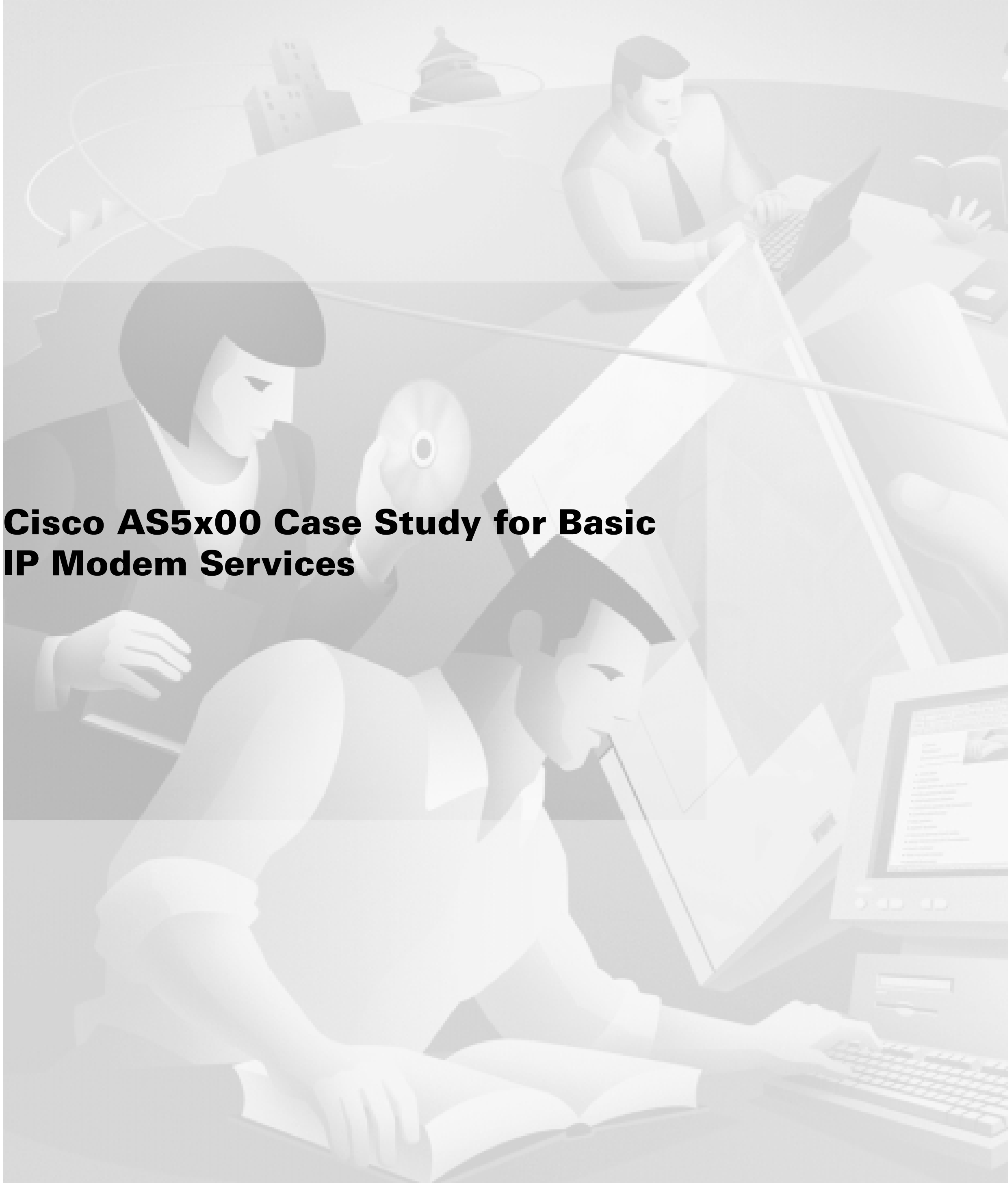

Cisco AS5x00 Case Study for Basic IP Modem Services

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Cisco Systems, Inc.
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Text Part Number: OL-0364-01

The following information is for FCC compliance of Class A devices: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

The following information is for FCC compliance of Class B devices: The equipment described in this manual generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco's installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

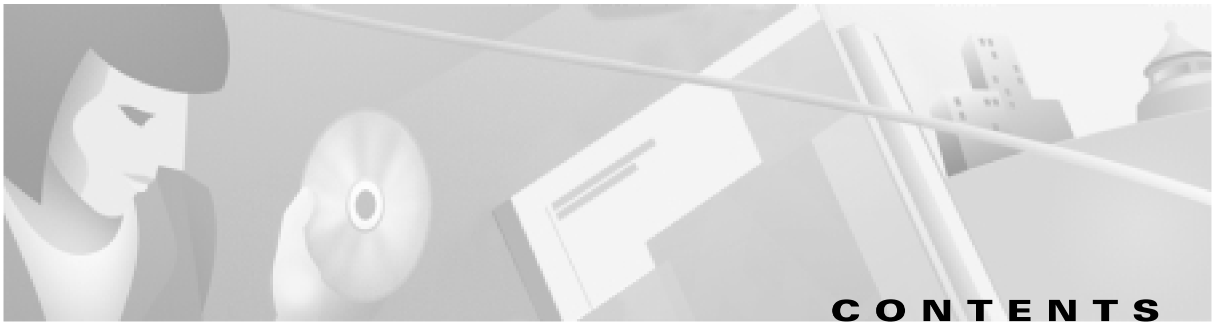
Modifying the equipment without Cisco's written authorization may result in the equipment no longer complying with FCC requirements for Class A or Class B digital devices. In that event, your right to use the equipment may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Rotate the television or radio antenna until the interference stops.
- Move the equipment to one side or the other of the television or radio.
- Move the equipment farther away from the television or radio.
- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

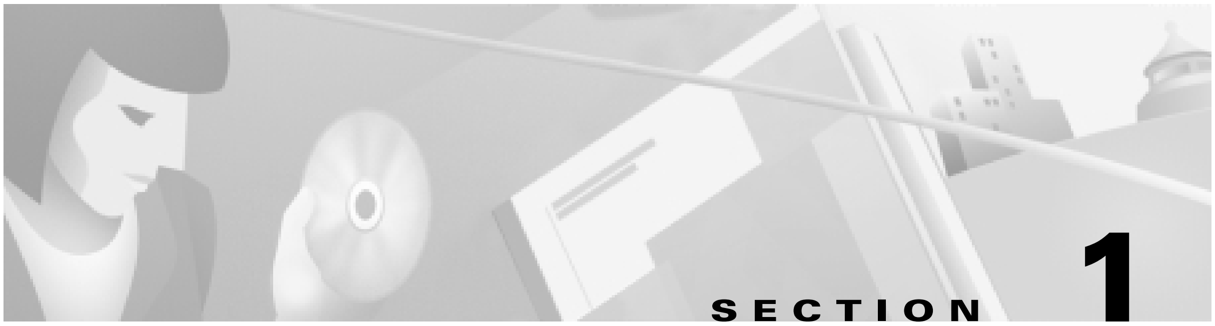
Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

Cisco AS5x00 Case Study for Basic IP Modem Services



CONTENTS

SECTION 3



SECTION 1

Network Design and Case Study Overview

Introduction

This case study describes how two companies set up basic modem IP services by using Cisco AS5x00 network access servers.

The two companies

- Plan and design a basic IP modem dial-up network.
- Deploy networking equipment by configuring, verifying, and troubleshooting the Cisco IOS.
- Prepare for operations by inspecting modem call statistics and enabling basic management protocols.

This case study

- Is for network engineers who work with dial-up access technologies.
- Assumes that the reader has a CCNA or higher level of familiarity with Cisco IOS routers and technologies.

Note The term Cisco AS5x00 refers to the Cisco AS5300 and AS5800 network access servers. Although this case study uses two specific companies as examples and seems very specific at times, the principles in this case study can be applied on a general level.

Scenario Description

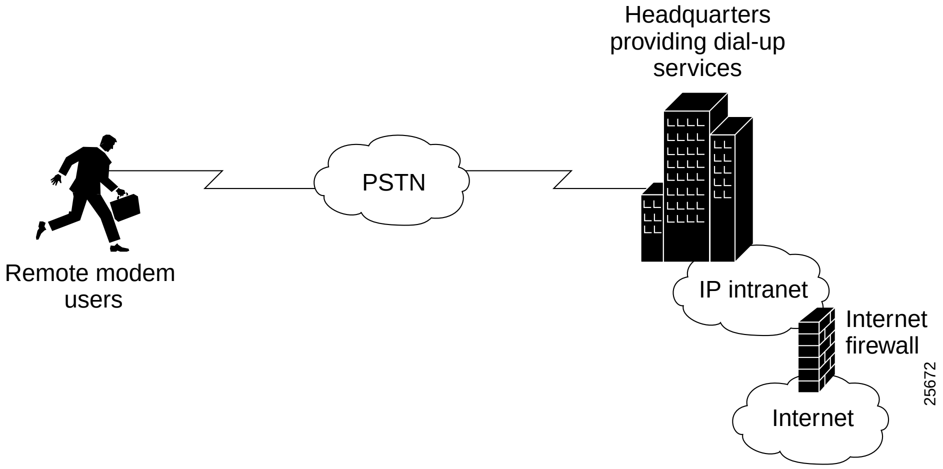
The following two companies are used in the case study:

- **Maui Onions**—A co-operative marketing and distribution company for onions grown in Maui. The company is installing a dial-up service for their members and roaming sales force.
- **THEnet**—A competitive Internet Service Provider (ISP) in Austin, Texas. The company is providing dial-up services to household consumers and university students. THEnet’s users want to send email and surf the Internet with a web browser.

Both companies

- 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.
- Have almost identical technology requirements and business applications. Therefore, one business scenario diagram is shown for both companies. Figure 1-1 shows the business scenario.

Figure 1-1 Business Scenario



This case study describes how to set up one network access server (NAS). Setting up the following components is outside the scope of this document:

- NAS stacking
- AAA server setup
- IP address scaling
- Remote-node ISDN configuration (synchronous PPP)

Dial Planning Questionnaire

Both companies answer a planning questionnaire. Based on their design choices, both companies create a network-service definition.

The dial questionnaire in Table 1-1 shows the following:

- A series of planning design questions and configuration issues
- A list of design options
- Maui Onions' design choices
- THEnet's design choices

Table 1-1 Dial Services Questionnaire

Design Questions	Design Options	Maui Onions' Design Choices	THEnet's Design Choices
What is the user-growth projection for the next 5 years.[1]	• 3 months • 1 Year • 5 Years	500 users 1,000 users 2,000 users	5,000 users 20,000 users 1 million users
What is the user-to-line ratio during busy hours?		15:1	10:1
What access media is used for the dial services?	• Analog lines • ISDN BRI lines	Yes No	Yes No
What type of remote devices will be supported?	• Analog modems • Remote LANs • PCBUS ISDN terminal adaptors • V.110 • V.120	Yes No No No No	Yes No No No No
What operating systems will be supported?	• Windows 95 • Windows 98 • Windows NT • UNIX • MacOS	Yes Yes Yes No No	Yes Yes Yes Yes Yes
Will you support dial-in modem services?	• Yes or No	Yes	Yes
Rank these technology priorities.	• AAA design • IP design • V.90 modem performance	#1 #2 #3	#2 #3 #1

Table 1-1 Dial Services Questionnaire (continued)

Design Questions	Design Options	Maui Onions' Design Choices	THEnet's Design Choices
When users connect to modems, what access service will they use?	• EXEC shell sessions • PPP sessions • SLIP sessions	Yes Yes No	Yes Yes No
Will you support multilink? If yes, will you scale to a stacked multi-chassis solution?	• Yes or No	No	Yes. A stacked solution.
Will you support PPP timeouts (accounting)?	• Yes or No	No	No
For the short term, where are the users' passwords stored?	• Local AAA database in the router • Remote AAA database in a server	Local AAA	Local AAA
In the long term, will you use a AAA server? If yes, what protocol will you use?	• TACACS+ • RADIUS	Yes TACACS+	Yes RADIUS
Will users be allowed to change their own passwords? If yes, how?	• EXEC shell • CiscoSecure web page	Yes EXEC shell	Yes CiscoSecure web page
Will the access network use an external authentication database such as SecureID, Windows NT, or Novell NDS?	• Yes or No	Yes	No
Will you support per-user attribute definitions (authorization)?	• Yes or No	Yes	No
Do you have an existing accounting system to monitor call-detail records?	• Yes or No	No	Yes
Are you running an existing network management system?	• Yes or No	No	No

1. Three months = current deployment requirement.
One year = current design plan requirement.
Five years = future scalability plan requirement.

Network Service Definition

Based on the design choices in Table 1-1, each company creates its own network-to-user service definition. Table 1-2 provides the definition for each company.

Table 1-2 User-to-Network Service Definitions

Maui Onions' Requirements	THEnet's Requirements
Line requirements[1] for the next 5 years: • 3 months: 25 lines • 1 year: 50 lines • 5 years: 100 lines	Line requirements for the next 5 years: • 3 months: 500 lines • 1 year: 2000 lines • 5 years: 100,000 lines
One Cisco AS5300 is required for the first year.	One Cisco AS5800 is required for the first three months.
Analog lines and modems.	Analog lines and modems.
Supported operating systems: Windows 95, 98, and NT. Maui Onions controls the client types used by its employees.	Supported operating systems: Windows 95, 98, NT, UNIX, and MacOS. THEnet offers Internet access to all client types.
AAA is the highest technology priority.	V.90 modem performance is the highest technology priority.
Dial-in only support.	Dial-in only support.
EXEC shell and PPP session support.	EXEC shell and PPP session support.
No multilink PPP support.	Multilink PPP support in a stacked solution for deployment in a future phase of this project.
PPP timeouts will not be supported.	PPP timeouts will not be supported.
Remote AAA TACACS+ server to store users' passwords. Users can change their passwords by using the EXEC shell.	Remote AAA RADIUS server to store users' passwords. Users can change their passwords by using the Cisco Secure web page.
Per-user attribute definitions (authorization) are supported.	Per-user attribute definitions are not supported.
A network element management server is needed.	A network element management server is needed.

[1] The line requirement is calculated by dividing the number of users by the user-to-line ratio during busy hours.

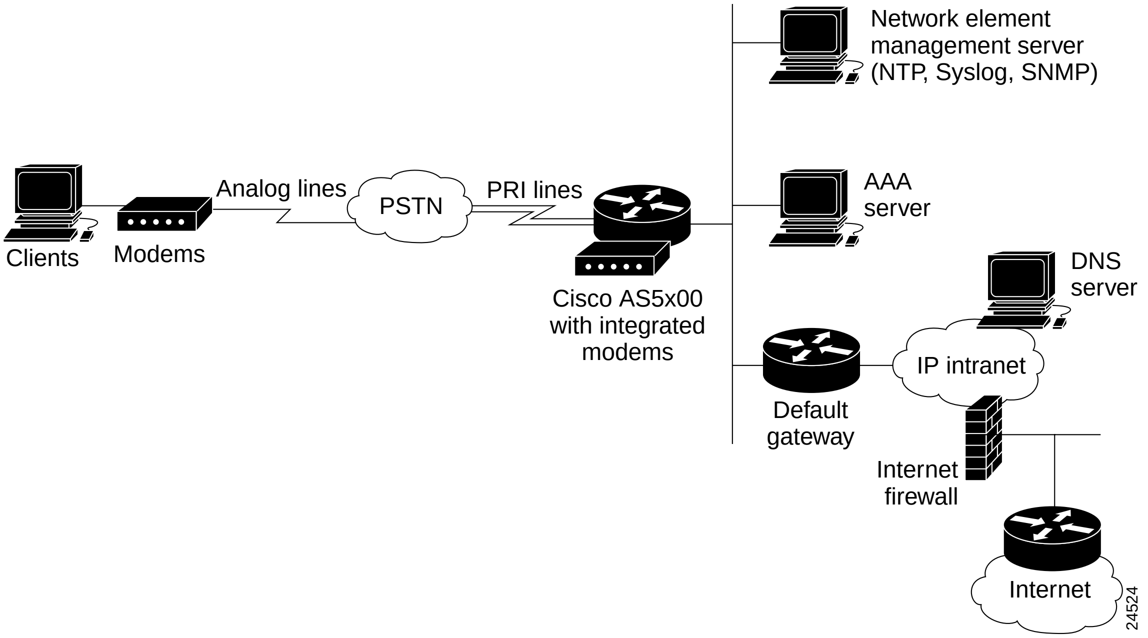
The network service definition for each company is different:

- Maui Onions' scaling projections are much smaller than THEnet's projections. For this reason, THEnet requires higher density network access servers (that is, THEnet requires a Cisco AS5800 instead of a Cisco AS5300).
- Maui Onions cares more about security and less about billing. THEnet cares more about billing and less about security.
- THEnet has a higher V.90 priority and, for this reason, will spend more time fine tuning V.90 than Maui Onions. THEnet's primary objective is to get 56K modem-connections enabled. For THEnet, higher connect speeds equate to increased sales, whereas Maui Onions' revenue stream does not depend on high modem-connect speeds. Maui Onions will use dial-up service for its employees.
- AAA design is important to Maui Onions. A defined security policy protects enterprise network resources.
- Maui Onions enables its network administrator users to change their own passwords by using an EXEC shell login. THEnet allows its users to change their own passwords using a web page interface.
- For the short term, both companies store users' passwords in a local-username database inside the router. In the long term, Maui Onions will scale to use TACACS+ security. THEnet will use RADIUS security.
- Maui Onions supports per-user attribute definitions. THEnet provides Internet access only. Maui Onions enables specific onion vendors to dial in, pass through filters, and access specific devices.

Network Topology, Hardware, and Software Selection

Figure 1-3 shows the devices that are used to build both dial-up access environments. One recommended topology is used for both companies.

Figure 1-3 Network Topology Elements



Both companies have similar network topologies. The hardware elements and software releases are described in the following tables.

Table 1-1 Hardware Elements

Element	Purpose	Maui Onions	THEnet
Remote clients and analog modems	To access the IP backbone through the PSTN.	PCs	PCs, Macs, UNIX workstations
Cisco AS5x00 NAS	To terminate modem calls and Point-to-Point Protocol (PPP) sessions.	Cisco AS5300	Cisco AS5800
PRI lines	To provide high throughput (64K) for digital and analog calls. In general, T1 and T3 trunks can be ISDN PRIs or channelized T1s.	T1 trunks	T3 trunks
Network element management server	To maintain and monitor the NAS.	NTP[1], syslog[2], SNMP[3]	NTP, syslog, SNMP
Remote AAA server	To perform basic user authentication.	TACACS+	RADIUS

Table 1-1 Hardware Elements (continued)

Element	Purpose	Maui Onions	THEnet
Default gateway	To forward packets to the IP intranet and Internet.	Router	Router
Internet firewall	To protect the IP intranet from intruders and hackers.	Cisco PIX	Cisco PIX
Edge router	To provide connectivity between the access subnet and the IP backbone.	Router	Router

[1] Network Time Protocol

[2] System logs (logging)

[3] Simple Network Management Protocol

To obtain the latest Cisco IOS features and bug fixes, the access servers are upgraded to the following software releases:

Table 1-2 Software Releases: Cisco IOS and MICA Portware

Hardware	Start with	Upgrade to
Cisco AS5300	Cisco IOS Release 11.3(7)AA MICA portware 2.6.2.0	Cisco IOS Release 12.0(5)T MICA portware 2.7.1.0
Cisco AS5800	Cisco IOS Release 11.3(9)AA2 MICA portware 2.6.2.0	Cisco IOS Release 12.0(4)XL1 MICA portware 2.6.2.0 (same)

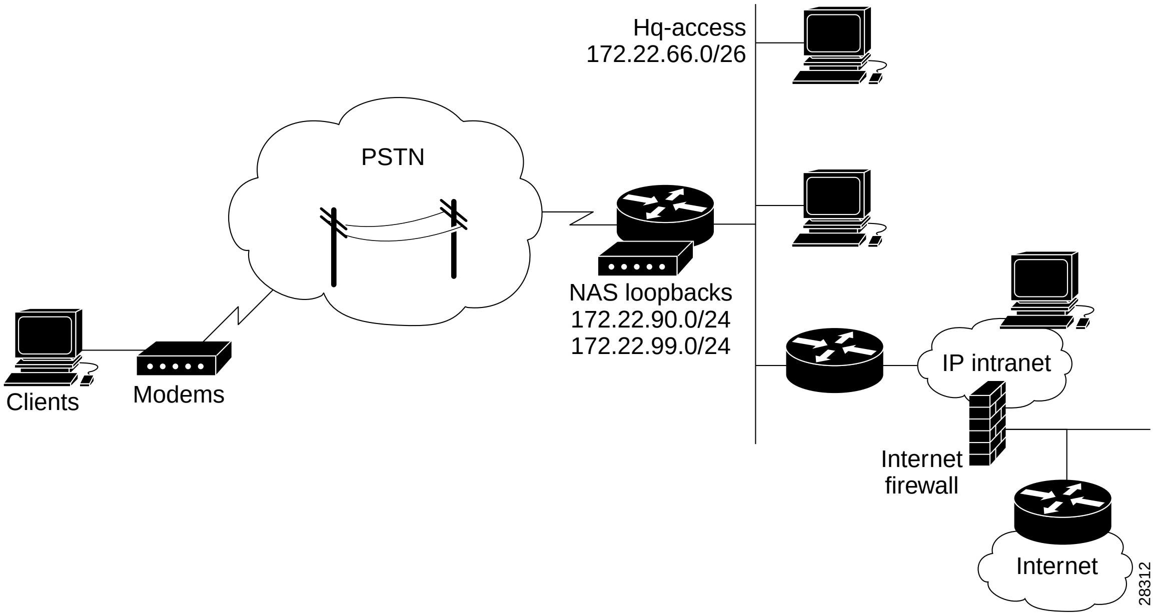
Use a mature Cisco IOS release whenever possible. For example, a mature release is 12.0(10)T not 12.0(1)T. Maintenance release 10 is more mature than maintenance release 1. During the development of this document, the most mature releases available are 12.0(5)T and 12.0(4)XL1.

