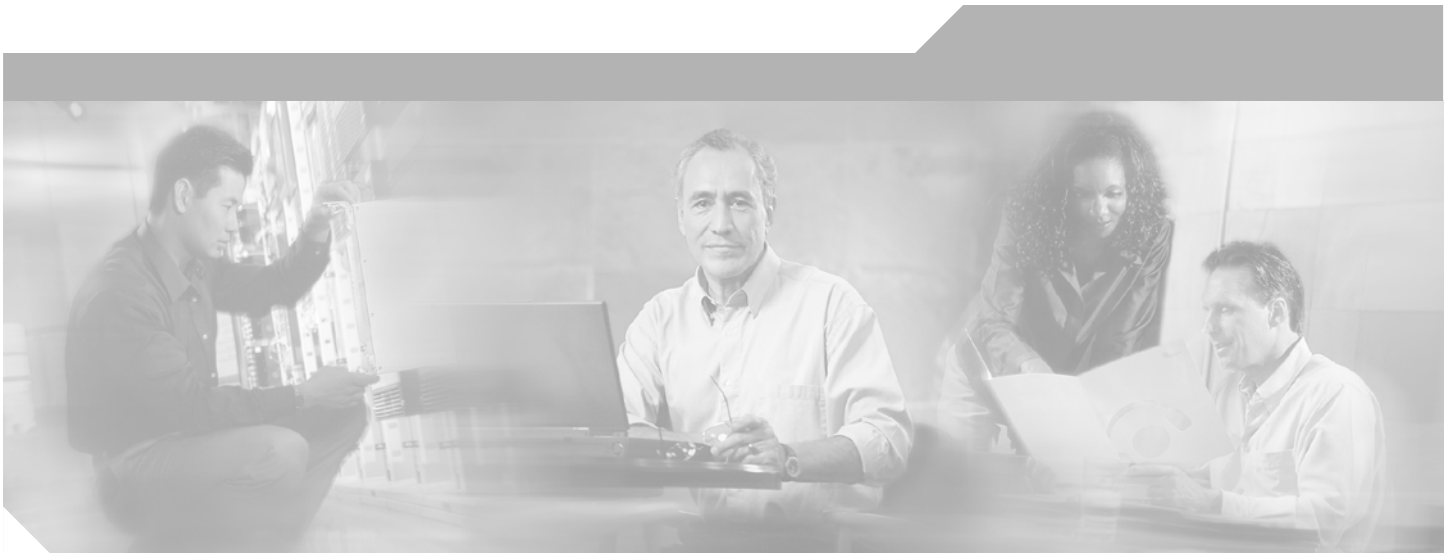

Configuration Guide for Cisco DSLAMs with NI-2

Cisco IOS Release 12.2(12)DA
December 2002

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Configuration Guide for Cisco DSLAMs with NI-2

CHAPTER 7 **Configuring NI-2 IP Services 7-1**

About This Guide

This preface tells you who should read this guide, the purpose of the guide, how the guide is organized, and the document conventions used.

Audience

This guide is written for anyone who installs or operates Cisco digital subscriber line access multiplexers (DSLAMs) with NI-2 controller cards. This includes the following chassis:

- Cisco 6015 DSLAM
- Cisco 6130 DSLAM
- Cisco 6160 DSLAM
- Cisco 6260 DSLAM

Purpose

The *Configuration Guide for Cisco DSLAMs with NI-2* describes protocols, configuration tasks, and Cisco IOS software functionality and contains comprehensive configuration examples. After completing the Cisco IOS configuration procedures covered in this guide, refer to the appropriate related documents. For additional information on related documentation, see "Related Documentation" later in this preface.

Organization

This guide is organized as follows:

- Chapter 1, "Cisco DSLAM User Interface," describes the DSLAM user interface and provides instructions for using the command-line interface. This chapter describes how to access and list the commands available in each command mode, and explains the primary uses for each command mode.
- Chapter 2, "Configuring Terminal Lines and Modem Support," explains how to configure lines, modems, and terminal settings to access the ATM switch for management purposes.
- Chapter 3, "Initially Configuring the Cisco DSLAM," describes the initial configuration of the Cisco DSLAM.

- Chapter 4, “Configuring Digital Subscriber Lines,” describes how to configure the DSLAM for digital subscriber line (DSL) service.
- Chapter 5, “Configuring In-Band Management,” describes how to configure in-band management for the DSLAM.
- Chapter 6, “Configuring MPLS VPN Mapping,” describes how to configure Cisco Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) mapping of RFC 1483 routed sessions.
- Chapter 7, “Configuring NI-2 IP Services,” describes how to configure Cisco NI-2 IP services.
- Chapter 8, “Configuring the Trunk and Subtended Interfaces,” describes configuring the trunk and subtended interfaces on the Cisco DSLAM NI-2 card.
- Chapter 9, “Loading System Software Images and Configuration Files,” describes how to load and maintain system software images and configuration files.
- Index

Other information necessary for ATM configuration tasks available on Cisco DSLAMs is contained in the *ATM Switch Router Software Configuration Guide.* Here are chapter locations for subjects treated in that guide:

- Chapter 4, “Configuring System Management Functions”
- Chapter 5, “Configuring ATM Network Interfaces”
- Chapter 6, “Configuring Virtual Connections”
- Chapter 7, “Configuring Operation, Administration, and Maintenance”
- Chapter 8, “Configuring Resource Management”
- Chapter 9, “Configuring ILMI”
- Chapter 10, “Configuring ATM Routing and PNNI”
- Chapter 11, “Using Access Control”
- Chapter 14, “Configuring ATM Accounting and ATM RMON”
- Chapter 16, “Configuring Signalling Features”

Conventions

This publication uses the document conventions described in this section.

Table 1 Font Conventions

Type Convention	Definition	Sample
Times bold	Used for any argument, command, keyword, or punctuation that is part of a command that you enter in text and command environments. Also used for names of some GUI elements.	This is similar to the UNIX **route** command.
Times italic	Used for publication names and for emphasis.	See the *Cisco 6100 Series User Guide* for further details.

Table 1 Font Conventions (continued)

Type Convention	Definition	Sample
`Courier`	Used for screen displays, prompts, and scripts.	`Are you ready to continue? [Y]`
`Courier bold`	Used to indicate what you enter in examples of command environments.	Login: **`root`** Password: **`<password>`**

Table 2 Command Syntax Conventions

Convention	Definition	Sample
Vertical bar (|)	Separates alternative, mutually exclusive elements.	**offset-list** {**in** | **out**} *offset*
Square brackets ([ ])	Indicate optional elements.	[**no**] **offset-list** {**in** | **out**} *offset*
Braces ({ })	Indicate a required choice.	**offset-list** {**in** | **out**} *offset*
Braces within square brackets ([{ }])	Indicate a required choice within an optional element.	[{*letter*|*number*}**Enter**]
Boldface	Indicates commands and keywords that you enter literally as shown.	[**no**] **offset-list** {**in** | **out**} *offset*
Italic	Indicates arguments for which you supply values. **Note** In contexts that do not allow italics, arguments are enclosed in angle brackets (< >).	**offset-list** {**in** | **out**} *offset*

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

Tip Means *the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information or information that might save time.

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

Warning **Means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, you must be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translated versions of the warning, refer to the *Regulatory Compliance and Safety* document that accompanied the device.**

Related Documentation

A complete list of DSL hardware documentation is available on the World Wide Web at this URL:

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

A complete list of all DSL IOS software documentation is available at this URL:

http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/ios_dsl/index.htm

In the ATM software product related documentation, look for information on the Cisco LightStream 1010 switch, which uses the same software base as the NI-2 DSL systems. The documentation is available at:

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

Obtaining Documentation

These sections explain how to obtain documentation from Cisco Systems.

World Wide Web

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

http://www.cisco.com

Translated documentation is available at the following URL:

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

Documentation CD-ROM

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

Ordering Documentation

You can order Cisco documentation in these ways:

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

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

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

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

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

Documentation Feedback

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

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You can submit your comments by mail to the following address:

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

We appreciate your comments.

Obtaining Technical Assistance

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

Cisco.com

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

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

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

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

http://www.cisco.com

Technical Assistance Center

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

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

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

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

Cisco TAC Web Site

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

http://www.cisco.com/tac

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

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

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

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

If you have Internet access, it is recommended that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

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

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

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

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

Cisco DSLAM User Interface

This chapter describes the Cisco DSLAM user interface, provides instructions for using the command-line interface, and describes how to use the help system. The chapter also describes the command editing and command history features that enable you to recall previous command entries and edit previously entered commands.

This chapter includes the following sections:

Understanding the User Interface

The Cisco DSLAM user interface provides access to several different command modes, each with related commands. For security, the user interface provides three levels of access to commands:

- User mode—Called user EXEC mode.
- Privileged mode—The privileged mode is called privileged EXEC mode and requires a password.

  Note Because all commands available in user EXEC mode are also available in privileged EXEC mode, user EXEC mode is referred to as EXEC mode in this guide.

  From the privileged EXEC mode, you can access global configuration mode and three specific configuration modes:

  - Terminal
  - Memory
  - Network configuration
- (ROM) monitor mode—This mode accesses a basic system kernel to which the Cisco DSLAM might default at startup if it does not find a valid system image, or if its configuration file is corrupted.

You can enter commands in uppercase, lowercase, or both. Only passwords are case sensitive. You can abbreviate commands and keywords to a unique number of characters. For example, you can abbreviate the **show** command as **sh**. After you enter the command line at the system prompt, press **Return** to execute the command.

Most configuration commands have a **no** form. In general, follow these guidelines:

- Use the **no** form of a command to disable a feature or function.
- Use the command without the **no** keyword to re-enable a disabled feature or to enable a feature disabled by default.

The context-sensitive help system allows you to obtain a list of commands available for each command mode or a list of available options for a specific command by entering a question mark (**?**).

Accessing Command Modes

This section describes how to access the Cisco DSLAM command modes. Table 1-1 lists the following information:

- The command mode names.
- The method to access that mode.
- The prompt you see while in that mode. (For the purpose of this guide, the prompts use the default node name DSLAM.)
- The method to exit that mode.

Note Table 1-1 does not include all of the possible ways to access or exit each command mode.

Table 1-1 Command Modes

Command Mode	Access Method	Prompt	Exit Method
EXEC (user)	Log in to the switch or Cisco DSLAM.	`DSLAM>`	Use the **logout** command.
Privileged EXEC	From user EXEC mode, use the **enable** command and enter your password.	`DSLAM#`	To return to user EXEC mode, use the **disable** command.
ROM monitor	From privileged EXEC mode, use the **reload** command. Press **Break** during the first 60 seconds while the system boots.	`rommon x>`	The x represents the number of commands that have been entered at the DSLAM prompt. To exit to ROM monitor mode, use the **cont** command.
Global configuration	From privileged EXEC mode, use the **configure** command. Use the keyword **terminal** to enter commands from your terminal.	`DSLAM(config)#`	To exit to privileged EXEC mode, use the **exit** or **end** command or press **Ctrl-Z**.

Table 1-1 Command Modes (continued)

Command Mode	Access Method	Prompt	Exit Method
Interface configuration	From global configuration mode, enter by specifying an interface with the **interface** command.	`DSLAM(config-if)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
Profile configuration	From global configuration mode, enter by specifying a profile with a **dsl-profile** command.	`DSLAM(cfg-dsl-profile)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
Line configuration	From global configuration mode, enter by specifying a management interface with a **line** command.	`DSLAM(config-line)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
ATM router configuration	From global configuration mode, configure the ATM router configuration with the **atm router pnni** command.	`DSLAM(config-atm-router)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
PNNI node configuration	From ATM router configuration mode, configure the PNNI routing node with the **node** command.	`DSLAM(config-pnni-node)#`	To exit to ATM router configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
Auto-sync configuration	From global configuration mode, configure redundancy synchronization features with the **auto-sync** command.	`DSLAM(config-auto-sync)`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
Redundancy configuration	From global configuration mode, configure additional redundancy options with the **redundancy** command.	`DSLAM(config-red)`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.

Table 1-1 Command Modes (continued)

Command Mode	Access Method	Prompt	Exit Method
VRF configuration	From global configuration mode, configure a VPN routing/forwarding (VRF) routing table with the **ip vrf** command.	`DSLAM(config-vrf)`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
DHCP pool configuration	From global configuration mode, configure the DHCP address pool name and enter DHCP pool configuration mode, with the **ip dhcp pool** command.	`DSLAM(dhcp-config)`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
ATM accounting file configuration	From global configuration mode, define an ATM accounting file with the **atm accounting file** command.	`DSLAM(config-acct-file)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
ATM accounting selection configuration	From global configuration mode, define an ATM accounting selection table entry with the **atm accounting selection** command.	`DSLAM(config-acct-sel)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.
ATM E.164 translation table configuration	From global configuration mode, enter the **atm e164 translation-table** command.	`DSLAM(config-atm-e164)`	To exit to privileged EXEC mode, use the **exit** command, the end command, or press **Ctrl-Z**.
ATM signaling diagnostics configuration	From global configuration mode, enter the command **atm signalling diagnostics** *index*.	`DSLAM(cfg-atmsig-diag)`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, use the **end** command or press **Ctrl-Z**.

Understanding Command Modes

This section describes the various command modes and their levels of user access, including:

User EXEC Mode

When you log in to the Cisco DSLAM, you are in user EXEC, or simply EXEC, command mode. The EXEC mode commands available at the user level are a subset of those available at the privileged level. The user EXEC mode commands allow you to connect to remote switches, change terminal settings on a temporary basis, perform basic tests, and list system information.

The user EXEC mode prompt consists of the DSLAM host name followed by the angle bracket (>):

```
Frodo>
```

or

```
DSLAM>
```

The default host name is DSLAM, unless it has been changed through use of the **host name** global configuration command.

Privileged EXEC Mode

The privileged EXEC mode command set includes all user EXEC mode commands and the **configure** command, through which you can access global configuration mode and the remaining configuration submodes. Privileged EXEC mode also includes high-level testing commands, such as **debug**, and commands that display potentially secure information.

To enter or exit privileged EXEC mode, follow these steps:

	Command	Task
Step 1	`DSLAM> enable` `Password:password`	Enter privileged EXEC mode from EXEC mode.[1]
Step 2	`DSLAM#`	Enter privileged EXEC commands.
Step 3	`DSLAM# disable` `DSLAM>`	Exit privileged EXEC mode and return to EXEC mode.[2]

1. The prompt changes to the DSLAM host name followed by the pound sign (#).
2. The prompt changes back to the DSLAM host name followed by the angle bracket (>).

The system administrator uses the **enable password** global configuration command to set the password, which is case sensitive. If an enable password was not set, you can access privileged EXEC mode only from the console.

ROM Monitor Mode

ROM monitor mode provides access to a basic system kernel, from which you can boot the Cisco DSLAM or perform diagnostic tests. The system can enter ROM mode automatically if the Cisco DSLAM does not find a valid system image, or if the configuration file is corrupted. The ROM monitor prompt is rommon x> without the DSLAM host name. The x represents the number of commands entered into the prompt.

You can also enter ROM monitor mode by interrupting the boot sequence with the **Break** key during loading.

To return to EXEC mode from ROM monitor mode, use the **cont** command:

```
rommon 1> cont
DSLAM>
```

Global Configuration Mode

Global configuration mode provides access to commands that apply to the entire system. From global configuration mode you can also enter the other configuration modes described in these sections.

	Command	Task

Step 1	`DSLAM# configure`
	or
	`DSLAM# configure terminal`
		Enter global configuration mode from privileged EXEC mode.

Step 2	`Configuring from terminal, memory, or network [terminal]? <CR>`	This prompt appears only if you use the first option in Step 1. Specify the source of the configuration commands at the prompt. You can specify the terminal, NVRAM, or a file stored on a network server as the source of configuration commands. The default is to enter commands from the terminal console.
Step 3	`DSLAM(config)#`	Enter configuration commands.[1]
Step 4	`DSLAM(config)# exit`	Exit global configuration mode and return to privileged EXEC mode.

1. The prompt changes to (config)#.

Interface Configuration Mode

Interface configuration mode provides access to commands that apply to an interface. Use these commands to modify the operation of an interface such as an ATM, Ethernet, or asynchronous port.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface interface-type interface-number`	Enter interface configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-if)# exit`	Exit interface configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-if)#.

Profile Configuration Mode

Profile configuration mode provides access to DSL profile commands. (See Chapter 4, “Configuring Digital Subscriber Lines”.)

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile profile-name`	Enter profile configuration mode and specify a profile.[1]
Step 3	`DSLAM(cfg-dsl-profile)# exit`	Exit profile mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (cfg-dsl-profile)#.

Line Configuration Mode

Line configuration mode provides access to commands used to configure lines on the DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# line line-index`	Enter line configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-line)# exit`	Exit profile mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-line)#.

ATM Router Configuration Mode

ATM router configuration mode provides access to commands used to configure Private Network-to-Network Interface (PNNI) routing.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm router pnni`	Enter ATM router configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-atm-router)# exit`	Exit ATM router configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-atm-router)#.

PNNI Node Configuration Mode

The PNNI node configuration mode is a submode of ATM router configuration mode and provides access to commands you use to configure PNNI nodes on the Cisco DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm router pnni`	Enter ATM router configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-atm-router)# node` *node-index*	Enter PNNI node configuration mode from ATM router configuration mode.[2]
Step 4	`DSLAM(config-pnni-node)# exit`	Exit PNNI node configuration mode and return to ATM router configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-atm-router)#.
2. The prompt changes to (config-pnni-node)#.

Auto-sync Configuration Mode

The auto-sync configuration mode is a submode for automatically synchronizing the configuration/flash between the Cisco primary and secondary redundant NI-2s.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# auto-sync`	Enter auto-sync configuration mode.[1]
Step 3	`DSLAM(config-auto-sync)#` *file*	Enter the configuration or flash file that you want to be automatically synchronized.
Step 4	`DSLAM(config-auto-sync)# exit`	Exit auto-sync configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to `(config-auto-sync)#`.

Redundancy Configuration Mode

The redundancy configuration mode provides access to commands used to configure redundancy on the DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# redundancy`	Enter redundancy configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-red)# exit`	Exit redundancy configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-red)#.

VRF Configuration Mode

The VPN routing/forwarding instance (VRF) configuration mode provides access to commands used to configure a VRF on the DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip vrf` *vrf-name*	Enter VRF configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-vrf)# exit`	Exit VRF configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-vrf)#.

DHCP Pool Configuration Mode

The DHCP configuration mode provides access to commands used to configure a DHCP server on the DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip dhcp pool` *name*	Enter DHCP pool configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-dhcp)# exit`	Exit DHCP configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-dhcp)#.

ATM Accounting File Configuration Mode

ATM accounting file configuration mode provides access to commands used to configure a file for accounting and billing of virtual circuits (VCs).

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm accounting file` *accounting-filename*	Enter ATM accounting file configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-acct-file)# exit`	Exit ATM accounting file configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-acct-file)#.

ATM Accounting Selection Configuration Mode

ATM accounting selection configuration mode provides access to commands used to specify the connection data to be gathered from the DSLAM.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm accounting selection` *accounting-selection-index*	Enter ATM accounting selection configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-acct-sel)# exit`	Exit ATM accounting selection configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-acct-sel)#.

ATM E.164 Translation Table Configuration Mode

ATM E.164 translation table configuration mode provides access to commands that you use to configure the translation table that maps native E.164 format addresses to ATM end system (AESA) format addresses.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm e164 translation-table`	Enter ATM E.164 translation table configuration mode from global configuration mode.[1]
Step 3	`DSLAM(config-atm-e164)# exit`	Exit ATM E.164 translation table configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

1. The prompt changes to (config-atm-e164)#.

ATM Signaling Diagnostics Configuration Mode

ATM signaling diagnostics configuration mode provides access to commands used to configure the signaling diagnostics table.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# atm signalling diagnostics`	Enter ATM signaling diagnostics configuration mode.
Step 3	`DSLAM(cfg-atmsig-diag)# exit`	Exit ATM signaling diagnostics configuration mode and return to global configuration mode. Enter **end** to return to privileged EXEC mode.

Using Context-Sensitive Help

The user interface provides context-sensitive help in all modes. This section describes how to configure and display context-sensitive help.

Configuring Help for Terminal Sessions

The following commands configure full help.

Command	Task
`DSLAM# terminal full-help`	In privileged EXEC mode, configure the current terminal session to receive help for the full set of user-level commands.
`DSLAM(config-line)# full-help`	In line configuration mode, configure a specific line to allow users without privileged access to obtain full help.

Displaying Context-Sensitive Help

To get help specific to a command mode, a command, a keyword, or an argument, perform one of these tasks:

Using Word Help

Command	Task
help	Obtain a brief description of the help system in any command mode.
abbreviated-command-entry?	Obtain a list of commands that begin with a particular character string.
abbreviated-command-entry<**Tab**>	Complete a partial command name.
?	List all commands available for a particular command mode.
command **?**	List the associated keywords of a command.
command keyword **?**	List the associated arguments of a keyword.

To view a list of commands that begin with a particular character sequence, type those characters followed immediately by the question mark (?). Do not include a space. This form of help is called word help, because it completes a word for you.

In this example, the system displays the possible commands in privileged EXEC mode that begin with “co.”

```
DSLAM# co?
configure  connect  copy
```

This form helps you determine the minimum subset that you can use to abbreviate a command.

Command Syntax Help

To list keywords or arguments, enter a question mark (**?**) in place of a keyword or argument. Include a space before the ?. This form of help is called command syntax help, because it reminds you which keywords or arguments are applicable based on the command, keywords, and arguments you have already entered.

This example demonstrates the use of command syntax help to complete the **access-list** command. Entering the question mark (**?**) displays the allowed arguments:

```
DSLAM(config)# access-list ?
  <1-99>     IP standard access list
  <100-199>  IP extended access list
```

Enter the access list number, **99**, followed by a question mark (**?**) to display the allowed keywords:

```
DSLAM(config)# access-list 99 ?
  deny    Specify packets to reject
  permit  Specify packets to forward
```

Enter the **deny** argument followed by a question mark (**?**) to display the next argument (host name or IP address) and two keywords:

```
DSLAM(config)# access-list 99 deny ?
  Hostname or A.B.C.D  Address to match
  any                  Any source host
  host                 A single host address
```

Enter the IP address followed by a question mark (**?**) to display a final (optional) argument. The <cr> indicates that you can press **Return** to execute the command:

```
DSLAM(config)# access-list 99 deny 131.108.134.0 ?
  A.B.C.D  Wildcard bits
  <cr>
DSLAM(config)# <cr>
```

The system adds an entry to access list 99 that denies access to all hosts on subnet 131.108.134.0.

Checking Command Syntax

The user interface provides an error indicator (^) that appears in the command string in which you have entered an incorrect or incomplete command, keyword, or argument.

This example shows a command entry that is correct up to the last element:

```
DSLAM# clock set 13:04:30 28 apr 98
                                  ^
% Invalid input detected at '^' marker.
```

The caret symbol (^) and help response indicate the location in which the error occurs. To list the correct syntax, re-enter the command, substituting a question mark (**?**) where the error occurred:

```
DSLAM# clock set 13:32:00 23 February ?
  <1993-2035> Year
DSLAM# clock set 13:32:00 23 February
```

Enter the year, using the correct syntax, and press **Enter** to execute the command:

```
DSLAM# clock set 13:32:00 23 February 1993
```

Using the Command History Features

The user interface provides a history or record of commands you enter. You can use the command history feature for recalling long or complex commands or entries, including access lists. With the command history feature, you can complete the tasks in the following sections:

- Setting the Command History Buffer Size, page 1-14
- Recalling Commands, page 1-14
- Disabling the Command History Feature, page 1-14

Setting the Command History Buffer Size

By default, the system records ten command lines in its history buffer. Use the following commands to set the number of command lines the system records:

Command	Task
DSLAM# **terminal history** [**size** *number-of-lines*]	In privileged EXEC mode, enable the command history feature for the current terminal session.
DSLAM(config-line)# **history** [**size** *number-of-lines*]	In line configuration mode, enable the command history feature for a specific line.

Recalling Commands

To recall commands from the history buffer, perform one of these tasks:

Key Sequence/Command	Task
Press **Ctrl-P** or the **Up Arrow** key.[1]	Recall commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Press **Ctrl-N** or the **Down Arrow** key.[1]	Return to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the **Up Arrow** key. Repeat the key sequence to recall successively more recent commands.
DSLAM> **show history**	While in EXEC mode, list the last several commands you have just entered.

1. The arrow keys function only on ANSI-compatible terminals such as VT100s.

Disabling the Command History Feature

The command history feature is automatically enabled. Use the following commands to disable it:

Command	Task
DSLAM> **terminal no history**	In EXEC mode, disable the command history feature for the current terminal session.
DSLAM(config-line)# **no history**	In line configuration mode, configure the line to disable the command history feature.

Using the Editing Features

The user interface includes an enhanced editing mode that provides a set of editing functions similar to those of the Emacs editor. Using the editing features, you can perform the tasks described in the following sections:

Enabling Enhanced Editing Mode

Although the current software release enables the enhanced editing mode by default, you can disable it and revert to the editing mode of previous software releases. Use the following commands to re-enable the enhanced editing mode:

Command	Task
`DSLAM> terminal editing`	In EXEC mode, enable the enhanced editing features for the current terminal session.
`DSLAM(config-line)# editing`	In line configuration mode, enable the enhanced editing features for a specific line.

Moving Around on the Command Line

Use these keystrokes to move the cursor around on the command line for corrections or changes:

Keystrokes	Task
Press **Ctrl-B** or press the **Left Arrow** key.[1]	Move the cursor back one character.
Press **Ctrl-F** or press the **Right Arrow** key.[1]	Move the cursor forward one character.
Press **Ctrl-A**.	Move the cursor to the beginning of the command line.
Press **Ctrl-E**.	Move the cursor to the end of the command line.
Press **Esc B**.	Move the cursor back one word.
Press **Esc F**.	Move the cursor forward one word.

1. The arrow keys function only on ANSI-compatible terminals such as VT100s.

Completing a Partial Command Name

If you cannot remember a complete command name, you can use **Tab** to allow the system to complete a partial entry:

Keystrokes	Task
Enter the first few letters and press **Tab**.	Complete a command name.

If your keyboard does not have **Tab**, press **Ctrl-I** instead.

In this example, when you enter the letters **conf** and press **Tab**, the system provides the complete command:

```
DSLAM# conf<Tab>
DSLAM# configure
```

If you enter an ambiguous set of characters, the system generates an error message. To display the list of legal commands beginning with the specified string, enter a question mark (**?**) after you see the error message. See the "Using Word Help" section on page 1-12.

Pasting in Buffer Entries

The system provides a buffer that contains the last ten items you deleted. You can recall these items and paste them in the command line by using these keystrokes:

Keystrokes	Task
Press **Ctrl-Y**.	Recall the most recent entry in the buffer.
Press **Esc Y**.	Recall the next buffer entry.

The buffer contains only the last ten items you have deleted or cut. If you press **Esc Y** more than 10 times, you cycle back to the first buffer entry.

Editing Command Lines that Wrap

The new editing command set provides a wraparound feature for commands that extend beyond a single line on the screen. When the cursor reaches the right margin, the command line shifts 10 spaces to the left. You cannot see the first 10 characters of the line, but you can scroll back and check the syntax at the beginning of the command. To scroll back, use these keystrokes:

Keystrokes	Task
Press **Ctrl-B** or the left arrow key[1] repeatedly.	Scroll back one character at a time to the beginning of a command line to verify that you entered a lengthy command correctly.
Press **Ctrl-A**.	Return directly to the beginning of the line.

1. The arrow keys function only on ANSI-compatible terminals such as VT100s.

In the following example, the **access-list** command entry extends beyond one line. When the cursor reaches the end of the line, the line is shifted ten spaces to the left and redisplayed. The dollar sign ($) indicates that the line has been scrolled to the left. Each time the cursor reaches the end of the line, the line is again shifted ten spaces to the left.

```
DSLAM(config)# access-list 101 permit tcp 131.108.2.5 255.255.255.0 131.108.1
DSLAM(config)# $ 101 permit tcp 131.108.2.5 255.255.255.0 131.108.1.20 255.25
DSLAM(config)# $t tcp 131.108.2.5 255.255.255.0 131.108.1.20 255.255.255.0 eq
DSLAM(config)# $108.2.5 255.255.255.0 131.108.1.20 255.255.255.0 eq 45
```

When you complete the entry, press **Ctrl-A** to check the complete syntax before pressing **Return** to execute the command. The dollar sign ($) appears at the end of the line to indicate that the line has scrolled to the right:

```
DSLAM(config)# access-list 101 permit tcp 131.108.2.5 255.255.255.0 131.108.1$
```

The Cisco DSLAM default is a terminal screen that is 80 columns wide. If you have a width other than that, use the **terminal width** command to provide the correct width.

Use line wrapping together with the command history feature to recall and modify previous complex command entries.

Deleting Entries

Use any of these keystrokes to delete command entries if you make a mistake or change your mind:

Keystrokes	Task
Press **Delete** or **Backspace**.	Erase the character to the left of the cursor.
Press **Ctrl-D**.	Delete the character at the cursor.
Press **Ctrl-K**.	Delete all characters from the cursor to the end of the command line.
Press **Ctrl-U** or **Ctrl-X**.	Delete all characters from the cursor to the beginning of the command line.
Press **Ctrl-W**.	Delete the word to the left of the cursor.
Press **Esc D**.	Delete from the cursor to the end of the word.

Scrolling Down a Line or a Screen

When you use the help facility to list the commands available in a particular mode, the list is often longer than the terminal screen can display. In such cases, a More prompt appears at the bottom of the screen. To respond to the More prompt, use these keystrokes:

Keystrokes	Task
Press **Return**.	Scroll down one line.
Press **Space**.	Scroll down one screen.
Press **Esc**.	Stop scrolling and return to the main prompt.

Redisplaying the Current Command Line

If you enter a command and a message appears on your screen, you can easily recall your current command line entry. To do so, use these keystrokes:

Keystrokes	Task
Press **Ctrl-L** or **Ctrl-R**.	Redisplay the current command line.

Transposing Mistyped Characters

If you have mistyped a command entry, you can transpose the mistyped characters by using these keystrokes:

Keystrokes	Task
Press **Ctrl-T**.	Transpose the character to the left of the cursor and the character located at the cursor.

Controlling Capitalization

You can capitalize or lowercase words or capitalize a set of letters with these keystrokes:

Keystrokes	Task
Press **Esc C**.	Capitalize at the cursor.
Press **Esc L**.	Change the word at the cursor to lowercase.
Press **Esc U**.	Capitalize letters from the cursor to the end of the word.

Designating a Keystroke as a Command Entry

To use a particular keystroke as an executable command, insert a system code:

Keystrokes	Task
Press **Ctrl-V** or **Esc Q**.	Insert a code to indicate to the system that the keystroke that follows should be treated as a command entry, *not* an editing key.

Disabling Enhanced Editing Mode

To disable enhanced editing mode and revert to the editing mode, use this command in privileged EXEC mode:

Command	Task
DSLAM# **terminal no editing**	Disable the enhanced editing features for the local line.

If you have prebuilt scripts that do not interact well when enhanced editing is enabled, you can disable enhanced editing mode. To re-enable enhanced editing mode, use the **terminal editing** command.

Ending a Session

After you use the **setup** command or another configuration command, exit the Cisco DSLAM and quit the session.

To end a session, use this EXEC command:

Command	Task
DSLAM> **quit**	End the session.

Configuring Terminal Lines and Modem Support

This chapter describes how to configure lines, modems, and terminal settings to access the ATM switch for management purposes. The Cisco DSLAM has two types of terminal lines:

- A console line
- An auxiliary line

Most line setup is the same for all types of lines, but certain commands, such as those having to do with modem control, apply only to the auxiliary port.

This chapter includes these sections:

Configuring Terminal Lines

Configuring terminal lines is a two-step process:

Step 1 Set up the lines for the terminals or other asynchronous devices attached to them.

Step 2 Configure the parameters for each line.

The tasks involved in these steps are described in the following sections:

Preparing to Configure Lines

Use line configuration mode to enter line configuration commands that affect a specified console, auxiliary, or virtual terminal line. To enter line configuration mode, use this command in global configuration mode:

Command	Task
DSLAM(config)# **line** [**aux** | **console** | **vty**] *line-number* [*ending-line-number*]	Specify an auxiliary, console, or virtual terminal line to configure.

The terminal from which you locally configure the system is attached to the console port.

Example

This example specifies the console port and begins line configuration mode:

```
DSLAM(config)# line con 0
DSLAM(config-line)#
```

The auxiliary port supports modem connections. See the "Setting Up Modem Control on the Auxiliary Port" section on page 2-4, to set up modem support on the auxiliary port.

Configuring the console port or virtual terminal lines allows you to specify communication parameters and automatic baud connections, and configure terminal operating parameters for the terminal you are using. These tasks are described in the "Defining Terminal Operation Characteristics" section on page 2-9.

You can also use the line command to create virtual terminal lines. This example shows how to create and configure the maximum 4 virtual terminal lines with the **no login** command:

```
DSLAM(config)# line vty 0 4
DSLAM(config-line)# no login
```

Setting Communication Parameters

You can change the default parameters for terminal communications to meet the requirements of the terminal or host to which you are attached. To do so, use one or more of these commands in line configuration mode:

Command	Task
speed *bps* **txspeed** *bps* **rxspeed** *bps*	Set the line speed. Choose from line speed, transmit speed, or receive speed. Speed applies to the auxiliary port only.
databits {**5** | **6** | **7** | **8**}	Set the data bits.
stopbits {**1** | **1.5** | **2**}	Set the stop bits.
parity {**none** | **even** | **odd** | **space** | **mark**}	Set the parity bit.

This example shows how to configure the auxiliary line with a speed of 19,200 bps:

```
DSLAM(config)# line aux 0
DSLAM(config-line)# speed 19200
```

Configuring Flow Control for Communication

On the auxiliary port, you can set both hardware and software flow control between the DSLAM and the devices attached to it.

To configure flow control between the DSLAM and attached device, use one or more of the commands in line configuration mode:

Command	Task
flowcontrol {**none** | **software** [**in** | **out**] | **hardware** [**in** | **out**]}	Set the terminal flow control.
start *ascii-number*	Set the flow control start character.
stop-character *ascii-number*	Set the flow control stop character.

Allowable values for the **start** and **stop-character** commands are CHAR or 0 through 255.

Both software and hardware flow control are bidirectional. If you do not specify a direction, the DSLAM enables software flow control in both directions. For information about setting up hardware flow control on the EIA/TIA-232 line, see the hardware installation and maintenance manual for your product.

Specifying the Transport Protocol for a Specific Line

You can specify the protocols for individual lines by setting the protocol for incoming and outgoing connections and changing the default (preferred) protocol for a line. The default transport protocol is Telnet.

To specify transport protocols, use one or more of these commands in line configuration mode:

Command	Task
transport input {**all** | **telnet** | **none**}	Define which protocols can connect to a specific line of the DSLAM.
transport output {**all** | **telnet** | **none**}	Determine the protocols for outgoing connections from a line.
transport preferred {**all** | **telnet** | **none**}	Specify the protocol to use if the user did not specify one.
transport preferred none	Prevent errant connection attempts.

The system accepts a host name entry at the EXEC system prompt as a Telnet command. If you incorrectly type the host name, the system interprets the entry as an incorrect Telnet command and displays an error message indicating that the host does not exist. The **transport preferred none** command disables this option if you incorrectly type a command at the EXEC prompt, and the system does not attempt to make a Telnet connection.

Establishing Terminal Session Limits

You can set a time limit on a terminal session. To limit terminal sessions, use the following command in line configuration mode:

Command	Task
`session-timeout` *minutes* `[output]`	Set the idle session timeout interval.

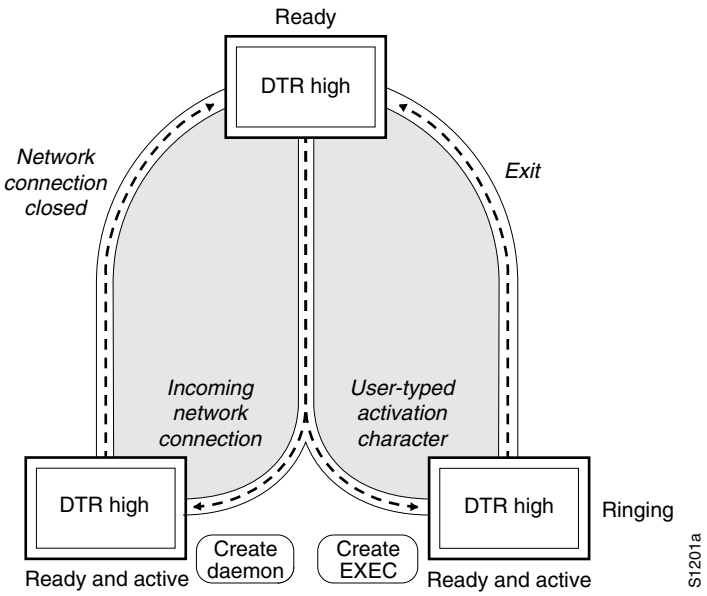
Setting Up Modem Control on the Auxiliary Port

This section describes modem control and how to configure it on the modem port:

Modem Control Process

Figure 2-1 illustrates how modem control works on the DSLAM auxiliary port.

Figure 2-1 EXEC and Daemon Creation on a Line with No Modem Control



The figure shows two processes:

- The create daemon process, used to create a TTY daemon that handles the incoming network connection
- The create EXEC process, used to create the process that interprets user commands

In the figure, the current signal state and the signal line are listed inside each box. The state of the line is listed next to the box. (You can display the current state of a line with the **show line** command.) Events that change that state appear in italics along the event path, with the software actions described within the ovals.

Figure 2-1 illustrates line behavior when no modem control is set. The data terminal ready (DTR) output is always high, and CTS and RING are ignored. The DSLAM creates an EXEC when the you type an activation character. Incoming TCP connections occur instantly if the line is not in use and can be closed only by the remote host.

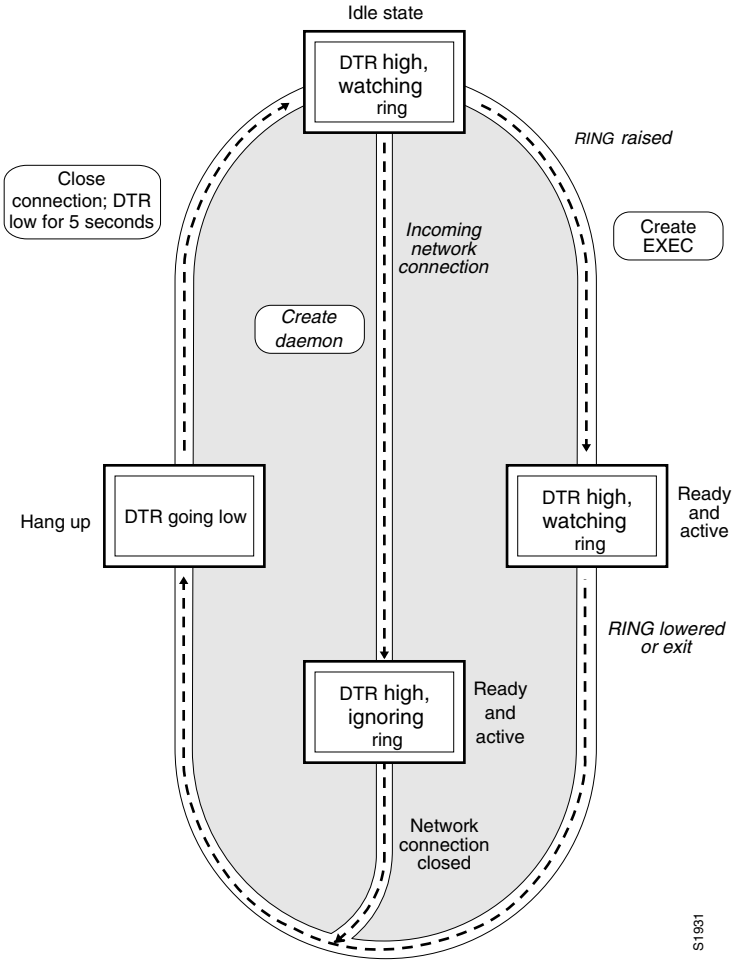
Supporting Dial-In and Dial-Out Modems

To configure a line for both incoming and outgoing calls, use this command in line configuration mode:

Command	Task
`DSLAM (config-line)# modem inout`	Configure a line for both incoming and outgoing calls.

Figure 2-2 illustrates the modem in-out process.

Figure 2-2 EXEC and Daemon Creation on a Line Configured for Incoming and Outgoing Calls



If the line is activated by:

- Raising RING, it behaves exactly as a line configured with the **modem dialin** subcommand.
- An incoming TCP connection, the line behaves similarly to a nonmodem line.

Note If your system uses dial-out modems, consider using access lists to prevent unauthorized use.

Configuring a Line Timeout Interval

You can change the interval that the DSLAM waits for CTS after raising DTR in response to RING from the default of 15 seconds. To do so, use this command in line configuration mode:

Command	Task
`modem answer-timeout` *seconds*	Configure modem line timing.

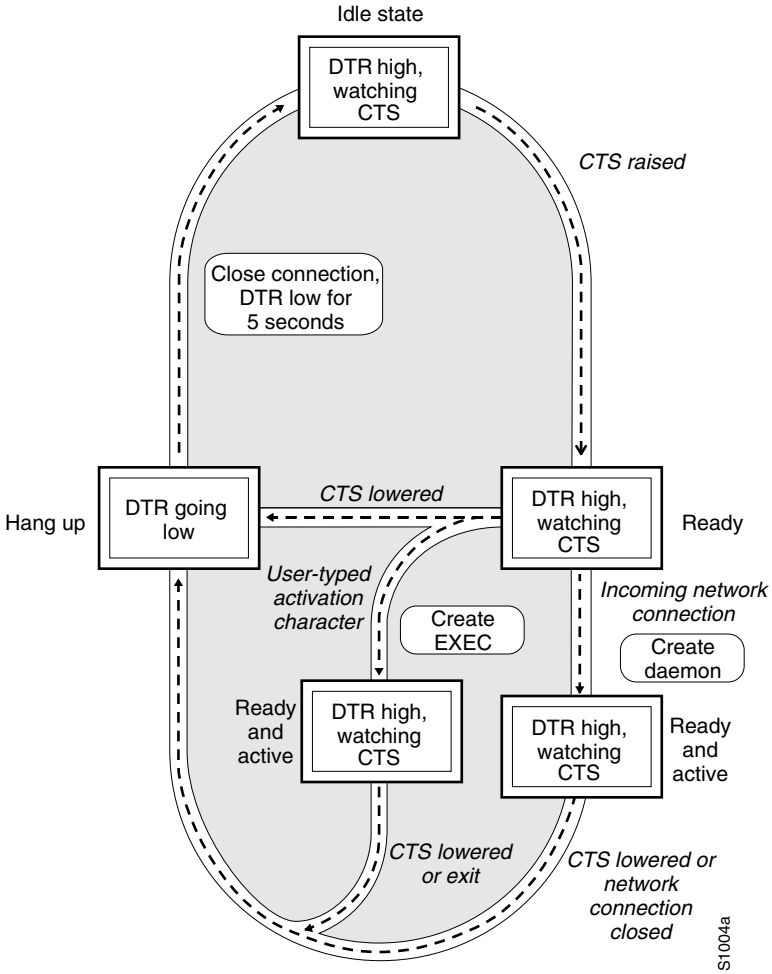
Closing Modem Connections

You can configure a line to close all connections from a user terminal when the terminal is turned off, and prevent inbound connections to devices that are out of service. To do so, use this command in line configuration mode:

Command	Task
`modem printer`	Configure a line to close all connections.

Figure 2-3 illustrates the modem printer process requirement for a high CTS throughout the use of the line.

Figure 2-3 EXEC and Daemon Creation on a Line Configured for Continuous CTS



If CTS is not high, your typed input is ignored and incoming connections are refused (or stepped to the next line in a rotary group).

A DSLAM can reliably detect a CTS signal change if the signal remains in the new state for at least one full second.

Configuring Rotary Groups

You can make connections to the next free line in a group of lines, also called a rotary or hunt group. A line can be in only one rotary group. A rotary group can consist of a single line or several contiguous lines. The console line (line 0) cannot be in a rotary group.

If you want to assign the rotary as the single auxiliary port line you can do so because the auxiliary port is not necessarily the same line number on all hardware. When you assign the line to a rotary group, you do not have to track the actual line number. Another reason to use a rotary group is that if the device supports local area transport (LAT), an inbound service can only be bound to a rotary group. It cannot be bound to a port number.

To configure a rotary group, use this command in line configuration mode:

Command	Task
rotary *group*	Add a line to the specified rotary group.

Configuring High-Speed Modem Support

Modems that operate over normal dial-up telephone lines at speeds of 9600 bps and higher do not guarantee a specific throughput; instead, they operate at a speed that depends on the quality of the line, the effectiveness of data compression algorithms on the data being transmitted, and other variables. These modems use hardware flow control to stop the data from reaching the host by toggling an EIA/TIA-232 signal when they cannot accept any more data.

In addition to hardware flow control, dial-up modems require special software handling. You must configure the modems to:

- Create an EXEC when you dial in.
- Hang up when you exit the EXEC.
- Close any existing network connections if the telephone line hangs up in the middle of a session.

The DSLAM supports hardware flow control on its CTS input, which is also used by the normal modem handshake. To configure and use a high-speed modem, perform these tasks, beginning in line configuration mode:

	Command	Task
Step 1	`DSLAM(config-line)# flowcontrol hardware`	In line configuration mode, enable outgoing hardware flow control based on the CTS input.
Step 2	`DSLAM(config-line)# end`	Enter privileged EXEC command mode.
Step 3	`DSLAM# debug modem`	Display informational messages on the console terminal about modem control events, such as signal transitions and automatic baud progress.
Step 4	`DSLAM# show line`	Display the status of a line. In the detailed command output, a Status line of Idle identifies inactive modem dial-in lines and all other modem lines; a Status line of Ready identifies lines in use.

Supporting Reverse TCP Connections

The DSLAM can receive incoming connections on the auxiliary port. This capability allows you to attach serial printers, modems, and other shared peripherals to the DSLAM and drive them remotely from other systems. The DSLAM supports reverse TCP connections.

Front-Ending

The specific TCP port or socket to which you attach the peripheral device determines the type of service the DSLAM provides on that line. When you attach the serial lines of a computer system or a data terminal switch to the auxiliary port of the DSLAM, the DSLAM acts as a network front end for a host that does not support the TCP/IP protocols. This arrangement is sometimes called front-ending or reverse connection mode.

To connect the auxiliary port, the remote host or terminal must specify a particular TCP port on the DSLAM. If Telnet protocols are required, that port is 2000 (decimal) plus the decimal value of the line number.

TCP Streams

If a raw TCP stream is required, the port is 4000 (decimal) plus the decimal line number. The raw TCP stream is usually the required mode for sending data to a printer.

The Telnet protocol requires that carriage return characters be translated into carriage return and line feed character pairs. You can turn this translation off by specifying the Telnet binary mode option. To specify this option, connect to port 6000 (decimal) plus the decimal line number.

Defining Terminal Operation Characteristics

In line configuration mode, you can set terminal operation characteristics for that line until you change the line parameters.

You can temporarily change the line settings using the **terminal** EXEC commands described in Chapter 1, “Cisco DSLAM User Interface.”

Define the terminal operation characteristics by performing the tasks in the following sections:

Specifying the Terminal Type

You can specify the type of terminal connected to a line. This feature has two benefits: it records the type of terminal attached to a line, and it can inform the remote host of the terminal type for display management. To specify the terminal type, use this command in line configuration mode:

Command	Task
terminal-type *terminal-name*	Specify the terminal type.

Setting the Terminal Screen Length and Width

By default, the DSLAM provides a screen display of 24 lines by 80 characters. You can reconfigure these values if they do not meet the needs of your terminal by performing the following tasks in line configuration mode:

	Command	Task
Step 1	`length` *screen-length*	Set the screen length.
Step 2	`width` *characters*	Set the screen width.

The values set can be learned by some host systems that use this type of information in terminal negotiation. Set a value of 0 for the screen length to disable pausing between windows of output.

Defining the Escape Character

You can define or modify the system escape function with the **escape-character** command in line configuration mode:

Command	Task
escape-character *ascii-number*	Change the system escape sequence. The escape sequence indicates that the codes that follow have special meaning. The default sequence is Ctrl-^.

Note If you are using the **autoselect** command, do not change the activation character from the default value of Return. If you change this default, **autoselect** may not function immediately.

Specifying the International Character Display

You can use a 7-bit character set (such as ASCII) or you can enable a full 8-bit international character set (such as ISO 8859) to allow special graphical and international characters for use in banners and prompts, and to add special characters such as software flow control. You can configure these settings globally by interface or locally at the user level. Use these criteria for determining the configuration mode to use when setting up this feature:

- If a large number of connected terminals support nondefault ASCII bit settings, use the global configuration commands.
- If only a few of the connected terminals support nondefault ASCII bit settings, use line configuration commands or the EXEC local terminal setting commands.

Note Setting the EXEC character width to 8 bits can cause failures. If you enter the help command on a terminal that is sending parity, an unrecognized command message appears because the system is reading all 8 bits, although the eighth bit is not needed for the **help** command.

To specify a character set on a global basis, use one or both of these commands in global configuration mode:

Command	Task
default-value exec-character-bits {**7** | **8**}	Specify the character set used in EXEC and configuration command characters.
default-value special-character-bits {**7** | **8**}	Specify the character set used in special characters such as software flow control, hold, escape, and disconnect characters.

To specify a character set based on hardware or software, or on a per-line basis, use the appropriate command in line configuration mode:

Command	Task
databits {**5** | **6** | **7** | **8**}	Set the number of databits per character that are generated and interpreted by hardware.
data-character-bits {**7** | **8**}	Set the number of databits per character that are generated and interpreted by software.

Command	Task
exec-character-bits {**7** | **8**}	Specify the character set used in EXEC and configuration command characters on a per-line basis.
special-character-bits {**7** | **8**}	Specify the character set used in special characters such as software flow control, hold, escape, and disconnect characters on a per-line basis.

Note If you are using the **autoselect** function, set the activation character default to Return, and **exec-character-bits** default to 7. If you change these defaults, the application does not recognize the activation request.

Setting Character Padding

You can change the character padding on a specific output character. Character padding adds a number of null bytes to the end of the string and can make a string conform to an expected length. To set character padding, use this command in line configuration mode:

Command	Task
padding *ascii-number count*	Set padding count, on a specific output character, ascii-number, for the specified line.

Disabling Enhanced Editing Mode

To disable enhanced editing mode and revert to the editing mode of earlier software releases, use this command in line configuration mode:

Command	Task
no editing	Disable the enhanced editing features for a particular line.

You can disable enhanced editing if you have prebuilt scripts that do not interact well when enhanced editing is enabled. You can re-enable enhanced editing mode using the **editing** command.

Providing Line Connection Information after the Login Prompt

You can provide the host name, line number, and location each time an EXEC is started or an incoming connection is made. The line number banner appears immediately after the EXEC banner or incoming banner. It is useful for tracking problems with modems because it lists the host and line for the modem connection. Modem information is also included if applicable.

To provide service line number information, use this command in global configuration mode:

Command	Task
service *linenumber*	Provide service line number information after the EXEC or incoming banner.

Enabling Password Checking at Login

You can enable password checking on a particular line so that the user is prompted to enter a password at the system login screen. You must then also specify a password. To do so, perform these tasks in line configuration mode:

	Command	Task
Step 1	`login`	Enable password checking on a per-line basis using the password specified with the **password** command.
Step 2	`password` *password*	Assign a password to a particular line.

You can enable password checking on a per-user basis so that authentication is based on the user name specified with the **username** global configuration command. To enable this type of password checking, use one of these commands in line configuration mode:

Command	Task
login local	Enable password checking on a per-user basis using the user name and password specified with the **username** global configuration command.
login tacacs	Select the TACACS-style user ID and password-checking mechanism.

Use the **login tacacs** command with Terminal Access Controller Access Control System (TACACS) and extended TACACS Plus.

By default, virtual terminals require passwords. If you do not set a password for a virtual terminal, it responds to attempted connections by displaying an error message and closing the connection. Use the **no login** command to disable this behavior and allow connections without a password.

Checking Password Examples

This example shows password checking enabled for a virtual terminal line 1:

```
DSLAM(config)# line vty 1
DSLAM(config-line)# login
DSLAM(config-line)# password letmein
```

This example shows password checking enabled on a per-user basis:

```
DSLAM(config)# username jksmith password 0 letmein
DSLAM(config)# username lmjones password 0 littlerock
DSLAM(config)# line vty 1
DSLAM(config-line)# login local
```

Configuring Terminal Banner Messages

The following sections explain how to configure terminal messages:

Configuring a Message-of-the-Day Banner

You can configure a message-of-the-day (MOTD) banner to display on all connected terminals. This message is displayed at login and is useful for sending messages that affect all network users, such as impending system shutdowns. To do so, use this command in global configuration mode:

Command	Task
banner motd *c message c*	Configure a message-of-the-day banner.

Configuring a Line Activation Message

You can configure a line activation message to display when an EXEC process such as line activation or an incoming connection to a virtual terminal is created. To do so, use this command in global configuration mode:

Command	Task
banner exec *c message c*	Configure a message to be displayed on terminals with an interactive EXEC.

Configuring an Incoming Message Banner

You can configure a message to display on terminals connected to reverse Telnet lines. This message is useful for providing instructions to users of these types of connections. Reverse Telnet connections are described in more detail in the "Supporting Reverse TCP Connections" section on page 2-9.

To configure the message that will be sent on incoming connections, use this command in global configuration mode:

Command	Task
banner incoming *c message c*	Configure messages to display on terminals connected to reverse Telnet lines.

Configuring an Idle Terminal Message

You can configure messages to display on a console or terminal that is not in use. Also called a *vacant message*, this message is different from the banner message displayed when an EXEC process is activated. To configure an idle terminal message, use this command in line configuration mode:

Command	Task
vacant-message *c message c*	Display an idle terminal message.

Enabling or Disabling the Display of Messages

You can control display of the MOTD and line activation banners. By default, these banners display on all lines. To suppress or resume these messages, use one of these commands in line configuration mode:

Command	Task
no exec-banner	Suppress banner display.
exec-banner	Resume the display of the EXEC or MOTD banners.

Banner Message Example

This example shows how to use the **banner** global configuration command and **no exec-banner** line configuration command to notify your users that the server will be reloaded with new software:

```
DSLAM(config)# banner exec /
Enter TEXT message.  End with the character '/'.

Unauthorized access prohibited./
DSLAM(config)# banner incoming /
You are connected to a Hayes-compatible modem.

Enter the appropriate AT commands.
Remember to reset anything to change before disconnecting.
/
DSLAM(config)# banner motd /
The switch will go down at 6pm for a software upgrade.
/
DSLAM(config)# line vty 0 4
DSLAM(config-line)# no exec-banner
DSLAM(config-line)#
```

CHAPTER 3

Initially Configuring the Cisco DSLAM

This chapter describes how to initially configure the Cisco DSLAMs, and includes these sections:

Methods for Configuring the DSLAM

The Cisco DSLAM default configuration is suitable for operation with most networks. By using network management applications and the text-based command-line interface (CLI), you can configure and customize all aspects of DSLAM operation to suit your needs.

The Cisco DSLAM ships with the ATM address autoconfigured, allowing the DSLAM to accomplish the following tasks:

- Automatically configure attached end systems using the Interim Local Management Interface (ILMI) protocol.
- Establish itself as a node in a single-level Private Network to Network Interface (PNNI) routing domain.

