/0`
Identifies controller type and number to be configured. The controller type is a T3 and the controller is in shelf 1, slot 0, port 0.

`5800(config-controller)# framing m23`
Enables m23 framing. Sets the framing type under the T3 controller.

`5800(config-controller)# cablelength 224`
Sets the cable length to 224 feet.

`5800(config-controller)# t1 1 controller`
Enables the first T1 in the T3. Configures individual T1 controllers under the T3 controller. Range is 1-28.

`5800(config-controller)# t1 2 controller`
Enables the second T1 in the T3. Configures individual T1 controllers under the T3 controller. Range is 1-28.

`5800(config-controller)# . . .`
Configures additional individual T1 controllers under the T3 controller. Range is 1-28.

`5800(config-controller)# exit`
Exits this controller configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
isdn switch-type primary-ni (ISDN)
controller t3 1/0/0
framing m23
cablelength 224
t1 1 controller
t1 2 controller
exit
```

T1 Ingress Configuration

The following Cisco IOS CLI script serves as a sample T1 ingress interface configuration or setup.

Sample Configuration

```
5800(config)# controller t1 1/0/0:1
5800(config-controller) # framing esf
5800(config-controller) # linecode b8zs     (t1-pri)
5800(config-controller) # pri-group timeslots 1-24
5800(config-controller)# controller t1 1/0/0:2
5800(config-controller)# framing esf
5800(config-controller)# pri-group timeslots 1-24
5800(config-controller)# exit
5800(config)#
```

Command Line Description

`5800(config)# controller t1 1/0/0:1`
Configures the first T1 on the T3 card in slot 0. Enters the controller configuration mode and configures controller t1 1 under the T3 controller.

`5800(config-controller) # framing esf`
Enables T1 Extended Superframe Framing. Sets framing to Extended Super Frame (ESF).

`5800(config-controller) # linecode b8zs     (t1-pri)`
Enable Binary 8 Zero Substitution line coding. Sets the line coding to Binary 8 Zero Substitution (B8ZS).

`5800(config-controller) # pri-group timeslots 1-24`
Configures the controller for ISDN PRI on time slots 1 through 24. Time slot 24 is the D-channel.

`5800(config-controller)# controller t1 1/0/0:2`
Configures the second T1 on the T3 card in slot 0. Configures controller t1 2 under the T3 controller.

`5800(config-controller)# framing esf`
Sets framing to Extended Super Frame (ESF).

`5800(config-controller)# pri-group timeslots 1-24`
Configures the controller for ISDN PRI on time slots 1 through 24. Time slot 24 is the D-channel.

`5800(config-controller)# exit`
Exits controller configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
controller t1 1/0/0:1
framing esf
linecode b8zs
pri-group timeslots 1-24
controller t1 1/0/0:2
framing esf
pri-group timeslots 1-24
Exit
```

Line Signaling

When configuring a router for signaling, line signaling can be used for both inbound and outbound calls. The line signaling configuration must match the corresponding telco switch configuration.

Line Signaling Requisites

The following requisites are significant considerations to identify before configuring line signaling:

- Facilities(T1 / T3 / E1 / E3)
- Circuit type (ISDN CAS)
- Telco parameters
- ISDN switch type
- CAS signaling
- Dial-shelf slots

Line Signaling (ISDN) Configuration

The following Cisco IOS CLI script serves as a sample ISDN line signaling configuration or setup.

Sample Configuration

```
5800(config)# isdn switch-type primary-ni1
5800(config)# controller t1 1/0/0
5800(config-controller)# pri-group timeslots 1-24
5800(config-controller)# exit
5800(config)#
```

Command Line Description

`5800(config)# isdn switch-type primary-ni1`
Configures the ISDN switch-type that the access server is connected to.

`5800(config)# controller t1 1/0/0`
Configures the first T1 on slot 0.

`5800(config-controller)# pri-group timeslots 1-24`
Enables this T1 to use ISDN PRI signaling on all 24 timeslots.

`5800(config-controller)# exit`
Exits controller configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
isdn switch-type primary-ni1
controller t1 1/0/0
pri-group timeslots 1-24
exit
```

Line Signaling (CAS) Configuration

The following Cisco IOS CLI script serves as a sample CAS line signaling configuration or setup.

Sample Configuration

```
5800(config)# controller t1 1/0/11
5800(config-controll)# framing esf
5800(config-controll)# linecode b8zs
5800(config-controll)# ds0-group 0 timeslots 1-24 type e&m-fgb
5800(config-controller)# exit
5800(config)#
```

Command Line Description

`5800(config)# controller t1 1/0/11`
Enters the controller configuration mode.

`5800(config-controll)# framing esf`
Sets framing to Extended Super Frame (ESF).

`5800(config-controll)# linecode b8zs (t1-cas)`
Sets the line coding to Binary 8 Zero Substitution (B8ZS).

`5800(config-controll)# ds0-group 0 timeslots 1-24 type e&m-fgb`
Configures this T1 CAS line to use E&M feature-group B signaling on all 24 timeslots.

`5800(config-controller)# exit`
Exits controller configuration mode to global configuration mode.

To Modify, Copy, & Paste

```
controller t1 1/0/0:1
framing esf
linecode b8zs
ds0-group 0 timeslots 1-24 type
exit
```

D-Channels (ISDN)

This is the 24th timeslot on T1/PRI or the 16th timeslot on E1/PRI and is used for signaling information. Call setup and tear down information is sent over the D-channel.

D-Channel Requisites

The following requisites are significant considerations to identify before configuring ISDN D-Channels:

- Interface switch-type
- IP configuration
- Encapsulation
- Analog (voice) access
- Cause code for hunting
- Rotary configuration

D-Channel Configuration

The following Cisco IOS CLI script serves as a sample ISDN D-Channel configuration or setup.

Sample Configuration

```
5800(config)# interface s 1/0/0:1:23
5800(config-if)# no ip address
5800(config-if)# no ip directed-broadcast
5800(config-if)# encapsulation ppp
5800(config-if)# dialer rotary-group 0
5800(config-if)# isdn switch-type primary-5ess
5800(config-if)# isdn incoming-voice modem
5800(config-if)# no cdp enable
5800(config-if)# exit
5800(config)#
```

Command Line Description

`5800(config)# interface s 1/0/0:1:23`
Defines the D-channel to configure. Configure the D-channel on controller T1 1 under the T3 controller in shelf 1, slot 0, and port 0.

`5800(config-if)# no ip address`
Not assigning an IP address on the D-channel.

`5800(config-if)# no ip directed-broadcast`
Disables the translation of directed broadcast to physical broadcasts

`5800(config-if)# encapsulation ppp`
Sets the encapsulation type to PPP.

`5800(config-if)# dialer rotary-group 0`
Configures the D-channel for rotary-group. Make this interface a member of the Dialer 0 rotary interface. This is legacy DDR configuration and it assigns the physical interface serial 1/0/0:1:23 to rotary-group 0.

`5800(config-if)# isdn switch-type primary-5ess`
Sets the ISDN switch-type to primary-5ess.

`5800(config-if)# isdn incoming-voice modem`
Incoming voice calls should be handed off to the CSM and terminated on a modem. Accept speech (voice) bearer-type calls and route them to a voice or modem resource.

`5800(config-if)# no cdp enable`
Disables Cisco Discovery Protocol (CDP). If an incoming speech call cannot be terminated because all voice/modem resources are in use, disconnect the call with a cause code of user-busy.

`5800(config-if)# exit`
Exits interface configuration mode to global configuration mode.

To Modify, Copy, & Paste

```
interface s 1/0/0:1:23
no ip address
no ip directed-broadcast
encapsulation ppp
dialer rotary-group 0
isdn switch-type primary-5ess
isdn incoming-voice modem
no cdp enable
```

AAA

Triple A security in billing that stands for Authentication, Authorization and Accounting.

AAA Plan and Requisites

The following requisites are significant considerations to identify before configuring AAA:

- Dial in authentication method
- Dial in authorization method
- Dial in accounting method
- Administrative AAA method

For detailed AAA configuration information, refer to *Authentication, Authorization, and Accounting (AAA)*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113ed_cr/secur_c/scprt1/

AAA Server Options

The following AAA server options are significant network design considerations:

- AAA servers
- Backup plan

For detailed RADIUS Server configuration information, refer to *RADIUS Commands*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113ed_cr/secur_r/srprt2/

AAA Authentication Configuration

The following Cisco IOS CLI script serves as a sample AAA authentication configuration or setup.

Sample Configuration

```
5800(config)# aaa new-model
5800(config)# aaa authentication login CONSOLE none
5800(config)# aaa authentication login LOCAL none
5800(config)# aaa authentication login USE-RADIUS group radius local
5800(config)# aaa authentication login USE-TACACS tacacs+ enable
5800(config)# aaa authentication enable default enable tacacs+
5800(config)# aaa authentication ppp USE-RADIUS if-needed radius
5800(config)# username cisco password cisco
```

Command Line Description

`5800(config)# aaa new-model`
Turns on the AAA process on a Cisco router. Enables the AAA security paradigm.

`5800(config)# aaa authentication login CONSOLE none`
Configure an authentication method list called CONSOLE that requires no authentication. Defines the login authentication method for EXEC users. The method list is called CONSOLE and it points to none so there is no authentication for method list CONSOLE.

`5800(config)#` **`aaa authentication login LOCAL none`**
Configures an authentication method list called LOCAL that consults the local database of user names and passwords.

`5800(config)#` **`aaa authentication login USE-RADIUS group radius local`**
Defines the login authentication for method list USE-RADIUS that points to RADIUS server. User will be authenticated against the RADIUS database. Configure an authentication method list called USE-RADIUS that uses the global RADIUS server list. If the RADIUS servers do not respond, then fallback to the local user database.

`5800(config)#` **`aaa authentication login USE-TACACS tacacs+ enable`**
Defines the login authentication for method list USE-TACACS that point to TACACS+ server. Users will be authenticated against the TACACS+ database. Configure an authentication method list called USE-TACACS that uses the global TACACS+ server list. If the TACACS+ servers do not respond, fallback to using the enable password.

`5800(config)#` **`aaa authentication enable default enable tacacs+`**
Defines the authentication method for enable privilege on the router. The method list is called "default" and it points to the enable password defined on the router and then to the TACACS+ server.

`5800(config)#` **`aaa authentication ppp USE-RADIUS if-needed radius`**
Defines the authentication method for PPP users. Method list is called "USE-RADIUS" and it points to the radius server if authentication is required. The "if-needed" option states that if users have already been authenticated then do not re-authenticate them. Configure an authentication method list called USE-RADIUS that uses the global RADIUS server list.

`5800(config)#` **`username cisco password cisco`**
Defines the username and password locally on the router for local authentication. Configure a local user account to authenticate when the RADIUS server is not available.

To Modify, Copy, & Paste