Configuration Design Parameters

Before the equipment is deployed at the customer sites, both companies define the following configuration design parameters:

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

Figure 1-4 IP Subnetting Diagram



Note This case study uses private RFC 1918 IP addresses. For more information, refer to the following URL:

http://www.ietf.org/rfc/rfc1918.txt

For Maui Onions and THEnet, Table 1-5 through Table 1-7 describe the following:

- IP subnetting plan
- Device parameters
- Dial plan

Table 1-5 IP Subnetting Plan

Network Name	Assigned Subnet	Description
Headquarters Block	172.22.0.0/17[1]	The block of IP addresses reserved for the devices inside the corporate network.
Remote block	172.22.128.0/17	The block of IP addresses reserved for the incoming remote-node modem clients.
Hq-access	172.22.66.0/26	The headquarter's access Ethernet subnet. All the 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.

Table 1-5 IP Subnetting Plan

Network Name	Assigned Subnet	Description
NAS loopback 0	172.22.99.0/24	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 used to identify devices can support 254 distinct nodes with unique loopback IP addresses.
NAS loopback 1	172.22.90.0/24	Used to host 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. Setting up interior gateway protocols (IGP) is outside the scope of this document. For example, OSPF and EIGRP.

[1] The /17 means there are 17 bits in the subnet mask. For /26, there are 26 bits in the subnet mask and so on.

Note A simple IP address strategy is used for this case study. Scaling IP addresses is outside the scope of this document.

Table 1-6 Device Parameters

Device	Parameters
Router host names	5300-NAS 5800-NAS
Interface ethernet 0	172.22.66.23 255.255.255.0
Interface loopback 0	172.22.99.1 255.255.255.255
Interface loopback 1	172.22.90.1 255.255.255.0
IP local address pool	5300-NAS = 172.22.90.2 through 172.22.90.97 5800-NAS = 172.22.90.2 through 172.22.90.254
Primary and secondary name servers	172.22.11.10 172.22.12.11
Default gateway	172.22.66.1
IP domain names	mauionions.com the.net
Network element management server (NTP, SNMP, syslog)	172.22.66.18
SNMP community strings	Read only (RO) = poptarts Read write (RW) = pixysticks

Table 1-7 Dial Plan

Item	Value	Description
PRI telephone numbers	4085551234 4085556789	Telephone numbers assigned to the T1 trunks. These numbers are used for: • Testing new modem firmware • Isolating debugs for specific users
ISDN PRI switch type	5ESS	The telco’s switch type that connects to the T1 PRI trunks. In this case study, the T1 trunks are not using channel associated signaling (CAS).
Framing type	• ESF is used for Maui Onions’ T1 trunks. • M23 is used for THEnet’s T3 trunk.	Defines the control bits and data bits.
Line code type	• B8ZS is used for Maui Onions’ T1 trunks. • No line code is used for THEnet’s T3 trunk.	An encoding method used to allow synchronous data to be transmitted in a compatible format.

Table 1-7 Dial Plan (continued)

Item	Value	Description

Test call login	username = dude
	password = dude-pw
		Username password for sending test calls into the NAS.

Deployment and Operation Task Strategy

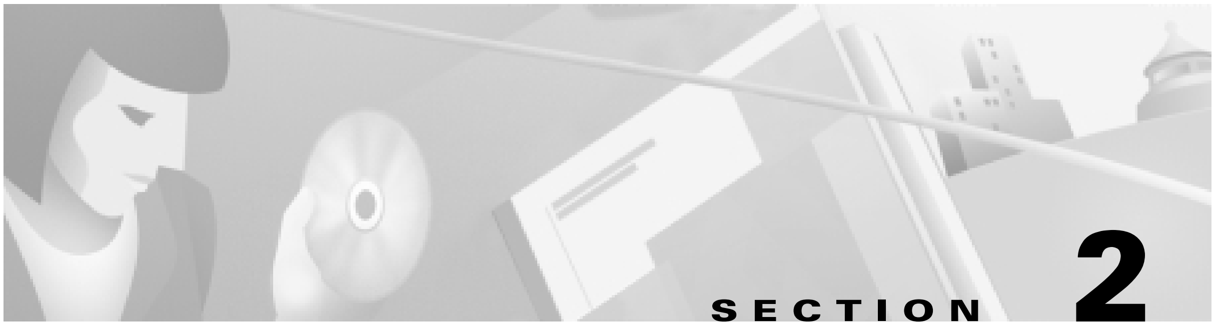
Table 1-8 describes the deployment and operation task strategy used in this case study. Maui Onions and THEnet use a common strategy.

Table 1-8 Deployment and Operation Task Strategy

Section	Task	Description
2	Commissioning the Cisco AS5300 Hardware	• Understanding the Cisco AS5300 basic hardware architecture. • Supporting EXEC terminal shell services and login prompts for modem clients.
3	Commissioning the Cisco AS5800 Hardware	• Understanding the Cisco AS5800 basic hardware architecture. • Supporting EXEC terminal shell services and login prompts for modem clients.
4	Verifying Modem Performance	• Understanding and troubleshooting basic modem connectivity. • Optimizing modem connect speeds.
5	Configuring PPP and Authentication	• Configuring PPP authentication for local AAA. • Configuring IP Control Protocol (IPCP) options. • Configuring Link Control Protocol (LCP) options. • Enabling PPP autoselect. • Testing asynchronous PPP connections. • Inspecting active call states.
6	Modem Management Operations	• Managing modem firmware. • Configuring modems by using modem autoconfigure. • Gathering and viewing call statistics.

Table 1-8 Deployment and Operation Task Strategy (continued)

Section	Task	Description
7	Enabling Management Protocols: NTP, SNMP, and Syslog	Enabling the following management protocols as part of commissioning a dial access service: • NTP • SNMP • Syslog
8	Inspecting the Final Running Configuration for the Cisco AS5300 and AS5800	Referencing and editing full-function Cisco IOS NAS configurations.



Commissioning the Cisco AS5300 Hardware

In this Section

This section describes how to configure Cisco AS5300 to support terminal EXEC shell services and login prompts for client modems.

The following sub sections are provided:

- Understanding the Basic Hardware Architecture
- Task 1. Verifying Basic Setup
- Task 2. Configuring Cisco IOS Basics
- Task 3. Enabling the T1 Controllers
- Task 4. Configuring the Serial Interfaces
- Task 5. Configuring Modems and Lines
- Task 6. Enabling IP Basic Setup
- Task 7. Testing Asynchronous-Shell Connections
- Task 8. Confirming the Final Running-Config

In this case study, Maui Onions commissions the Cisco AS5300. Local-based authentication is used. After the Cisco AS5300 is commissioned, Maui Onions configures and tests PPP as described in the section "Configuring PPP and Authentication." In the future, Maui Onions will use a AAA TACACS+ server.

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

Understanding the Basic Hardware Architecture

Figure 2-1 shows the logical and physical system architecture for the Cisco AS5300. It illustrates the components used to process a call.

Figure 2-1 Cisco AS5300 Basic System Architecture

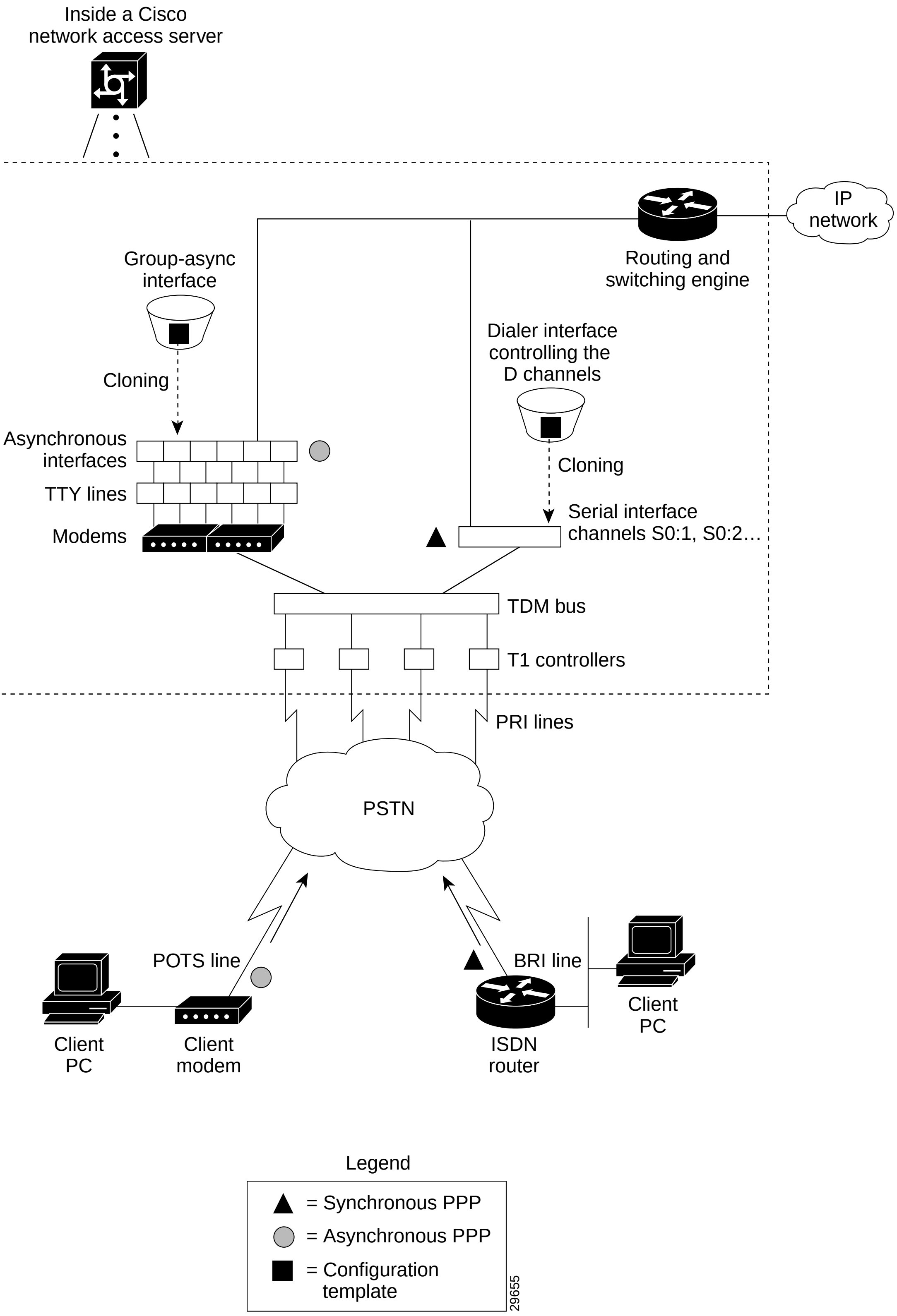


Figure 2-1 shows the following:

- Client modems and ISDN routers dial into the access server through the PSTN.
- Analog PPP calls 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 connect to serial interface channels (for example, S0:1 and S0:2).
- Synchronous interfaces clone their configurations from a dialer interface.

One analog PPP call consumes:

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

One synchronous PPP call consumes:

- One T1 DS0 channel
- One serial interface channel

Task 1. Verifying Basic Setup

The following subsections detail the tasks required to verify that basic system components are functioning normally:

- 1.1 Analyzing the System Boot Dialog
- 1.2 Checking the Initial Running-Config
- 1.3 Exploring the Cisco IOS File System
- 1.4 Investigating Memory Usage
- 1.5 Inspecting CPU Utilization

1.1 Analyzing the System Boot Dialog

The Cisco AS5300 has a specific boot sequence. To view the boot sequence through a terminal session, you must have a console connection to the access server before it powers up.

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

```
System Bootstrap, Version 11.2(9)XA, RELEASE SOFTWARE (fc2)
Copyright (c) 1997 by cisco Systems, Inc.
AS5300 platform with 65536 Kbytes of main memory

program load complete, entry point: 0x80008000, size: 0xf5914
Self decompressing the image : #################################################
## [OK]

Notice: NVRAM invalid, possibly due to write erase.
```

```
program load complete, entry point: 0x80008000, size: 0x45497c
Self decompressing the image : #################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
##################### [OK]
```

Event 1—In the previous segment, the NAS decompresses the system boot image, tests the NVRAM for validity, and decompresses the Cisco IOS image.

```
              Restricted Rights Legend

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

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


Cisco Internetwork Operating System Software
IOS (tm) 5300 Software (C5300-IS-M), Version 11.3(7)AA, EARLY DEPLOYMENT MAINTENANCE
RELEASE SOFTWARE ()
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Fri 08-Jan-99 13:43 by jjgreen
Image text-base: 0x60008920, data-base: 0x60788000

cisco AS5300 (R4K) processor (revision A.32) with 65536K/16384K bytes of memory.
Processor board ID 11811596
R4700 processor, Implementation 33, Revision 1.0 (512KB Level 2 Cache)
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software copyright 1990 by Meridian Technology Corp).
Primary Rate ISDN software, Version 1.1.
Backplane revision 2
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x30,
 Board Hardware Version 1.64, Item Number 800-2544-2,
 Board Revision B0, Serial Number 11811596,
 PLD/ISP Version 0.0, Manufacture Date 9-Dec-1998.
1 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
96 terminal line(s)
4 Channelized T1/PRI port(s)
128K bytes of non-volatile configuration memory.
16384K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)
```

Event 2—The following components are detected: Cisco IOS Release, available memory, hardware interfaces, and modem lines.

If a hardware card is not recognized, verify that you are running the optimum version of Cisco IOS. Refer to the Hardware-Software Compatibility Matrix at the following URL:

http://cco-sj-1.cisco.com/cgi-bin/front.x/Support/HWSWmatrix/hwswmatrix.cgi

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

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

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

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

```
00:00:18: %LINK-3-UPDOWN: Interface Ethernet0, changed state to up
00:00:18: %LINK-3-UPDOWN: Interface FastEthernet0, changed state to up
00:00:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0, changed stp
00:00:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0, changen
00:00:43: %LINK-5-CHANGED: Interface Ethernet0, changed state to administrativen
00:00:43: %LINK-5-CHANGED: Interface FastEthernet0, changed state to administran
00:00:44: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0, changedn
00:00:46: %SYS-5-RESTART: System restarted --

00:01:07: %MICA-5-BOARDWARE_RUNNING: Slot 1 is running boardware version 1.3.7.0
00:01:07: %MICA-5-BOARDWARE_RUNNING: Slot 2 is running boardware version 1.3.7.0

Press RETURN to get started!


Router>
```

Event 4—The state of the LAN interfaces is displayed, and the MICA modem boardware version is detected (version 1.3.7.0). The Cisco AS5300 can be fitted with MICA or Microcom modems.

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

```
Router>enable
Router#show version
Cisco Internetwork Operating System Software
IOS (tm) 5300 Software (C5300-IS-M), Version 11.3(7)AA, EARLY DEPLOYMENT MAINTENANCE
RELEASE SOFTWARE ()
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Fri 08-Jan-99 13:43 by jjgreen
Image text-base: 0x60008920, data-base: 0x60788000

ROM: System Bootstrap, Version 11.2(9)XA, RELEASE SOFTWARE (fc2)
BOOTFLASH: 5300 Software (C5300-BOOT-M), Version 11.2(9)XA1,

Router uptime is 9 minutes
System restarted by power-on at 16:59:44 PST Fri Dec 31 1999
System image file is "flash:c5300-is-mz.113-7.AA"

cisco AS5300 (R4K) processor (revision A.32) with 65536K/16384K bytes of memory.
Processor board ID 11811596
R4700 processor, Implementation 33, Revision 1.0 (512KB Level 2 Cache)
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software copyright 1990 by Meridian Technology Corp).
```

```
Primary Rate ISDN software, Version 1.1.
Backplane revision 2
Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x30,
 Board Hardware Version 1.64, Item Number 800-2544-2,
 Board Revision B0, Serial Number 11811596,
 PLD/ISP Version 0.0, Manufacture Date 9-Dec-1998.
1 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
96 terminal line(s)
4 Channelized T1/PRI port(s)
128K bytes of non-volatile configuration memory.
16384K bytes of processor board System flash (Read/Write)
8192K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102
```

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

Table 2-1 Show Version Command Field Descriptions

Field	Description
`Router uptime is 9 minutes`	Watch for unscheduled reloads by inspecting this field.
`System restarted by power-on at 16:59:44 PST Fri Dec 31 1999`	Tells you why the access server last reloaded. If the field displays “power-on,” a power interruption caused the reload.
`System image file is "flash:c5300-is-mz.113-7.AA"`	The Cisco AS5300 booted from this image location.

1.2 Checking the Initial Running-Config

The Cisco IOS creates an initial running configuration. Inspect the configuration to get familiar with the default settings.

```
Router>enable
Router#show running-config
Building configuration...

Current configuration:
!
version 11.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
controller T1 0
 clock source line primary
!
controller T1 1
 clock source line secondary
```

```
!
controller T1 2
 clock source internal
!
controller T1 3
 clock source internal
!
interface Ethernet0
 no ip address
 shutdown
!
interface FastEthernet0
 no ip address
 shutdown
!
ip classless
!
line con 0
 transport input none
line 1 96
line aux 0
line vty 0 4
!
end
```

1.3 Exploring the Cisco IOS File System

Get familiar with the file system and memory storage areas. The Cisco IOS File System (IFS) feature provides a single 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).

IFS first appeared in Cisco IOS Releases 11.3 AA and 12.0. For more information about IFS, refer to the chapter *Using the Cisco IOS File System* in the Release 12.0 Configuration Fundamentals Configuration Guide at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt2/fcifs.htm

Figure 2-2 shows the memory locations inside the Cisco AS5300.

Figure 2-2 AS5300 Memory Locations

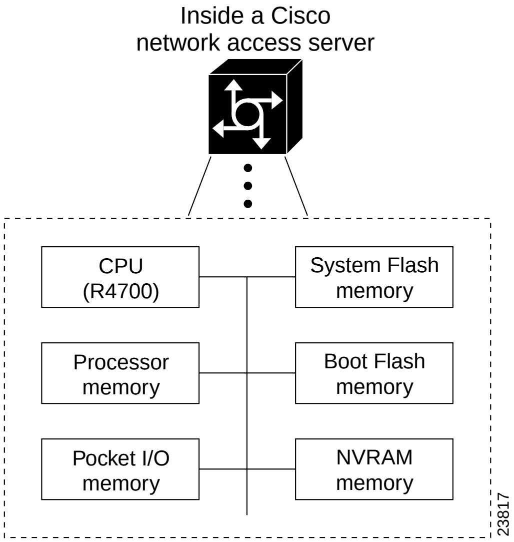


Table 2-2 describes the memory locations shown in Figure 2-2.

Table 2-2 Memory Location Descriptions

Component	Description
R4700 CPU	RISC 4700 central processing unit.
Processor memory	The Cisco IOS image is initially read out of Flash memory, decompressed, and loaded into processor memory (also known as main memory or DRAM). Routing tables, call control blocks, and other data structures are also stored here.
Packet I/O memory	Packets are temporarily stored in I/O memory.
System Flash and Boot Flash memory	Stores Cisco IOS images, modem firmware/portware, and custom web pages.
NVRAM memory	Non-volatile configuration memory.

To inspect the file system, enter the **show file systems** command and **dir** comand as shown in the following bullet list:

- View the different file storage areas and file management functions:

```
Router#show file systems
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
           -           -    opaque     wo   modem:
           -           -    opaque     rw   null:
           -           -    opaque     rw   system:
           -           -   network     rw   tftp:
*   16777216    12236072     flash     rw   flash:
     8388608     7382416     flash     rw   bootflash:
      126968      126968     nvram     rw   nvram:
           -           -    opaque     wo   lex:
           -           -   network     rw   rcp:
           -           -   network     rw   ftp:
```

  In addition, verify that you have everything that you ordered (for example, 16 MB of Flash memory). The asterisk (*) indicates the current directory.

- Display the objects in the system memory directory:

```
5300-NAS#dir system:
Directory of system:/

  2  dr-x           0              <no date>  memory
  1  -rw-        4492              <no date>  running-config
 13  dr-x           0              <no date>  ucode
```

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

- Inspect the contents of boot Flash:

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

  1  -rw-     1006128              <no date>  c5300-boot-mz.112-9.XA1

8388608 bytes total (7382416 bytes free)
```

  In the example, the boot image is c5300-boot-mz.112-9.XA1. The compressed file size is 1,006,128 bytes. The total boot Flash memory size is 8,388,608 bytes. The number of free bytes is 7,382,416.

- Display the contents of Flash memory:

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

  1  -rw-     4541080              <no date>  c5300-is-mz.113-7.AA

16777216 bytes total (12236072 bytes free)
```

  The Cisco IOS image named c5300-is-mz.113-7.AA is present.

- Inspect the NVRAM directory:

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

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

126968 bytes total (126968 bytes free)
```

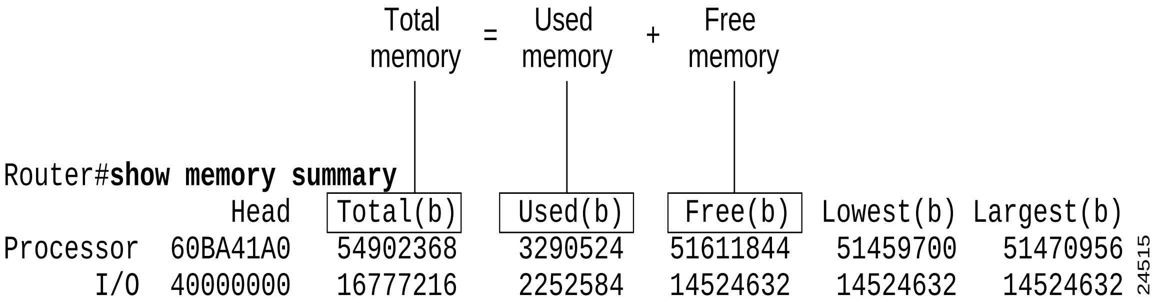
In the example, two files are present: startup-config and private-config. The private-config is a secure file that is part of the startup configuration. It supports encryption technologies, but it is not user accessible.

1.4 Investigating Memory Usage

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

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

Figure 2-3 Processor and I/O Memory Usage



```
Router#show memory summary
                Head   Total(b)    Used(b)    Free(b)  Lowest(b) Largest(b)
Processor   60BA41A0   54902368    3290524   51611844   51459700   51470956
      I/O   40000000   16777216    2252584   14524632   14524632   14524632
```

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

1.5 Inspecting CPU Utilization

Enter the **show processes cpu** command to investigate high CPU utilization. High utilization causes network performance problems. For example, knowing when the router is running at over 50% utilization is critical. The router might start dropping packets if an unexpected traffic burst comes through or if OSPF gets recalculated. Fast switching reduces CPU utilization.