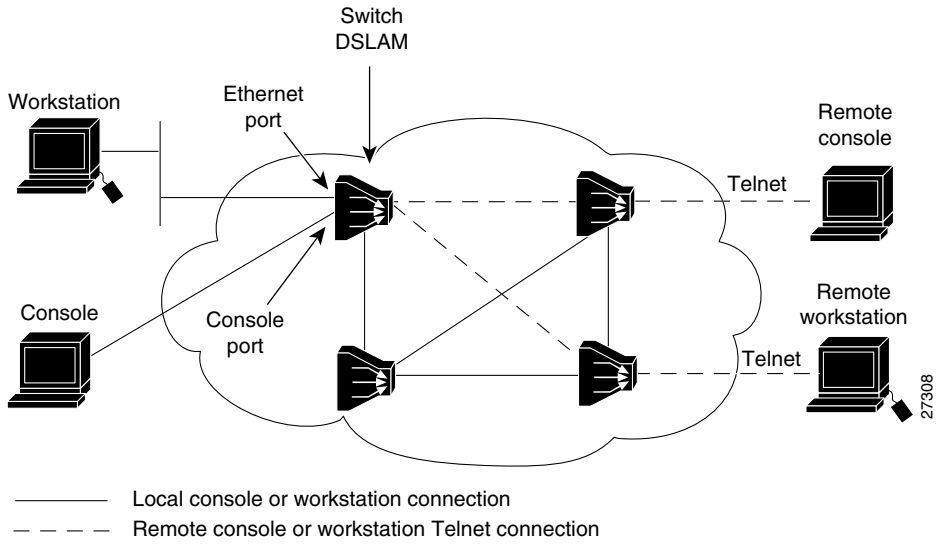
The ILMI and PNNI protocols allow the DSLAM to be entirely self-configured when you use these protocols with an IP address autoconfiguration mechanism such as BOOTP.

You must assign an IP address to allow up to eight simultaneous Telnet sessions to connect to the DSLAM or to use the Simple Network Management Protocol (SNMP) system for the DSLAM. The Ethernet IP address is assigned either manually or by a BOOTP server. See the "Configuring IP Interface Parameters" section on page 3-11.

You can use either of two methods for configuring a DSLAM (see Figure 3-1):

- From a local console or workstation—Connect to the console port or connect to the Ethernet port of a DSLAM. This connection allows you to issue CLI commands directly to the DSLAM chassis.
- From a remote console or workstation—Initiate a Telnet connection to a target DSLAM. Telnet allows you to remotely issue CLI commands to that chassis.

Figure 3-1 Two Methods of Configuring a DSLAM



Port and Slot Configuration

The DSLAM contains an NI-2 card and up to 32 line (modem) cards depending on the DSLAM. The slot configurations on the different DSLAMs are as follows:

- Cisco 6015 DSLAM
  - Six line card slots
  - One NI-2 card slot
- Cisco 6100 DSLAM
  - 32 line card slots
  - Two NI-2 card slots (only one slot active)

- Cisco 6130 DSLAM
  - 32 line card slots
  - Two NI-2 card slots (to provide redundancy)
- Cisco 6160 DSLAM
  - 32 line card slots
  - Two NI-2 card slots (to provide redundancy)
- Cisco 6260 DSLAM
  - 30 line card slots
  - Two NI-2 card slots (to provide redundancy)

Table 3-1 lists the NI-2 cards that can be installed in each of the DSLAM chassis, as well as the associated product numbers.

Table 3-1 NI-2 Card and Chassis Compatibility

NI-2 Card	Product Number	Cisco 6015	Cisco 6100/6130	Cisco 6160	Cisco 6260
DS3+T1/E1 IMA[1]	NI-2-DS3-T1E1=	Yes	No	Yes[2]	Yes[3]
DS3/2DS3	NI-2-DS3-DS3=	No	Yes	Yes	Yes[4] [5]
OC-3c/OC-3c SMF[6]	NI-2-155SM-155SM=	Yes	Yes	Yes	Yes[7]
OC-3c/OC-3c MMF[8]	NI-2-155MM-155MM=	Yes	Yes	Yes	Yes[7]
OC-3c/2DS3 SMF	NI-2-155SM-DS3=	No	No	Yes	No
OC-3c/2DS3 MMF	NI-2-155MM-DS3=	No	No	Yes	No

1. IMA = inverse multiplexing over ATM.
2. In a Cisco 6160 system, use only with the DS3/2DS3+8xT1 IMA I/O card (part number 6160-1-I/O-2=).
3. In a Cisco 6260 system, use only with the E1 I/O module.
4. When the DS3/2DS3 NI-2 card and the E3 I/O module are installed in the Cisco 6260 chassis, the system assumes E3 functionality.
5. In a Cisco 6260 system, use only with the E3 I/O module.
6. SMF = single-mode fiber.
7. In a Cisco 6260 system, use only with the OC-3c I/O module.
8. MMF = multimode fiber.

Line cards are assigned ports 1 to 4 or 1 to 8 in consecutive slots. Table 3-2 lists NI-2 port assignments. See the Hardware Installation Guide for your specific DSLAM system for more detailed information about possible subtending topologies.

Table 3-2 NI-2 Port Assignments

Port Type	OC3xOC3	OC3x2DS3	DS3x2DS3	DS3xE1/T1	Function
Switch, Ethernet	eth 0/0	eth 0/0	eth 0/0	eth 0/0	The ATM switch or Ethernet CPU port (internal).
Trunk	atm 0/1	atm 0/1	atm 0/1	atm 0/1[1]	The trunk port connects to the network, either directly or through a subtended port in another DSLAM.

Table 3-2 NI-2 Port Assignments (continued)

Port Type	OC3xOC3	OC3x2DS3	DS3x2DS3	DS3xE1/T1	Function
Subtend 1	atm 0/2	atm 0/2	atm 0/2	—	A subtended port connects a second DSLAM to the network through a primary DSLAM. See the Hardware Installation Guide for your specific DSLAM.
Subtend 2	—	atm 0/3	atm 0/3	—	The DS3 configuration has a second subtended port.
T1/E1 1-8	—	—	—	atm 0/2 through atm 0/9	The DS3+T1/E1 IMA NI-2 card allows you to configure any WAN interface (the DS3, any T1 link, any E1 link, or any IMA group) as the trunk.
IMA Groups	—	—	—	atm0/ima0 through atm0/ima3	The eight links on the DS3+T1/E1 IMA NI-2 can be independent ATM links or can be configured into one or more IMA groups.

1. E1 does not have an atm 0/1 trunk.

Configuration Prerequisites

Obtain this information before you configure your DSLAM:

- To configure a BOOTP server to inform the DSLAM of its Ethernet IP address and mask, you need the Media Access Control (MAC) address of the Ethernet port.
- To configure a new ATM address for the DSLAM (an autoconfigured ATM address is assigned by Cisco), you need an ATM address assigned by your system administrator.
- If you are not using BOOTP, obtain an IP address and a subnet mask.

Verifying Installed DSLAM Software and Hardware

When you first power on your console and DSLAM, a screen similar to the following example appears:

```
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
```

The script then displays the banner information, including the software version, followed by the installed hardware configuration.

```
cisco 6015 (NI2) processor with 60416K/5120K bytes of memory.
RC64475 CPU at 100Mhz, Implementation XX, Rev X.X
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
14 ATM network interface(s)
```

```
522232 bytes of non-volatile configuration memory.

4096K bytes of Boot Flash (Sector size 128K).
16384K bytes of Flash internal SIMM (Sector size 256K).
```

Configuring the BOOTP Server

BOOTP automatically assigns an Ethernet IP address by adding the MAC and IP addresses of the Ethernet port to the BOOTP server configuration file. When the DSLAM boots, it automatically retrieves the IP address from the BOOTP server.

The DSLAM performs a BOOTP request only if the current IP address is set to 0.0.0.0. (This is the default for a new DSLAM or a DSLAM that has had its configuration file cleared using the **erase startup-config** command.)

To allow the DSLAM to retrieve its IP address from a BOOTP server you must first determine the MAC address of the DSLAM and then add that MAC address to the BOOTP configuration file on the BOOTP server.

Complete the following tasks to create a BOOTP server configuration file:

Step 1 Install the BOOTP server code on the workstation, if it is not already installed.

Step 2 Determine the MAC address from the label on the chassis.

Step 3 Add an entry in the BOOTP configuration file (usually */usr/etc/bootptab*) for each DSLAM. Press **Enter** after each entry to create a blank line between each entry. See the sample BOOTP configuration file that follows this step list.

Step 4 Restart the DSLAM to automatically request the IP address from the BOOTP server.

Example

This example of a BOOTP configuration file shows the newly added DSLAM entry:

```
# /etc/bootptab: database for bootp server (/etc/bootpd)
#
# Blank lines and lines beginning with '#' are ignored.
#
# Legend:
#
#       first field -- hostname
#                       (may be full domain name)
#
#       hd -- home directory
#       bf -- bootfile
#       cs -- cookie servers
#       ds -- domain name servers
#       gw -- gateways
#       ha -- hardware address
#       ht -- hardware type
#       im -- impress servers
#       ip -- host IP address
#       lg -- log servers
#       lp -- LPR servers
#       ns -- IEN-116 name servers
#       rl -- resource location protocol servers
#       sm -- subnet mask
#       tc -- template host (points to similar host entry)
```

```
#       to -- time offset (seconds)
#       ts -- time servers

<display truncated>

#########################################################################
# Start of individual host entries
#########################################################################
Switch:         tc=netcisco0:   ha=0000.0ca7.ce00:      ip=192.31.7.97:
dross:          tc=netcisco0:   ha=00000c000139:        ip=192.31.7.26:

<information deleted>
```

Setting the Subtend Node Identifier

In a subtended network configuration, the head node acts as the host node connecting all the nodes to the network. The head node at the top of the subtend tree—that is, the node that is connected to the trunk—must have the subtend ID 0. (Subtend ID 0 is the default.)

You identify the node to the network with the **subtend-id** command. You must assign a unique subtend ID to each node in a subtend tree so that all subtended nodes have fair access to the trunk port of the head node.

To set the subtend node identifier, use the following command:

Command	Task
`DSLAM(config)# subtend-id` *node#*	Identify node# as the subtend host node.

Example

In this example, the DSL subtend node identifier is set to node 12:

```
DSLAM# configure terminal
DSLAM(config)# subtend-id 12
```

Configuring the ATM Address

The DSLAM is autoconfigured with an ATM address that uses a hierarchical addressing model similar to the OSI Network Service Access Point (NSAP) addresses. PNNI uses this hierarchy to construct ATM peer groups. ILMI uses the first 13 bytes of this address as the switch prefix that it registers with end systems.

Note If you manually change an ATM address, you must maintain the uniqueness of the address across the network.

Configuring ATM Addressing

This section describes the ATM addressing scheme and tells you how to accomplish the following tasks:

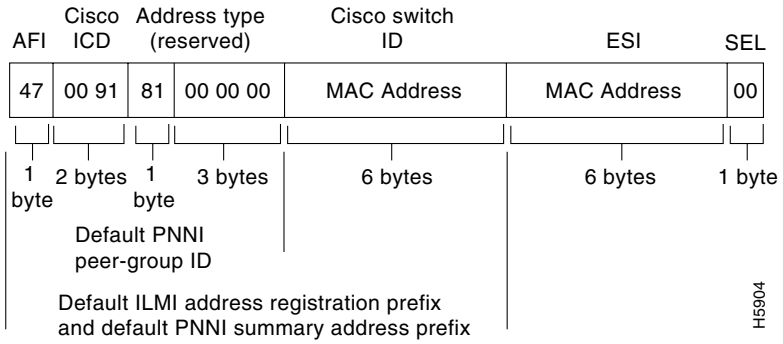
- Using the ATM Default Addressing Scheme, page 3-7
- Manually Setting the ATM Address, page 3-8

Using the ATM Default Addressing Scheme

This section describes the default addressing scheme and the features and implications of using this scheme.

During the initial startup, the DSLAM generates an ATM address using the defaults shown in Figure 3-2.

Figure 3-2 ATM Address Format Defaults



The default addressing scheme includes:

- Authority and format identifier (AFI)—1 byte
- Cisco-specific International Code Designator (ICD)—2 bytes
- Cisco-specific information—4 bytes
- Cisco switch ID—6 bytes (used to distinguish multiple switches). The first 13 bytes of the address is a switch prefix used by ILMI in assigning addresses to end stations connected to User-Network Interface (UNI) ports.
- MAC address of the switch—6 bytes (used to distinguish multiple end system identifier [ESI] addresses). Both the DSLAM ID and ESI MAC address fields in the ATM address are the same, but they might not be the same as the address printed on the chassis label. Use the ATM address fields when you configure the ATM addressing scheme.
- Selector (SEL) equals 0—1 byte

If you use the default address format, the following features and implications apply:

- The default address format enables you to manually configure other switches to be used in a single-level PNNI routing domain consisting primarily of autoconfigured Cisco ATM switches. You must use a globally unique MAC address to generate the ATM address.
- You can assign the same MAC address for bytes 8 through 13 and bytes 14 through 19.
- To achieve scalable ATM routing, you need two addresses when you connect to a large ATM network with multiple levels of PNNI hierarchy.
- Do not use summary addresses with fewer than 13 bytes with autoconfigured ATM addresses. Other switches with autoconfigured ATM addresses that match the DSLAM summary can exist outside of the default peer group.

Manually Setting the ATM Address

You can configure a new ATM address that replaces the previous ATM address when running IISP software only, or that replaces the previous ATM address and generates a new PNNI node ID and peer group ID as follows:

- To configure a new ATM address that replaces the previous ATM address when running IISP software only, see the *ATM Switch Router Software Configuration Guide,* Chapter 10.

  http://www.cisco.com/univercd/cc/td/doc/product/atm/c8540/12_1/lhouse/sw_confg/ilmi_cnf.htm

- To configure a new ATM address that replaces the previous ATM address and generates a new PNNI node ID and peer group ID, see the *ATM Switch Router Software Configuration Guide,* Chapter 11.

  http://www.cisco.com/univercd/cc/td/doc/product/atm/c8540/12_1/lhouse/sw_confg/access.htm

You can configure multiple addresses for a single switch and use this configuration during ATM address migration. ILMI registers end systems with multiple prefixes during this period until you remove an old address. PNNI automatically summarizes all the switch prefixes in its reachable address advertisement.

For operation with ATM addresses other than the autoconfigured ATM address, use the **atm address** command to manually assign a 20-byte ATM address to the switch. The **atm address** command *address_template* variable can be a full 20-byte address or a 13-byte prefix followed by ellipses (...). Entering the ellipses automatically adds one of the 6-byte switch MAC addresses in the ESI portion and 0 in the selector portion of the address.

Caution ATM addressing can lead to conflicts if you do not configure it correctly. For example, when configuring a new ATM address, you must remove the old one from the configuration.

When the switch initially powers on without previous configuration data, the ATM interfaces configure automatically on the physical ports. The DSLAM uses ILMI and the physical card type to automatically derive the following information:

- ATM interface type
- UNI version
- Maximum virtual path identifier (VPI) and virtual channel identifier (VCI) bits
- ATM interface side
- ATM UNI type

You can accept the default ATM interface configuration or overwrite the default interface configuration using the CLI commands (see the *ATM Switch Router Software Configuration Guide,* Chapter 5, Configuring ATM Network Interfaces).

Modifying the Physical Layer Configuration of the Default ATM Interface

This section describes how to modify an ATM interface from the default configuration listed in Chapter 5, “Configuring In-Band Management.” You can accept the ATM interface configuration or overwrite the default interface configuration using the CLI commands, which are described in *ATM Switch Router Software Configuration Guide*, Chapter 6, Configuring Virtual Connections.

Example

This example shows how to modify an OC-3 interface from the default settings to:

- Disable scrambling cell-payload.
- Disable scrambling STS-streaming.
- Change the SONET mode of operation from Synchronous Time Stamp level 3c (STS-3c) mode to Synchronous Transfer Module level 1 (STM-1).

To change the configuration of an ATM interface, follow these steps:

	Command	Task
Step 1	DSLAM# **configure terminal**	Enter global configuration mode.
Step 2	DSLAM(config)# **interface atm** *slot/port*	Select the physical interface to be configured and enter interface configuration mode.
Step 3	DSLAM(config-if)# **no scrambling cell-payload**	Disable cell-payload scrambling.
Step 4	DSLAM(config-if)# **no scrambling sts-stream**	Disable STS-stream scrambling.
Step 5	DSLAM(config-if)# **sonet** {**stm-1** | **sts-3c**}	Configure SONET mode as SDH/STM-1.
Step 6	DSLAM(config-if)# **end**	Return to privileged EXEC mode.
Step 7	DSLAM#	—

Example

This example shows how to disable cell-payload scrambling and STS-stream scrambling and changes the SONET mode of operation to Synchronous Digital Hierarchy/Synchronous Transfer Module 1 (SDH/STM-1) of OC-3 physical interface 0/0:

```
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# no scrambling cell-payload
DSLAM(config-if)# no scrambling sts-stream
DSLAM(config-if)# sonet stm-1
DSLAM(config-if)# exit
DSLAM(config)#
```

To display the physical interface configuration, use these privileged EXEC commands:

Command	Task
DSLAM# **show interfaces atm** *slot/port*	Show the physical layer configuration.
DSLAM# **show running-config**	Show the physical layer configuration.

Example

In this example, the OC-3 physical interface configuration is displayed after you modify the defaults:

```
DSLAM# show interfaces atm 0/1
ATM0/1 is up, line protocol is up
  Hardware is suni_dual
  MTU 4470 bytes, sub MTU 4470, BW 155520 Kbit, DLY 100 usec,
     reliability 250/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Last input 00:00:00, output 00:00:00, output hang never
```

```
  Last clearing of "show interface" counters 3w1d
  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
     435 packets input, 23055 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     4220 input errors, 4355 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     374 packets output, 19822 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

In this example, the OC-3 physical layer configuration is displayed after you modify the defaults:

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

Current configuration : 3080 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname ra6260_3
!
boot system tftp://64.101.176.211/test_image
slot 1 ATUC-4FLEXIDMT
slot 2 STUC-4-2B1Q-DIR-1
slot 3 ATUC-4FLEXICAP
slot 4 ATUC-4FLEXIDMT
slot 5 ATUC-1-DMT8
slot 6 ATUC-1-4DMT
slot 10 NI-2-155SM-155SM
slot 18 ATUC-1-4DMT
no logging console
enable password test
!
!
dsl-profile default
!
network-clock-select 1 ATM0/1
redundancy
ip subnet-zero
no ip domain-lookup
!
!
no atm oam intercept end-to-end
atm address 47.0091.8100.0000.0004.6dce.7401.0004.6dce.7401.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
  redistribute atm-static
!
!
!
!
interface ATM0/0
 no ip address
 atm maxvp-number 0
 atm maxvc-number 4096
!
interface Ethernet0/0
```

```
 ip address 10.91.209.71 255.255.255.0
!
interface ATM0/1
 no ip address
 sonet stm-1
 no scrambling sts-stream
 no scrambling cell-payload
 no atm ilmi-keepalive
!
interface ATM0/2
 no ip address
 no atm ilmi-keepalive
!
interface ATM1/1
 no ip address
 no atm ilmi-keepalive
!
interface ATM1/2
 no ip address
 no atm ilmi-keepalive!
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.91.209.1
no ip http server
ip pim bidir-enable
!
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
 exec-timeout 0 0
 password test
 login
!
end
```

Configuring IP Interface Parameters

This section describes how to configure IP addresses on the DSLAM processor interfaces. You configure each IP address for one of the following types of connections:

- Ethernet port—Configure either from the BOOTP server or by using the **ip address** command in interface-configuration mode for the Ethernet 0/0 interface.
- Serial Line Internet Protocol/Point-to-Point Protocol (SLIP/PPP)—See Chapter 2, “Configuring Terminal Lines and Modem Support.”

Note These IP connections are used only for network management.

To configure the DSLAM to communicate using the Ethernet interface, provide the IP address and subnet mask bits for the interface as described in this section.

Defining an IP address

This section provides a summary of IP addressing concepts for those who are familiar with IP addressing.

Internet addresses are 32-bit values assigned to hosts that use the IP protocols. These addresses are in dotted decimal format (four decimal numbers separated by periods), such as 192.17.5.100. Each number is an 8-bit value between 0 and 255.

IP addresses are divided into three classes. These classes differ in the number of bits allocated to the *network* and *host* portions of the address:

- The Class A Internet address format allocates the highest 8 bits to the network field and sets the highest-order bit to 0 (zero). The remaining 24 bits form the host field.
- The Class B Internet address allocates the highest 16 bits to the network field and sets the two highest-order bits to 1, 0. The remaining 16 bits form the host field.
- The Class C Internet address allocates the highest 24 bits to the network field and sets the three highest-order bits to 1, 1, 0. The remaining 8 bits form the host field.

The default IP address is none.

Enter your Internet address in dotted decimal format for each interface you plan to configure.

Defining Subnet Mask Bits

Subnetting is an extension of the Internet addressing scheme that allows multiple physical networks to exist within a single Class A, B, or C network. The subnet mask determines whether subnetting is in effect on a network. The usual practice is to use a few of the far-left bits in the host portion of the network address to assign a subnet field.

Internet addressing conventions allow a total of 24 host bits for Class A addresses, 16 host bits for Class B addresses, and 8 host bits for Class C addresses. When you are further subdividing your network (that is, subnetting your network), the number of host addressing bits is divided between subnetting bits and actual host address bits. You must specify a minimum of two host address bits, or the subnetwork is not populated by hosts.

Note Because all zeros in the host field specifies the entire network, subnetting with subnet address 0 is illegal and is strongly discouraged.

Table 3-3 provides a summary of subnetting parameters.

Table 3-3 Subnetting Parameters

First Class	First Byte	Network Bits	Host Bits	
			Max Subnet Bits	Min Address Bits
A	1 to 126	8	22	2
B	128 to 191	16	14	2

You define subnet mask bits as a decimal number between:

- 0 and 22 for Class A addresses
- 0 and 14 for Class B addresses
- 0 and 6 for Class C addresses

Note Do not specify 1 as the number of bits for the subnet field. That specification is reserved by Internet conventions.

To configure the IP address, perform the following steps, beginning in global configuration mode:

	Command	Task
Step 1	DSLAM(config) **interface ethernet** *slot/port*	Select the interface to be configured.
Step 2	DSLAM(config) **ip address** *A.B.C.D sub_net_A.B.C.D*	Configure the IP and subnetwork address.

Example

This example shows how to configure the Ethernet CPU interface 0/0 with IP address 172.20.40.93 and subnetwork mask 255.255.255.0, and displays the interface information:

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# interface ethernet 0/0
DSLAM(config-if)# ip address 172.20.40.93 255.255.255.0
DSLAM(config-if)# end
DSLAM# show interface ethernet 0/0
Ethernet0/0 is up, line protocol is up
  Hardware is AmdP2, address is 0001.64ff.a97f (bia 0001.64ff.a97f)
  Internet address is 172.21.186.145/24
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  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
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 4000 bits/sec, 5 packets/sec
  5 minute output rate 2000 bits/sec, 3 packets/sec
     906236 packets input, 202482126 bytes, 0 no buffer
     Received 889038 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     163965 packets output, 21172110 bytes, 0 underruns
     0 output errors, 9 collisions, 1 interface resets
     0 babbles, 0 late collision, 33 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

Testing the Ethernet Connection

After you configure the IP addresses for the Ethernet interface, test for connectivity between the DSLAM and a host. The host can reside anywhere in your network. To test for Ethernet connectivity, use this command in EXEC mode:

Command	Task
DSLAM# **ping ip** *ip_address*	Test the configuration using the **ping** command. The **ping** command sends an echo request to the host specified in the command line.

For example, to test Ethernet connectivity from the DSLAM to a workstation with an IP address of 172.20.40.201, enter the command **ping ip 172.20.40.201**. If the DSLAM receives a response, this message appears:

```
DSLAM# ping ip 172.20.40.201

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.20.40.201, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1000 ms
```

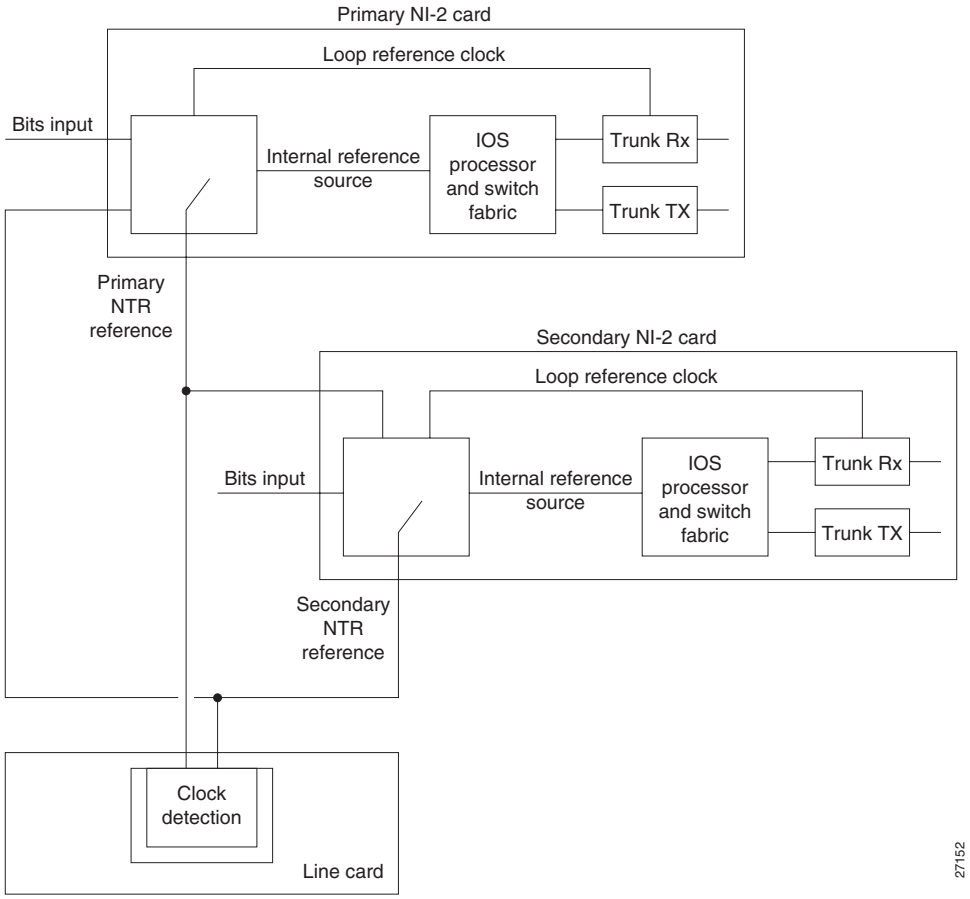
Configuring Network Clocking

This section describes how to configure network clocking for the DSLAM. Each port has a transmit clock and derives its receive clock from the receive data. You can configure transmit clocking for each port in one of these ways:

- Network derived—Transmit clocking is derived from the highest priority configured source, either from the internal clock (the default) or the public network.
- Loop-timed—Transmit clocking is derived from the receive clock source.

The DSLAM receives derived clocking, along with data, from a specified interface. For example, in Figure 3-3, the DSLAM extracts transmit clocking from the data received at ATM 0/1 and distributes it as the transmit clock to the rest of the DSLAM. ATM 0/2 then uses network-derived transmit clocking received from ATM 0/1.

Figure 3-3 Transmit Clock Distribution



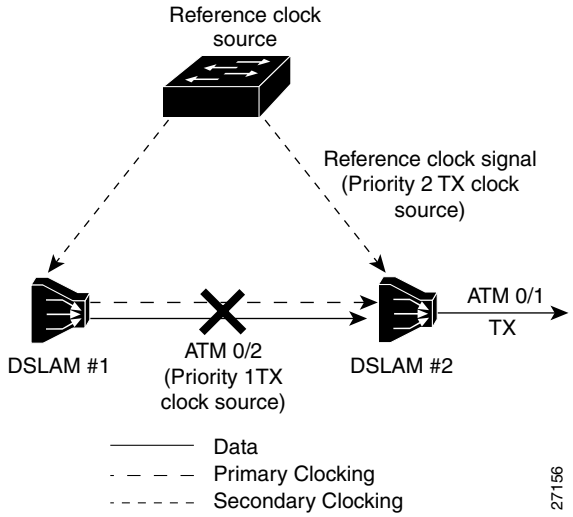
Because the port providing the network clock source could fail, Cisco IOS software provides the ability to configure additional interfaces as clock sources with priorities 1 to 4.

If the network clock source interface stops responding, the software switches to the next highest-configured priority network clock source. For example, Figure 3-4 shows:

- DSLAM number two is configured to use ATM 0/2 as its highest-priority clock source, and an external reference clock as its second highest-priority clock source.
- ATM 0/1 uses network-derived transmit clocking.
- ATM 0/2 fails.
- The external reference clock becomes the active clock signal and is distributed to the WAN ports and line cards. ATM 0/1 uses the external reference clock.
- If the configuration option network-clock-select revertive is set, the DSLAM continuously attempts to revert to the valid clock source with the highest priority. To be considered valid, a clock source must remain stable for a least 1 minute.

Note By default, the network clock is nonrevertive. Nonrevertive means that once a network clock source fails and the DSLAM switches to the clock source with the next highest priority, manual intervention is required to force the DSLAM to switch back to a higher-priority clock source. The algorithm to switch to the highest priority best clock only runs if you configure the **network-clock-select** command as revertive.

Figure 3-4 Transmit Clocking Priority Configuration Example



These sections describe network clocking:

- Configuring Network Clock Priorities and Sources, page 3-16
- Configuring the Transmit Clocking Source, page 3-17
- Providing Clock Synchronization Services, page 3-18

Configuring Network Clock Priorities and Sources

To configure the network clocking priorities and sources, use the following commands in global configuration mode:

Command	Task
DSLAM(config) **network-clock-select** *priority* {**BITS** | **system** | **atm** *slot/port*}	Configure the priority of a timing source. Priority values are 1 to 4.
DSLAM(config) **network-clock-select BITS {T1 | E1}** *margin***}**	Configure the type and margin, in decibels, of the BITS line for a T1 or an E1 line. Margin values vary according to the length of the T1 or E1 line.
DSLAM(config) **network-clock-select revertive**	Configure the system to revert to a higher priority timing source when it becomes available.

Examples

This example sets up the DSLAM building-integrated time source (BITS) interface as the highest-priority clock source, then configures the BITS interface for T1 at 0.6 dB (0 to 133 feet, or 0 to 40.5 meters).

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# network-clock-select 1 BITS
DSLAM(config)# network-clock-select BITS T1 0.6db
```

This example configures ATM 0/1, the trunk, as the second-highest priority timing source.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# network-clock-select 2 atm 0/1
```

This example configures the DSLAM system clock as the third-highest priority timing source.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# network-clock-select 3 system
```

This example shows how to configure the network clock to revert back to the highest priority clock source after a failure:

```
DSLAM(config)# network-clock-select revertive
DSLAM(config)#
```

Configuring the Transmit Clocking Source

To configure the location from which an interface receives its transmit clocking, perform the following steps, beginning in global configuration mode:

	Command	Task
Step 1	`DSLAM(config)# interface atm` *slot/port*	Select the interface to be configured.
Step 2	`DSLAM(config-if)# clock source {loop-timed | network-derived}`	Configure the interface network clock source.

Note When an interface has its clock source set to Network-Derived, the interface uses the highest-priority valid clock source available (assuming that the network clock source is configured to be revertive).

Examples

This example configures ATM 0/1 to receive its transmit clocking from a network-derived source:

```
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# clock source network-derived
DSLAM(config-if)#
```

This example displays the network clocking configuration shown in Figure 3-4:

```
DSLAM# show network-clocks
PLL failed: 58886; PLL Passed: 1082982
FAIL: 0; NCO: F984; REF: F982; ERR: 2; ERR_D: 0; MAG: -1;
clock configuration is NON-Revertive
Priority 1 clock source: BITS clock
```

```
Priority 2 clock source: No clock
Priority 3 clock source: No clock
Priority 4 clock source: No clock
Priority 5 clock source: System clock

Current clock source:System clock, priority:5

Nettime Config Register Contents:
NDIV:FF SRC:2, SLOCK:0, TLOCK:0, NFAIL:0, E1:0, NSEL:0
Trunk LED Register CLK_SEL:3

BITS Register Contents:
CR1: CB, CR2: 0, CR3: 0, ICR: 0, TSR: C1, PSR: 31, ESR: 77, CR4: 0

BITS Source configured as: T1 Short Haul, 0-133ft/0.6db pulse, 100 ohm cable, 1n
```

This example displays the clock source configuration of ATM 0/2:

```
DSLAM# show running-config interface atm 0/2
Building configuration...

Current configuration : 62 bytes
!
interface ATM0/2
 no keepalive
 atm manual-well-known-vc
 atm access-group tod1 in
 atm pvc 0 35 rx-cttr 3 tx-cttr 3  interface  ATM0/2 0 any-vci  encap qsaal
 atm route-optimization soft-vc interval 360 time-of-day 18:0 5:0
 clock-source network-derived
!
```

Providing Clock Synchronization Services

Any module in a DSLAM chassis capable of receiving and distributing a network timing signal can propagate that signal to any similarly capable module in the chassis. These modules are capable of receiving and distributing a primary reference source (PRS) for the clock:

- A BITS clock through the I/O card
- An OC-3 in a DSLAM chassis
- A quad DS3 module in a DSLAM chassis that derives the clock from the trunk interface

Note A trunk port can propagate a clocking signal in either direction.

If you issue the **network-clock-select** command with the appropriate parameters, you can define a particular port in a DSLAM chassis (subject to the above limitations) to serve as the source of a PRS for the entire chassis or for other devices in the networking environment. This command is described in the "Configuring Network Clock Priorities and Sources" section on page 3-16.

You can also use the **network-clock-select** command to designate a particular port in a DSLAM chassis to serve as a master clock source for distributing a single clocking signal throughout the chassis or to other network devices. You can distribute this reference signal in any location the network needs to globally synchronize the flow of constant bit rate (CBR) data.

Configuring the Network Routing

For network routing, the default software image for the DSLAM contains the PNNI routing protocol. The PNNI protocol provides the route dissemination mechanism for complete plug-and-play capability. This section describes modifications you can make to the default PNNI or Interim-Interswitch Signaling Protocol (IISP) routing configurations.

Use the **atm route** command to configure a static route. Static route configuration allows ATM call setup requests to be forwarded on a specific interface if the addresses match a configured address prefix.

Note An interface must be UNI or IISP if it is configured with a static route. Static routes configured as PNNI interfaces default as down.

Example

This example shows how to use the **atm route** command to configure the 13-byte peer group prefix as 47.0091.8100.567.0000.0ca7.ce01 at ATM 0/1:

```
DSLAM(config)# atm route 47.0091.8100.567.0000.0ca7.ce01 atm 0/1
DSLAM(config)#
```

Configuring NI-2 Card and APS Link Redundancy

This section describes how to configure redundancy for the NI-2 card and APS link and includes the following information:

NI-2 Card Redundancy Overview

The NI-2 Card redundancy feature provides redundancy on the Cisco 6130, Cisco 6160, and Cisco 6260 DSLAM systems. This redundancy feature has two main components.

- Recovery from failure on an NI-2 card lets the standby card take over if the active card fails.
- Recovery from failure due to a cut fiber or the failure of an optical transmitter or receiver (SONET APS) lets the active NI-2 switch to the fiber interface on the standby NI-2.

NI-2 Cold Redundancy

On a system with two NI-2 cards of the same interface types (trunk and subtend), the NI-2 cold redundancy feature allows a standby NI-2 card to assume system operations if the active NI-2 card completely fails. The NI-2 card in slot 10 is called the primary card and the card in slot 11 is called the secondary card. Either card can be active or standby.

The standby NI-2 begins the boot process but does not process its configuration. While the standby unit is monitoring the state of the active unit, the active unit synchronizes configuration changes with the standby unit if it is configured to do so. This allows the standby unit to become active with the most recent configuration possible following a switchover. Configuration information could be lost during the switchover if configuration synchronization is disabled.

The switchover from one NI-2 to the other NI-2 does not cause a reset of the line cards. The active unit communicates line card information to the standby unit to decrease switchover time. When the switchover is complete, the object database on the newly active unit may not match the objects in the system, but this situation will correct itself during normal operation as the active unit discovers the new cards or discovers that cards have been removed.

Automatic Protection Switching

SONET APS provides recovery from a cut fiber or the failure of an optical transmitter or receiver for OC-3 interfaces on an NI-2 card. APS redundancy is available on OC-3c/2DS3 NI-2 card trunk interfaces and OC-3c/OC-3c NI-2 card trunk and subtend interfaces. The active interface switches over when a SONET failure condition (loss of signal or loss of frame) is detected.

When both primary and secondary fiber connections are cabled, the active NI-2 card transmits and receives identical data signals over both fiber connections and can switch the receive path between the two upon a fiber or OC-3c port failure.

APS fiber redundancy is nonrevertive. The NI-2 will switch back to the primary fiber only if manually forced through a CLI command or if a failure condition occurs on the secondary fiber. If both fibers are failed, the system will switch to the first good fiber that is available.

Restrictions

Cold redundancy is redundancy in which the standby unit does not completely mirror the state of the active unit. With cold redundancy, the standby unit loses transient state information and must process its configuration during the switchover, which may lead to a period of data loss.

Cisco recommends testing the redundancy feature in the local test environment before placing the unit in production.

Supported Platforms

Table 3-4 lists the NI-2 cards and compatible chassis that support cold redundancy.

Table 3-4 Redundant NI-2 Cards and Chassis Compatibility

NI-2 Card	Cisco 6130	Cisco 6160	Cisco 6260
DS3/2DS3	Yes	Yes	Yes[1]
OC-3c/OC-3c SMF[2, 3]	Yes	Yes	Yes[4]
OC-3c/OC-3c MMF[3, 5]	Yes	Yes	Yes
OC-3c/2DS3 SMF[2, 6]	No	Yes	No
OC-3c/2DS3 MMF[5, 6]	No	Yes	No
DS3+T1/E1 IMA[7]	No	Yes[8]	No

1. When the DS3/2DS3 NI-2 card and the E3 I/O module are installed in the Cisco 6260 chassis, the system assumes E3 functionality
2. SMF = single-mode fiber
3. APS provides link redundancy on the trunk and subtended interfaces
4. When the OC-3c/OC-3c NI-2 card and the OC-3c I/O module are installed in the Cisco 6260 chassis, the system assumes OC-3c functionality
5. MMF = multimode fiber
6. APS provides link redundancy only on the OC-3c trunk interface
7. IMA = inverse multiplexing over ATM
8. Use only with the DS3/2DS3+8T1 IMA system I/O card (part number 6160-1-I/O-2=)

Ensure that the following product revisions are installed on your system:

- Cisco NI-2 card, daughterboard item number 73-3952-05 Rev. AO or later. Use the Cisco IOS command **show hardware slot 10** or **show hardware slot 11** to determine the currently installed NI-2 card daughterboard item number and revision.
- For the Cisco 6260 chassis, Cisco 6260 backplane item number 73-3999-05 Rev. AO or later. Use the Cisco IOS command **show hardware chassis** to determine the Cisco 6260 backplane item number and revision.

Prerequisites

To properly configure and activate redundancy, ensure that you are running Cisco IOS Release 12.1(7)DA or a later version of IOS on one of the Supported Platforms. You must install a second NI-2 card (must be the same type as the primary NI-2 card).

Configuration Tasks

Perform the task in the "Configure the NI-2 Cards for File Synchronization" section on page 3-22 to configure NI-2 cards and SONET ports.

Configure the NI-2 Cards for File Synchronization

NI-2 cold redundancy supports autosynchronization of the primary and secondary NI-2 card file systems, but you must manually synchronize the flash files and bootflash files before you can enable autosynchronization.

To manually synchronize the flash and bootflash on the NI-2 cards, complete the following steps:

	Command	Purpose
Step 1	`DSLAM> enable`	Enter privileged EXEC mode.
Step 2	`DSLAM# secondary sync flash`	Manually synchronize the flash files.
Step 3	`DSLAM# secondary sync bootflash`	Manually synchronize the bootflash files.

After you manually synchronize the flash and bootflash, configure the NI-2 cards for automatic synchronization. To enable autosynchronization of the primary and secondary NI-2 cards, complete the following steps:

	Command	Purpose
Step 1	`DSLAM# configure terminal`	Enter global configuration mode.
Step 2	`DSLAM(config)# auto-sync`	Enter autosync submode.
Step 3	`DSLAM(config-auto-sync)# flash`	Autosynchronize the flash files.[1]
Step 4	`DSLAM(config-auto-sync)# bootflash`	Autosynchronize the bootflash files.[1]
Step 5	`DSLAM(config-auto-sync)# config`	Autosynchronize the startup configuration file (default).
Step 6	`DSLAM(config-auto-sync)# running-config`	Autosynchronize the running configuration file (default).
Step 7	`DSLAM(config-auto-sync)# exit`	Exit from autosync submode.

1. You will not be able to perform this operation until you manually synchronize the file systems.

Verifying File Synchronization

Use the **show running-config** command to verify that you entered the commands correctly. Use the **dir flash**, **dir secondary-flash**, **dir bootflash**, and **dir secondary-bootflash** commands to verify that the files synchronized properly.

Note Because the config and running-config synchronizations are enabled by default, they do not show up in the running configuration.

Troubleshooting Tips

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain documentation, troubleshooting tips, and sample configurations from online tools.

For Cisco.com registered users, additional troubleshooting tools are available from the TAC website. To obtain troubleshooting help, go to the Cisco Troubleshooting Assistant web site on Cisco Connection Online (CCO) at http://www.cisco.com/public/support/tac/troubleshoot.shtml. Also see the "Monitoring Redundancy States" section on page 3-23.

Monitoring Redundancy States

Use the **show redundancy states** command to display the current redundancy states of the NI-2 cards.

Use the **show aps** command to display the APS status of each SONET port on both NI-2 cards.

Configuration Examples

This section provides output from the **show running-config** command.

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

Current configuration : 1917 bytes
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname DSLAM
!
slot 7 ATUC-4FLEXIDMT
slot 10 NI-2-155MM-155MM
slot 11 NI-2-155MM-155MM
slot 34 ITUC-1-8IDSL
enable password test
!
!dsl-profile default
network-clock-select 1 ATM0/1
redundancy
auto-sync
 flash
 bootflash
ip subnet-zero
ip host-routing
no ip finger
no ip domain-lookup
ip host spur 123.45.678.91
ip domain-name cisco.com
ip name-server 123.45.678.92
ip name-server 123.45.6.789
!
no atm oam intercept end-to-end
atm address 47.0091.8100.0000.0030.b690.ac01.0030.b690.ac01.00
atm address 47.0091.8100.0000.00b0.c2ff.6001.00b0.c2ff.6001.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
  redistribute atm-static
!
icm size 4194304
!
interface ATM0/0
 no ip address
 atm cac service-category abr deny
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvci-bits 12
!interface ATM7/3
```

```
 no ip address
 no atm ilmi-keepalive
...
```

Configuring the Time, Date, and System Name

You can set several system parameters as part of the initial system configuration, but these parameters are not required. To set the system parameters, perform the following steps, beginning in privileged EXEC mode:

	Command	Task
Step 1	`DSLAM> clock set` *hh:mm:ss day month year*	Set the internal clock.
Step 2	`DSLAM> configure terminal`	Enter global configuration mode from the terminal.
Step 3	`DSLAM(config)# hostname` *name*	Set the system name.

Examples

This example shows how to configure the time, date, and month using the **clock set** command:

```
DSLAM# clock set 15:01:00 17 October 2000
```

This example shows how to configure the host name using the **hostname** command:

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

This example shows how to confirm the clock setting using the **show clock** command:

```
Publications# show clock
*15:03:12.015 UTC Fri Oct 17 2000
Publications#
```

Configuring SNMP Management

This section describes the Simple Network Management Protocol (SNMP), SNMP MIBs, and how to configure SNMP on Cisco DSLAMs in the following sections:

- Understanding SNMP, page 3-24
- SNMP Configuration Task List, page 3-30
- SNMP Configuration Examples, page 3-37
- MIB Features in Cisco IOS Release 12.2DA, page 3-38

Understanding SNMP

SNMP is an application-layer protocol that provides a message format for communication between SNMP managers and agents. SNMP provides a standardized framework and a common language used for the monitoring and management of devices in a network.

The SNMP framework has three parts:

- An SNMP manager
- An SNMP agent
- A MIB

The SNMP manager is the system used to control and monitor the activities of network hosts using SNMP. For Cisco DSLAMS, this system is called the Cisco Digital Subscriber Line (DSL) Manager (CDM) and its associated framework, the Cisco Element Manager Framework (Cisco EMF). A plug-in software module, referred to as an element manager, adds custom graphical user interface (GUI) windows and modeling behavior to the standard Cisco EMF system. Element manager software allows you to manage specific types of network equipment, such as Cisco DSLAMs. Cisco EMF software is the framework that supports the functions of the CDM element manager..

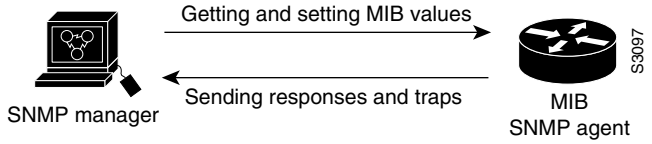
The SNMP agent is the software component within the managed device that maintains the data for the device and reports these data, as needed, to managing systems. The agent and MIB reside on the routing device (DSLAM, access server, or switch). To enable the SNMP agent on a Cisco routing device, you must define the relationship between the manager and the agent.

The Management Information Base (MIB) is a virtual information storage area for network management information, which consists of collections of managed objects. Within the MIB there are collections of related objects, defined in MIB modules. MIB modules are written in the SNMP MIB module language, as defined in STD 58, RFC 2578, RFC 2579, and RFC 2580 (see the ““MIBs and RFCs” section on page 3-28” for an explanation of RFC and STD documents). Note that individual MIB modules are also referred to as MIBs; for example, the Interfaces Group MIB (IF-MIB) is a MIB module within *the* MIB on your system.

The SNMP agent contains MIB variables whose values the SNMP manager can request or change through Get or Set operations. A manager can get a value from an agent or store a value into that agent. The agent gathers data from the MIB, the repository for information about device parameters and network data. The agent can also respond to manager requests to Get or Set data.

Figure 3-5 illustrates the communications relationship between the SNMP manager and agent. A manager can send the agent requests to get and set MIB values. The agent can respond to these requests. Independent of this interaction, the agent can send unsolicited notifications (traps or informs) to the manager to notify the manager of network conditions.

Figure 3-5 Communication Between an SNMP Agent and Manager



Note This chapter discusses how to enable the SNMP agent on your Cisco device, and how to control the sending of SNMP notifications from the agent. For information on using SNMP management systems, see the appropriate documentation for your NMS application.

SNMP Notifications

A key feature of SNMP is the ability to generate notifications from an SNMP agent. These notifications do not require that requests be sent from the SNMP manager. Unsolicited (asynchronous) notifications can be generated as *traps* or *inform requests*. Traps are messages alerting the SNMP manager to a condition on the network. Inform requests (informs) are traps that include a request for confirmation of receipt from the SNMP manager. Notifications can indicate improper user authentication, restarts, the closing of a connection, loss of connection to a neighbor DSLAM, or other significant events.

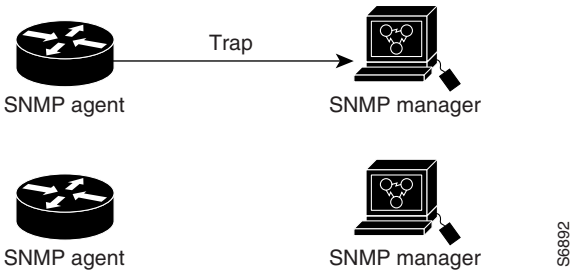
Traps are less reliable than informs because the receiver does not send any acknowledgment when it receives a trap. The sender cannot determine if the trap was received. An SNMP manager that receives an inform request acknowledges the message with an SNMP response protocol data unit (PDU). If the manager does not receive an inform request, it does not send a response. If the sender never receives a response, the inform request can be sent again. Thus, informs are more likely to reach their intended destination.

However, traps are often preferred because informs consume more resources in the DSLAM and in the network. Unlike a trap, which is discarded as soon as it is sent, an inform request must be held in memory until a response is received or the request times out. Also, traps are sent only once, while an inform may be retried several times. The retries increase traffic and contribute to a higher overhead on the network. Thus, traps and inform requests provide a trade-off between reliability and resources. If it is important that the SNMP manager receives every notification, use inform requests. However, if you are concerned about traffic on your network or memory in the DSLAM and you need not receive every notification, use traps.

Figure 3-6 through Figure 3-9 illustrate the differences between traps and inform requests.

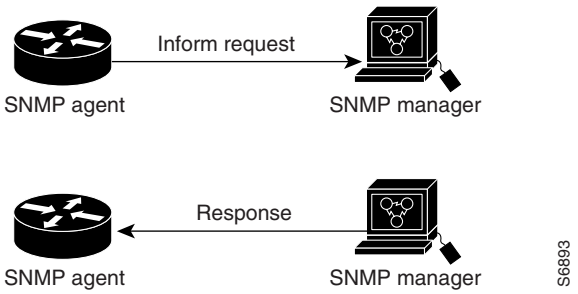
In Figure 3-6, the agent DSLAM successfully sends a trap to the SNMP manager. Although the manager receives the trap, it does not send any acknowledgment to the agent. The agent has no way of knowing that the trap reached its destination.

Figure 3-6 Trap Successfully Sent to SNMP Manager



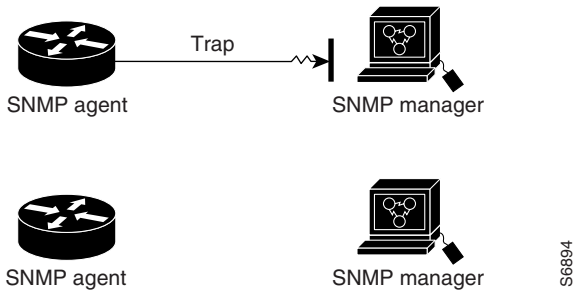
In Figure 3-7, the agent DSLAM successfully sends an inform request to the manager. When the manager receives the inform request, it sends a response to the agent. Thus, the agent knows that the inform request reached its destination. Notice that, in this example, twice as much traffic is generated as in Figure 3-6; however, the agent knows that the manager received the notification.

Figure 3-7 Inform Request Successfully Sent to SNMP Manager



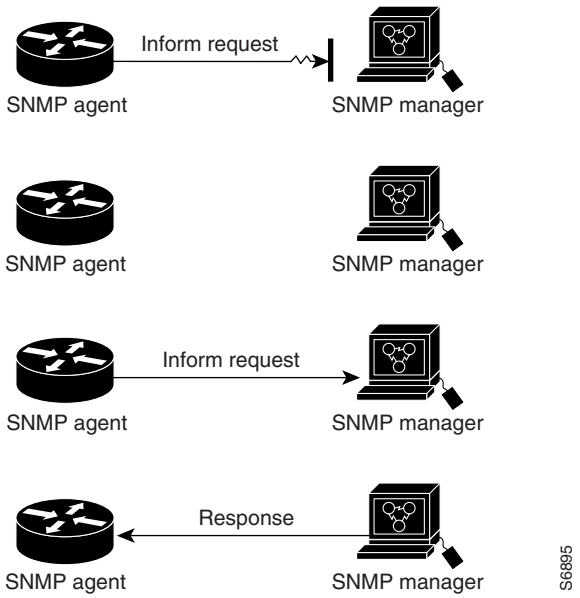
In Figure 3-8, the agent sends a trap to the manager, but the trap does not reach the manager. Because the agent has no way of knowing that the trap did not reach its destination, the trap is not sent again. The manager never receives the trap.

Figure 3-8 Trap Unsuccessfully Sent to SNMP Manager



In Figure 3-9, the agent sends an inform request to the manager, but the inform request does not reach the manager. Because the manager did not receive the inform request, it does not send a response. After a period of time, the agent will resend the inform request. The second time, the manager receives the inform request and replies with a response. In this example, there is more traffic than in Figure 3-8; however, the notification reaches the SNMP manager.

Figure 3-9 Inform Request Unsuccessfully Sent to SNMP Manager



MIBs and RFCs

MIB modules typically are defined in RFC documents submitted to the Internet Engineering Task Force (IETF), an international standards body. RFCs are written by individuals or groups for consideration by the Internet Society and the Internet community as a whole, usually with the intention of establishing a recommended Internet standard. Before being given RFC status, recommendations are published as Internet Draft (I-D) documents. RFCs that have become recommended standards are also labeled as standards (STD) documents. You can learn about the standards process and the activities of the IETF at the Internet Society website at http://www.isoc.org. You can read the full text of all RFCs, I-Ds, and STDs referenced in Cisco documentation at the IETF website at http://www.ietf.org.

The Cisco implementation of SNMP uses the definitions of MIB II variables described in RFC 1213 and definitions of SNMP traps described in RFC 1215.

Cisco provides its own private MIB extensions with every system. Cisco enterprise MIBs comply with the guidelines described in the relevant RFCs unless otherwise noted in the documentation. You can find the MIB module definition files and list of which MIBs are supported on each Cisco platform on the Cisco MIB website on Cisco.com.

For a list of MIB-related functionality, see the "MIB Features in Cisco IOS Release 12.2DA" section on page 3-38".

SNMP Versions

Cisco IOS software supports the following versions of SNMP:

- SNMPv1—The Simple Network Management Protocol: A Full Internet Standard, defined in RFC 1157. (RFC 1157 replaces the earlier versions that were published as RFC 1067 and RFC 1098.) Security is based on community strings.
- SNMPv2c—The community-string based Administrative Framework for SNMPv2. SNMPv2c (the "c" stands for "community") is an Experimental Internet Protocol defined in RFC 1901, RFC 1905, and RFC 1906. SNMPv2c is an update of the protocol operations and data types of SNMPv2p (SNMPv2 Classic), and uses the community-based security model of SNMPv1.
- SNMPv3—Version 3 of SNMP. SNMPv3 is an interoperable standards-based protocol defined in RFCs 2273 to 2275. SNMPv3 provides secure access to devices by a combination of authenticating and encrypting packets over the network.

  The security features provided in SNMPv3 are as follows:

  - Message integrity—Ensuring that a packet has not been tampered with in transit.
  - Authentication—Determining that the message is from a valid source.
  - Encryption—Scrambling the contents of a packet prevent it from being learned by an unauthorized source.

Both SNMPv1 and SNMPv2c use a community-based form of security. The community of managers able to access the agent MIB is defined by an IP address Access Control List and password.

SNMPv2c support includes a bulk retrieval mechanism and more detailed error message reporting to management stations. The bulk retrieval mechanism supports the retrieval of tables and large quantities of information, minimizing the number of round-trips required. The SNMPv2C improved error handling support includes expanded error codes that distinguish different kinds of error conditions; these conditions are reported through a single error code in SNMPv1. Error return codes now report the error type. Three kinds of exceptions are also reported: no such object exceptions, no such instance exceptions, and end of MIB view exceptions.

SNMPv3 provides for both security models and security levels. A security model is an authentication strategy that is set up for a user and the group in which the user resides. A security level is the permitted level of security within a security model. A combination of a security model and a security level will determine which security mechanism is employed when handling an SNMP packet.

Three security models are available: SNMPv1, SNMPv2c, and SNMPv3. Table 3-5 identifies what the combinations of security models and levels mean.