```
aaa new-model
aaa authentication login CONSOLE none
aaa authentication login USE-RADIUS radius
aaa authentication login TAC_PLUS tacacs+ enable
aaa authentication login LOCAL local
aaa authentication enable default enable tacacs+
aaa authentication ppp USE-RADIUS if-needed radius
username cisco password cisco
```

AAA Authorization Configuration

The following Cisco IOS CLI script serves as a sample AAA authorization configuration or setup.

Sample Configuration

```
5800(config)# aaa authorization exec USE-RADIUS group radius if-authenticated
5800(config)# aaa authorization exec USE-TACACS group tacacs+ if-authenticated
5800(config)# aaa authorization network default radius if-authenticated
5800(config)# aaa authorization network USE-RADIUS group radius if-authenticated
```

Command Line Description

`5800(config)# **aaa authorization exec USE-RADIUS group radius if-authenticated**`
Configures an authorization method list called USE-RADIUS that uses the global RADIUS server list. EXEC authorization is required to process per-user attribute such as autocommands. Defines the authorization method for EXEC (shell). Method list is called "USE-RADIUS" and it points to the radius server. If the radius server does not respond, the user, if authenticated, is automatically authorized due to the "if-authenticated" option.

`5800(config)# **aaa authorization exec USE-TACACS group tacacs+ if-authenticated**`
Configure an authorization method list called USE-TACACS that uses the global TACACS+ server list. EXEC authorization is required to process per-user attribute such as autocommands. Defines the authorization method for EXEC (shell). Method list is called "USE-TACACS" and it points to the TACACS+ server. If the TACACS+ server does not respond, the user, if authenticated, is automatically authorized due to the "if-authenticated" option.

`5800(config)# **aaa authorization network default radius if-authenticated**`
Defines the authorization method for network services (PPP, SLIP, ARAP). Method list is called "default" and it points to the radius server. If the radius server does not respond the user, if already authenticated, will be automatically authorized due to the "if-authenticated" option.

`5800(config)# **aaa authorization network USE-RADIUS group radius if-authenticated**`
Defines the authorization method for network services (PPP, SLIP, ARAP). Method list is called "USE-RADIUS" and it points to the radius server. If the radius server does not respond the user, if already authenticated, will be automatically authorized due to the "if-authenticated" option.

To Modify, Copy, & Paste

```
aaa authorization exec USE-RADIUS group radius if-authenticated
aaa authorization exec USE-TACACS group tacacs+ if-authenticated
aaa authorization network default radius if-authenticated
aaa authorization network USE-RADIUS group radius if-authenticated
```

AAA Accounting Configuration

The following Cisco IOS CLI script serves as a sample AAA accounting configuration or setup.

Sample Configuration

```
5800(config)# aaa accounting suppress null-username
5800(config)# aaa accounting exec default start-stop group radius
5800(config)# aaa accounting network default start-stop group radius
5800(config)# aaa accounting system default start-stop group radius
```

Command Line Description

`5800(config)# **aaa accounting suppress null-username**`
Do not generate accounting records for users with a null-username.

`5800(config)# **aaa accounting exec default start-stop group radius**`
Generates accounting records for EXEC (shell) service. Start and Stop records should be generated without wait. Radius server is being used for this accounting. This enables accounting records for all EXEC sessions. The accounting record will be sent at the beginning and the end of the EXEC session. The record will be sent to the global RADIUS server list.

`5800(config)#` **`aaa accounting network default start-stop group radius`**
Generates accounting records for network services (PPP, SLIP, ARAP). Start and Stop records should be generated without wait. Radius server is being used for this accounting. This enables accounting records for all network sessions (PPP/SLIP). The accounting record will be sent at the beginning and the end of the network session. The record will be sent to the global RADIUS server list.

`5800(config)#` **`aaa accounting system default start-stop group radius`**
Generates accounting records for systems events. Start and Stop records should be generated using the Radius server. This enables accounting records for system events. The accounting record will be sent when the access server is booted and when accounting is turned on or off. The record will be sent to the global RADIUS server list.

To Modify, Copy, & Paste

```
aaa accounting suppress null-username
aaa accounting exec default start-stop group radius
aaa accounting network default start-stop group radius
aaa accounting system default start-stop group radius
```

AAA RADIUS Server Configuration

The following Cisco IOS CLI script serves as a sample AAA Radius Server configuration or setup.

Sample Configuration

```
5800(config)# radius-server host x.x.x.x auth-port x acct-port x non-standard
5800(config)# radius-server host a.b.c.d auth-port x acct-port y key mysharedsecret
5800(config)# radius-server deadtime 5
5800(config)# radius-server timeout 3
5800(config)# radius-server retransmit 2
5800(config)# radius-server attribute nas-port format c
```

Command Line Description

`5800(config)#` **`radius-server host x.x.x.x auth-port x acct-port x non-standard`**
Defines the radius server IP address and the authentication (UDP 1645) and accounting (UDP 1646) ports. The non-standard option enable the parsing of attributes that violate the RADIUS standard.

`5800(config)#` **`radius-server host a.b.c.d auth-port x acct-port y key mysharedsecret`**
Defines a RADIUS server at IP address a.b.c.d, with authentication being done on UDP port x and accounting being done on UDP port y. The key "mysharedsecret" is used to encrypt the wire password.

`5800(config)#` **`radius-server deadtime 5`**
Defines the time to stop using a server that does not respond. The time is defined in minutes.

`5800(config)#` **`radius-server timeout 3`**
Defines the time to wait for a RADIUS server to reply. The time is defined in seconds.

`5800(config)#` **`radius-server retransmit 2`**
Specifies the number of retries to active server.

`5800(config)#` **`radius-server attribute nas-port format c`**
Sets the format of the NAS-Port attribute to “c” which means:
Data format(bits): shelf(2), slot(4), port(5), channel(5).

To Modify, Copy, & Paste

```
radius-server host x.x.x.x auth-port x acct-port x non-standard
radius-server host a.b.c.d auth-port x acct-port y key mysharedsecret
radius-server deadtime 5
radius-server timeout 3
radius-server retransmit 2
radius-server attribute nas-port format c
```

TACACS Server Configuration

The following Cisco IOS CLI script serves as a sample TACACS Server configuration or setup.

Sample Configuration

```
5800(config)# tacacs-server host x.x.x.x key mysharedsecret
```

Command Line Description

```
5800(config)# tacacs-server host x.x.x.x key mysharedsecret
```
Defines a TACACS+ server at IP address a.b.c.d. The key "mysharedsecret" is used to encrypt the all transactions with the TACACS+ server on the wire.

To Modify, Copy, & Paste

```
tacacs-server host x.x.x.x key mysharedsecret
```

Modem Pools

The modem pool covers a specified range of modems that accept calls based on the number called by dial in users. If there is only one dialin number, then all modems can be defined under the default modem pool. It is also used for modem firmware upgrades.

Modem Pool Requisites

The following requisites are significant considerations to identify before configuring modem pools:

- Modem firmware
- Modem pool plan
- DNIS pooling
- Dial-shelf slots

For information, refer to *Modem Management Commands*, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/drmodmgt.htm

Modem Pool Configuration

The following Cisco IOS CLI script serves as a sample modem pool configuration or setup.

Sample Configuration

```
5800(config)# modem-pool Default
5800(config-modem-pool)# pool-range 1/2/00-1/11/143
5800(config-modem-pool)# firmware 2.6.2.0
5800(config-modem-pool)# exit
5800(config)# modem recovery action none
5800(config)# modem call-record terse
```

Command Line Description

`5800(config)# modem-pool Default`
Defines the default modem pool by creating a new modem pool called "Default".

`5800(config-modem-pool)# pool-range 1/2/00-1/11/143`
Defines the pool range for the modems to be included in the modem pool. The modem pool spans all modems between 1/2/00 and 1/11/143. Empty slots are ignored.

`5800(config-modem-pool)# firmware 2.6.2.0`
Defines the firmware to be loaded onto the modems. Configures all modems within a modem-pool to run version 2.6.2.0 of Portware.

`5800(config-modem-pool)# exit`
Exits from the configuration mode.

`5800(config)# modem recovery action none`
Disables the modem recovery process. Disables the automatic recovery of faulty modems. Modem recovery may be enabled if you are temporarily working around a specific problem of hung modems.

`5800(config)# modem call-record terse`
Generates a Terse Modem Call Record at the end of a call. Enables modem call records logging that provide detailed connection information, which aids in troubleshooting call failure patterns.

To Modify, Copy, & Paste

```
modem-pool Default
pool-range 1/2/00-1/11/143
firmware 2.6.2.0
exit
modem recovery action none
modem call-record terse
```

TTY Line

These are asynchronous lines on the router. TTY is a line configuration, not an interface configuration. These lines correspond to async interfaces that are configured separately.

TTY Line Requisites

The following requisites are significant considerations to identify before configuring a TTY line:

- Timeouts
- Autoselected protocols
- Authorization/Authentication
- Modem service
- Transport

TTY Line Configuration

The following Cisco IOS CLI script serves as a sample TTY line configuration or setup.

Sample Configuration