```
Router#show processes cpu
CPU utilization for five seconds: 1%/0%; one minute: 0%; five minutes: 0%
 PID  Runtime(ms)  Invoked  uSecs    5Sec   1Min   5Min TTY Process
   1           0     18973      0   0.00%  0.00%  0.00%   0 Load Meter
   2          44       122    360   0.57%  0.06%  0.01%  98 Virtual Exec
   3       70388     12820   5490   0.00%  0.04%  0.05%   0 Check heaps
   4           0         2      0   0.00%  0.00%  0.00%   0 Pool Manager
   5           0         2      0   0.00%  0.00%  0.00%   0 Timers
   6           0         2      0   0.00%  0.00%  0.00%   0 Serial Backgroun
   7          68      1876     36   0.00%  0.00%  0.00%   0 ARP Input
   8           8     22758      0   0.00%  0.00%  0.00%   0 HC Counter Timer
   9           0         2      0   0.00%  0.00%  0.00%   0 DDR Timers
  10           0         2      0   0.00%  0.00%  0.00%   0 Dialer event
  11           4         2   2000   0.00%  0.00%  0.00%   0 Entity MIB API
  12           0         1      0   0.00%  0.00%  0.00%   0 SERIAL A'detect
  13           0         4      0   0.00%  0.00%  0.00%   0 Critical Bkgnd
  14        3396    165554     20   0.00%  0.00%  0.00%   0 Net Background
  15           8        43    186   0.00%  0.00%  0.00%   0 Logger
  16      377776     94479   3998   0.40%  0.23%  0.24%   0 TTY Background
  17           4     94488      0   0.00%  0.00%  0.00%   0 Per-Second Jobs
  18           0     47432      0   0.00%  0.00%  0.00%   0 CSM periodical p
  19           0     47435      0   0.00%  0.00%  0.00%   0 CSM timer proces
  20           0         2      0   0.00%  0.00%  0.00%   0 CSM Tone process
  21           0         6      0   0.00%  0.00%  0.00%   0 Call Management
```

Snip

Look at the top line of the output. If you see high utilization numbers, for example 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.

Task 2. Configuring Cisco IOS Basics

The following subsections detail the tasks required to apply a basic-running configuration to the NAS:

- 2.1 Configuring the Host Name, Enable Secret, and Time Stamps
- 2.2 Configuring Local AAA Security
- 2.3 Setting Up a Login Banner
- 2.4 Configuring the Loopback Interfaces, Ethernet Interface, and IP Route
- 2.5 Upgrading to a New Cisco IOS Release

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

2.1 Configuring the Host Name, Enable Secret, 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.
- Enable secret passwords allow you to prevent unauthorized configuration changes.
- Encrypted passwords in the configuration file adds greater security to the NAS.
- Time stamps help you trace debug output for testing connections. Not knowing exactly when an event occurs hinders you from examining background processes.

Step 1 Enter the following commands in global configuration mode:

```
hostname 5300-NAS
enable secret 0 yourpasswordhere
service password-encryption
service timestamps debug datetime msec
service timestamps log datetime msec
```

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

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

```
5300-NAS#disable
5300-NAS>enable
Password:
5300-NAS#show privilege
Current privilege level is 15
5300-NAS#
```

2.2 Configuring Local AAA Security

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

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

In this basic case study, 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 dudepasshere
!
```

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
!
```

The following table describes the previous configuration snippet.

Table 2-3 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:

```
5300-NAS#login

User Access Verification

Username:admin
Password:

5300-NAS#
```

Successfully logging in means that your local username will work on any TTY or VTY line. Do not disconnect your session until you can log in.

2.3 Setting Up a Login Banner

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

Step 1 Create the banner:

```
5300-NAS(config)#banner login |
Enter TEXT message.  End with the character '|'.
This is a secured device.
Unauthorized use is prohibited by law.
|
5300-NAS(config)#^Z
5300-NAS#
```

Step 2 Test the banner:

```
5300-NAS#login

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

User Access Verification

Username:admin
Password:

5300-NAS#
```

2.4 Configuring the Loopback Interfaces, Ethernet Interface, and IP Route

To commission a basic dial access service:

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

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 Ethernet0
 ip address 172.22.66.23 255.255.255.0
!
ip route 0.0.0.0 0.0.0.0 172.22.66.1
!
```

In this example:

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

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

```
5300-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

5300-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 routers are 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 ARP entry (address resolution protocol) for the external device. A 100% success rate is achieved the next time you ping the device.

2.5 Upgrading to a New Cisco IOS Release

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

Step 1 Display the contents of Flash memory:

```
5300-NAS#cd flash:
5300-NAS#dir
Directory of flash:/

  1  -rw-     4541080              <no date>  c5300-is-mz.113-7.AA

16777216 bytes total (12236072 bytes free)
5300-NAS#
```

Step 2 Copy the new image from the remote TFTP server into Flash memory. Make sure to specify your own TFTP server's IP address and Cisco IOS file name. In this example, Flash memory is erased before the new image is downloaded. To see the bangs (!) during the download operation, you must have line wrap enabled in your terminal emulation software.

Timesaver Leave both images in Flash memory if you have the available space. If needed, you can easily revert back to the previous image. Enter the **boot system flash** *newiosname.bin* command to point to the new image file name. By default, the first image in Flash memory is loaded.

```
5300-NAS#copy tftp: flash:
Address or name of remote host []? 172.22.66.18
Source filename []? goon/c5300-is-mz.120-5.T
Destination filename []? c5300-is-mz.120-5.T
Accessing tftp://172.22.66.18/goon/c5300-is-mz.120-5.T...
Erase flash: before copying? [confirm]y
Erasing the flash filesystem will remove all files! Continue? [confirm]y
Erasing device... eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
ee ...erased
Erase of flash: complete
Loading goon/c5300-is-mz.120-5.T from 172.22.66.18 (via Ethernet0): !!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 5633184/11266048 bytes]

Verifying checksum...  OK (0x1AAF)
5633184 bytes copied in 30.480 secs (187772 bytes/sec)
```

Warning **Occasionally TFTP errors will occur. Make sure the verifying checksum reports "OK." Do not reload the access server if the checksum reports errors.**

Step 3 Verify that the old image was erased and the new image was downloaded. In this example, notice that the 12.0(5)T image is larger than the old 11.3(7)AA image.

```
5300-NAS#dir flash:
Directory of flash:/

  1  -rw-     5633184              <no date>  c5300-is-mz.120-5.T

16777216 bytes total (11143968 bytes free)
```

Step 4 Reload the NAS to run the new image. If you erased the old Cisco IOS image, make sure the **boot system flash** *oldiosname.bin* command is not enabled and pointing to the old image file name. Otherwise, the NAS will get stuck trying to reload the old image over and over again.

```
5300-NAS#reload
Proceed with reload? [confirm]

*Jan  1 04:50:32.814: %SYS-5-RELOAD: Reload requested
System Bootstrap, Version 11.2(9)XA, RELEASE SOFTWARE (fc2)
Copyright (c) 1997 by cisco Systems, Inc.
AS5300 platform with 65536 Kbytes of main memory

program load complete, entry point: 0x80008000, size: 0xf5914
Self decompressing the image : #################################################
## [OK]
```

Snip

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

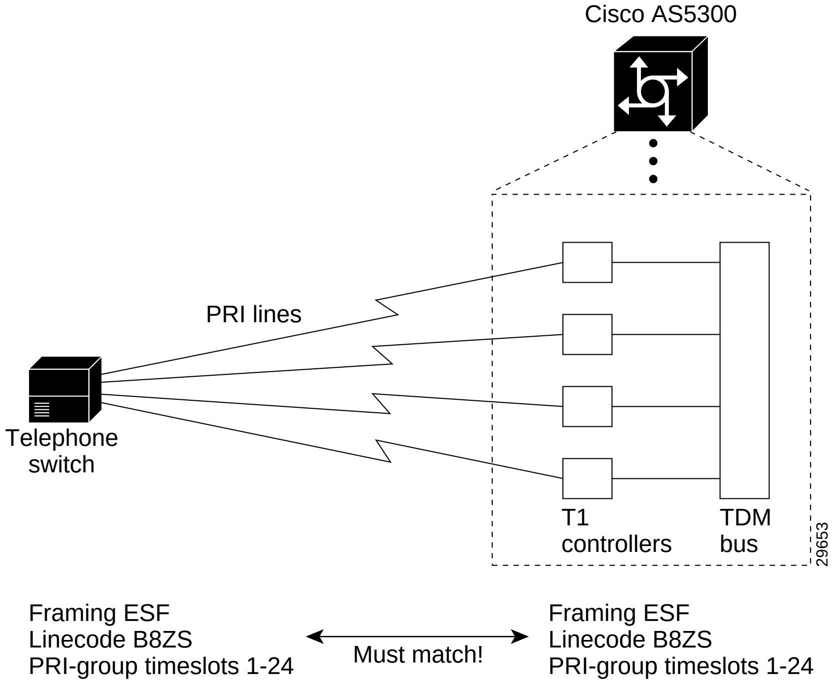
For more information about TFTP, refer to the document "Loading and Maintaining System Images and Microcode" at:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt2/fcimages.htm

Task 3. Enabling the T1 Controllers

Specify the settings for the T1 controllers. T1 controller settings must match the settings on the telephone switch side. Mismatched settings cause problems that may not be detected for a long time.

Figure 2-4 Matching T1 Controller Settings



Step 1 Define the ISDN switch type and T1 controller settings:

```
!
isdn switch-type primary-5ess
!
```

Step 2 Specify the T1 controller settings:

```
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 1
 framing esf
 clock source line secondary 1
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
```

```
!
controller T1 3
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
```

Table 2-4 describes some of the T1-controller concepts that are applied in the previous example.

Table 2-4 T1 Controller Concepts and Descriptions

Concept	Description
Framing type	Defines the control bits and data bits. Cisco supports super frame (SF) and extended super frame (ESF) for T1s. • 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. SF uses the framing bit to identify the channel and voice-related signaling within the frame. 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 for T1 transmission. Common line codes are RZ (return to zero), NRZ (non-return to zero), B8ZS, AMI, and HDB3 (high density bipolar order 3). • AMI—Alternate mark inversion. Signal transitions are referenced by a binary 1 (mark). AMI is used on older T1 circuits. It is not reliable. • 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. By default, the access server uses the line clock from the switch that is coming in on controller 0. Controller 0 is the primary clock source. Controllers 1 and higher are secondary clock sources. If a primary clock fails, a secondary clock steps in.
Timeslot assignment	Timeslots are assigned to channels. For T1 PRI scenarios, all 24 T1 timeslots are assigned as ISDN PRI channels. After the timeslots are assigned by the **pri-group** command, D-channel serial interfaces are automatically created in the configuration file (for example S0:23, S1:23, and so on).

Step 3 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.

```
5300-NAS#show controller t1
T1 0 is up.
Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  Version info of slot 0:  HW: 4, Firmware: 16, PLD Rev: 0

Manufacture Cookie Info:
 EEPROM Type 0x0001, EEPROM Version 0x01, Board ID 0x42,
 Board Hardware Version 1.32, Item Number 73-2217-5,
 Board Revision B16, Serial Number 09356963,
 PLD/ISP Version 0.0, Manufacture Date 18-Jun-1998.

  Framing is ESF, Line Code is B8ZS, Clock Source is Line Primary.
  Data in current interval (28 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Total Data (last 1 15 minute intervals):
     12 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 323 Fr Loss Secs, 5 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 323 Unavail Secs
```

Snip

After each controller is correctly set up, clear the counters and look for ongoing line violations and errors. To do this, enter the **clear controller t1** *number* command followed by the **show controller t1** command. In the display output, focus on the data in the current interval. Error counters stop increasing when the controller is configured correctly.

Tech Tip The **clear controller t1** *number* command does not reset or bring down the controller. The T1 stays up. Only the counters are cleared.

If the counters are increasing on a specific T1 controller, look closely at the error statistics. Refer to the commands in Table 2-5.

Table 2-5 Different Options for the Show Controller T1 Command

Command	Purpose
show controller t1	Provides brief output statistics for the current interval and the last 24 hours.
show controller t1 *number*	Displays counters for all 96 intervals.
show controller t1 *number* **| begin Total**	Modifies the output as described in the Cisco IOS configuration guides. The "T" in Total is case sensitive. (Release 12.0 T is required.)

Table 2-6 provides a list of T1 alarm conditions and descriptions from the reference point of the NAS.

Table 2-6 Alarm Conditions

Alarm	Description
CRC Errors	Occurs 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 that the received signal is lost. This is a blue alarm. AIS occurs when a stream of 1s is received.
Loop Back	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 section “Channelized E1 & Channelized T1 Setup Commands” at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/index.htm

Step 4 Verify that the individual serial D channels and B channels are present. In the following example, B channels S0:0 through S0:22 are rotary members of the signaling D channel S0:23.

```
5300-NAS#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0                  172.22.66.23    YES NVRAM  up                    up
FastEthernet0              unassigned      YES NVRAM  administratively down down
Loopback0                  172.22.99.1     YES NVRAM  up                    up
Loopback1                  172.22.90.1     YES NVRAM  up                    up
Serial0:0                  unassigned      YES unset  down                  down
Serial0:1                  unassigned      YES unset  down                  down
Serial0:2                  unassigned      YES unset  down                  down
Serial0:3                  unassigned      YES unset  down                  down
Serial0:4                  unassigned      YES unset  down                  down
Serial0:5                  unassigned      YES unset  down                  down
Serial0:6                  unassigned      YES unset  down                  down
Serial0:7                  unassigned      YES unset  down                  down
Serial0:8                  unassigned      YES unset  down                  down
Serial0:9                  unassigned      YES unset  down                  down
Serial0:10                 unassigned      YES unset  down                  down
```

```
Serial0:11                 unassigned      YES unset  down                  down
Serial0:12                 unassigned      YES unset  down                  down
Serial0:13                 unassigned      YES unset  down                  down
Serial0:14                 unassigned      YES unset  down                  down
Serial0:15                 unassigned      YES unset  down                  down
Serial0:16                 unassigned      YES unset  down                  down
Serial0:17                 unassigned      YES unset  down                  down
Serial0:18                 unassigned      YES unset  down                  down
Serial0:19                 unassigned      YES unset  down                  down
Serial0:20                 unassigned      YES unset  down                  down
Serial0:21                 unassigned      YES unset  down                  down
Serial0:22                 unassigned      YES unset  down                  down
Serial0:23                 unassigned      YES unset  up                    up
:
```

Snip

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.

- After timeslots are assigned by the **pri-group** command, D-channel serial interfaces are automatically created in the configuration file (for example S0:23, S1:23, and so on).
- Individual B-channel serial interfaces are created as rotary members of their signaling D channels (for example S0:0 through S0:22). The D-channel interface functions like a dialer for all the 23 B-channels using the controller.

Table 2-7 describes the relationship between T1 controllers and serial interfaces.

Table 2-7 Controller-to-Channel Relationships

T1 Controllers	D Channels	B Channels
Controller T1 0	Interface serial 0:23	S0:0 through S0:22
Controller T1 1	Interface serial 1:23	S1:0 through S1:22
Controller T1 2	Interface serial 2:23	S2:0 through S2:22
Controller T1 3	Interface serial 3:23	S3:0 through S3:22
...	...	...

Step 1 Apply the **isdn incoming-voice modem** command to each D-channel serial interface:

```
!
interface Serial0:23
 isdn incoming-voice modem
!
interface Serial1:23
 isdn incoming-voice modem
!
interface Serial2:23
 isdn incoming-voice modem
```

```
!
interface Serial3:23
 isdn incoming-voice modem
!
```

Different versions of Cisco IOS enables different default commands. Release 12.0(5)T enables the commands in Table 2-8.

Table 2-8 Release 12.0(5)T Default Commands

Command	Purpose
no ip directed-broadcast	Enhances security by preventing broadcasts to this subnet from unauthorized sources.
isdn switch-type primary-5ess	The ISDN global switch type value is propagated to the serial-interface level. This happens during initial configuration or a reload. Per interface switch-types are first introduced in Release 11.3AA.
no cdp enable	Turns off the cisco discovery protocol (cdp). Otherwise, the protocol attempts to be negotiated on the PPP links.

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.

```
5300-NAS#show isdn status
Global ISDN Switchtype = primary-5ess
ISDN Serial0:23 interface
        dsl 0, interface ISDN Switchtype = primary-5ess
    Layer 1 Status:
        ACTIVE
    Layer 2 Status:
        TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
        0 Active Layer 3 Call(s)
    Activated dsl 0 CCBs = 0
    The Free Channel Mask:  0x807FFFFF
```

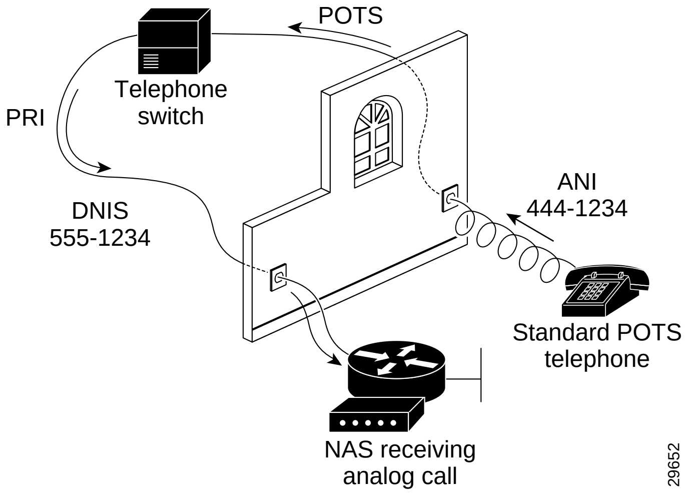
Snip

- Verify that PRI is working between the remote switch and the Cisco AS5300. After you enter the **debug isdn q921** command, you should see a SAPI message transmitted and received every 10 seconds. A SAPI message indicates that Layer 2 is functioning properly, and there are no apparent cable problems.

```
5300-NAS#debug isdn q921
ISDN Q921 packets debugging is on
5300-NAS#
Sep 23 04:19:07.887: ISDN Se0:23: TX ->  RRp sapi = 0  tei = 0 nr = 23
Sep 23 04:19:07.891: ISDN Se0:23: RX <-  RRf sapi = 0  tei = 0  nr = 23
5300-NAS#undebug isdn q921
ISDN Q921 packets debugging is off
```

Step 3 Test the configuration by sending a standard telephone (POTS) call into the NAS. The configuration works if the modem answers (that is, you hear modem squelch), the configuration works. Figure 2-5 shows how this step works.

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



A different telephone number is associated with each end of the connection. In Figure 2-5, the called number 555-1234 is assigned to the PRI trunk. This number is dialed from the POTS telephone. The calling number 444-1234 is assigned to the POTS telephone line.

Task 5. Configuring Modems and Lines

Modems and lines are configured after:

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

Each modem is mapped to a dedicated asynchronous line inside the 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 default settings for integrated modems.

Step 1 Support incoming and outgoing modem calls. In this example, the NAS has 96 integrated modems.

```
!
line 1 96
 modem InOut
!
```

Step 2 Verify that the asynchronous TTY lines support incoming and outgoing calls. These lines are simulated R2-232 ports.

```
5300-NAS#show line
   Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
*    0 CTY              -    -      -    -    -      0       0     0/0       -
     1 TTY              - inout     -    -    -      0       0     0/0       -
     2 TTY              - inout     -    -    -      0       0     0/0       -
     3 TTY              - inout     -    -    -      0       0     0/0       -
     4 TTY              - inout     -    -    -      0       0     0/0       -
     5 TTY              - inout     -    -    -      0       0     0/0       -
     6 TTY              - inout     -    -    -      0       0     0/0       -
     7 TTY              - inout     -    -    -      0       0     0/0       -
     8 TTY              - inout     -    -    -      0       0     0/0       -
     9 TTY              - inout     -    -    -      0       0     0/0       -
    10 TTY              - inout     -    -    -      0       0     0/0       -
:
```

Snip

Step 3 (Optional) Choose a specific line and inspect the modem-to-TTY association. In this example, TTY 1 is associated with modem 1/0. The modem state is idle because no users have dialed in yet.