Table 3-5 SNMP Security Models and Levels

Model	Level	Authentication	Encryption	What Happens
v1	noAuthNoPriv	Community String	No	Uses a community string match for authentication.
v2c	noAuthNoPriv	Community String	No	Uses a community string match for authentication.
v3	noAuthNoPriv	Username	No	Uses a username match for authentication.

Table 3-5 SNMP Security Models and Levels (continued)

Model	Level	Authentication	Encryption	What Happens
v3	authNoPriv	MD5 or SHA	No	Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms.
v3	authPriv	MD5 or SHA	DES	Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms. Provides DES 56-bit encryption in addition to authentication based on the CBC-DES (DES-56) standard.

Note SNMPv2p (SNMPv2 Classic) is not supported in any Cisco IOS releases after 11.2. SNMPv2c replaces the Party-based Administrative and Security Framework of SNMPv2p with a Community-based Administrative Framework. SNMPv2c retained the bulk retrieval and error handling capabilities of SNMPv2p.

You must configure the SNMP agent to use the version of SNMP supported by the management station. An agent can communicate with multiple managers; for this reason, you can configure the Cisco IOS software to support communications with one management station using the SNMPv1 protocol, one using the SNMPv2c protocol, and another using SMNPv3.

The SNMPv3 feature supports RFCs 1901 to 1908, 2104, 2206, 2213, 2214, and 2271 to 2275. For additional information on SNMPv3, refer to RFC 2570, *Introduction to Version 3 of the Internet-standard Network Management Framework* (note that this is not a standards document).

SNMP Configuration Task List

There is no specific command that you use to enable SNMP. The first **snmp-server** command that you enter enables the supported versions of SNMP.

To configure SNMP support, perform the tasks described in the following sections.

- Creating or Modifying an SNMP View Record (Optional)
- Creating or Modifying Access Control for an SNMP Community (Required)
- Specifying an SNMP-Server Engine Name (ID) (Optional)
- Specifying SNMP-Server Group Names (Optional)
- Configuring SNMP-Server Hosts (Required)
- Configuring SNMP-Server Users (Optional)
- Setting the Contact, Location, and Serial Number of the SNMP Agent (Optional)
- Setting the Contact, Location, and Serial Number of the SNMP Agent (Optional)
- Defining the Maximum SNMP Agent Packet Size (Optional)

- Limiting the Number of TFTP Servers Used via SNMP (Optional)
- Monitoring and Troubleshooting SNMP Status (Optional)
- Disabling the SNMP Agent (Optional)
- Configuring SNMP Notifications (Required)
- Configuring the DSLAM as an SNMP Manager (Optional)

Creating or Modifying an SNMP View Record

You can assign views to community strings to limit which MIB objects an SNMP manager can access. You can use a predefined view, or create your own view. If you are using a predefined view or no view at all, skip this task.

To create or modify an SNMP view record, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server view** *view-name oid-tree* {**included** | **excluded**}	Creates or modifies a view record.

To remove a view record, use the **no snmp-server view** command.

You can enter this command multiple times for the same view record. Later lines take precedence when an object identifier is included in two or more lines.

Creating or Modifying Access Control for an SNMP Community

Use an SNMP community string to define the relationship between the SNMP manager and the agent. The community string acts like a password to regulate access to the agent on the DSLAM. Optionally, you can specify one or more of the following characteristics associated with the string:

- An access list of IP addresses of the SNMP managers that are permitted to use the community string to gain access to the agent.
- A MIB view, which defines the subset of all MIB objects accessible to the given community.
- Read and write or read-only permission for the MIB objects accessible to the community.

To configure a community string, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server community** *string* [**view** *view-name*] [**ro** | **rw**] [*number*]	Defines the community access string.

You can configure one or more community strings. To remove a specific community string, use the **no snmp-server community** command.

For an example of configuring a community string, see the "SNMP Configuration Examples" section on page 3-37.

Specifying an SNMP-Server Engine Name (ID)

To specify an identification name (ID) for a local SNMP engine, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server engineID local** *engineid-string*	Specifies the name of the local SNMP engine (or copy of SNMP).

To specify an ID for a remote SNMP engine, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server engineID remote** *ip-address* [**udp-port** *port-number*] *engineid-string*	Specifies the name of the remote SNMP engine (or copy of SNMP).

Specifying SNMP-Server Group Names

To specify a new SNMP group, or a table that maps SNMP users to SNMP views, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server group** [*groupname* {**v1** | **v2c** | **v3** [**auth** | **noauth** | **priv**]}][**read** *readview*] [**write** *writeview*] [**notify** *notifyview*] [**access** *access-list*]	Configures a new SNMP group, or a table that maps SNMP users to SNMP views.

Configuring SNMP-Server Hosts

To configure the recipient of an SNMP trap operation, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server host** *host-id* [**traps** | **informs**][**version** {**1** | **2c** | **3** [**auth** | **noauth** | **priv**]}] *community-string* [**udp-port** *port-number*] [*notification-type*]	Specifies whether you want the SNMP notifications sent as traps or informs, the version of SNMP to use, the security level of the notifications (for SNMPv3), and the recipient (host) of the notifications.

Configuring SNMP-Server Users

To configure a new user to an SNMP group, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server user** *username groupname* [**remote** *ip-address* [**udp-port** *port*]] {**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password*]} [**access** *access-list*]	Configures a new user to an SNMP group.

Setting the Contact, Location, and Serial Number of the SNMP Agent

You can set the system contact, location, and serial number of the SNMP agent so that these descriptions can be accessed through the configuration file. To do so, use the following commands in global configuration mode, as needed:

Command	Purpose
DSLAM(config)# **snmp-server contact** *text*	Sets the system contact string.
DSLAM(config)# **snmp-server location** *text*	Sets the system location string.
DSLAM(config)# **snmp-server chassis-id** *number*	Sets the system serial number.

Defining the Maximum SNMP Agent Packet Size

You can define the maximum packet size permitted when the SNMP agent is receiving a request or generating a reply. To do so, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server packetsize** *byte-count*	Establishes the maximum packet size.

Limiting the Number of TFTP Servers Used via SNMP

You can limit the number of TFTP servers used for saving and loading configuration files via SNMP to the servers specified in an access list. To do so, use the following command in global configuration mode:

Command	Purpose
DSLAM(config)# **snmp-server tftp-server-list** *number*	Limits the number of TFTP servers used for configuration file copies via SNMP to the servers in an access list.

Monitoring and Troubleshooting SNMP Status

To monitor and troubleshoot SNMP status and information, use the following commands in EXEC mode, as needed:

Command	Purpose
DSLAM> **show snmp**	Monitors SNMP status.
DSLAM> **show snmp engineID** [**local** | **remote**]	Displays information about the local SNMP engine and all remote engines that have been configured on the device.
DSLAM> **show snmp groups**	Displays information about each SNMP group on the network.
DSLAM> **show snmp user**	Displays information about each SNMP username in the SNMP users table.

To monitor SNMP trap activity in real time for the purposes of troubleshooting, use the SNMP **debug** commands, including the **debug snmp packet** EXEC command. For documentation of SNMP **debug** commands, see the *Cisco IOS Debug Command Reference.*

Disabling the SNMP Agent

To disable any version of the SNMP agent, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# no snmp-server`	Disables SNMP agent operation.

Configuring SNMP Notifications

To configure the DSLAM to send SNMP traps or informs, perform the tasks described in the following sections:

- Configuring the DSLAM to Send SNMP Notifications (Required)
- Changing Notification Operation Values (Optional)
- Controlling Individual RFC 1157 SNMP Traps (Optional)

Note Most Cisco IOS commands use the word "traps" in their command syntax. Unless there is an option within the command to specify either traps or informs, the keyword **traps** should be taken to mean either traps or informs, or both. Use the **snmp-server host** command to specify whether you want SNMP notifications to be sent as traps or informs.

Configuring the DSLAM to Send SNMP Notifications

To configure the DSLAM to send traps or informs to a host, use the following commands in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# snmp-server engineID remote` *remote-ip-addr remote-engineID*	Specifies the engine ID for the remote host.
Step 2	`DSLAM(config)# snmp-server user` *username groupname* [**remote** *host* [**udp-port** *port*] {**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password*]} [**access** *access-list*]	Configures an SNMP user to be associated with the host created in Step 1. **Note** You cannot configure a remote user for an address without first configuring the engine ID for that remote host . This is a restriction imposed in the design of these commands; if you try to configure the user before the host, you will receive a warning message and the command will not be executed.
Step 3	`DSLAM(config)# snmp group` *groupname* {**v1** | **v2** | **v3** {**auth** | **noauth** | **priv**}} [**read** *readview*] [**write** *writeview*] [**notify** *notifyview*] [**access** *access-list*]	Configures an SNMP group.

	Command	Purpose
Step 4	`DSLAM(config)# snmp-server host host [traps | informs] [version {1 | 2c | 3 [auth | noauth | priv]}] community-string [notification-type]`	Specifies whether you want the SNMP notifications sent as traps or informs, the version of SNMP to use, the security level of the notifications (for SNMPv3), and the recipient (host) of the notifications.
Step 5	`DSLAM(config)# snmp-server enable traps [notification-type] [notification-option]`	Enables sending of traps or informs, and specifies the type of notifications to be sent. To discover which notifications are available on your system, enter the **snmp-server enable traps ?** command.
Step 6	`DSLAM(config)# snmp-server manager`	Enables the SNMP manager.

The **snmp-server host** command specifies which hosts will receive SNMP notifications, and whether you want the notifications sent as traps or inform requests. The **snmp-server enable traps** command globally enables the production mechanism for the specified notification types (such as traps, config traps, entity traps, and so on).

Changing Notification Operation Values

You can specify a value other than the default for the source interface, message (packet) queue length for each host, or retransmission interval.

To change notification operation values, use the following commands in global configuration mode, as needed:

Command	Purpose
`DSLAM(config)# snmp-server trap-source interface`	Specifies a source interface for trap or inform notifications.
`DSLAM(config)# snmp-server queue-length length`	Establishes the message queue length for each notification.
`DSLAM(config)# snmp-server trap-timeout seconds`	Defines how often to resend notifications on the retransmission queue.

For inform requests, you can configure inform-specific operation values in addition to the operation values mentioned. To change inform operation values, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# snmp-server informs [retries retries] [timeout seconds] [pending pending]`	Sets the maximum number of times to resend an inform request, the number of seconds to wait for an acknowledgment before resending, and the maximum number of informs waiting for acknowledgments at any one time.

Controlling Individual RFC 1157 SNMP Traps

You can globally enable or disable authenticationFailure, linkUp, linkDown, warmStart, and coldStart notifications (traps or informs) individually. (These traps constitute the "generic traps" defined in RFC 1157.) To enable any of these notification types, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# snmp-server enable traps snmp [authentication] [linkup] [linkdown] [warmstart] [coldstart]`	Enables RFC 1157 generic traps. When used without any of the optional keywords, enables authenticationFailure, linkUp, linkDown, warmStart, and coldStart traps. When used with keywords, enables only the trap types specified.

For example, to globally enable only linkUp and linkDown SNMP traps or informs for all interfaces, use the **snmp-server enable traps snmp linkup linkdown** form of this command.

Note that linkUp and linkDown notifications are enabled by default on specific interfaces, but will not be sent unless they are enabled globally. To control (disable or re-enable) the sending of linkUp/linkDown notifications for specific interfaces, use the **no snmp trap link-status** command in interface configuration mode. You can also specify the linkUp and linkDown traps from within a DSL profile. See the "Enabling and Disabling LinkUp/Down Traps" section on page 4-16 for more information about enabling and disabling them.

Configuring the DSLAM as an SNMP Manager

The SNMP manager feature allows a DSLAM to serve as an SNMP manager. As an SNMP manager, the DSLAM can send SNMP requests to agents and receive SNMP responses and notifications from agents. When the SNMP manager process is enabled, the DSLAM can query other SNMP agents and process incoming SNMP traps.

Security Considerations

Most network security policies assume that DSLAMs will accept SNMP requests, send SNMP responses, and send SNMP notifications.

With the SNMP manager functionality enabled, the DSLAM may also send SNMP requests, receive SNMP responses, and receive SNMP notifications. Your security policy implementation may need to be updated prior to enabling this feature.

SNMP requests typically are sent to User Datagram Protocol (UDP) port 161. SNMP responses are typically sent from UDP port 161. SNMP notifications are typically sent to UDP port 162.

SNMP Sessions

Sessions are created when the SNMP manager in the DSLAM sends SNMP requests, such as inform requests, to a host, or receives SNMP notifications from a host. One session is created for each destination host. If there is no further communication between the DSLAM and host within the session timeout period, the session will be deleted.

The DSLAM tracks statistics, such as the average round-trip time required to reach the host, for each session. Using the statistics for a session, the SNMP manager in the DSLAM can set reasonable timeout periods for future requests, such as informs, for that host. If the session is deleted, all statistics are lost. If another session with the same host is later created, the request timeout value for replies will return to the default value.

Sessions consume memory. A reasonable session timeout value should be large enough that regularly used sessions are not prematurely deleted, yet small enough such that irregularly used, or one-time sessions, are purged expeditiously.

Enabling the SNMP Manager

To enable the SNMP manager process and set the session timeout value, use the following commands in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# snmp-server manager`	Enables the SNMP manager.
Step 2	`DSLAM(config)# snmp-server manager session-timeout` *seconds*	(Optional) Changes the session timeout value.

Monitoring the SNMP Manager

To monitor the SNMP manager process, use the following commands in EXEC mode, as needed:

Command	Purpose
`DSLAM> show snmp`	Displays global SNMP information.
`DSLAM> show snmp sessions [brief]`	Displays information about current sessions.
`DSLAM> show snmp pending`	Displays information about current pending requests.

SNMP Configuration Examples

The following example enables SNMPv1, SNMPv2c, and SNMPv3. The configuration permits any SNMP manager to access all objects with read-only permissions using the community string named public. This configuration does not cause the DSLAM to send any traps.

```
DSLAM(config)# snmp-server community public
```

The following example permits any SNMP to access all objects with read-only permission using the community string named public. The DSLAM also will send alarm traps to the hosts 172.16.1.111 and 172.16.1.33 using SNMPv1 and to the host 172.16.1.27 using SNMPv2c. The community string named public is sent with the traps.

```
DSLAM(config)# snmp-server community public
DSLAM(config)# snmp-server enable traps alarms
DSLAM(config)# snmp-server host 172.16.1.27 version 2c public
DSLAM(config)# snmp-server host 172.16.1.111 version 1 public
DSLAM(config)# snmp-server host 172.16.1.33 public
```

The following example allows read-only access for all objects to members of access list 4 that specify the comaccess community string. No other SNMP managers have access to any objects. SNMP Authentication Failure traps are sent by SNMPv2c to the host cisco.com using the community string named public.

```
DSLAM(config)# snmp-server community comaccess ro 4
DSLAM(config)# snmp-server enable traps snmp authentication
DSLAM(config)# snmp-server host cisco.com version 2c public
```

The following example sends Entity MIB inform notifications to the host cisco.com. The community string is restricted. The first line enables the DSLAM to send Entity MIB notifications in addition to any traps or informs previously enabled. The second line specifies that the notifications should be sent as inform requests, specifies the destination of these informs, and overwrites any previous **snmp-server host** commands for the host cisco.com.

```
DSLAM(config)# snmp-server enable traps entity
DSLAM(config)# snmp-server host informs cisco.com restricted entity
```

The following example enables the DSLAM to send all traps to the host myhost.cisco.com using the community string public:

```
DSLAM(config)# snmp-server enable traps
DSLAM(config)# snmp-server host myhost.cisco.com public
```

The following example will not send traps to any host. The syslog traps are enabled for all hosts, but only ATM soft traps are enabled to be sent to a host.

```
DSLAM(config)# snmp-server enable traps syslog
DSLAM(config)# snmp-server host bob public atm-soft
```

The following example enables the DSLAM to send all inform requests to the host myhost.cisco.com using the community string named public:

```
DSLAM(config)# snmp-server enable traps
DSLAM(config)# snmp-server host myhost.cisco.com informs version 2c public
```

In the following example, the SNMP manager is enabled and the session timeout is set to a larger value than the default:

```
DSLAM(config)# snmp-server manager
DSLAM(config)# snmp-server manager session-timeout 1000
```

MIB Features in Cisco IOS Release 12.2DA

This section describes the MIB features available in Cisco IOS Release 12.2DA. You can download the SNMP (version2) standard and Cisco enterprise specific MIBs from the following URL:

ftp://ftp.cisco.com/pub/mibs/v2/

Standard MIB Modules

ACCOUNTING-CONTROL-MIB

The MIB module is for managing the collection and storage of accounting information for connections in a connection-oriented network such as ATM.

ADSL-CAP-LINE-MIB

The MIB module describes managed objects for ADSL CAP line interfaces.

ADSL-DMT-LINE-MIB

The MIB module describes managed objects for ADSL DMT line interfaces. This MIB contains a table to configure the DSL profile.

ADSL-LINE-MIB

The MIB module defines objects for the management of a pair of ADSL modems at each end of the ADSL line. This MIB contains a table to configure the DSL profile.

ADSL-TC-MIB

The MIB module which provides an ADSL line coding textual convention to be used by ADSL lines.

ATM-MIB

This is the MIB Module for ATM and AAL5-related objects for managing ATM interfaces, ATM virtual links, ATM cross-connects, AAL5 entities, and AAL5 connections.

ATM-SOFT-PVC-MIB

Updated version of the Soft PVC MIB released with the PNNI V1.0 Errata and PICS (af-pnni-81.00). This MIB reflects the characteristics unique to soft PVC.

ENTITY-MIB

The MIB module is for representing physical entities in the system.

IANAifType-MIB

The MIB module defines the IANAifType textual convention, and thus the enumerated values of the ifType object defined in MIB-II's ifTable.

IF-MIB

The MIB module, derived from RFC-2233, describes generic objects for network interface sub-layers. This MIB is an updated version of MIB-II's ifTable, and incorporates the extensions defined in RFC-1229.

IMA-MIB

The MIB module manages Inverse Multiplexing for ATM (IMA) interfaces.

PerfHist-TC-MIB

This MIB module provides textual conventions to be used by systems supporting 15-minute based performance history counts.

PNNI-MIB

The MIB module manages ATM PNNI routing.

RFC1213-MIB

This MIB module defines the second version of the Management Information Base (MIB-II) for use with network management protocols in TCP/IP- based internets.

RFC1406-MIB

This MIB module defines objects for managing DS1 interfaces, including T1 and E1.

RFC1407-MIB

This MIB module defines objects for managing DS3 and E3 interfaces.

RFC1595-MIB

The MIB module describes SONET/SDH interfaces objects.

SNMP-FRAMEWORK-MIB

This MIB Module defines the SNMP Management Architecture. See RFC-2271 for a description of this MIB module.

SNMP-TARGET-MIB

This MIB module defines MIB objects that provide mechanisms to remotely configure the parameters used by an SNMP entity for the generation of SNMP messages. See RFC-2273 for a description of this MIB module.

SNMP-USM-MIB

This MIB module contains management information definitions for the SNMP User-based Security Model. See RFC-2274 for a description of this MIB module.

SNMPv2-CONF

This MIB module is the SNMPv2 conformance MIB. See RFC-1904 for a description of this MIB module.

SNMPv2-MIB

This MIB module defines all SNMPv2 entities. See RFC-1907, Management Information Base for Version 2 of the Simple Network Management Protocol, for a description of this MIB module.

SNMPv2-SMI

See RFC-1902, Structure of Management Information for Version 2 of the Simple Network Management Protocol, for a description of this MIB module.

SNMPv2-TC

See RFC-1903, Textual Conventions for Version 2 of the Simple Network Management Protocol for a description of this MIB module.

SNMP-VACM-MIB

The management information definitions for the View-based Access Control Model for SNMP. See RFC-2275 for a description of this MIB module.

Cisco Enterprise MIB Modules

CISCO-ADSL-CAP-LINE-MIB

This MIB module defines managed objects that extend the ADSL-DMT-LINE-MIB. This MIB contains a table to configure the DSL profile.

CISCO-ADSL-DMT-LINE-MIB

This MIB module defines managed objects that extend the ADSL-DMT-LINE-MIB. This MIB contains a table to configure the DSL profile.

CISCO-ATM2-MIB

This MIB module extends the capabilities of the ATM-MIB. Specifically, it defines the managed objects that support signal monitoring and SVC signaling management.

CISCO-ATM-ACCESS-LIST-MIB

This MIB module defines the managed objects that support ATM access control.

CISCO-ATM-CONN-MIB

This MIB module augments the atmVplTable and atmVclTable defined by the ATM-MIB. In addition, it provides address tables for SVPs and SVCs.

CISCO-ATM-IF-MIB

This MIB module defines the managed objects that support the configuration of ATM interfaces.

CISCO-ATM-IF-PHYS-MIB

A set of managed objects for tracking the status of DS3/E3/DS1/E1 and SONET interfaces.

CISCO-ATM-RM-MIB

This MIB module defines the managed objects that support ATM resource management.

CISCO-ATM-SIG-DIAG-MIB

This MIB module defines the managed objects that facilitate the diagnosis of failures of ATM signaling requests.

CISCO-ATM-SWITCH-FR-IWF-MIB

This MIB module manages Frame Relay to ATM interworking connections, and Frame Relay to Frame Relay switched connections via an ATM switching fabric, on a Cisco ATM switch.

CISCO-ATM-SWITCH-FR-RM-MIB

This MIB module describes a set of objects used for switch Resource Management (RM) for Frame Relay/Frame based User-to-Network (FUNI) to ATM interworking function (IWF) connections.

CISCO-ATM-TRAFFIC-MIB

This MIB module augments the definition of the atmTrafficDescrParamTable defined by the ATM-MIB.

CISCO-BULK-FILE-MIB

This MIB module defines the managed objects that support the creation (and deletion) of bulk files of SNMP data.

CISCO-CONFIG-COPY-MIB

This MIB facilitates writing of configuration files in the following ways: to and from the net, copying running configurations to startup configurations and vice-versa, and copying a configuration (running or startup) to and from the local IOS file system.

CISCO-CONFIG-MAN-MIB

This MIB module defines the managed objects that facilitate the management of configuration files.

CISCO-ENTITY-ALARM-MIB

This MIB module defines the managed objects that support the monitoring of alarms generated by physical entities contained by the system.

CISCO-ENTITY-ASSET-MIB

This MIB module monitors the asset information of items in the ENTITY-MIB, such as serial numbers, and software and hardware revision levels.

CISCO-ENTITY-PROVISIONING-MIB

This MIB module defines the objects that support provisioning of “container'” class physical entities.

CISCO-ENTITY-VENDORTYPE-OID-MIB

This MIB module defines the enterprise-specific object identifiers that Cisco products use to populate the entPhysicalTable of the ENTITY-MIB.

CISCO-FTP-CLIENT-MIB

The MIB module is for invoking Internet File Transfer Protocol (FTP) operations for network management purposes.

CISCO-IDSL-LINE-MIB

This MIB module describes IDSL (ISDN Digital Line Subscriber) line interfaces. The structure of this module resembles that of the ADSL-LINE-MIB (RFC-2662).

CISCO-OAM-MIB

The MIB module describes objects for invoking OAM loopback ping on ATM connections.

CISCO-PNNI-MIB

The MIB module defines objects for managing Cisco specific extensions to the PNNI MIB.

CISCO-PRODUCTS-MIB

This MIB module defines the Cisco enterprise-specific object identifiers assigned to platforms. A platform assigns its corresponding object identifier to the sysObjectID object.

CISCO-SDSL-LINE-MIB

This MIB module describes all variations of the symmetric DSL line interfaces. The structure of this module resembles and maintains consistency with the ADSL-LINE-MIB, ADSL-DMT-LINE-MIB, CISCO-ADSL-DMT-LINE-MIB, and CISCO-ADSL-CAP-LINE-MIB.

CISCO-SMI

This MIB module defines the Cisco enterprise-specific structure of management information.

CISCO-SYSLOG-MIB

This MIB module defines the managed objects that support syslog monitoring.

CISCO-SYSTEM-MIB

The systemGroup (see RFC-1907) provides a standard set of basic system information. This MIB module contains Cisco-defined extensions to the systemGroup

CISCO-TABLE-MODIFICATION-TRACKING-MIB

The MIB module tracks and stores the modifications in data of NMS specified MIB tables implemented in the SNMP agent.

CISCO-XDSL-LINE-MIB

The MIB module contains a collection of managed objects that are general in nature and apply to different types of DSL modems. The structure of this module resembles the ADSL-LINE-MIB, CISCO-SDSL-LINE-MIB, ADSL-DMT-LINE-MIB, and CISCO-ADSL-DMT-LINE-MIB.

Storing the Configuration

After you complete autoconfiguration and any manual configurations, copy the configuration into NVRAM. If you power off your DSLAM prior to saving the configuration in NVRAM you lose all manual configuration changes.

An example of the **copy running-config** command is:

```
DSLAM# copy running-config startup-config
Building configuration...
[OK]
```

Testing the Configuration

After you finish configuring the DSLAM, you can use the commands described in this section to confirm the hardware, software, and interface configuration:

Confirming the Hardware Configuration

Use the **show hardware** command to confirm the correct hardware installation. For example:

```
DSLAM# show hardware
Chassis Type: C6260
I/O Card: 6260-E1-IO

Slot 1 : ATUC-1-4DMT                        Slot 17: STUC-4-2B1Q-DIR-1
Slot 2 : ATUC-1-4DMT                        Slot 18: ATUC-1-DMT8
Slot 3 : ATUC-1-4DMT                        Slot 19: ATUC-1-4DMT
Slot 4 : ATUC-1-4DMT                        Slot 20: ATUC-1-DMT8
Slot 5 : ATUC-1-4DMT                        Slot 21: ATUC-1-4DMT
Slot 6 : ATUC-1-4DMT                        Slot 22: ATUC-1-4DMT
Slot 7 : ATUC-1-4DMT                        Slot 23: ATUC-1-4DMT
Slot 8 : ATUC-1-4DMT                        Slot 24: ATUC-1-4DMT
Slot 9 : ATUC-4FLEXIDMT                     Slot 25: ATUC-1-4DMT
Slot 10: NI-2-DS3-T1E1                      Slot 26: ATUC-1-4DMT
Slot 11: EMPTY                              Slot 27: ATUC-4FLEXIDMT
Slot 12: ATUC-1-4DMT                        Slot 28: ATUC-1-4DMT
Slot 13: ATUC-4FLEXIDMT                     Slot 29: ATUC-1-DMT8
Slot 14: STUC-4-2B1Q-DIR-1                  Slot 30: ATUC-1-4DMT
```

```
Slot 15: STUC-4-2B1Q-DIR-1                    Slot 31: STUC-4-2B1Q-DIR-1
Slot 16: STUC-4-2B1Q-DIR-1                    Slot 32: ATUC-1-4DMT-I

Fan Module 1: Present   2: Present

Power Supply Module 1: 6260-PEM-AC
Power Supply Module 2: 6260-PEM-AC
```

Confirming the Software Version

Use the **show version** command to confirm that the correct version and type of software are being used and that the configuration register has been installed. For example:

```
DSLAM# show version
Cisco Internetwork Operating System Software
IOS (tm) NI2 Software (NI2-DSL-M), Experimental Version 12.1(20010416:212622) []
Copyright (c) 1986-2001 by cisco Systems, Inc.
Compiled Mon 16-Apr-01 17:26 by chrel
Image text-base: 0x800082C0, data-base: 0x8132A000

ROM: System Bootstrap, Version 12.0(5)DA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc)
BOOTFLASH: NI2 Software (NI2-DBOOT-M), Version 12.1(6)DA, EARLY DEPLOYMENT RELE)

6260_E1IMA uptime is 1 week, 6 days, 5 hours, 48 minutes
System returned to ROM by reload
System image file is "flash:ni2-dsl-mz.v121_7_da.20010416"

cisco 6260 (NI2) processor with 60416K/5120K bytes of memory.
RC64475 CPU at 100Mhz, Implementation 48, Rev 0.0
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
112 DMT DSL Port interface(s)
20 SDSL DSL Port interface(s)
13 ATM network interface(s)
522232 bytes of non-volatile configuration memory.

4096K bytes of Boot Flash (Sector size 128K).
16384K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
```

Confirming the Ethernet Configuration

Use the **show interface ethernet** command to confirm that the Ethernet interface is configured correctly. For example:

```
DSLAM# show interface ethernet 0/0
Ethernet0/0 is up, line protocol is up
  Hardware is AmdP2, address is 0001.64ff.a97f (bia 0001.64ff.a97f)
  Internet address is 172.21.186.145/24
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  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
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 2000 bits/sec, 3 packets/sec
```

```
  5 minute output rate 1000 bits/sec, 2 packets/sec
     910869 packets input, 202979554 bytes, 0 no buffer
     Received 890807 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     166029 packets output, 21332341 bytes, 0 underruns
     0 output errors, 9 collisions, 1 interface resets
     0 babbles, 0 late collision, 33 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

Confirming the ATM Address

Use the **show atm addresses** command to confirm correct configuration of the ATM address for the DSLAM. For example:

```
DSLAM# show atm addresses

Switch Address(es):
  47.0091.8100.0000.0001.64ff.a980.0001.64ff.a980.00 active
  NOTE: Switch addresses with selector bytes 01 through 7F
        are reserved for use by PNNI routing

PNNI Local Node Address(es):
  47.0091.8100.0000.0001.64ff.a980.0001.64ff.a980.01 Node 1

Soft VC Address(es):
  47.0091.8100.0000.0001.64ff.a980.4000.0c98.0020.00 ATM0/2
  47.0091.8100.0000.0001.64ff.a980.4000.0c98.0030.00 ATM0/3

Soft VC Address(es) for Frame Relay Interfaces :

ILMI Switch Prefix(es):
  47.0091.8100.0000.0001.64ff.a980

ILMI Configured Interface Prefix(es):

LECS Address(es):
```

Testing the Ethernet Connection

After you configure the IP addresses for the Ethernet interface, test for connectivity between the DSLAM and a host. The host can reside in any location on your network. To test for Ethernet connectivity, use this command:

Command	Task
DSLAM# **ping ip** *ip_address*	Test the configuration using the **ping** command. The **ping** command sends an echo request to the host specified in the command line.

For example, to test Ethernet connectivity from the DSLAM to a workstation with an IP address of 172.20.40.201, enter the command **ping ip 172.20.40.201**. If the DSLAM receives a response, this message appears:

```
DSLAM# ping ip 172.20.40.201

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.20.40.201, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1000 ms
```

Confirming the ATM Connections

Use the **ping atm** command to confirm that the ATM interfaces are configured correctly. For example:

```
DSLAM# ping atm interface atm 0/1 5 seg-loopback

Type escape sequence to abort.
Sending Seg-Loopback 5, 53-byte OAM Echoes to a neighbour,timeout is 5 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
DSLAM#
```

Confirming the ATM Interface Configuration

Use the **show atm interface** command to confirm the ATM interfaces are configured correctly. For example:

```
DSLAM# show atm interface

Interface:      ATM0/0          Port-type:      cpu
IF Status:      UP              Admin Status:   UP
Auto-config:    disabled        AutoCfgState:   not applicable
IF-Side:        not applicable  IF-type:        not applicable
Uni-type:       not applicable  Uni-version:    not applicable
Max-VPI-bits:   4               Max-VCI-bits:   14
Max-VP:         0               Max-VC:         4096
ConfMaxSvpcVpi: 0               CurrMaxSvpcVpi: 0
ConfMaxSvccVpi: 0               CurrMaxSvccVpi: 0
ConfMinSvccVci: 35              CurrMinSvccVci: 35
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
     26        0       0       0       0        0       0         26         26
Logical ports(VP-tunnels):     0
Input cells:    106840          Output cells:   0
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 0, Output AAL5 pkts: 0, AAL5 crc errors: 0


Interface:      ATM0/2          Port-type:      e1_ima_link
IF Status:      UP              Admin Status:   UP
Auto-config:    enabled         AutoCfgState:   waiting for response from peer
IF-Side:        Network         IF-type:        UNI
Uni-type:       Private         Uni-version:    V3.0
Max-VPI-bits:   8               Max-VCI-bits:   14
Max-VP:         255             Max-VC:         16383
ConfMaxSvpcVpi: 255             CurrMaxSvpcVpi: 255
ConfMaxSvccVpi: 255             CurrMaxSvccVpi: 255
ConfMinSvccVci: 35              CurrMinSvccVci: 35
```

```
Svc Upc Intent: pass            Signalling:     Enabled
ATM Address for Soft VC: 47.0091.8100.0000.0001.64ff.a980.4000.0c98.0020.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      2        0       0       0       1        0       0          3          2
Logical ports(VP-tunnels):     0
Input cells:    925             Output cells:   74
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 0, Output AAL5 pkts: 0, AAL5 crc errors: 0

         [additional interfaces deleted]
```

Confirming the Interface Status

Use the **show atm status** command to confirm the status of ATM interfaces. For example:

```
DSLAM# show atm status
NUMBER OF INSTALLED CONNECTIONS: (P2P=Point to Point, P2MP=Point to MultiPoint,)

Type     PVCs SoftPVCs     SVCs     TVCs     PVPs SoftPVPs     SVPs      Total
P2P        26        0        0        0        0        0        0         26
P2MP        0        0        0        0        0        0        0          0
MP2P        0        0        0        0        0        0        0          0
                                     TOTAL INSTALLED CONNECTIONS =         26

PER-INTERFACE STATUS SUMMARY AT 07:15:04 UTC Wed Oct 18 2000:
   Interface      IF         Admin  Auto-Cfg    ILMI Addr     SSCOP    Hello
     Name       Status       Status    Status    Reg State     State    State
------------- -------- ------------ -------- ------------ --------- --------
ATM0/0             UP           up      n/a  UpAndNormal      Idle      n/a
ATM0/2             UP           up  waiting   Restarting      Idle      n/a
```

Confirming Virtual Channel Connections

Use the **show atm vc** command to confirm the status of ATM virtual channels. For example:

```
DSLAM# show atm vc
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI  Encap Status    Name
ATM0/0       0     36     PVC     ATM0/2       0     16    ILMI   DOWN
ATM0/0       0     38     PVC     ATM0/2       0     5     QSAAL  DOWN
ATM0/0       0     500    PVC     ATM0/1       0     500   SNAP   UP
ATM0/1       0     500    PVC     ATM0/0       0     500   SNAP   UP
ATM0/2       0     5      PVC     ATM0/0       0     38    QSAAL  DOWN
ATM0/2       0     16     PVC     ATM0/0       0     36    ILMI   DOWN
```

Confirming the Running Configuration

Use the **show running-config** command to confirm that the configuration being used is configured correctly. For example:

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

Current configuration : 12407 bytes
!
version 12.1
no service pad
```

```
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 6260_E1IMA
!
boot system flash:ni2-dsl-mz.v121_7_da.20010416
slot 1 ATUC-1-4DMT
slot 2 ATUC-1-4DMT
slot 3 ATUC-1-4DMT
slot 4 ATUC-1-4DMT
slot 5 ATUC-1-4DMT
slot 6 ATUC-1-4DMT
slot 7 ATUC-1-4DMT
slot 8 ATUC-1-4DMT
slot 9 ATUC-4FLEXIDMT
slot 10 NI-2-DS3-T1E1
slot 12 ATUC-1-4DMT
slot 13 ATUC-4FLEXIDMT
slot 14 STUC-4-2B1Q-DIR-1
slot 15 STUC-4-2B1Q-DIR-1
slot 16 STUC-4-2B1Q-DIR-1
slot 17 STUC-4-2B1Q-DIR-1
slot 18 ATUC-1-DMT8
slot 19 ATUC-1-4DMT
slot 20 ATUC-1-DMT8
slot 21 ATUC-1-4DMT
slot 22 ATUC-1-4DMT
slot 23 ATUC-1-4DMT
slot 24 ATUC-1-4DMT
slot 25 ATUC-1-4DMT
slot 26 ATUC-1-4DMT
slot 27 ATUC-4FLEXIDMT
slot 28 ATUC-1-4DMT
slot 29 ATUC-1-DMT8
slot 30 ATUC-1-4DMT
slot 31 STUC-4-2B1Q-DIR-1
slot 32 ATUC-1-4DMT-I
no logging console
enable password cisco
!
!
!
!
!
!
dsl-profile default
 alarms
 dmt check-bytes interleaved downstream 4 upstream 6
 dmt codeword-size downstream 16 upstream 8
 sdsl bitrate 528
!
atm oam max-limit 1600
no atm oam intercept end-to-end
atm address 47.0091.8100.0000.0001.64ff.a980.0001.64ff.a980.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
  redistribute atm-static
!
atm ni2-switch trunk ATM0/IMA0
!
icm size 4194304
!
```

```
!
interface ATM0/0
 no ip address
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvpi-bits 4
!
interface Ethernet0/0
 ip address 172.21.186.145 255.255.255.0
!
interface ATM0/2
 no ip address
 no atm ilmi-keepalive
 atm oam 0 5 seg-loopback
 atm oam 0 16 seg-loopback
 clock source loop-timed
 framing crc4
 lbo short gain10
 ima-group 0
!
ip default-gateway 172.21.186.129
ip classless
ip route 0.0.0.0 0.0.0.0 172.21.186.129
no ip http server
!
atm route 47.0091.8100.5670.0000.ca7c.e01... ATM0/0
snmp-server trap-source ATM0/0
snmp-server enable traps config
snmp-server enable traps alarms
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password cisco
 login
!
end
```

Confirming the Saved Configuration

Use the **show startup-config** command to confirm that the configuration saved in NVRAM is configured correctly. For example:

```
DSLAM# show startup-config
Using 1657 out of 522232 bytes
!
! Last configuration change at 11:35:31 EDT Thu Jun 3 1999
! NVRAM config last updated at 11:40:08 EDT Thu Jun 3 1999
!
version XX.X
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service internal
!
hostname ni2-3
!
enable password lab
!
```

```
!
dmt-profile default
network-clock-select 1 ATM0/1
network-clock-select 2 system
ip subnet-zero
ip host-routing
ip domain-name cisco.com
ip name-server 171.69.204.11
!
atm address 47.0091.8100.0000.007b.f444.7801.007b.f444.7801.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
  redistribute atm-static
!
clock timezone EST -5
clock summer-time EDT recurring
!
process-max-time 200
!
interface ATM0/0
 ip address 70.0.0.2 255.0.0.0
 no ip directed-broadcast
 map-group test
 atm cac service-category abr deny
 atm maxvp-number 0
!
interface Ethernet0/0
 ip address 172.27.32.157 255.255.255.0
 no ip directed-broadcast
 no ip proxy-arp
 no keepalive
!
interface ATM0/1
 no ip address
 no ip directed-broadcast
 no atm auto-configuration
 no atm ilmi-keepalive
 no atm address-registration
 no atm ilmi-enable
 atm cac service-category abr deny
 atm manual-well-known-vc
 atm nni
 atm pvc 0 500  interface  ATM0/0 0 500  encap aal5snap
 atm oam 0 500 seg-loopback
!
interface ATM0/2
 no ip address
 no ip directed-broadcast
 no atm ilmi-keepalive
 atm cac service-category abr deny
!
ip default-gateway 172.27.144.4
ip classless
!
!
map-list test
 ip 70.0.0.1 atm-vc 500
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
```

```
 exec-timeout 0 0
 password lab
 login
!
sntp server 171.69.204.139
end
```

Configuring Digital Subscriber Lines

This chapter describes how to configure Cisco digital subscriber line access multiplexers (DSLAMs) with NI-2 for digital subscriber line (DSL) service. The chapter contains the following sections:

Configuring Line Card Elements

The following sections discuss configuring ports and slots on line cards:

Enabling and Disabling a Port

This section describes how to enable or disable a port.

To enable a port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Go to interface configuration mode and specify the port you want to enable.
Step 3	`DSLAM(config-if)# no shutdown`	Enable the specified port.

To disable a port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm slot/port`	Go to interface configuration mode and specify the port you want to disable.
Step 3	`DSLAM(config-if)# shutdown`	Disable the specified port.

Example

This example enables port 1 on slot 20 and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# interface atm 20/1
DSLAM(config-if)# no shutdown
DSLAM(config-if)# end
DSLAM# show dsl interface atm 20/1
Port Status:
   Subscriber Name:          Circuit ID:
   IOS admin: UP     oper: UP     Card status: Present
   Last Change: 36352 days, 13 hrs, 51 min, 47 sec No. of changes: 0
   Line Status: TRAINED
   Test Mode:   NONE

ADSL Chipset Self-Test: NONE

CO Modem Firmware Version: 0x1319BE02
.
.
.
```

Note The admin status is modified by the **shutdown** and **no shutdown** commands. The oper (operational) status is a function of the ATM switch fabric and the DSL line state.

Assigning Port Names

This section describes how to assign a name to a DSL subscriber port. The name can contain up to 64 printable characters. Alphanumerics and most special characters (underscores, hyphens, and ampersands, for example) are allowed. Spaces and quotes are not allowed.

To assign a name to a DSL subscriber port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm slot/port`	Specify the slot and port.
Step 3	`DSLAM(config-if)# dsl subscriber name`	Assign *name* to the port.

Example

In this example, the name “curley” is assigned to slot 9, port 2.

```
DSLAM# configure terminal
DSLAM(config)# interface atm 9/2
DSLAM(config-if)# dsl subscriber curley
```

Assigning Circuit IDs

This section describes how to assign an identifier to a DSL circuit. The circuit ID may contain up to 32 printable characters. Alphanumerics and most special characters (underscores, hyphens, and ampersands, for example) are allowed. Spaces and quotes are not allowed.

To assign an identifier to a DSL circuit, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Specify the slot and port.
Step 3	`DSLAM(config-if)# dsl circuit` *circuit-id*	Assign *circuit-id* to the port.

Example

In this example, the circuit ID 341 is assigned to slot 9, port 2.

```
DSLAM# configure terminal
DSLAM(config)# interface atm 9/2
DSLAM(config-if)# dsl circuit 341
```

Displaying Debugging Information for a Port

This section describes how to display debugging information for a port.

To display debugging information for a port, follow this step:

	Command	Task
Step 1	`DSLAM# show controllers atm` *slot/port*	Display debugging information for the selected port.

The output for this command varies with the interface type. It provides low level diagnostic information specific to the physical layer chipset.

Command output for a DMT interface, for example, includes these items:

- Absolute signal-to-noise ratio (SNR) for each of the upstream bins.
- Bit allocation for each of the upstream and downstream bins.

Note Output items for SDSL and SHDSL ports will display one value for both upstream and downstream.

- Downstream transmit power boost (power spectral density mask, config, and actual). Autoconfigured power boost displays as a whole number of decibels. Actual power boost displays in decibels to one decimal place (0.1 dB) accuracy.
- The contents of the configuration management variables (CMV) for 4xDMT line cards:

Example

In this example, the command displays debugging information for ATM 0/1 and ATM 5/2:

```
DSLAM> show controllers atm 0/1

IF Name: ATM0/1    Chip Base Address: B3809000
Port type: OC3    Port rate: 155000 kbps    Port medium: SM Fiber

Alarms:
Source: ATM0/1 working  Severity: CRITICAL Description: 5    Loss of Pointer

                                  local            peer
                                (working)        (protection)
                                 ACTIVE           INACTIVE
                               ---------------   ---------------
Port status                           PATH LOP     Not available
Loopback                                  None     Not available
Flags                                   0x8000     Not available
TX clock source                network-derived     Not available
Framing mode                             stm-1     Not available
Cell payload scrambling                    Off     Not available
Sts-stream scrambling                      Off     Not available
TX Led:                                    Off     Not available
RX Led:                                     On     Not available
TST Led:                                   Off     Not available

OC3 counters:
  cells transmitted                    1839247                0
  cells received                       2024203                0
  cells sent to peer                   1839247                0
  cells received from peer                   0                0
  section BIP-8 errors                 9645705                0
  line BIP-8 errors                   21155177                0
  path BIP-8 errors                   12760636                0
  OOCD errors (not supported)                0                0
  line FEBE errors                    46129207                0
  path FEBE errors                    35186798                0
  correctable HEC errors                325812                0
  uncorrectable HEC errors             5844870                0

OC3 errored seconds:
  section BIP-8                         703612                0
  line BIP-8                            706598                0
  path BIP-8                            703393                0
  OOCD (not supported)                       0                0
  line FEBE                             1107288                0
  path FEBE                             1108785                0
  correctable HEC                        177587                0
  uncorrectable HEC                      588255                0

OC3 error-free secs:
  section BIP-8                         414959                0
  line BIP-8                            411973                0
  path BIP-8                            415178                0
  OOCD (not supported)                       0                0
  line FEBE                              11283                0
  path FEBE                               9786                0
  correctable HEC                        940984                0
  uncorrectable HEC                      530316                0
```

```
                 local   peer                        local   peer
                 -----   ----                        -----   ----
Per chip registers
  mr             0x69    0x00    |   mmc              0x6B    0x00
  mcmr           0x6F    0x00    |   cscsr            0x54    0x00
  ictl           0x5F    0x00    |   opc              0x00    0x00
  pop0sr         0x3E    0x00    |   pop1sr           0x06    0x00
  pop2sr         0x3E    0x00    |   pop3sr           0x06    0x00

Per port registers
  mcfgr          0x70    0x00    |   misr             0x21    0x00
  mctlr          0x50    0x00    |   crcsr            0x20    0x00
  transs         0x00    0x00    |   rsop_cier        0x66    0x00
  rsop_sisr      0x58    0x00    |   rsop_bip80r      0x74    0x00
rsop_bip81r     0xBB   0x00    |   tsop_ctlr       0xC0   0x00
  tsop_diagr     0xC0    0x00    |   rlop_csr         0x00    0x00
  rlop_ieisr     0x04    0x00    |   rlop_bip8_240r   0x76    0x00
  rlop_bip8_241r 0x38    0x00    |   rlop_bip8_242r   0x31    0x00
  rlop_febe0r    0x00    0x00    |   rlop_febe1r      0x00    0x00
  rlop_febe2r    0x00    0x00    |   tlop_ctlr        0x20    0x00
  tlop_diagr     0x20    0x00    |   tx_k1            0x00    0x00
  tx_k2          0x00    0x00    |   rpop_scr         0x60    0x00
  rpop_isr       0x03    0x00    |   rpop_ier         0x00    0x00
  rpop_pslr      0xFF    0x00    |   rpop_pbip80r     0x49    0x00
  rpop_pbip81r   0x7C    0x00    |   rpop_pfebe0r     0x67    0x00
  rpop_pfebe1r   0x48    0x00    |   rpop_pbip8cr     0x00    0x00
  tpop_cdr       0x00    0x00    |   tpop_pcr         0x00    0x00
  tpop_ap0r      0x00    0x00    |   tpop_ap1r        0x08    0x00
  tpop_pslr      0x13    0x00    |   tpop_psr         0x00    0x00
  racp_csr       0x86    0x00    |   racp_iesr        0x00    0x00
  racp_mhpr      0x00    0x00    |   racp_mhmr        0x00    0x00
  racp_checr     0x00    0x00    |   racp_uhecr       0x00    0x00
  racp_rcc0r     0x00    0x00    |   racp_rcc1r       0x00    0x00
  racp_rcc2r     0x00    0x00    |   racp_cfgr        0xFC    0x00
  tacp_csr       0x06    0x00    |   tacp_iuchpr      0x01    0x00
  tacp_iucpopr   0x6A    0x00    |   tacp_fctlr       0x10    0x00
  tacp_tcc0r     0xAE    0x00    |   tacp_tcc1r       0x63    0x00
  tacp_tcc2r     0x65    0x00    |   tacp_cfgr        0x08    0x00
  rase_ie        0x06    0x00    |   rase_is          0x00    0x00
  rase_cc        0x00    0x00    |   rase_sfap1       0x08    0x00
  rase_sfap2     0x00    0x00    |   rase_sfap3       0x00    0x00
  rase_sfst1     0xFF    0x00    |   rase_sfst2       0xFF    0x00
  rase_sfdt1     0x45    0x00    |   rase_sfdt2       0x42    0x00
  rase_sfct1     0x86    0x00    |   rase_sfct2       0x82    0x00
  rase_rK1       0xAD    0x00    |   rase_rK2         0x71    0x00
  rase_rS1       0x0E    0x00

APS control register:    0x0051 |   0x0000

Local bus timeouts detected:       0
Remote bus timeouts detected:      0
UTOPIA bus parity errors detected: 0
```

```
DSLAM> show controllers atm 5/2

ATM 5/2

Upstream SNR (in Tenths of dB)
      Sub Channel    SNR      Sub Channel    SNR
          0            0         16           250
          1            0         17           270
          2            0         18           269
          3            0         19           286
          4            0         20           279
          5            0         21           307
          6            0         22           313
          7            0         23           312
          8            0         24           328
          9            0         25           323
         10            0         26           349
         11          282         27           349
         12          271         28           366
         13          278         29           356
         14          258         30           349
         15          262         31           353

Upstream Bit Allocation
      Sub Channel    Bits Allocated      Sub Channel    Bits Allocated
          0                0              16                2
          1                0              17                2
          2                0              18                2
          3                0              19                3
          4                0              20                3
          5                0              21                3
          6                0              22                3
          7                0              23                2
          8                0              24                2
          9                0              25                2
         10                0              26                2
         11                2              27                3
         12                2              28                2
         13                2              29                2
         14                2              30                2
         15                2              31                3

Upstream TX Gain (in Tenths of dB)
      Sub Channel        TX Gain         Sub Channel        TX Gain
          0                0              16                0
          1                0              17                0
          2                0              18                0
          3                0              19                0
          4                0              20                0
          5                0              21                0
          6                0              22                0
          7                0              23                0
          8                0              24                0
          9                0              25                0
         10                0              26                0
         11                0              27                0
         12                0              28                0
         13                0              29                0
         14                0              30                0
         15                0              31                0
```

```
Downstream Bit Allocation
    0   16   32   48   64   80   96  112  128  144  160  176  192  208  224  240
--------------------------------------------------------------------------------
    0    0    0    0    0    2    2    2    2    0    2    0    0    2    0    0
    0    0    0    0    0    2    2    2    2    2    0    0    0    2    0    0
    0    0    0    0    0    2    2    2    2    0    2    0    0    2    0    0
    0    0    0    0    2    2    2    2    0    0    2    0    2    2    0    0
    0    0    0    0    0    2    0    2    2    0    2    0    2    0    0    0
    0    0    0    0    2    2    2    2    2    0    0    0    0    0    0    0
    0    0    0    0    0    2    0    2    0    0    2    0    2    0    0    0
    0    0    0    0    2    2    2    2    2    2    2    0    2    0    0    0
    0    0    0    0    2    2    0    2    2    2    2    0    0    0    0    0
    0    0    0    0    2    2    0    2    0    0    2    0    2    0    0    0
    0    0    0    0    2    2    2    2    0    0    0    0    2    0    0    0
    0    0    0    0    2    2    2    2    0    0    0    0    2    0    0    0
    0    0    0    0    2    2    2    2    0    2    0    2    2    0    0    0
    0    0    0    0    2    2    0    2    0    2    2    0    2    0    0    0
    0    0    0    0    2    0    2    2    0    2    2    0    2    0    0    0
    0    0    0    0    2    2    0    2    0    2    0    0    2    0    0    0

Downstream TX Gain (in Tenths of dB)
    0   16   32   48   64   80   96  112  128  144  160  176  192  208  224  240
--------------------------------------------------------------------------------
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

Configuring a Slot

To configure a slot for a specific card type, use these commands:

	Command	Task
Step 1	`DSLAM#` **`configure terminal`**	Go to global configuration mode.
Step 2	`DSLAM(config)#` **`slot`** *`slot# cardtype`*	Configure the *slot#* to the desired *cardtype***.**

The slot number range varies by platform; the maximum range is 1 to 38. These card types are available:

- ATUC-1-4DMT—4-port DMT card
- ATUC-1-4DMT-I—4-port DMT over ISDN card
- ATUC-1-DMT8—8-port DMT card
- ATUC-1-DMT8-I—8-port DMT over ISDN card

- ATUC-4FLEXICAP—4-port flexi card configured as CAP
- ATUC-4FLEXIDMT—4-port flexi card configured as DMT
- ATUC-8-DMT-1-H—8-port DMT OSP card
- ITUC-1-8IDSL—8-port IDSL card
- STUC-4-2B1Q-DIR-1—4-port SDSL card
- STUC-8-TCPAM—8-port G.SHDSL card

Note Some line cards do not function in all NI-2 DSLAM systems. Consult the hardware documentation for your DSLAM to determine which line cards it supports.

Example

This example configures slot 12 for a 4-port SDSL card and displays the hardware associated with the slot.

```
DSLAM# configure terminal
DSLAM(config)# slot 12 STUC-4-2B1Q-DIR-1
DSLAM(config)# exit
DSLAM# show hardware slot 12

Slot 12: STUC-4-2B1Q-DIR-1

        Hardware Revision        : 2.0
        Part Number              : 800-07416-02
        Board Revision           : A0
        Deviation Number         : 0-0
        Fab Version              : 02
        PCB Serial Number        : FX900561224
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        CLEI Code                : VALITKFBAC
        Asset Identifier         :
        Platform features        : 48 79 AD 35 56 41 4C 49
                                   54 4B 46 42 41 43 BC C1
                                   7B 12 41 E8 E1 85 0C 41
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 40 01 D6 41 02 00 C0 46 03 20 00 1C F8 02
          0x10: 42 41 30 80 00 00 00 00 02 02 C1 8B 46 58 39 30
          0x20: 30 35 36 31 32 32 34 03 00 81 00 00 00 00 04 00
          0x30: C6 8A 56 41 4C 49 54 4B 46 42 41 43 CC 20 00 00
          0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 C9 18
          0x60: 48 79 AD 35 56 41 4C 49 54 4B 46 42 41 43 BC C1
          0x70: 7B 12 41 E8 E1 85 0C 41 FF FF FF FF FF FF FF FF
```

If the detected card type matches the slot provisioning for ATU-C or STU-C, the respective card type is displayed. When a provisioned slot is empty or does not match the slot provisioning, the word “Missing” is displayed.

Note If you attempt to provision an empty slot, the major alarm “Provisioned slot is empty” is asserted.

Intermixing Line Cards

The line coding used by the 4-port flexi line card is spectrally incompatible with the line coding for both the 8-port IDSL line card and the 4-port SDSL (STU-C) line card. If you install spectrally incompatible cards in the same half of the chassis, the lines served by those cards can suffer reduced performance.

The 8xDMT line card is not spectrally compatible with SDSL or IDSL. Place these cards in a separate chassis half when using them in the same chassis as 8xDMT line cards. For best performance in a chassis with a mixture of line card types, always install flexi or 8xDMT cards in one half of the chassis and install IDSL and SDSL cards on the opposite side.

In the Cisco 6160 and Cisco 6260 chassis, you can mix DMT line cards and G.SHDSL line cards by chassis quadrant instead of chassis half. You can mix the 4xDMT, 4xFlexi DMT, and 8xDMT cards in the same quadrant. For example, you can install 24 DMT cards in quadrants 1, 2, and 3 and 6 G.SHDSL cards in quadrant 4.

Note See the hardware installation guide for your specific DSLAM system for more detailed information about line card intermixing.

Errors

Card mismatch error conditions occur under the following circumstances:

- If a line card of a different type is already installed in the named slot
- If you provision a slot for one type of card and insert another type of card into the named slot

Note You must provision an ATU-C flexi for CAP or DMT line coding before it will operate.