```
5800(config)# line 1/2/00 1/11/143
5800(config-line)# location “Async call”
5800(config-line)# exec-timeout 0 0
5800(config-line)# autoselect PPP
5800(config-line)# autoselect during-login
5800(config-line)# login authentication USE-RADIUS
5800(config-line)# authorization exec USE-RADIUS
5800(config-line)# modem Dialin
5800(config-line)# no modem log rs232
5800(config-line)# transport preferred none
5800(config-line)# exit
5800(config)#
```

Command Line Description

`5800(config)#  line 1/2/00 1/11/143`
Defines the range for lines to be configured.

`5800(config-line)# location “Async call”`
Defines the location of the async line.

`5800(config-line)# exec-timeout 0 0`
Sets the EXEC-timeout under the line to indefinite.

`5800(config-line)# autoselect ppp`
Sets line to allow PPP autoselection. Enables the automatic the detection of PPP packets.

`5800(config-line)# autoselect during-login`
Automatically selects at the Username/Password prompt. Present the login prompt before beginning autoselect process.

`5800(config-line)# login authentication USE-RADIUS`
Defines the authentication method for login and points it to the “USE-RADIUS” list defined in the AAA process. Configures EXEC authentication on this line to use the USE-RADIUS method list.

`5800(config-line)# authorization exec USE-RADIUS`

Defines the authorization method for EXEC service and point it to the “USE-RADIUS” list defined in the AAA process. Configures EXEC authorization on the line to use the USE-RADIUS method list.

`5800(config-line)# modem Dialin`
Configures the line to allow a modern modem to dial-in (dial-out not allowed).

`5800(config-line)# no modem log rs232`
Turns off the rs232 log events. Does not log EIA/TIA-232 events in the modem log.

`5800(config-line)# transport preferred none`
Sets the preferred protocol to none. Does not try to auto-connect the user to a host with a particular protocol.

`5800(config-line)# exit`
Exits line configuration mode to global configuration mode.

To Modify, Copy, & Paste

```
line 1/2/00 1/11/143
location “Async call”
exec-timeout 0 0
autoselect ppp
autoselect during-login
login authentication USE-RADIUS
authorization exec USE-RADIUS
modem Dialin
no modem log rs232
transport preferred none
```

Async Interface

Asychronous interface is used to terminate analog (async) dialin calls.

Async Interface Requisites

The following requisites are significant considerations to identify before configuring an async interface:

- IP configuration
- Encapsulation
- Dialer parameters
- Default IP allocation
- PPP authentication
- Multilink
- Async mode
- Default timeouts
- Modem range

Async Interface Configuration

The following Cisco IOS CLI script serves as a sample async interface configuration or setup.

Sample Configuration

```
5800(config)# interface group-async0
5800(config-if)# ip unnumbered loopback0
5800(config-if)# encapsulation ppp
5800(config-if)# dialer in-band
5800(config-if)# dialer idle-timeout 2700
5800(config-if)# dialer-group 1
5800(config-if)# async mode interactive
5800(config-if)# ntp disable
5800(config-if)# no snmp trap link-status
5800(config-if)# peer default ip address pool default
5800(config-if)# no cdp enable
5800(config-if)# ppp authentication pap callin USE-RADIUS
5800(config-if)# ppp multilink
5800(config-if) group-range 1/2/00 1/11/143
5800(config-if) exit
5800(config)#
```

Command Line Description

`5800(config)# interface group-async0`
Creates a group-async interface used to configure all the async interfaces at one time.

`5800(config-if)# ip unnumbered loopback0`
Unnumbers the interface to the IP address of loopback 0 interface.

`5800(config-if)# encapsulation ppp`
Sets the default encapsulation type to PPP.

`5800(config-if)# dialer in-band`
Enables dial on demand routing on this interface. Establishes a dialer interface.

`5800(config-if)# dialer idle-timeout 2700`
Defines the idle-timeout under the interface. If the call is idle for 45 minutes (2700 seconds) then the command disconnects the user. Default is 120 seconds.

`5800(config-if)# dialer-group 1`
Assigns interface to dialer-list 1. Use dialer-list 1 to determine what kind of traffic is valid.

`5800(config-if)# async mode interactive`
Allows the user to run PPP or SLIP on this interface. Line may be switched between interactive use and async interface.

`5800(config-if)# ntp disable`
Disables the processing of Network Time Protocol (NTP) on this interface.

`5800(config-if)# no snmp trap link-status`
Disables SNMP LINKUP and LINKDOWN traps. Do not send SNMP traps when this interface goes up or down.

`5800(config-if)# peer default ip address pool default`
Use IP pool mechanism to allocate a peer IP address. The pool in this case is called “default”.

`5800(config-if)# no cdp enable`
Disables Cisco Discovery Protocol (CDP) on this interface.

`5800(config-if)# ppp authentication pap callin USE-RADIUS`

Defines the authentication protocol (PAP) to be used for authenticating incoming calls only. The USE-RADIUS list is defined in the AAA process. PPP clients must authenticate themselves using the Password Authentication Protocol. Authentication will be done using the USE-RADIUS method list.

`5800(config-if)# ppp multilink`
Configures the interface for multilink. Enable this interface to negotiate PPP multilink.

`5800(config-if) group-range 1/2/00 1/11/143`
Defines the group-range for interface to be covered under this group-async interface. Apply this configuration to interfaces from Async1/2/00 to Async1/11/143.

`5800(config-if) exit`
Exits interface configuration mode to global configuration mode.

`5800(config)#`
Global configuration mode prompt.

To Modify, Copy, & Paste

```
interface group-async0
ip unnumbered loopback0
encapsulation ppp
dialer in-band
dialer idle-timeout 2700
dialer-group 1
async mode interactive
ntp disable
no snmp trap link-status
peer default ip address pool default
no cdp enable
ppp authentication pap callin USE-RADIUS
ppp multilink
group-range 1/2/00 1/11/143
exit
```

Dial Interface

These interfaces are used for ending digital calls. Dialer interfaces are also used for async calls.

Dial Interface Requisites

The following requisites are significant considerations to identify before configuring a dial interface:

- IP configuration
- Encapsulation
- Dialer parameters
- PPP authentication
- Multilink
- Default timeouts

Dial Interface Configuration

The following Cisco IOS CLI script serves as a sample dial interface configuration or setup.

Sample Configuration

```
5800(config)# interface dialer0
5800(config-if)# ip unnumbered loopback0
5800(config-if)# encapsulation ppp
5800(config-if)# no ip mroute-cache
5800(config-if)# dialer in-band
5800(config-if)# dialer idle-timeout 2700
5800(config-if)# dialer-group 1
5800(config-if)# ntp disable
5800(config-if)# no snmp trap link-status
5800(config-if)# peer default ip address pool default
5800(config-if)# no cdp enable
5800(config-if)# ppp authentication pap callin USE-RADIUS
5800(config-if)# ppp multilink
5800(config-if)# exit
5800(config)# dialer-list 1 protocol ip permit
```

Command Line Description

`5800(config)# interface dialer0`
Defines the dialer interface. Creates a dialer interface used to configure all dialer interfaces at one time.

`5800(config-if)# ip unnumbered loopback0`
Unnumbers the interface to the IP address of loopback 0 interface.

`5800(config-if)# encapsulation ppp`
Sets the default encapsulation type to PPP.

`5800(config-if)# no ip mroute-cache`
Turns off fast switching for multicast traffic.

`5800(config-if)# dialer in-band`
Enables dial on demand routing on this interface. Enables this interface to be a dialer interface.

`5800(config-if)# dialer idle-timeout 2700`
Defines the idle-timeout under the interface. If the call is idle for 45 minutes (2700 seconds) then the command disconnects the user. Default is 120 seconds.

`5800(config-if)# dialer-group 1`
Assigns interface to dialer-list 1. Use dialer-list 1 to determine what kind of traffic is considered interesting.

`5800(config-if)# ntp disable`
Disables the processing of Network Time Protocol (NTP) on this interface.

`5800(config-if)# no snmp trap link-status`
Disables SNMP LINKUP and LINKDOWN traps. Do not send SNMP traps when this interface goes up or down.

`5800(config-if)# peer default ip address pool default`
Use IP pool mechanism to allocate a peer IP address. The pool in this case is called “default”.

`5800(config-if)# no cdp enable`
Disables Cisco Discovery Protocol (CDP) on this interface.

`5800(config-if)# ppp authentication pap callin USE-RADIUS`

Defines the authentication protocol (PAP) to be used for authenticating incoming calls only. The USE-RADIUS list is defined in the AAA process. PPP clients must authenticate themselves using the Password Authentication Protocol. Authentication will be done using the USE-RADIUS method list.

`5800(config-if)# ppp multilink`
Configures the interface for multilink. Enable this interface to negotiate PPP multilink.

`5800(config-if)# exit`
Exits interface configuration mode to global configuration mode.

`5800(config)# dialer-list 1 protocol ip permit`
Configures dialer-list 1 to consider all IP traffic as interesting.

To Modify, Copy, & Paste

```
interface dialer0
ip unnumbered loopback0
no ip directed broadcast
encapsulation ppp
no ip mroute-cache
dialer in-band
dialer idle-timeout 2700
dialer-group 1
ntp disable
no snmp trap link-status
peer default ip address pool default
no cdp enable
ppp authentication pap callin USE-RADIUS
ppp multilink
exit
dialer-list 1 protocol ip permit
```

IP Address Pools

Administratively defined numeric group of available internet protocol (IP) network device identifier. Range of numeric IP addresses set aside for a specific allocation purpose, such as DHCP. As clients connect to the Network Access Server (NAS), they request and are assigned an IP address from the configured IP address pool.

IP Address Pools Requisites

The following requisites are significant considerations to identify before configuring an IP address pool:

- Local IP pools
- DHCP pools

IP Address Pools Configuration

The following Cisco IOS CLI script serves as a sample IP address pool configuration or setup.

Sample Configuration