```
5300-NAS#show line 1
   Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
     1 TTY              - inout     -    -    -      0       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, 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 noRTS
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 udptn v120 lapb-ta.  Preferred is pad t
elnet rlogin udptn v120 lapb-ta.
No output characters are padded
No special data dispatching characters
5300-NAS#
```

Task 6. Enabling IP Basic Setup

Fine tune the IP routing functions and domain-name services for EXEC shell users.

Step 1 Optimize IP routing functions 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 legal subnet.
`no ip source-route`	Tightens security by ensuring that IP-header packets cannot define their own paths through the network access server (NAS).
`ip classless`	Ensures that all unknown subnets use the default route.

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

```
ip domain-lookup
ip host dirt 172.22.100.9
ip domain-name mauionions.com
ip name-server 172.22.11.10
ip name-server 172.22.11.11
```

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 dirt 172.22.100.9`	Creates a local name-to-address map. When the NAS is not entered in a DNS server, this map is useful.
`ip domain-name mauionions.com`	Tells the NAS how to qualify DNS lookups. In this example, mauonions.com is appended to the end of each looked-up name.

`ip name-server 172.22.11.10`
`ip name-server 172.22.12.11`
	Specifies the primary and secondary name servers. The ip name-server command is used for mapping names to IP addresses.

Task 7. Testing Asynchronous-Shell Connections

This task verifies that the following components are working:

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

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

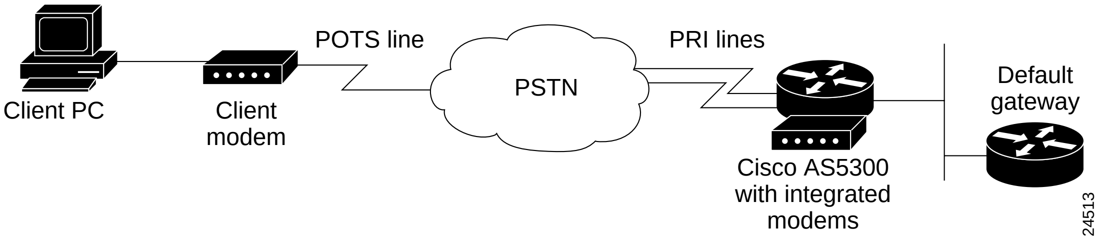
The EXEC:

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

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

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

Figure 2-6 Test Environment



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

```
at
OK
```

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

```
atdt5551234
CONNECT 28800 V42bis
```

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

Step 4 Log into the EXEC session:

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


User Access Verification

Username: dude
Password:

5300-NAS>
```

Step 5 Identify the line where the call landed. The following example shows that line TTY 1 accepted the call. The call has been up and active for 48 seconds.

```
5300-NAS>show caller
                                               Active    Idle
  Line         User              Service       Time      Time
  con 0        admin             TTY           00:05:33  00:00:00
  tty 1        dude              TTY           00:00:48  00:00:22

5300-NAS>show caller user dude

  User: dude, line tty 1, service TTY
        Active time 00:01:12, Idle time 00:00:46
  Timeouts:            Absolute  Idle      Idle
                                 Session   Exec
      Limits:          -         -         00:10:00
      Disconnect in:   -         -         00:09:13
  TTY: Line 1
  DS0: (slot/unit/channel)=0/0/0
  Line: Baud rate (TX/RX) is 115200/115200, no parity, 1 stopbits, 8 databits
  Status: Ready, Active, No Exit Banner
  Capabilities: Hardware Flowcontrol In, Hardware Flowcontrol Out
                Modem Callout, Modem RI is CD, Integrated Modem
  Modem State: Ready
```

Note The **show caller** command is added to the Cisco IOS software in 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.

```
5300-NAS>telnet 172.22.66.26
Trying 172.22.66.26 ... Open


User Access Verification

Username: admin
Password:

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


SunOS 5.6
```

```
login: dude
Password:
Last login: Wed Oct  6 08:57:46 from dhcp-aus-163-236
Sun Microsystems Inc.   SunOS 5.6       Generic August 1997
/cms/resource/.cmsrc: No such file or directory
people%
```

Task 8. Confirming the Final Running-Config

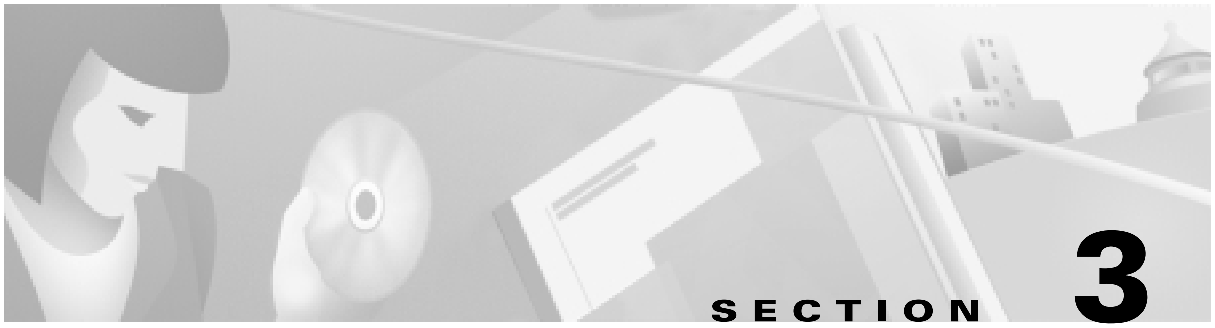
The final running configuration looks like this:

```
5300-NAS#show running-config

Building configuration...

Current configuration:
!
version 12.0
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname 5300-NAS
!
aaa new-model
aaa authentication login default local
aaa authentication ppp default if-needed local
enable secret 5 $1$Ec9Q$KsERiSHdKGL/rGaewXeIz.
!
username admin password 7 045802150C2E
username dude password 7 070C285F4D06
spe 1/0 1/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
spe 2/0 2/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
!
resource-pool disable
!
ip subnet-zero
no ip source-route
ip host dirt 172.22.100.9
ip domain-name mauionions.com
ip name-server 172.22.11.10
ip name-server 172.22.12.11
!
isdn switch-type primary-5ess
mta receive maximum-recipients 0
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 1
 framing esf
 clock source line secondary 1
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 3
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
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 Ethernet0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial0:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial1:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial3:23
 no ip address
 no ip directed-broadcast
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface FastEthernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
no ip http server
```

```
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
!
banner login ^C
This is a secured device.
Unauthorized use is prohibited by law.
^C
!
line con 0
 transport input none
line 1 96
 modem InOut
line aux 0
line vty 0 4
!
end
```

What to do Next

Perform the tasks in the section “Verifying Modem Performance.”



SECTION 3

Commissioning the Cisco AS5800 Hardware

In this Section

This section describes how to configure the Cisco AS5800 to support terminal EXEC shell services and login prompts for client modems.

The following subsections are provided:

- Understanding the Basic Hardware Architecture
- Task 1. Verifying Basic Setup
- Task 2. Configuring Cisco IOS Basics
- Task 3. Enabling the T3/T1 Controllers
- Task 4. Configuring the Serial Interfaces
- Task 5. Configuring Modems and Lines
- Task 6. Enabling IP Basic Setup
- Task 7. Testing Asynchronous EXEC Shell Connections
- Task 8. Confirming the Final Running-Config

In this case study, THEnet commissions the Cisco AS5800 network access server (NAS). Local-based authentication is used. After the Cisco AS5800 is commissioned, THEnet configures and tests PPP as described in “Configuring PPP and Authentication.” In the future, THEnet will use a AAA RADIUS server.

Note For a description of terminal EXEC shell services, see the section “Task 7. Testing Asynchronous EXEC Shell Connections.”

Understanding the Basic Hardware Architecture

To build an access network by using the Cisco AS5800, you need to understand the following:

- The Cisco 7206 Router Shelf and the Cisco DS5814 Dial Shelf
- Call-Processing Components

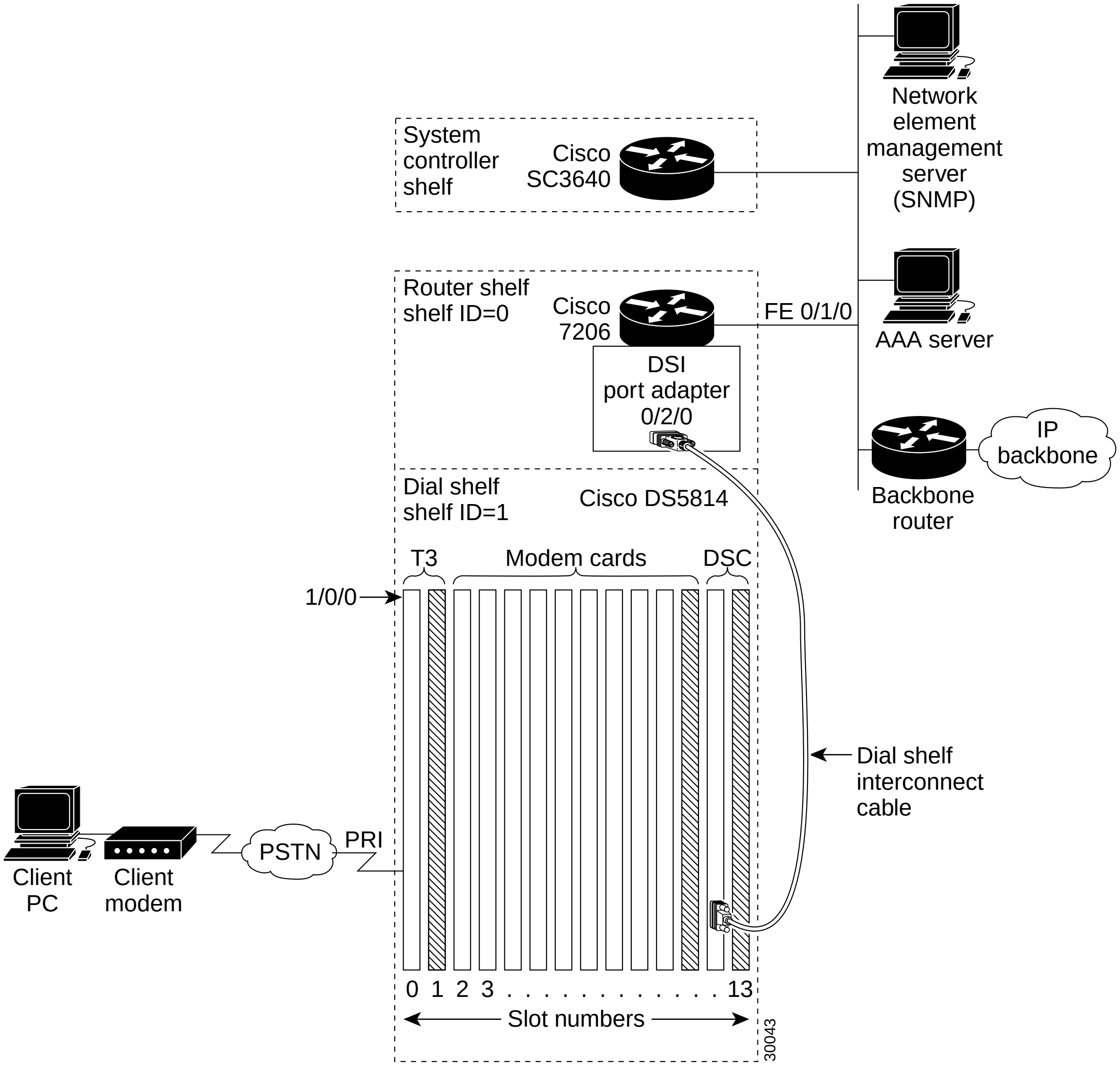
The Cisco 7206 Router Shelf and the Cisco DS5814 Dial Shelf

The Cisco AS5800 access server contains:

- A Cisco 7206 router shelf (egress). It connects to the IP backbone.
- A Cisco DS5814 dial shelf (ingress). It connects to the PSTN.

Figure 3-1 shows the Cisco AS5800's system architecture for this case study:

Figure 3-1 Cisco AS5800 System Architecture



Note The Cisco IOS 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 this case study, the Cisco 7206 uses Fast Ethernet (FE) 0/1/0 to connect to the IP backbone.
  - A dial shelf interconnect (DSI) port adapter. In this case study, the adapter is located at 0/2/0.

    The Cisco 7206 communicates with the Cisco DS5814 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 DS5814.
  - Service adapters (for example, compression and encryption).
  - By default, a shelf ID of 0 is assigned to the router shelf.
- The Cisco DS5814 dial shelf contains the following:
  - Dial shelf controller (DSC) cards. They fit in slots 12 or 13 only. If you have only one DSC card, slot 12 is recommended. One DSC card is used in this case study.

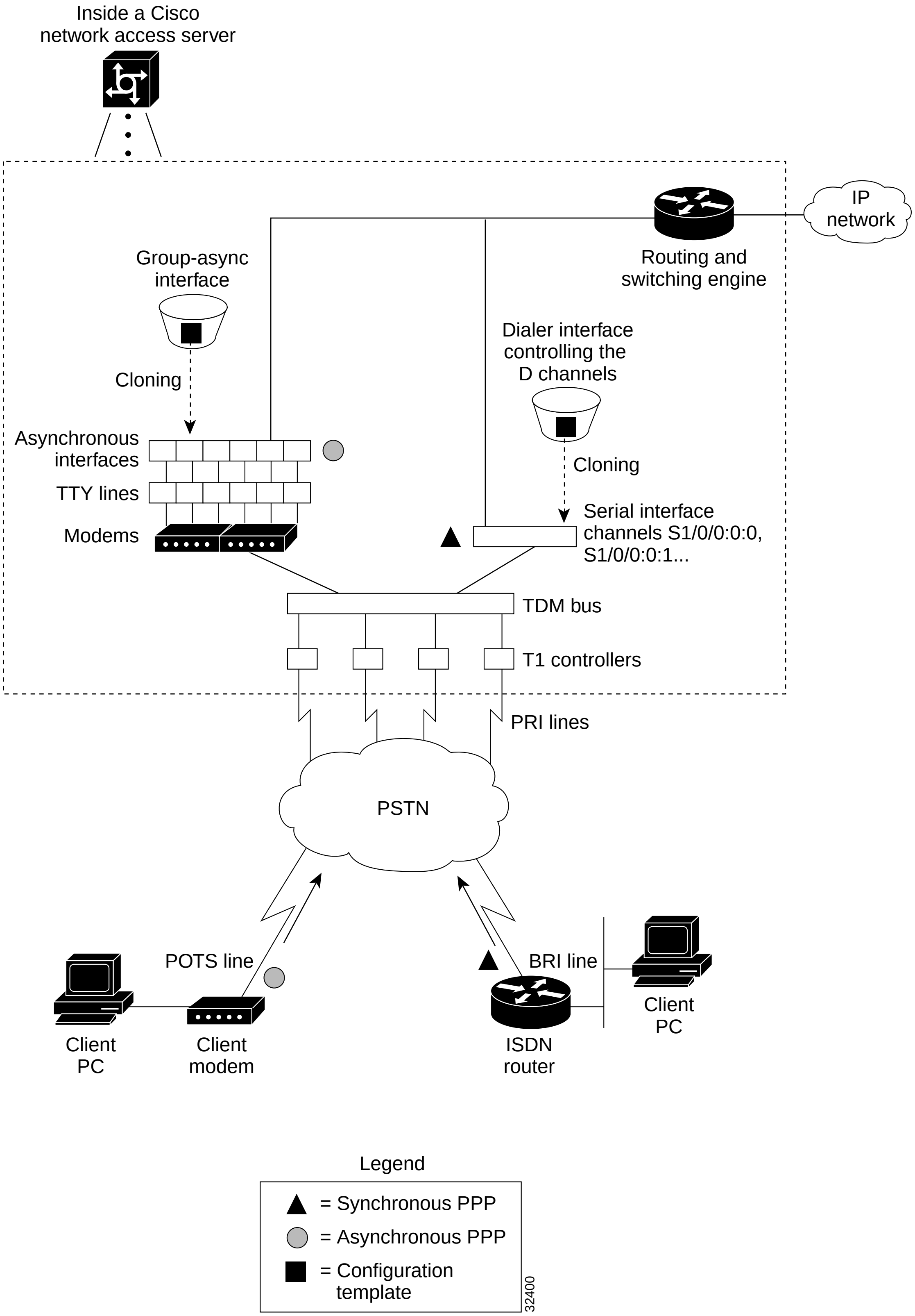
    The DSC card contains its own Cisco IOS image. For maintenance purposes only, the card can be accessed through its console port and Ethernet interface. No IP packets originating from any trunk or modem cards go out this Ethernet interface.
  - T3/T1/E3/E1 cards. They connect to the PSTN and fit in slots 0 through 5 only. Slots 0 and 1 are recommended. In this case study, one T3 trunk card is located at 1/0/0.
  - Modem/voice cards. They fit in slots 0 through 11. In this case study, 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 off loading
  - Out-of-band console access

Call-Processing Components

As shown in Figure 3-2, the following components are used to process a call:

- Client modems and ISDN routers dial into 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 3-2 Cisco AS5800 Call-Processing Components



One asynchronous PPP call consumes:

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

One synchronous PPP call consumes:

- One T1 DS0 channel
- One serial interface channel

Tech Tip 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:

- 1.1 Analyzing the System Boot Dialog
- 1.2 Matching the Cisco IOS Images
- 1.3 Inspecting the Dial Shelf
- 1.4 Understanding DSIP Commands
- 1.5 Checking the Initial Running-Config
- 1.6 Exploring the Cisco IOS File System
- 1.7 Investigating Memory Usage
- 1.8 Inspecting CPU Utilization

1.1 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 11.1(13)CA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
Copyright (c) 1997 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 12.0 may not be correctly under
stood.
%OIR-3-SEATED: Insert/removal failed (slot 2), check card seating
%OIR-3-SEATED: Insert/removal failed (slot 2), check card seatingCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Read 7314384 bytes from file slot0:c5800-p4-mz.120-4.XL1.bin
Self decompressing the image : #################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
############################ [OK]
```

1. In the previous segment, the NAS decompresses the system boot image, tests the NVRAM for validity, and decompresses the Cisco IOS 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. However, *do not* ignore error messages that appear after the Cisco IOS image decompresses.

```
              Restricted Rights Legend

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

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



Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-P4-M),
Version 12.0(4)XL1, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
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 (NPE200) processor with 114688K/16384K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
6 slot midplane, Version 1.3

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).
```

2. The following components are detected: Cisco IOS Release, available memory, and available interfaces.

   If a hardware card is not recognized, verify that you are running the optimum version of Cisco IOS. Refer to the Hardware-Software Compatibility Matrix at:

   http://cco-sj-1.cisco.com/cgi-bin/front.x/Support/HWSWmatrix/hwswmatrix.cgi

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

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

3. Because the NAS has never been configured, the Cisco IOS cannot find a startup-config file. Abort the configuration dialog. In this case study, the Cisco IOS is configured manually. The automatic setup script is not used. Manually configuring the Cisco IOS develops your expertise.

```
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!


Router>
```

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

   Depending on how many cards are 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 the Cisco AS5800 is powered up, enter the **show environment** command. Verify that there are no critical grounding, heating, or power problems. The following example shows a normal 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>
```

1.2 Matching the Cisco IOS Images

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

- Both images must be from the same Cisco IOS Release. They *must* match. In this case study, the Cisco IOS release is 12.0(4)XL1.
- The router shelf's image is in the Cisco 7206's 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 image, uptime, and restart reason:

```
Router#show version
Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-P4-M), Version
12.0(4)XL1, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
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 11.1(13)CA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version 11.1(24)CC, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)

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 (NPE200) processor with 114688K/16384K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
6 slot midplane, Version 1.3

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 3-1 describes the significant output fields in the previous display:

Table 3-1 Show Version Command Field Descriptions

Field	Description
`5800 Software (C5800-P4-M), Version 12.0(4)XL1`	Cisco IOS 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 an internal Flash. If the PCMCIA Flash card is missing, the router shelf will not boot.

On the dial shelf, check the Cisco IOS 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.

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

DA-Slot12>
Cisco Internetwork Operating System Software IOS (tm) 5800 Software (C5800-DSC-M),
Version 12.0(4)XL1, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
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 11.3(1)AA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
ROM: 5800 Software (C5800-DSC-M), Version 11.3(9)AA2, EARLY DEPLOYMENT RELEASE SOFTWARE
(fc1)

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
```

1.3 Inspecting the Dial Shelf

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

```
Router#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
Router#
```

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

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 boards 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 re-seating 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:

```
Router>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
```

Snip

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 watch them.

```
Router#
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
Router#
```

Note In a production environment, 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.

```
Router>
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
Router>
```

The following boot sequence occurs in the previous example:

1. The DSC card takes 32 seconds to boot up. Afterwards, the card checks the dial shelf's inventory.
2. 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 boards.
3. More than two minutes elapse before the DSC card detects the first "DSIP Hello" message from the first feature board (in shelf 1 slot 0). If the DSC card *never* comes up, the feature boards in the dial shelf cannot communicate with the router shelf.
4. The router shelf gives the feature boards the appropriate images.

Step 5 If the DSC card is still down, the card might have an incorrect Cisco IOS 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, and try re-initializing 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:

```
Router#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]
Router#
```

Warning **The router shelf provides the DSC card with the required configuration. Do not change the DSIP settings in the DSC card's configuration.**

Feature Board Troubleshooting Tips

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

```
debug dsip transport
debug dsip trace
debug dsip boot
```

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 boards.

1.4 Understanding DSIP Commands

The router shelf communicates with the dial shelf by using:

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

For the DSIP command reference and other system management functions, refer to the document *Dial and System Management Commands for the Cisco AS5800* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113aa/113aa_2/58cfeats/c5800uas.htm

To understand how DSIP functions, enter the commands in 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 **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
```

Snip

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

```
Router#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
Router#
```

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

```
Router#show dsip version

DSIP version information:
------------------------
Local DSIP major version =  5,   minor version = 2

All feature boards 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:
-----------------------------------
Router#
```

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

1.5 Checking the Initial Running-Config

The Cisco IOS creates an initial running configuration. To get familiar with the default settings, inspect the configuration.

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

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

Current configuration:
!
version 12.0
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 card, display the configuration on the Cisco DS5814 dial shelf:

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

DA-Slot12#
Building configuration...

Current configuration:
!
version 12.0
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
```

1.6 Exploring the Cisco IOS File System

Get familiar with the file system and memory storage areas. The Cisco IOS File System (IFS) 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).

IFS first appeared in Cisco IOS Releases 11.3 AA and 12.0. For more information about IFS, refer to the chapter Using the Cisco IOS File System in the Release 12.0 *Configuration Fundamentals Configuration Guide* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt2/fcifs.htm

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

Figure 3-3 Cisco AS5800 Memory Locations

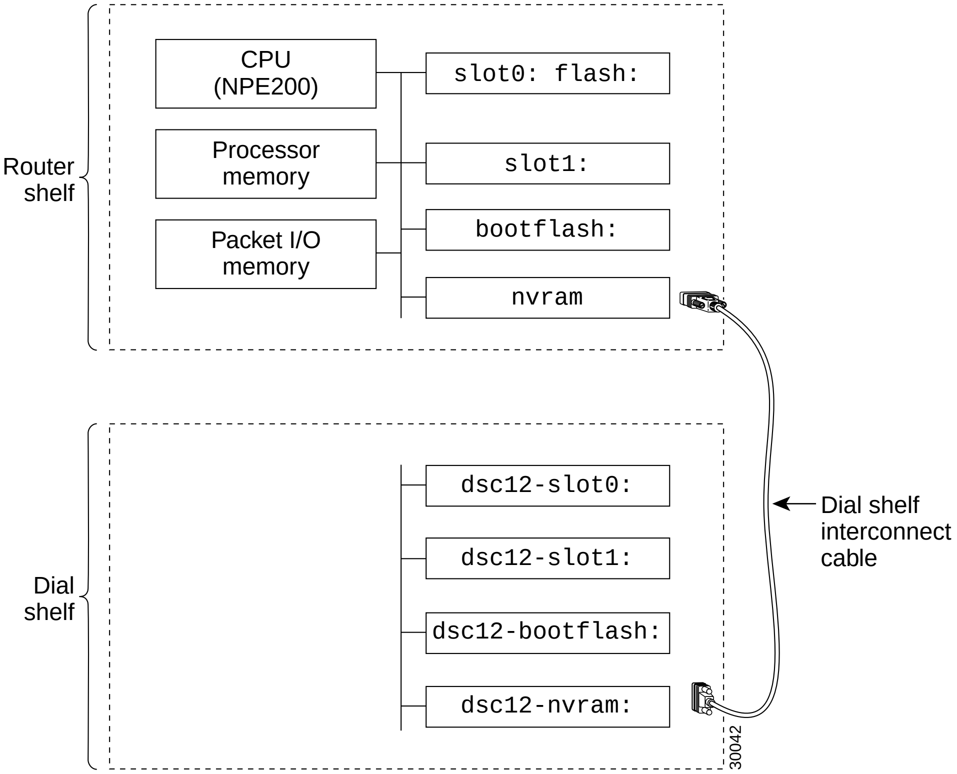


Table 3-2 describes the memory locations shown in Figure 3-3.