Using DSL Profiles

The following sections discuss using the DSL profiles:

- Creating, Modifying, or Deleting a Profile, page 4-10
- Copying a Profile, page 4-11
- Attaching or Detaching a Profile, page 4-12
- Displaying a Profile, page 4-13

With the exception of a few dynamic operational modes, port configuration takes place through a configuration profile rather than by direct configuration. A profile is a named list of configuration parameters with a value assigned to each parameter. You can change the value of each parameter in the profile. To configure a subscriber, you need only attach the desired profile to that subscriber. When you change a parameter in a profile you change the value of that parameter on all ports using that profile. If you want to change a single port or a subset of ports, you can copy the profile, change the desired parameters, and then assign the new profile to the desired ports.

Note If you modify an existing profile, that change takes effect on every asymmetric digital subscriber line (ADSL) port linked to that profile.

This profile configuration approach is consistent with ADSL management information base (MIB) standards.

The DSLAM implementation uses the dynamic profile approach as opposed to the static profile approach. The dynamic profile approach supports a many-to-one correspondence between ports and profiles; that is, multiple ports can share the same profile but not vice versa. Also, with the dynamic approach, profiles are created and destroyed dynamically (with the exception of a special profile named "default"). Direct configuration of port parameters is not allowed.

Note When you create a profile, it inherits all of the configuration settings of the special profile named "default" at the time of creation. If you subsequently modify the special profile "default," the changes do not propagate to profiles created by the original default profile.

Using profiles introduces a new command mode, profile mode. Use the command **dsl-profile** to enter profile mode. When you are in profile mode, changes you make to parameters affect only the profile you specify.

The following example sets the interleaved forward error correction (FEC) check bytes for a profile named "test" to 6 upstream and 4 downstream. Other profiles do not change:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile test
DSLAM(cfg-dsl-profile)# dmt check-bytes interleaved downstream 4 upstream 6
```

Creating, Modifying, or Deleting a Profile

This section describes how to create or delete a profile, and how to select a profile for modification.

To create a profile, or to select a profile for modification, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Create a profile named *profile-name*, or select an existing profile named *profile-name* for modification.

To delete a profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# no dsl-profile` *profile-name*	Deleted *profile-name*.

Examples

The following example creates a DSL profile named "fast2." After you execute these steps, you can modify the parameters for this profile:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile fast2
DSLAM(cfg-dsl-profile)#
```

Copying a Profile

To copy a profile to an identical profile with a different name, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-copy-profile [force] source source-profile destination new-profile`	Copy the profile named *source-profile* to a profile named *new-profile.* Force lets you overwrite the destination profile, if it exists.

If the destination profile indicated in this command does not exist, **dsl-copy-profile** creates it. The command then copies all nondefault configurations defined for the source profile to the destination profile.

Example

This example copies the default profile to a profile named “fast” and displays the results. If “fast” does not exist, the command creates it. Use the command **show dsl profile** to confirm the existence and parameters for the new profile:

```
DSLAM# configure terminal
DSLAM(config)# dsl-copy-profile force source default destination fast
DSLAM(config)# exit
DSLAM# show dsl profile fast
dsl profile fast:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled
DMT profile parameters
      Maximum Bitrates:
         Interleave Path:  downstream:  8032/kbs,   upstream:   480/kbs
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
.
.
.
```

Attaching or Detaching a Profile

This section describes how to attach a profile to or detach a profile from a slot or port.

To attach a profile from a slot or port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Go to interface configuration mode and specify the *slot/port* to which you want to attach the profile.
Step 3	`DSLAM(config-if)# dsl profile` *profile-name*	Attach *profile-name* to the slot/port.

To detach a profile from a slot or port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Go to interface configuration mode and specify the *slot/port* from which you want to detach the profile.
Step 3	`DSLAM(config-if)# no dsl profile` *profile-name*	Detach *profile-name* from the specified slot/port.

Example

This example attaches the profile "test1" to slot 20, port 1, and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# interface atm 20/1
DSLAM(config-if)# dsl profile test1
DSLAM(config-if)# exit
DSLAM(config)# exit
DSLAM# show dsl interface atm 20/1
Port Status:
   Subscriber Name:          Circuit ID:
   IOS admin: UP     oper: UP     Card status: Present
   Last Change: 36352 days, 13 hrs, 51 min, 47 sec No. of changes: 0
   Line Status: TRAINED
   Test Mode:   NONE

ADSL Chipset Self-Test: NONE

CO Modem Firmware Version: O.21

Configured:
      DMT Profile Name: fast
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled
.
.
.
```

Displaying a Profile

To display a profile and all the ports currently connected to it, complete the following task:

Command	Task
DSLAM# **show dsl profile** *profile-name*	Display a profile and all the ports currently connected to it.

Note If you omit the *profile-name* argument, this command displays profile information for all existing DSL profiles.

Example

This example displays the profile “fast”:

```
DSLAM# show dsl profile fast

dsl profile fast:
Link Traps Enabled: NO
      Alarms Enabled: YES
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
.
.
.
```

Setting DSL Profile Parameters

The following sections describe the various parameters that can be set within a DSL profile:

Enabling and Disabling Alarms

You can enable and disable alarms for a selected DSL profile using a single command. The alarms apply to these event classes:

- Near End LOS (loss of signal)
- Near End LOCD (loss of cell delineation)
- Near End LOF (loss of frame)
- ATU-C DMT port failure
- Up or downstream bit rate not above minimum bit rate

DSL alarms are disabled by default.

To enable DSL alarms, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify a profile.
Step 3	`DSLAM(cfg-dsl-profile)# alarms`	Enable alarms for that profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To disable DSL alarms, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to the global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify a profile.
Step 3	`DSLAM(cfg-dsl-profile)# no alarms`	Disable alarms for that profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

This example enables alarms for the default profile and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# alarms
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile default

dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: YES
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path: downstream:  640/kbs,   upstream:  128/kbs
      Minimum Bitrates:
         Interleave Path: downstream:    0/kbs,   upstream:    0/kbs
         .
         .
         .
```

Enabling and Disabling LinkUp/Down Traps

You can enable and disable linkUp/Down traps for a selected DSL profile using a single command. The linkUp/Down traps are generated only when the global configuration, the profile configuration and the interface level configuration are all enabled. The traps are disabled on a profile by default.

To enable the linkUp/Down traps follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global config mode.
Step 2	`DSLAM(config)# dsl-profile profilename`	Specify a profile.
Step 3	`DSLAM(cfg-dsl-profile)# snmp trap link-status`	Enable traps for that profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile config mode.

To disable the linkUp/Down traps, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global config mode.
Step 2	`DSLAM(config)# dsl-profile profilename`	Specify a profile.
Step 3	`DSLAM(cfg-dsl-profile)# no snmp trap link-status`	Enable traps for that profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile config mode.

Example

This example enables linkUp/Down traps for the default profile and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# snmp trap link-status
DSLAM(cfg-dsl-profile)# end

DSLAM# show dsl profile default

dsl profile default:
      Link Traps Enabled: YES
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled

 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
```

Enabling and Disabling Payload Scrambling

This section describes how to enable and disable cell payload scrambling on a DMT subscriber port. Payload scrambling is enabled by default.

To disable payload scrambling, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify the *profile-name* for which you want to disable payload scrambling.
Step 3	`DSLAM(cfg-dsl-profile)# no payload-scrambling`	Disable payload scrambling.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To enable payload scrambling, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify the *profile-name* for which you want to enable payload scrambling.
Step 3	`DSLAM(cfg-dsl-profile)# payload-scrambling`	Enable payload scrambling.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

The two ends of a connection must have the same payload scrambling value—that is, payload scrambling must be enabled at both ends or disabled at both ends. Otherwise, the line does not train.

Enabling or disabling payload scrambling does not cause the port to retrain.

Setting CAP Upstream and Downstream Baud Rate Margins

This section describes how to configure upstream and downstream baud rate margins for ATU-C CAP, and ATU-C flexi CAP interfaces.

Cisco IOS supports provisioning additional baud rates for interface line codes. The following rules apply:

- Valid rate, Cisco IOS selects a rate less than or equal to the rate that you specified.
- Invalid rate, Cisco IOS modifies the rate to the closest available rate that is less than or equal to the rate that you specified.

In addition to the existing upstream 136 kilobaud rate, Cisco IOS also supports an upstream 17 kilobaud rate and an upstream 68 kilobaud rate. You can independently enable or disable the new baud rates.

The following list contains the valid upstream/downstream pairs within the available rates:

- An upstream rate of 17 kilobaud is valid only with a downstream rate of 136 kilobaud.
- An upstream rate of 68 kilobaud is valid only with a downstream rate of 136 kilobaud or a downstream rate of 340 kilobaud.
- All other combinations are valid.

Table 4-1 and Table 4-2 show the upstream and downstream baud rates and their corresponding bit rates for the ATU-C CAP and ATU-C flexi CAP interfaces.

Table 4-1 ATU-C CAP and ATU-C Flexi CAP Upstream Baud Rates and Corresponding Bit Rates

Module	Upstream Baud Rate	Upstream Bit Rate (kbps)
ATU-C CAP/ ATU-C flexi CAP	136 kilobaud	1088, 952, 816, 680, 544, 408, 272 91
	68 kilobaud	544, 476, 408, 340, 272, 204, 136, 46
	17 kilobaud	136, 119, 102, 85, 68, 51, 34, 12

Table 4-2 ATU-C CAP and ATU-C Flexi CAP Downstream Baud Rates and Corresponding Bit Rates

Module	Downstream Baud Rate	Downstream Bit Rate (kbps)
ATU-C CAP/ ATU-C flexi CAP	952 kilobaud	7168, 6272, 4480, 2688
	680 kilobaud	5120, 4480, 3200, 1920
	340 kilobaud	2560, 2240, 1920, 1600, 1280, 960, 640
	136 kilobaud—RS[1] enabled	1024, 896, 768, 640, 512, 384, 256
	136 kilobaud—RS disabled	1088, 952, 816, 680, 544, 408, 272

1. Reed-Solomon coding—long/short interleave

The following information applies to Table 4-1 and Table 4-2:

- Enabling 17 kilobaud upstream and 68 kilobaud upstream rates are not mutually exclusive.
- The valid upstream rates are the union of the common rates (136 kilobaud upstream) and the bit rates corresponding to the new bauds (17 kilobaud upstream and 68 kilobaud upstream).
- If a given upstream rate appears in more than one selected baud rate list, the higher baud rate applies.

To enable baud rates, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to enable baud rates.
Step 3	`DSLAM(cfg-dsl-profile)# cap baud {downstream` *baudrate* `| upstream` *baudrate*`}`	Enable one or more baud rates for the designated CAP profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To disable baud rates, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to disable baud rates.
Step 3	`DSLAM(cfg-dsl-profile)# no cap baud` {**downstream** *baudrate* | **upstream** {*baudrate* | *baudrate* }}	Disable one or more baud rates for the specified CAP profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Setting Upstream and Downstream Bit Rates

This section describes how to configure upstream and downstream bit rates for ATU-C CAP and ATU-C flexi CAP, DMT, STU-C, and SHTU-C interfaces.

Setting Bit Rate Parameters for ATU-C CAP Interfaces

To set the downstream and upstream minimum or maximum bit rates for a CAP interface, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the bit rate.
Step 3	`DSLAM(cfg-dsl-profile)# cap bitrate` {**minimum** | **maximum**} **downstream** *int* **upstream** *int*	Set the bit rate for downstream and upstream for the CAP interface for this profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To return the downstream and upstream bit rates for a CAP interface to their default values, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the default bit rate.
Step 3	`DSLAM(cfg-dsl-profile)# no cap bitrate` {**minimum** | **maximum** } **downstream** *int* **upstream** *int*	Set this profile to the default bit rate.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Defaults

The following list shows the defaults for minimum and maximum downstream and upstream bit rates for the ATU-C CAP interface.

Value Type	Default
Minimum downstream	0 kbps
Minimum upstream	0 kbps
Maximum downstream	640 kbps
Maximum upstream	91 kbps

The alarm subsystem uses the minimum bit rate settings. Cisco IOS software asserts an alarm if the line card trains at a rate below the configured minimum bit rate.

Examples

In this example, the command sets the maximum downstream and upstream bit rates to 7168 kbps, and 1088 kbps, respectively:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# cap bitrate maximum downstream 7168 upstream 1088
DSLAM(cfg-dsl-profile)# end
```

In this example, the command sets the maximum downstream and upstream bit rates to the default values for that particular interface. In this case, it is a quad-port ATU-C flexi CAP.

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# cap bitrate maximum downstream 640 upstream 91
DSLAM(cfg-dsl-profile)# end
```

Setting Bit Rate Parameters for DMT Interfaces

To set the maximum allowed bit rate for interleaved-path DMT parameters for a specific profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the maximum allowed bit rate for interleaved-path DMT profile parameters.
Step 3	`DSLAM(cfg-dsl-profile)# dmt bitrate max interleaved downstream` *dmt-bitrate* `upstream` *dmt-bitrate*	Set the maximum allowed downstream and upstream bit rates for interleaved-path DMT profile parameters to *dmt-bitrate*.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To set the minimum allowed bit rate for interleaved-path DMT parameters for a specific profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the minimum allowed bit rate for interleaved-path DMT profile parameters
Step 3	`DSLAM(cfg-dsl-profile)# dmt bitrate min interleaved downstream` *dmt-bitrate* `upstream` *dmt-bitrate*	Set the maximum allowed downstream and upstream bit rates for interleaved path DMT profile parameters to *dmt-bitrate*.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

The Cisco IOS software does not send minimum bit rate settings to the line card. The software uses these settings locally to determine if a line rate alarm should be set for a port.

Setting the DMT minimum bit rate to 0 disables the associated minimum DMT bit rate alarm.

Table 4-3 lists the allowable ranges and default values for DMT bit rate.

Table 4-3 Allowable Ranges and Default Values for DMT Bit Rates

		Downstream Bit Rate			Upstream Bit Rate		
Configuration Parameter	**Data Path**	**Aggregate Range (kbps)**	**Path Range (kbps)**	**Path Default (kbps)**	**Aggregate Range (kbps)**	**Path Range (kbps)**	**Path Default (kbps)**
DMT bit rate max	Fast	8064 to 32	8064 to 32	0	1024 to 32	1024 to 0	0
DMT bit rate min	Fast	8064 to 32	8064 to 0	0	1024 to 32	1024 to 0	0
DMT bit rate max	Interleaved	8064 to 32	8064 to 32	640	1024 to 32	1024 to 0	128
DMT bit rate min	Interleaved	8064 to 32	8064 to 0	128	1024 to 0	1024 to 0	0

Caution The **dmt bitrate** command causes the port to retrain when you change the value of the bit rate parameter.

If you set a parameter to its current value, the port does not retrain. If a port is training when you change the parameter, the port stops training and retrains to the new parameter.

Example

This example sets the maximum interleaved path bit rate of the default profile to 640 kbps downstream and 128 kbps upstream, and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt bitrate interleaved downstream 640 upstream 128
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl-profile

dsl profile default:
      Alarms Enabled: NO

 DMT profile parameters
      Maximum Bitrates:
Interleave Path:  downstream:   640/kbs,   upstream:   128/kbs
      Minimum Bitrates:
         Interleave Path:  downstream:     0/kbs,   upstream:     0/kbs
      Margin:              downstream:     3 db,    upstream:     3 db
      Interleave Delay:    downstream: 16000 usecs, upstream: 16000 usecs
      FEC Redundancy Bytes:
         Interleave Path:  downstream:    16,       upstream:    16
      RS Codeword Size:   downstream:  auto,       upstream:  auto
      Trellis Coding:          Enabled
      Overhead Framing:        Mode 1
      Bit-Swap:                Enabled
      Bit-Swap From Margin:       3 dB
      Bit-Swap To Margin:         3 dB
      Operating Mode:          Automatic
      Training Mode:           Standard

 SDSL profile parameters
```

In this example, the command sets the maximum fast bit rate of the default profile to 3200 kbps downstream and 640 kbps upstream:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(config-dsl-prof)# dmt bitrate maximum fast downstream 3200 upstream 640
```

Setting DMT Minrate Blocking

To specify the bit rate below which a DMT port does not retrain, use the **dmt minrate-blocking** command.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the maximum allowed bit rate for interleaved-path DMT profile parameters.
Step 3	`DSLAM(cfg-dsl-profile)# dmt minrate-blocking`	Force a port not to retrain when actual bit rates fall below the values configured in the command.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Setting Bit Rate Parameters for STU-C Interfaces

To set the bit rate for STU-C parameters for a profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode, specifying the *profile-name* for which you want to set the maximum allowed bit rate.
Step 3	`DSLAM(cfg-dsl-profile)# sdsl bitrate` *bitrate*	Set the downstream and upstream bit rates for the profile. The STU-C downstream and upstream bit rates are identical. The loop characteristics determine the achievable rate.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

In this example, the command sets the bit rate of the default profile to 528 kbps downstream and upstream:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# sdsl bitrate 528
```

The Cisco IOS software does not send minimum bit rate settings to the STU-C line card. The software uses the settings locally to determine if a line rate alarm should be set for a port.

The following allowable STU-C bit rate values occur in units of kilobits per second:

2320

2064

1552

1168

1040

784

528

400

272

144

Caution The **sdsl bitrate** *bitrate* command causes the port to retrain when you change the parameter.

Setting a parameter to its current value does not cause a retrain. If a port is training when you change the parameter, the port untrains and retrains to the new parameter value.

Setting Bit Rate Parameters for SHTU-C Interfaces

To set the bit rate for SHTU-C parameters for a profile, use the following procedure that modifies the default bit rate parameters in your DSL profile:

	Command	Purpose
Step 1	`DSLAM(config)# dsl-profile austin`	Enter DSL profile configuration mode.
Step 2	`DSLAM(cfg-dsl-profile)# shdsl bitrate` *rate*	Configure a bit rate in kbps. The valid rates are 72, 136, 200, 264, 392, 520, 776, 1032, 1160, 1544, 2056, and 2312 kbps.
Step 3	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

The following example shows how to use the **shdsl bitrate** command to configure the upstream and downstream bandwidth at 2312 kbps:

```
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-prof)# shdsl bitrate 2312
```

Setting Signal-to-Noise Ratio Margins

This section describes how to set signal-to-noise ratio (SNR) margins for both downstream and upstream traffic for ATU-C CAP, ATU-C flexi CAP, ATU-C flexi DMT, 4xDMT, and SHTU-C interfaces. The higher the SNR margin the more protection there is against data corruption. The higher the SNR margin the lower the data rate a given loop can support.

ATU-C CAP and ATU-C Flexi CAP Interfaces

Use the following profile configuration commands to set the SNR value for a selected ATU-C CAP or ATU-C flexi CAP profile:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set SNR margins.
Step 3	`DSLAM(cfg-dsl-profile)# cap margin downstream` *0-12* `upstream` *0-12*	Set the SNR downstream and upstream margins to integers 0 through 12.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To set the SNR margin values for an ATU-C CAP interface to the default values of 3 dB downstream and 6 dB upstream, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set SNR margins.
Step 3	`DSLAM(cfg-dsl-profile)# no cap margin {downstream | upstream}`	Set the SNR downstream or upstream margins to the default value (3 dB downstream and 6 dB upstream).
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

In this example, the command sets the SNR margin at 8 dB downstream and 5 dB upstream for the DSL "issis" profile:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# cap margin downstream 8 upstream 5
DSLAM(cfg-dsl-profile)# end
```

ATU-C 4DMT and 8xDMT Interfaces

The range of DMT margin values is 0 to 15 dB in each direction. The default value for each direction is 6 dB.

To set SNR margins for a 4xDMT or 8xDMT interface, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set SNR margins.
Step 3	`DSLAM(cfg-dsl-profile)# dmt margin downstream` *dmt-margin* `upstream` *dmt-margin*	Set the SNR downstream and upstream margins to *dmt-margin*.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

Example

This example sets the SNR margins of the default profile to 6 dB upstream and 6 dB downstream and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt margin downstream 6 upstream 6
DSLAM(cfg-dsl-profile)# end
DSLAM# show running-config

Building configuration...
```

```
Current configuration:
!
!
version XX.X
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname DSLAM
!
slot 1 atuc-1-4dmt
.
.
.
slot 32 atuc-1-4dmt
enable password lab
!
!
dsl-profile default
!
dsl-profile fast
 dmt training-mode quick
dmt margin downstream 6 upstream 6
 dmt bitrate maximum interleaved downstream 8032 upstream 480
network-clock-select 1 ATM0/1
network-clock-select 2 system
.
.
.
```

SHTU-C Interfaces

You can set SNR margins for minimum, target, and threshold on selected SHTU-C profiles.

- **Target**—In rate adaptive mode, the target margin determines the amount of margin required before the line trains. If the line cannot achieve the target margin it attempts to train at a lower rate. The line continues to lower the rate until it finds a line rate that supports the target margin.
- **Min**—Configures the minimum SNR margin for the selected DSL profile. If the SNR falls below the configured value after the line has trained for 5 seconds, the line drops and attempts to retrain.
- **Threshold**—Configures the minimum SNR threshold margin. If the SNR margin falls below the configured value, an SNR margin threshold alarm is issued.

To set SNR margins for an 8xG.SHDSL interface, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set SNR margins.

Step 3	`DSLAM(cfg-dsl-profile)# shdsl margin min 0`
	`DSLAM(cfg-dsl-profile)# shdsl margin target 3`
	`DSLAM(cfg-dsl-profile)# shdsl margin threshold 0`
		Configure SNR margin values for the DSL profile.
		Note We suggest that you use the default configuration shown in this step.

Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

The following example shows you how to configure the shdsl margin values **min** 2, **threshold** 10, and **target** 0:

```
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-prof)# shdsl margin min 2
DSLAM(cfg-dsl-prof)# shdsl margin threshold 10
DSLAM(cfg-dsl-prof)# shdsl margin target 0
```

Monitoring Signal-to-Noise Ratio

DMT rate adaptation monitors upstream and downstream DMT ports for signal-to-noise ratio (SNR) margins during specified time intervals. If an unacceptable SNR margin is detected, the port is retrained at a lower bit rate to improve the SNR margins. To change the intervals during which a DMT port is monitored for signal-to-noise ratio (SNR) margins, use the **dmt rate adaptation interval** command in DSL profile configuration mode.

	Command	Task
Step 1	DSLAM# **configure terminal**	Go to global configuration mode.
Step 2	DSLAM(config)# **dsl-profile** *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set SNR margins.
Step 3	DSLAM(cfg-dsl-profile)# **dmt rate-adaptation enable**	Enable rate adaptation on a DMT port.
Step 4	DSLAM(cfg-dsl-profile)**dmt rate-adaptation interval {downshift [downstream** *number-of eoc-updates* **upstream** *seconds*]}	Change the intervals during which a DMT port is monitored for signal-to-noise ratio (SNR) margins.
Step 5	DSLAM(cfg-dsl-profile)# **end**	Exit from profile configuration mode.

Example

The following example enables **dmt rate-adaptation** with default interval and margin values:

```
DSLAM# config terminal
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-profile)# dmt rate-adaptation enable
```

Setting DMT Power-Management-Additional-Margin

Often, the capacity of a customer line is greater than the data rate of the customer service. This situation generally manifests itself as an SNR margin that is in excess of the target margin. In such a case, you should reduce the excess margin and bring it closer to the target margin, by reducing power. Power cutback is desirable for both a reduction in power dissipation and a reduction in cross talk.

The 8xDMT line card can run in power-management mode in the G.dmt or the T1.413 mode. Only 8xDMT line cards support power management. All CPE may not support the DSL functionality for power management to function correctly. Check with a Cisco customer representative to verify CPE compatibility with the 8xDMT power management.

You control the Power Management feature by issuing a **dmt power-management-additional-margin** command inside a profile and assigning that profile to a line card interface. This IOS command allows you to set the additional margin for each channel from 0 dB (off) to 15 dB. This sets the additional margin that will be added to the target margin. If the sum of the target margin and additional margin

exceeds 15dB, it is capped at 15dB. If the actual margin of the line is higher than the sum of the configured target and additional margin, then power management attempts to reduce the actual margin, and as a consequence the power level as well.

Not all CPE support power management. If you connect an unsupported CPE to a port on which power management is turned on, you will not see a reduction in the actual margin or power level. The operating modes supported by power management are T1.413and g-992-1 (g.dmt). A reduction in the power level occurs if there is excess margin on the line. For the downstream direction, if there is excess margin, then IOS displays a reduction in margin for the modes listed above, and a reduction in transmit power for T1.413 mode. For the upstream direction, if there is excess margin, then IOS displays a reduction in the margin for g-992-1 mode only. IOS will not display a reduction in transmit power for the upstream direction.

To set power management mode for a DMT profile, use the **dmt power-management-additional-margin** command.

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set power management mode.
Step 3	`DSLAM(cfg-dsl-profile)# dmt power-management-additional-margin downstream` *dmt margin* `upstream` *dmt margin*	Set the downstream and upstream power management margins for the profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

In the following example, power management would begin at 9 dB because the original margin is 6 dB and the additional margin is 3 dB:

```
DSLAM# config terminal
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-profile)# dmt margin downstream 6 upstream 6
DSLAM(cfg-dsl-profile)# dmt power-management-additional-margin downstream 3 upstream 3
```

Setting the Interleaving Delay

This section describes how to set the interleaving delay for both the upstream and downstream traffic for DMT and CAP interfaces.

If possible, the DSLAM sets the actual interleaving delays to match the values configured in the profile. However, depending upon the bit rate to which the port finally trains, some settings of interleaving delay may not be achievable. In this case, the DSLAM chooses an actual interleaving delay that is closest (numerically) to the configured interleaving delay. Table 4-4 lists the values of interleaving delay that are achievable for all bit rates.

DMT Interfaces

Interleaving delay helps protect against impulse noise and clipping, but adds delay, which might not be tolerable for some applications.

The allowable values for configured interleaved delay are 0, 500, 1000, 2000, 4000, 8000, and 16000 microseconds. The default interleaved delay (the value assigned when a DSL profile is created) is 16000 microseconds for both upstream and downstream directions.

Table 4-4 Achievable Combinations of Interleaving Delay and Symbols per Reed Solomon Codeword for Different Bit Rate Ranges

Bit Rate Range (kbps)	Symbols per RS Codeword Allowed	Interleaving Delay Allowed (microseconds)
8032 to 3616	1	0, 500, 1000, 2000, 8000, 16000
3584 to 3168	1 or 2	0, 500, 1000, 2000, 8000, 16000 **Note** A value of 500 is allowed only when symbols per codeword = 1.
3136 to 1760	2	0, 1000, 2000, 8000, 16000
1728 to 1568	2 or 4	0, 1000, 2000, 4000, 8000, 16000 **Note** A value 1000 is allowed only when symbols per codeword = 2. A value of 4000 is allowed only when symbols per codeword = 4.
1536 to 832	4	0, 2000, 4000, 8000, 16000
800 to 768	4 or 8	0, 2000, 4000, 8000, 16000 **Note** A value of 2000 is allowed only when symbols per codeword = 4.
736 to 384	8	0, 4000, 8000, 16000
352 to 0	16	0, 8000, 16000

To set upstream and downstream interleaving delay for a specific DMT profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the interleaving delay.
Step 3	`DSLAM(cfg-dsl-profile)# dmt interleaving-delay downstream` *delay-in-usecs* `upstream` *delay-in-usecs*	Set the downstream and upstream interleaving delay times as *delay-in-usecs*.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

Example

This example sets the interleaving delay of the profile named “fast” to 2000 usec downstream and 4000 usec upstream, and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile fast
DSLAM(cfg-dsl-profile)# dmt interleaving-delay downstream 2000 upstream 4000
DSLAM(cfg-dsl-profile)# exit
DSLAM(config)# exit
DSLAM# show dsl profile fast

dsl profile fast:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream:  2000 usecs,  upstream:  4000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled
.
.
.
```

CAP Interfaces

Table 4-5 shows the amount of delay (in milliseconds) that results from various combinations of baud rate, constellation, and **cap interleaving-delay** settings (short or long) on a 4-port flexi card configured for CAP. Interleaving delay is applied only in the downstream direction. Interleaving is not used on upstream traffic.

Table 4-5 Downstream Interleaving Delay

Constellation	Short or Long Delay	136 Kbaud	340 Kbaud	680 Kbaud	952 Kbaud
8	short	4.4 ms	4.4 ms	–	–
	long	49 ms	49 ms	–	–
16	short	3.0 ms	3.0 ms	3.0 ms	2.7 ms
	long	31 ms	31 ms	16 ms	11 ms
32	short	2.3 ms	2.3 ms	–	–
	long	24 ms	24 ms	–	–
64	short	1.9 ms	1.9 ms	1.8 ms	1.7 ms
	long	19 ms	19 ms	9.6 ms	6.8 ms
128	short	1.6 ms	1.6 ms	–	–
	long	16 ms	16 ms	–	–
256	short	1.4 ms	1.4 ms	1.4 ms	1.2 ms
	long	14 ms	14 ms	6.8 ms	5.0 ms
256 uncorrected	short	1.3 ms	1.3 ms	1.2 ms	1.0 ms
	long	12 ms	12 ms	6.0 ms	4.3 ms

You can choose the interleaving-delay option **none** only when 136 k downstream baud rate is enabled. If you configure the interleaving-delay as **none** but the line card trains at a downstream bit rate that uses a baud rate that is other than 136 k, the actual interleaving-delay value is **short**.

The following table shows the relationship between the interleaving-delay value chosen and the state of the Reed-Solomon error correction function.

Interleave Value	Reed-Solomon Relationship
Short	RS error correction on
Long	RS error correction on
None	RS error correction off

Note If you set interleaving delay to **none**, the subscriber line might provide service at a higher bit rate than the one configured. This can happen because setting interleaving delay to **none** turns off Reed-Solomon error correction, and turning off error correction reduces the overhead on the line, leaving more bandwidth available to the subscriber.

To set the interleaving delay for a specific CAP profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the interleaving delay.
Step 3	`DSLAM(cfg-dsl-profile)# cap interleaving-delay {short | long | none}`	Set interleaving-delay for a designated CAP profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Return to privileged EXEC mode.

To return the interleaved delay to its default (long) setting, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the interleaving delay.
Step 3	`DSLAM(cfg-dsl-profile)# no cap interleaving-delay`	Set interleaving-delay to the default value (long) for a designated CAP profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Examples

This example shows how to set the interleaving-delay value to **none** for the profile named “issis”:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# cap interleaving-delay
DSLAM(cfg-dsl-profile)# end
```

This example shows how to set the default interleaving delay value for the profile named “issis”.

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# no cap interleaving-delay none
DSLAM(cfg-dsl-profile)# end
```

Setting the Number of Symbols per Reed-Solomon Codeword

This section describes how to set the number of symbols per Reed-Solomon codeword. This information applies to DMT interfaces only.

The allowable values for configured symbols per codeword are 1, 2, 4, 8, 16, or auto. If you select auto (automatic), the line card chooses the optimum symbols per codeword based upon the bit rate to which the line trains. The optimum value keeps the ratio of user data to error correction bytes roughly constant. The default symbols per codeword setting (the value assigned when a DSL profile is created) is auto for both upstream and downstream directions.

If the symbols per codeword is set explicitly (any value other than auto), the DSLAM attempts to match the configured symbols per codeword. However, depending upon the bit rate to which the port finally trains, some settings of symbols per codeword may not be achievable. When this occurs, the DSLAM

chooses an actual symbols-per-codeword value that is closest (numerically) to the configured symbols per codeword. Table 4-6 lists the values of symbols per codeword that are allowable for various bit rate ranges.

Table 4-6 Symbols-per-Codeword Values for Different Bit Rate Ranges

Bit Rate Range (kbps)	Symbols per RS Codeword for Auto	Symbols per RS Codeword Allowed
8032 to 3616	1	1
3584 to 3168	2	1 or 2
3136 to 1760	2	2
1728 to 1568	4	2 or 4
1536 to 832	4	4
800 to 768	8	4 or 8
736 to 384	8	8
352 to 0	16	16

When the training mode is set to quick, the modem DSP automatically chooses the codeword size. The one exception is that if check bytes is set to 0 and the training mode is quick, the codeword size is always 1.

To set the number of symbols per Reed-Solomon codeword, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to the global configuration mode.
Step 2	`DSLAM(config)# dsl-profile default`	Go to the profile mode.
Step 3	`DSLAM(cfg-dsl-profile)# dmt codeword-size downstream {symbols | auto} upstream {symbols | auto}`	Set codeword size. The allowable values for codeword size (in symbols per RS codeword) are 1, 2, 4, 8, 16, or auto.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

If you set the codeword size to **auto**, the number of symbols per codeword depends upon the actual DMT bit rate. The default codeword size is auto.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

Example

This example sets the number of symbols per Reed-Solomon codeword to 8 upstream and 16 downstream and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt codeword-size downstream 16 upstream 8
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile default

dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled
```

```
DMT profile parameters
     Maximum Bitrates:
        Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
        Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
     Minimum Bitrates:
        Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
        Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
     Margin:               downstream:     6 dB,     upstream:     6 dB
     Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
     Check Bytes (FEC):
        Interleave Path:   downstream:     4,        upstream:     6
        Fast Path:         downstream:     0,        upstream:     0
     RS Codeword Size:    downstream:    16,        upstream:     8
     Trellis Coding:         Disabled
     Overhead Framing:       Mode 3
     Operating Mode:         Automatic
     Training Mode:          Quick
     Minrate blocking:       Disabled
     SNR Monitoring:         Disabled
.
.
.
```

Setting FEC Check (Redundancy) Bytes

This section describes how to set upstream and downstream interleaved FEC check (redundancy) bytes per Reed-Solomon (RS) codeword for a specific profile for DMT interfaces. The higher the check byte setting, the better the error correction, but the check bytes subtract from user bytes.

The configured number of FEC check bytes must be an even number in the range 0 to 16. The default (the value assigned when a DSL profile is created) is 16 check bytes for both the upstream and downstream directions.

If possible, the DSLAM sets the actual number of FEC check bytes to match the value configured in the profile. However, depending upon the bit rate to which the port finally trains, some settings of FEC check bytes may not be achievable. In this case, the DSLAM chooses an actual number of FEC check bytes that is closest (numerically) to the configured number of FEC check bytes. Table 4-7 lists the values of FEC check bytes that are achievable for all bit rates.

Table 4-7 Achievable Combinations of FEC Check Bytes and Symbols per Reed-Solomon Codeword for Different Bit Rate Ranges

Bit Rate Range (kbps)	Symbols per RS Codeword Allowed	FEC Check Bytes Allowed
8032 to 3616	1	0, 2, 4, 6, 8, 10, 12, 14, 16
3584 to 3168	1 or 2	0, 2, 4, 6, 8, 10, 12, 14, 16
3136 to 1760	2	0, 2, 4, 6, 8, 10, 12, 14, 16
1728 to 1568	2 or 4	0, 2, 4, 6, 8, 10, 12, 14, 16 **Note** A value of 2, 6, 10, or 14 is allowed only when symbols per RS codeword = 2.
1536 to 832	4	0, 4, 8, 12, 16

Table 4-7 Achievable Combinations of FEC Check Bytes and Symbols per Reed-Solomon Codeword for Different Bit Rate Ranges (continued)

Bit Rate Range (kbps)	Symbols per RS Codeword Allowed	FEC Check Bytes Allowed
800 to 768	4 or 8	0, 4, 8, 12, 16 **Note** A value of 4 or 12 is allowed only when symbols per RS codeword = 4.
736 to 384	8	0, 8, 16
352 to 0	16	0, 16

To set upstream and downstream FEC check (redundancy) bytes for a specific profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set FEC check bytes.
Step 3	`DSLAM(cfg-dsl-profile)# dmt check-bytes {fast | interleaved} downstream` *bytes* `upstream` *bytes*	Set the check bytes on the specified latency path to the specified number of *bytes* downstream and *bytes* upstream.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

It is normally desirable to keep the ratio of check bytes to user bytes roughly constant regardless of the bit rate. This requires you to change both the check bytes and the codeword size parameters.

When the training mode is set to quick, the DSLAM automatically chooses the check bytes value. However, if check bytes is set to zero and the training mode is quick, the system always uses a check bytes value of 0.

Example

This example sets the FEC check bytes for the default profile to 6 upstream and 4 downstream and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt check-bytes interleaved downstream 4 upstream 6
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile default

dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
```

```
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:     4,        upstream:     6
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled
.
.
.
```

Enabling and Disabling Trellis Coding

To enable trellis coding, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify the *profile-name* for which you want to enable trellis coding.
Step 3	`DSLAM(cfg-dsl-profile)# dmt encoding trellis`	Enable trellis coding.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To disable trellis coding, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Specify the *profile-name* for which you want to disable trellis coding.
Step 3	`DSLAM(cfg-dsl-profile)# no dmt encoding trellis`	Disable trellis coding.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

The system can use trellis coding only if the profile enables it and the CPE supports trellis coding.

Example

This example turns off trellis encoding for the default profile and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# no dmt encoding trellis
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile
dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: YES
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:     4,        upstream:     6
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:    16,        upstream:     8
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 2
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled
.
.
.
```

Setting the Overhead Framing Mode

To set the overhead framing mode of a DMT profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the overhead framing mode.
Step 3	`DSLAM(cfg-dsl-profile)# dmt overhead-framing {mode0 | mode1 | mode2 | mode3}`	Set the overhead framing mode. **Note** If you use a mode other than mode3, the following warning appears: ”Not all Framing Modes are supported by each Line Card or CPE. Verify actual framing mode once the CPE has trained with **show dsl interface atm**.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

This command does not retrain the port when you change the parameter value.

If the actual framing mode used is the mode the ATU-C port requested, or if the ATU-R CPE does not support the ATU-C choice, then the highest mode the ATU-R does support is used.

Example

This example sets the overhead framing mode in the default profile to mode3 and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt overhead-framing mode3
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile

dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      R-S Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
      Maximum Bitrates: 784 kbps

 SHDSL profile parameters
      Maximum Bitrates:          776 kbps
      SNR margin threshold:        3 dB
      SNR margin target:           0 dB
      SNR margin min:              0 dB
      Masktype:                symmetric
      Annex:                        auto
      Rate mode:                fixed

 CAP profile parameters
      Maximum Bitrates:     downstream:   640 kb/s,   upstream:    91 kb/s
      Minimum Bitrates:     downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     3 dB,     upstream:     6 dB
      PSDM:                 downstream:   -40 dBm/Hz, upstream:   -38 dBm/Hz
      Interleaving Delay:     Long (Reed-Solomon enabled)
      136K Baud DS Rates:     Enabled
68K Baud US Rates:      Disabled
      17K Baud US Rates:      Disabled
      CPE Signature:          0
```

```
 IDSL profile parameters
      Bitrate:              128 kbit/sec
      Encapsulation:        llc-ppp
      Frame Relay parameters:
         UPC intent:           pass
         Bc default:           32768 bytes
         LMI type:             cisco
         lmi-n392dce:          2 events
         lmi-n393dce:          2 events
         lmi-t392dce:          15 seconds

dsl profile austin:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      R-S Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
      Maximum Bitrates: 784 kbps

 SHDSL profile parameters
      Maximum Bitrates:          776 kbps
SNR margin threshold:        3 dB
      SNR margin target:           0 dB
      SNR margin min:              0 dB
      Masktype:                symmetric
      Annex:                       auto
      Rate mode:                fixed

 CAP profile parameters
      Maximum Bitrates:     downstream:   640 kb/s,   upstream:    91 kb/s
      Minimum Bitrates:     downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     3 dB,     upstream:     6 dB
      PSDM:                 downstream:   -40 dBm/Hz, upstream:   -38 dBm/Hz
      Interleaving Delay:     Long (Reed-Solomon enabled)
      136K Baud DS Rates:     Enabled
      68K Baud US Rates:      Disabled
      17K Baud US Rates:      Disabled
      CPE Signature:          0
```

```
 IDSL profile parameters
      Bitrate:              128 kbit/sec
      Encapsulation:        llc-ppp
      Frame Relay parameters:
         UPC intent:           pass
Bc default:           32768 bytes
         LMI type:             cisco
         lmi-n392dce:          2 events
         lmi-n393dce:          2 events
         lmi-t392dce:          15 seconds

dsl profile name:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
Fast Path:         downstream:     0,        upstream:     0
      R-S Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
      Maximum Bitrates: 784 kbps

 SHDSL profile parameters
      Maximum Bitrates:          776 kbps
      SNR margin threshold:        3 dB
      SNR margin target:           0 dB
      SNR margin min:              0 dB
      Masktype:                symmetric
      Annex:                        auto
      Rate mode:               fixed

 CAP profile parameters
      Maximum Bitrates:     downstream:   640 kb/s,   upstream:    91 kb/s
Minimum Bitrates:     downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     3 dB,     upstream:     6 dB
      PSDM:                 downstream:   -40 dBm/Hz, upstream:   -38 dBm/Hz
      Interleaving Delay:     Long (Reed-Solomon enabled)
      136K Baud DS Rates:     Enabled
      68K Baud US Rates:      Disabled
      17K Baud US Rates:      Disabled
      CPE Signature:          0
```

```
IDSL profile parameters
     Bitrate:              128 kbit/sec
     Encapsulation:        llc-ppp
     Frame Relay parameters:
        UPC intent:           pass
        Bc default:           32768 bytes
        LMI type:             cisco
        lmi-n392dce:          2 events
        lmi-n393dce:          2 events
        lmi-t392dce:          15 seconds
```

Modifying the Operating Mode

To modify the operating mode of a DMT profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to modify the operating mode.
Step 3	`DSLAM(cfg-dsl-profile)# dmt operating-mode {auto | g992-1 | g992-2 | t1-413}`	Set an operating mode for the selected profile. **4xDMT**—g992-1 and t1-413. **8xDMT** —auto, g992-1, g992-1, or t1-413. **4xflexi**—auto, g992-1, g992-1, or t1-413.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To set the operating mode of a DMT profile to the default mode, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to modify the operating mode.
Step 3	`DSLAM(cfg-dsl-profile)# no dmt operating-mode`	Force the operating mode to the default mode, auto.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

An ADSL line uses one of these operating modes:

- **auto**—An ATU-C port that employs this operating mode automatically detects the capabilities of the ATU-R CPE and uses a startup sequence specified by either G.992.1, G.992.2, or T1.413-1998. Auto mode is the default for an ADSL line.
- **g992-1**—In this mode the line uses the G994.1 startup sequence. After startup, the line complies with G992.1 operation.
- **g992-2**—In this mode the line uses the G994.1 startup sequence. After startup, the line complies with G992.2 operation. (G992.2 is also known as G.lite.)
- **t1-413**—This mode forces the ATU-R CPE to use the T1.413-1998 startup sequence.

This command retrains the port if you change the parameter value. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter value.

Example

This example sets the operating mode of the default profile to G992.1 and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt operating-mode G992.1
DSLAM# show dsl profile default
dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled

 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      R-S Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         G992-1
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled
```

Modifying the DMT Training Mode

To modify the training mode of a DMT profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to modify the training mode.
Step 3	`DSLAM(cfg-dsl-profile)# dmt training-mode {standard | quick}`	Modify the training mode. The choices are **standard** and **quick**.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

To set the training mode of a DMT profile to its default value, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to modify the training mode.
Step 3	`DSLAM(cfg-dsl-profile)# no dmt training-mode`	Set the training mode to its default value.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

The above procedures specify the mode employed by the ATU-C port when it is training to an ATU-R CPE. There are two training modes:

- **Standard**—This mode uses the G.994.1 or T1.413-1998 initialization sequence depending on configuration. In standard training mode the ATU-C port trains with the modem once, and if the configured rates and settings are not obtainable, the line card reads the line quality and retrains, selecting the best available rates and settings. This mode allows more control over DMT parameters.
- **Quick**—This mode is the default. It uses the extended exchange sequence for T1.413-1998 initialization or the G.994.1 initialization, depending on configuration. In quick training mode the modem DSP automatically determines the best available rate based on the parameters provided. The DSP may be forced to change some of the configuration settings based on the line characteristics. This training mode is faster than the standard mode.

This command does not retrain the port when you change the parameter value.

Example

This example sets the training mode of the default profile to quick and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile default
DSLAM(cfg-dsl-profile)# dmt training-mode quick
DSLAM(cfg-dsl-profile)# end
DSLAM# show dsl profile default

dsl profile default:
      Link Traps Enabled: NO
      Alarms Enabled: YES
      ATM Payload Scrambling: Enabled


 DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:     4,        upstream:     6
         Fast Path:         downstream:     0,        upstream:     0
      RS Codeword Size:    downstream:    16,        upstream:     8
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 2
      Operating Mode:         Automatic
```

```
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled

 SDSL profile parameters
.
.
.
```

Modifying the G.SHDSL Training Mode

To modify the training mode of a G.SHDSL profile, follow these steps:

	Command	Task
Step 1	DSLAM# **configure terminal**	Go to global configuration mode.
Step 2	DSLAM(config)# **dsl-profile** *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to modify the training mode.
Step 3	DSLAM(cfg-dsl-profile)# **shdsl; ratemode** {*fixed* | *adaptive*}	**Fixed—**In fixed training mode, no rates are negotiated. The line rate selected is the line rate to which the port attempts to train. If the port is unable to attain that line rate, it does not train. **Adaptive**—In adaptive training mode, the rate is negotiated during training. If the line cannot train at the selected rate, the line trains at the next best rate. Rates are negotiated in 64 kbps decrements.
Step 4	DSLAM(cfg-dsl-profile)# **end**	Exit from profile configuration mode.

Example

In the following example the training mode is configured as adaptive:

```
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-profile)# shdsl ratemode adaptive
```

Setting the Power Spectral Density Mask for ATU-C CAP and ATU-C flexi CAP

This section describes how to set the ATU-C CAP and ATU-C flexi CAP power spectral density mask (PSDM) upstream and downstream values.

To set the ATU-C CAP and ATU-C flexi CAP PSDM upstream and downstream values, follow these steps:

	Command	Task
Step 1	DSLAM# **configure terminal**	Go to global configuration mode.
Step 2	DSLAM(config)# **dsl-profile** *profile-name*	Go to profile configuration mode, specifying the *profile-name* for which you want to set the PSDM value.

	Command	Task
Step 3	`DSLAM(cfg-dsl-profile)# cap psdm downstream` *psdm* `upstream` *psdm*	Set the PSDM rate downstream and upstream for this profile.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Defaults

The default decibel values for PSDM rates are as follows:

- –40 dB downstream
- –38 dB upstream

Examples

In this example, the command sets the CAP PSDM value at –37 dB downstream and –41 dB upstream for the "issis" profile.

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# cap psdm downstream -37 upstream -41
DSLAM(cfg-dsl-profile)# end
```

In this example, the command sets the CAP PSDM value to the default downstream and upstream settings of –40 dB and –38 dB for the "issis" profile.

```
DSLAM# configure terminal
DSLAM(config)# dsl-profile issis
DSLAM(cfg-dsl-profile)# no cap psdm downstream -40 upstream -38
DSLAM(cfg-dsl-profile)# end
```

Setting the Power Spectral Density Mask for SHTU-C

This section describes how to set the SHTU-C power spectral density mask (PSDM).

To set the SHTU-C PSDM, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode, specifying the *profile-name* for which you want to set the PSDM value.
Step 3	`DSLAM(cfg-dsl-profile)# shdsl masktype symmetric`	Set the DSL mask type as symmetric. **Note** In future software releases, asymmetric masks will be supported for certain bit rates.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

The following example shows you how to configure a symmetric mask type:

```
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-prof)# shdsl masktype symmetric
```

Setting SHTU-C Annex

You can set the SHTU-C annex type for each configuration profile. Use Annex A in North American network implementations. Annex B is appropriate for European SHDSL implementations. Use auto to allow the CO to detect the CPE side annex during training.

To set the annex type for a designated profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the CPE signature value.

Step 3	`DSLAM(cfg-dsl-profile)# annex a`
	or
	`DSLAM(cfg-dsl-profile)# annex b`
	or
	`DSLAM(cfg-dsl-profile)# auto`
		Configure SHDSL annex type A.
		Configure SHDSL annex type B.
		Allow the CO to detect and then select the CPE side annex type during training.

Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Example

The following example shows how to configure SHDSL Annex B:

```
DSLAM(config)# dsl-profile austin
DSLAM(cfg-dsl-prof)# shdsl annex b
```

Setting the ATU-C CAP CPE-Signature

You can set the customer premises equipment (CPE) signature for each configuration profile. The CPE signature indicates the CPE equipment supported feature set. To set the CAP CPE-signature for a designated profile, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# dsl-profile` *profile-name*	Go to profile configuration mode and specify the *profile-name* for which you want to set the CPE signature value.
Step 3	`DSLAM(cfg-dsl-profile)# cap cpe-signature` *0-127*	Set the CPE signature value.
Step 4	`DSLAM(cfg-dsl-profile)# end`	Exit from profile configuration mode.

Enabling and Disabling ATM Local Loopback

When you enable the loopback functionality, loopback cells are inserted on designated VPCs/VCCs. The NI-2 notifies you through the management information base (MIB) or Interim Local Management Interface (ILMI) if loopback cells do not return.

This section describes how to enable and disable ATM local loopback on a port.

To enable ATM local loopback on a port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Go to interface configuration mode and specify the port for which you want to enable local loopback.
Step 3	`DSLAM(config-if)# loopback diagnostic`	Enable the loopback diagnostic for the selected port.
Step 4	`DSLAM(config-if)# end`	Exit from profile configuration mode.

To disable ATM local loopback on a port, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# interface atm` *slot/port*	Go to interface configuration mode and specify the port for which you want to enable local loopback.
Step 3	`DSLAM(config-if)# no loopback diagnostic`	Disable the loopback diagnostic for the selected port.
Step 4	`DSLAM(config-if)# end`	Exit from profile configuration mode.

This command retrains the port if you change the parameter. Setting a parameter to its previous value does not cause a retrain. If a port is training when you change this parameter, the port untrains and retrains to the new parameter.

Example

This command disables ATM local loopback for port 1 on slot 1 and displays the results:

```
DSLAM# configure terminal
DSLAM(config)# interface atm 1/1
DSLAM(config-if)# no loopback diagnostic
DSLAM(config-if)# end
DSLAM# show dsl interface atm 1/1
Port Status:
   Subscriber Name:          Circuit ID:
   IOS admin: UP     oper: UP     Card status: Present
   Last Change: 36352 days, 13 hrs, 51 min, 47 sec No. of changes: 0
   Line Status: TRAINED
   Test Mode:   NONE
Loopback: NONE

ADSL Chipset Self-Test: NONE
CO Modem Firmware Version: 0x1319BE02
.
.
.
```

Displaying DSL and ATM Status

To display DSL status for a line card and ATM status for a port, follow these steps:

	Command	Task
Step 1	DSLAM# **show dsl status** *line card type*	Display the administrative and operational status of the line card, the actual line rates, the subscriber name and circuit ID assigned to the port, and the subtend ID for the specified *line card*.
Step 2	DSLAM# **show dsl interface atm** *slot/port*	Display the information provided by **show dsl status**, plus configured profile parameters and actual parameter values for the specified *slot/port*.

Example

This example displays the DSL status for a 4xDMT line card and the ATM status for port 1 in slot 4:

```
DSLAM# show dsl status dmt
DSLAM# show dsl interface atm 4/1
Port Status:
   Subscriber Name:          Circuit ID:
   IOS admin: UP     oper: DOWN     Card status: ATUC-1-4DMT
   Last Change: 00 days, 00 hrs, 12 min, 33 sec No. of changes: 684
   Line Status: NO CPE DETECTED
   Test Mode: NONE

ADSL Chipset Self-Test: NONE

CO Modem Firmware Version: 0x30CCBE05

Configured:
      DMT Profile Name: default
      Link Traps Enabled: NO
      Alarms Enabled: NO
      ATM Payload Scrambling: Enabled


DMT profile parameters
      Maximum Bitrates:
         Interleave Path:   downstream:   640 kb/s,   upstream:   128 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Minimum Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
      Margin:               downstream:     6 dB,     upstream:     6 dB
      Interleaving Delay:   downstream: 16000 usecs,  upstream: 16000 usecs
      Check Bytes (FEC):
         Interleave Path:   downstream:    16,        upstream:    16
         Fast Path:         downstream:     0,        upstream:     0
      R-S Codeword Size:    downstream:  auto,        upstream:  auto
      Trellis Coding:         Disabled
      Overhead Framing:       Mode 3
      Operating Mode:         Automatic
      Training Mode:          Quick
      Minrate blocking:       Disabled
      SNR Monitoring:         Disabled
      Power Management Additional Margin:
                            downstream:     2 dB,     upstream:     3 dB
```

```
Status:
    Bitrates:
         Interleave Path:   downstream:     0 kb/s,   upstream:     0 kb/s
         Fast Path:         downstream:     0 kb/s,   upstream:     0 kb/s
    Attainable Aggregate
    Bitrates:
                            downstream:     0 kb/s,   upstream:     0 kb/s
    Margin:                 downstream:     0 dB,     upstream:     0 dB
    Attenuation:            downstream:     0 dB,     upstream:     0 dB
    Interleave Delay:       downstream:     0 usecs,  upstream:     0 usecs
    Check Bytes (FEC):
         Interleave Path:   downstream:     0,        upstream:     0
         Fast Path:         downstream:     0,        upstream:     0
    RS Codeword Size:      downstream:     0,        upstream:     0
    Trellis Coding:           Not In Use
    Overhead Framing:         Mode 0
    Line Fault:               NONE
    Operating Mode:           Unknown
    Line Type:                Fast and Interleaved

    Alarms:
       status:                NONE

ATM Statistics:
   Interleaved-Path Counters:
      Cells:                downstream:          0     upstream:          0
      HEC errors:           downstream:          0     upstream:          0
      LOCD events:          near end:            0     far end:           0
   Fast-Path Counters:
      Cells:                downstream:          0     upstream:          0
      HEC errors:           downstream:          0     upstream:          0
      LOCD events:          near end:            0     far end:           0

DSL Statistics:
   Init Events:           341
   Transmitted Superframes: near end:            0     far end:           0
   Received Superframes:    near end:            0     far end:           0
   Corrected Superframes:   near end:            0     far end:           0
   Uncorrected Superframes: near end:            0     far end:           0

CPE Info
   Serial Number:          00000000
   Vendor ID:              0
   Version Number:         0
```

Displaying Hardware Information

This section describes how to display information about the DSLAM hardware components.

To display a list of the cards in the chassis and the chassis type, and to indicate whether the power supply and fan interfaces are present, complete the following task:

Command	Task
DSLAM# **show hardware**	Display the type of card in each slot in the chassis and the chassis type, and indicate whether the power supply and fan interfaces are present.

To display the name of the card in the specified slot, complete the following task:

Command	Task
DSLAM# **show hardware slot** *slot*	Display the name of the card in the specified slot.

To display the manufacturing information for the card in the slot, including chassis type, chassis name, H/W revision, Serial #, Asset ID, Alias, and CLEI code, complete the following task:

Command	Task
DSLAM# **show hardware chassis**	Display the manufacturing information for the DSLAM: chassis type, chassis name, H/W revision, Serial #, Asset ID, Alias, and CLEI code.

To display the online insertion and removal (OIR) status of the line cards, complete the following task:

Command	Task
DSLAM# **show oir status** [*slot*]	Display the line card status and timer running delay.

The **show oir status** command reports the status of line card slots in the DSLAM chassis. The reported status is one of the following:

- Loading—The line card in this slot is loading a new image, which typically takes about 2 minutes.
- Running—The line card in this slot is operating normally.
- Keepalive—The NI-2 is unable to communicate with the line card in this slot. The NI-2 keeps the line card in keepalive state for several seconds. If communication does not resume, the system assumes the card was removed.

When the NI-2 cannot communicate with a line card, the NI-2 provides no entry for the slot where the card is located. The **show oir status** command displays a history of attempts to communicate with the line card.