```
5800(config)# ip dhcp-server x.x.x.x (if using dhcp)
5800(config)# ip local pool default 1.1.1.1 1.1.1.255
5800(config)# ip local pool default 1.1.2.1 1.1.2.255
5800(config)# ip local pool default 21.21.21.1 21.21.21.255
5800(config)# ip local pool 1 10.100.1.1 10.100.1.64
5800(config)# ip local pool 1 172.17.18.1 172.17.18.255
```

Command Line Description

`5800(config)# ip dhcp-server x.x.x.x (if using dhcp)`
Defines the IP address for the DHCP server. Cisco IOS queries this particular DHCP server (instead of broadcasting on all interfaces) when it needs to get an address for a client from DHCP.

`5800(config)# ip local pool default 1.1.1.1 1.1.1.255`
Defines the IP address pool for network 1.1.1.0. The range is from 1 to 254 as 255 is a broadcast address. Configures a local address pool called “default” with addresses spanning 1.1.1.1 to 1.1.1.255.

`5800(config)# ip local pool default 1.1.2.1 1.1.2.255`
Defines the IP address pool for network 1.1.2.0. The range is from 1 to 254 since 255 is a broadcast address. Appends the address range 1.1.2.1 to 1.1.2.255 to the address pool called “default”.

`5800(config)# ip local pool default 21.21.21.1 21.21.21.255`
Defines the IP address pool for network 1.1.2.0. The range is from 1 to 254 since 255 is a broadcast address. Appends the address range 21.21.21.1 to 21.21.21.255 to the address pool called “default”.

`5800(config)# ip local pool 1 10.100.1.1 10.100.1.64`
Defines the IP address pool for network 1.1.2.0. Range is from 1 to 64. Configures a local address pool called “1” with the address spanning from 10.100.1.1 to 10.100.1.64.

`5800(config)# ip local pool 1 172.17.18.1 172.17.18.255`
Defines the IP address pool for network 1.1.2.0. The range is from 1 to 254 since 255 is a broadcast address. Appends the address range 172.16.18.1 to 172.17.18.255 to the address pool called “1”.

To Modify, Copy, & Paste

```
ip dhcp-server x.x.x.x
ip local pool default 1.1.1.1 1.1.1.255
ip local pool default 1.1.2.1 1.1.2.255
ip local pool default 21.21.21.1 21.21.21.255
ip local pool 1 10.100.1.1 10.100.1.64
ip local pool 1 172.17.18.1 172.17.18.255
```

Virtual Template

Virtual Templates are used for cloning virtual-access interfaces for inbound calls.

Virtual Template Requisites

The following requisites are significant considerations to identify before configuring a virtual template:

- IP configuration
- Encapsulation
- Default IP allocation
- PPP authentication

Virtual Template Configuration

The following Cisco IOS CLI script serves as a sample virtual template configuration or setup.

Sample Configuration

```
5800(config)# interface virtual-template 1
5800(config-if)# ip unnumbered loopback0
5800(config-if)# no ip directed broadcast
5800(config-if)# no ip mroute-cache
5800(config-if)# ntp disable
5800(config-if)# no snmp trap link-status
5800(config-if)# ppp authentication pap callin USE-RADIUS
5800(config-if)# ppp multilink
5800(config-if)# exit
```

Command Line Description

`5800(config)# interface virtual-template 1`
Defines the Virtual-Template interface used for cloning virtual-access interfaces.

`5800(config-if)# ip unnumbered loopback0`
Unnumbers the interface to the IP address of loopback 0 interface.

`5800(config-if)# no ip directed broadcast`
Disables the translation of directed broadcast to physical broadcasts. It drops the directed broadcasts destined for this subnet.

`5800(config-if)# no ip mroute-cache`
Turns off fast switching for multicast traffic.

`5800(config-if)# ntp disable`
Disables the processing of Network Time Protocol (NTP) on this interface.

`5800(config-if)# no snmp trap link-status`
Disables SNMP LINKUP and LINKDOWN traps. Do not send SNMP traps when this interface goes up or down.

`5800(config-if)# ppp authentication pap callin USE-RADIUS`
Defines the authentication protocol (PAP) to be used for authenticating incoming calls only. The USE-RADIUS list is defined in the AAA process. PPP clients must authenticate themselves using the Password Authentication Protocol. Authentication will be done using the USE-RADIUS method list.

```
5800(config-if)# ppp multilink
```
Configures the interface for multilink. Enables this interface to negotiate PPP multilink.

```
5800(config-if)# exit
```
Exits interface configuration mode to global configuration mode.

To Modify, Copy, & Paste

```
interface virtual-template 1
ip unnumbered loopback0
no ip directed broadcast
no ip mroute-cache
ntp disable
no snmp trap link-status
ppp authentication pap callin USE-RADIUS
ppp multilink
exit
```

SGBP

Stack Group Bidding Protocol (SGBP) is a protocol used for configuring Multichassis multilink PPP.

SGBP Requisites

The following requisites are significant considerations to identify before configuring SGBP:

- Global SGBP password
- Member list hostnames
- Member list IP addresses
- Bidding priority—refer to *Multichassis Multilink PPP (MMP)*, available online at http://www.cisco.com/warp/public/131/3.html

SGBP Configuration

The following Cisco IOS CLI script serves as a sample SGBP configuration or setup.

Sample Configuration

```
5800(config)# username sg-group password anything
5800(config)# sgbp group sg-group
5800(config)# sgbp source-ip [loopback0 ip address]
5800(config)# sgbp member nas01 [nas01 loop0 ip]
5800(config)# sgbp member nas02 [nas02 loop0 ip]
```

Command Line Description

`5800(config)#` **`username sg-group password anything`**
Defines the username and password for the SGBP stack group. Configures a shared secret for the SGBP group name that will be used to authenticate peers into the stack group.

`5800(config)#` **`sgbp group sg-group`**
Defines “sg-group” as the sgbp stack group name.

`5800(config)#` **`sgbp source-ip`** `[loopback0 ip address]`
Defines the source IP address for the SGBP stack. Forces the NAS to source the SGBP packets from the loopback0 interface.

`5800(config)#` **`sgbp member nas01`** `[nas01 loop0 ip]`
Defines the SGBP member “nas01” and its IP address. Statically configures the peer, name, and IP addresses of other peers in the stack group.

`5800(config)#` **`sgbp member nas02`** `[nas02 loop0 ip]`
Defines the member “nas02” and its IP address. Statically configures the peer, name, and IP addresses of other peers in the stack group.

To Modify, Copy, & Paste

```
username sg-group password anything
sgbp group sg-group
sgbp source-ip
sgbp member nas01
sgbp member nas02
```

VPDN

Virtual Private Dialup Network (VPDN) enables forwarding of PPP links from an Internet Service Provider (ISP) to a Home Gateway. L2TP and L2F are common options for tunneling protocol.

VPDN Requisites

The following requisites are significant considerations to identify before configuring VPDN:

- L2TP
- L2F
- DNIS/Domain based VPDN
- LNS load-balancing/backup

VPDN Configuration

The following Cisco IOS CLI script serves as a sample VPDN configuration or setup.

Sample Configuration

```
5800(config)# vpdn enable
5800(config)# vpdn search-order dnis domain
```

Command Line Description

`5800(config)# vpdn enable`
Enables VPDN on the router. Enables the processing of VPDN calls. VPDN calls are determined either by a special DNIS number or a special format to the username.

`5800(config)# vpdn search-order dnis domain`
Configures the order for searching different VPDN tunnel types. It looks for DNIS based tunnels first and then looks for DOMAIN based tunnels.

To Modify, Copy, & Paste

```
vpdn enable
vpdn search-order dnis domain
```

SNMP

Simple Network Management Protocol (SNMP) is used for monitoring and managing network devices.

SNMP Requisites

The following requisites are significant considerations to identify before configuring SNMP:

- RO community
- RW community
- Trap hosts
- Traps list

SNMP Configuration

The following Cisco IOS CLI script serves as a sample SNMP configuration or setup.

Sample Configuration

```
5800(config)# snmp-server community public RO
5800(config)# snmp-server community private RW
5800(config)# snmp-server enable traps snmp
5800(config)# snmp-server enable traps envmon
5800(config)# snmp-server enable traps syslog
5800(config)# snmp-server host 9.9.9.9 public
5800(config)# snmp-server host 10.10.10.10 public
```

Command Line Description

`5800(config)#` **`snmp-server community public RO`**
Enables SNMP and sets community string and access privileges for public to read-only. Allows users with the public community string to read-only.

`5800(config)#` **`snmp-server community private RW`**
Sets community string and access privileges for private to read-write. Allows users with the private community string to read and write.

`5800(config)#` **`snmp-server enable traps snmp`**
Enables SNMP traps.

`5800(config)#` **`snmp-server enable traps envmon`**
Enables SNMP environmental monitor traps. Sends an SNMP trap when the router detects an anomaly in the environmental conditions.

`5800(config)#` **`snmp-server enable traps syslog`**
Enables SNMP syslog traps. Sends traps to the syslog server.

`5800(config)#` **`snmp-server host 9.9.9.9 public`**
Specifies host 9.9.9.9 to receive SNMP notifications for public. Defines the SNMP server and community string.

`5800(config)#` **`snmp-server host 10.10.10.10 public`**
Specifies host 10.10.10.10 to receive SNMP notifications for public. Defines the SNMP server and community string.

To Modify, Copy, & Paste

```
snmp-server community public RO
snmp-server community private RW
snmp-server enable traps snmp
snmp-server enable traps envmon
snmp-server enable traps syslog
snmp-server host 9.9.9.9 public
snmp-server host 10.10.10.10 public
```

Virtual Profiles

Virtual Profiles is a unique Point-to-Point application. It can create and configure a virtual access interface dynamically when a dial-in call is received, and tear down the interface dynamically when the call ends.

Virtual Profile Requisites

The following requisites are significant considerations to identify before configuring a virtual profile:

- User profile in AAA server
- Interface virtual-template
- Virtual-profile AAA
- Virtual-profile virtual-template

Virtual Profile Configuration

The following Cisco IOS CLI script serves as a sample virtual profile configuration or setup.

Sample Configuration

```
5800(config)# virtual-profile virtual-template 1
5800(config)# virtual-profile aaa
```

Command Line Description

`5800(config)# virtual-profile virtual-template 1`
Enables virtual profiles by virtual interface template. Creates a virtual-access interface for every user that is connected to the access server. This is necessary when applying certain per-user attributes (such as timeouts).

`5800(config)# virtual-profile aaa`
Enables virtual profiles by AAA configuration. Allows the installation of per-user configurations specified by the interface-config attributes in a user's TACACS+/RADIUS profile.

To Modify, Copy, & Paste