Table 3-2 Memory Location Descriptions

Component	Description
CPU (NPE200)	Central processing unit.
Processor memory	The Cisco IOS 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.

`slot0: flash:`
`slot1:`
	PCMCIA Flash memory cards in the router shelf. They store Cisco IOS images, modem firmware/portware, and custom web pages.

`bootflash:`	Flash memory on the Cisco 7206's motherboard.
`nvram:`	Non-volatile 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:`	Non-volatile configuration memory in the DSC card.

To inspect the file system, enter the commands in the following bullet list:

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

```
Router#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:

Router#
```

- Display the objects in the system memory directory:

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

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

No space information available
Router#
```

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

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

```
Router#pwd
slot0:
Router#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)
Router#
Router#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)
Router#
```

- Inspect the bootFlash on both shelves:

```
Router#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
Router#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)
```

Cisco recommends that you 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 shelf and dial shelf. Three files are present: startup-config, private-config, and underlying-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.

```
Router#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)
Router#
Router#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)
Router#
```

1.7 Investigating Memory Usage

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

- Understand how memory is used for different processor and I/O memory processes.
- Identify memory fragmentation and memory leaks.
  - Memory 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.

The following exercise explains how to inspect and calculate memory usage:

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 Do not enter the **show memory summary** command with the **terminal length 0** command enabled. Otherwise, you will produce many screens of output which might interrupt your session.

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

Table 3-3 Show Memory Summary Output Field Descriptions

Field	Description
`Processor`	Processor memory. The Cisco IOS image is initially read out of Flash memory, decompressed, and placed into 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. In the example, there is a small amount of fragmentation.

Step 2 Convert bytes to megabytes:

- 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)

  Tip: MB = bytes / (1024 X 1024)

Step 3 Perform some useful memory calculations:

Total processor = total RAM minus the IOS image size (use the **show version** command to get the MB assigned for all of IOS + processor)

```
cisco 7206 (NPE200) 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 that 112.0 MB - 89.7 MB = 22.3 MB. This means that 22.3 MB are not available for processor memory.

1.8 Inspecting CPU Utilization

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

```
Router#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
:
:
```

Snip

Look at the top line of the output. If you see high utilization numbers, for example 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. The CPU utilization is displayed at the top of the display. See the following table for the field descriptions.

Table 3-4 describes the significant output fields in the previous example:

Table 3-4 CPU Utilization Display Fields

Field	Description
`CPU utilization for five seconds: 20%/6%;`	The first % number is the CPU utilization for the last 5 seconds. The second % number is the percentage of CPU time spent at the packet-based interrupt level.
`one minute: 31%;`	CPU utilization for the last minute.
`five minutes: 19%`	CPU utilization for the last 5 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. At times, the Cisco IOS causes memory leaks. Whenever this happens, the Cisco TAC:

- Further investigates the problem
- Finds out which sub-routine is causing the leak
- Suggests an Cisco IOS upgrade

Task 2. Configuring Cisco IOS Basics

Apply a basic-running configuration to the NAS:

- 2.1 Configuring the Host Name, Enable Secret, and Time Stamps
- 2.2 Configuring Local AAA Security
- 2.3 Setting Up a Login Banner
- 2.4 Configuring Basic IP

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

2.1 Configuring the Host Name, Enable Secret, 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 hinders you from examining background processes.

Step 1 Enter the following commands in global configuration mode:

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

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

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#
```

2.2 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 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 case study, 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 dudepasshere
!
```

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
!
```

Table 3-5 describes the previous configuration fragment:

Table 3-5 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#
```

Successfully logging in means that your local username will work on any TTY or VTY line. Do not disconnect your session until you can log in.

2.3 Setting Up a Login 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 might 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#
```

2.4 Configuring Basic IP

To commission a basic dial access service:

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

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 used to identify devices can support 254 distinct nodes with unique loopback IP addresses.
- Interface loopback 1—Used to host 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.

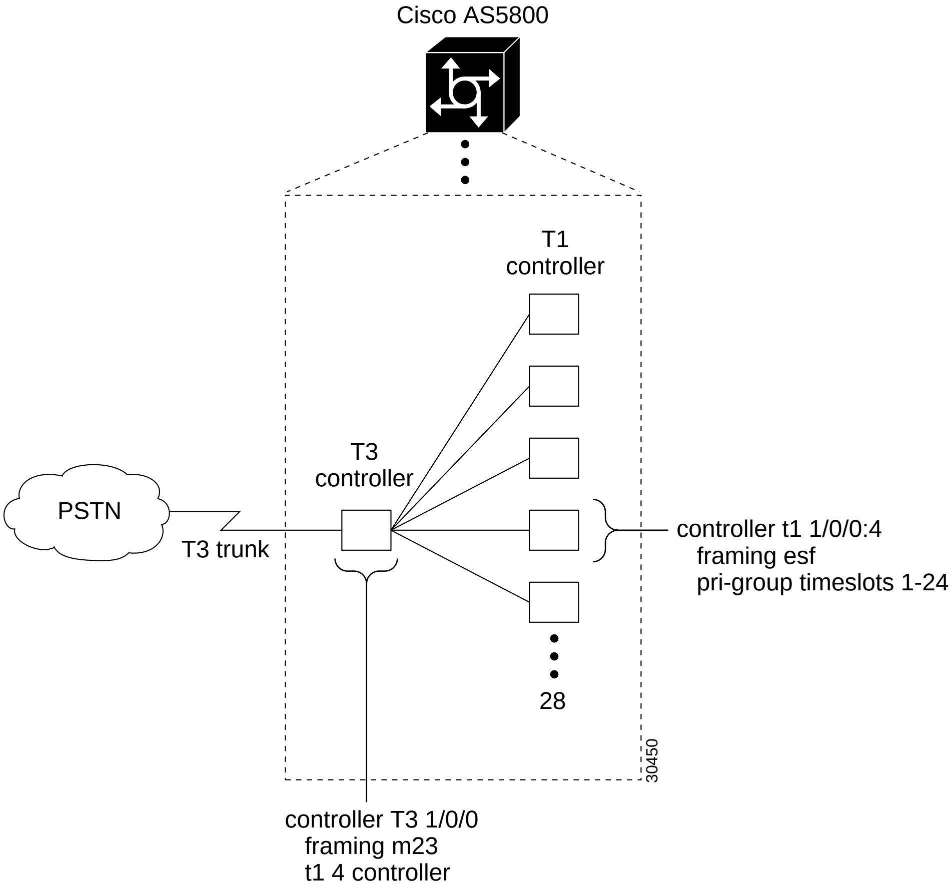
Note An 80% ping-success rate is normal for the first time you ping an external device. The NAS does not yet have an ARP entry (address resolution protocol) for the external device. A 100% success rate is achieved the next time you ping the device.

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 3-4 shows the logical controller components inside a Cisco AS5800. It 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 3-4 Logical T3/T1 Components



Step 1 Define the ISDN PRI switch type. In this case study, 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 next section "Task 4. Configuring the Serial Interfaces."
- Globally across all PRI trunks. All trunks use the same switch type (as in this case study).

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 T1 controller 1/0/0:4. The number of logical T1 controllers should match the number of TI PRI lines coming into the 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 their 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 cl
ock 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 changed
to down
00:02:21: %ISDN-6-LAYER2UP: Layer 2 for Interface Se1/0/0:4:23, TEI 0 changed to up
5800-NAS>
```

Table 3-6 describes some of the T3 and T1-controller concepts that are applied in the previous steps.

Table 3-6 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 control 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 controller** command followed by the **show controller** command:

```
clear controller t3
show controller t3
clear controller t1 1/0/0:4
show controller T1 1/0/0:4
```

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

Tech Tip The **clear controller t1** 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 3-7 provides a list of T1 alarm conditions and descriptions.

Table 3-7 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.
Loop Back	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 section “Channelized E1 & Channelized T1 Setup Commands” at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/index.htm

Step 5 Verify that the 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#
```

Additionally, enter the **show interface S1/0/0:4:23** command.

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 3-8 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. Per interface switch types are first introduced in Release 11.3AA.

Table 3-8 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.

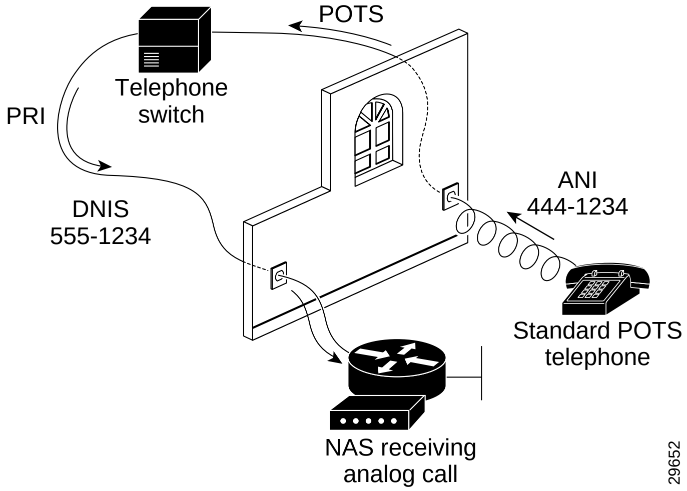
```
5800-NAS#show isdn status
Global ISDN Switchtype = primary-ni
ISDN Serial1/0/0:4:23 interface
        dsl 0, interface ISDN Switchtype = primary-ni
    Layer 1 Status:
        ACTIVE
    Layer 2 Status:
        TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
        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 0
5800-NAS#
```

Step 3 Test the configuration by sending a plain old telephone service (POTS) call into the Cisco AS5800 network access server (NAS). If the modem answers (you hear modem squelch), the configuration works. See Figure 3-5.

Figure 3-5 Sending a POTS Telephone Call into a NAS



A different telephone number is associated with each end of the connection.

In Figure 3-5:

- 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 this case study, the telephone dialed 555-1234.
- 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 case study, 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 Understand 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%
:
```

Snip

Step 3 Choose a specific modem and inspect the modem-to-TTY line association. TTY lines are simulated RS-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 this case study, the first modem card is in slot 2 (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
```

Snip

Task 6. Enabling IP Basic Setup

Tune IP routing behavior and domain-name services for EXEC shell users:

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

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

Table 3-9 describes the previous commands:

Table 3-9 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 dirt 172.22.100.9
ip domain-name the.net
ip name-server 172.22.11.10
ip name-server 172.22.12.10
```

Table 3-10 describes the previous commands:

Table 3-10 Domain-Name Commands

Command	Purpose
`ip domain-lookup`	Enables IP domain-name lookups.
`ip host dirt 172.22.100.9`	Creates a local name-to-address map. When the NAS is not entered in a DNS server, this map is useful.
`ip domain-name the.net`	Tells the NAS how to qualify DNS look ups. In this example, the.net 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:

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

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

The EXEC:

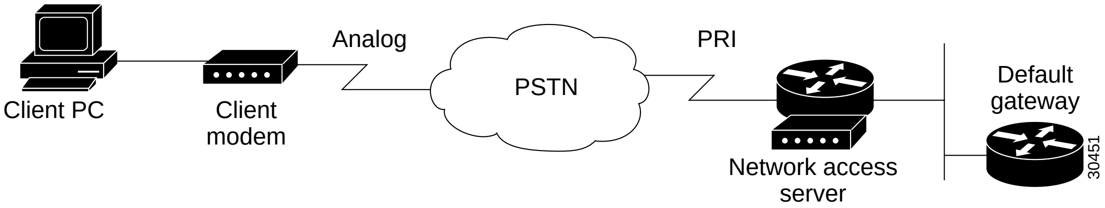
- Can be accessed by dialing in with a modem
- Provides access to terminal EXEC shell services (no PPP) to do the following:
  - Modify configuration files
  - Change passwords
  - Troubleshoot possible problems including modem connections
  - Access other network resources by using telnet

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 EXEC's login prompt can be accessed by a client modem. Taking a layered approach to building a network isolates problems and saves you time.

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 assistance 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 Dial-Up Networking) and connect to the client modem. The following figure shows the network environment for this test.

Figure 3-6 Test Environment



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

```
at
OK
```

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

```
atdt5551234
CONNECT 28800 V42bis
```

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

Step 4 Log into the EXEC session:

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

User Access Verification

Username: dude
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      dude                TTY           00:00:20  00:00:08
```

```
5800-NAS#show caller user dude

  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 the Cisco IOS software in 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 people
Translating "people"...domain server (172.22.11.10) [OK]
Trying people.cisco.com (172.22.2.2)... Open


SunOS 5.6

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

Task 8. Confirming the Final Running-Config

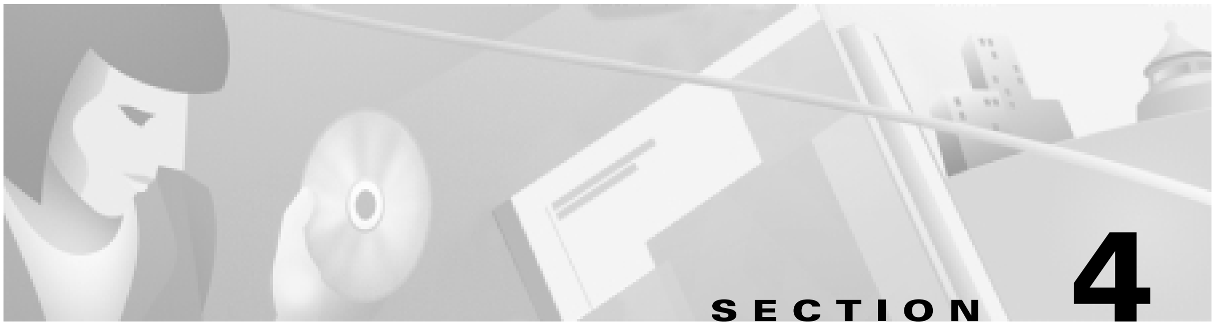
After completing the tasks in this section, the final running configuration looks like this:

```
5800-NAS#show running-config

Building configuration...

Current configuration:
!
version 12.0
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 dirt 172.22.100.9
ip domain-name the.net
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
```

What to do Next

Perform the tasks in the section “Verifying Modem Performance.”



Verifying Modem Performance

In this Section

This section describes how to verify and test modem performance on a Cisco AS5300 and AS5800 by using an EXEC terminal shell service.

The following sections are provided:

- Background on Asynchronous Data Communications
- Understanding Modem Modulation Standards
- Task 1. Initiating a Modem Loopback Test Call
- Task 2. Initiating and Inspecting a V.90 Test Call

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.

In this case study, Maui Onions and THEnet perform the same tasks to verify modem performance and set up V.90. Maui Onions uses a Cisco AS5300; THEnet uses a Cisco AS5800.

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

Background on Asynchronous Data Communications

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

- Async DataComm Model
- Logical Packet and Circuit Components of a NAS
- RS-232 in Cisco IOS
- Cisco IOS Line-Side Inspection

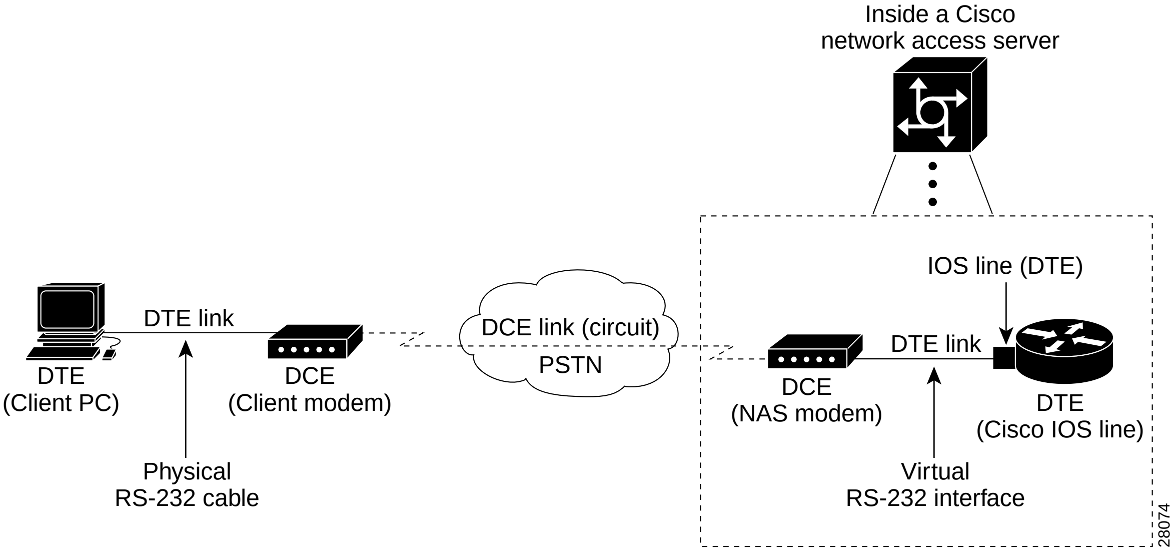
Async DataComm Model

Figure 4-1 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 RS-232 and Cisco IOS:

- 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. RS-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 4-1 A Standard Dial-Up Connection



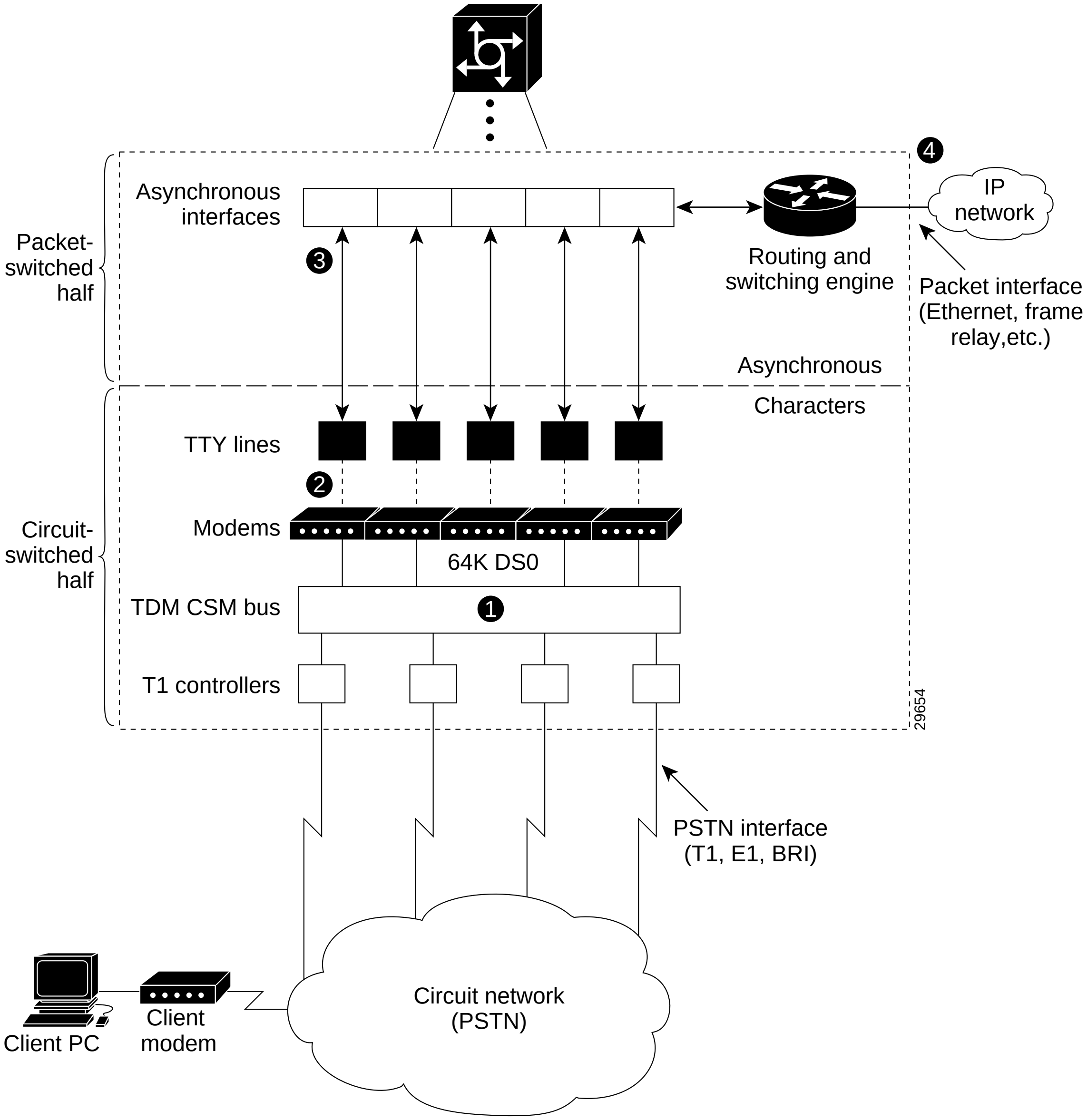
Logical Packet and Circuit Components of a NAS

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). RS-232 signaling on the line is displayed by the **show line** command and **debug modem** command. Figure 4-2 shows the modem access connectivity path.