Examples

This example displays the physical card in the chassis and the chassis type and indicates if the power supply and fan interfaces are present:

```
DSLAM# show hardware

Chassis Type:C6160

Slot 1 :EMPTY                                    Slot 18:EMPTY
Slot 2 :EMPTY                                    Slot 19:ATUC-4FLEXICAP
Slot 3 :EMPTY                                    Slot 20:EMPTY
Slot 4 :EMPTY                                    Slot 21:ATUC-1-4DMT
Slot 5 :EMPTY                                    Slot 22:ATUC-4FLEXIDMT
Slot 6 :EMPTY                                    Slot 23:EMPTY
Slot 7 :EMPTY                                    Slot 24:EMPTY
Slot 8 :EMPTY                                    Slot 25:EMPTY
Slot 9 :EMPTY                                    Slot 26:EMPTY
Slot 10:NI-2-DS3-DS3                             Slot 27:EMPTY
Slot 11:EMPTY                                    Slot 28:EMPTY
Slot 12:STUC-4-2B1Q-DIR-1                        Slot 29:EMPTY
```

```
Slot 13:EMPTY                                   Slot 30:EMPTY
Slot 14:EMPTY                                   Slot 31:EMPTY
Slot 15:EMPTY                                   Slot 32:EMPTY
Slot 16:EMPTY                                   Slot 33:EMPTY
Slot 17:EMPTY                                   Slot 34:EMPTY

Fan Module 1: Present   2: Present

Power Supply Module 1: 6260-PEM-AC
Power Supply Module 2: 6260-PEM-AC
```

This example displays information on the cards in slots 20 and 21:

```
DSLAM# show hardware slot 20

Slot 20:EMPTY

DSLAM# show hardware slot 21

Slot 21: ATUC-1-4DMT

        Hardware Revision        : 1.0
        Part Number              : 800-05262-03
        Board Revision           : A0
        Deviation Number         : 0-0
        Fab Version              : 03
        PCB Serial Number        : SAL04300VR2
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        CLEI Code                : DML2GGCAAB
        Asset Identifier         :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 40 01 53 41 01 00 C0 46 03 20 00 14 8E 03
          0x10: 42 41 30 80 00 00 00 00 02 03 C1 8B 53 41 4C 30
          0x20: 34 33 30 30 56 52 32 03 00 81 00 00 00 00 04 00
          0x30: C6 8A 44 4D 4C 32 47 47 43 41 41 42 CC 20 00 00
          0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 FF FF
          0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

This example displays the manufacturing information for the DSLAM, including information on the NI-2 card, backplane, I/O card, and power modules:

```
DSLAM# show hardware chassis

Chassis Type: C6260

NI2 Daughtercard EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 73-3952-05
        Board Revision           : A0
        Deviation Number         : 0-0
        Fab Version              : 02
        PCB Serial Number        : 00010218817
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        Unknown Field (type 0086): 00 00 00 00
        EEPROM format version 4
```

```
        EEPROM contents (hex):
          0x00: 04 FF 40 01 4F 41 01 00 82 49 0F 70 05 42 41 30
          0x10: 80 00 00 00 00 02 02 C1 8B 30 30 30 31 30 32 31
          0x20: 38 38 31 37 03 00 81 00 00 00 00 04 00 86 00 00
          0x30: 00 00 FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x40: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x50: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

NI2 Motherboard EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 800-05631-05
        Board Revision           : 01
        Deviation Number         : 0-0
        Fab Version              : 03
        PCB Serial Number        : 00010218817
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        CLEI Code                : unassigned
        Asset Identifier         : 00000000000000000000000000000000
        Processor type           : 00
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 40 01 94 41 01 00 C0 46 03 20 00 15 FF 05
          0x10: 42 30 31 80 00 00 00 00 02 03 C1 8B 30 30 30 31
          0x20: 30 32 31 38 38 31 37 03 00 81 00 00 00 00 04 00
          0x30: C6 8A 75 6E 61 73 73 69 67 6E 65 64 CC 20 30 30
          0x40: 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30
          0x50: 30 30 30 30 30 30 30 30 30 30 30 30 30 30 09 00
          0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

BackPlane EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 73-3999-05
        Board Revision           : A0
        Deviation Number         : 0-0
        Fab Version              : 04
        PCB Serial Number        : SAA04090051
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        Chassis Serial Number    : SCA041007X7
        CLEI Code                : DMM3BH0ERA
        Asset Identifier         :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 41 01 00 82 49 0F 9F 05 42 41 30 80 00 00
          0x10: 00 00 02 04 C1 8B 53 41 41 30 34 30 39 30 30 35
          0x20: 31 03 00 81 00 00 00 00 04 00 C2 8B 53 43 41 30
          0x30: 34 31 30 30 37 58 37 C6 8A 44 4D 4D 33 42 48 30
          0x40: 45 52 41 CC 20 00 00 00 00 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x60: 00 00 00 00 00 FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

```
I/O Card EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 800-08690-01
        Board Revision           : 01
        Deviation Number         : 0-0
        Fab Version              : 01
        PCB Serial Number        : SAD04350CBB
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        Chassis MAC Address      : 0001.64ff.a97f
        MAC Address block size   : 1024
        CLEI Code                : ABCDEFGHIJ
        Asset Identifier         :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 40 02 43 41 01 00 C0 46 03 20 00 21 F2 01
          0x10: 42 30 31 80 00 00 00 00 02 01 C1 8B 53 41 44 30
          0x20: 34 33 35 30 43 42 42 03 00 81 00 00 00 00 04 00
          0x30: C3 06 00 01 64 FF A9 7F 43 04 00 C6 8A 41 42 43
          0x40: 44 45 46 47 48 49 4A CC 20 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x60: 00 00 00 00 00 00 00 00 00 FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

Slot 1 Power Module EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 34-1695-01
        Deviation Number         : 0-0
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        Chassis Serial Number    : 00000000562
        Power Supply Type        : AC
        CLEI Code                :
        Asset Identifier         :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 41 01 00 82 22 06 9F 01 80 00 00 00 00 03
          0x10: 00 81 00 00 00 00 04 00 C2 8B 30 30 30 30 30 30
          0x20: 30 30 35 36 32 0B 00 C6 8A 00 00 00 00 00 00 00
          0x30: 00 00 00 CC 20 00 00 00 00 00 00 00 00 00 00 00
          0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 FF FF FF FF FF FF FF FF FF FF FF
          0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

```
Slot 2 Power Module EEPROM:
        Hardware Revision        : 1.0
        Part Number              : 34-1695-01
        Deviation Number         : 0-0
        RMA Test History         : 00
        RMA Number               : 0-0-0-0
        RMA History              : 00
        Chassis Serial Number    : 00000000552
        Power Supply Type        : AC
        CLEI Code                :
        Asset Identifier         :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 41 01 00 82 22 06 9F 01 80 00 00 00 00 03
          0x10: 00 81 00 00 00 00 04 00 C2 8B 30 30 30 30 30 30
          0x20: 30 30 35 35 32 0B 00 C6 8A 00 00 00 00 00 00 00
          0x30: 00 00 00 CC 20 00 00 00 00 00 00 00 00 00 00 00
          0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
          0x50: 00 00 00 00 00 FF FF FF FF FF FF FF FF FF FF FF
          0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
          0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

CHAPTER 5

Configuring In-Band Management

This chapter describes how to configure in-band management on Cisco DSLAMs with NI-2 cards.

This chapter includes the following sections:

Configuring In-Band Management

The DSLAM allows in-band management through the trunk interface. In-band management uses the IP over ATM protocol. The DSLAM is a client in an IP over ATM environment; it provides none of the ARP server functions found in the Cisco LightStream 1010 switch. SNMP is used above the IP layer to provide management functionality. This section describes configuring a port on a switch to allow in-band management of the switch CPU.

Configuring In-Band Management in an SVC Environment

This section describes in-band management in an SVC environment. In-band management requires configuring the DSLAM with its own ATM address and that of a single ATM Address Resolution Protocol (ARP) server.

In-band management in an SVC environment is configured by the DSLAM in the following process:

1. The initial IP packet sent by client A triggers a request to the ARP server to look up the IP address and the corresponding ATM address of client B in the ARP server ARP table.
2. The ARP server sends back a response to client A with the matching ATM address.
3. Client A uses the ATM address it just obtained from the ARP server to set up an SVC directly to client B.
4. When client B replies with an IP packet to client A, it also triggers a query to the ARP server.

Note When client B receives the ATM address for client A, client B usually discovers it already has a call set up to the client A ATM address and does not set up another call.

After the connection is known to both clients, they communicate directly over the SVC.

The ATM ARP client (the DSLAM) tries to maintain a connection to the ATM ARP server. The ATM ARP server can remove the connection, but the client attempts once each minute to bring the connection back up. No error messages are generated for a failed connection, but the client does not route packets until the ATM ARP server is connected and translates IP network addresses.

For each packet with an unknown IP address, the client (the DSLAM) sends an ATM ARP request to the ARP server. Until that address is resolved, any IP packet routed to the ATM interface causes the client to send another ATM ARP request.

Configuring ATM ARP

In an SVC environment, configure the ATM ARP mechanism on the interface by performing these tasks, beginning in global configuration mode:

	Command	Task
Step 1	`DSLAM(config)# interface atm` *slot/port*`[.`*sub_inter#*`]`	Select the interface to be configured.
Step 2	`DSLAM(config-if)# atm nsap-address` *nsap-address* or `DSLAM(config-if)# atm esi-address` *esi-address*	Specify the NSAP ATM address of the interface. or Specify the end-system-identifier (ESI) address of the interface.
Step 3	`DSLAM(config-if)# ip address` *address mask*	Specify the IP address of the interface.
Step 4	`DSLAM(config-if)# atm arp-server nsap` *nsap-address*	Specify the ATM address of the ATM ARP server.
Step 5	`DSLAM(config-if)# exit`	Exit interface configuration mode.
Step 6	`DSLAM(config)# atm route` {*addr-prefix*[1]} `atm 0/0 internal`	Configure a static route through the switch to the CPU interface. **Note** You need to specify only a static route when configuring an ARP client using a network service access point (NSAP) address.

1. First 19 bytes of the NSAP address.

NSAP Address Example

This example shows how to configure CPU interface 0/0 of client A using the NSAP address:

```
Client A(config)# interface atm 0/0
Client A(config-if)# $dress 47.0091.8100.0000.1111.1111.1111.1111.1111.1111.00
Client A(config-if)# ip address 123.233.45.1 255.255.255.0
Client A(config-if)# $dress 47.0091.8100.0000.1111.1111.1111.2222.2222.2222.00
Client A(config-if)# exit
Client A(config)# $0.0000.1111.1111.1111.1111.1111.1111 atm 0/0 internal
```

These commands:

- Identify CPU interface 0/0 for configuration.
- Configure the interface as an ATM ARP client with NSAP address 47.0091.8100.0000.1111.1111.1111.1111.1111.1111.00.
- Configure the IP address as 123.233.45.1 with a subnet mask of 255.255.255.0.

- Configure the ARP server NSAP address as 47.0091.8100.0000.1111.1111.1111.2222.2222.2222.00.
- Exit interface configuration mode.
- Configure an internal static route with an NSAP address of 47.0091.8100.0000.1111.1111.1111.1111.1111.1111.00 to the interface atm 0/0.

Note In the preceding example, some of the commands extended beyond the single line of the screen and the command line shifted ten spaces to the left. The dollar sign ($) indicates this shift.

ESI Example

This example shows how to configure atm 0/0 of client A (Figure 5-2), using the ESI:

```
Client A(config)# interface atm 0/0
Client A(config-if)# atm esi-address 0041.0b0a.1081.40
Client A(config-if)# ip address 123.233.45.1 255.255.255.0
Client A(config-if)# $7.0091.8100.0000.1111.1111.1111.2222.2222.2222.00
Client A(config-if)# exit
```

These commands:

- Identify the interface atm 0/0 for configuration.
- Configure the interface as an ATM ARP client with end-system identifier 0041.0b0a.1081.40.
- Configure the interface IP address as 123.233.45.1 with a subnet mask of 255.255.255.0.
- Specify the ARP server NSAP address as 47.0091.8100.0000.1111.1111.1111.2222.2222.2222.00.

Note In the preceding example, one command extended beyond the single line of the screen and the command line shifted ten spaces to the left. The dollar sign ($) indicates this shift.

Show ATM ARP Example

In this example, the **show atm arp** command displays the configuration of ATM 0/0:

```
Switch# show atm arp

Note that a '*' next to an IP address indicates an active call

      IP Address         TTL     ATM Address
ATM0/0:
    * 10.0.0.5           19:21   47009181005670000000000112200410b0a108140
```

Show ATM MAP Example

This example displays the map-list configuration of the switch static map and IP-over-ATM interfaces:

```
Switch# show atm map
Map list ATM0/0_ATM_ARP : DYNAMIC
arp maps to NSAP 36.0091810000000003D5607900.0003D5607900.00
        , connection up, VPI=0 VCI=73, ATM0/0
ip 5.1.1.98 maps to NSAP 36.0091810000000003D5607900.0003D5607900.00
        , broadcast, connection up, VPI=0 VCI=77, ATM0/0

Map list ip : PERMANENT
ip 5.1.1.99 maps to VPI=0 VCI=200
```

Configuring In-Band Management in a PVC Environment

This section describes how to configure in-band management in a PVC environment. The ATM Inverse ARP mechanism is applicable to networks that use PVCs, where connections are established but the network addresses of the remote ends are not known.

In a PVC environment, configure the ATM Inverse ARP mechanism by performing these tasks:

	Command	Task
Step 1	`DSLAM(config)# interface atm slot/port`	Select the interface to be configured.
Step 2	`DSLAM(config-if)# ip address address mask`	Specify the IP address of the interface.
Step 3	`DSLAM(config-if)# atm pvc vpi vci encap aal5snap [inarp minutes]`	Create a PVC and enable Inverse ARP on it.

Repeat these tasks for each PVC you want to create.

The **inarp** *minutes* interval specifies how often Inverse ARP datagrams are sent on this virtual circuit. The default value is 15 minutes.

Note The ATM ARP and Inverse ATM ARP mechanisms work with IP only. All other protocols require **map-list** command entries to operate.

Example

This example configures an IP-over-ATM interface in a PVC environment and displays the map-list configuration of the switch static map and in-band management interfaces.

These commands:

- Identify the interface atm 0/0 for configuration.
- Configure the IP address on the interface as 11.11.11.11.
- Create an ATM PVC with AAL5 SNAP encapsulation, inverse ARP set to 10 minutes, on the interface atm 0/0 VPI = 50 VCI = 100.
- Display the in-band interface configuration.

```
DSLAM(config)# interface atm 0/0
DSLAM(config)# ip address 11.11.11.11
DSLAM(config-if)# atm pvc 0 100 encap aal5snap inarp 10 interface atm 0/0 50 100

DSLAM# show atm map
Map list yyy : PERMANENT
ip 1.1.1.2 maps to VPI=0 VCI=200

Map list zzz : PERMANENT

Map list a : PERMANENT

Map list 1 : PERMANENT

Map list ATM0/0_ATM_ARP : DYNAMIC
arp maps to NSAP 47.009181005670000000001122.00410B0A1081.40
        , connection up, VPI=0 VCI=85, ATM0/0
ip 10.0.0.5 maps to NSAP 47.009181005670000000001122.00410B0A1081.40
        , broadcast, ATM0/0
```

Mapping a Protocol Address to a PVC

The ATM interface supports a static mapping scheme that identifies the ATM address of remote hosts or switches. This IP address is specified as a PVC or as an NSAP address for SVC operation. Configurations for both PVC and SVC map lists are described in these sections:

- Configuring a PVC-Based Map List, page 5-5
- Configuring an SVC-Based Map List, page 5-6

Configuring a PVC-Based Map List

This section describes how to map a PVC to an address, which is a required task if you are configuring a PVC.

You can enter mapping commands as groups. To do so, create a map list and then associate the map list with an interface. Begin with the following steps:

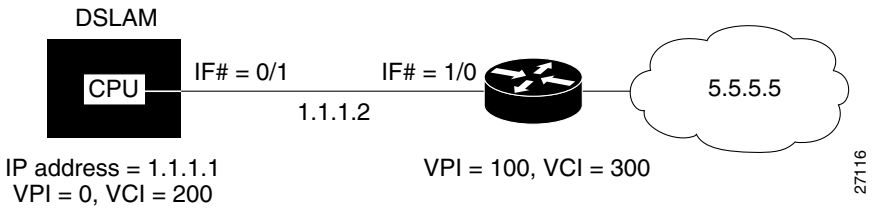
	Command	Task
Step 1	DSLAM(config)# **ip host-routing**	Enable IP host based routing.
Step 2	DSLAM(config)# **interface atm** *slot/port*[*.sub_inter#*]	Specify an ATM interface and enter interface configuration mode.
Step 3	DSLAM(config-if)# **ip address** A.B.C.D mask	Enter the IP address and subnet mask associated with this interface.
Step 4	DSLAM(config-if)# **map-group** *name*	Enter the map group name associated with this PVC.
Step 5	DSLAM(config-if)# **atm pvc** *vpi vci* **[encap** *aal5lane aal5mux aal5snap***]** [**upc** *upc*] [**pd** *pd*] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *slot/port*[.sub_inter#] *vpi vci* [**upc** *upc*]	Configure the PVC.
Step 6	DSLAM(config-if)# **exit**	Exit interface configuration mode.
Step 7	DSLAM(config)# **ip route** *A.B.C.D mask* [*A.B.C.D* | **atm** | **ethernet** | **null**]	Configure an IP route to the router.
Step 8	DSLAM(config)# **map-list** *name*	Create a map list by naming it, and enter map-list configuration mode.
Step 9	DSLAM(config-map-list)# **ip** *A.B.C.D* **atm-nsap** *address* | **atm-vc** vci {**aal5mux** *encapsulation* | **broadcast** *pseudo-broadcast* | **class** *class-name*}	Associate a protocol and address to a specific virtual circuit.

You can create multiple map lists, but only one map list can be associated with an interface. Different map lists can be associated with different interfaces.

Example

Figure 5-1 illustrates a connection configured with a PVC map list.

Figure 5-1 PVC Map List Configuration Example



The commands used to configure the connection in Figure 5-1 are:

```
DSLAM(config)# ip host-routing
DSLAM(config)# interface atm 0/0
DSLAM(config-if)# ip address 1.1.1.1 255.0.0.0
DSLAM(config-if)# map-group yyy
DSLAM(config-if)# atm pvc 0 200 encap aal5snap interface atm 0/1 100 300
DSLAM(config-if)# exit
DSLAM(config)# ip route 1.1.1.1 255.0.0.0 1.1.1.2
DSLAM(config)# map-list yyy
DSLAM(config-map-list)# ip 1.1.1.2 atm-vc 200
DSLAM(config-map-list)# end
```

These commands enable IP host-based routing to:

- Change to interface configuration mode on the interface atm 0/0.
- Configure the interface with map group name “yyy.”
- Configure an internal cross-connect PVC from the atm 0/0 to atm 0/1 VPI 100 and VCI 300.
- Exit interface configuration mode.
- Configure a static IP route between the DSLAM and the router.
- Change to map list configuration mode and create a map group with the name “yyy.”
- Associate the map list to the IP network connection 1.1.1.2 and ATM VC 200 configured on atm 0/1.

Example

This example displays the map-list configuration of the DSLAM at atm 0/0:

```
DSLAM# show atm map
Map list yyy : PERMANENT
ip 1.1.1.2 maps to VPI=0 VCI=200
```

Configuring an SVC-Based Map List

This section describes how to map an SVC to an NSAP address. This is a required task if you are configuring an SVC.

You can enter mapping commands as groups. To do so, create a map list and then associate it with the map list interface. Perform the following steps:

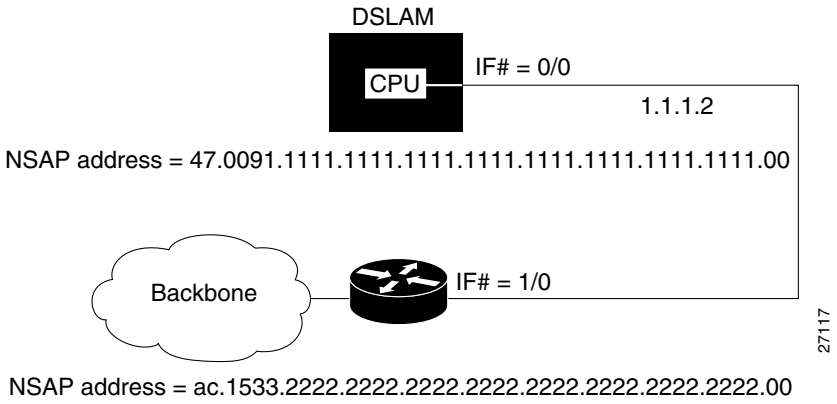
	Command	Task
Step 1	`DSLAM(config)# ip host-routing`	Enable IP host-based routing.
Step 2	`DSLAM(config)# interface atm` *slot/port[.sub_inter#}*	Specify an ATM interface and enter interface configuration mode.
Step 3	`DSLAM(config-if)# atm nsap-address` *20-octet NSAP address*	Configure the interface NSAP address.
Step 4	`DSLAM(config-if)# ip address` *A.B.C.D mask*	Enter the IP address and subnet mask associated with this interface.
Step 5	`DSLAM(config-if)# map-group` *name*	Enter the map-group name associated with this PVC.
Step 6	`DSLAM(config-if)# exit`	Exit interface configuration mode.
Step 7	`DSLAM(config)# map-list` *name*	Create a map list by naming it, and enter map-list configuration mode.
Step 8	`DSLAM(config-map-list)# ip` *A.B.C.D* **atm-nsap** *address* | **atm-vc** *vci* {**aal5mux** *encapsulation* | **broadcast** *pseudo-broadcast* | **class** *class-name*}	Associate a protocol and address to a specific virtual circuit.

You can create multiple map lists, but only one map list can be associated with an interface. Different map lists can be associated with different interfaces.

Examples

Figure 5-2 illustrates an SVC connection configured with a map list.

Figure 5-2 SVC Map List Configuration Example



This example shows the commands used to configure the connection in Figure 5-2:

```
DSLAM(config)# ip host-routing
DSLAM(config)# interface atm 0/0
DSLAM(config-if)# ip address 1.1.1.1 255.0.0.0
DSLAM(config-if)# map-group zzz
DSLAM(config-if)# atm nsap-address 47.0091.1111.1111.1111.1111.1111.1111.1111.1111.00
DSLAM(config-if)# exit
DSLAM(config)# ip route 1.1.1.1 255.0.0.0 1.1.1.2
DSLAM(config)# map-list zzz
```

```
DSLAM(config-map-list)# ip 1.1.1.2 atm-nsap
ac.1533.2222.2222.2222.2222.2222.2222.2222.2222.00
DSLAM(config-map-list)# end
```

These commands:

- Enable IP host-based routing.
- Change to interface configuration mode on atm 0/0.
- Configure the interface with map group name “zzz.”
- Configure the interface with IP address 1.1.1.1 and a subnet mask.
- Configure the interface with NSAP address 47.0091.1111.1111.1111.1111.1111.1111.1111.1111.00.
- Exit interface configuration mode.
- Configure a static IP route between interface 1.1.1.1 and 1.1.1.2.
- Switch to map-list configuration mode to map group name “zzz.”
- Associate the IP interface 1.1.1.2 with NSAP address ac.1533.2222.2222.2222.2222.2222.2222.2222.2222.2222.00.

Example

This example displays the map-list configuration of the DSLAM at atm 0/0:

```
DSLAM# show atm map

Map list yyy : PERMANENT
ip 1.1.1.1 maps to VPI=0 VCI=200
ip 1.1.1.2 maps to VPI=0 VCI=200

Map list zzz : PERMANENT
```

Configuring MPLS VPN Mapping

This chapter describes the Cisco Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) Mapping of Routed Sessions implementation on all Cisco digital subscriber line access multiplexers (DSLAMs) using the second-generation network interface module (NI-2).

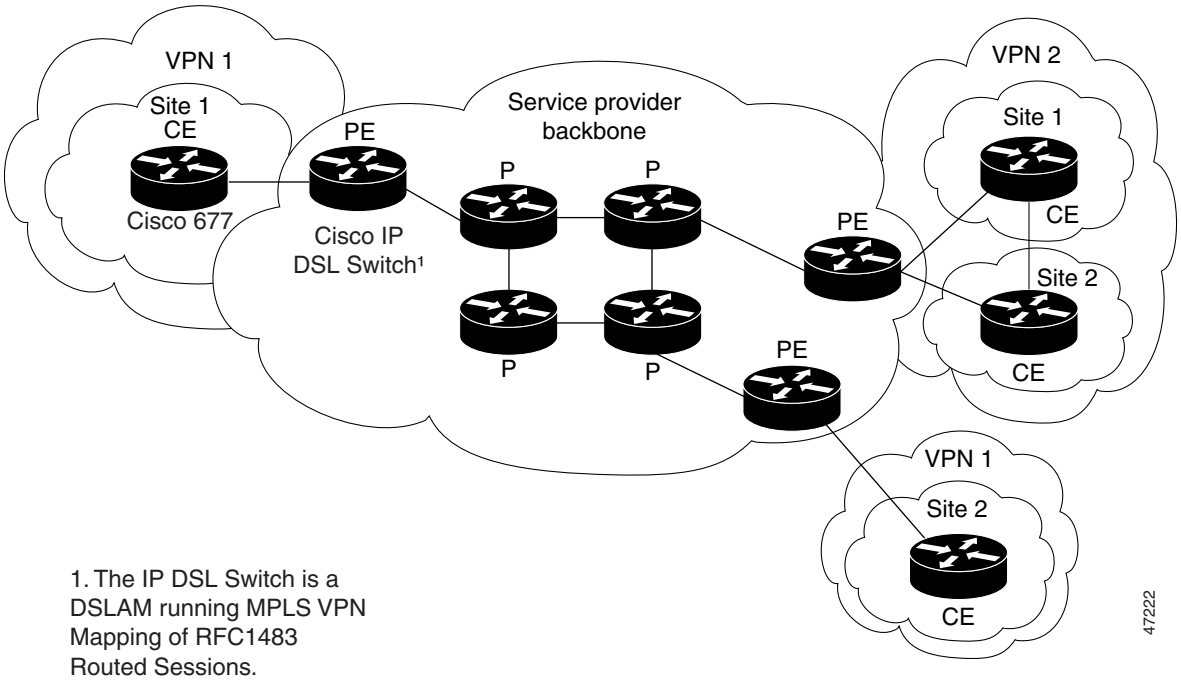
MPLS VPN Overview

The Cisco MPLS VPN mapping of routed sessions implementation enables Cisco DSLAMs with NI-2 controller cards and connected customer premises equipment (CPE) to participate in MPLS VPNs. This implementation promotes the rapid deployment of secure IP VPNs that enable revenue-generating services, such as:

- Intranets
- Extranets
- Application and data hosting
- Network commerce
- Secure telecommuter access to corporate networks

Figure 6-1 shows an example of an MPLS VPN with a service provider (P) backbone network, service provider edge routers (PEs), and customer edge routers (CEs).

Figure 6-1 VPNs with a Service Provider Backbone



1. The IP DSL Switch is a DSLAM running MPLS VPN Mapping of RFC1483 Routed Sessions.

Benefits

In LANs, IP-based intranets have had an impact on the way companies conduct business. Companies meet the needs of their customers, suppliers, and partners by using extranets (an intranet that encompasses multiple businesses). Using extranets, companies reduce business process costs through supply-chain automation, electronic data interchange (EDI), and content hosting services. Virtual Private Networks address these needs by providing secure, private network services over the public Internet.

Cisco provides Layer 2 mechanisms that enable service providers (SPs) to deploy VPNs. To meet the scalability challenges inherent in provisioning fully-meshed Layer 2 VPNs, SPs must:

- Scale their networks to support an explosion of broadband subscribers.
- Quickly deploy value-added services, such as secure telecommuter access and extranets that differentiate their positions in a competitive marketplace.

MPLS VPN mapping of routed sessions provides a solution to both of these problems:

- Because MPLS VPNs are created in Layer 3, they are more scalable and easier to configure than Layer 2 VPNs.
- MPLS VPNs offer an advanced, revenue-generating service.

The MPLS VPN mapping of routed sessions also:

- Leverages existing NI-2 based DSLAM hardware in the SP network.
- Provides a platform for the rapid deployment of managed IP services, including intranets and extranets.
- Reduces the cost of connecting branch offices, telecommuters, and mobile users to a corporate intranet.
- Provides a more cost-effective solution than private WANs constructed with leased lines.

Comparison of Conventional VPNs and MPLS VPNs

Conventional VPNs

Conventional VPNs do not scale well. Layer 2 VPNs are provisioned by creating and maintaining a full mesh of tunnels or permanent virtual circuits among all sites belonging to a particular VPN, using:

- IPSec
- Layer 2 Tunneling Protocol (L2TP)
- Layer 2 Forwarding (L2F) Protocol
- Generic Routing Encapsulation (GRE)
- Frame Relay
- ATM protocols

The resources and equipment required to provision and manage connection-based schemes cannot be supported in an SP network that must support hundreds or thousands of VPNs, each with multiple sites and thousands or tens of thousands of routes.

MPLS VPNs

MPLS VPNs offer all of the value of traditional VPNs. Furthermore, since MPLS VPNs are created in Layer 3, they are more scalable, and easier to configure and manage than Layer 2 VPNs.

MPLS VPNs offer

- Privacy and security equal to that provided by Layer-2 VPNs by limiting the distribution of VPN routes to only those routers that are members of the VPN
- Seamless integration with customer intranets
- Increased scalability over current VPN implementations
- Easy management of VPN membership and provisioning of new VPNs for rapid deployment
- Scalable any-to-any connectivity for extended intranets and extranets that encompass multiple businesses

Supported MPLS Features

The following features are supported for the delivery of MPLS VPN mapping of routed sessions:

- Routed sessions mapping:
  - RFC 1483 routed sessions
  - PPPoA routed sessions
  - RBE routed sessions
- IP Routing protocols:
  - Static routing
  - Routing Information Protocol (RIP)
  - Border Gateway Protocol (BGP)

  - Open Shortest Path First (OSPF)
  - IS-IS
  - Enhanced Interior Gateway Routing Protocol (EIGRP)
  - Interior Gateway Routing Protocol (IGRP)
- MPLS Label Edge Router functionality (LER)
- Routed termination of Multiprotocol Encapsulation over AAL5 (referred to as RFC 1483)
- Cisco Express Forwarding (CEF)

Restrictions

This section describes restrictions to Cisco MPLS VPN mapping of routed sessions.

Number of Configurable MPLS VPNs Limited to 50

Each IP DSL switch can support up to 50 MPLS VPNs.

Integrated Routing and Bridging Not Supported

MPLS VPN mapping of routed sessions must not be confused with Integrated Routing and Bridging (IRB). IRB is not supported by MPLS VPN mapping of routed sessions.

VPN Interfaces Restricted to Trunk Interfaces

Do not configure subtended interfaces for MPLS VPN services. Only trunk interfaces support MPLS VPN mapping of routed sessions.

MPLS ATM-Label Switch Router Functionality Not Supported

IP DSL switches are not meant to be used as MPLS ATM-Label Switch Routers (ATM-LSRs). When designing your network, keep in mind that IP DSL switches act only as Label Edge Routers (LERs).

Performance Restrictions for MPLS VPN Traffic

MPLS VPN-enabled interfaces do not perform as well as switched VCs.

Restricted Layer 3 Services

The following Layer 3 services are not supported:

- IP quality of service
- IP queueing
- IP multicast

Restricted MPLS Features

The following MPLS-related features are not a part of the MPLS VPN mapping of routed sessions:

- MPLS Traffic Engineering
- MPLS multicast

DSL Interface Limitations

In IP DSL switches, each DSL interface can support multiple permanent virtual circuits (PVCs), but only one routed MPLS VC.

Configuration of MPLS VPN mapping of routed sessions Not Supported by Cisco DSL Manager

Cisco DSL Manager (CDM) users can provision switched VCs, but CDM does not support configuring routed termination of RFC 1483 sessions.

MPLS VPN Mapping of Routed Sessions not Supported on the Eight-Port IDSL ITU-C Line Card

Routed termination of IDSL connections is not supported.

Related Documents

- *Cisco IOS IP Configuration Guide,* Release 12.2
- Cisco MPLS Virtual Private Networks Feature Module
- Cisco MPLS Virtual Private Network Enhancements Feature Module
- *Cisco IOS Switching Services Configuration Guide*

New Terminology for MPLS

Table 6-1 lists old tag switching and more current MPLS terms:

Table 6-1 MPLS Terminology

Old Designation	New Designation
Tag Switching	MPLS, Multiprotocol Label Switching.
Tag (short for Tag Switching)	MPLS.
Tag (item or packet)	Label.
TDP (Tag Distribution Protocol)	LDP (Label Distribution Protocol). Cisco TDP and LDP (MPLS Label Distribution Protocol) are nearly identical in function, but use incompatible message formats and some different procedures. Cisco now implements a standards-compliant LDP.
Tag Switched	Label Switched.
TFIB (Tag Forwarding Information Base)	LFIB (Label Forwarding Information Base).
TSR (Tag Switching Router)	LSR (Label Switching Router).
TSC (Tag Switch Controller)	LSC (Label Switch Controller).
ATM-TSR (ATM Tag Switch Router)	ATM-LSR (ATM Label Switch Router, such as the Cisco BPX 8650 switch).
TVC (Tag VC, Tag Virtual Circuit)	LVC (Label VC, Label Virtual Circuit).
XTag ATM (extended Tag ATM port)	XmplsATM (extended MPLS ATM port).

New Terminology for MPLS VPN mapping of routed sessions

DSLAMs running the MPLS VPN mapping of routed sessions feature are referred to as IP DSL switches.

Configuration Prerequisites

Your network must be running the following services before you configure MPLS VPN mapping of routed sessions:

- MPLS in provider backbone routers
- MPLS with VPN code running in provider edge (PE) routers
- BGP in all routers providing an MPLS VPN service
- Cisco Express Forwarding (CEF) in every MPLS-enabled router
- RFC 1483 encapsulation on any DSL CPE devices participating in an MPLS VPN
- IOS Release 12.1(4)DA or later on NI-2 based DSLAMs participating in MPLS VPNs

Configuration Tasks

This section describes the configuration tasks to enable MPLS VPN mapping on supported DSLAM platforms.

Configuring MPLS VPN mapping of routed sessions is similar to configuring MPLS VPNs on other Cisco MPLS platforms. For general MPLS VPN configuration tasks, examples, and command references, consult the MPLS Virtual Private Networks and MPLS Virtual Private Network Enhancements feature modules.

To enable MPLS VPN mapping of routed sessions, perform the following configuration tasks:

- Installing the Latest Cisco IOS Release, page 6-7
- Enabling Cisco Express Forwarding, page 6-7
- Configuring a VPN Forwarding Routing Instance, page 6-7
- Creating a Loopback Interface and Associating It with a VRF, page 6-8
- Creating a Loopback Interface to Be Associated with the Uplink Interface, page 6-8
- Creating Uplink ATM Subinterfaces and Virtual Path Tunnels and Enabling MPLS, page 6-9
- Configuring the PE-to-CE Interface Using RFC 1483 Routing, page 6-9
- Configuring the PE-to-CE Interface Using RBE, page 6-10
- Configuring the PE-to-CE Interface Using PPPoA, page 6-11
- Configuring Routing Sessions, page 6-11
- Verifying VPN Operation, page 6-13

Installing the Latest Cisco IOS Release

See the software installation documentation for the DSLAM platform on which MPLS VPN mapping of routed sessions will be installed.

Enabling Cisco Express Forwarding

To enable Cisco Express Forwarding (CEF) on NI-2 based DSLAMs, enter the following command:

Command	Purpose
`DSLAM(config)# ip cef`	This command enables Cisco Express Forwarding (CEF).

Command Usage Example

```
DSLAM(config)# ip cef
DSLAM(config)# end
DSLAM#
```

Configuring a VPN Forwarding Routing Instance

To define VPN forwarding routing instances (VRFs), use the following commands in router configuration mode on a PE router:

	Command	Purpose
Step 1	`DSLAM(config)# ip vrf` *vrf-name*	Enters VRF configuration mode and defines the VPN routing instance by assigning a VRF name.
Step 2	`DSLAM(config-vrf)# rd` *route-distinguisher*	Creates routing and forwarding tables.
Step 3	`DSLAM(config-vrf)# route-target` {**import** | **export** | **both**} *route-target-ext-community*	Creates a list of import and export route target communities for the specified VRF.
Step 4	`DSLAM(config-vrf)# import map` *route-map*	(Optional) Associates the specified route map with the VRF.

Command Usage Example

```
DSLAM(config)# ip vrf vpn1
DSLAM(config-vrf)# rd 100:1
DSLAM(config-vrf)# route-target export 100:1
DSLAM(config-vrf)# route-target import 100:1
DSLAM(config-vrf)# end
DSLAM#
```

Creating a Loopback Interface and Associating It with a VRF

To create a loopback interface and associate it with a VRF, enter the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface loopback` *loopback_interface_number*	Creates a loopback interface to associate with the VRF.
Step 2	`DSLAM(config-if)# ip vrf forwarding` *vrf-name*	Associates the interface with the VRF.
Step 3	`DSLAM(config-if)# ip address` *ip-address subnet-mask*	Assigns an IP address to the loopback interface.

Command Usage Example

```
DSLAM(config)# interface Loopback1
DSLAM(config-if)# ip vrf forwarding vpn1
DSLAM(config-if)# ip address 6.6.6.6 255.255.255.255
DSLAM(config-if)# end
DSLAM#
```

Creating a Loopback Interface to Be Associated with the Uplink Interface

You should configure a loopback interface on DSLAMs running MPLS VPN mapping of routed sessions configured for label switching. This virtual interface is always active.

The IP address you assign to the loopback interface is used as the Label Distribution Protocol (LDP) identifier for the IP DSL switch.

If a loopback interface:

- Does not exist—The LDP identifier is associated with the highest IP address configured on the IP DSL switch.
- Is administratively shut down—All LDP sessions through the IP DSL switch restart.

Therefore, we recommend that you configure a loopback interface. You must associate the VRF with a routed interface using the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface loopback` *loopback_interface_number*	Enters interface configuration mode.
Step 2	`DSLAM(config-if)# ip address` *ip-address subnet-mask*	Assigns an IP address and subnet mask to the loopback interface.

Command Usage Example

```
DSLAM(config)# interface Loopback0
DSLAM(config-if)# ip address 172.16.1.6 255.255.255.255
DSLAM(config-if)# end
DSLAM#
```

Creating Uplink ATM Subinterfaces and Virtual Path Tunnels and Enabling MPLS

To create a virtual path tunnel from the MPLS uplink port to the service provider network, enter the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface atm slot/port`	Enters interface configuration mode.
Step 2	`DSLAM(config-if)# atm pvp vpi`	Creates the virtual path tunnel that connecting the uplink interface to the SP network. **Note** The VPI value created here must match that of the connected MPLS core router.
Step 3	`DSLAM(config-if)# exit`	Returns to global configuration mode.
Step 4	`DSLAM(config)# interface atm slot/port.vpi point-to-point`	Enters configuration mode for the PVP.
Step 5	`DSLAM(config-subif)# ip unnumbered loopback loopback_interface_number`	Enables IP processing for this subinterface. **Note** Insert the **loopback_interface_number** parameter that you configured in Step 1 of the "Creating a Loopback Interface to Be Associated with the Uplink Interface" section above.
Step 6	`DSLAM(config-subif)# tag-switching ip`	Enables MPLS for IPv4 packets on this subinterface.

Command Usage Example

```
DSLAM(config)# interface ATM0/1
DSLAM(config-if)# atm pvp 61
DSLAM(config-if)# exit
DSLAM(config)# interface ATM0/1.61 point-to-point
DSLAM(config-subif)# ip unnumbered Loopback0
DSLAM(config-if)# tag-switching ip
DSLAM(config-subif)# end
DSLAM#
```

Configuring the PE-to-CE Interface Using RFC 1483 Routing

To create the PE-to-CE DSL interface using RFC 1483 routing and configure it for membership in an MPLS VPN, enter the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface atm slot/port`	Creates the ATM interface.
Step 2	`DSLAM(config-if)# ip vrf forwarding vrf-name`	Associates the DSL interface with the configured VRF.
Step 3	`DSLAM(config-if)# ip unnumbered loopback loopback_interface_number`	Enables IP unnumbered on the ATM interface and assigns the unnumbered interface to the loopback interface that you have created.

	Command	Purpose
Step 4	`DSLAM(config-if)# pvc vpi/vci`	Creates an ATM PVC on the DSL interface.
Step 5	`DSLAM(config-if-atm-vc)# encapsulation encapsulation_type`	Configures the required RFC 1483 encapsulation on the DSL-to-IP DSL switch interface. **Note** The default encapsulation type is *aal5snap*. Cisco 600 series CPE devices support only *aal5snap* encapsulation. The Cisco 827 CPE supports both *aal5snap* and *aal5mux ip* encapsulation.

Command Usage Example

```
DSLAM(config)# interface ATM1/2
DSLAM(config-if)# ip vrf forwarding vpn1
DSLAM(config-if)# ip unnumbered Loopback1
DSLAM(config-if)# pvc 1/32
DSLAM(config-if-atm-vc)# encapsulation aal5snap
DSLAM(config-if-atm-vc)# end
DSLAM#
```

Configuring the PE-to-CE Interface Using RBE

To create the PE-to-CE DSL interface using RBE and configure it for membership in an MPLS VPN, enter the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface atm slot/port`	Creates the ATM interface.
Step 2	`DSLAM(config-if)# ip vrf forwarding vrf-name`	Associates the DSL interface with the configured VRF.
Step 3	`DSLAM(config-if)# ip unnumbered loopback loopback_interface_number`	Enables IP unnumbered on the ATM interface and assigns the unnumbered interface to the loopback interface that you have created.
Step 4	`DSLAM(config-if)# atm route-bridged ip`	Enables Route 1483 Ethernet-encapsulated packets.
Step 5	`DSLAM(config-if)# pvc vpi/vci`	Creates an ATM PVC on the DSL interface.
Step 6	`DSLAM(config-if-atm-vc)# encapsulation encapsulation_type`	Configures the required encapsulation on the DSL-to-IP DSL switch interface. **Note** The default encapsulation type is *aal5snap*. Cisco 600 series CPE devices support only *aal5snap* encapsulation. The Cisco 827 CPE supports both *aal5snap* and *aal5mux ip* encapsulation.

Command Usage Example

```
DSLAM(config)# interface ATM1/2
DSLAM(config-if)# ip vrf forwarding vpn1
DSLAM(config-if)# ip unnumbered Loopback1
DSLAM(config-if)# atm route-bridged ip
DSLAM(config-if)# pvc 1/32
DSLAM(config-if-atm-vc)# encapsulation aal5snap
DSLAM(config-if-atm-vc)# end
DSLAM#
```

Configuring the PE-to-CE Interface Using PPPoA

To create the PE-to-CE DSL interface using PPPoA and configure it for membership in an MPLS VPN, enter the following commands:

	Command	Purpose
Step 1	`DSLAM(config)# interface virtual-template 1`	Creates the virtual-template interface.
Step 2	`DSLAM(config-if)# ip vrf forwarding vrf-name`	Associates the virtual-template interface with the configured VRF.
Step 3	`DSLAM(config-if)# ip unnumbered loopback loopback_interface_number`	Enables IP unnumbered on the virtual-template interface and assigns the unnumbered interface to the loopback interface that you have created.
Step 4	`DSLAM(config-if)# ppp authentication chap`	Enables CHAP authentication.
Step 5	`DSLAM(config-if)# interface atm slot/port`	Creates the ATM interface.
Step 6	`DSLAM(config-if)# pvc vpi/vci`	Creates an ATM PVC on the DSL interface.

Step 7	`DSLAM(config-if-atm-vc)# encapsulation encapsulation_type`
	or, for aaal5snap
	`DSLAM(config-if-atm-vc)# encapsulation aaal5snap`
	`DSLAM(config-if-atm-vc)# protocol ppp`
		Configures the required PPPoA encapsulation on the DSL-to-IP DSL switch interface.
		Note Encapsulation available on the IP DSL switch interface to support PPP termination is aal5ciscoppp, aal5ciscomux ppp, or aal5snap ppp.

Command Usage Example

```
DSLAM(config)# interface virtual-template 1
DSLAM(config-if)# ip vrf forwarding vpn1
DSLAM(config-if)# ip unnumbered Loopback1
DSLAM(config-if)# ppp authentication chap
DSLAM(config)# interface ATM1/2
DSLAM(config-if)# pvc 1/32
DSLAM(config-if-atm-vc)# encapsulation aal5smux ppp virtual-template 1
DSLAM(config-if-atm-vc)# end
DSLAM(config)# interface atm 1/3
DSLAM(config-if-atm-vc)# encapsulation aal5ciscoppp virtual-template 1
DSLAM(config-if-atm-vc)# end
```

Configuring Routing Sessions

This section describes the routing protocol configuration tasks necessary to enable MPLS VPNs in your network.

To configure an operational MPLS VPN, you must complete the following tasks:

- Configure BGP routing sessions.
- Configure an MPLS core routing protocol. (OSPF is used in the example in the "Configuring MPLS Core Routing Protocols" section on page 6-12 section below.)
- Configure a PE to CE routing instance. (In the example below, RIP is used, but you can configure static routes or BGP routing sessions.)

Configuring BGP Routing Sessions

To configure BGP routing sessions in a provider network, use the following commands in router configuration mode on the PE router:

	Command	Purpose
Step 1	DSLAM(config)# **router bgp** *autonomous_system_number*	Configures the BGP routing process with the autonomous system number passed along to other BGP routers.
Step 2	DSLAM(config-router)# **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *number*	Specifies a neighbor IP address or BGP peer group, identifying it to the local autonomous system.
Step 3	DSLAM(config-router)# **neighbor** *ip-address* **update-source** *loopback-interface*	Specifies a loopback interface as the source for routing updates.
Step 4	DSLAM(config-router)# **address-family vpnv4** [**unicast**]	Defines IBGP parameters for VPNv4 Network Layer Reachability Information (NLRI) exchange.
Step 5	DSLAM(config-router-af)# **neighbor** *address* **send-community both**	Defines an IBGP session to exchange VPNv4 NLRIs.
Step 6	DSLAM(config-router-af)# **neighbor** *address* **activate**	Activates the advertisement of the IPv4 address family.

Command Usage Example

```
DSLAM(config)# router bgp 100
DSLAM(config-router)# neighbor 172.16.0.8 remote-as 100
DSLAM(config-router)# neighbor 172.16.0.8 update-source Loopback0
DSLAM(config-router)# address-family vpnv4
DSLAM(config-router-af)# neighbor 172.16.0.8 send-community both
DSLAM(config-router-af)# neighbor 172.16.0.8 activate
DSLAM(config-router-af)# exit-address-family
```

Configuring MPLS Core Routing Protocols

Though there are several routing protocols to choose from, the configuration example below uses OSPF as an IGP:

	Command	Purpose
Step 1	DSLAM(config)# **router ospf** *process-id*	Creates an OSPF routing process between the IP DSL switch and the core MPLS routers.
Step 2	DSLAM(config-router)# **network** *ipaddress wildcard-mask* **area** *area-id*	Defines an interface on which OSPF runs and also defines the area ID for that interface.

For information on configuring other routing protocols, consult the *Cisco IOS IP Command Reference* for Cisco IOS Release 12.2.

Command Usage Example

```
DSLAM(config)# router ospf 6
DSLAM(config-router)# network 172.16.0.0 0.0.255.255 area 0
DSLAM(config-router)# end
DSLAM#
```

Configuring RIP PE-to-CE Routing Sessions

To configure BGP PE-to-CE routing sessions, use the following commands in router configuration mode on the PE router:

	Command	Purpose
Step 1	DSLAM(config)# **router rip**	Enables RIP.
Step 2	DSLAM(config-router)# **address-family ipv4** [**unicast**] **vrf** *vrf-name*	Defines RIP parameters for PE-to-CE routing sessions. **Note** The default is Off for auto-summary and synchronization in the VRF address-family submode.
Step 3	DSLAM(config-router-af)# **redistribute bgp** [autonomous-system] [**metric** *metric-value*] **transparent**	Redistributes VRF BGP routes into the VRF RIP table.
Step 4	DSLAM(config-router-af)# **network** ip_address_*prefix*	Enables RIP on the PE to CE link.

Command Usage Example

```
DSLAM(config)# router rip
DSLAM(config-router)# address-family ipv4 vrf vpn1
DSLAM(config-router-af)# redistribute bgp 100 metric transparent
DSLAM(config-router-af)# network 6.0.0.0
DSLAM(config-router-af)# exit-address-family
DSLAM(config-router)# end
DSLAM#
```

Verifying VPN Operation

To verify the proper operation of an MPLS VPN, use the following commands:

	Command	Purpose
Step 1	DSLAM# **show ip vrf**	Displays the set of defined VRFs and interfaces.
Step 2	DSLAM# **show ip vrf** [{**brief** | **detail** | **interfaces**}] *vrf-name*	Displays information about defined VRFs and associated interfaces.
Step 3	DSLAM# **show ip route vrf** *vrf-name*	Displays the IP routing table for a VRF.
Step 4	DSLAM# **show ip protocols vrf** *vrf-name*	Displays the routing protocol information for a VRF.
Step 5	DSLAM# **show ip cef vrf** *vrf-name*	Displays the CEF forwarding table associated with a VRF.
Step 6	DSLAM# **show ip interface** *interface-number*	Displays the VRF table associated with an interface.
Step 7	DSLAM# **show ip bgp vpnv4 all** [**tags**]	Displays information about all BGPs.
Step 8	DSLAM# **show tag-switching forwarding vrf** *vrf-name* [*prefix mask/length*][**detail**]	Displays label forwarding entries that correspond to VRF routes advertised by the DSLAM.

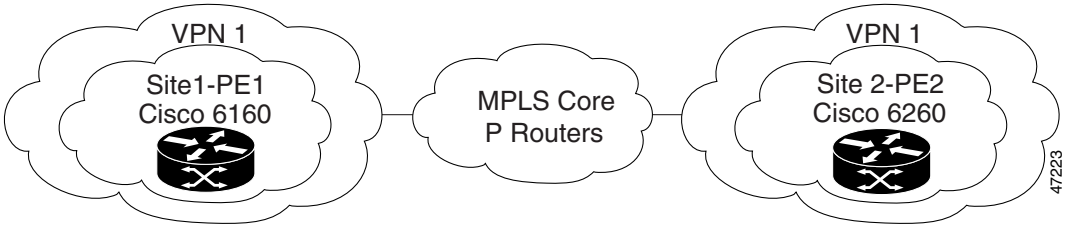
Configuration Samples

This section provides sample configurations of MPLS VPN mapping of routed sessions.

The configuration samples represent a simple hub-and-spoke network with two adjacent IP DSL switches. Figure 6-2 illustrates the network topology for the sample configurations below.

Note Comments are highlighted with two sets of three exclamation points. For example, `!!!This is a comment.!!!` Comments appear before the configurations they describe.