```
virtual-profile virtual-template 1
virtual-profile aaa
```

Multilink Virtual Template

A virtual template from which the specified Multilink PPP bundle can clone its interface parameters.

Multilink Virtual Template Requisites

The following requisites are significant considerations to identify before configuring a multilink virtual template:

- IP configuration
- Encapsulation
- Default IP allocation
- PPP authentication

Multilink Virtual Template Configuration

The following Cisco IOS CLI script serves as a sample multilink virtual template configuration or setup.

Sample Configuration

```
5800(config)# multilink virtual-template 1
5800(config)# multilink bundle-name both
```

Command Line Description

`5800(config)# multilink virtual-template 1`
Defines a virtual template used to clone parameters for a virtual access interface for Multilink PPP. Allows the virtual-access interface for a user to clone form the virtual-template interface in case there is no physical/dialer interface to clone from. This is necessary on all stack group members.

`5800(config)# multilink bundle-name both`
Uses peer's authenticated name and endpoint discriminator for naming multilink bundles. Sets the router to uniquely identify this multilink session through a combination of the authentication username and the endpoint discriminator. This is necessary when multiple users are dialing in with the same username.

To Modify, Copy, & Paste

```
multilink virtual-template 1
multilink bundle-name both
```

V.120 Support

V.120 dedicated PPP Dialin.

- Access-dial technical tips, available online at http://www.cisco.com/warp/public/471/index.shtml

V.120 Requisites

None.

V.120 Configuration

The following Cisco IOS CLI script serves as a sample V.120 configuration or setup.

Sample Configuration

```
5800(config)# interface s 1/0/0:1:23
5800(config-if)# autodetect encapsulation v120 ppp
5800(config-if)# line vty 5 20
5800(config-line)# transport input v120
5800(config-line)# login authentication USE-RADIUS
5800(config-line)# authorization exec USE-RADIUS
5800(config-line)# exit
5800(config)#
```

Command Line Description

`5800(config)#` **`interface s 1/0/0:1:23`**
Defines the serial interface to configure.

`5800(config-if)#` **`autodetect encapsulation v120 ppp`**
Configures the router to automatically switch between ISDN PPP users and ISDN V.120 users. Creates new VTY's for V.120 users to start on.

`5800(config-if)#` **`line vty 5 20`**
Creates new VTY's for V.120 users to start on.

`5800(config-line)#` **`transport input v120`**
Only allows V.120 users to connect to this VTY.

`5800(config-line)#` **`login authentication USE-RADIUS`**
Configures EXEC authentication on this line to use the USE-RADIUS method list.

`5800(config-line)#` **`authorization exec USE-RADIUS`**
Configures EXEC authorization on the line to use the USE-RADIUS method list.

`5800(config-line)#` **`exit`**
Exits line configuration mode to global configuration mode.

`5800(config)#`
Return to global configuration mode.

To Modify, Copy, & Paste

```
interface s 1/0/0:1:23
autodetect encapsulation v120 ppp
line vty 5 20
transport input v120
login authentication USE-RADIUS
authorization exec USE-RADIUS
exit
```

VoIP

A technology used to transport voice traffic over the Internet using the existing IP network infrastructure. For sample configurations and command line descriptions, refer to *Voice Over IP for the Cisco AS5800*, available online at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/

Global Parameters

These following parameters are defined in global configuration mode on the router.

- Hostname
- Service timestamps
- Service password
- Network time protocol
- Timezone
- Enable secret

Global Parameter Requisites

None.

Global Parameter Configuration

The following Cisco IOS CLI script serves as sample configurations or setups for global parameters.

Sample Configuration

```
5800(config)# service timestamps debug datetime msec localtime
5800(config)# service timestamps log datetime msec localtime
5800(config)# service password-encryption
5800(config)# hostname [name of your nas]
5800(config)# enable secret thisissecret
5800(config)# clock timezone EST - 5
5800(config)# clock summer-time EDT recurring
5800(config)# ip subnet-zero
5800(config)# no ip source-route
5800(config)# async-bootp dns-server x.x.x.x
5800(config)# ntp server x.x.x.x prefer
5800(config)# ntp server y.y.y.y
```

Command Line Description

`5800(config)# service timestamps debug datetime msec localtime`
Turns on millisecond timestamps for debugs. The debugs are printed with a date and time in millisecond timestamps. Enables debugs to be timestamped with millisecond resolution. This is critical to have when sending in debug traces to the TAC.

`5800(config)# service timestamps log datetime msec localtime`
Turns on millisecond timestamps for log messages. Log messages are printed with a date and time in millisecond timestamps. Enables log messages to be timestamped with millisecond resolution. This is critical to have when sending in debug traces to the TAC.

`5800(config)# service password-encryption`
Turns on service password encryption so the passwords defined on the router are encrypted when displayed in the running and startup config. Enables “light” encryption of passwords.

`5800(config)# hostname [name of your nas]`
Defines and changes the hostname of the router.

`5800(config)# enable secret thisissecret`
Configures a cryptographically strong version of the password used to gain access to the router.

`5800(config)# clock timezone EST - 5`
Sets the clock with the appropriate timezone. Sets the timezone and clock offset from GMT time.

`5800(config)# clock summer-time EDT recurring`
Configures recurring summer (daylight savings) time. Sets the clock to adjust for daylight savings time.

`5800(config)# ip subnet-zero`
Allows “subnet zero” subnets. Allows the router to use subnet zero.

`5800(config)# no ip source-route`
Disables processing of packets with source routing header options.

`5800(config)# async-bootp dns-server x.x.x.x`
Sets DNS name servers. Configures the DNS server the router responds with when dealing with PPP clients that implement RFC1877.

```
5800(config)# ntp server x.x.x.x prefer
```
Configures NTP server and prefers this peer when possible.

```
5800(config)# ntp server y.y.y.y
```
Configures NTP server. Configures the router to sync to the NTP server at y.y.y.y.

To Modify, Copy, & Paste

```
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
hostname [name of your nas]
clock timezone EST - 5
clock summer-time EDT recurring
ip subnet-zero
no ip source-route
async-bootp dns-server x.x.x.x
ntp server x.x.x.x prefer
ntp server y.y.y.y
```

Finalizing Operational Configurations

Finishing up the router configurations and getting the router ready for operational mode.

Final Operational Requisites

None.

Final Operational Configurations

The following Cisco IOS CLI script serves as a sample finalized operational configurations or setups.

Sample Configuration

```
5800(config)# no logging console
5800(config)# line con 0
5800(config)# login authentication CONSOLE
5800(config)# exec-timeout 0 0
5800(config)# line vty 0 4
5800(config)# exec-timeout 0 0
5800(config)# login authentication LOCAL
5800(config)# exit
5800#
```

Command Line Description

`5800(config)# **no logging console**`
Turns off console logging so messages do not appear on the router console. Prevents debug messages to be sent to the console. Flooding of debug messages on the console has an operational impact on the router.

`5800(config)# **line con 0**`
Enters console configuration mode.

`5800(config)# **login authentication CONSOLE**`
Sets the login authentication for console access. The method list CONSOLE is defined in the global AAA process. User will be prompted for a username and password when attempting console access. Configures EXEC authentication on this line to use the CONSOLE method list.

`5800(config)# **exec-timeout 0 0**`
Sets EXEC timeout for the console to indefinite. Disables idle timeout for EXEC sessions on this line.

`5800(config)# **line vty 0 4**`
Enters virtual terminal line configuration mode. These lines are used for Telnetting to the router.

`5800(config)# **exec-timeout 0 0**`
Sets the EXEC timeout to indefinite. Disables the idle timeout for EXEC sessions on this line.

`5800(config)# **login authentication LOCAL**`
Sets the login authentication under the virtual terminal lines. The method list LOCAL is defined in the global AAA process. Configures EXEC authentication on this line to use the LOCAL method list.

`5800(config)# **exit**`
Exits global configuration mode to privileged EXEC mode.

`5800#`
Privileged EXEC mode prompt.

To Modify, Copy, & Paste