Figure 4-2 Modem Access Connectivity Path



To understand the general call-processing sequence, match the following numbered list with the numbers shown in Figure 4-2:

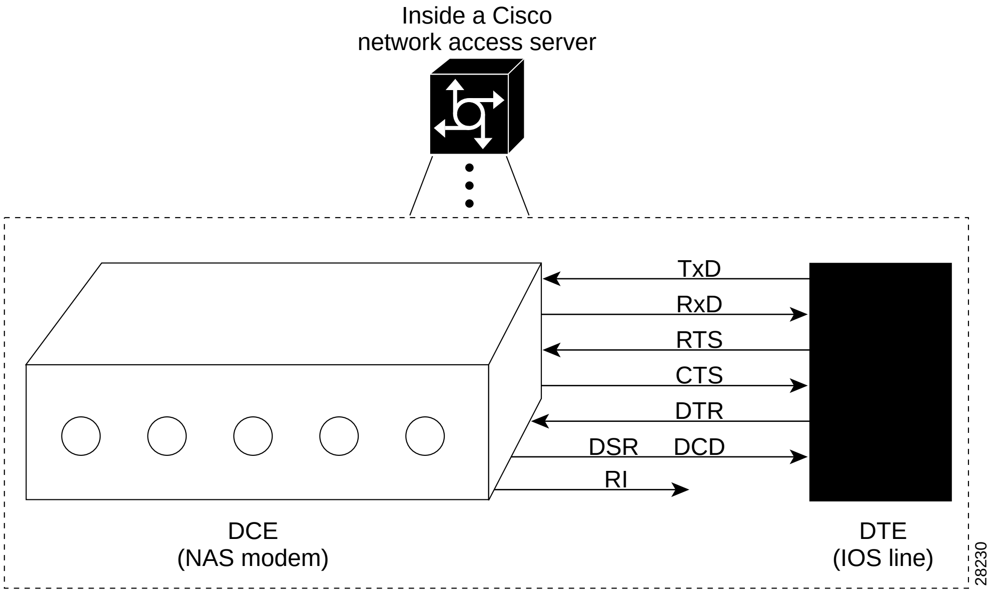
1. 64K DS0 circuits extend from the NAS modems, through the internal TDM CSM bus, and through the circuit network (PSTN).
2. The NAS modems demodulate digital streams into analog-voiceband modulation. The virtual RS-232 interface connects the modems (DCE) to the TTY lines.
3. The TTY lines are mapped into asynchronous interfaces. Interfaces are Cisco IOS 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.

RS-232 in Cisco IOS

The Cisco IOS variation of asynchronous RS-232 is shown in Figure 4-3. The variation exists between the Cisco IOS line (DTE) and the NAS modem (DCE).

- Six RS-232 pins exist between each NAS modem and Cisco IOS line. One or more grounding wires also exist on physical RS-232 lines; however, these wires do not convey signaling.
- Each pin controls a different RS-232 signal.
- The arrows in Figure 4-3 indicate the signal transmission direction.

Figure 4-3 Cisco IOS RS-232



Tech Tip In Figure 4-3, notice that the DSR signal is the DCD signal for the modem. In the scheme of Cisco IOS, the DCD pin on the DCE is strapped to the DSR pin on the Cisco IOS DTE side. What the Cisco IOS 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.

Table 4-1 describes how Cisco uses it's RS-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 4-1 RS-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 RS-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:

```
5300-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 4-2 describes some of the significant fields shown in the previous example:

Table 4-2 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 that 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 RS-232 signal state status. CTS and noDSR 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
- V.90 Basic Rules

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.

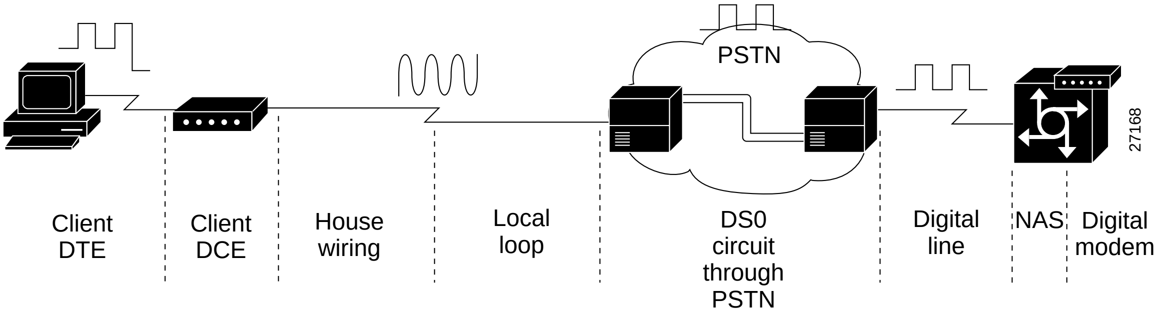
The following six items reduce the achieved V.34 speed:

1. Robbed-bit signaling links in the circuit, which reduce SNR.
2. Extra analog-to-digital conversions. For example, non-integrated 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 4-4.

Figure 4-4 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. You must be a registered CCO user to view the link:

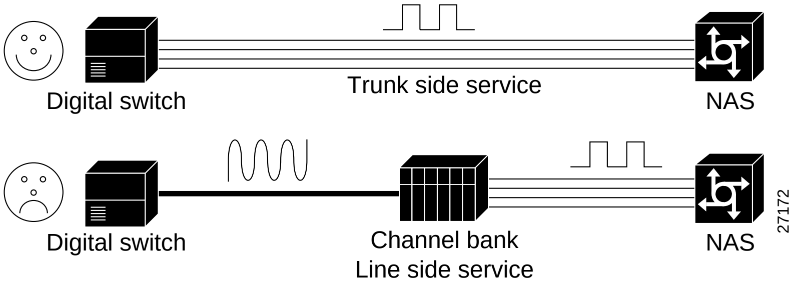
  http://www.cisco.com/kobayashi/sw-center/sw-access.shtml
- Run a Cisco IOS release that is compatible with V.90. Table 4-3 shows the V.90 supported Cisco IOS Releases at the time of this publication.

Table 4-3 V.90 Supported Cisco IOS Releases

Chassis	Modem Type	Cisco IOS
Cisco AS5800	MICA	11.3(6+)AA
		12.0(1+)T
Cisco AS5300	MICA	12.0(1+)
	Microcom	11.3(5+) {T, AA, NA}
		11.2(16+)P
Cisco AS5200	MICA	11.3(5+) {T and AA}
	Microcom	12.0(1+)
		11.2(14+)P (Microcom only)
Cisco 3600	MICA	12.0(1+)
		11.3(5+) {T, AA, NA}
		11.2(16+)P

- 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 4-5 shows this.

Figure 4-5 No Channel Banks for V.90



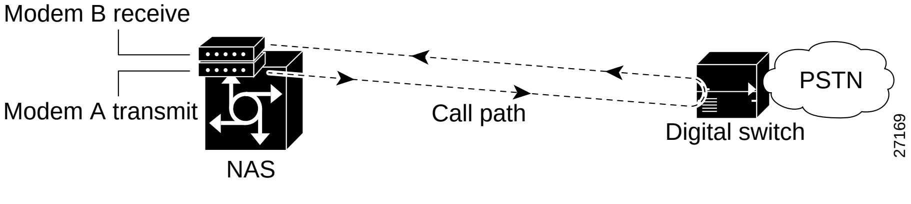
- In the local loop, less than three miles of twisted-pair copper line with no load coils is ideal. Load coils limit frequencies (passband). V.90 requires a 3000 Hz passband. A circuit that does not deliver a 3200 Hz passband will most likely not deliver V.90. Load coils are common in long loops in North 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 section “V.34 Basic Rules.”

Task 1. 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 4-6 shows this test.

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

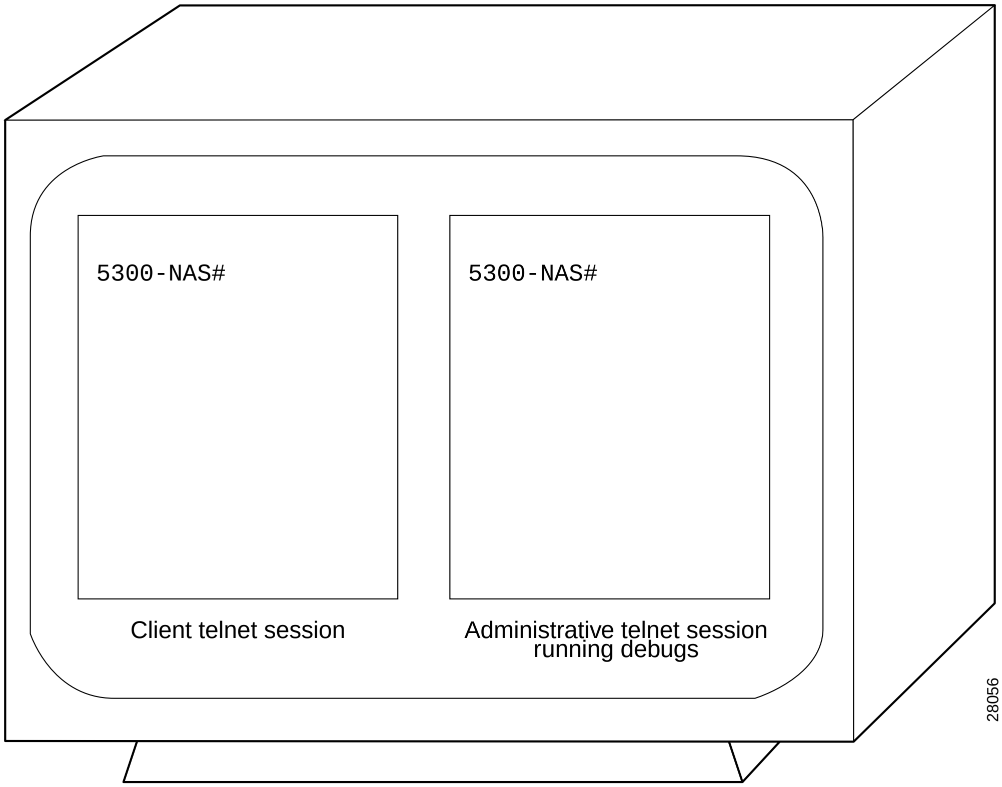
Figure 4-6 Initiating and Terminating a Modem Call on the Same NAS



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. Figure 4-7 shows an example of this.

Figure 4-7 Opening Two Telnet Sessions



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

```
!
line 1 96
 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.

```
5300-NAS#debug isdn q931
ISDN Q931 packets debugging is on
5300-NAS#debug csm modem
Modem Management Call Switching Module debugging is on
5300-NAS#debug modem
Modem control/process activation debugging is on
5300-NAS#show debug
General OS:
  Modem control/process activation debugging is on
ISDN:
  ISDN Q931 packets debugging is on
  ISDN Q931 packets debug DSLs. (On/Off/No DSL:1/0/-)
  DSL  0 --> 7
  1 1 1 - - - - -
```

```
Modem Management:
  Modem Management Call Switching Module debugging is on
5300-NAS#
```

Tech Tip 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.

```
5300-NAS(config)#service internal
5300-NAS(config)#end
5300-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 work-around, complete the following steps:

1. Determine the slot positions of each card. Enter the **show dial-shelf** command.
2. 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.
3. 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:

```
5300-NAS#terminal monitor
```

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).

```
5300-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
:
```

Snip

```
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 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:

```
*Jan  1 00:34:47.863:ISDN Se0:23:RX <-  SETUP pd = 8  callref = 0x0053
*Jan  1 00:34:47.863:        Bearer Capability i = 0x8090A2
*Jan  1 00:34:47.863:        Channel ID i = 0xA98381
*Jan  1 00:34:47.863:        Calling Party Number i = 0x0083, '408'
*Jan  1 00:34:47.863:        Called Party Number i = 0xC1, '5551234'
*Jan  1 00:34:47.867:ISDN Se0:23:TX ->  CALL_PROC pd = 8  callref = 0x8053
*Jan  1 00:34:47.867:        Channel ID i = 0xA98381
*Jan  1 00:34:47.867:ISDN Se0:23:TX ->  ALERTING pd = 8  callref = 0x8053
*Jan  1 00:34:47.867:EVENT_FROM_ISDN::dchan_idb=0x6149A144, call_id=0x1A,ces=0x1
   bchan=0x0, event=0x1, cause=0x0
```

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 RS-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
5300-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.

```
5300-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.mauionions.com

  Interface  User      Mode                     Idle Peer Address
```

Step 11 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 2000** command instead.

```
5300-NAS>terminal length 0
```

Step 12 Generate traffic across the modem link. Force the answering modem (in the NAS) to send a data steam 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.

```
5300-NAS>show modem log
Modem 1/0 Events Log:
  2d09h   :Startup event:MICA Hex modem (Managed)
           Modem firmware = 2.7.1.0
  2d09h   :RS232 event:  noRTS, noDTR, CTS, noDCD
  2d09h   :RS232 event:  noRTS, DTR, CTS, noDCD
  2d09h   :RS232 event:  RTS, DTR, CTS, noDCD
  2d09h   :RS232 event:  noRTS, DTR, CTS, noDCD
  2d09h   :RS232 event:  noRTS, noDTR, CTS, noDCD
  2d09h   :RS232 event:  noRTS, DTR, CTS, noDCD
  2d09h   :RS232 event:  RTS, DTR, CTS, noDCD
:
:
```

Snip

Step 13 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.

```
5300-NAS>show modem operational-status 1/2
Modem(1/2) 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:
..............................*
................................*
.................................*
................................*
................................*
.................................*
.................................*
.................................*
................................*
.................................*
.................................*
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.................................*
.................................*
...............................*
```

Table 4-4 describes the significant parameters in the previous example. For a complete command reference description, refer to the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/drmodmgt.htm

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

Parameter	Description
`Parameter #1  Connect Protocol: LAP-M`	LapM 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.
`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 most likely 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.

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

Parameter	Description

`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 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 14 Turn off all debug commands:

```
5300-NAS#undebug all
All possible debugging has been turned off
```

Task 2. 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 might not be supported by your modem. For more information, see the following URLs:

- http://56k.com/links/Modem_Manuals/
- http://808hi.com/56k/trouble1.htm

Step 1 Locate a client PC, client modem, and an analog line. The following figure shows the network environment for this test.

Step 2 Test your RS-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 web site.

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:dude
Password:

5300-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.

```
5300-NAS>show caller
                                                Active    Idle
  Line         User                Service       Time      Time
  tty 1        dude                TTY           00:00:36  00:00:00
  vty 0        admin               VTY           00:02:29  00:02:16

5300-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.

```
5300-NAS>show terminal
Line 50, 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, Line usable as async interface
  Integrated Modem
Modem state: Ready
  modem(slot/port)=1/0, state=CONNECTED
  dsx1(slot/unit/channel)=0/0/0, status=VDEV_STATUS_ACTIVE_CALL.VDEV_STATUS_ALLO
CATED.
Modem hardware state: CTS DSR  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: 00:00:36
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 udptn v120 lapb-ta.  Preferred is pad t
elnet rlogin udptn v120 lapb-ta.
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:

```
5300-NAS>terminal length 0
```

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

```
5300-NAS>show modem log
Modem 1/0 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
```

Snip

The output generated by the **show modem log** command sends a sizeable 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.

```
5300-NAS>show modem operational-status 1/0
Modem(1/0) 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:
.........................*
................................*
.................................*
.................................*
................................*
.................................*
.................................*
.................................*
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...............................*
...............................*
..............................*
............................*
......................*
```

Table 4-5 describes the significant output fields (**bold** font) in the previous example:

Table 4-5 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.

Table 4-5 Show Modem Operational-Status Field Descriptions (continued)

Parameter	Description

`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.

`Parameter 30`
`Characters transmitted, received:`
`67109, 43`
	67109 characters are transmitted by the NAS modem to the client modem over the synchronous/asynchronous connection.

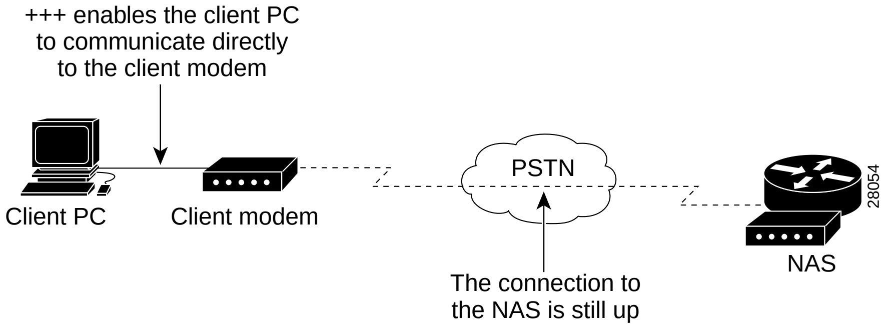
`Line shape:`
`.........................*`
`................................*`
`.................................*`
`.................................*`
`................................*`
`.................................*`
`.................................*`
`.................................*`
`................................*`
`................................*`
`................................*`
`................................*`
`................................*`
`................................*`
`................................*`
	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.

```
5300-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 4-8.

Figure 4-8 Using Modem-Escape Mode to View Client-Side Modem Statistics


+++ enables the client PC to communicate directly to the client modem
Client PC
Client modem
PSTN
28054
NAS
The connection to the NAS is still up

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 Window's 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
```

Tech Tip For a detailed explanation of this command, refer to the following URL: 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).

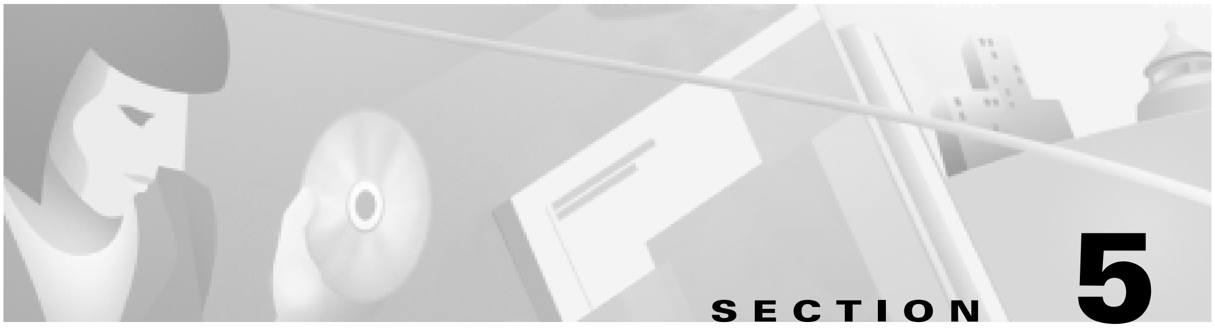
```
aty11

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
5300-NAS>
```

What to do Next

Perform the tasks in the section "Configuring PPP and Authentication."



Configuring PPP and Authentication

In this Section

This section describes how to configure the Cisco AS5300 and AS5800 for PPP and local authentication.

The following sections are provided:

- Task 1. Configuring PPP Authentication for Local AAA
- Task 2. Configuring IPCP Options
- Task 3. Configuring LCP Options
- Task 4. Enabling PPP Autoselect
- Task 5. Testing Asynchronous PPP Connections
- Task 6. Inspecting Active Call States
- Task 7. Confirming the Final Running-Config

In this case study, Maui Onions and THEnet perform these same tasks to configure their network access servers (NAS). Maui Onions uses a Cisco AS5300; THEnet uses a Cisco AS5800. After local authentication if verified, Maui Onions expects to use TACACS+ and a remote authentication server. THEnet expects to use RADIUS.

Task 1. Configuring PPP Authentication for Local AAA

Configure AAA to perform login 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 login username database in global configuration mode. In this example, admin is used for the administrator. In this case study, the remote client's login password is dude.

```
!
username admin password adminpasshere
username dude password dudepasshere
!
```

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:dude
Password:

5800-NAS#
```

Warning **Successfully logging in 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.)**

Task 2. 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.

Tech Tip 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#
```

Task 3. Configuring LCP Options

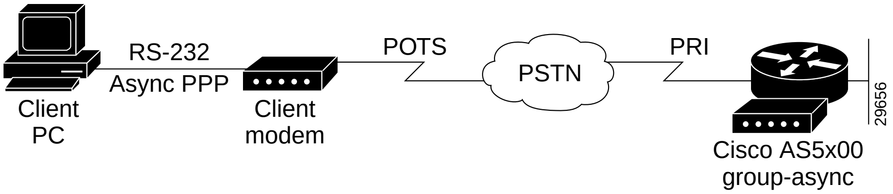
The group-async interface is a template that controls the configuration of all the asynchronous interfaces in the NAS.

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 5-1 shows this concept.

Figure 5-1 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 5-1 describes the previous configuration snippet in more detail:

Table 5-1 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.

Table 5-1 Interface Group Async Command Descriptions (continued)

Command	Purpose
`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.
`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.)

Task 4. 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 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.

Task 5. 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.

5.1 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:

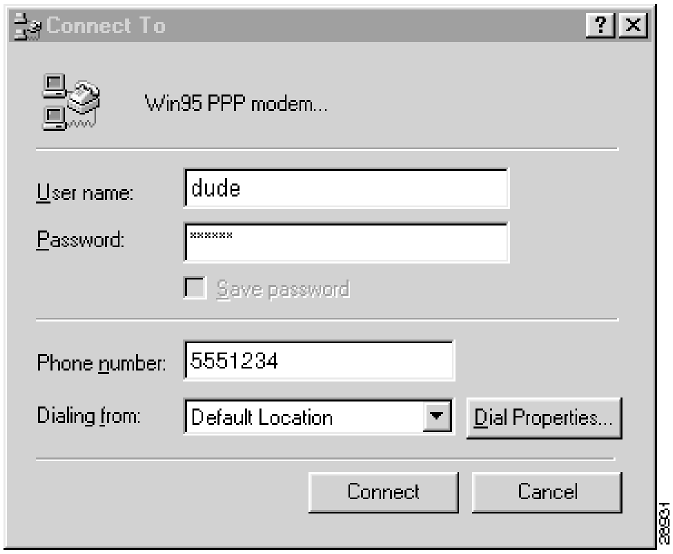
```
5800-NAS#debug ppp authentication
PPP authentication debugging is on
5800-NAS#debug aaa authentication
AAA Authentication debugging is on
5800-NAS#show debug
General OS:
  AAA Authentication debugging is on
PPP:
  PPP authentication debugging is on
```

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

```
5800-NAS#terminal monitor
```

Step 3 From the client, send a test call into the NAS by using Dial-Up Networking. Figure 5-2 shows an example Windows Dial-Up Networking display.

Figure 5-2 Windows Dial-Up Networking


Connect To

Win95 PPP modem...