Figure 6-2 Simple Hub and Spoke MPLS VPN Network Diagram



Site 1–PE1 Configuration—Cisco 6160 DSLAM

```
hostname dsl-6
!
boot system flash:ni2-dslp5-mz.ni2_mpls.20000720
slot 1 ATUC-4FLEXIDMT
!
dsl-profile 4dmt2func
 dmt training-mode standard
 dmt overhead-framing mode1
 dmt bitrate minimum interleaved downstream 8032 upstream 864
 dmt bitrate maximum interleaved downstream 8032 upstream 864

network-clock-select 1 system
ip subnet-zero
!
!!!Define and configure the VRF. See the "Configuring a VPN Forwarding Routing Instance"
section on page 6-7.!!!
ip vrf vpn1
 rd 100:1
 route-target export 100:1
 route-target import 100:1
!
!!!The following command enables Cisco Express Forwarding. See the "Enabling Cisco Express
Forwarding" section on page 6-7.!!!
ip cef
!
atm address 47.0091.8100.0000.0010.06ec.9102.0010.06ec.9102.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
 redistribute atm-static
!
!!!Create an uplink loopback interface. See the "Creating a Loopback Interface to Be
Associated with the Uplink Interface" section on page 6-8.!!!
!
```

```
interface Loopback0
 ip address 172.16.1.6 255.255.255.255
!
!!!Configure a loopback interface and associate it with a VRF. See the "Creating a
Loopback Interface and Associating It with a VRF" section on page 6-8.!!!

interface Loopback1
 ip vrf forwarding vpn1
 ip address 6.6.6.6 255.255.255.255

interface ATM0/0
 no ip address
 atm cac service-category abr deny
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvci-bits 12
!
interface Ethernet0/0
 ip address 10.1.1.56 255.255.255.0
!
interface ATM0/1
 no ip address
 no atm ilmi-keepalive
 atm cac service-category abr deny

 !!!Create Uplink ATM Subinterfaces. See the
 "Creating Uplink ATM Subinterfaces and Virtual Path Tunnels and Enabling MPLS" section on
page 6-9.!!!
 atm pvp 61
 atm pvp 62
 atm pvp 67
!
!!!Create VP tunnels and enable MPLS. See the "Creating Uplink ATM Subinterfaces and
Virtual Path Tunnels and Enabling MPLS" section on page 6-9.!!!

interface ATM0/1.61 point-to-point
 ip unnumbered Loopback0
 tag-switching ip
!
!!!Create VP tunnels and enable MPLS. See the "Creating Uplink ATM Subinterfaces and
Virtual Path Tunnels and Enabling MPLS" section on page 6-9.!!!
!
interface ATM0/1.62 point-to-point
 ip unnumbered Loopback0
 tag-switching ip
!
!!!Create VP tunnels and enable MPLS. See the "Creating Uplink ATM Subinterfaces and
Virtual Path Tunnels and Enabling MPLS" section on page 6-9.!!!
!
interface ATM0/1.67 point-to-point
 ip unnumbered Loopback0
 tag-switching ip
!
!!!Create a DSL interface and associate it with a VRF. See the "Configuring the PE-to-CE
Interface Using RFC 1483 Routing" section on page 6-9.!!!
!
interface ATM1/2
 ip vrf forwarding vpn1
 ip unnumbered Loopback1
 dsl profile 4dmt2func
 no atm ilmi-keepalive
 pvc 1/32
!
```

```
!!!Configure OSPF as the MPLS core routing protocol. Configuring MPLS Core Routing
Protocols, page 6-12
router ospf 6
 network 172.16.0.0 0.0.255.255 area 0
 !
!!!Configure RIP PE to CE routing sessions. See the "Configuring RIP PE-to-CE Routing
Sessions" section on page 6-13.!!!
!
router rip
 address-family ipv4 vrf vpn1
 redistribute bgp 100 metric transparent
 network 6.0.0.0
 no auto-summary
 exit-address-family
!
!!!Configure BGP. See the "Configuring BGP Routing Sessions" section on page 6-12.!!!
!
router bgp 100
 no synchronization
 neighbor 172.16.1.7 remote-as 100
 neighbor 172.16.1.7 update-source Loopback0
 !
 address-family ipv4 vrf vpn1
 redistribute connected
 redistribute static
 redistribute rip
 no auto-summary
 no synchronization
 exit-address-family
 !
 !!!Enable PE to PE routing sessions. See the
 "Configuring BGP Routing Sessions" section on page 6-12.!!!
 address-family vpnv4
 neighbor 172.16.1.7 activate
 neighbor 172.16.1.7 send-community both
 exit-address-family
!
ip classless
no ip http server
!
!
line con 0
 exec-timeout 0 0
 privilege level 15
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

Site 2–PE2 Configuration—Cisco 6260 DSLAM

```
hostname dsl-7
!
boot system flash:ni2-dslp5-mz.ni2_mpls.20000720
slot 1 ATUC-1-4DMT
slot 2 ATUC-1-4DMT
slot 3 ATUC-1-4DMT
slot 4 ATUC-1-4DMT
slot 5 ATUC-1-4DMT
!
dsl-profile 4dmt2func
 dmt training-mode standard
 dmt overhead-framing mode1
 dmt margin downstream 3 upstream 3
 dmt bitrate minimum interleaved downstream 8032 upstream 864
 dmt bitrate maximum interleaved downstream 8032 upstream 864
network-clock-select 1 system
ip subnet-zero
!
!!!Define and configure the VRF. See the "Configuring a VPN Forwarding Routing Instance"
section on page 6-7.!!!
ip vrf vpn1
 rd 100:1
 route-target export 100:1
 route-target import 100:1
!
!!!The following command enables Cisco Express Forwarding. See the "Enabling Cisco Express
Forwarding" section on page 6-7.!!!
ip cef
!
atm address 47.0091.8100.0000.0010.06ec.8b02.0010.06ec.8b02.00
atm address 47.0091.8100.0000.0030.b688.3801.0030.b688.3801.00
atm address 47.0091.8100.0000.0060.3e0f.0301.0060.3e0f.0301.00
atm address 47.0091.8100.0000.0060.3e0f.2b01.0060.3e0f.2b01.00
atm address 47.0091.8100.0000.0073.9a88.6301.0073.9a88.6301.00
atm router pnni
 no aesa embedded-number left-justified
 node 1 level 56 lowest
  redistribute atm-static
!
!!!Create an uplink loopback interface. See the "Creating a Loopback Interface to Be
Associated with the Uplink Interface" section on page 6-8.!!!
!
interface Loopback0
 ip address 172.16.1.7 255.255.255.255
!
!!!Configure a loopback interface and associate it with a VRF. See the "Creating a
Loopback Interface and Associating It with a VRF" section on page 6-8.!!!
!
interface Loopback1
 ip vrf forwarding vpn1
 ip address 7.7.7.7 255.255.255.255
!
interface ATM0/0
 no ip address
 atm cac service-category abr deny
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvci-bits 12
!
interface Ethernet0/0
 ip address 10.1.1.57 255.255.255.0
```

```
!
interface ATM0/1
 no ip address
 no atm ilmi-keepalive
 atm cac service-category abr deny
 !!!Create Uplink ATM Subinterfaces. See the
 "Creating Uplink ATM Subinterfaces and Virtual Path Tunnels and Enabling MPLS" section on
page 6-9.!!!
 atm pvp 67
 atm pvp 72
!
!!!Create VP tunnels and enable MPLS. See the "Creating Uplink ATM Subinterfaces and
Virtual Path Tunnels and Enabling MPLS" section on page 6-9.!!!
!
interface ATM0/1.67 point-to-point
 ip unnumbered Loopback0
 tag-switching ip
!
!!!Create VP tunnels and enable MPLS. See the "Creating Uplink ATM Subinterfaces and
Virtual Path Tunnels and Enabling MPLS" section on page 6-9.!!!
!
interface ATM0/1.72 point-to-point
 ip unnumbered Loopback0
 tag-switching ip
!
!!!Create a DSL interface and associate it with a VRF. See the "Configuring the PE-to-CE
Interface Using RFC 1483 Routing" section on page 6-9.!!!
!
interface ATM1/1
 ip vrf forwarding vpn1
 ip unnumbered Loopback1
 dsl profile 4dmt2func
 no atm ilmi-keepalive
 atm cac service-category abr deny
 pvc 1/33
 !
!!!Configure OSPF as the MPLS core routing protocol. Configuring MPLS Core Routing
Protocols, page 6-12
!
router ospf 7
 router-id 172.16.1.7
 network 172.16.0.0 0.0.255.255 area 0
!
!!!Configure RIP PE to CE routing sessions. See the "Configuring RIP PE-to-CE Routing
Sessions" section on page 6-13.!!!
!
router rip
 address-family ipv4 vrf vpn1
 redistribute bgp 100 metric transparent
 network 7.0.0.0
 no auto-summary
 exit-address-family
!
!!!Configure BGP. See the "Configuring BGP Routing Sessions" section on page 6-12.!!!
!
router bgp 100
 no synchronization
 network 10.1.1.0 mask 255.255.255.0
 neighbor 172.16.1.6 remote-as 100
 neighbor 172.16.1.6 update-source Loopback0
```

```
 address-family ipv4 vrf vpn1
 redistribute connected
 redistribute static
 redistribute rip
 no auto-summary
 no synchronization
 exit-address-family
 address-family ipv4 vrf vpn
 no auto-summary
 no synchronization
 exit-address-family
 !
 !!!Enable PE to PE routing sessions. See the
 "Configuring BGP Routing Sessions" section on page 6-12.!!!
 !
 address-family vpnv4
 neighbor 172.16.1.6 activate
 neighbor 172.16.1.6 send-community both
 exit-address-family
!
ip classless
no ip http server
!
line con 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

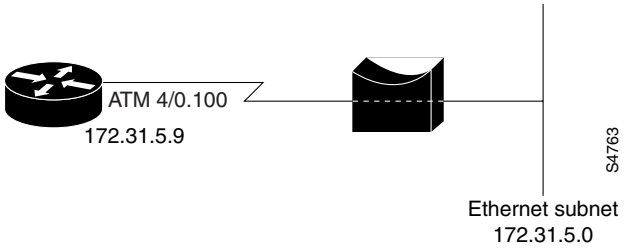
Configuring NI-2 IP Services

This chapter describes the Cisco NI-2 IP Services on all DSLAMs using the second-generation network interface module (NI-2) card. It includes the following sections:

Configuring ATM Route-Bridged Encapsulation

The ATM route-bridged encapsulation feature on a DSLAM is used to route IP over bridged RFC 1483 Ethernet traffic from a stub-bridged LAN.

Figure 7-1 ATM Route-Bridged Encapsulation



Bridged IP packets received on an ATM interface configured in route-bridged mode are routed by means of the IP header. Such interfaces take advantage of the characteristics of a stub LAN topology commonly used for digital subscriber line (DSL) access and offer performance and flexibility superior to those offered by integrated routing and bridging (IRB).

ATM route-bridged encapsulation reduces the security risk associated with normal bridging or IRB by reducing the size of the nonsecured network. By using a single virtual circuit (VC) allocated to a subnet (which could be as small as a single IP address), ATM route-bridged encapsulation limits the “trust environment” to a single customer premises that uses IP addresses in the subnet.

Restrictions

ATM route-bridged encapsulation does not support MAC-layer access lists. Only IP access lists are supported.

Configuring ATM Route-Bridged encapsulation

Perform the following tasks to configure ATM route-bridged encapsulation on your DSLAM:

	Command	Purpose
Step 1	`DSLAM(config)# interface atm slot/port`	Specify an ATM interface.
Step 2	`DSLAM(config-if)# pvc VPI/VCI`	Configure a virtual channel to carry the route-bridged traffic.
Step 3	`DSLAM(config-if)# atm route-bridge ip`	Enable ATM route-bridged encapsulation for IP.
Step 4	`DSLAM(config-if)# ip address ip-address mask [secondary]`	Provide an IP address on the same subnetwork as the remote network.
Step 5	`DSLAM(config-if)# ^Z`	Exit to EXEC mode.

Only the specified network layer (IP) is routed. Any remaining protocols can be passed on to bridging or other protocols. In this manner, ATM route-bridged encapsulation can be used to route IP while other protocols (such as IPX) are bridged normally.

Examples

This section provides the following configuration examples:

- ATM Route-Bridged encapsulation, page 7-2
- ATM Route-Bridged encapsulation on an Unnumbered Interface, page 7-2
- Concurrent Bridging and ATM Route-Bridged encapsulation, page 7-3

ATM Route-Bridged encapsulation

The following example shows a typical ATM route-bridged encapsulation configuration (172.69.5.9 is the address of the ethernet 0/0 interface):

```
DSLAM(config)# interface atm 1/1
DSLAM(config-if)# ip address 172.69.5.9 255.255.255.0
DSLAM(config-if)# pvc 0/32
DSLAM(config-if)# atm route-bridged ip
```

ATM Route-Bridged encapsulation on an Unnumbered Interface

The following ATM route-bridged encapsulation example uses a static route to point to an unnumbered interface:

```
DSLAM(config)# interface atm 1/1
DSLAM(config-if)# ip unnumbered ethernet 0/0
DSLAM(config-if)# pvc 0/32
DSLAM(config-if)# atm route-bridged ip

DSLAM(config-if)# ip route 172.69.5.9 255.255.255.0 interface atm 1/1
```

Concurrent Bridging and ATM Route-Bridged encapsulation

The following example shows concurrent use of ATM route-bridged encapsulation with normal bridging. IP datagrams are route-bridged, and other protocols (such as IPX or AppleTalk) are bridged.

```
DSLAM(config)# radius 1 protocol ieee
DSLAM(config)# interface atm 1/1
DSLAM(config-if)# ip address 172.69.5.9 255.255.255.0
DSLAM(config-if)# pvc 0/32
DSLAM(config-if-atm-vc)# bridge-group 1
DSLAM(config-if-atm-vc)# atm route-bridged ip
```

Configuring Layer 2 Tunnel Protocol

Defined by RFC 2661, Layer 2 Tunnel Protocol (L2TP) is an emerging Internet Engineering Task Force (IETF) standard that combines the best features of two existing tunneling protocols: Cisco's Layer 2 Forwarding (L2F) and Microsoft's Point-to-Point Tunneling Protocol (PPTP). For a description of L2TP and a summary of its benefits, restrictions, and configuration information, see the Cisco IOS Release 12.0(1) T Layer 2 Tunnel Protocol feature module and the "Configuring Virtual Private Networks" chapter of the *Cisco IOS Dial Services Configuration Guide: Network Services,* Release 12.1.

The "Configuring VPDN on the LAC" section on page 7-3 discusses configuring L2TP.

Configuring VPDN on the LAC

The L2TP access concentrator (LAC) is typically (although not always) located at the service provider POP. Initial configuration and ongoing management is done by the service provider. Enter the following commands to enable VPDN on a LAC by using L2TP, beginning in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# vpdn enable`	Enables VPDN and tells the router to look for tunnel definitions from an LNS.
Step 2	`DSLAM(config)# vpdn-group` *group-number*	Defines a local group number identifier for which other VPDN variables can be assigned. Valid group numbers are in the range 1 to 3000.
Step 3	`DSLAM(config-vpdn)# request-dialin [l2f | l2tp] ip` *ip-address* {`domain` *domain-name* }	Enables the DSLAM to request a dial-in tunnel to an IP address if the dial-in user belongs to a specific domain.
Step 4	`DSLAM(config-vpdn-req-in)# protocol` *protocol*	Identifies the protocol for the dial-in request.
Step 5	`DSLAM(config-vpdn-req-in)# domain` *domain-name*	Identifies the specific domain.
Step 6	`DSLAM(config-vpdn-req-in)# initiate to ip` *ip address of the LNS*	Identifies the IP address of the LNS.
Step 7	`DSLAM(config-vpdn-req-in)# local name` *name*	Identifies the name of the IP address.

Example

The following example configures VPDN on the LAC. The vpdn-group 1 initiates the outgoing L2TP sessions to the LNS. The domain is cisco.com. The IP address of the LNS is 172.16.0.2. The vpdn-group pppoe accepts the incoming PPPoE session on atm 1/1. The PPPoA session is on atm 1/2.

```
DSLAM(config)# vpdn enable
DSLAM(config)# vpdn-group 1
DSLAM(config-vpdn)# request-dialin
DSLAM(config-vpdn-req-in)# protocol l2tp
DSLAM(config-vpdn-req-in)# domain cisco.com
DSLAM(config-vpdn-req-in)# initiate-to ip 172.16.0.2
DSLAM(config-vpdn-req-in)# local name r1-1
DSLAM(config-vpdn-req-in)# exit
DSLAM(config-vpdn)# exit
!
DSLAM(config)# vpdn-group pppoe
DSLAM(config-vpdn)# accept-dialin
DSLAM(config-vpdn-acc-in)# protocol pppoe
DSLAM(config-vpdn)# virtual-template 1
!
DSLAM(config-vpdn)# interface virtual-template 1
DSLAM(config-if)# ppp authentication chap
DSLAM(config-if)# no peer default ip address
!

DSLAM(config-if)# interface atm 1/1
DSLAM(config-if)# pvc 1/1
DSLAM(config-if)# encapsulation aal5snap
DSLAM(config-if)# protocol pppoe

DSLAM(config-if)# interface atm1/2 -> configuration for PPPoA session
DSLAM(config-if)# pvc 1/1
DSLAM(config-if)# encapsulation aal5mux ppp virtual-template 1
```

Monitoring and Troubleshooting VPDN and L2TP

To troubleshoot VPDN and L2TP, enter the privileged EXEC command **show vpdn tunnel all**, which contains information for these L2TP scalability enhancements. These fields are described in Table 7-1.

```
DSLAM# show vpdn tunnel all

 L2TP Tunnel Information (Total tunnels=1 sessions=500)

 Tunnel id 20 is up, remote id is 12, 500 active sessions
   Tunnel state is established, time since change 00:00:33
   Remote tunnel name is LAC
     Internet Address 10.1.1.1, port 1701
   Local tunnel name is LNS
     Internet Address 10.1.1.2, port 1701
   971 packets sent, 1259 received, 19892 bytes sent, 37787 received
   Control Ns 501, Nr 746
   Local RWS 3000 (default), Remote RWS 3000 (max)
   Retransmission time 4, max 8 seconds
   Unsent queuesize 0, max 0
   Resend queuesize 251, max 261
   Total resends 390, ZLB ACKs 251
   Current nosession queue check 0 of 5
   Retransmit time distribution: 0 0 0 0 1 0 0 0 1
   Sessions disconnected due to lack of resources 0
```

Table 7-1 **show vpdn tunnel all *Field Descriptions***

Field	Description
Retransmission time 4, max 8 seconds	Current retransmit timeout for the tunnel; maximum retransmit timeout reached by the tunnel.
Unsent queuesize 0, max 0	Number of control packets waiting to be sent to the peer; maximum number of control packets in the unsent queue.
Resend queuesize 251, max 261	Number of control packets sent but not acknowledged; maximum number of unacknowledged control packets in the resend queue.
Total resends 390, ZLB ACKs 251	Total number of packets resent; number of zero length body acknowledgment messages sent.
Current nosession queue check 0 of 5	Number of tunnel timeout periods since the last session ended. Up to 5 tunnel timeouts are used if there are outstanding control packets on the unsent or resend queue. Otherwise, the tunnel is dropped after 1 tunnel timeout.
Retransmit time distribution: 0 0 0 0 1 0 0 0 1	Histogram showing the number of retransmissions at 0, 1, 2, ..., and 8 seconds, respectively.
Sessions disconnected due to lack of resources 0	Number of sessions for which there were no precloned interfaces available. By default, a request for a new session at an LNS is refused if a precloned interface is not available.

Table 7-2 describes privileged EXEC commands that help you monitor and maintain VPDNs that use L2TP tunnels.

Table 7-2 VPDN Monitoring and Maintaining Commands

Command	Purpose
`DSLAM# show vpdn tunnel [all | packets | state | summary | transport]`	Displays VPDN tunnel information including tunnel protocol, ID, packets sent and received, receive window sizes, retransmission times, and transport status.
`DSLAM# show vpdn session [all [interface | tunnel | username]| packets | sequence | state | timers | window]`	Displays VPDN session information including interface, tunnel, username, packets, status, and window statistics.
`DSLAM# clear vpdn tunnel l2tp remote-name local-name`	Shuts down a specific tunnel and all the sessions within the tunnel, then restarts the tunnel.

Troubleshooting components in VPDN is not always straightforward because there are multiple technologies and OSI layers involved. Table 7-3 describes EXEC commands that help you isolate and identify problems on VPDNs that use L2TP tunnels.

Table 7-3 VPDN Troubleshooting Commands

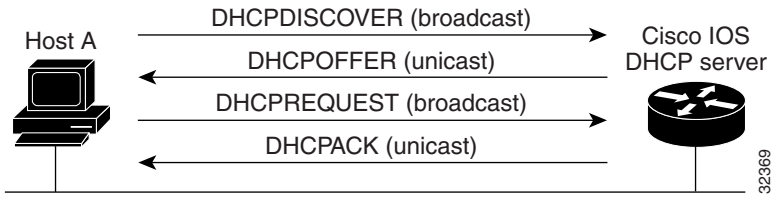
Command	Purpose
DSLAM# **clear vpdn tunnel** [**l2f** [**nas-name** | **hgw-name**] | **l2tp** [**remote-name** | **local-name**]]	Shuts down a specific tunnel and all the sessions within the tunnel.
DSLAM# **debug ppp negotiation**	Displays information about packets transmitted during PPP start-up and detailed PPP negotiation options.
DSLAM# **debug ppp chap**	Displays CHAP packet exchanges.
DSLAM# **debug vpdn event** [**protocol** | **flow-control**]	Displays VPDN errors and basic events within the protocol (such as L2TP, L2F, PPTP) and errors associated with flow control. Flow control is only possible if you are using L2TP and the remote peer "receive window" is configured for a value greater than zero.
DSLAM# **debug vpdn packet** [**control** | **data**] [**detail**]	Displays protocol-specific packet header information, such as sequence numbers if present, such as flags and length.
DSLAM# **show interface virtual-access** *number*	Displays information about the virtual access interface, LCP, protocol states, and interface statistics. The status of the virtual access interface should be: "Virtual-Access3 is up, line protocol is up."
DSLAM# **show vpdn session** [**all** [**interface** | **tunnel** | **username**] | **packets** | **sequence** | **state** | **timers** | **window**]	Displays VPDN session information including interface, tunnel, username, packets, status, and window statistics.
DSLAM# **show vpdn tunnel** [**all** [**id** | **local-name** | **remote-name**] | **packets** | **state** | **summary** | **transport**]	Displays VPDN tunnel information including tunnel protocol, ID, local and remote tunnel names, packets sent and received, tunnel, and transport status.

Configuring the Cisco IOS DHCP Server

The Dynamic Host Control Protocol (DHCP) enables you to automatically assign reusable IP addresses to DHCP clients. The Cisco IOS DHCP Server feature is a full DHCP server implementation that assigns and manages IP addresses from specified address pools within the DSLAM to DHCP clients. If the Cisco IOS DHCP Server cannot satisfy a DHCP request from its own database, it can forward the request to one or more secondary DHCP servers defined by the network administrator.

Figure 7-2 shows the basic steps that occur when a DHCP client requests an IP address from a DHCP server. The client, host A, sends a DHCPDISCOVER broadcast message to locate a Cisco IOS DHCP server. A DHCP server offers configuration parameters (such as an IP address, a MAC address, a domain name, and a lease for the IP address) to the client in a DHSCPOFFER unicast message.

Figure 7-2 DHCP Request for an IP Address from a DHCP Server



Note A DHCP client might receive offers from multiple DHCP servers and can accept any one of the offers; however, the client usually accepts the first offer it receives. Additionally, the offer from the DHCP server is not a guarantee that the IP address will be allocated to the client; however, the server usually reserves the address until the client has had a chance to formally request the address.

The client returns a formal request for the offered IP address to the DHCP server in a DHCPREQUEST broadcast message. The DHCP server confirms that the IP address has been allocated to the client by returning a DHCPACK unicast message to the client.

Note The formal request for the offered IP address (the DHCPREQUEST message) that is sent by the client is broadcast so that all other DHCP servers that received the DHCPDISCOVER broadcast message from the client can reclaim the IP addresses that they offered to the client.

If the configuration parameters sent to the client in the DHCPOFFER unicast message by the DHCP server are invalid (a misconfiguration error exists), the client returns a DHCPDECLINE broadcast message to the DHCP server.

The DHCP server will send to the client a DHCPNAK denial broadcast message, which means the offered configuration parameters have not been assigned, if an error has occurred during the negotiation of the parameters or the client has been slow in responding to the DHCPOFFER message (the DHCP server assigned the parameters to another client) of the DHCP server.

The Cisco IOS DHCP Server feature offers the following benefits:

- Reduced Internet access costs.
- Using automatic IP address assignment at each remote site substantially reduces Internet access costs. Static IP addresses are considerably more expensive to purchase than are automatically allocated IP addresses.
- Reduced client configuration tasks and costs.
- Because DHCP is easy to configure, it minimizes operational overhead and costs associated with device configuration tasks and eases deployment by nontechnical users.
- Centralized management.
- Because the DHCP server maintains configurations for several subnets, an administrator . needs to update only a single, central server when configuration parameters change.

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on Cisco.com at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

Prerequisites

Before you configure the Cisco IOS DHCP Server feature, complete the following tasks:

- Identify an external File Transport Protocol (FTP), Trivial File Transfer Protocol (TFTP), or remote copy protocol (RCP) server to use to store the DHCP bindings database.
- Identify the IP addresses that the DHCP server can assign, and the IP addresses to exclude.
- Identify DHCP options for devices where necessary, including:
  - Default boot image name
  - Default router(s)
  - Domain Name System (DNS) server(s)
  - NetBIOS name server
- Decide on a NetBIOS node type (b, p, m, or h).
- Decide on a DNS domain name.

DHCP Configuration Task List

The DHCP server database is organized as a tree. The root of the tree is the address pool for natural networks, branches are subnetwork address pools, and leaves are manual bindings to clients. Subnetworks inherit network parameters and clients inherit subnetwork parameters. Therefore, common parameters, such as the domain name, should be configured at the highest (network or subnetwork) level of the tree.

Note Inherited parameters can be overridden. For example, if a parameter is defined in both the natural network and a subnetwork, the definition of the subnetwork is used.

Address leases are not inherited. If a lease is not specified for an IP address, by default, the DHCP server assigns a one-day lease for the address.

To configure the Cisco IOS DHCP server feature, first configure a database agent or disable conflict logging, and then configure IP addresses that the DHCP server either should not assign (excluded addresses) or should assign (a pool of available IP addresses) to requesting clients. These configuration tasks are explained in the following sections.

- Configuring a DHCP Database Agent or Disabling DHCP Conflict Logging, page 7-9 (Required)
- Excluding IP Addresses, page 7-9 (Required)
- Configuring a DHCP Address Pool, page 7-9 (Required)
- Configuring Manual Bindings, page 7-11 (Optional)
- Configuring a DHCP Server Boot File, page 7-12 (Optional)
- Configuring the Number of Ping Packets, page 7-12 (Optional)
- Configuring the Timeout Value for Ping Packets, page 7-13 (Optional)
- Enabling the Cisco IOS DHCP Server Feature, page 7-13 (Optional)

Configuring a DHCP Database Agent or Disabling DHCP Conflict Logging

A DHCP database agent is any host, for example, an FTP, TFTP, or RCP server that stores the DHCP bindings database. You can configure multiple DHCP database agents and you can configure the interval between database updates and transfers for each agent. To configure a database agent and database agent parameters, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# ip dhcp database` *url* [`timeout` *seconds* | `write-delay` *seconds*]	Configures the database agent and the interval between database updates and database transfers.

If you choose not to configure a DHCP database agent, disable the recording of DHCP address conflicts on the DHCP server. To disable DHCP address conflict logging, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# no ip dhcp conflict logging`	Disables DHCP address conflict logging.

Excluding IP Addresses

The DHCP server acts as if all IP addresses in a DHCP address pool subnet are available for assigning to DHCP clients. You must specify the IP addresses that the DHCP server should not assign to clients. To do so, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# ip dhcp excluded-address` *low-address* [*high-address*]	Specifies the IP addresses that the DHCP server should not assign to DHCP clients.

Configuring a DHCP Address Pool

You can configure a DHCP address pool with a name that is a symbolic string (such as “engineering”) or an integer (such as 0). Configuring a DHCP address pool also places you in DHCP pool configuration mode—identified by the (dhcp-config)# prompt—from which you can configure pool parameters (for example, the IP subnet number and default router list). To configure a DHCP address pool, complete the required tasks in the following sections.

Configuring the DHCP Address Pool Name and Entering DHCP Pool Configuration Mode

To configure the DHCP address pool name and enter DHCP pool configuration mode, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# ip dhcp pool` *name*	Creates a name for the DHCP server address pool and places you in DHCP pool configuration mode (identified by the dhcp-config# prompt).

Configuring the DHCP Address Pool Subnet and Mask

To configure a subnet and mask for the newly created DHCP address pool, which contains the range of available IP addresses that the DHCP server may assign to clients, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# network` *network-number* [*mask* | */prefix-length*]	Specifies the subnet network number and mask of the DHCP address pool. The prefix length specifies the number of bits that make up the address prefix. The prefix is an alternative way of specifying the network mask of the client. The prefix length must be preceded by a forward slash (/).

Configuring the Domain Name for the Client

The domain name of a DHCP client places the client in the general grouping of networks that make up the domain. To configure a domain name string for the client, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# domain-name` *domain*	Specifies the domain name for the client.

Configuring the Domain Name System IP Servers for the Client

DHCP clients query DNS IP servers when they need to correlate host names to IP addresses. To configure the DNS IP servers that are available to a DHCP client, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# dns-server` *address* [*address2 ... address8*]	Specifies the IP address of a DNS server that is available to a DHCP client. One IP address is required; however, you can specify up to eight IP addresses in one command line.

Configuring the NetBIOS Windows Internet Naming Service IP Servers for the Client

Windows Internet Naming Service (WINS) is a name resolution service that Microsoft DHCP clients use to correlate host names to IP addresses within a general grouping of networks. To configure the NetBIOS WINS servers that are available to a Microsoft DHCP client, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# netbios-name-server` *address* [*address2 ... address8*]	Specifies the NetBIOS WINS server that is available to a Microsoft DHCP client. One address is required; however, you can specify up to eight addresses in one command line.

Configuring the NetBIOS Node Type for the Client

The NetBIOS node type for Microsoft DHCP clients can be one of four settings: broadcast, peer-to-peer, mixed, or hybrid. To configure the NetBIOS node type for a Microsoft DHCP, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# netbios-node-type type`	Specifies the NetBIOS node type for a Microsoft DHCP client.

Configuring the Default DSLAM for the Client

After a DHCP client has booted, the client begins sending packets to its default DSLAM. The IP address of the default DSLAM should be on the same subnet as the client. To configure a default DSLAM for a DHCP client, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# default-router address [address2 ... address8]`	Specifies the IP address of the default router for a DHCP client. One IP address is required, although you can specify up to eight addresses in one command line.

Configuring the Address Lease Time

By default, each IP address assigned by a DHCP server comes with a one-day lease, which is the amount of time that the address is valid. To change the lease value for an IP address, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# lease {days [hours][minutes] | infinite}`	Specifies the duration of the lease. The default is a a one-day lease.

Configuring Manual Bindings

An address binding is a mapping between the IP address and Media Access Control (MAC) address of a client. The IP address of a client can be assigned manually by an administrator or assigned automatically from a pool by a DHCP server.

Manual bindings are IP addresses that have been manually mapped to the MAC addresses of hosts that are found in the DHCP database. Manual bindings are stored in NVRAM on the DHCP server. Manual bindings are just special address pools. There is no limit on the number of manual bindings.

Automatic bindings are IP addresses that have been automatically mapped to the MAC addresses of hosts that are found in the DHCP database. Automatic bindings are stored on a remote host called a database agent. The bindings are saved as text records for easy maintenance.

To configure a manual binding, first create a host pool, then specify the IP address and hardware address of the client or client identifier. The hardware address is the MAC address. The client identifier, which is required for Microsoft clients (instead of hardware addresses), is formed by concatenating the media type and the MAC address of the client. Refer to the “Address Resolution Protocol Parameters” section of RFC 1700, *Assigned Numbers*, for a list of media type codes.

To configure manual bindings, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# ip dhcp pool name`	Creates a name for the a DHCP server address pool and places you in DHCP pool configuration mode—identified by the (dhcp-config)# prompt.
Step 2	`DSLAM(dhcp-config)# host address [mask | /prefix-length]`	Specifies the IP address and subnet mask of the client. The prefix length specifies the number of bits that comprise the address prefix. The prefix is an alternative way of specifying the network mask of the client. The prefix length must be preceded by a forward slash (/).

Step 3	`DSLAM(dhcp-config)# hardware-address hardware-address type`
	or
	`DSLAM(dhcp-config)# client-identifier unique-identifier`
		Specifies a hardware address for the client.
		Specifies the distinct identification of the client in dotted-hexadecimal notation, for example, 01b7.0813.8811.66, where 01 represents the Ethernet media type.

Step 4	`DSLAM(dhcp-config)# client-name name`	(Optional) Specifies the name of the client using any standard ASCII character. The client name should not include the domain name. For example, the name **mars** should not be specified as **mars.cisco.com**.

Configuring a DHCP Server Boot File

The boot file is used to store the boot image for the client. The boot image is generally the operating system the client uses to load. To specify a boot file for the DHCP client, use the following command in DHCP pool configuration mode:

Command	Purpose
`DSLAM(dhcp-config)# bootfile filename`	Specifies the name of the file that is used as a boot image.

Configuring the Number of Ping Packets

By default, the DHCP server pings a pool address twice before assigning the address to a requesting client. If the ping is unanswered, the DHCP server assumes (with a high probability) that the address is not in use and assigns the address to the requesting client. To change the number of ping packets the DHCP server should send to the pool address before assigning the address, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# ip dhcp ping packets number`	Specifies the number of ping packets the DHCP server sends to a pool address before assigning the address to a requesting client. The default is two packets.

Configuring the Timeout Value for Ping Packets

By default, the DHCP server waits 500 milliseconds before timing out a ping packet. To change the amount of time the server waits, use the following command in global configuration mode:

Command	Purpose
`DSLAM(config)# ip dhcp ping timeout milliseconds`	Specifies the amount of time the DHCP server must wait before timing out a ping packet. The default is 500 milliseconds.

Enabling the Cisco IOS DHCP Server Feature

By default, the Cisco IOS DHCP Server feature is enabled on your DSLAM. If the feature is disabled, use the following command in global configuration mode to reenable the Cisco IOS DHCP Server feature on your DSLAM:

Command	Purpose
`DSLAM(config)# service dhcp`	Enables the Cisco IOS DHCP Server feature on your DSLAM. Use the **no** form of this command to disable the Cisco IOS DHCP Server feature.

Monitoring and Maintaining the DHCP Server

To clear DHCP server variables, use the following commands in privileged EXEC mode, as needed:

Command	Purpose
`DSLAM# clear ip dhcp binding address | *`	Deletes an automatic address binding from the DHCP database. Specifying *address* clears the automatic binding for a specific (client) IP address whereas specifying asterisk (*) clears all automatic bindings.
`DSLAM# clear ip dhcp conflict address | *`	Clears an address conflict from the DHCP database. Specifying *address* clears the conflict for a specific IP address whereas specifying an asterisk (*) clears conflicts for all addresses.
`DSLAM# clear ip dhcp server statistics`	Resets all DHCP server counters to 0.

To enable DHCP server debugging, use the following command in privileged EXEC mode, as needed:

Command	Purpose
`DSLAM# debug ip dhcp server {events | packets | linkage}`	Enables debugging on the DHCP server.

To display DHCP server information, use the following commands in EXEC mode, as needed:

Command	Purpose
DSLAM> **show ip dhcp binding** [*address*]	Displays a list of all bindings created on a specific DHCP server.
DSLAM> **show ip dhcp conflict** [*address*]	Displays a list of all address conflicts recorded by a specific DHCP server.
DSLAM# **show ip dhcp database** [*url*]	Displays recent activity on the DHCP database. Use this command in privileged EXEC mode.
DSLAM> **show ip dhcp server statistics**	Displays count information about server statistics and messages sent and received.

Configuration Examples

This section provides the following configuration examples:

- DHCP Database Agent Configuration Example, page 7-14
- DHCP Address Pool Configuration Example, page 7-14
- Manual Bindings Configuration Example, page 7-15

DHCP Database Agent Configuration Example

The following example stores bindings on host 172.16.4.253. The file transfer protocol is FTP. The server should wait 2 minutes (120 seconds) before writing database changes.

```
DSLAM> ip dhcp database ftp://user:password@172.16.4.253/router-dhcp write-delay 120
```

DHCP Address Pool Configuration Example

In the following example, three DHCP address pools are created: one in network 172.16.0.0, one in subnetwork 172.16.1.0, and one in subnetwork 172.16.2.0. Attributes from network 172.16.0.0, such as the domain name, DNS server, NetBIOS name server, and NetBIOS node type, are inherited in subnetworks 172.16.1.0 and 172.16.2.0. In each pool, clients are granted 30-day leases and all addresses in each subnetwork, except the excluded addresses, are available to the DHCP server for assigning to clients. Table 7-4 lists the IP addresses for the devices in three DHCP address pools.

Table 7-4 DHCP Address Pool Devices

Pool 0 (Network 172.16.0.0)		Pool 1 (Subnetwork 172.16.1.0)		Pool 2 (Subnetwork 172.16.2.0)	
Device	**IP Address**	**Device**	**IP Address**	**Device**	**IP Address**
Default routers	—	Default routers	172.16.1.100 172.16.1.101	Default routers	172.16.2.100 172.16.2.101
DNS server	172.16.1.102 172.16.2.102	—	—	—	—

Table 7-4 DHCP Address Pool Devices (continued)

Pool 0 (Network 172.16.0.0)		Pool 1 (Subnetwork 172.16.1.0)		Pool 2 (Subnetwork 172.16.2.0)	
Device	**IP Address**	**Device**	**IP Address**	**Device**	**IP Address**
NetBIOS name server	172.16.1.103 172.16.2.103	—	—	—	—
NetBIOS node type	h-node	—	—	—	—

```
ip dhcp database ftp://user:password@172.16.4.253/router-dhcp write-delay 120
ip dhcp excluded-address 172.16.1.100 172.16.1.103
ip dhcp excluded-address 172.16.2.100 172.16.2.103
!
ip dhcp pool 0
network 172.16.0.0 /16
domain-name cisco.com
dns-server 172.16.1.102 172.16.2.102
netbios-name-server 172.16.1.103 172.16.2.103
netbios-node-type h-node
!
ip dhcp pool 1
network 172.16.1.0 /24
default-router 172.16.1.100 172.16.1.101
lease 30
!
ip dhcp pool 2
network 172.16.2.0 /24
default-router 172.16.2.100 172.16.2.101
lease 30
```

Manual Bindings Configuration Example

The following example creates a manual binding for a client named Mars.cisco.com. The MAC address of the client is 02c7.f800.0422 and the IP address of the client is 172.16.2.254.

```
ip dhcp pool Mars
host 172.16.2.254
hardware-address 02c7.f800.0422 ieee802
client-name Mars
```

Because attributes are inherited, the previous configuration is equivalent to the following:

```
ip dhcp pool Mars
host 172.16.2.254 mask 255.255.255.0
hardware-address 02c7.f800.0422 ieee802
client-name Mars
default-router 172.16.2.100 172.16.2.101
domain-name cisco.com
dns-server 172.16.1.102 172.16.2.102
netbios-name-server 172.16.1.103 172.16.2.103
netbios-node-type h-node
```

Configuring DHCP Relay Support for Unnumbered Interfaces

RFC 2131 outlines how DHCP should work, but does not account for handling interfaces within routing devices that are configured as IP unnumbered. Point-to-point connections can be configured as IP unnumbered. That is, the interface does not have an IP address of its own but shares the IP address of another interface within the same physical device. This allows you to conserve IP addresses, by associating one or more IP unnumbered interfaces with a numbered interface.

Cisco has enhanced the DHCP Relay feature within Cisco IOS software so that, in addition to numbered interfaces, IP unnumbered interfaces can now be supported to send and receive DHCP requests.

The ability to support IP unnumbered interfaces:

- Allows DHCP clients across multiple IP unnumbered interfaces to share pools (scopes) of IP addresses, which conserves IP addresses and allows IP addresses to be used more efficiently.
- Removes the requirement for static host route information—this is handled dynamically by DHCP Relay.

DHCP Relay keeps track of DHCP "clients" and is able to add and delete routing information dynamically. Optionally, you can configure DHCP Relay to save client information that is tracked to a local file (for those devices supporting FlashDisk storage) or remotely to a workstation through TFTP. This information is read by DHCP Relay at (re)start time.

Benefits

- The **ip dhcp database** command has been enhanced for use with the DHCP Relay feature.
- IP unnumbered interfaces are now supported.
- Conserves IP addresses.
- Eases provisioning, by removing the requirement to configure static routes per interface.

Configuration Task

	Command	Purpose
Step 1	`DSLAM(config)# interface loopback` *loopback_interface_number*	Creates a loopback interface to associate with the IP address.
Step 2	`DSLAM(config-if)# ip address` *ip-address subnet-mask*	Assigns an IP address to the loopback interface.
Step 3	`DSLAM(config)# interface atm` *slot/port*	Enters interface configuration mode.
Step 4	`DSLAM(config-if)# atm route-bridged ip`	Enables ATM route-bridged encapsulation for IP.
Step 5	`DSLAM(config-if)# pvc` [*name*]	Configures a new ATM PVC by assigning a name.
Step 6	`DSLAM(config-if)# encapsulation aaal5snap`	Configures the ATM adaptation layer (AAL) and encapsulation type.

Example

```
DSLAM(config)# int loopback 1
DSLAM(config-if)# ip address 1.1.1.1 255.255.255.255
DSLAM(config-if)# interface atm 1/ ip unnumbered loopback 1
DSLAM(config-if)# atm route-bridged ip
```

```
DSLAM(config-if)# pvc 1/1
DSLAM(config-if)# encapsulation aaal5snap
```

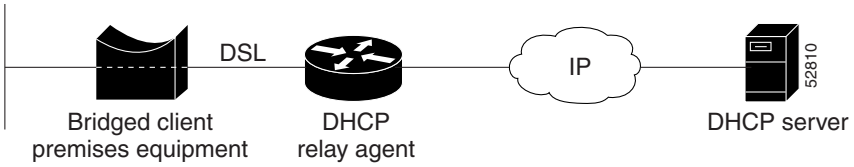
Configuring DHCP Option 82 Support for Route-Bridged Encapsulation

The DHCP relay agent information option (option 82) enables a Dynamic Host Configuration Protocol (DHCP) relay agent to include information about itself when forwarding client-originated DHCP packets to a DHCP server. The DHCP server can use this information to implement IP address or other parameter-assignment policies.

Service providers are increasingly using ATM route-bridged encapsulation to configure digital subscriber line (DSL) access. The DHCP Option 82 Support for Route-Bridged Encapsulation feature enables those service providers to use DHCP to assign IP addresses and DHCP option 82 to implement security and IP address assignment policies.

DHCP Option 82 Support for Route-Bridged Encapsulation provides support for the DHCP relay agent information option when ATM route-bridged encapsulation (RBE) is used. Figure 7-3 shows a typical network topology in which ATM RBE and DHCP are used. The DSLAM that is using ATM RBE is also serving as the DHCP relay agent.

Figure 7-3 Network Topology Using ATM RBE and DHCP



Option 82 communicates information to the DHCP server using a suboption of the DHCP relay agent information option called *agent remote ID*. The information sent in the agent remote ID includes an IP address identifying the relay agent and information about the ATM interface and the PVC over which the DHCP request came in. The DHCP server can use this information to make IP address assignments and security policy decisions.

Figure 7-4 shows the format of the agent remote ID suboption.

Figure 7-4 Format of the Agent Remote ID Suboption

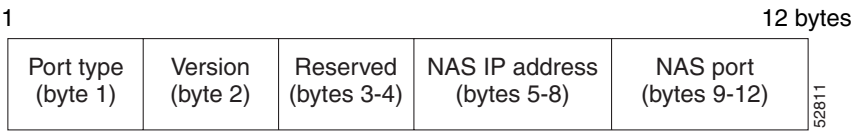


Table 7-5 describes the agent remote ID suboption fields displayed in Figure 7-4.

Table 7-5 Agent Remote ID Suboption Field Descriptions

Field	Description
Port Type	Port type. The value 0x01 indicates RBE. (1 byte)
Version	Option 82 version. The value 0x01 specifies the RBE version of Option 82. (1 byte)
Reserved	Reserved. (2 bytes)
NAS IP Address	IP address of one of the interfaces on the DHCP relay agent. The **rbe nasip** command can be used to specify which IP address will be used. (4 bytes)
NAS Port	RBE-enabled virtual circuit on which the DHCP request has come in. See Figure 7-5 for the format of this field. (4 bytes)

Figure 7-5 shows the format of the network access server (NAS) port field in the agent remote ID suboption.

Figure 7-5 Format of the NAS Port Field

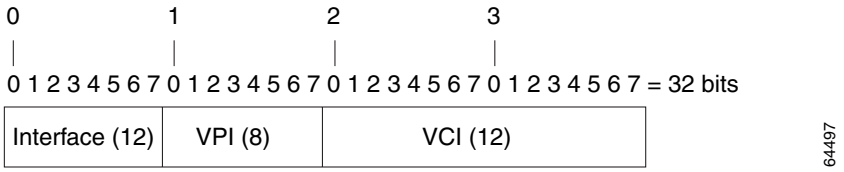
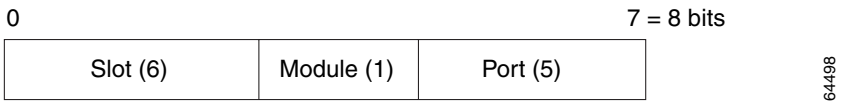


Figure 7-6 shows the format of the interface field. Module 1 indicates an IMA interface; otherwise, Module is 0. Port is offset by one for IMA interfaces: for example, atm0/ima4 is Slot 0, Module 1, Port 3.

Figure 7-6 Format of the Interface Field



Prerequisites

DHCP support must be configured before you can use the DHCP Option 82 Support.

DHCP option 82 support must be configured on the DHCP relay agent using the **ip dhcp relay information option** command before you can use the DHCP Option 82 Support for Route-Bridged Encapsulation feature.

Configuration Tasks

See the following sections for configuration tasks for the DHCP Option 82 Support for Route-Bridged Encapsulation feature.

- Configuring DHCP Option 82 for RBE (Required)
- Verifying DHCP Option 82 for RBE Configuration (Optional)

Configuring DHCP Option 82 for RBE

To configure DHCP option 82 support for RBE, use the following commands in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# ip dhcp relay information option`	Enables the system to insert the DHCP relay agent information option in forwarded BOOT REQUEST messages to a Cisco IOS DHCP server.
Step 2	`DSLAM(config)# rbe nasip` *source_interface*	Specifies the IP address of an interface on the DHCP relay agent that is sent to the DHCP server through the Agent Remote ID suboption.

Verifying DHCP Option 82 for RBE Configuration

To verify that the DHCP Option 82 Support for Route-Bridged Encapsulation feature is configured correctly, use the following command in privileged EXEC mode:

Command	Purpose
`DSLAM# more system:running-config`	Displays the running configuration.

DHCP Option 82 for RBE Configuration Example

In the following example, DHCP option 82 support is enabled on the DHCP relay agent using the **ip dhcp relay agent information option** command. The **rbe nasip** command configures the DSLAM to forward the IP address for Loopback0 to the DHCP server.

```
!
DSLAM(config)# ip dhcp relay information option
DSLAM(config)# ip dhcp-server 10.0.0.202
> !
DSLAM(config)# rbe nasip Loopback1
> !
DSLAM(config)# interface Loopback1
DSLAM(config-if)# ip address 18.52.86.120 255.255.255.255>
!
DSLAM(config-if)# interface Ethernet0/0
DSLAM(config-if)# ip address 10.0.0.40 255.0.0.0
> !
DSLAM(config-if)# interface atm1/1
DSLAM(config-if)# ip address 11.0.0.1 255.0.0.0
DSLAM(config-if)# ip helper-address 10.0.0.202
DSLAM(config-if)# atm route-bridged ip
DSLAM(config-if)# no atm ilmi-keepalive
```

```
DSLAM(config-if)# pvc 1/1
DSLAM(config-if)# encapsulation aal5snap
> !
DSLAM(config-if)# interface ATM1/2
DSLAM(config-if)# ip address 12.0.0.1 255.0.0.0
DSLAM(config-if)# ip helper-address 10.0.0.202
DSLAM(config-if)# atm route-bridged ip
DSLAM(config-if)# no atm ilmi-keepalive
DSLAM(config-if)# pvc 1/1
DSLAM(config-if)# encapsulation aal5snap
>  !
```

For the configuration example above, the value (in hexadecimal) of the agent remote ID suboption is 01010000123456784101001. Table 7-6 shows the value of each field within the agent remote ID suboption.

Table 7-6 Agent Remote ID Suboption Field Values

Agent Remote ID Suboption Field	Value
Port Type	0x01
Version	0x01
Reserved	Undefined
NAS IP Address	12345678 (Hexadecimal value of 18.52.86.120)
NAS Port	
• Interface (slot/module/port)	1/0/1
• VPI	1
• VCI	1

Configuring VPI/VCI Authentication

NAS-Port Attribute

VPI/VCI authentication is done through the NAS-Port RADIUS attribute. The exact format of this attribute is not specified by the RADIUS RFC, but some formats are common enough to be well-known. The Cisco 6400 system uses format D for VPI/VCI authentication, but this format does not allocate enough bits to uniquely identify the slot and port of a DSLAM.

The NAS-Port attribute is specified, however, not to exceed 32bits in length. To provide the maximum flexibility, the format E setting was created to allow the user to explicitly specify the assignment of each bit in the NAS-Port attribute. For a DSLAM, the assignment should have enough bits to uniquely specify slot and port, even if this limits the range of another field within the attribute (for example, VCI).

The recommended solution is to allocate 6 bits for slot, 1 bit for module (required for IMA), 5 bits for port, 8 bits for VPI, and 12 bits for VCI. If done in this order (MSB to LSB), this format resembles the format D NAS-Port attribute as much as possible, without the ambiguity of the format D solution.

Cisco Access Registrar Use of NAS-Port

The Cisco Access Registrar performs special processing for devices it is configured to treat as Cisco NASes (for example, 6400) After the device is identified, the User-Name attribute is replaced with the pseudo-User-Name. This new value is the concatenation of 6400 <module>/<slot>/<port> information (treated as if it were sent in format D) and the packet is treated as a regular user authentication from this point on.

The DSLAM can use this mechanism, but because the format is different, the pseudo-User-Name is not as straightforward as it is for the Cisco 6400 system. Instead, the name must be synthesized by calculating the format E NAS-Port value as configured, and then breaking it down into its format D parts.

The format of the new User-Name attribute is the printf of "%s-%d-%d-%d-%d-%d" for the following values (assuming the recommended format E configuration is used):

- NAS-IP—Dotted decimal format of the NAS-IP-Address attribute (for example, 10.10.10.10).
- slot—Apply mask 0xF0000000 on NAS-Port attribute and shift right 28 bits (for example, the NAS-Port is 0x10000000 and the slot value is 1).
- module—Apply mask 0x08000000 on NAS-Port attribute and shift right 27 bits (for example, the NAS-Port is 0x08000000 and the module value is 1).
- port—Apply mask 0x07000000 on NAS-Port attribute and shift right 24 bits (for example, the NAS-Port is 0x06000000 and the port value is 6).
- VPI—Apply mask 0x00FF0000 on NAS-Port attribute and shift right 16 bits (for example, the NAS-Port is 0x00110000 and the VPI value is 17).
- VCI—Apply mask 0x0000FFFF on NAS-Port attribute (for example, the NAS-Port is 0x00001001 and the VCI value is 4097).

Configuring VPI/VCI Authentication

To configure the VPI/VCI authentication:

```
DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp default radius
DSLAM(config)# radius-server host 10.0.0.99 ;ip address of RADIUS server
DSLAM(config)# radius-server attribute nas-port format e SSSSSSAPPPPPIIIIIIIICCCCCCCCCCCC
DSLAM(config)# radius-server key the_secret
```

Note Replace *the_secret* above with your own key.

```
DSLAM(config)# interface atm1/1
DSLAM(config-if)# pvc encapsulation aal5ciscoppp virtual-template2
DSLAM(config-if)# interface virtual-template2
DSLAM(config-if)# ppp authentication pap
```

Configuring PPP

The following sections describe the PPP features supported in Cisco IOS Release 12.2:

- Configuring PPPoA, page 7-22
- Configuring PPPoE on ATM, page 7-27

Configuring PPPoA

The following tasks provide the minimum steps needed to configure PPP over ATM on the DSLAM. For more information about PPP over ATM, see "Configuring ATM" in the *Wide-Area Networking Configuration Guide* of the Cisco IOS 12.1 documentation set.

Configuring a PPP Virtual Template

The DSLAM uses virtual templates to assign PPP features to a PVC. As each PPP session comes online, a virtual access interface is "cloned" from the virtual template. This virtual-access interface inherits all the configuration specified in the virtual template. When the virtual template is changed, the changes are automatically propagated to all virtual-access interfaces cloned from that particular virtual template.

Restrictions

- We recommend that you use a virtual template rather than a dialer interface when configuring a PPP session.
- The number of simultaneous PPP sessions is 256.

To configure a virtual template, perform these steps starting in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# interface virtual-template` *number*	Associates a virtual template with a virtual template interface.
Step 2	`DSLAM(config-if)# ip unnumbered ethernet 0/0`	Enables IP on the interface without assigning a specific IP address.
Step 3	`DSLAM(config-if)# peer default ip address {pool [`*poolname*`] | dhcp }`	Specifies a dynamic IP address assignment method, either from an IP address pool or a DHCP server.
Step 4	`DSLAM(config-if)# ppp authentication {pap | chap} [pap | chap]`	Selects the authentication protocol and optional secondary protocol.
Step 5	`DSLAM(config-if)# exit`	Returns to global configuration mode.
Step 6	`DSLAM(config)# ip local pool` *poolname low-ip-address* `[`*high-ip-address*`]`	(Optional) Configures a local pool of IP addresses to be used when a remote peer connects to a point-to-point interface.
Step 7	`DSLAM(config)# ip dhcp-server {`*ip-address* `|` *name*`}`	(Optional) Specifies which DHCP servers to use on your network.

Caution Do not use a static IP assignment within a virtual template; routing problems can occur. Always enter the **ip unnumbered** command when configuring a virtual template.

Examples

The following example shows a typical virtual template configuration for the DSLAM:

```
DSLAM(config)# interface virtual-template 1
DSLAM(config-if)# ip unnumbered ethernet 0/0
DSLAM(config-if)# peer default ip address pool telecommuters
DSLAM(config-if)# ppp authentication chap
DSLAM(config-if)# exit
DSLAM(config)# ip local pool telecommuters 10.36.1.1 10.36.1.254
```

In this configuration, it is assumed that all PPP over ATM VCs (users) cloned from virtual template 1 use CHAP authentication and are allocated an IP address from the pool named "telecommuters" configured on the router. In addition, the local end of the PPP over ATM connection is running without an IP address (recommended). Instead, the IP address of the Ethernet interface is used for addressability.

To configure a different class of users on the same router, you can provision a separate virtual template interface. The following shows a DHCP server rather than a local pool and PAP authentication over CHAP:

```
DSLAM(config)# interface Virtual-Template 2
DSLAM(config-if)# ip unnumbered ethernet 0/0
DSLAM(config-if)# peer default ip address dhcp
DSLAM(config-if)# ppp authentication pap chap
DSLAM(config-if)# exit
DSLAM(config)# ip dhcp-server 10.5.20.149
```

You can configure up to 25 virtual templates.

Configuring AAA Authentication

Large-scale deployment of PPP user services requires the use of a central database, such as RADIUS to ease the configuration burden. RADIUS servers, collectively known as authentication, authorization, and accounting (AAA) servers for PPP over ATM (and other media), contain the per-user configuration database, including password authentication and authorization information. For more information about AAA, see the chapter "Authentication, Authorization, and Accounting (AAA)" in the *Cisco IOS Security Configuration Guide*.

To configure the DSLAM to use AAA for PPP authentication only, enter the following configuration commands:

	Command	Description
Step 1	`DSLAM(config)# aaa new-model`	Enables the AAA access control model.
Step 2	`DSLAM(config)# aaa authentication ppp {default | list-name} method1 [method2...]`	Specifies one or more AAA authentication methods for use on interfaces running PPP.

The *list-name* option refers to the name of this particular method list (or default, if it is the default list), and the *method* option is a list of methods. For example, to configure virtual template 4 to use RADIUS before local authentication, enter the following commands:

```
DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp list2 radius local

DSLAM(config)# interface virtual-template 4
DSLAM(config-if)# ip unnumbered ethernet 0/0
DSLAM(config-if)# ppp authentication chap list2
DSLAM(config-if)# ^z
```

Using a Local Authentication Database

Enter the **aaa authentication ppp** command with the method keyword **local** to specify that the Cisco router or access server will use the local username database for authentication. The following example shows how to configure authentication by using the local username database:

```
DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp default local
```

Configuring a RADIUS Server

To configure the DSLAM to use a RADIUS server, enter the following commands starting in global configuration mode:

	Command	Purpose
Step 1	DSLAM(config)# **aaa new-model**	Enables the authentication, authorization, and accounting (AAA) access control model.
Step 2	DSLAM(config)# **radius-server host** {*hostname* | *ip-address*} [**auth-port** *port-number*] [**acct-port** *port-number*]	Specifies a RADIUS server host.
Step 3	DSLAM(config)# **radius-server key** *key*	Sets the encryption key to match that used on the RADIUS server.
Step 4	DSLAM(config)# **radius-server attribute nas-port format e**	Selects the ATM virtual channel extended format (**e**) for the NAS port field.

In the following example, a RADIUS server is enabled and identified, and the NAS port field is set to ATM virtual-channel extended format:

```
DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp default radius

DSLAM(config)# radius-server host 172.31.5.96 auth-port 1645 acct-port 1646
DSLAM(config)# radius-server key foo
DSLAM(config)# radius-server attribute nas-port format e
```

The authentication and accounting port need not be specified, because they default to 1645 and 1646, respectively.

Configuring PVCs

After you have configured a virtual template for PPP over ATM, you must configure the PVCs that carry traffic from the DSLAM to the ATM interfaces. To configure PPP over ATM on a PVC, enter the following commands starting in global configuration mode:

	Command	Purpose
Step 1	DSLAM(config)# **interface atm 1/1** [*.subinterface-number* {**multipoint** | **point-to-point**}]	Specifies the ATM interface and optional subinterface.
Step 2	DSLAM(config-if)# atm **pvp 1**	Create the PVP subinterface if the interface is multipoint.
Step 3	DSLAM(config-if)# **pvc** [*name*] *vpi/vci*	Configures a new ATM PVC by assigning a name (optional) and VPI/VCI numbers.
Step 4	DSLAM(config-if)# **encapsulation aal5mux ppp virtual-Template** *number*	Configures the ATM adaptation layer (AAL) and encapsulation type, and configures a PVC to use a virtual-template as the default PPP interface configuration.