```
no logging console
line con 0
login authentication CONSOLE
exec-timeout 0 0
line vty 0 4
exec-timeout 0 0
login authentication LOCAL
exit
```

Other Operational Configuration Considerations

Access Lists

Access lists are defined on the router to control the flow of incoming and outgoing traffic. Access lists define the kind of traffic permitted and denied.

Route Summarization

Route summarization is used to summarize the routes advertised to other routers in the network. Routes are normally summarized to classful boundaries.

Show Commands

The **show** commands are used to look at various information and statistics on the router.

- **show version**
- **show controller {t1}**
- **show isdn {status | service}**
- **show modem {summary}**
- **show ip local pool**
- **show line summary**
- **show caller**
- **show caller user username**
- **show dial-shelf**

Debug Commands

The **debug** commands are used for isolating and troubleshooting problems on the router. If something is not working on the router, use debug commands to find the cause of the problem.

- **debug isdn q931**
- **debug isdn q921**
- **debug csm modem**
- **debug aaa authentication**
- **debug aaa authorization**
- **debug aaa accounting**
- **debug aaa per-user**
- **debug ppp authentication**
- **debug ppp negotiation**
- **debug radius**
- **debug vpdn l2x-events**
- **debug vpdn l2x-errors**

A

AAA

Triple A security in billing that stands for authentication, authorization and accounting.

access charge

Charges long distance providers pay to local telephone service providers for use of the local network to complete long distance calls.

access line

The circuit between a telephone subscriber and the local switching center.

access server

Communications processor that connects asynchronous devices to a LAN or WAN through network and terminal emulation software. Performs both synchronous and asynchronous routing of supported protocols. Sometimes called a network access server. See also communication server.

accounting management

One of five categories of network management defined by ISO for management of OSI networks. Accounting management subsystems are responsible for collecting network data relating to resource usage. See also configuration management, fault management, performance management, and security management.

address

Data structure or logical convention used to identify a unique entity, such as a particular process or network device.

address mapping group (RMON2)

A list of MAC addresses that correspond to the network addresses discovered by the SwitchProbe device.

address mask

Bit combination used to describe which portion of an address refers to the network or subnet and which part refers to the host. Sometimes referred to simply as mask. See also subnet mask.

administrative applications

TrafficDirector applications performed by a network administrator that concentrate on performing the necessary configuration tasks to functionally link data-monitoring devices to utilities that display the monitored data.

advertising

Router process in which routing or service updates are sent at specified intervals so that other routers on the network can maintain lists of usable routes.

agent

Firmware embedded or software installed on a device.

agent group

A collection of one or more agents created by a network administrator. The TrafficDirector application handles an agent group as a single agent, allowing you to collectively monitor network statistics from more than one segment or point on a segment.

alarm

SNMP message notifying an operator, or administrator, of a network problem. Similar to event or trap. Notification that a threshold (rising or falling) established by the user has been met.

alarm discovery

Alarm information displayed on the lower half of the Domain Discovery window that includes alarms configured on an agent. You can obtain additional details by selecting a specific alarm.

alarm group (RMON1)

Periodically takes statistical samples from variables in the SwitchProbe device and compares them with previously configured thresholds. If the monitored variable crosses a threshold, an event is generated. A mechanism is implemented to limit the generation of alarms. This group includes the alarm Table and requires the implementation of the Event group. Elements include alarm type, interval, starting threshold, and stop threshold.

alert

A message sent to all IP addresses defined in the trap community string.

Alert Monitor

A TrafficDirector application that displays alerts when a threshold is met.

All Conversations

A TrafficDirector application that displays, for a selected domain, all conversations taking place between a pair of hosts.

All Talkers

A TrafficDirector application that displays, for a selected domain, all talkers seen by the agent connected to the network segment.

analog signal (AS)

A signal in the form of a continuous varying physical quantity, e.g. , voltage, which reflects variations in some quantity, like loudness in the human voice.

analyzer port

A port on a switch designated by the switch management console to host a SwitchProbe device or analyzer. This port is most often put in receive-only mode and packets are mirrored to it when the mirroring function is activated.

assigned numbers

RFC [STD2] documents the currently assigned values from several series of numbers used in network protocol implementations. This RFC is updated periodically, and current information can be obtained from the IANA. If you are developing a protocol or application that will require the use of a link, socket, port, protocol, and so forth, contact the IANA to receive a number assignment.

async interface

Asychronous interface is used to terminate analog (async) dialin calls.

asynchronous transmission

This term describes digital signals that are transmitted without precise clocking. Such signals generally have different frequencies and phase relationships. Asynchronous transmissions usually encapsulate individual characters in control bits (called start and stop bits) that designate the beginning and end of each character. A method of sending data over a communications line by placing a block of transmitted bits in an “envelope.” The envelope begins with a "start" bit that tells a computer a character is beginning. The “stop” bit sends a message that a character has ended. Asynchronous transmission also has the advantage of not needing precise clocking mechanisms that maintain a time relationship between transmitter and receiver.

Asynchronous Transfer Mode (ATM)

An international packet switching standard. The standard uses a cell-switched approach, in which each packet of information features a uniform size of 53 bytes (digital words of eight bits each). Of the total cell, 48 bytes is the “payload,” or information to be transmitted. Five bytes are used as a “header,” providing all the addressing information for that particular packet. ATM could switch and route information of all types, including video, voice and data.

authentication

In security, the verification of the identity of a person or process.

B

B channel

Bearer channel. In ISDN, a full-duplex, 64-kbps channel used to send user data. Compare to D channel, E channel, and H channel.

backplane

Physical connection between an interface processor or card and the data buses and the power distribution buses inside a chassis.

bandwidth

Difference between the highest and lowest frequencies available for network signals. The term is also used to describe the rated throughput capacity of a given network medium or protocol. The transmission capacity of a telecommunications link (e.g., 64 kbps).

baseband

The total frequency band occupied by the aggregate of all the voice and data signals used to modulate a radio carrier.

baseline report

Compares two similar time ranges in one report. A baseline time range is maintained (protected against purge action) so that baseline data is available at report time. The baseline time range can be one to 30 days. You can baseline both detail and summary data, and you can store up to two baseline time ranges. However, the comparison reports run on any two time ranges where data is available. The baseline comparison is a one-to-one comparison; therefore, no computation of average, minimum, maximum, or standard deviation is performed on the baseline data.

basic service

The minimum set of capabilities deemed necessary for use of the public telecommunications network. Current basic service includes an access line (usually one-party, analog, rotary dial), access to local and long distance calling, access to emergency calling (911), and access to voice/nonvoice relay service.

baud

A unit of signaling speed. The speed in Baud is the number of discrete conditions or signal elements per second. If each signal event represents only one bit condition, then Baud is the same as bits per second. Baud does not equal bits per second.

Bell operating company (BOC)

A local telephone company formerly owned by AT&T.

Bellcore

Bell Communications Research. Organization that performs research and development on behalf of the RBOCs.

Broadband Integrated Services Digital Network (BISDN)

A high speed ISDN service intended to support full motion video and image applications, as well as data, at speeds of approximately 150 Mbps.

bit

A binary digit, the smallest unit of information in a computer, represented as a 0 or 1. One character is typically seven or eight bits in length.

bit rate

The speed at which digital signals are transmitted, expressed in bits per second.

bit/byte

A bit is the most basic element of digital information. One bit represented by either a 0 or 1, the absence or presence of electricity or light is combined with other bits to form an eight-bit word or Byte. Bytes are the words of our digital language. Depending on how the bits within them are ordered, these bytes can be translated into numbers, words, or commands.

bps

Bits per second, used to refer to transmission speeds of sending data (e.g., 2400 bps, 14,400 bps, etc.). Speed takes on particular importance when using on-line Internet services. See also “kbps.”

Basic Rate Interface (BRI)

This ISDN scheme is identified as 2B+D, and permits two “bearer” channels, each operating at 64 kbps, and one “data” channel, operating at 16 kbps, to be carried over a single twisted pair copper wire.

broadband

A transmission facility having a bandwidth of greater than 20 kHz. Any communications system able to deliver multiple channels or services of video, voice, or data to its users or subscribers over a broad band of RF spectrum.

broadcast address

Special address reserved for sending a message to all stations. Generally, a broadcast address is a MAC destination address of all ones.

bus

Common physical signal path, or highway, composed of wires or other media across which signals can be sent from one part of a computer to another.

byte

A collection of bits used to form a character or some other information.

C

call

Establishment of (or attempt to establish) a voice or data connection between two endpoints, or between two points which provide a partial link (e.g. a trunk) between two endpoints.

capture group (RMON 2)

Storage of packets, based on filters, for later retrieval.

carrier

A long distance company which uses primarily its own transmission facilities, as opposed to resellers which lease or buy most or all transmission facilities from carriers. Many people refer to any type of long distance company, whether it has its own network or not, as a carrier, so the term is not as restrictive as it used to be.

Channel-Associated Signaling (CAS)

Comitre Consultatif Internationale de Telegraphique et Telephonique (CCITT)

An international group operating under the auspices of the International Telecommunications Union (ITU) and charged with establishing telecommunications standards. Name recently changed to ITU-TSS (International Telecommunications Union-Telecommunications Standards Sector).

cell

An ATM unit of segmented data that consists of 53 bytes or octets. Of these, five constitute the header and the remaining 48 carry the data payload. Cell-switching gives maximum utilization of physical resources.

central office (CO)

The telephone company facility housing the switches and other equipment that provide telephone service for customers in an immediate geographical area.

channel

A transmission path between two points. For example, a DS0 in a T1 line.

circuit

A path for the transmission of electromagnetic signals to include all conditioning and signaling equipment.

circuit switching

The type of signal switching traditionally used by telephone companies to create a physical connection between a caller and a called party.

Cisco IOS

Cisco-proprietary Internetwork Operating System.

Cisco Discovery Protocol Media (CDP)

The protocol-independent, device-discovery protocol that runs on all Cisco-manufactured equipment including routers, access servers, bridges, and switches. Using CDP, a device can advertise its existence to other devices and receive information about other devices on the same LAN, or on the remote side of a WAN. Runs on all media that support SNAP, including LANs, Frame Relay, and ATM.

Command Language Interpreter (CLI)

Basic Cisco IOS configuration and management interface.

client

End-user computer on a network (local or Internet).

client/server

A distributed computing architecture in which numerous dispersed terminals, each has its own central processor and memory, communicates with centralized processing, storage and output resources. In a client/server network, the client is a front end resource for a user, while the server represents the back end set of resources. Servers include mainframe computers, minicomputers, personal computers, hard disk, and other types of memory devices. Clients typically are personal computers. Client/server also is a concept used by software programs running on distributed computing platforms. In a cable TV context, a client is a set top terminal or other intelligent device at a customer premises.