User name: dude

Password: ******

□ Save password

Phone number: 5551234

Dialing from: Default Location

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, move on to 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 "dude"
*Sep 24 13:05:55.404: As1/2/09 PAP: Authenticating peer dude
```

PPP is allowed to start on the interface. The client sends an authentication request called *dude*. 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 ada
pter=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='dude' 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.

5.2 Failed PPP Negotiation Debug and Troubleshooting

Failed authentication is a common occurrence. Misconfigured or mismatched usernames 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='dude' 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 vali
dation failure"
*Sep 24 13:13:59.036: AAA/MEMORY: free_user (0x63E9846C) user='dude' ruser='' po
rt='Async1/2/11' rem_addr='4089548211/51121' authen_type=PAP service=PPP priv=1
```

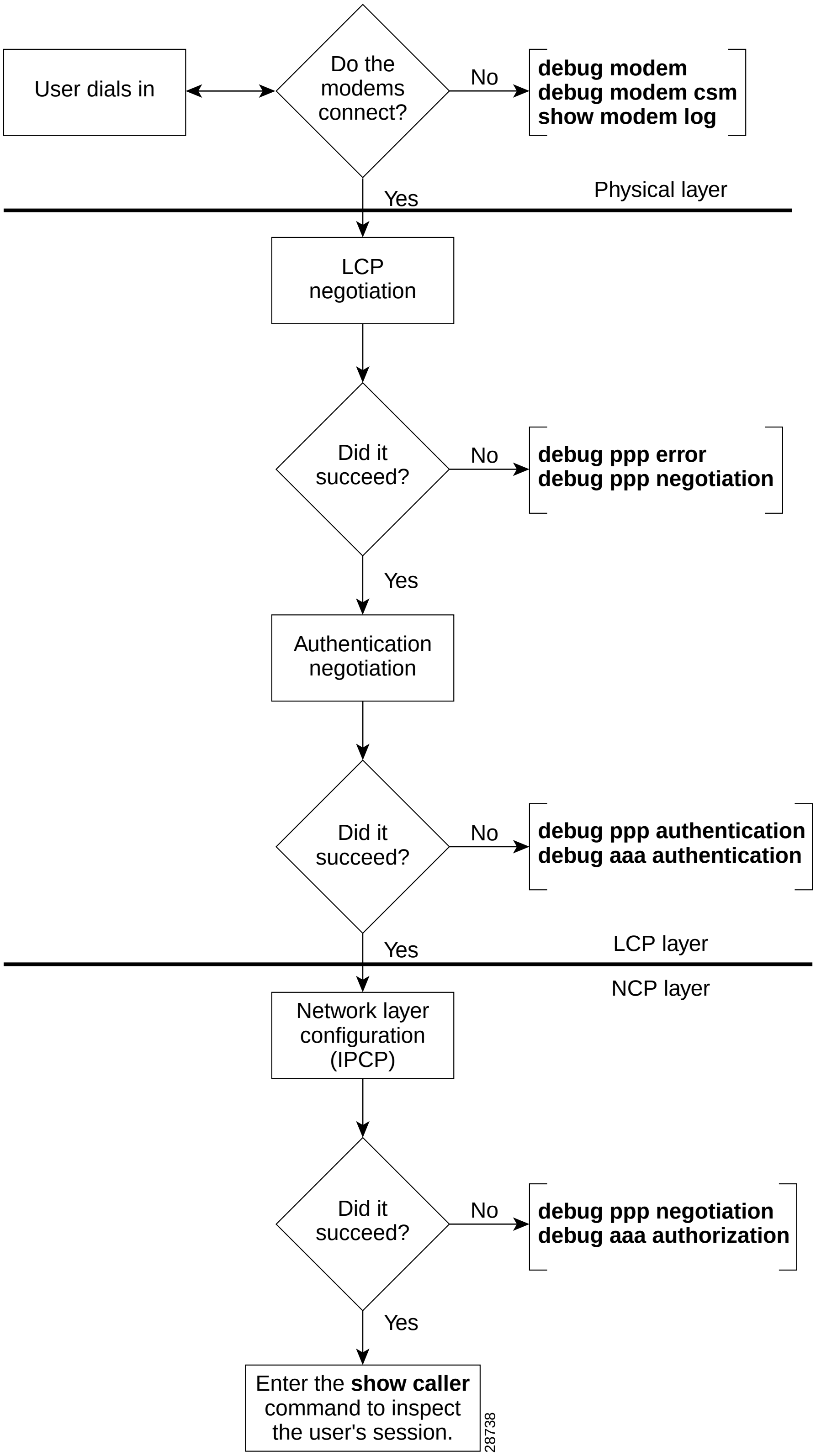
Snip

5.3 Troubleshooting Flow Diagrams

Figure 5-3 provides a flowchart for troubleshooting the following three PPP layers:

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

Figure 5-3 Troubleshooting Flow Chart for PPP and Authentication


User dials in
Do the modems connect?
No
debug modem
debug modem csm
show modem log
Yes
Physical layer
LCP negotiation
Did it succeed?
No
debug ppp error
debug ppp negotiation
Yes
Authentication negotiation
Did it succeed?
No
debug ppp authentication
debug aaa authentication
Yes
LCP layer
NCP layer
Network layer configuration (IPCP)
Did it succeed?
No
debug ppp negotiation
debug aaa authorization
Yes
Enter the **show caller** command to inspect the user's session.
28738

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 5-4 shows an example LCP negotiation process for Peer 1 using the fictional options W, X, Y, Z. Additionally, Figure 5-4 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 5-4 LCP Layer Negotiations

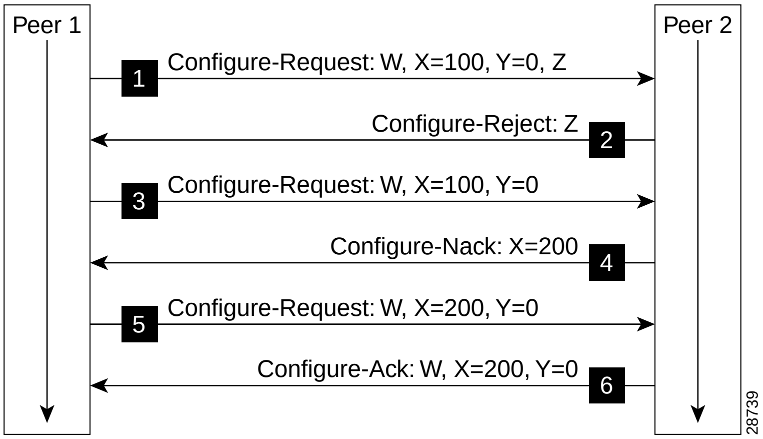

Peer 1
Peer 2
1
Configure-Request: W, X=100, Y=0, Z
Configure-Reject: Z
2
3
Configure-Request: W, X=100, Y=0
Configure-Nack: X=200
4
5
Configure-Request: W, X=200, Y=0
Configure-Ack: W, X=200, Y=0
6
28739

Figure 5-4 shows that:

1. 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.)
2. Peer 2 does not understand option Z so it sends a Configure-Reject containing option Z.
3. Peer 1 sends a new Configure-Request packet requesting option W, option X set to 100, and option Y set to 0.
4. Peer 2 prefers that option X be set to 200 so it sends a Configure-Nack containing option X and its preferred value.
5. Peer 1 sends a new Configure-Request packet requesting option W, option X set to 200, and option Y set to 0.
6. 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.

Task 6. 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.

6.1 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      dude               Async         00:00:15  00:00:00
  As1/2/09     dude               PPP           00:00:08  00:00:00

5800-NAS#show caller user dude

  User: dude, 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: dude, 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 dude detailed** command displays detailed LCP negotiated parameters.

Table 5-2 describes some of the significant display output fields of the **show caller user** command:

Table 5-2 Show Caller User Command Descriptions

Field	Description
`User: dude, 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.
`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 dude 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.

6.2 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.

- Inspect the queueing characteristics of the asynchronous interface. Notice that the queueing 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
```

- 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
5800-NAS#
```

- 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
```

Note For more information, refer to the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/switch_r/xrswcmd.htm#xtocid872762

Task 7. Confirming the Final Running-Config

After completing the tasks in this section, the Cisco AS5800's final running configuration looks like the following example:

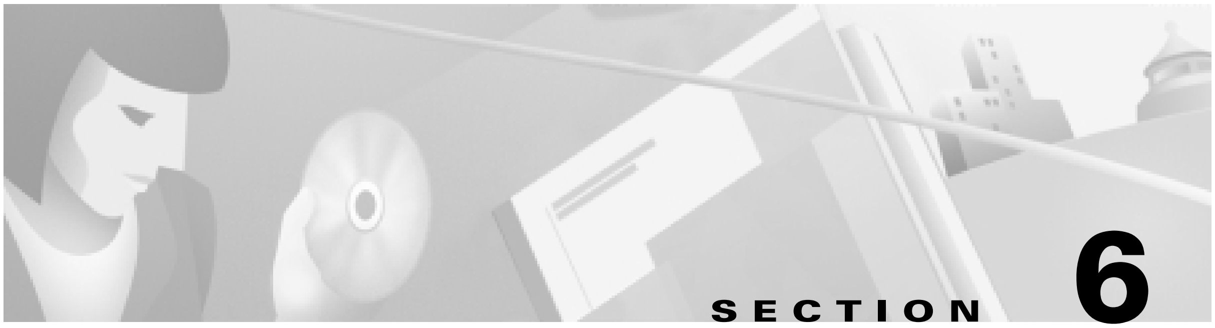
```
5800-NAS#show running-config
Building configuration...

Current configuration:
!
version 12.0
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 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 dirt 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
 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
THEnet 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
```

What to do Next

Perform the tasks in the section “Modem Management Operations.”



SECTION 6

Modem Management Operations

In this Section

This section describes how to manage the modems on a Cisco AS5300 and AS5800 by using the Cisco IOS.

The following sections are provided:

- Task 1. Managing Modem Firmware
- Task 2. Configuring Modems Using Modem Autoconfigure
- Task 3. Gathering and Viewing Call Statistics

In this case study, Maui Onions and THEnet perform these same tasks to manage modem operations of their network access servers (NAS). Maui Onions uses a Cisco AS5300; THEnet uses a Cisco AS5800.

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

Table 6-1 provides a list of terms for this section.

Table 6-1 List of Terms

Term	Description
MICA module	MICA modem card containing 6 (HMM) or 12 (DMM) modems.
Portware	MICA modem code.
Firmware	Microcom 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, a 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 image. (In general, Cisco does not refer to modem code microcode.)
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.

The following documents are related to modem management operations:

- *Dial Solutions Configuration Guide, Managing Modems,* Release 12.0

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_c/dcmodmgt.htm

- *Dial Solutions Command Reference, Modem Management Commands,* Release 12.0

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/drmodmgt.htm

- *Firmware and Portware Information*

  http://www.cisco.com/univercd/cc/td/doc/product/access/fwpwinfo/index.htm

Task 1. 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 image. The modem will not look outside the bundled image unless you manually change the configuration settings by using the **copy** *source* **modem** command or **spe** command.

1.1 Inspecting Modem Firmware

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

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

```
5300-NAS#show modem version

        Modem module     Firmware   Boot          DSP
  Mdm   Number           Rev        Rev           Rev
  1/0             0       2.6.2.0
  1/1             0       2.6.2.0
  1/2             0       2.6.2.0
  1/3             0       2.6.2.0
  1/4             0       2.6.2.0
  1/5             0       2.6.2.0
  1/6             1       2.6.2.0
  1/7             1       2.6.2.0
  1/8             1       2.6.2.0
  1/9             1       2.6.2.0
  1/10            1       2.6.2.0
  1/11            1       2.6.2.0
  1/12            2       2.6.2.0
  1/13              2       2.6.2.0
  1/14              2       2.6.2.0
  1/15              2       2.6.2.0
  1/16              2       2.6.2.0
  1/17              2       2.6.2.0
```

Snip

- Find the version of firmware that is bundled with the Cisco IOS. The **show modem map** command displays the region of NVRAM that identifies where the modems get their firmware from at bootup.

  The field “IOS-Default” indicates that the modem gets its firmware from the bundled IOS image. At the end of the display, you see the versions of firmware that the Cisco IOS found and where they are stored. Bundled firmware is stored in the directory system:/ucode.

  The following example shows that MICA portware 2.6.2.0 is mapped to the modems and bundled with the Cisco IOS software:

```
5300-NAS#show modem map

Slot 1 has Mica Carrier card.


        Modem      Firmware   Firmware
Module  Numbers    Rev        Filename
  0   1/0  - 1/5   2.6.2.0    IOS-Default
  1   1/6  - 1/11  2.6.2.0    IOS-Default
  2   1/12 - 1/17  2.6.2.0    IOS-Default
  3   1/18 - 1/23  2.6.2.0    IOS-Default
  4   1/24 - 1/29  2.6.2.0    IOS-Default
  5   1/30 - 1/35  2.6.2.0    IOS-Default
  6   1/36 - 1/41  2.6.2.0    IOS-Default
  7   1/42 - 1/47  2.6.2.0    IOS-Default

Slot 2 has Mica Carrier card.


        Modem      Firmware   Firmware
Module  Numbers    Rev        Filename
  0   2/0  - 2/5   2.6.2.0    IOS-Default
  1   2/6  - 2/11  2.6.2.0    IOS-Default
  2   2/12 - 2/17  2.6.2.0    IOS-Default
  3   2/18 - 2/23  2.6.2.0    IOS-Default
  4   2/24 - 2/29  2.6.2.0    IOS-Default
  5   2/30 - 2/35  2.6.2.0    IOS-Default
  6   2/36 - 2/41  2.6.2.0    IOS-Default
  7   2/42 - 2/47  2.6.2.0    IOS-Default


Firmware-file                                     Version  Firmware-Type
=============                                     =======  =============
system:/ucode/mica_board_firmware                 2.0.2.0  Mica Boardware
system:/ucode/mica_port_firmware                  2.6.2.0  Mica Portware
system:/ucode/microcom_firmware                   5.1.20   Microcom F/W and DSP
5300-NAS#
```

The Cisco AS5800 does not support the **show modem map** command. Use **show modem bundled-firmware** command instead:

```
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
```

- Inspect the directory that stores the bundled firmware files. The files are loaded into the system main memory through the ucode directory.

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

  ```
  5300-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
  ```

- Look at the existing contents of Flash or boot Flash for the following reasons:
  - Determine what firmware versions you already have.
  - Determine if your Flash or boot Flash is read-only or read/write.
  - Determine if you have enough free space.

Snip

The commands **show flash** and **show bootflash** are supported in all versions of Cisco IOS. The commands **dir flash:** and **dir bootflash:** are supported in Release 12.0T.

```
AS5300-1#show flash

System flash directory:
File  Length   Name/status
  1   6436752  c5300-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)

AS5300-1#show bootflash

Boot flash directory:
File  Length   Name/status
  1   1220196  c5300-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)

AS5200-2#show flash

System flash directory:
File  Length   Name/status
  1   6721924  c5200-is-l.113-7.T.bin
[6721988 bytes used, 10055228 available, 16777216 total]
16384K bytes of processor board System flash (Read ONLY)

AS5200-2#show bootflash

Boot flash directory:
File  Length   Name/status
  1   3414112  c5200-boot-l.112-11.P2.bin
  2   374826   pw2514.ios
  3   378153   pw2515.ios
  4   381540   pw2615.ios
  5   381540   pw2617.ios
  6   381540   mica-modem-pw.2.6.2.0.bin
[5312100 bytes used, 3076508 available, 8388608 total]
8192K 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:

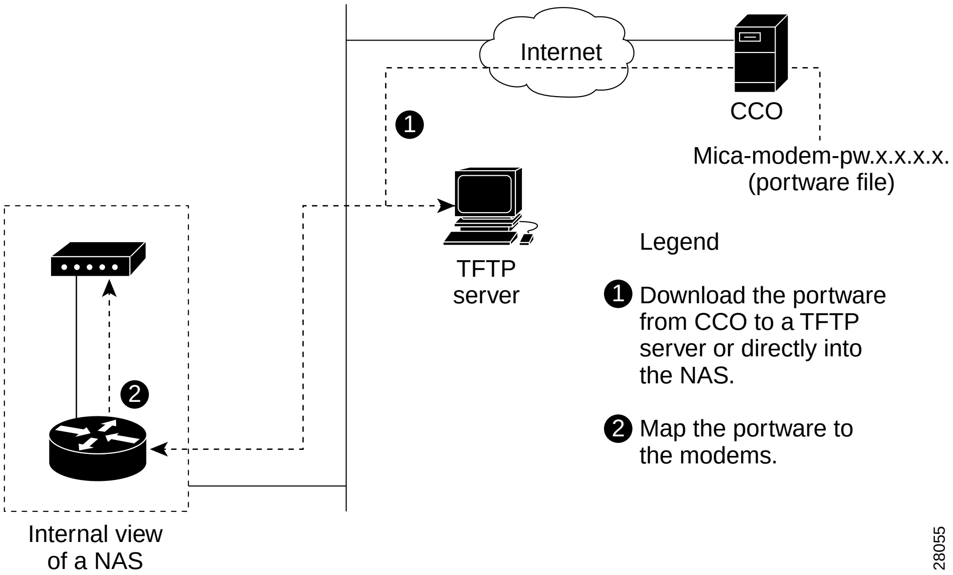
1. Copy the existing files that you want to keep onto a TFTP server.
2. Erase the Flash.
3. Copy the desired files into Flash.

1.2 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 6-1 summarizes the firmware upgrade procedure.

Figure 6-1 Modem Firmware Download Operation Example


Internet
CCO
Mica-modem-pw.x.x.x.x.
(portware file)
1
TFTP
server
Legend
1 Download the portware from CCO to a TFTP server or directly into the NAS.
2 Map the portware to the modems.
2
Internal view
of a NAS
28055

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 following URL for the latest release notes:

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 you are running, there are two ways you can get the latest firmware from CCO into the NAS Flash or bootFlash. Table 6-2 describes these two methods.

Table 6-2 Firmware Copy Commands

Cisco IOS	Command	Purpose
12.0T and later	`copy ftp`	Copy a file directly from CCO into Flash, 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).

```
5300-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
5300-NAS#
5300-NAS#copy ftp://CCOUSERNAME:CCOPASSWORD@ftp.cisco.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.cisco.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)
5300-NAS#
```

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

```
5300-NAS#dir flash:
Directory of flash:/

  1  -rw-     4583276              <no date>  C5300-IS-MZ.113-9_AA
  2  -rw-     4675992              <no date>  c5300-js-mz.112-18.P.bin
  3  -rw-      392241              <no date>  mica-modem-pw.2.7.1.0.bin
  4  -rw-     5947548              <no date>  c5300-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 **debug modem maintenance** command to watch the modem mapping operation take place:

```
5300-NAS#debug modem maintenance
Modem Maintenance debugging is on
5300-NAS#show debug
Modem Management:
  Modem Maintenance debugging is on
5300-NAS#terminal monitor
```

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 6-3 describes these two commands.

Table 6-3 Modem Mapping Commands

Cisco IOS	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 variable *source* with the keyword **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).

```
5300-NAS#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5300-NAS(config)#spe 1/0 1/7
5300-NAS(config-spe)#firmware location flash:mica-modem-pw.2.7.1.0.bin
5300-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 the previous 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 below that 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.

```
!
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
cisco#
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 image (see the field IOS-Default).

```
5300-NAS#show modem map

Slot 1 has Mica Carrier card.


        Modem      Firmware   Firmware
Module  Numbers    Rev        Filename
  0   1/0  - 1/5   2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  1   1/6  - 1/11  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  2   1/12 - 1/17  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  3   1/18 - 1/23  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  4   1/24 - 1/29  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  5   1/30 - 1/35  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  6   1/36 - 1/41  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
  7   1/42 - 1/47  2.7.1.0    flash:mica-modem-pw.2.7.1.0.bin
```

```
Slot 2 has Mica Carrier card.


        Modem      Firmware   Firmware
Module  Numbers    Rev        Filename
  0   2/0  - 2/5   2.6.2.0    IOS-Default
  1   2/6  - 2/11  2.6.2.0    IOS-Default
  2   2/12 - 2/17  2.6.2.0    IOS-Default
  3   2/18 - 2/23  2.6.2.0    IOS-Default
  4   2/24 - 2/29  2.6.2.0    IOS-Default
  5   2/30 - 2/35  2.6.2.0    IOS-Default
  6   2/36 - 2/41  2.6.2.0    IOS-Default
  7   2/42 - 2/47  2.6.2.0    IOS-Default


Firmware-file                                     Version  Firmware-Type
=============                                     =======  =============
system:/ucode/mica_board_firmware                 2.0.2.0  Mica Boardware
system:/ucode/mica_port_firmware                  2.6.2.0  Mica Portware
system:/ucode/microcom_firmware                   5.1.20   Microcom F/W and DSP
bootflash:mica-modem-pw.2.6.2.0.bin               2.6.2.0  Mica Portware
flash:mica-modem-pw.2.7.1.0.bin                   2.7.1.0  Mica Portware
5300-NAS#
```

Task 2. 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, 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.

2.1 Basic Rules for Modem Autoconfigure

The following list describes the basic rules:

1. Never use the **modem autoconfigure discovery** command. Applying specific modemcaps reduces the risk of error.
2. Always use the **modem autoconfigure type** *modem-name* command. This command improves your modem’s performance. See CSCdk15302 for an explanation.

   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).
3. 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.
4. 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 non-cisco 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. See CSCdk15260 and CSCdk15302 for an explanation.

2.2 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:

```
5300-NAS#debug confmodem
Modem Configuration Database debugging is on
5300-NAS#show debug
Modem Autoconfig:
  Modem Configuration Database debugging is on
5300-NAS#terminal monitor
```

Step 2 Remove any previous modem autoconfigure entry:

```
5300-NAS#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5300-NAS(config)#no modemcap entry mica-noKflex
% Modemcap entry 'mica-noKflex' does not exist
```

Step 3 Add the new entry:

```
5300-NAS(config)#modemcap edit mica-noKflex misc &F&D2s53=0
```

Note The MICA and Microcom AT command references are posted at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/5300/mod_info/at/index.htm

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.

```
5300-NAS(config)#line 1 2
5300-NAS(config-line)#modem autoconfigure type mica-noKflex
5300-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
5300-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 releases, the built-in **mica** modemcap entry will do this.)

Task 3. 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:

- 3.1 Using the Cisco IOS EXEC (CLI)
- 3.2 Using Modem Call-Record Terse
- 3.3 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.

3.1 Using the Cisco IOS EXEC (CLI)

The Cisco IOS 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.

- Here is a list of the **show modem** command options:

```
5300-NAS#show modem ?
  <0-2>               Slot/Port number (i.e. 1/1)
  at-mode             AT session connections
  call-stats          Calling statistics for all system modems
  configuration       Modem configuration
  connect-speeds      Connection speeds for all system modems
  cookie              Hex dump of all modem cookies
  csm                 CSM modem information
  group               Modem group information
  log                 Modem event log
  mapping             Show modem firmware mapping
  mica                Modem exec commands
  operational-status  Modem operational status
  summary             Summary statistics for all system modems
  test                Modem test log
  version             Version information for all system modems
  |                   Output modifiers
  <cr>
```

- Display a summary of the modem call statistics:

```
5300-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%
```

The following table describes some of the significant fields in the previous example.