Example

The following example shows a typical configuration for PPP over ATM, using a RADIUS authentication server:

```
DSLAM(config)# interface virtual-template 1
DSLAM(config-if)# ip unnumbered ethernet 0/0
DSLAM(config-if)# peer default ip address pool telecommuters
DSLAM(config-if)# ppp authentication chap
DSLAM(config-if)# exit
DSLAM(config)# ip local pool telecommuters 10.36.1.1 10.36.1.254

DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp default radius
DSLAM(config)# radius-server host 172.31.5.96
DSLAM(config)# radius-server key foo
DSLAM(config)# radius-server attribute nas-port format e

DSLAM(config)# interface atm 1/1
DSLAM(config-if)# atm pvp 1
DSLAM(config-if)# interface atm 1/1.40 multipoint
DSLAM(config-subif)# pvc 0/50
DSLAM(config-if-atm-vc)# encapsulation aal5mux ppp virtual-template 1
DSLAM(config-if-atm-vc)# exit
DSLAM(config-subif)# pvc 0/51
DSLAM(config-if-atm-vc)# encapsulation aal5mux ppp virtual-template 1
DSLAM(config-if-atm-vc)# exit
```

Configuring an IPCP Subnet Mask

IPCP subnet mask support allows CPE to connect to the DSLAM and obtain IP addresses and subnet mask ranges that the CPE can use to populate the DHCP server database. The DSLAM brings up PPP sessions with the CPE and authenticates each CPE as a separate user. An extension of the normal IPCP negotiations enables the CPE to obtain an IP subnet mask associated with the returned IP address. The DSLAM adds a static route for the IP address with the subnet mask specified. If the IP and subnet mask is specified by the Framed-IP-Address and Framed-IP-Netmask attribute in the RADIUS user profile, the DSLAM passes the subnet mask and IP address to the CPE during IPCP negotiation. The CPE uses the subnet mask to calculate an IP address pool from which IP addresses are assigned to PCs using the LAN (Ethernet) connection.

Because the CPE can receive both the IP address and subnet mask during PPP setup negotiation, DHCP support is no longer required on the client side. Both the Cisco 67x and Cisco 82x CPEs support the subnet mask delivery.

Restrictions

IPCP subnet mask negotiation is not supported across a MPLS/VPN connection.

Example

```
DSLAM(config)# aaa new-model
DSLAM(config)# aaa authentication ppp ipcp-method group radius <-- This is required
DSLAM(config)# aaa authorization network ipcp-method group radius <-- This is required
DSLAM(config)# aaa accounting network default start-stop group radius <- This is optional
!
DSLAM(config)# ip cef

DSLAM(config)# interface Loopback1
DSLAM(config-if)# ip address 1.1.1.1 255.255.255.255
!
DSLAM(config-if)# interface Ethernet0/0
```

```
DSLAM(config-if)# ip address 198.1.2.1 255.255.255.0
!
DSLAM(config-if)# interface atm2/1
DSLAM(config-if)# pvc 100/1
DSLAM(config-if)# encapsulation aal5mux ppp Virtual-Template1
!
DSLAM(config-if)# interface Virtual-Template1
DSLAM(config-if)# ip unnumbered Loopback1
DSLAM(config-if)# ppp authentication chap callin ipcp-method
DSLAM(config-if)# ppp authorization ipcp-method
DSLAM(config-if)# exit
DSLAM(config)# aaa new-model
DSLAM(config)# radius-server host 198.1.2.128 auth-port 1645 acct-port 1646
DSLAM(config)# radius-server key cisco

DSLAM# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
C       1.1.1.1 is directly connected, Loopback1
U       200.1.1.0/25 [1/0] via 200.1.1.1
C       200.1.1.1/32 is directly connected, Virtual-Access10
C    198.1.2.0/24 is directly connected, Ethernet0/0
```

Verifying and Troubleshooting PPPoA

The global configuration command **show atm pvc ppp** shows the PPP over ATM characteristics of all PVCs on the ATM interface:

```
DSLAM# show atm pvc ppp
VCD /                                          Peak Avg/Min Burst
ATM Int.   Name       VPI   VCI  Type     VA VASt  SC    Kbps  Kbps   Cells VCSt
2/2.100    167        100     1   PVC      3 UP UBR   10000              ACTIVE
```

The VA column shows the virtual-access interface used for this particular PPP over ATM session. A subsequent **show interface virtual-access** command gives the PPP specific characteristics of the session:

```
DSLAM# show interface virtual-access 2
Virtual-Access2 is up, line protocol is up
  Hardware is Virtual Access interface
  Internet address is 10.123.1.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive not set
  DTR is pulsed for 5 seconds on reset
  LCP Open
  Open: IPCP
  Bound to ATM2.2.100 VCD: 167, VPI: 0, VCI: 34
  Cloned from virtual-template: 1
  Last input 01:04:26, output never, output hang never
  Last clearing of "show interface" counters 5d02h
  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
   782 packets input, 30414 bytes, 0 no buffer
   Received 3 broadcasts, 0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   395 packets output, 5540 bytes, 0 underruns
   0 output errors, 0 collisions, 0 interface resets
   0 output buffer failures, 0 output buffers swapped out
   0 carrier transitions
```

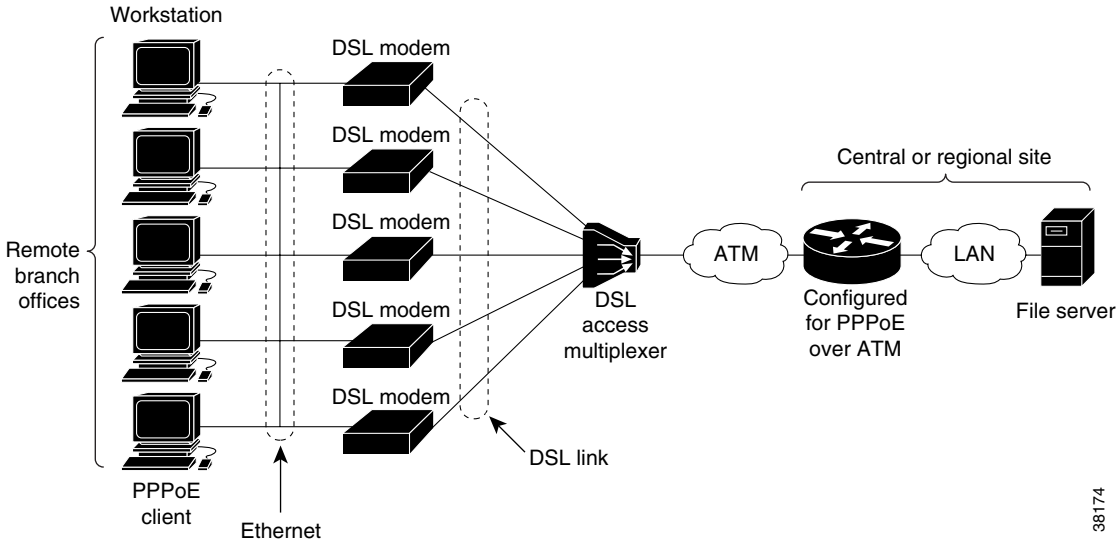
The lines included in this example show the Layer 3 protocols enabled on this interface, the VPI and VCI numbers, and the master virtual template from which this virtual access interface was cloned.

Configuring PPPoE on ATM

PPPoE on ATM provides the ability to connect a network of hosts over a simple bridging-access device to a remote access concentrator. With this model, each host utilizes its own PPPoE stack and the user is presented with a familiar user interface. Access control, billing and type of service can be done on a per-user, rather than a per-site, basis. Before a point-to-point connection over Ethernet can be provided, each PPP session must learn the Ethernet address of the remote peer and establish a unique session identifier. A unique session identifier is provided by the PPPoE Discovery Stage protocol.

Figure 7-7 shows a sample network topology using PPPoE on ATM.

Figure 7-7 PPPoE on ATM Sample Network Topology



PPPoE Stage Protocols

PPPoE has two distinct stage protocols. The stage protocols are summarized in Table 7-7.

Table 7-7 PPPoE Stage Protocols

Stage Protocols	Description
Discovery Stage protocol	Remains stateless until a PPPoE session is established. Once the PPPoE session is established, both the host and the access concentrator *must* allocate the resources for a PPP virtual access interface.
PPP Session Stage protocol	Once the PPPoE session is established, sends PPPoE data as in any other PPP encapsulation.

There are four steps to the discovery stage:

1. Host broadcasts a PPPoE Active Discovery Initiation (PADI) packet.
2. When the access concentrator receives a PADI that it can serve, it replies by sending a PPPoE Active Discovery Offer (PADO) packet to the host.
3. Because the PADI was broadcast, the host might receive more than one PADO packet. The host looks through the PADO packets it receives and chooses one. The choice can be based on the AC name or the services offered. The host then sends a single PPPoE Active Discovery Request (PADR) packet to the access concentrator that it has chosen.
4. When the access concentrator receives a PADR packet, it prepares to begin a PPP session. It generates a unique SESSION_ID for the PPPoE session and replies to the host with a PPPoE Active Discovery Session-confirmation (PADS) packet.

When a host wishes to initiate a PPPoE session, it must first perform discovery to identify the Ethernet MAC address of the peer and establish a PPPOE SESSION_ID. Although PPP defines a peer-to-peer relationship, discovery is inherently a client/server relationship. In the discovery process, a host (the client) discovers an access concentrator (the server). Based on the network topology, there may be more than one access concentrator that the host can communicate with. The Discovery Stage allows the host to discover all access concentrators and then select one. When discovery is completed, both the host and the selected access concentrator have the information they will use to build their point-to-point connection over Ethernet.

Benefits

The PPPoE on ATM provides DSL support. As you begin DSL deployments, two of your most significant goals are to ease and facilitate consumer end adoption and to preserve as much of the dialup model as possible. PPPoE serves to advance both of these goals by leveraging Ethernet scale curves and embedded base (such as ATM NICs) and by preserving the point-to-point session used by internet service providers (ISPs) in the dialup model.

Using a PPPoE client (available from RouterWare), you can initiate a PPP session on an Ethernet connected client through a standard DSL modem. The session is transported over the ATM DSL link through RFC 1483 Ethernet bridged frames and can terminate either in the LAN emulation client (LEC) central office or the ISP point of presence (POP).

As you deploy asymmetric DSL (ADSL), you will encounter the need to enable users to access remote-access concentrators over simple bridges connecting Ethernet and ATM networks.

Restrictions

The following restrictions apply when PPPoE on ATM is used:

- PPPoE is not supported on Frame Relay.
- PPPoE is not supported on actual Ethernet interfaces.
- PPPoE is not supported on any other LAN interfaces such as FDDI and Token Ring.
- Fast switching is supported. PPP over Ethernet over RFC 1483 FIB switching is supported for IP. All other protocols are switched over process switching.
- Bridging is supported on the ATM permanent virtual connections (PVCs) running PPPoE.
- PPPoE is supported on ATM PVCs compliant with RFC 1483 only.
- Only dial-in mode is be supported. Dial-out mode is not supported.
- Up to 256 simultaneous PPP sessions are supported on the DSLAM.

Prerequisites

Before you can configure PPPoE on ATM, you need to configure a virtual private dial-up network (VPDN) group using the **accept-dialin** command, enable PPPoE, and specify a virtual template for PPPoE sessions.

Configuration Tasks

See the following sections for configuration tasks for the PPPoE on ATM feature:

- Enabling PPP over ATM in a VPDN Group, page 7-29 (Required)
- Creating and Configuring a Virtual Template, page 7-30 (Optional)
- Specifying an ATM Subinterface, page 7-31 (Optional)
- Creating an ATM PVC, page 7-31 (Required)
- Enabling PPPoE on an ATM PVC, page 7-32 (Required)

Enabling PPP over ATM in a VPDN Group

After you configure the Cisco router or access server for Ethernet encapsulation, you must configure the physical interface with the PVC and apply a virtual template with PPP encapsulation to the PVC that it applies to. To configure the physical interface that will carry the PPPoE session and link it to the appropriate virtual template interface, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# vpdn enable`	Sets up the PPP over Ethernet discovery daemon.
Step 2	`DSLAM(config-if)# vpdn-group` *name*	Associates a VPDN group to a customer or VPDN profile.
Step 3	`DSLAM(config-vpdn)# accept-dialin`	Creates an accept dial-in VPDN group.
Step 4	`DSLAM(config-vpdn-acc-in)# protocol pppoe`	Specifies the VPDN group used to establish PPPoE sessions.
Step 5	`DSLAM(config-vpdn-acc-in)#` **virtual-template** *template-number*	Specifies the virtual template that is used to clone virtual access interfaces.

Creating and Configuring a Virtual Template

Prior to configuring the ATM PVC for PPPoE on ATM, you typically create and configure a virtual template. To create and configure a virtual template, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	`DSLAM(config)# interface virtual-template` *number*	Creates a virtual template, and enters interface configuration mode.
Step 2	`DSLAM(config-if)# encapsulation ppp`	Enables PPP encapsulation on the virtual template.
Step 3	`DSLAM(config-if)# ip unnumbered ethernet` *number*	Optionally, enables IP without assigning a specific IP address on the LAN.

Other optional configuration commands can be added to the virtual template configuration. For example, you can enable the PPP authentication on the virtual template using the **ppp authentication chap** command. Refer to the "Virtual Interface Template Service" chapter in the *Cisco IOS Dial Solutions Configuration Guide* for additional information about configuring the virtual template.

All PPP parameters are managed within the virtual template configuration. Configuration changes made to the virtual template are automatically propagated to the individual virtual access interfaces. Multiple virtual access interfaces can be created from a single virtual template; therefore, multiple PVCs can use a single virtual template.

Cisco IOS software supports up to 25 virtual template configurations. If greater numbers of tailored configurations are required, an authentication, authorization, and accounting (AAA) server can be employed. Refer to the "Per-User Configuration" chapter in the *Cisco IOS Dial Solutions Configuration Guide* for further information on configuring an AAA server.

If the parameters of the virtual template are not explicitly defined before the ATM PVC is configured, the PPP interface is brought up using default values from the virtual template identified. Some parameters (such as an IP address) take effect only if specified before the PPP interface comes up. Therefore, we recommend that you explicitly create and configure the virtual template before configuring the ATM PVC to ensure such parameters take effect. Alternatively, if parameters are specified after the ATM PVC has already been configured, you should issue a **shutdown** command followed by a **no shutdown** command on the ATM subinterface to restart the interface; this restart causes the newly configured parameters (such as an IP address) to take effect.

Network addresses for the PPP-over-ATM connections are not configured on the main ATM interface or subinterface. Instead, these connections are configured on the appropriate virtual template or obtained through AAA.

The virtual templates support all standard PPP configuration commands; however, not all configurations are supported by the PPP-over-ATM virtual access interfaces. These restrictions are enforced at the time the virtual template configuration is applied (cloned) to the virtual access interface. These restrictions are described in the following paragraphs.

Only standard first-in, first-out (FIFO) queueing is supported when applied to PPP-over-ATM virtual access interfaces. Other types of queueing that are typically configured on the main interface are not (for example, fair queueing). If configured, these configuration lines are ignored when they are applied to a PPP-over-ATM interface.

Although Cisco Express Forwarding (CEF) switching is supported, fast switching, flow, and optimum switching are not; these configurations are ignored on the PPP-over-ATM virtual access interface. CEF is enabled by default for IP. All other protocol traffic is processed switched.

Note The PPP reliable link that uses Link Access Procedure, Balanced (LAPB) is not supported.

Because an ATM PVC is configured for this feature, the following standard PPP features are not applicable and should not be configured:

- Asynchronous interfaces
- Dialup connections
- Callback on PPP

Specifying an ATM Subinterface

After you create a virtual template for PPPoE on ATM, specify a multipoint or point-to-point subinterface per PVC connection. To specify an ATM multipoint subinterface, use one of the following commands in global configuration mode:

Command	Purpose
`DSLAM(config)# interface atm` *slot/port.subinterface-number* **multipoint** | **point-to-point** or `DSLAM(config)# interface atm` *number.subinterface-number* **multipoint** | **point-to-point**	Specifies the ATM subinterface using the appropriate format of the **interface atm** command. We recommend a **multipoint** subinterface for interface conservation. A **point-to-point** subinterface greatly restricts the total number of active PPPoE sessions you can have.

Creating an ATM PVC

After you create a virtual template and specify an ATM subinterface, you must create an ATM PVC. To create an ATM PVC, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	`DSLAM(config-if)# pvc` [*name*] *vpi/vci*	Creates an ATM PVC.
Step 2	`DSLAM(config-if-atm-vc)# encapsulation aal5snap`	Specifies AAL5 SNAP for ATM encapsulation.

The peak rate value is typically identical to the average rate or some suitable multiple thereof.

Set the average rate value to the line rate available at the remote site, because the remote line rate typically has the lowest speed of the connection.

For example, if the remote site has a T1 link, set the line rate to 1.536 Mbps. Because the average rate calculation on the ATM PVC includes the cell headers, a line rate value plus 10 or 15 percent might result in better remote line utilization.

The burst size depends on the number of cells that can be buffered by the receiving ATM switches and is coordinated with the ATM network connection provider. If you do not specify this value, the default, which is the equivalent to one maximum length frame on the interface, is used.

Operations, Administration, and Maintenance (OAM) F5 cell loopback is provided by the remote AXIS shelf so that OAM can be enabled. However, PPPoE on ATM is not typically an end-to-end ATM connection; therefore, we do not recommend enabling OAM.

Once you configure the router for PPPoE on ATM, the PPP subsystem starts and the router attempts to send a PPP configure request to the remote peer. If the peer does not respond, the router periodically goes into a "listen" state and waits for a configuration request from the peer. After a timeout (typically, 45 seconds), the router again attempts to reach the remote router by sending configuration requests.

Enabling PPPoE on an ATM PVC

To enable PPPoE on an ATM PVC, use the following command in interface configuration mode:

Command	Purpose
`DSLAM(config-if)# protocol pppoe`	Specifies the VPDN group to be used for establishing PPPoE sessions.

PPPoE on ATM Example

The following example configures PPPoE on ATM to accept dial-in PPPoE sessions. The virtual access interface for the PPP session is cloned form virtual template interface 1. On subinterface atm 2/0.1, ATM PVC with VPI 0 and VCI 60 is configured with Logical Link Control (LLC)/Subnetwork Access Protocol (SNAP) encapsulation and is configured to run PPPoE. Bridged Ethernet protocol data units (PDUs) with destination MAC address set to the ATM interface MAC address and Ethernet type set to 0x8863 for that PVC are enqueued to the PPPoE discovery process. All bridged Ethernet PDUs with destination MAC address set to the ATM interface MAC address and an Ethernet type set to 0x8864 coming in from that PVC are forwarded to the virtual access interface associated with the PPP session.

```
DSLAM(config)# vpdn enable

DSLAM(config)# vpdn-group 1
DSLAM(config-vpdn)# accept-dialin
DSLAM(config-vpdn-acc-in)# protocol pppoe
DSLAM(config-vpdn-acc-in)# virtual-template 1

DSLAM(config)# interface atm 2/1 point-to-point
DSLAM(config-if)# pvc 0/60
DSLAM(config-if)# encapsulation aal5snap
DSLAM(config-if)# protocol pppoe

DSLAM(config-if)# interface virtual-template 1
DSLAM(config-if)# ip addr 10.0.1.2 255.255.255.0
DSLAM(config-if)# ip mtu 1492
```

For PPPoE virtual template interfaces, you must configure "ip mtu 1492" because Ethernet has a maximum payload size of 1500 bytes, the PPPoE header is 6 bytes, and PPP Protocol ID is 2 bytes.

Note Dial-out mode is not supported.

Configuring the Trunk and Subtended Interfaces

This chapter describes the steps required to configure the trunk and subtended interfaces on the Cisco DSLAM NI-2 card. It includes these sections:

NI-2 Card and DSLAM Compatibility

Table 8-1 shows the NI-2 card and DSLAM chassis compatibility with regard to both trunk and subtending connections.

Table 8-1 NI-2 Card and DSLAM Chassis Compatibility

NI-2 Card	Cisco 6015	Cisco 6100 / Cisco 6130	Cisco 6160	Cisco 6260
DS3+T1/E1 IMA[1] • DS3 trunk • T1/E1 trunk and subtending • T1/E1 IMA trunk and subtending	Yes	No	Yes[2]	Yes[3]
DS3/2DS3 • DS3 trunk • Two DS3 subtending ports	No	Yes	Yes	Yes[4]
OC-3c/OC-3c single-mode fiber (SMF) • OC-3c trunk • One OC-3c subtending port	Yes	Yes	Yes	Yes[5]

Table 8-1 NI-2 Card and DSLAM Chassis Compatibility (continued)

NI-2 Card	Cisco 6015	Cisco 6100 / Cisco 6130	Cisco 6160	Cisco 6260
OC-3c/OC-3c multimode fiber (MMF) • OC-3c trunk • One OC-3c subtending port	Yes	Yes	Yes	Yes[4]
OC-3c/2DS3 single-mode fiber (SMF) • OC-3c trunk • Two DS3 subtending ports	No	No	Yes	No
OC-3c/2DS3 multimode fiber (MMF) • OC-3c trunk • Two DS3subending ports	No	No	Yes	No

1. Inverse multiplexing over ATM.
2. Use only with the DS3/2DS3+8xT1 system I/O card.
3. When the E1 I/O module is installed, the system assumes E1 IMA functionality.
4. When the E3 1/O module is installed, the system assumes E3 funtionality.
5. When the OC-3c I/O module is installed, the system assumes OC-3c functionality.

NI-2 Subtending Support

NI-2 cards offer the same level of service and traffic fairness in subtending Cisco 6015, Cisco 6100, Cisco 6130, Cisco 6160, and Cisco 6260 DSLAMs. The level of service remains the same for both NI-1 and NI-2 based subtended nodes. (That is, you can mix NI-1 and NI-2 cards in the same subtending network for the Cisco 6100 and Cisco 6130 DSLAM.)

The following guidelines apply to subtending on an NI-2 supported DSLAM:

- For Cisco 6100 and Cisco 6130 DSLAMs, the NI-2 card has the same virtual path (VP) and virtual circuit (VC) constraints as the NI-1.
- The NI-2 card allows subtending for up to 1664 ports per system.
  - The Cisco 6015 has 1 subtend host chassis and up to 7 subtended node chassis for T1 without using DS3 or E1, 8 for T1 with a DS3 trunk, 12 in daisy-chain subtending.
  - The other chassis have 1 subtend host chassis and up to 12 subtended node chassis.
- The NI-2 card supports tree and daisy-chain subtending.

Configuring 155 Mbps OC-3 SM and MM Interfaces

The NI-2 card supports system controller-type connectors.

Each port can be configured to support these clocking options:

- Self-timing based on an internal clock.
- Loop timing from the received data stream—Ideal for public network connections.

- Timing synchronized to a selected master clock port—Required for distribution of a single clock across a network.
- Traffic pacing allows you to set the aggregate output traffic rate on any port to a rate below the line rate. This feature is useful when you are communicating with a slow receiver or when you are connected to public networks with peak-rate tariffs.

The plug-and-play mechanisms of the DSLAM allow the interface to launch automatically. You can save all configuration information between hot swaps and reboots, while interface types are automatically discovered by the DSLAM, eliminating the need for mandatory manual configuration.

Default 155 Mbps ATM Interface Configuration Without Autoconfiguration

If Integrated Local Management Interface (ILMI) has been disabled or if the connecting end node does not support ILMI, these defaults are assigned to all 155 Mbps (OC-3c) interfaces:

- ATM interface type = User Network Interface (UNI)
- UNI Version = 4.0
- Maximum virtual path identifier (VPI) bits = 8
- Maximum virtual channel identifier (VCI) bits = 14
- ATM interface side = network
- ATM UNI type = private
- Framing = sts-3c
- Clock source = network derived
- Synchronous Transfer Signal (STS) stream scrambling = enabled
- Cell payload scrambling = enabled

The default subtend ID for each NI-2 DSLAM is 0 (zero).

Manual 155 Mbps Interface Configuration

To manually change any of the default configuration values, perform these tasks:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# subtend-id 0-12`	Assign to this node a subtend ID that is unique in the subtend tree. The node attached to the trunk must have subtend ID 0.
Step 3	`DSLAM(config)# interface atm slot/port`	Specify an ATM interface and enter interface configuration mode.
Step 4	`DSLAM(config-if)# atm uni [side {network | user} type {private | public} version {3.0 | 3.1 | 4.0}]`	Modify the ATM interface side, type, or version.
Step 5	`DSLAM(config-if)# atm maxvpi-bits 0-8`	Modify the maximum VPI bits configuration.
Step 6	`DSLAM(config-if)# atm maxvci-bits 0-14`	Modify the maximum VCI bits configuration.
Step 7	`DSLAM(config-if)# sonet {stm-1 | sts-3c}`	Modify the framing mode.

	Command	Task
Step 8	`DSLAM(config-if)# clock source {loop-timed | network-derived}`	Modify the clock source.
Step 9	`DSLAM(config-if)# scrambling {cell-payload | sts-stream}`	Modify the scrambling mode.
Step 10	`DSLAM(config-if)# exit`	Return to global configuration mode.
Step 11	`DSLAM(config)# subtend-id 0-12`	Assign to this interface a subtend ID that is unique in the subtend tree. (This subtend ID identifies the subtended node attached to the interface, in the case where the attached node does not support the subtend ID feature.)

Note Note that Steps 2 and 11 are alternatives; do not perform both steps.

Examples

This example shows how to change the default ATM interface type to "private" using the **atm uni type private** command.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# atm uni type private
```

This example shows how to change the clock source using the **clock source network-derived** command.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# clock source network-derived
```

Note See the "Interface Configuration Troubleshooting" section on page 8-19, to confirm your interface configuration.

Configuring DS3 and E3 Interfaces

Use the 45 Mbps DS3 to accomplish the following tasks:

- Set up wide-area connections.
- Link multiple campuses.
- Connect to public networks.

You can configure the NI-2 ports as redundant links using the switch routing protocols. You can also configure each port to support these clocking options:

- Self-timing based on an internal clock.
- Loop timing from the received data stream—Ideal for public network connections.
- Timing synchronized to a selected master clock port—Required to distribute a single clock across a network.

Traffic pacing allows you to set the aggregate output traffic rate on any port to a rate below the line rate. This feature is useful when you are communicating with a slow receiver or when you are connected to public networks with peak-rate tariffs.

The plug-and-play mechanisms of the DSLAM allow the interface to launch automatically. You can save all configuration information between hot swaps and reboots, while interface types are automatically discovered by the DSLAM, eliminating the need for mandatory manual configuration.

Default DS3 ATM Interface Configuration Without Autoconfiguration

If ILMI has been disabled or if the connecting end node does not support ILMI, these defaults are assigned to all DS3 interfaces:

- ATM interface type = UNI
- UNI Version = 4.0
- Maximum VPI bits = 8
- Maximum VCI bits = 14
- ATM interface side = network
- ATM UNI type = private

These defaults are assigned to all DS3 interfaces:

- Framing = cbit-adm
- Cell payload scrambling = disabled
- Clock source = network-derived
- Electrical line build out (LBO) = short
- Auto-far-end remote failure(ferf) on loss of signal (LOS) = on
- Auto-ferf on out of frame (OOF) = on
- Auto-ferf on red = on
- Auto-ferf on loss of cell delineation (LCD) = on
- Auto-ferf on alarm indication signaling (AIS) = on

These defaults are assigned to all E3 interfaces:

- Framing = G.832 adm
- Cell payload scrambling = on
- Clock source = network derived
- Auto-ferf on LOS = on
- Auto-ferf on OOF = on
- Auto-ferf on LCD = on (applicable to non-PLCP mode only)
- Auto-ferf on AIS = on

The default subtend ID for each NI-2 DSLAM is 0 (zero).

Manual DS3 and E3 Interface Configuration

To manually change any of the DS3 or E3 default configuration values, perform these tasks:

	Command	Task
Step 1	DSLAM# **configure terminal**	Go to global configuration mode.
Step 2	DSLAM(config)# **subtend-id** *0-12*	Assign to this node a subtend ID that is unique in the subtend tree. The node attached to the trunk must have subtend ID 0.
Step 3	DSLAM(config)# **network-clock-select** {**1-4_priority** | **bits** | **system**} **atm** *slot/port*	Configure the network-derived clock.
Step 4	DSLAM(config)# **interface atm** *slot/port*	Specify an ATM interface and enter interface configuration mode.
Step 5	DSLAM(config-if)# **atm uni** [**side** {**network** | **user**} **type** {**private** | **public**} **version** {**3.0** | **3.1** | **4.0**}]	Modify the ATM interface side, type, or version.
Step 6	DSLAM(config-if)# **atm maxvpi-bits** *0-8*	Modify the maximum VPI bits configuration.
Step 7	DSLAM(config-if)# **atm maxvci-bits** *0-14*	Modify the maximum VCI bits configuration.
Step 8	DSLAM(config-if)# **framing** {**cbitadm** | **cbitplcp** | **m23adm** | **m23plcp**}	Modify the framing mode (DS3 shown).
Step 9	DSLAM(config-if)# **scrambling** {**cell-payload**}	Modify the scrambling mode.
Step 10	DSLAM(config-if)# **clock source** { **loop-timed** | **network-derived**}	Modify the clock source.
Step 11	DSLAM(config-if)# **lbo** {**long** | **short**}	Modify the line build-out.
Step 12	DSLAM(config-if)# **auto-ferf** {**ais** | **lcd** | **los** | **oof** | **red**}	Modify the auto-ferf configuration.
Step 13	DSLAM(config-if)# **exit**	Return to global configuration mode.
Step 14	DSLAM(config)# **subtend-id** *0-12*	Assign to this interface a subtend ID that is unique in the subtend tree. (This subtend ID identifies the subtended node attached to the interface, in the case where the attached node does not support the subtend ID feature.)

Note Note that Steps 2 and 14 are alternatives; do not perform both steps.

Examples

This example shows how to change the default ATM interface type to "private" using the **atm uni type private** command.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# atm uni type private
```

This example shows how to change the clock source using the **clock source network-derived** command.

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# interface atm 0/1
DSLAM(config-if)# clock source network-derived
```

Note See the "Interface Configuration Troubleshooting" section on page 8-19, to confirm your interface configuration.

Configuring T1/E1 Multiplexing over ATM

Cisco IOS Inverse Multiplexing over ATM (IMA) is available for Cisco 6015 and Cisco 6160 DSLAMs with installed DS3+T1/E1 IMA NI-2 cards.

The T1/E1 inverse multiplexing over ATM uses IMA technology to aggregate multiple low-speed links (T1/E1) into one or more IMA groups at speeds between 1.5 Mbps and 12 Mbps for T1 and between 2 Mbps and 16 Mbps for E1. IMA breaks up the ATM cell stream and distributes the cells over the multiple physical links of an IMA group and then recombines the cells into a single stream at the other end of the connection. The multiple links of an IMA group increase the logical link bandwidth to approximately the sum of the individual link rates.

The T1/E1 IMA features for the Cisco 6015 and the Cisco 6160 DSLAMs offer the following benefits:

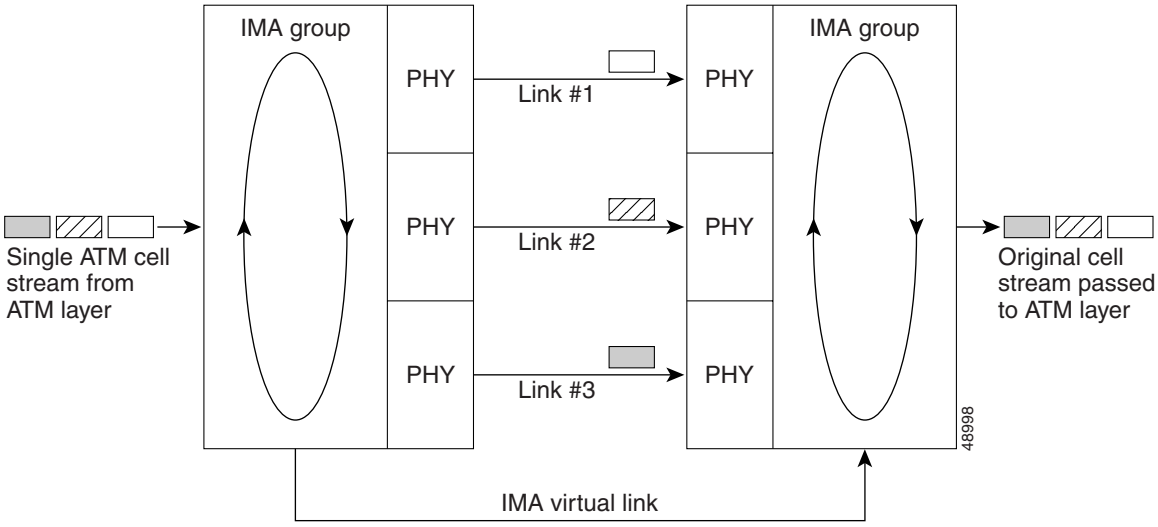
- High-bandwidth performance at a cost lower than that offered by DS3 transmission facilities
- Migration path to high bandwidth without the need to change transport facilities
- Link recovery that passes cells from a failed IMA group link to the other IMA group links

How IMA Works

IMA links transmit IMA control protocol (ICP) cells, which enable the reconstruction of the original ATM cell stream. ICP cells define and separate IMA frames passing through each physical link in an IMA group. ICP cells also control the operation of IMA by accounting for cell delay variation (CDV), which is introduced by ICP cells, and the link differential delays on physical links to ensure the proper reassembly of IMA frames. If an IMA frame length of 128 cells is used, 1 out of every 128 cells on a physical link is an ICP cell. In this scenario, a frame containing fewer than 128 cells is injected with filler cells. The receiving end of an IMA group extracts the ICP and filler cells as the IMA stream is reconstructed into an ATM cell stream and passed to the ATM layer. IMA operation is transparent to ATM layer protocols. Therefore, the ATM layer operates as if a single physical interface were being used.

Figure 8-1 illustrates IMA with three bundled links.

Figure 8-1 IMA Inverse Multiplexing and Demultiplexing



Depending upon the installed I/O module (1DS3+8T1 I/O or 8xE1 I/O), IMA can be configured by a grouping of the following physical links (see the "Supported Platforms" section on page 8-9):

- T1
- E1 (Only the Cisco 6015 DSLAM supports the 8xE1 I/O module.)

Note See the "Supported Platforms" section on page 8-9 for detailed information on platform-specific support of the network I/O modules.

The DS3+T1/E1 IMA NI-2 supports three modes of operation:

- DS3 trunk with 8xT1 IMA subtend
- 8xT1 IMA trunk/subtend
- 8xE1 IMA trunk/subtend (Cisco 6015 DSLAM only)

Note The type of network I/O module (1DS3+8T1 I/O or 8xE1 I/O) detected at system startup determines the mode of operation.

The eight links on the DS3+T1/E1 IMA NI-2 can be independent ATM links or can be configured into one or more IMA groups. There are four static IMA groups. Each IMA group can contain from zero to eight T1/E1 links. Any combination of independent T1/E1 links and IMA groups is allowed, up to eight T1/E1 links total.

Some examples of allowed combinations are:

- Two links and one IMA group with six links
- Four IMA groups with two links in each
- Four links and two IMA groups with two links in each

Supported Platforms

Table 8-2 show the supported platforms for the IMA feature.

Table 8-2 Supported Platforms for T1/E1 Multiplexing over ATM

NI-2	Chassis	I/O Module	Minimum IOS Release
DS3+T1/E1 IMA	6015	1DS3+8xT1	12.1(4)DA
DS3+T1/E1 IMA	6015	8xE1	12.1(4)DA
DS3+T1/E1 IMA	6160	1DS3+8xT1	12.1(5)DA
DS3+T1/E1 IMA	6260	8xE1	Future

Prerequisites

Before you can configure a Cisco 6015 or Cisco 6160 DSLAM to provide T1/E1 IMA service, you must perform the following tasks:

- Install a DS3 + 8xT1/E1 IMA NI-2 card in your DSLAM.
- Install an 1DS3+8xT1 network I/O module or an 8xE1 network I/O module.

Configuration Tasks

Perform the following tasks to configure ATM interfaces for IMA:

- Configuring a Trunk Interface, page 8-9 (Required)
- Configuring T1/E1 Interfaces, page 8-10 (Required)
- Configuring IMA Interfaces, page 8-11 (Required)

Each link can be used as an independent T1/E1 ATM link with all the properties and functionality of ATM interfaces. When the link becomes part of an IMA group, its independent ATM functionality ceases; however, the IMA group can be configured like a single ATM port.

Configuring a Trunk Interface

The DS3+T1/E1 IMA NI-2 card supports the trunk selection feature. This feature allows you to configure any WAN interface (the DS3, any T1 link, any E1 link, or any IMA group) as the trunk. When you configure a T1 link or an IMA group as the trunk, the DS3 port is disabled. When you select the DS3 port as the trunk, the T1 links and IMA groups are all treated as subtended ports.

	Command	Purpose

Step 1	`DSLAM> enable`
	`Password:<password>`
	`DSLAM#`
		Enter enable mode.
		Enter the password.
		The enable mode prompt is `DSLAM#`.

Step 2	`DSLAM# configure terminal` `DSLAM(config)#`	Enter global configuration mode, which has the prompt `DSLAM(config)#`.

	Command	Purpose
Step 3	`DSLAM(config)# interface atm 0/1`	Enter interface configuration mode, which has the prompt `DSLAM(config-if)#`.
Step 4	`DSLAM(config-if)# shutdown`	Disable the individual link by enabling the **shutdown** command.
Step 5	`DSLAM(config-if)# exit`	Return to global config mode.
Step 6	`DSLAM(config)# atm ni2-switch trunk atm 0/1`	Select the interface to use as the trunk.
Step 7	`DSLAM(config)# interface atm 0/1`	Enter interface configuration mode, which has the prompt `DSLAM(config-if)#`.
Step 8	`DSLAM(config-if)# no shutdown`	Enable the individual link by canceling the shutdown state.
Step 9	`DSLAM(config-if)# end`	Return to enable mode when you finish configuring interfaces.

Verifying the Trunk Interface

Use the **show running-config** command to verify that the DSLAM running configuration contains the following statement:

```
atm ni2-switch trunk ATM 0/1
```

If the trunk interface is not the interface you meant to select, using the **atm ni2-switch trunk** command, repeat the procedure in the "Configuring a Trunk Interface" section on page 8-9.

Configuring T1/E1 Interfaces

To configure a T1 or E1 interface, use the following procedure:

	Command	Purpose

Step 1	`DSLAM> enable`
	`Password: <password>`
	`DSLAM#`
		Enter enable mode.
		Enter the password.
		The enable mode prompt is `DSLAM#`.

Step 2	`DSLAM# configure terminal` `DSLAM(config)#`	Enter global configuration mode, which has a prompt of `DSLAM config)#`.
Step 3	`DSLAM(config)# interface atm 0/2` `DSLAM(config-if)#`	Enter interface configuration mode, which has a prompt of `DSLAM(config-if)#`.
Step 4	`DSLAM(config-if)# no shutdown`	Enable the individual link by canceling the shutdown state. Repeat Steps 3 and 4 if your DSLAM has more than one interface that you need to configure.

Step 5	`DSLAM(config-if)# linecode ami`
	or
	`DSLAM(config-if)# linecode hdb3`
		Select the line coding for the T1 link.
		Note If you select ami linecoding, enable scrambling on the link.
		Select the line coding for the E1 link.

	Command	Purpose

Step 6	`DSLAM(config-if)# framing esf`
	or
	`DSLAM(config-if)# framing pcm30`
		Select the frame type for the T1 data link.
		Select the frame type for the E1 data link.

Step 7	`DSLAM(config-if)# lbo short 133`	Specify the line length (**short** or **long**), followed by the length. You can view the acceptable lengths by including the **?** option after the **lbo long** or **lbo short** commands.
Step 8	`DSLAM(config-if)# clock source loop-timed`	Select the transmit clock source for a link.
Step 9	`DSLAM(config-if)# end`	When you finish configuring interfaces, return to enable mode.

Verifying T1/E1 Interfaces

After configuring your T1/E1 interfaces, use the following commands to verify their operational status:

	Command	Purpose
Step 1	`DSLAM# show interface atm0/2`	Displays the interface configuration, status, and statistics of the ATM interface.
Step 2	`DSLAM# show controllers atm0/2`	Displays diagnostic information for the specified interface.

If an interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, make sure that the T1/E1 interface is properly connected and configured.

Configuring IMA Interfaces

To configure an IMA interface, you must use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the DSLAM prompt.

	Command	Purpose
Step 1	`DSLAM> enable`	Enter enable mode.
Step 2	`DSLAM# configure terminal`	Enter global configuration mode, which has a prompt of `DSLAM(config)#`.
Step 3	`DSLAM(config)# interface atm 0/2`	Enter interface configuration mode, which has a prompt of `DSLAM(config-if)#`.
Step 4	`DSLAM(config-if)# ima-group 2`	Assign the ATM interface to an IMA group (numbered from 0 to 3). After the interface is assigned to an IMA group, individual ATM functionality is no longer available on the link.
Step 5	`DSLAM(config-if)# no shutdown`	Enable the individual link by canceling the shutdown state. Repeat Step 3 through Step 5 if your DSLAM has more than one interface that you need to configure.
Step 6	`DSLAM(config-if)# exit`	Return to global configuration interface mode.

	Command	Purpose
Step 7	`DSLAM(config)# interface atm0/ima2`	Begin configuring the IMA interface.
Step 8	`DSLAM(config-if)# ima clock-mode independent`	Select the transmit clock mode for the selected IMA group.
Step 9	`DSLAM(config-if)# ima differential-delay-maximum 68`	Enter the maximum differential delay in milliseconds for the selected IMA group.
Step 10	`DSLAM(config-if)# ima active-links-minimum 2`	Enter the minimum number of links that need to be operational for the selected IMA group.
Step 11	`DSLAM(config-if)# no shutdown`	Enable the IMA group by canceling the shutdown state.
Step 12	`DSLAM(config-if)# end`	When you finish configuring interfaces, return to enable mode.

Verifying the IMA Configuration

After configuring your IMA interfaces, use the following commands to verify their operational status.

	Command	Purpose
Step 1	`DSLAM# show interface atm0/ima2`	Displays interface configuration, status, and statistics for the IMA interface.
Step 2	`DSLAM# show controllers atm0/ima2`	Displays diagnostic information for the specified IMA group.
Step 3	`DSLAM# show ima interface atm0/ima2`	Displays configuration information and operational status for the specified IMA group.
Step 4	`DSLAM# show ima interface atm 0/2`	Displays information for a single link in an IMA group.

If an interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, make sure that the new interface is properly connected and configured.

Troubleshooting Tips

Use the following general guidelines to troubleshoot IMA groups and the individual links of an IMA group.

Make Sure T1/E1 Links Are Error Free

	Command	Purpose
Step 1	`DSLAM# show interface atm 0/2`	Use the **show interface atm** command to verify the status of a T1 or E1 link. Verify that the administrative status and protocol status are both *up*. Also, check for CRC errors and loopback status.
Step 2	`DSLAM# show running-config interface atm 0/2`	Verify that the interface is not shut down. Also, compare the interface configuration with the far end interface to ensure that there are no configuration mismatches.
Step 3	`DSLAM# show controllers`	Use the **show controllers** command to verify the port status and view any active alarms states.

Troubleshoot the IMA Groups and Links

	Command	Purpose
Step 1	DSLAM# **show ima interface atm0/ima0**	Verify that the IMA group status is *up*. Also, use the command output to verify the IMA configuration at the near and far end.
Step 2	DSLAM# **show ima interface atm 0/2**	Verify that the member links of the IMA group are *up*.
Step 3	DSLAM# **show ima counters**	The **show ima counters** command reports IMA statistics in 15-minute intervals with 24 hour totals.

See http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/6015/user/hig/index.htm for troubleshooting information.

Monitoring and Maintaining IMA

This section describes commands that you can use to monitor and maintain IMA configurations. Table 8-3 lists the commands.

Table 8-3 Commands for Monitoring and Maintaining IMA

Command	Purpose
DSLAM# **show ima interface**	Displays information about all IMA groups and the links in those groups.
DSLAM# **show ima interface atm0/ima***ima-group-number*	Displays information about a single IMA group and the links in that group.
DSLAM# **show controllers**	Displays information about current settings and performance at the physical level.
DSLAM# **show ima interface atm 0/***atm-interface-number*	Displays IMA information for an individual link in an IMA group.

Configuration Examples

This section contains sample configurations that show how to configure the following trunks:

- IMA Trunk with IMA Subtended Chassis, page 8-14
- DS3 Trunk with IMA and T1 Subtended Chassis, page 8-17

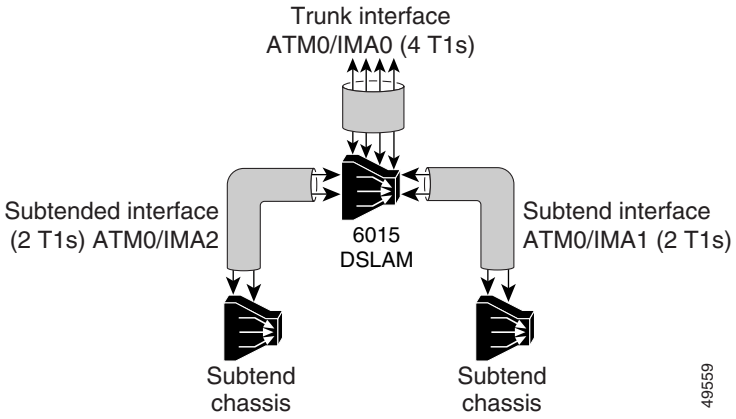
IMA Trunk with IMA Subtended Chassis

The following sample configuration shows how to configure the following groups:

- An IMA group containing four links as a trunk interface
- Two IMA groups, each containing two links, connecting subtended Cisco 6015 or Cisco 6160 DLSAM

Figure 8-2 illustrates the network topology being configured in the following configuration sample.

Figure 8-2 IMA Trunk with IMA Subtended Chassis



Note Comments are written in boldface type and encapsulated with exclamation points.

```
...
atm ni2-switch trunk ATM0/IMA0 !Configures interface ATM0/IMA0 as the trunk!

!
!
!
interface ATM0/0
 no ip address
 no ip route-cache
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvci-bits 12
!
interface Ethernet0/0
 ip address 192.168.1.1 255.255.255.0
 no ip route-cache
!
interface ATM0/1
 no ip address
 no ip route-cache
 shutdown
 no atm ilmi-keepalive
!
```

```
interface ATM0/2
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/3
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/4
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/5
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/6
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 1 !Adds this interface to IMA group 1!
!
interface ATM0/7
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 1 !Adds this interface to IMA group 1!
```

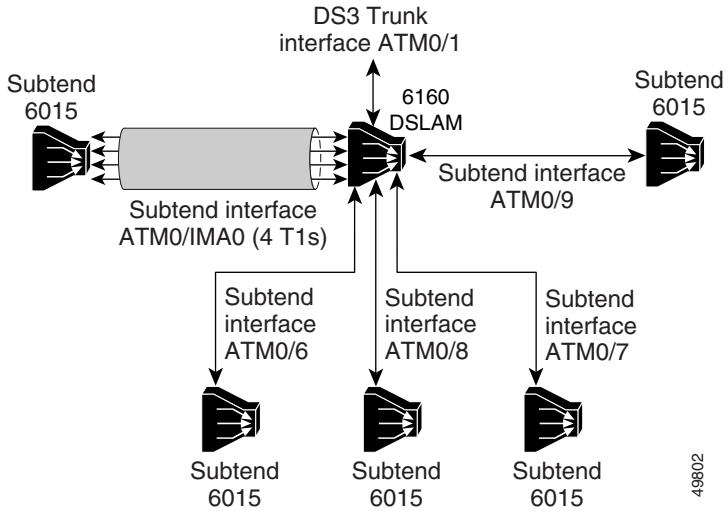
```
!
interface ATM0/8
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 2 !Adds this interface to IMA group 2!
!
interface ATM0/9
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
 ima-group 2 !Adds this interface to IMA group 2!
!
interface ATM0/IMA0 !IMA group 0 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 ima active-links-minimum 2
 ima clock-mode independent
 ima differential-delay-maximum 68
!
interface ATM0/IMA1 !IMA group 1 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 ima active-links-minimum 2
 ima clock-mode independent
 ima differential-delay-maximum 68
!
interface ATM0/IMA2 !IMA group 2 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 ima active-links-minimum 2
 ima clock-mode independent
 ima differential-delay-maximum 68
!
interface ATM0/IMA3
 no ip address
 no ip route-cache
 shutdown
 no atm ilmi-keepalive
...
```

DS3 Trunk with IMA and T1 Subtended Chassis

The following sample configuration involves a network topology containing a mixture of IMA, T1, and DS3 interfaces. It is relevant only to IMA on platforms with the 1DS3+8xT1 I/O module installed.

Figure 8-3 illustrates the network topology being configured in the following configuration sample.

Figure 8-3 DS3 Trunk with IMA and T1 Subtended Chassis




```
...
atm ni2-switch trunk ATM0/1 !DS3 is the default trunk!
!
!
!
interface ATM0/0
 no ip address
 no ip route-cache
 atm maxvp-number 0
 atm maxvc-number 4096
 atm maxvci-bits 12
!
interface Ethernet0/0
 ip address 192.168.1.1 255.255.255.0
 no ip route-cache
!
interface ATM0/1
 no ip address
 no ip route-cache
 no atm ilmi-keepalive
!
interface ATM0/2
 no ip address
 no ip route-cache
 no atm ilmi-keepalive
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/3
 no ip address
 no ip route-cache
 no atm ilmi-keepalive
 ima-group 0 !Adds this interface to IMA group 0!
!
```

```
interface ATM0/4
 no ip address
 no ip route-cache
 no atm ilmi-keepalive
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/5
 no ip address
 no ip route-cache
 no atm ilmi-keepalive
 ima-group 0 !Adds this interface to IMA group 0!
!
interface ATM0/6 !T1 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
!
interface ATM0/7 !T1 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
!
interface ATM0/8 !T1 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
!
interface ATM0/9 !T1 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 clock source loop-timed
 scrambling cell-payload
 linecode ami
 lbo short 133
!
interface ATM0/IMA0 !IMA group 0 configuration!
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 ima active-links-minimum 4
 ima clock-mode independent
 ima differential-delay-maximum 68
!
```

```
interface ATM0/IMA1
 no ip address
 no ip route-cache
 shutdown
 no atm ilmi-keepalive
!
interface ATM0/IMA2
 no ip address
 no ip route-cache
 shutdown
 no atm ilmi-keepalive
!
interface ATM0/IMA3
 no ip address
 no ip route-cache
 shutdown
 no atm ilmi-keepalive
...
```

Interface Configuration Troubleshooting

You can use the following privileged EXEC mode commands to confirm that the hardware, software, and interfaces for the DSLAM are configured as intended.

Command	Purpose
DSLAM# **show version**	Confirm that software of the correct version and type is installed.
DSLAM# **show hardware**	Confirm the type of hardware installed in the system.
DSLAM# **show interface ethernet** [**slot/port**]	Confirm that the Ethernet interface is configured correctly.
DSLAM# **show atm addresses**	Confirm the ATM address is configured correctly.
DSLAM# **ping atm interface atm** [**slot/port**] [**vpi**] **ip-address xxx.xxx.xxx.xxx**	Test for connectivity between the DSLAM and a host.
DSLAM# **show** {**atm** | **ces**} **interface**	Confirm that the ATM interfaces are configured correctly.
DSLAM# **show atm status**	Confirm the status of the ATM interfaces.
DSLAM# **show atm vc**	Confirm the status of ATM virtual interfaces.
DSLAM# **show running-config**	Confirm that the configuration being used is configured correctly.
DSLAM# **show startup-config**	Confirm that the configuration saved in NVRAM is configured correctly.
DSLAM# **show controllers** {**atm** | **ethernet**}	Confirm interface controller memory addressing.

You can also view an ATM layer fault state and loss of cell delineation using the CLI and MIB. The default alarm level for this fault state is Major.

You can use the following privileged EXEC mode commands to initiate line loopbacks.

Command	Purpose
DSLAM# **loopback diagnostic**	Diagnostic loopback. The outgoing cells are looped back toward the switch. This command is available on all ports.
DSLAM# **loopback line**	Line loopback. The incoming line is looped back toward the coax. This command is available only on trunk and subtending ports.
DSLAM# **loopback payload**	Payload loopback. The incoming payload is looped back toward the coax. This command is available only on DS3 trunk and subtending ports.

Loading System Software Images and Configuration Files

This chapter describes how to load and maintain system software images and configuration files for Cisco digital subscriber line access multiplexers (DSLAMs) with NI-2. The instructions in this chapter assume that your DSLAM contains a minimal configuration that allows you to interact with the system software.

The tasks in the first four sections are typical tasks for all DSLAMs:

Configuring a Static IP Route

If you are managing the DSLAM through an Ethernet interface or ATM subinterface on the ATM switch processor (ASP), and your management station or TFTP server is on a subnet different from the one where the DSLAM is, you must first configure a static IP route.

Caution If you do not configure a static IP route before you install the new image, you will lose remote administrative access to the DSLAM. If this happens, you can regain access from a direct console connection to the DSLAM, but this requires physical access to the console port.

To configure a static IP route, follow these steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip route`[1] *prefix mask*[2] `[ethernet | atm] 0/0[.`*subinterface*`]`	Configure a static IP route on the Ethernet interface or ATM subinterface of the ASP.
Step 3	`DSLAM(config)# end`	Return to privileged EXEC mode.
Step 4	`DSLAM# copy running-config startup-config`	Save the configuration to NVRAM.

1. The IP route prefix of the remote network in which the management station or TFTP server resides.
2. The subnet mask of the remote network in which the management station or TFTP server resides.

Retrieving System Software Images and Configuration Files

If you have a minimal configuration that allows you to interact with the system software, you can retrieve other system images and configuration files from a network server and modify them for use in your particular routing environment. To retrieve system images and configuration files for modification, perform the tasks described in this section.

Copying System Software Images from a Network Server to the DSLAM

You can copy system images from a TFTP, remote copy protocol (rcp), or Maintenance Operation Protocol (MOP) server to the DSLAM flash memory. The DSLAM uses embedded flash memory.

Using Flash Memory

In flash memory, if free space is:

- Available, you can erase the existing flash memory before writing onto it.
- Not available, or if the flash memory has never been written to, you must use the format routine before you can copy new files.

The system informs you of these conditions and prompts you for a response. If you accept the erasure, the system prompts you again to confirm before erasing.

Note The flash memory is erased at the factory before shipment.

If you attempt to copy into flash memory a file that already exists there, a prompt informs you that a file with the same name already exists. The older file is deleted when you copy the new file into flash. The first copy of the file still resides within flash memory, but it is made unusable in favor of the newer version, and is listed with the “deleted” tag when you use the **show flash** command. If you terminate the copy process, the newer file is marked “deleted” because the entire file was not copied. In this case, the original file in flash memory is valid and available to the system.

Note You can copy normal system images or system images compressed with the UNIX **compress** command to flash memory.

Copying from a TFTP Server to Flash or Bootflash Memory

To copy a system image from a TFTP server to flash or bootflash memory, follow these steps:

	Command	Task
Step 1	DSLAM> **enable** Password:	Go to privileged EXEC mode.
Step 2	See the instructions in the "Copying System Images from Flash Memory to a Network Server" section on page 9-30.	Make a backup copy of the current system software image.
Step 3	DSLAM# **copy tftp** [**flash** | **bootflash**] or DSLAM# **copy tftp** *file_id*	Copy a system image to flash or bootflash memory.
Step 4	*ip-address* or *name*	If prompted, enter the IP address or domain name of the server.
Step 5	*filename*	If prompted, enter the filename of the server system image. Filenames are case sensitive.

Note Be sure there is ample space available before copying a file to flash memory. Use the **dir** command and compare the size of the file you want to copy to the amount of available flash memory shown. If the space available is less than the space required by the file you want to copy, the copy process aborts. The failure message "%Error copying tftp://tftpboot/ni2-dsl-mz (Not enough space on device)" appears.

When you issue the **copy tftp [flash | bootflash]** command, the system prompts you for the IP address or domain name of the TFTP server. This server can be another switch or DSLAM serving software images. The system prompts you for the filename of the software image to copy.

If no free flash memory space is available, or if the flash memory has never been written to, the erase routine is required before new files can be copied. The system informs you of these conditions and prompts you for a response.