coaxial cable

Cable that has been used for cable television installation. Being replaced by fiber optic cable of greater capacity and bandwidth.

command line interface

The TrafficDirector command-line interface on UNIX. Accessible at the shell prompt on UNIX, and accessible at the DOS prompt on Microsoft Windows. When invoked, displays CLI usage options.

common carrier

An entitry that provides a public communications conduit without regard to content.

communications protocol

A collection of rules that ensure compatibility of transmitting and receiving equipment. Protocols usually have three main parts, the method by which data is coded, the method by which codes are received, and the methods used to establish control, detect errors and failures, and intiate corrective action.

Configuration Manager

A TrafficDirector application allows you to add and configure agents, agent groups, switches, and Frame Relay agents. Configuration Manager also provides a means for installing domains, logging, traps, and resources on a variety of agents including DLCIs and switch ports.

Configuration Rollup (or Config Rollup)

A TrafficDirector application that allows you to define the number of days that different kinds of data are stored in an SQL report database before being deleted.

constrained modem pool

A modem pool that has a condition imposed on the starting and ending modem numbers for it pool sub-ranges. The condition is that the start of a pool sub-range must coincide with the start of a modem module, and the end of a pool sub-range must coincide with the end of a modem module.

constraint-capable modem pool

A constraint-free modem-pool that has its pool sub-ranges specified that the conditions for a constrained modem-pool are met.

constraint-free modem pool

A modem pool that has no conditions imposed on the starting and ending modem numbers for its pool sub-ranges. A modem pool is created by default to be constraint-free.

customer premises equipment (CPE)

Equipment employed at the clients location or premises (other than a carrier) to originate, route, or end telecommunications.

D

D-channel (ISDN)

This is the 24th timeslot on T1/PRI or the 16th timeslot on E1/PRI and is used for signaling information. Call setup and teardown information is sent over the D-channel.

default firmware

The modem firmware in a firmware list that would be loaded on the modem modules in the absence of any modem firmware-related configuration commands. This will always be the first firmware image in the firmware list.

demodulation (MOD)

The process of retrieving data from a modulated signal.

dial interface

These interfaces are used for ending digital calls. Dialer interfaces are also used for async calls.

dial pulsing (DP)

The transmitting of telephone address signals by momentarily opening a DC circuit a number of times corresponding to the decimal digit which is dialed. Transmission and/or reception of address digits using “onhook” and “offhook” transitions of the DC signaling variable.

dial selective signaling (DSS)

A multipoint network in which the called party is selected by a prearranged dialing code.

dial tone (DT)

A tone indicating that automatic switching equipment is ready to receive dial signals.

dialing parity

A company that is not an affiliate of a local phone company is able to provide phone services in such a manner that customers have the ability to route their calls automatically without the use of any access code.

digital transmission

Transmission of data, audio, or video messages in discrete codes generated by computers.

domain

The name of a computer or network on the Internet, specifically the characters to the right of the "@" sign, indicating the organization and the type of organization (.mil=military; .org=nonprofit; .edu=educational institution; .com=commercial, etc.) that operates that domain or the physical location of the computer (.ca=Canada, .uk=United Kingdom)

DS3

Digital signal level 3. Framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility. See also E3 and T3.

DS0 Channel

Digital Signal Level 0. A 56 or 64 kbit/s channel. The DS0 channels for the T1 also pass signaling information using "robbed-bit" signaling.

duplex signaling (DS)

A long-range bidirectional signaling method using paths derived from transmission cable pairs. It is based on a balanced and symmetrical circuit that is identical at both ends. This circuit presents an E&M lead interface to connecting circuits.

E

E3

Wide-area digital transmission scheme used predominantly in Europe. E3 carries data at a rate of 34.368 Mbps. See also DS3. Compare with T3.

egress interface

Egress interfaces are network connections, or ports, used for outbound traffic flow.

EIA/TIA-232

Common physical layer interface standard, developed by EIA and TIA, that supports unbalanced circuits at signal speeds up to 64 kbps. Closely resembles the V.24 specification. Formerly called RS-232.

eligible telecommunications carrier

A telecommunications carrier is eligible to receive universal service support, if it offers phone service to all customers throughout a service area without preference, and it advertises the available supported services through the mass media.

Email

Electronic mail. Messages are composed on computers and then sent over a network, in electronic form to other network users.

Ethernet

Baseband LAN specification originated by Xerox and developed jointly by Xerox, Intel, and Digital Equipment Corp. Nodes on Ethernet networks use CSMA/CD to contend for access to the transmission medium. 10-Mbps Ethernet includes specifications for many different cable types, including 10Base2, 10Base5, 10BaseF, 10BaseT, and 10Broad36. A newer standard, Fast Ethernet, calls for data to be carried at 100 Mbps. Ethernet is similar to IEEE 802.3.

exchange access

The offering of access to telephone exchange services or facilities to originate or end telephone toll services.

F

faceplate

The front panel of a plug-in module such as a line card or power supply.

Federal Communications Commission

Government agency that regulates wire, satellite, and over-the-air transmissions.

fiber optic

The rapid transmission of light pulses in a coded digital format through the fiber cable. In a fiber optic transmitter, a light source such as a laser or light-emitting diode (LED) is connected to the fiber cable. This light source converts an electronic input signal into a series of light pulses (representing bits) by blinking on and off millions of times per second. This stream of light pulses is the combination of many lower rate bit streams formed using digital multiplexing techniques. At the other end of the fiber, fiber optics receivers capture the light pulses for conversion to electrical signals.

fiber optic cable

Cable that consists of several strands of glass-like material capable of transmitting modilated light using a laser, with the capacity of 600 times that of coaxial cable.

File Transfer Protocol (FTP)

The first and most fundamental way to transfer files to and from remote computer sites. “Anonymous ftp” refers to accessing public file archives without a password (login=anonymous, password=your email address).

firmware list

The list of available bundled modem firmware images in the modem card image running in a particular modem slot.

G

grade of service (GS)

The probability of a call being blocked by busy trunks, expressed as a decimal fraction, and usually meaning the busy-hour probability.

H

host

On the Internet, a host, or host computer, can serve as both way station and entry point for network users. Hosts serve information to remote users, for example using World Wide Web or Gopher. They also provide access to the Internet for local users, capable of logging in through a particular account. A host is similar to node, except that “host” usually implies a computer system, whereas “node” generally applies to any networked system, including access servers and routers. See node.

hypertext

The World Wide Web is built around this concept. Documents are formatted with special tools that permit authors to link information to other documents of relevance elsewhere on the Internet. The Web is composed of “pages,” documents written in hypertext, or HyperText Markup Language (HTML). Using this information, graphical browsers like Mosaic or Netscape display images and text. By clicking on highlighted text, one can move to related information and images located anywhere around the world, reading and accessing countless pages of online information in various media (audio, video, pictures, etc.). A nongraphical browser called Lynx also enables access to Hypertext documents, with keystrokes instead of a mouse.

I

information service

The offering for generating, acquiring, storing, transforming, processing, retrieving, utilizing, making information available using telecommunications. This service includes electronic publishing, but does not include management, control, or operation of a telecommunications system or the management of a telecommunications service.

ingress interface

Interfaces used for inbound traffic flow.

interexchange carrier (IXC)

Telecommunications providers that provide service between local service areas.

Internet

An international network of computer networks with common protocol standards. World wide computer interconnection. Provides any computer with the capability of linking to any and all other computers through mainframe computer links and telephone connections.

IOS

See Cisco IOS.

IP address

The 32-bit address assigned to hosts using TCP/IP. An IP address belongs to one of five classes (A, B, C, D, or E) and is written as four octets separated by periods. This is called dotted decimal format. For example: 172.16.211.0. Each address consists of a network number, an optional subnetwork number, and a host number. The network and subnetwork numbers together are used for routing, and the host number is used to address an individual host within the network or subnetwork. A subnet mask is used to extract network and subnetwork information from the IP address. Also called Internet address. See also IP and subnet mask.

IP address pools

Administratively defined numeric group of available internet protocol (IP) network device identifier. Range of numeric IP addresses set aside for a specific allocation purpose, such as DHCP. As clients connect to the Network Access Server (NAS), they request and are assigned an IP address from the configured IP address pool.

Integrated Services Digital Network (ISDN)

In its simplest form, called Basic rate ISDN, it provides a means of transmitting two voice channels (each operating at 64 Kbps) and one data channel (operating at 16 Kbps) over a single pair of twisted copper conductors. The two voice channels are called bearer, or “B” channels; the single data channel is the “D” channel. A more complex form of ISDN is called Primary rate ISDN; in this system there are 23 "B" channels operating at 64 Kbps and one “D” channel operating at 64 Kbps. Thus the transmission capability of Basic rate is 144 Kbps, and that of Primary rate ISDN at 1.5 Mbps.

Internet service provider (ISP)

A company that allows home and corporate users to connect to the Internet.

ITU-T

International Telecommunications Union, Standardization Sector. ITU-T is the telecommunication standardization sector of ITU. This sector is responsible for making technical recommendations about telephone and data (including fax) communications systems for service providers and suppliers. The ITU-T carries out the functions of the former CCITT. A sister organization, ITU-R, carries out similar functions for radio.

L

local area network (LAN)

A limited distance network connecting a defined set of terminals. It could connect workstations within an office, offices in a building, or buildings within a campus.

leased line

A dedicated telephone line for whatever purpose designated by the lessee. Leased lines are capable of higher transmission speeds for data communications than regular telephone lines, and are often required for large computers with multiple users connecting simultaneously to the Internet.

line

(a) From a switching viewpoint, the Loop, Station Equipment and Central Office - associated equipment assigned to a customer. (b) From a Transmission view point , the transmission path between a customers station equipment and a switching System (also called a Loop). (c) In Carrier Systems, the portion of the transmission system between two terminal locations. The line includes the transmission media and associated line Repeaters. (d) The side of the Central Office equipment that connects to the Outside Plant. The other side is called the drop side.

line signaling

When configuring a router for signaling, line signaling can be used for both inbound and outbound calls. The line signaling configuration must match the corresponding telco switch configuration.

local area network (LAN)

Intraoffice communication system usually used to provide data transmission in addition to voice transmission.

local exchange carrier (LEC)

Any company that is engaged in the provision of telephone exchange service or exchange access.

loopback

A method of performing transmission tests on a circuit not requiring the assistance of personnel at the distant end. A diagnostic test that returns a transmitted signal to the sending device after it has passed through a network or across a particular link. The returned signal can then be compared to the transmitted one. The discrepancy between the two helps you to trace faults. When you are trying to locate a faulty piece of equipment, you can use repeated loopbacks to eliminate healthy machines until the problem is found.

loopback interface