Table 6-4 Show Modem Summary Field Descriptions

Field	Description
Succ 60005	60,005 calls successfully trained up. The Cisco IOS 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).

- Display the disconnect reasons for the modems that trained up:

```
5300-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 6-5 describes some of the significant fields in the previous example.

Table 6-5 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 (DTE) informed the modem to terminate the call. For example: • Idle timeouts • Absolute timeouts • Authentication failures • PPP negotiation failures • The Cisco IOS 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. 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.

- Look at detailed disconnect reasons for individual modems:

```
5300-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
```

- 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.

```
5300-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
```

- 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.

```
5300-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
```

- 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.

```
5300-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
```

Snip

3.2 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:

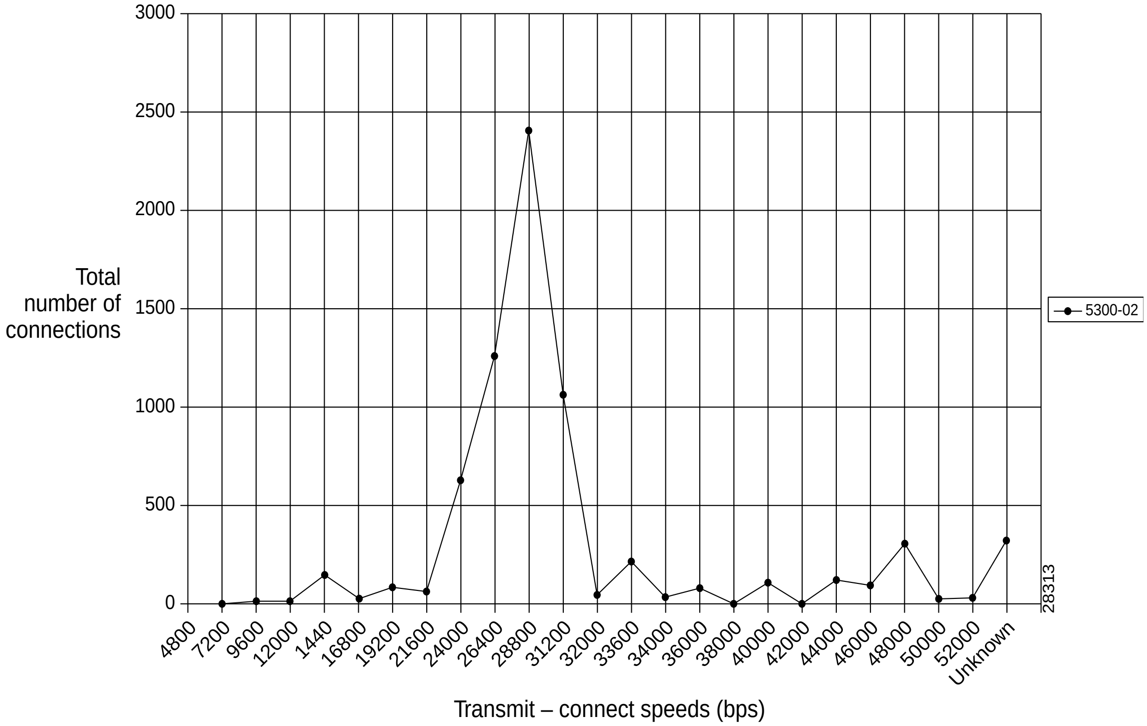
- To the console—if you do not have the **no logging console** command enabled.
- To the terminal line—if you have the **terminal monitor** command enabled.
- To a syslog host—if you have one configured.

```
5300-NAS#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
5300-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, cal
led=5710945, std=V.34+, prot=LAP-M, comp=V.42bis both, init-rx/tx b-rate=26400/2
6400, 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 - n
ot OK/EC condition - locally detected/received DISC frame -- normal LAPM termina
tion
```

3.3 Using SNMP

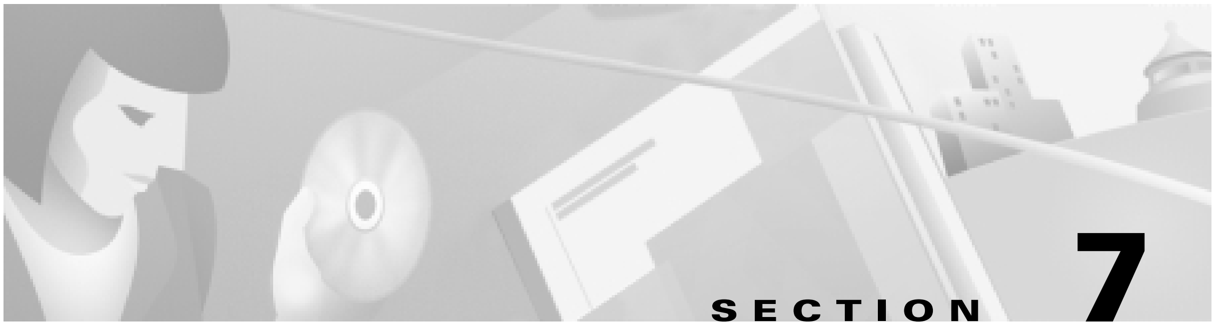
Modem connect speeds can be graphed using SNMP MIBs. The graph shown in Figure 6-2 was created with Cisco Access Manager (CAM). The graph describes the modem connect-speed performance activity of one NAS for one month. The following connect speeds are transmitted by the NAS and received by the client modem. Most of the calls performed between 28000 and 31200 bps. This NAS is one member of an access stack.

Figure 6-2 Graphed Modem-Connect Speeds for One Month



What to do Next

Perform the tasks in the section “Enabling Management Protocols: NTP, SNMP, and Syslog.”



SECTION 7

Enabling Management Protocols: NTP, SNMP, and Syslog

In this Section

This section describes how to enable basic management protocols on a Cisco AS5800 and Cisco AS5300 as part of a dial access service.

The following sub sections are provided:

- Understanding Network Management Basics
- Task 1. Enabling the Network Time Protocol
- Task 2. Enabling Syslog
- Task 3. Enabling SNMP
- Task 4. Disabling the Logging of Access Interfaces
- Task 5. Confirming the Final Running-Config

This section does not describe how to integrate the Cisco IOS with NT or UNIX servers. Management protocols are described only from the perspective of the Cisco IOS.

In this case study, Maui Onions and THEnet perform these same tasks to manage their network access servers (NAS).

Understanding Network Management Basics

Figure 7-1 shows a logical view of how management protocols interact between the Cisco IOS (client) and the network element management server. The dashed lines indicated different protocols and functions.

- NTP synchronizes time between network devices.
- The SNMP element manager (EM) receives SNMP traps from the Cisco IOS. A unidirectional, unsolicited SNMP datagram. The SNMP manager uses SNMP to query variables and set configurations.
- The Cisco IOS sends logging messages to a syslog daemon.

Figure 7-1 NTP, SNMP, and Syslog Interactions

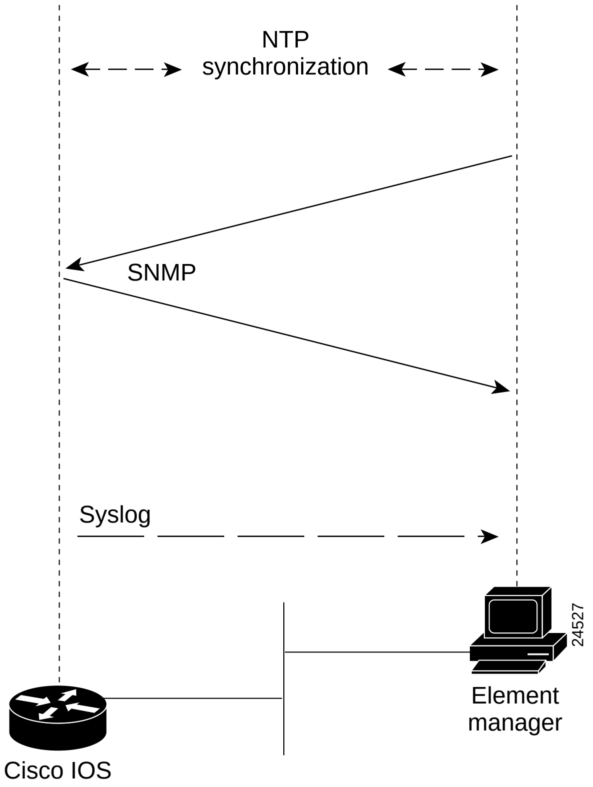


Table 7-1 provides the RFCs and URLs for the management protocols described in this section:

Table 7-1 Management Protocol RFCs

Management Protocol	RFC	URL
SNMP	RFC 1157	http://www.ietf.org/rfc/rfc1157.txt
NTP	RFC 1305	http://www.ietf.org/rfc/rfc1305.txt

For more information about system management, refer to Release 12.0 *Configuration Fundamentals Configuration Guide* and *Command Reference* at the following URL:

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

Task 1. 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 one another. NTP runs over UDP, which in turn runs over IP.

Note For more information, refer to the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/fun_c/fcprt3/fcgenral.htm

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.

```
5300-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
5300-NAS#
```

The following command identifies how often the NAS is polling and updating to the stratum clock. An asterisk (*) next to the NTP server's IP address indicates successful synchronization with the stratum clock.

```
5300-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
5300-NAS#
```

Task 2. Enabling Syslog

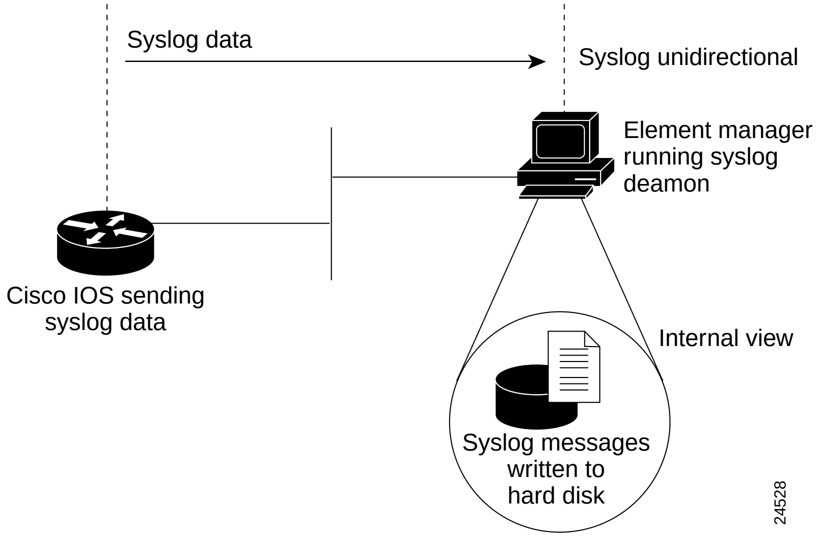
The Cisco IOS can send syslog messages to one or more element manager servers. Syslog messages are then collected by a standard UNIX or NT type syslog daemon.

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 7-2 shows the Cisco IOS sending syslog data to an element manager. Syslog data either stays in the Cisco IOS buffer or is pushed out and written to the element manager's hard disk.

Figure 7-2 Syslog Messages Written to Hard Disk


Syslog data
Syslog unidirectional
Element manager running syslog deamon
Cisco IOS sending syslog data
Internal view
Syslog messages written to hard disk
24528

Note Cisco System's UNIX syslog format is compatible with 4.3 BSD UNIX.

Step 1 Enable debug timestamps and include the 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.

```
5300-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
:
:
```

Snip

```
5300-NAS(config)#no logging console
5300-NAS(config)#^Z
5300-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
```

Warning **Not entering the no logging console command, might cause CPU interrupts, dropped packets, and denial of service events. The router might lock up.**

Step 3 Specify the logging configuration:

```
!
logging 172.22.66.18
logging buffered 10000 debugging
logging trap debugging
!
```

Figure 7-2 describes the commands in the previous configuration fragment.

Table 7-2 Syslog Commands

Command	Purpose
`logging 172.22.66.18`	Specifies the syslog server’s IP address.
`logging buffered 10000 debugging`	Sets the internal log buffer to 10000 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:

```
5300-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
5300-NAS#
```

Task 3. Enabling SNMP

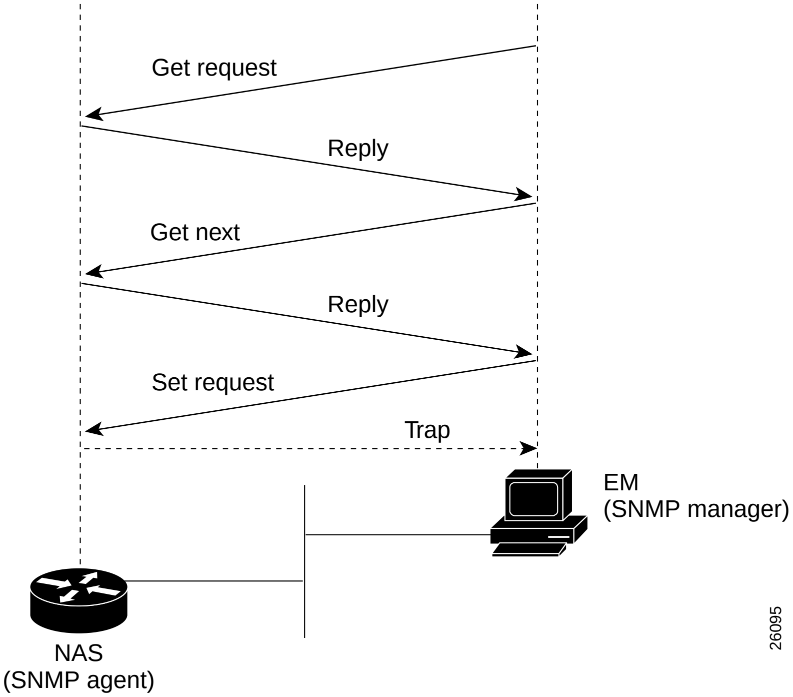
The SNMP traps generated by Cisco routers provide useful information:

- Potentially harmful environmental conditions
- Processor status
- Port status
- Security issues

The Cisco IOS generates SNMP traps based on the features that the Cisco IOS supports.

Figure 7-3 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. There are four functions of SNMP: trap, get request, get next, and set request.

Figure 7-3 SNMP Event Interaction and Timing



Note For a listing of all SNMP traps supported by Cisco, refer to the following URL:

http://www.cisco.com/public/mibs/traps/

Step 1 Configure the Cisco IOS 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 dude@mauionions.com
snmp-server location 5300-NAS-Maui
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 7-3 describes commands in the previous configuration fragment.

Table 7-3 SNMP Commands

Command	Purpose
`snmp-server contact admin dude@mauionions.com`	Specifies a contact name to notify whenever a MIB problems occurs.
`snmp-server location 5300-NAS-Maui`	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.

Warning **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 much 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

```
5300-NAS#show snmp
Chassis: 11811596
Contact: admin dude@mauionions.com
Location: 5300-NAS-Maui
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.
5300-NAS#
```

Task 4. Disabling the Logging of Access Interfaces

Limit the amount of output that is 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
!
```

Task 5. Confirming the Final Running-Config

After completing the tasks in this section, the Cisco AS5300's final-running configuration looks like this:

```
5300-NAS#show running-config
Building configuration...

Current configuration:
!
! Last configuration change at 05:59:00 UTC Mon Nov 1 1999 by admin
! NVRAM config last updated at 05:59:02 UTC Mon Nov 1 1999 by admin
!
version 12.0
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
hostname 5300-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 $1$Ec9Q$KsERiSHdKGL/rGaewXeIz.
!
username admin password 7 045802150C2E
username dude password 7 070C285F4D06
spe 1/0 1/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
spe 2/0 2/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
!
resource-pool disable
!
ip subnet-zero
no ip source-route
ip host dirt 172.22.100.9
ip domain-name mauionions.com
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-5ess
mta receive maximum-recipients 0
!
controller T1 0
```

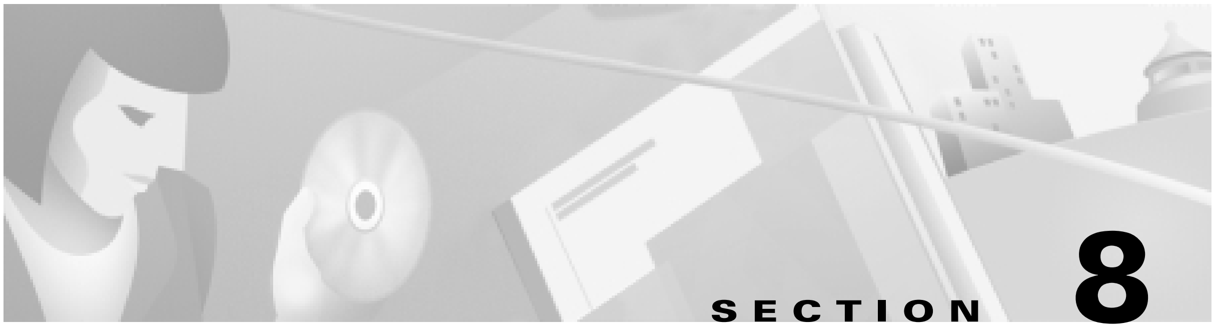
```
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 1
 framing esf
 clock source line secondary 1
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 3
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
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 Ethernet0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial0:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial1:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
```

```
!
interface Serial3:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface FastEthernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
interface Group-Async1
 ip unnumbered Ethernet0
 no ip directed-broadcast
 encapsulation ppp
 no logging event link-status
 async mode interactive
 no snmp trap link-status
 peer default ip address pool addr-pool
 no cdp enable
 ppp authentication pap chap
 group-range 1 96
!
ip local pool addr-pool 172.22.90.2 172.22.90.97
no ip http server
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
!
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 00000009020000107BE641BC
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 5300-NAS-Maui
snmp-server contact admin dude@mauionions.com
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 bgp
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
snmp-server enable traps syslog
snmp-server enable traps dlsw
snmp-server enable traps dial
snmp-server enable traps dsp card-status
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 1 96
 autoselect during-login
 autoselect ppp
 modem InOut
line aux 0
line vty 0 4
!
ntp clock-period 17179891
ntp update-calendar
ntp server 172.22.66.18 prefer
!
end
```

What to do Next

Inspect the final-running configuration as described in the section “Inspecting the Final Running Configuration for the Cisco AS5300 and AS5800.”



SECTION 8

Inspecting the Final Running Configuration for the Cisco AS5300 and AS5800

In this Section

This section provides the final running configuration files for the Cisco AS5300 and AS5800 used in this case study. These configuration files can be used as templates for configuring basic IP modem services.

To do this:

1. Copy the configuration file into a text editor.
2. Replace the command variables with your own network parameters.
3. Copy the modified configuration files into Flash memory.

Cisco AS5300 Configuration

Here is the final AS5300 running configuration. Cisco IOS Release 12.0(5)T is installed.

```
5300-NAS#show running-config
Building configuration...

Current configuration:
!
! Last configuration change at 05:59:00 UTC Mon Nov 1 1999 by admin
! NVRAM config last updated at 05:59:02 UTC Mon Nov 1 1999 by admin
!
version 12.0
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
hostname 5300-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 $1$Ec9Q$KsERiSHdKGL/rGaewXeIz.
!
```

```
username admin password 7 045802150C2E
username dude password 7 070C285F4D06
spe 1/0 1/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
spe 2/0 2/7
 firmware location bootflash:mica-modem-pw.2.7.1.0.bin
!
resource-pool disable
!
ip subnet-zero
no ip source-route
ip host dirt 172.22.100.9
ip domain-name mauionions.com
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-5ess
mta receive maximum-recipients 0
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 1
 framing esf
 clock source line secondary 1
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 3
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
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 Ethernet0
 ip address 172.22.66.23 255.255.255.0
 no ip directed-broadcast
!
interface Serial0:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial1:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial2:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface Serial3:23
 no ip address
 no ip directed-broadcast
 no logging event link-status
 no snmp trap link-status
 isdn switch-type primary-5ess
 isdn incoming-voice modem
 fair-queue 64 256 0
 no cdp enable
!
interface FastEthernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
interface Group-Async1
 ip unnumbered Ethernet0
 no ip directed-broadcast
 encapsulation ppp
 no logging event link-status
 async mode interactive
 no snmp trap link-status
 peer default ip address pool addr-pool
 no cdp enable
 ppp authentication pap chap
 group-range 1 96
!
ip local pool addr-pool 172.22.90.2 172.22.90.97
no ip http server
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.66.1
!
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 00000009020000107BE641BC
```

```
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 5300-NAS-Maui
snmp-server contact admin dude@mauionions.com
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 bgp
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
snmp-server enable traps syslog
snmp-server enable traps dlsw
snmp-server enable traps dial
snmp-server enable traps dsp card-status
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 1 96
 autoselect during-login
 autoselect ppp
 modem InOut
line aux 0
line vty 0 4
!
ntp clock-period 17179891
ntp update-calendar
ntp server 172.22.66.18 prefer
!
end
```

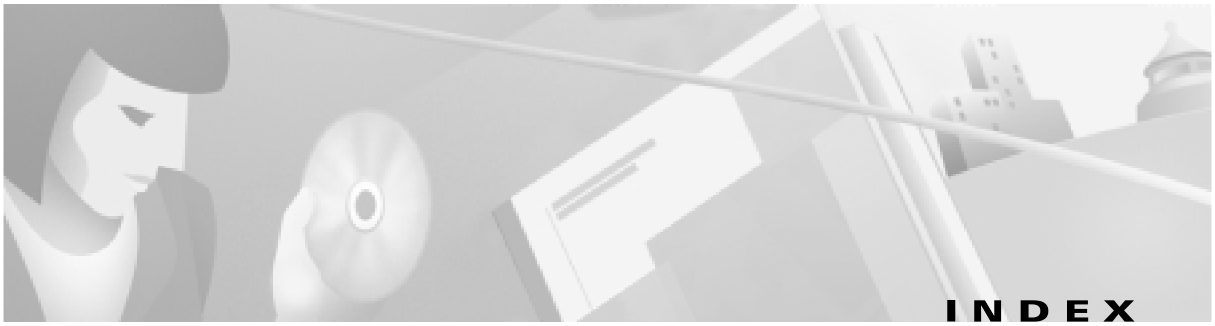
Cisco AS5800 Configuration

Here is the final AS5800 running configuration. Cisco IOS Release 12.0(4) XL1 is installed.

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

Current configuration:
!
version 12.0
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 dirt 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
```



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