A logical interface on the router that can be used for diagnostics and troubleshooting purposes. It is also used to conserve address space so other physical interfaces can be unnumbered to this interface. The state of the Loopback interface is always UP/UP.

M

management information base (MIB)

A database of network management information that is used and maintained by a network management protocol such as CMIP (Common Management Information Protocol) or SNMP (Simple Network Management Protocol). The value of a MIB object can be changed or retrieved using CMIP or SNMP commands, usually through a GUI-based network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.

MICA

Multiservice Cisco IOS Channel Aggregation. Technology that enables the simultaneous support of remote-access users through both analog modems and ISDN devices.

modem

A device that converts digital signals generated by a computer into analog signals for transmission over telephone lines. Modems also convert analog signals from telephone lines into digital signals for computer use. (The term stands for modulator/demodulator).

modem pools

The modem pool covers a specified range of modems that accept calls based on the number called by dialin users. If there is only one dial-in number, then all modems can be defined under the default modem pool. It is also used for modem firmware upgrades.

modulation

Alterations in the characteristics of carrier waves. Usually impressed on the amplitude and the frequency.

Multilink virtual template

A virtual template from which the specified Multilink PPP bundle can clone its interface parameters.

multiplexing

Creating multiple channels by interspersing more than one signal over a single relay, such as cable, or microwave.

N

network

A group of stations linked together to broadcast the same program simultaneously. Also used as designate cable program providers.

network element

A facility or the equipment used in the provision of a telecommunications service. The term includes subscriber numbers, databases, signaling systems, and information sufficient for billing and collection. It is also used in the transmission, routing, or other provision of a telecommunications service.

network trunks

Circuits connecting switching centers.

node

Endpoint of a network connection or a junction common to two or more lines in a network. Nodes can be processors, controllers, or workstations. Nodes, which vary in routing and other functional capabilities, can be interconnected by links, and serve as control points in the network. “Node” is sometimes used generically to refer to any entity that can access a network, and is frequently used interchangeably with “device.” See also host.

O

offline

The absence of connection to another computer. In an “off line” mail system, the user reads and writes e-mail messages in an editor without a modem connection to a remote computer. Another piece of software then automatically establishes a connection to a remote host computer, sends and receives accumulated e-mail, then hangs up. This is less interactive than online systems, but tends to be cheaper for the user and is sometimes a necessity in areas with particularly bad telephone lines.

online

A “live” connection to another computer. In an online e-mail system, a user works directly with a remote host computer, reading and sending e-mail while connected to that computer. Interactive Internet functions like WWW and Gopher require an online interface.

override firmware

The modem firmware that is indicated as the alternate firmware image to which the modem module is to be upgraded.

P

packet

A bundle of data packaged for transmission over a network. Packets can be various lengths, ranging from about 40 bytes up to 32,000 bytes on the Internet, but typically about 1,500 bytes in length. The Asynchronous Transfer Mode, a new standard for switching data of various types over private and public networks, specifies a packet of uniform 53 byte length.

personal communication service (PCS)

Wireless technology that offers ways to exchange voice and data. Competition for cellular telephones.

point of presence (PoP)

A physical location within a LATA at which an IC establishes itself for the purpose of obtaining LATA access, and to which the BOC provides access services.

point-to-point

A communications circuit between two terminations which does not connect with a public telephone system.

pool subrange

A contiguous range of modems. The pool-range set for a modem-pool is the logical union of a set of pool sub-ranges.

port

Entrance or access point to a computer, multiplexor device, or network where signals may be supplied, extracted, or observed.

public switched telephone network (PSTN)

General term referring to the various telephone networks and services in place worldwide. Sometimes called plain old telephone service (POTS).

protocol

A set of rules about how computers act when talking to each other. Standard protocols are Ethernet, IEEE 802.5 token ring, X Modem or Kermit.

Q

quality of service (QoS)

A contracted data rate that is negotiated between two ATM end points that guarantees throughput and data delivery. A measurement of performance for a transmission system that reflects its transmission quality and service availability.

queue

A temporary delay in providing service caused by the inability of the system provided to handle the number of messages or calls attempted.

R

regional Bell operating company (RBOC)

Corporate entities that emerged from the breakup of the AT&T monopoly to own local telephone service in designated geographic regions in the USA.

remote access (ra)

The ability of transmission points to gain access to a computer that is at a different location.

routing protocol

Protocol that accomplishes routing through the implementation of a specific routing algorithm. Examples of routing protocols include RIP, IGRP, EIGRP, OSPF, and BGP.

RS-232

See EIA/TIA-232.

S

server

The main computer on a network, including local area networks (LANs) and hosts on the Internet. So called because it “serves” software or information to the “client” computers on the network.

service provider

A company or organization that provides e-mail or Internet connectivity, typically for a fee.

Stack Group Bidding Protocol (SGBP)

Aprotocol used for configuring Multichassis Multilink PPP.

signaling

The transmission of Address, Supervision, or other Switching information between stations and Switching Systems, or between Switching Systems, including billing information.

Serial Line Internet Protocol and Point-to-Point Protocol (SL/IP and PPP)

Protocols used to establish real TCP/IP Internet connections over dialup lines, as opposed to leased lines.

Simple Network Management Protocol (SNMP)

Protocol used for monitoring and managing network devices.

software-defined network (SDN)

A switched long-distance service for large users with multiple locations. Instead of putting together their own network, large users can get special usage rates for calls made on regular long-distance company switched long distance services. The service is also know as virtual private network.

SONET

Synchronous Optical Network. Specification for a high-speed (up to 2.5 Gbps) synchronous network developed by Bellcore and designed to run on optical fiber. STS-1 is the basic building block of SONET. See also STS-1.

STS-1

Synchronous Transport Signal level 1. Basic building block signal of SONET, operating at 51.84 Mbps. Faster SONET rates are defined at STS-n, where n is a multiple of 51.84 Mbps. See also SONET.

STS-3c

Synchronous Transport Signal level 3, linked together. SONET format that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells. See also SONET.

subnet mask

A 32-bit address mask used in IP to indicate the bits of an IP address that are used for the subnet address. Sometimes referred to simply as a mask. See also IP address.

switching

The operations involved in interconnecting circuits in order to establish communications.

switching office (SO)

A telephone company office that contains a switch. Also known as Cenral Office (CO).

synchronous transmission

A method of sending information over a transmission line, and separating discrete characters and symbols by a precise separation in time. Synchronous transmission offers higher throughput because it does not require the start-stop bits used by asynchronous methods. Synchronous transmission is more expensive than other transmission methods.

T

Terminal Acess Controller Access Control System Plus (TACACS+)

A proprietary Cisco enhancement to Terminal Access Controller Access Control System (TACACS). Provides additional support for authentication, authorization, and accounting. Authentication protocol that provides remote access authentication and related services, such as event logging. User passwords are administered in a central database rather than in individual routers, providing an easily-scalable network security solution.

T-1 (T-1) (T1)

Twenty-four (24) voice channels digitized at 64,000 bps, combined into a single 1. 544-Mbps digital stream (8000-bps signaling), and carried over two pairs of regular copper telephone wires. Used primarily by telephone companies until 1983. Now used for dedicated local access to long distance facilities, long-haul private lines, and for regular local service. Today, most any 1.544 Mbps digital stream is called T-1, regardless of its makeup or transmission medium.

T-3 (T-3) (T3)

Digital WAN carrier facility. T3 transmits DS-3 formatted data or voice at 44.736 Mbps through the telephone switching network using fiber optic cable.

T-carrier (T-1)

A 4-wire digital transmission system which carries a 1.544-Mb/s digital bitstream in each direction. When using one of the framed formats (for example, D4 or ESF), T-1 has 1.536 Mb/s available for user data or digititized voice. Usually channelized into 24 voiceband channels using TDM (24 8-bit PCM samples per 193-bit frame).

TCP/IP

Transmission Control Protocol/Internet Protocol, TCP and IP are two open protocol standards used among computers connected to the Internet, allowing different computer systems and platforms to share data seamlessly. TCP/IP forms the foundation for Internet communications, and provides such services such as Gopher and World Wide Web.

Tellcordia Technologies

Formerly Bellcore. See Bellcore.

TELCO (BOC)

Local telephone company.

telecommunications

The transmission of voice and data through a medium of electrical impulses, and includes all aspects of transmitting information.

telecommunications carrier

Any provider or common carrier of telecommunications services.

telecommunications equipment

Equipment, other than customer premises equipment, used by a carrier to provide telecommunications services, and includes software integral to such equipment (including upgrades).

telecommunications service

The offering of telecommunications, for a fee, directly to the public.

Telnet

A method of connecting from one host computer system to another using the Internet. Telnet allows users to log in to accounts on remote systems, and retrieve text-based information from a remote host.

terminal

A point where information can enter or leave a communications network.

terminal equipment (TE)

Devices and their associated interfaces used to forward information to a local customer or distant terminal.

TFTP

Trivial File Transfer Protocol. Simplified version of FTP that allows files to be transferred between computers over a network.

tip and ring

The two sides of a telephone circuit. The names come from old telephone switch board plugs: the tip wire was connected to the tip of the plug, and the ring wire was connected to the ring at the base of the plug.

topology

Physical arrangement of network nodes and media within an enterprise networking structure.

traffic

Calls being sent and received over a communications network.

transmission (XMISSION) (XMIT)

The electrical transfer of a signal, message, or other form of data from one location to another, with acceptable loss of content due to attenuation, distortion, or noise.

trunk

A communication channel between two Switching Systems.

TTY line

These are asynchronous lines on the router. TTY is a line configuration, not an interface configuration. These lines correspond to async interfaces that are configured separately.

V

V.120

Dedicated PPP Dial-in.

virtual profiles

Virtual Profiles is a unique Point-to-Point application that can create and configure a virtual access interface dynamically when a dial-in call is received, and tear down the interface dynamically when the call ends.

virtual template

Virutal Templates are used for cloning virtual-access interfaces for inbound calls.

voiceband channel

A transmission channel with a nominal 4 kHz bandwidth, suitable for voice transmission. If sampled at an 8 kHz sampling rate with 8 bit/sample, it becomes a 64 kbit/s data stream.

voice over IP (VoIP)

A technology used to transport voice traffic over the Internet using the existing IP network infrastructure.

VPDN

Virtual Private Dialup Network. The forwarding of PPP links from an Internet Service Provider (ISP) to a home gateway. L2TP and L2F are common options for tunneling protocol.

W

wide area network (WAN)

An integrated data network linking metropolitan or local networks over common carrier facilities.

World Wide Web (WWW)

The newest and increasingly the most popular service on the Internet, WWW is a “hypertext” information system capable of presenting multimedia information to those with a “direct connection” to the Internet. It requires SL/IP, PPP, or some other dedicated Internet connection and browser software (like Mosaic or Netscape). Users without such a dedicated connection, but who have an online account, can use Lynx, a nongraphical, text-based browser.

Symbols

A

B

C

D

E

F

G

H

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K

L

M

N

O

P

Q

R

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T

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V

W