The *file_id* argument of the **copy tftp** *file_id* command specifies a device and filename as the destination of the copy operation. You can omit the device and enter only **copy tftp** *filename*. If you omit the device, the system uses the current device specified by the **cd** command.

Note Use the **pwd** command to display the current device.

Examples

This example shows how to copy a system image named "6260-wi-m_1.1(1)" into the current flash configuration:

```
DSLAM# copy tftp flash
Enter source file name: 6260-wi-m_1.1(1)
Enter destination file name [6260-wi-m_1.1(1)]:
7602048 bytes available on device bootflash, proceed? [confirm] y
Address or name of remote host [dirt.cisco.com]?
Accessing file "6260-wi-m_1.1(1)" on dirt.cisco.com ...FOUND
Loading 6260-wi-m_1.1(1) from 171.69.1.129 (via Ethernet0/0): !!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 2247751/4495360 bytes]
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

The exclamation points indicate that the process is working. A series of Cs indicates that a checksum verification of the image is occurring after the image is written to flash memory.

Use the **dir** command to confirm that the file transfer was successful.

```
DSLAM# dir
-#- -length- -----date/time------ name
1   2247751  May 03 2000 14:32:10 6260-wi-m_1.1(1)

5354296 bytes available (2247880 bytes used)
```

This example shows how to copy the "dslam-confg" file from a TFTP server to embedded flash memory. The copied file has the name "backup-confg".

```
DSLAM# copy tftp:dslam-confg bootflash:backup-confg
1244732 bytes available on device slot0, proceed? [confirm] y
Address or name of remote host [dirt.cisco.com]?
Accessing file "dslam-confg" on dirt.cisco.com ...FOUND
Loading dslam-confg from 171.69.1.129 (via Ethernet0/0): !!
[OK - 5204/10240 bytes]
```

Copying from an rcp Server to Flash or Bootflash Memory

You can copy a system image from an rcp network server to flash or bootflash memory.

For the **rcp** command to execute successfully, you must define an account on the network server for the remote username. You can override the default remote username sent on the rcp copy request by configuring the remote username.

For example, if the system image resides in the home directory of a user on the server, you can specify that user's name as the remote username. The rcp protocol implementation copies the system image from the remote server to the directory of the remote username if the remote server has a directory structure, as do UNIX systems.

To copy a system image from an rcp server to flash memory, follow these steps:

	Command	Tasks
Step 1	See the instructions in the "Copying System Images from Flash Memory to a Network Server" section on page 9-30.	Make a backup copy of the current system software image.
Step 2	`DSLAM# configure terminal`	Enter global configuration mode from the terminal. This step is required only if you override the default remote username (see Step 3).
Step 3	`DSLAM(config)# ip rcmd remote-username` *username*	Specify the remote username.
Step 4	`DSLAM(config)# end`	Exit global configuration mode.
Step 5	`DSLAM# copy rcp [flash | bootflash]` `DSLAM# copy rcp` *file_id*	Copy the system image from an rcp server to flash or bootflash memory.

	Command	Tasks
Step 6	*ip-address* or *name*	If prompted, enter the IP address or domain name of the network server.
Step 7	*filename*	If prompted, enter the filename of the server system image to be copied.

The **copy** command automatically displays the flash memory directory, including the amount of free space. If the file being downloaded to flash memory is an uncompressed system image, the **copy** command automatically determines the size of the file being downloaded and validates it with the space available in flash memory.

When you issue the **copy rcp [flash | bootflash]** or **copy rcp** *file_id* command, the system prompts you for the IP address or domain name of the server. This server can be another switch or DSLAM serving flash system software images. The system then prompts you for the filename of the software image to copy. With the **copy rcp flash** command, the system also prompts you to name the system image file that resides in flash memory after the copy is complete. You can use the filename of the source file, or you can choose another name.

Examples

This example shows how to copy a system image named "mysysim1" from the "netadmin1" directory on the remote server named "SERVER1.CISCO.COM" with an IP address of 171.69.1.129 to the DSLAM flash memory. To ensure that enough flash memory is available to accommodate the system image to be copied, the DSLAM software allows you to erase the contents of flash memory first.

```
DSLAM# configure terminal
DSLAM(config)# ip rcmd remote-username netadmin1
DSLAM(config)# end
DSLAM# copy rcp flash
Enter source file name: 6260-wi-m_1.1(1)
Enter destination file name [6260-wi-m_1.1(1)]:
3498136 bytes available on device slot0, proceed? [confirm] y
Address or name of remote host [server1.cisco.com]?

Connected to 171.69.1.129
Loading 2247751 byte file 6260-wi-m_1.1(1):
Connected to 171.69.1.129
Loading 2247751 byte file 6260-wi-m_1.1(1): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!! [OK]
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

The exclamation points indicate that the process is working.

Note If you enter **n** after the "proceed?" prompt, the copy process stops. If you enter **y** and confirm the copy, copying begins. Make sure there is enough flash memory available before entering **y** at the proceed prompt.

This example uses the **copy rcp** *file_id* command to copy the "dslam-image" file from a network server using rcp to the embedded flash memory:

```
DSLAM# configure terminal
DSLAM(config)# ip rcmd remote-username netadmin1
```

```
DSLAM(config)# end
DSLAM# copy rcp bootflash:dslam-image
```

Verifying the Image in Flash Memory

Before booting from flash memory, verify that the checksum of the image in flash memory matches the checksum listed in the README file that was distributed with the system software image. When you issue the **copy tftp flash**, **copy rcp flash**, or **copy rcp bootflash** command, the checksum of the image in flash memory appears at the bottom of the screen. The README file was copied to the network server automatically when you installed the system software image on the server.

Caution If the checksum value does not match the value in the README file, do not reboot the DSLAM. Instead, issue the copy request and compare the checksums again. If the checksum is repeatedly incorrect, copy the original system software image back into flash memory *before* you reboot the DSLAM from flash memory. If you have a corrupted image in flash memory and you attempt to boot from flash, the system fails to load the corrupted image and defaults to the boot image stored in bootflash. This image allows you to copy a valid system image into flash.

Copying Configuration Files from a Network Server to the DSLAM

You can copy configuration files from:

- A TFTP server or an rcp server to the DSLAM. You might use this process to:
  - Restore a configuration file to the DSLAM if you have backed up the file to a server. If you replace a DSLAM and want to use the configuration file that you created for the original DSLAM, you can restore that file instead of recreating it.
  - Copy to the DSLAM a different configuration, which is stored on a network server.
- An rcp or TFTP server to either the running configuration or the startup configuration. When you copy a configuration file to:
  - The running configuration, you copy to and run the file from RAM.
  - The startup configuration, you copy it to NVRAM or to the location specified by the CONFIG_FILE environment variable.

Copying from a TFTP Server to the DSLAM

To copy a configuration file from a TFTP server to the DSLAM, complete these tasks:

	Command	Task
Step 1	`DSLAM> enable` `Password:`	Go to privileged EXEC mode.

Step 2	`DSLAM# copy tftp running-config`
	or
	`DSLAM# copy tftp startup-config`
		Copy a configuration file from a TFTP server to the DSLAM running or startup configuration.

Step 3	*ip-address* or *name*	If prompted, enter the IP address or domain name of the server.
Step 4	*filename*	If prompted, enter the filename of the server system image.

Copying from an rcp Server to the DSLAM

The rcp protocol requires that a client send the remote username on each rcp request to a network server. When you issue a request to copy a configuration file from an rcp network server, the DSLAM sends a default remote username unless you override the default by configuring a remote username. By default, the DSLAM software sends the remote username associated with the current teletype (TTY) process, if that name is valid. If the TTY username is invalid, the DSLAM software uses the DSLAM host name as both the remote and local user names. You can also specify the path of an existing directory with the remote username.

For the rcp copy request to execute successfully, follow these steps:

Step 1 Define an account on the network server for the remote username.

Step 2 If you copy the configuration file from a personal computer used as a file server, make sure that the remote host computer supports the remote shell protocol.

To copy a configuration file from an rcp server to the running configuration or the startup configuration, perform these tasks:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip rcmd remote-username` *username*	Specify the remote username. This step is optional, but recommended.
Step 3	`DSLAM(config)# end`	Exit configuration mode.
Step 4	`DSLAM# copy rcp running-config` or `DSLAM# copy rcp startup-config`	Copy a configuration file from an rcp server to the DSLAM running or startup configuration.
Step 5	*ip-address*	If prompted, enter the IP address of the server.
Step 6	*filename*	If prompted, enter the name of the configuration file.

The **copy rcp startup-config** command copies the configuration file from the network server to the configuration file pointed to by the CONFIG_FILE environment variable. If you want to write the configuration file from the server to NVRAM on the DSLAM, be sure to set the CONFIG_FILE environment variable to NVRAM. See the "Setting the CONFIG_FILE Environment Variable" section on page 9-26 for instructions on setting the CONFIG_FILE environment variable.

Examples

Using the remote username netadmin1, this example shows copying a host configuration file host1-confg from the netadmin1 directory on the remote server to the DSLAM startup configuration:

```
DSLAM# configure terminal
DSLAM(config)# ip rcmd remote-username netadmin1
DSLAM(config)# end
DSLAM# copy rcp running-config
Host or network configuration file [host]?
Address of remote host [255.255.255.255]? 131.108.101.101
Name of configuration file [dslam-confg]? host1-confg
Configure using host1-confg from 131.108.101.101? [confirm]
Connected to 131.108.101.101
Loading 1112 byte file host1-confg:![OK]
```

```
DSLAM#
%SYS-5-CONFIG: Configured from host1-config by rcp from 131.108.101.101
```

Using the remote username netadmin1, this example shows copying the host configuration file host1-confg from the netadmin1 directory on the remote server to the DSLAM startup configuration:

```
DSLAM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DSLAM(config)# ip rcmd remote-username netadmin1
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy host2-confg rcp
Remote host []? dirt
Name of configuration file to write [dslam-confg]?
Write file dslam-confg on host 171.69.1.129? [confirm]
Writing dslam-confg !! [OK]
DSLAM# copy rcp startup-config
Address of remote host [255.255.255.255]? 171.69.1.129
Name of configuration file [dslam-confg]?
Configure using dslam-confg from 171.69.1.129? [confirm]

Connected to 171.69.1.129
Loading 5393 byte file dslam-confg: !! [OK]

Warning: distilled config is not generated
[OK]
DSLAM#
%SYS-5-CONFIG_NV: Non-volatile store configured from dslam-confg by console rcp
 from 171.69.1.129
```

Changing the Buffer Size for Loading Configuration Files

The buffer that holds the configuration commands is generally the size of NVRAM. Complex configurations might require a larger configuration file buffer size. To change the buffer size, use this command in global configuration mode:

Command	Task
DSLAM(config)# **boot buffersize** *bytes*	Change the buffer size to use for booting a host or network configuration file from a network server.

Example

In this example, the buffer size is set to 50000 bytes, and the running configuration is saved to the startup configuration:

```
DSLAM(config)# boot buffersize 50000
DSLAM(config)# end
DSLAM# copy running-config startup-config
Destination filename [startup-config]? y
Building configuration...
[OK]
```

Displaying System Image and Configuration Information

To display information about system software, system image files, and configuration files, use these privileged EXEC commands:

Command	Task
DSLAM# **show version**	List the system software release version, configuration register setting, and so on.
DSLAM# **show bootvar**	List the contents of the BOOT environment variable, the name of the configuration file pointed to by the CONFIG_FILE environment variable, and the contents of the BOOTLDR environment variable.
DSLAM# **show startup-config**	List the startup configuration information. The CONFIG_FILE environment variable points to the startup configuration.
DSLAM# **show file** *device*:*filename*	List the configuration information stored in a specified file.
DSLAM# **show running-config**	List the configuration information in running memory.
DSLAM# **show flash**	List information about flash memory, including system image filenames and amounts of memory used and remaining.

You can also use the **o** command in ROM monitor mode to list the configuration register settings.

Performing DSLAM Startup Tasks

This section describes the DSLAM startup tasks:

- Cisco Implementation of Environment Variables, page 9-9
- Formatting Flash Memory, page 9-11
- Managing Flash Files, page 9-12

Cisco Implementation of Environment Variables

Embedded flash memory can store executable images and configuration files. The DSLAM can now boot images and load configuration files from embedded flash, NVRAM, or the network.

Because a DSLAM can boot images and load configuration files from several locations, these systems use special ROM monitor environment variables to specify the location and filename of images and configuration files that the DSLAM uses for various functions. These special environment variables are

- BOOT environment
- BOOTLDR environment
- CONFIG_FILE environment
- Control environment

BOOT Environment Variable

The BOOT environment variable specifies a list of bootable images on various devices. Once you save the BOOT environment variable to your startup configuration, the DSLAM checks the variable upon startup to determine the device and filename of the image to boot.

The DSLAM tries to boot the first image in the BOOT environment variable list. If the DSLAM cannot boot that image, it tries to boot the next image specified in the list. The DSLAM tries each image in the list until it successfully boots. If the DSLAM cannot boot any image in the BOOT environment variable list, it attempts to boot the boot image.

If an entry in the BOOT environment variable list does not specify a device, the DSLAM acts as if the device is TFTP. If an entry in the BOOT environment variable list specifies an invalid device, the DSLAM skips that entry.

BOOTLDR Environment Variable

The BOOTLDR environment specifies the flash device and filename containing the boot image that the ROM monitor uses.

This environment variable allows you to have several boot images. You can also instruct the ROM monitor to use a specific boot image. After you save the BOOTLDR environment variable to your startup configuration, the DSLAM checks the variable upon startup to determine which boot image to use.

CONFIG_FILE Environment Variable

The CONFIG_FILE environment variable specifies the device and filename of the configuration file to use for initialization (startup). After you save the CONFIG_FILE environment variable to your startup configuration, the DSLAM checks the variable upon startup to determine the location and filename of the configuration file to use for initialization.

The DSLAM uses the NVRAM configuration during initialization when the CONFIG_FILE environment variable does not exist or when it is null (such as at first-time startup). If the DSLAM detects a problem with NVRAM or the configuration it contains, the DSLAM enters the autoconfiguration mode. See Chapter 3, “Initially Configuring the Cisco DSLAM.”

Control Environment Variables

Although the ROM monitor controls environment variables, you can create, modify, or view them with certain system image commands. To create or modify the BOOT, BOOTLDR, and CONFIG_FILE environment variables, use the **boot system**, **boot bootldr**, and **boot config** system image commands, respectively.

Note When you use these three global configuration commands, you affect only the running configuration. You must save the environment variable settings to your startup configuration to put the information under ROM monitor control and for the environment variables to function as expected. Use the **copy running-config startup-config** command to save the environment variables from your running configuration to your startup configuration.

You can view the contents of the BOOT, BOOTLDR, and CONFIG_FILE environment variables by issuing the **show bootvar** command. This command displays the settings for these variables as they exist in the startup configuration and in the running configuration if a running configuration setting differs from a startup configuration setting.

Use the **show startup-config** command to display the contents of the configuration file pointed to by the CONFIG_FILE environment variable.

Formatting Flash Memory

You must format embedded flash memory before using it.

You can reserve certain flash memory sectors as spares for use when other sectors fail. Use the **format** command to specify between 0 and 16 sectors as spares. If you reserve a small number of spare sectors for emergencies, you do not waste space because you can use most of flash memory. If you specify 0 spare sectors and some sectors fail, you must reformat flash memory and erase all existing data.

The system requires a monlib file for the format operation. The monlib file is the ROM monitor library. The ROM monitor uses the monlib file to access files in the flash file system. The system software contains the monlib file.

Caution The formatting procedure erases all information in flash memory. To prevent the loss of important data, proceed carefully.

To format flash memory, use this command in privileged EXEC mode:

Command	Task
DSLAM# **format** [**spare** *spare-number*] *device1*: [[*device2*:][*monlib-filename*]]	Format flash memory.

Example

This example shows how to use the **format** command to format embedded flash memory:

```
DSLAM# format bootflash:
Running config file on this device, proceed? [confirm] y
All sectors will be erased, proceed? [confirm] y
Enter volume id (up to 31 characters):
Formatting sector 1 (erasing)
Format device slot0 completed
```

When the DSLAM returns you to the EXEC prompt, flash memory is successfully formatted and ready for use.

Recovering from Locked Blocks

You can also format flash memory to recover from locked blocks. A locked block of flash memory occurs when power is lost during a write or erase operation. When a block of flash memory is locked, it cannot be written to or erased, and the operation consistently fails at a particular block location. You can recover from locked blocks only by reformatting flash memory with the **format** command.

Caution Formatting flash memory to recover from locked blocks causes existing data to be lost.

Managing Flash Files

You can manage files in embedded flash memory. This section describes the tasks to help you manage your files:

Setting the System Default Flash Device

You can specify the flash device that the system uses as the default device. Setting the default flash device allows you to omit an optional *device*: argument from related commands. For all EXEC commands that have an optional device: argument, the system uses the device specified by the cd command when you omit the optional device: argument. For example, the dir command contains an optional device: argument and displays a list of files on a flash memory device.

The DSLAM requires that the flash device be flash:, for embedded flash. Setting flash: as the default lets you skip the *device*: parameter.

To specify a default flash device, use this command in EXEC mode:

Command	Task
DSLAM> **cd** *device*:	Set a default flash memory device.

Example

This example shows how to set the default device to embedded flash (the only option for DSLAM):

```
DSLAM> cd flash:
```

Displaying the Current Default Flash Device

You might want to show the current setting of the **cd** command to see which device is the current default flash device. To display the current default flash device specified by the **cd** command, use this command in privileged EXEC mode:

Command	Task
DSLAM# **pwd**	Display the current flash memory device.

Examples

This example shows that the present working device specified by the **cd** command is flash:

```
DSLAM# pwd
flash:/
```

This example shows how to use the **cd** command to change the present working device to bootflash and then uses the **pwd** command to display that present working device:

```
DSLAM# cd bootflash:
DSLAM# pwd
bootflash:/
```

Showing a List of Files in Embedded Flash

You might want to view a list of the contents of embedded flash before manipulating its contents. For example, before copying a new configuration file to flash, you might want to verify that the device does not already contain a configuration file with the same name. Similarly, before copying a flash configuration file to another location, you might want to verify its filename for use in another command. You can check the contents of embedded flash with the **dir** EXEC command.

To show a list of files on a specified flash device, use the EXEC command:

Command	Task
DSLAM> **dir** [**/all**] **flash:** [*filename*]	Display a list of files in embedded flash.

Examples

This example shows how to instruct the DSLAM to list undeleted files for the default device specified by the **cd** command. Notice that the DSLAM displays the information in short format because no keywords are used:

```
Directory of bootflash:/

    1  -rw-     3419352   Sep 26 2000 23:59:56  ni2-dboot-mz.121-6.DA

3801088 bytes total (381608 bytes free)
```

Deleting Files in Embedded Flash

When you no longer need a file in flash, you can delete it.

Caution Be careful not to delete your only known good boot image. If you have enough available flash memory, create a backup image. The backup image allows you to revert to a known good boot image if you have trouble with the new image. If you delete all boot images you can no longer download any images.

To delete a file from embedded flash, use one of these commands in privileged EXEC mode:

Command	Task
DSLAM# **delete** {**bootflash: | flash:**} *filename* or DSLAM# **erase nvram:***filename*	Delete a file from embedded flash.

If you attempt to delete the configuration file specified by the CONFIG_FILE or BOOTLDR environment variable, the system prompts you to confirm the deletion. Also, if you attempt to delete the last valid system image specified in the BOOT environment variable, the system prompts you to confirm the deletion.

Examples

This example shows how to delete the myconfig file from embedded flash:

```
DSLAM# delete bootflash:myconfig
```

This example shows how to erase the myconfig file from embedded flash:

```
DSLAM# erase nvram:myconfig
```

Performing General Startup Tasks

If you modify your switching environment, you must perform some general startup tasks. For example, to modify a configuration file, you enter configuration mode. You also modify the configuration register boot field to tell the DSLAM if and how to load a system image upon startup. Also, instead of using the default system image and configuration file to start up, you can specify a particular system image and configuration file for the DSLAM to use to start up.

General startup tasks include:

Entering Configuration Mode and Selecting a Configuration Source

When you enter configuration mode using the **configure** privileged EXEC command, you must specify the source of the configuration as **terminal**, **memory**, **network**, or **overwrite-network**. Each of these methods is described in these subsections.

The DSLAM accepts one configuration command per line. You can

- Enter as many configuration commands as you want.
- Add comments to a configuration file by placing an exclamation point (!) at the beginning of each comment line. Comments, as well as default settings, are *not* stored in NVRAM or in the active copy of the configuration file and therefore do not appear when you list the active configuration with the **show running-config** EXEC command or the startup configuration with the **show startup-config** EXEC command (when the startup configuration is stored in NVRAM). However, you can list the comments in configuration files stored on a TFTP, rcp, or MOP server.

Configuring the DSLAM from the Terminal

When you configure the DSLAM from the terminal, you do so interactively: the DSLAM executes the commands as you enter them at the system prompts. To configure the DSLAM from the terminal, complete these tasks:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	See the appropriate chapter for specific configuration commands.	Enter the necessary configuration commands.

	Command	Task
Step 3	`DSLAM(config)# end`	Quit configuration mode.
Step 4	`DSLAM# copy running-config startup-config`	Save the configuration file to your startup configuration. This step saves the configuration to the location specified by the CONFIG_FILE environment variable.

Example

In this example, the DSLAM is configured from the terminal. The **hostname** command changes the DSLAM name to dslam2. The **end** command quits configuration mode, and the **copy running-config startup-config** command saves the current configuration to the startup configuration. The next time you start up the DSLAM the host name will be dslam2.

```
DSLAM# configure terminal
DSLAM(config)# hostname dslam2
dslam2(config)# end
dslam2# copy running-config startup-config
```

Configuring the DSLAM from Memory

When you configure the DSLAM from memory, the DSLAM executes the commands in NVRAM, or the configuration specified by the CONFIG_FILE environment variable. To configure from memory, use this command in privileged EXEC mode:

Command	Task
`DSLAM# configure memory`	Configure the DSLAM to execute the configuration specified by the CONFIG_FILE environment variable or NVRAM.

For an explanation of the CONFIG_FILE environment variable, see the "Setting the CONFIG_FILE Environment Variable" section on page 9-26.

Configuring the DSLAM from the Network

To configure the DSLAM by retrieving a configuration file stored on one of your network servers, perform the following steps, beginning in privileged EXEC mode:

	Command	Task
Step 1	`DSLAM# configure network`	Enter configuration mode with the network option.
Step 2	**host** or **network**	At the system prompt, select a network or host configuration file. The network configuration file contains commands that apply to all network servers and terminal servers on the network. The host configuration file contains commands that apply to only one network server.
Step 3	*ip-address*	At the system prompt, enter the optional IP address of the remote host from which you are retrieving the configuration file.
Step 4	*filename*	At the system prompt, enter the name of the configuration file or accept the default name.
Step 5	**y**	Confirm the configuration filename that the system supplies.

Example

In this example, the DSLAM is configured from the file *backup-config* at IP address 171.69.1.129:

```
DSLAM# configure network
Host or network configuration file [host]?
Address of remote host [255.255.255.255]? 171.69.1.129
Name of configuration file [dslam-confg]? backup-confg
Configure using backup-confg from 171.69.1.129? [confirm] y
DSLAM#
%SYS-5-CONFIG: Configured from backup-confg by console tftp from 171.69.1.129
```

Copying a Configuration File Directly to the Startup Configuration

You can copy a configuration file directly to your startup configuration without affecting the running configuration. This process loads a configuration file directly into NVRAM or into the location specified by the CONFIG_FILE environment variable without affecting the running configuration.

To copy a configuration file directly to the startup configuration, perform the following steps, beginning in privileged EXEC mode:

	Command	Task
Step 1	`DSLAM# configure overwrite-network`	Enter configuration mode with the network option.
Step 2	**host** or **network**	At the system prompt, select a network or host configuration file. The network configuration file contains commands that apply to all network servers and terminal servers on the network. The host configuration file contains commands that apply to only one network server.
Step 3	*ip-address*	At the system prompt, enter the optional IP address of the remote host from which you are retrieving the configuration file.
Step 4	*filename*	At the system prompt, enter the name of the configuration file or accept the default name.
Step 5	**y**	Confirm the configuration filename that the system supplies.

Modifying the Configuration Register Boot Field

The configuration register boot field determines whether the DSLAM loads an operating system image, and if so, where it obtains this system image. This section describes how the DSLAM uses the configuration register boot field and how to set and modify this field.

Using the Boot Field

The lowest four bits of the 16-bit configuration register (bits 3, 2, 1, and 0) form the boot field. These boot field values determine if the DSLAM loads an operating system and where the DSLAM obtains the system image:

- When the entire boot field equals 0-0-0-0, the DSLAM does not load a system image. Instead, the DSLAM enters ROM monitor or maintenance mode, from which you can enter ROM monitor commands to manually load a system image.
- When the entire boot field equals a value between 0-0-1-0 and 1-1-1-1, the DSLAM loads the system image specified by **boot system** commands in the startup configuration file. When the startup configuration file does not contain **boot system** commands, the DSLAM loads a default system image stored on a network server.

When you load a default system image from a network server, the DSLAM uses the configuration register settings to determine the default system image filename for booting from a network server. The default boot filename starts with the string “cisco”, followed by the octal equivalent of the boot field number in the configuration register, followed by a hyphen (-) and the processor type name (for example, “cisco nn-cpu”).

Setting the Boot Field

You must correctly set the configuration register boot field to ensure that your DSLAM loads the operating system image correctly. See Table 9-1 for boot field descriptions.

Table 9-1 Configuration Register Bootfield Description

Configuration Register	Break Enabled/Disabled[1]	Description
0x000	Enabled	Boot manually.
0x001	Enabled	Boot from ROM.
0x002 through 0x00F	Enabled	Boot from the default filename specified “*nn*” in boot system configuration.
0x100	Disabled	Boot manually.
0x101	Disabled	Boot from ROM.
0x102 through 0x10F	Disabled	Boot from the default filename specified “*nn*” in boot system configuration.

1. Enabled allows a hardware break during the first 30 seconds.

To set the boot field, follow these steps:

Step 1 Obtain the current configuration register setting, a hexadecimal value.

Step 2 Modify the current configuration register setting to reflect how you want the DSLAM to load a system image. To do so, change the least significant hexadecimal digit to one of these values:

- 0—Loads the system image manually using the **boot** command in ROM monitor mode.
- 1—Loads the system image from boot ROM.
- 2 to F—Loads the system image from **boot system** commands in the startup configuration file or from a default system image stored on a network server.

For example, if the current configuration register setting is 0x101 and you want to load a system image from **boot system** commands in the startup configuration file, change the configuration register setting to 0x102.

Step 3 Reboot the DSLAM to make your changes to the configuration register take effect.

Performing the Boot Field Modification Tasks

Use the hardware configuration register to modify the boot field of a DSLAM.

To modify the configuration register boot field, complete the following steps, beginning in privileged EXEC mode:

	Command	Task
Step 1	`DSLAM# show version`	Obtain the current configuration register setting.
Step 2	`DSLAM# configure terminal`	Enter global configuration mode, selecting the terminal option.
Step 3	`DSLAM(config)# config-register` *value*	Modify the existing configuration register setting to specify how you want the DSLAM to load a system image.
Step 4	`DSLAM(config)# end`	Exit configuration mode.
Step 5	`DSLAM# reload`	Reboot the DSLAM to make your changes take effect.

In ROM monitor mode, use the **o** command to list the value of the configuration register boot field.

Example

In this example, the **show version** command indicates that the current configuration register is set so that the DSLAM does not automatically load an operating system image. Instead, it enters ROM monitor mode and waits for user-entered ROM monitor commands. The new setting instructs the DSLAM to load a system image from commands in the startup configuration file or from a default system image stored on a network server.

```
DSLAM# show version
Cisco Internetwork Operating System Software

<information deleted>

8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0

DSLAM# configure terminal
DSLAM(config)# config-register 0x010F
```

Specifying the Startup System Image

You can enter multiple boot commands in the startup configuration file or in the BOOT environment variable to provide backup methods for loading a system image onto the DSLAM. There are two ways to load a system image:

- From flash memory—Flash memory provides non-volatile storage space for system images on the NI-2. Booting from flash memory removes the risk of network failures that might occur when loading system images from servers.
- From a network server—If flash memory becomes corrupted, specifying a system image to be loaded from a network server using TFTP, rcp, or MOP provides a backup boot method for the DSLAM. You can specify a bootstrap image to be loaded from a network server using TFTP or rcp.

You can enter the different types of boot commands in any order in the startup configuration file or in the BOOT environment variable. If you enter multiple boot commands, the DSLAM tries them in the order they are entered.

The DSLAM uses a minimally featured boot image to load the full system image. The boot image typically resides on its own flash device, although it can also be placed in the main flash device. The variable BOOTLDR points to the boot image.

Flash Memory Security

Flash memory provides the following security features:

- Flash memory provides write protection against accidental erasing or reprogramming. You can remove the write-protect jumper, located next to the flash components, to prevent reprogramming of embedded flash memory.
- You can change the system image stored in flash memory only from the privileged EXEC level on the console terminal.

Note When no BOOTLDR environment variable exists, the default boot image is the first image file in bootflash.

Booting from Flash Memory

Use this section to configure your DSLAM to boot from flash memory. Flash memory can reduce the effects of network failure by reducing dependency on files that can be accessed only over the network.

Note Booting from flash memory is faster and more reliable than booting from a network server.

Flash Memory

Legacy NI-2 cards have 16 MB of flash memory storage space for system images and 4 MB of bootflash memory for a dboot image. New NI-2 cards (NI-2-155SM-155SM2 and NI-2-155MM-155MM2) have 16 MB of flash memory and 8 MB of bootflash memory for a dboot2 image.

Flash memory allows you to:

- Copy the system image to flash memory using TFTP.
- Copy the system image to flash memory using rcp.
- Copy a bootstrap image to flash memory using TFTP or rcp.
- Boot a DSLAM from flash memory either automatically or manually.
- Copy the flash memory image to a network server using TFTP or rcp.
- Copy the flash memory bootstrap image to a network server using TFTP or rcp.

Booting from Flash Memory Configuration Tasks

To configure a DSLAM to automatically boot from an image in flash memory, perform these tasks:

	Command	Task
Step 1	Use TFTP, rcp, or FTP to copy a system image into flash and a dboot or dboot2 image into bootflash.	See Copying System Software Images from a Network Server to the DSLAM, page 9-2.
Step 2	`DSLAM# configure terminal`	Go to global configuration mode.
Step 3	`DSLAM(config)# boot bootldr [flash | bootflash] [filename]`	Enter the name of a boot image stored in flash memory.
Step 4	`DSLAM(config)# boot system [filename]` or `DSLAM(config)# boot system flash [filename]`	Enter the filename of an image stored in flash memory.
Step 5	`DSLAM(config)# config-register value`	Set the configuration register to enable loading of the system image from flash memory.
Step 6	`DSLAM(config)# end`	Exit configuration mode.
Step 7	`DSLAM# copy running-config startup-config`	Save the configuration file to your startup configuration in the location specified by the CONFIG_FILE environment variable.
Step 8	`DSLAM# show startup-config`	Optionally, verify the contents of the startup configuration.
Step 9	`DSLAM# reload`	Power-cycle and reboot the system to ensure that the system is functioning properly.

If you enter more than one image filename, the DSLAM tries to recognize the filenames in the order entered. If a filename already appears in the configuration file and you want to specify a new filename, remove the existing filename by using the **no boot system flash** *filename* command.

Note The **no boot system** configuration command disables all boot system configuration commands regardless of the argument. If you specify the flash keyword or the filename argument using the **no boot system** command, this disables only the commands specified by these arguments.

Example

This example shows how to configure the DSLAM to automatically boot from an image in flash memory:

```
DSLAM(config)# boot system flash 6260-wi-m_1.058.bin.Z
DSLAM(config)# boot bootldr bootflash ni2-dboot-mz.122-5.DA
DSLAM(config)# config-register 0x1000
DSLAM(config)# end
DSLAM# copy running-config startup-config
[ok]
DSLAM# reload
[confirm] y

%SYS-5-RELOAD: Reload requested
booting /tftpboot/6260-wi-m_1.058.bin.Z 171.69.1.129
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Uncompressing file:  ##############################################################
```

```
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
######################################


Loading network-confg from 171.69.1.129 (via Ethernet0/0): !
[OK - 86/128975 bytes]

%SYS-5-CONFIG: Configured from network-confg by console tftp from 171.69.1.129
Loading /tftpboot/dslam-confg from 171.69.1.129 (via Ethernet0/0): !
[OK - 962/128975 bytes]

%SYS-4-CONFIG_NEWER: Configurations from version 11.1 may not be correctly understood.
%SYS-5-CONFIG: Configured from /tftpboot/dslam-confg by console tftp from 171.69.1.129
Loading 6260-wi-m_1.058.bin.Z from 171.69.1.129 (via Ethernet
0/0): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 2200823/7554184 bytes]

Uncompressing file:  ###########################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
##############################################################################

<information deleted>

%SYS-5-RESTART: System restarted --

<information deleted>
```

After you have successfully configured flash memory, you might want to configure the system with the **no boot system flash** command to revert to booting from a network server.

Loading from a Network Server

You can configure the DSLAM to load a system image from a network server using TFTP, rcp, MOP, or FTP to copy the system image file.

To do so, you must set the configuration register boot field to the correct value. See the “Modifying the Configuration Register Boot Field” section on page 9-16.

If you do not boot from a network server using MOP and you do not specify TFTP, rcp, or FTP by default, the system image that you specify is booted from a network server through TFTP.

Note If you are using a Sun workstation as a network server and TFTP to transfer the file, set up the workstation to enable verification and generation of User Datagram Protocol (UDP) checksums. See the Sun documentation for details.

For increased performance and reliability, use rcp to boot a system image from a network server. The rcp implementation uses TCP, which ensures reliable data delivery.

You cannot explicitly specify a remote username when you issue the boot command. Instead, the host name of the DSLAM is used. If the remote server has a directory structure, as do UNIX systems, and you boot the DSLAM from a network server using rcp, the DSLAM software searches for the system image on the server relative to the directory of the remote username.

You can also boot from a compressed image on a network server. You can create a compressed software image on any UNIX platform using the **compress** command. See the documentation for your UNIX platform for the exact usage of the **compress** command.

To specify the loading of a system image from a network server, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# boot system [rcp | mop | ftp | tftp]` *filename* [*ip-address*]	Specify the system image file to be booted from a network server using rcp, MOP, FTP, or TFTP.
Step 3	`DSLAM(config)# config-register` *value*	Set the configuration register to enable loading of the system image from a network server.
Step 4	`DSLAM(config)# end`	Exit configuration mode.
Step 5	`DSLAM# copy running-config startup-config`	Save the configuration file to your startup configuration in the location specified by the CONFIG_FILE environment variable.

Example

In this example, the DSLAM uses rcp to boot from the testme5.tester system image file on a network server at IP address 131.108.0.1:

```
DSLAM(config)# boot system rcp testme5.tester 131.108.0.1
DSLAM(config)# config-register 0x010F
DSLAM(config)# end
DSLAM# copy running-config startup-config
```

Using a Fault-Tolerant Booting Strategy

Occasionally network failures make booting from a network server impossible. To lessen the effects of network failure, consider this booting strategy. After flash is installed and configured, you configure the DSLAM to boot in this order:

1. Boot an image from flash.
2. Boot an image from a system file on a network server.
3. Boot from a ROM image.

Note The ROM image provides limited access to system resources and does not support subscriber services.

This boot order provides the most fault-tolerant booting strategy. To allow the DSLAM to boot first from flash, then from a system file from a network server, and finally from ROM, perform the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# boot system` [*filename*] `DSLAM(config)# boot system flash:` [*filename*]	Configure the DSLAM to boot from flash memory.
Step 3	`DSLAM(config)# boot system` [`rcp` | `mop` | `ftp` | `tftp`] *filename* [*ip-address*]	Configure the DSLAM to boot from a system file on a network server.
Step 4	`DSLAM(config)# config-register` *value* [1]	Set the configuration register to enable loading of the system image from a network server or flash.
Step 5	`DSLAM(config)# end`	Exit configuration mode.
Step 6	`DSLAM# copy running-config startup-config`	Save the configuration file to your startup configuration in the location specified by the CONFIG_FILE environment variable.

1. See the "Modifying the Configuration Register Boot Field" section on page 9-16 for more information on systems that can use this command to modify the software configuration register.

Example

This example illustrates the order of the commands needed to implement a fault-tolerant booting strategy. In the example, the DSLAM is configured to first boot an embedded flash image called gsxx. If that image fails, the DSLAM boots the configuration file 6260xx from a network server.

```
DSLAM(config)# boot system flash 6260xx
DSLAM(config)# boot system 6260xx 131.131.101.101
DSLAM(config)# config-register 0x010F
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy running-config startup-config
[ok]
```

If you use this strategy, a DSLAM has three sources from which to boot. These alternative sources help lessen the negative effects of a failure on the network or file server from which the system image is copied.

Specifying the Startup Configuration File

Configuration files can be stored on network servers or in local NVRAM on the NI-2. You can configure the DSLAM to automatically request and receive the following two configuration files from the network server at startup:

- Network configuration file
- Host configuration file

The server first attempts to load the network configuration file. This file contains information that is shared among several DSLAMs. For example, it can be used to provide mapping between IP addresses and host names.

The server next attempts to load the host configuration file. This file contains commands that apply to only one DSLAM. Both the network and host configuration files must be readable and must reside on a network server reachable using TFTP, rcp, or MOP.

You can specify an ordered list of network configuration and host configuration filenames. The DSLAM scans this list until it successfully loads the appropriate network or host configuration file.

In addition to storing configuration files on network servers with the DSLAM, you can store configuration files in NVRAM and in flash memory. The CONFIG_FILE environment variable specifies the device and filename of the configuration file to use during initialization. For more information on environment variables, see the "Cisco Implementation of Environment Variables" section on page 9-9.

You can set the CONFIG_FILE environment variable to specify the startup configuration.

To specify a startup configuration file, perform *either* the first two tasks *or* the third task:

Step 1 Download the Network Configuration File.

Step 2 Download the Host Configuration File.

or perform only the following step:

Step 3 Download the CONFIG_FILE Environment Variable Configuration.

Downloading the Network Configuration File

To configure the DSLAM to download a network configuration file from a server at startup, perform the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# boot network` [`tftp` | `rcp` | **mop**] *filename* [*ip-address*]	Enter the network filename to set a file using TFTP, rcp, or MOP.
Step 3	`DSLAM(config)# service config`[1]	Enable the DSLAM to automatically load the network file upon restart.

1. For Step 2, if you do not specify a network configuration filename, the DSLAM uses the default filename network-confg. If you omit the tftp, rcp, and MOP keywords, the DSLAM acts as if you are using TFTP to transfer the file and the server whose IP address you specify supports TFTP.

If you configure the DSLAM to download the network configuration file from a network server using rcp and the server has a directory structure (as do UNIX systems)

- The DSLAM software searches for the system image on the server relative to the directory of the remote username. The DSLAM host name is used as the remote username.
- You can specify more than one network configuration file. The DSLAM uses each file in order until it loads one successfully. This procedure can be useful if you want to keep files with different configuration information loaded on a network server.

Downloading the Host Configuration File

To configure the DSLAM to download a host configuration file from a server at startup, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# boot host [tftp | rcp | mop]` *filename* [*ip-address*]	Optionally, enter the host configuration filename to be downloaded using TFTP, rcp, or MOP.[1]
Step 3	`DSLAM(config)# service config`	Enable the DSLAM to automatically load the host file upon restart.
Step 4	`DSLAM(config)# end`	Exit configuration mode.
Step 5	`DSLAM# copy running-config startup-config`	Save the configuration file to your startup configuration in the location specified by the CONFIG_FILE environment variable.
Step 6	`DSLAM# reload`	Reset the DSLAM with the new configuration information.

1. If you do not specify a host configuration filename, the DSLAM uses its own name to form a host configuration filename by converting the DSLAM name to all lowercase letters, removing all domain information, and appending -confg. If no host name information is available, the DSLAM uses the default host configuration filename dslam-confg.

You can specify more than one host configuration file. The DSLAM tries the files in order until it loads one successfully. This procedure can be useful if you want to keep files with different configuration information loaded on a network server.

Example

In this example, the DSLAM is configured to boot from the host configuration file hostfile1 and from the network configuration file networkfile1:

```
DSLAM(config)# boot host hostfile1
DSLAM(config)# boot network networkfile1
DSLAM(config)# service config
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy running-config startup-config
```

If the network server fails to load a configuration file during startup, it tries again every 10 minutes (the default) until a host provides the requested files. With each failed attempt, the network server displays a message on the console terminal. If the network server is unable to load the specified file, it displays the message:

```
Booting host-confg... [timed out]
```

The DSLAM uses the NVRAM configuration during initialization when the CONFIG_FILE environment variable does not exist or when it is null (such as at first-time startup). If the DSLAM detects a problem with NVRAM or the configuration it contains, the DSLAM enters the autoconfiguration mode. See Chapter 3, “Initially Configuring the Cisco DSLAM”, for more information on configuring the DSLAM.

Setting the CONFIG_FILE Environment Variable

When you load startup configuration files from a server, you can configure the DSLAM to load a startup configuration file specified by the CONFIG_FILE environment variable. To do so, complete these tasks, beginning in privileged EXEC mode:

	Command	Task
Step 1	DSLAM# **copy running-config** [**ftp** | **tftp** | **rcp** | **flash** | **bootflash** | **nvram**] DSLAM# **copy startup-config** [**ftp** | **tftp** | **rcp** | **flash** | **bootflash** | **nvram**]	Copy the configuration file to the device from which the DSLAM loads the file upon restart.
Step 2	DSLAM# **configure terminal**	Enter configuration mode from the terminal.
Step 3	DSLAM(config)# **boot config** *device*:*filename*	Set the CONFIG_FILE environment variable. This step modifies the runtime CONFIG_FILE environment variable.
Step 4	DSLAM(config)# **end**	Exit configuration mode.
Step 5	DSLAM# **copy running-config startup-config**	Save the runtime CONFIG_FILE environment variable to your startup configuration.
Step 6	DSLAM# **show boot**	Optionally, verify the contents of the CONFIG_FILE environment variable.

When the DSLAM saves the runtime CONFIG_FILE environment variable to the startup configuration, the DSLAM saves a complete version of the configuration file to the location specified by the CONFIG_FILE environment variable and saves a distilled version to NVRAM. The distilled version does not contain access list information. If NVRAM contains

- A complete configuration file, the DSLAM prompts you to confirm the overwrite of the complete version with the distilled version.
- A distilled configuration file, the DSLAM does not prompt you for confirmation and overwrites the existing distilled configuration file in NVRAM.

Clearing the Configuration Information

To clear the contents of your startup configuration, use this command in privileged EXEC mode:

Command	Task
DSLAM# **erase startup-config**	Clear the contents of your startup configuration. This command erases the configuration specified by the CONFIG_FILE environment variable.

When you use the **erase startup-config** command, the DSLAM deletes the configuration specified by the CONFIG_FILE environment variable. If the environment variable specifies or points to:

- NVRAM, the DSLAM erases NVRAM.
- A flash memory device and configuration filename, the DSLAM deletes the configuration file. That is, the DSLAM marks the file as "deleted," rather than erasing it. This feature allows you to recover a deleted file. See the "Managing Flash Files" section on page 9-12 for more information on recovering deleted files.

To erase a saved configuration from a specific flash device on a DSLAM, use one of the following commands in privileged EXEC mode:

Command	Task
DSLAM# **erase** [*device*:] *filename* or DSLAM# **delete** [*device*:] *filename*	Erase or delete a specified configuration file on a specified flash device.

As with the **erase startup-config** command, when you erase or delete a specific file, the system marks the file as deleted, allowing you to later recover it. If you omit the device, the DSLAM uses the default device specified by the **cd** command.

If you attempt to erase or delete the configuration file specified by the CONFIG_FILE or BOOTLDR environment variable, the system prompts you to confirm the deletion. Also, if you attempt to erase or delete the last valid system image specified in the BOOT environment variable, the system prompts you to confirm the deletion.

Examples

This example deletes the myconfig file from embedded flash:

```
DSLAM# delete flash:myconfig
```

Booting the Enhanced OC-3/OC-3 NI-2 Card

Before attempting to boot the DSLAM, consider the following:

- The new NI-2 cards (NI-2-155SM-155SM2 and NI-2-155MM-155MM2) work only with a new ni2-dboot2-mz image that is shipped preinstalled in the NI-2 bootflash. New NI-2 cards do not run with an old dboot image.
- Legacy NI-2 cards require an ni2-dboot-mz image; they do not run with the new dboot2 image.

Caution New NI-2 cards support Cisco IOS Release 12.2(12)DA and later, and Releases 12.1(7)DA2 to 12.2(10)DA. However, to run Releases 12.1(7)DA2 to 12.2(10)DA, you **must** load the dboot2 image before you load the Cisco IOS software image. Otherwise, the DSLAM becomes inoperable.

To boot the enhanced Cisco OC-3/OC-3 NI-2 card, follow the instructions in the *Configuration Guide for Cisco DSLAMs with NI-2*. See the section "Booting from Flash Memory Configuration Tasks" in chapter 9, "Loading System Software Images and Configuration Files," at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/ios_dsl/rel122/config/04conf09.htm

Correcting Bootup Problems

If you attempt to run an incorrect dboot or dboot2 image, or you attempt to boot a new NI-2 card with legacy Cisco IOS software before booting the new dboot2 image, the DSLAM becomes inoperable. If this occurs, see the following sections for information about how to correct the problem and make the DSLAM operational.

Running Cisco IOS Release 12.1(7)DA2 to 12.2(10)DA on a New NI-2 Card

You can run Cisco IOS Releases 12.1(7)DA2 to 12.2(10)DA on the new NI-2 cards (NI2-155MM-155MM2 and NI2-155SM-155SM2). However, before you attempt to boot the Cisco IOS software from flash, you must first boot the ni2-dboot2-mz (dboot2) image from bootflash.

Note To run Cisco IOS releases earlier than Release 12.2(12)DA on a new NI-2 card, do not boot from flash until you have booted the ni2-dboot2-mz image from bootflash. Otherwise, the DSLAM becomes inoperable.

If you encounter problems booting Cisco IOS Release 12.1(7)DA2 to 12.2(10)DA on the new NI-2 cards, perform the following steps to correct the problem and make the DSLAM operational:

Step 1 Issue the following command in to ensure that the correct dboot2 image is loaded in bootflash memory:

```
DSLAM> show ni2-switch register
```

Step 2 Check the command output to make sure the FPGA major revision is 3 (see highlighted text below). This indicates that the dboot2 image is loaded.

```
Upstream FPGA revision MAJ:3 Minor:0
```

Step 3 Issue the following command in global-configuration mode to set the configuration register to load the DSLAM image from the **boot system** commands in the startup configuration file:

```
DSLAM(config)# config-register 0x2102
```

Step 4 Exit configuration mode and reload (reboot) the DSLAM to make the DSLAM operational. This process loads the images in the correct order: dboot2 and then the legacy Cisco IOS software.

```
DSLAM(config)# end
DSLAM# reload
```

Using Rommon to Recover from Corrupted dboot2 Images

This procedure describes how to use ROM monitor (rommon) mode to recover from problems caused by an invalid or corrupt dboot2 image. This procedure uses the **xmodem** command to retrieve a valid dboot2 image from a PC or network server.

Note The **xmodem** command used in this procedure is extremely slow. Therefore, only perform this procedure if all other attempts to obtain a dboot2 image fail. Also note that the command is supported only on the new NI-2 cards (NI2-155MM-155MM2 and NI2-155SM-155SM2).

Step 1 Log in to the DSLAM through a console port. The rommon prompt (`rommon>`) should be displayed. If it is not, get into configuration mode and issue the command **config-register 0x0 end write reload**.

Step 2 Issue the following command at the rommon prompt.

```
rommon> config-register 0x2102
```

Step 3 Issue the following command to manually boot the DSLAM from bootflash.

```
rommon> boot bootflash: [filename]
```

Step 4 If Step 3 worked, you need not perform the rest of this recovery procedure. Instead, you should boot the Cisco IOS software and proceed to Step 7.

If Step 3 did not work, the rommon prompt is returned and you must proceed to Step 5 to continue with the recovery procedure.

Step 5 If the correct dboot2 image is not in bootflash or the image is corrupt, perform the following steps to use the **xmodem** command to download a valid dboot2 image to use to boot the DSLAM:

a. Open a terminal emulation window (such as Hyper Terminal) on a PC that is connected to the DSLAM through a console port.

b. Configure the following terminal emulation settings: port = **com1** or **com2**, data rate = **9600**, bits = **8**, parity = **none**, stop bits = **1**. You must use these values for the recovery procedure to work.

c. Make sure that the PC contains a valid dboot2 image or is connected to a network where a dboot2 image is stored on a server.

d. On the DSLAM, issue the following command to copy the dboot2 image to the specified *filename*. The command creates a temporary copy of the dboot2 image on the DSLAM; therefore, you must copy the image to bootflash or it will be lost when you reload the DSLAM (Step 6).

```
rommon> xmodem filename
```

e. Wait for a prompt indicating that rommon is ready to receive the file.

f. In the Hyper Terminal window on the PC, click **Transfer** in the menu bar at the top of the window and select **Send File**.

g. Select **Xmodem** as the protocol, and specify the name of the dboot2 image to copy to the DSLAM.

h. Click **Send** to start the copy.

Note It may take 1 hour or more for the copy to complete.

i. When the download completes, the DSLAM boots automatically.

Step 6 To complete the recovery procedure, copy the dboot2 image to bootflash memory (for example, using TFTP). If you do not perform this step, the dboot2 image will be lost when you reload the DSLAM.

Step 7 To finish booting the DSLAM, issue the following command:

```
DSLAM> reload
```

Redundant NI-2 Card Operation

When using NI-2 cards in a redundant fashion, we recommend that you issue the command **redundancy reload-peer** on the active NI-2 card after the system has loaded. This causes the redundant NI-2 to reload and ensures that the redundant configuration is operational.

In rare instances during testing, a redundant NI-2 card sometimes appeared to be functional but was not. Issuing the **redundancy reload-peer** command corrected the problem every time.

Storing System Images and Configuration Files

After modifying and saving your unique configurations, you can store them on a network server. You can use these network server copies of system images and configuration files as backup copies.

To store system images and configuration files, perform these tasks:

- Copying System Images from Flash Memory to a Network Server, page 9-30
- Copying Configuration Files from the DSLAM to a Network Server, page 9-33

Copying System Images from Flash Memory to a Network Server

You can copy system images from flash memory to an FTP server, a TFTP server, or an rcp server. You can use this server copy of the system image as a backup copy, or you can use it to verify that the copy in flash is the same as the original file on disk.

Copying from Flash Memory to a TFTP Server

You can copy a system image to a TFTP network server. In some implementations of TFTP, you must first create a dummy file on the TFTP server and give it read, write, and execute permissions before copying a file over it. See your TFTP documentation for more information.

To copy a system image to a TFTP network server, perform the following steps in privileged EXEC mode:

	Command	Task
Step 1	DSLAM# **show flash all** DSLAM# **show flash** [*device***:**]	(Optional) Display the name and note the exact spelling of the system image filename in flash memory.
Step 2	DSLAM# **copy flash tftp** or DSLAM# **copy** *file_id* **tftp**	Copy the system image from flash memory to a TFTP server.
Step 3	*ip-address* or *name*	At the prompt, enter the IP address or domain name of the TFTP server.
Step 4	*filename*	At the prompt, enter the filename of the system image in flash memory.

Example

In this example, uses the **show flash all** command is used to learn the name of the system image file, and the **copy flash tftp** command is used to copy the system image to a TFTP server. The name of the system image file appears in the filename listing at the top of the **show flash all** output.

```
DSLAM# show flash all
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image    7B115AB2  8BC974   29  8898804 Oct 05 2000 01:09:14 ni2-dsl-mz.6
2   .D unknown  EE690AA0  8C7AFC   17    45320 Oct 05 2000 01:28:24 startup-cibe
3   .D unknown  2121A3AD  8D3E3C   17    49856 Oct 15 2000 03:41:26 startup-cibe
4   .. unknown  2121A3AD  8E017C   17    49856 Oct 18 2000 07:38:33 startup-cibe

6946436 bytes available (9044348 bytes used)

-------- F I L E   S Y S T E M   S T A T U S --------
  Device Number = 1
DEVICE INFO BLOCK: flash
  Magic Number          = 6887635   File System Vers = 10000    (1.0)
```

```
  Length                = 1000000   Sector Size      = 40000
  Programming Algorithm = 6         Erased State     = FFFFFFFF
  File System Offset    = 40000     Length = F40000
  MONLIB Offset         = 100       Length = C628
  Bad Sector Map Offset = 3FFF8     Length = 8
  Squeeze Log Offset    = F80000    Length = 40000
  Squeeze Buffer Offset = FC0000    Length = 40000
  Num Spare Sectors     = 0
    Spares:
STATUS INFO:
  Writable
  NO File Open for Write
  Complete Stats
  No Unrecovered Errors
  No Squeeze in progress
USAGE INFO:
  Bytes Used     = 8A017C  Bytes Available = 69FE84
  Bad Sectors    = 0       Spared Sectors  = 0
  OK Files       = 2       Bytes = 888BB4
  Deleted Files  = 2       Bytes = 173C8
  Files w/Errors = 0       Bytes = 0
```

The following example uses the **show flash** [*device*:] command to display the name of the system image file to copy.

The file to copy is “test”. The example uses the **copy** *file_id* **tftp** command to copy “test” to a TFTP server.

```
DSLAM# show flash slot0:
-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. FFFFFFFF 129EECA3 214D4   13   5204     May 03 1996 14:07:35 backup-config
2   .. 1        AE9B32B  22A68   14   5393     May 03 1996 15:32:57 startup-config
3   .. FFFFFFFF E9D05582 247730  23   2247751  May 04 1996 12:08:51 6260-wi-m_1.1(1)
4   .. FFFFFFFF E9D05582 46C3F8  4    2247751  May 04 1996 13:25:14 test

3488776 bytes available (4506616 bytes used)
DSLAM# copy bootflash:test tftp
Enter destination file name [test]:
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Address or name of remote host [dirt.cisco.com]? 171.69.1.129
!
```

A series of Cs indicates that a checksum verification of the image is occurring, and an exclamation point indicates that the copy process is occurring. To stop the copy process, press **Ctrl**-**^**.

Copying from Flash Memory to an rcp Server

You can copy a system image from flash memory to an rcp network server.

The rcp protocol requires a client to send the remote username on each rcp request to the server. When you copy an image from flash memory to a network server using rcp, the DSLAM software sends the remote username associated with the current TTY (terminal) process, if that name is valid. If the TTY remote username is invalid, the DSLAM software uses the DSLAM host name as both the remote and local user names.

Note For Cisco, TTYs are commonly used in communication servers. The concept of TTY originated with UNIX. For UNIX systems, each physical device is represented in the file system. Terminals are called TTY devices, which stands for teletype, the original UNIX terminal.

You can configure a different remote username to be sent to the server. If the network server has a directory structure, as do UNIX systems, the rcp protocol implementation writes the system image to the directory associated with the remote username on the network server.

For the rcp command to execute properly, an account must be defined on the destination server for the remote username.

To stop the copy process, press **Ctrl-^**.

If you copy the system image to a personal computer used as a file server, the computer must support the rcp protocol.

To copy the system image from flash memory to a network server, perform the following steps, beginning in privileged EXEC mode:

	Command	Task
Step 1	DSLAM# **show flash all** DSLAM# **show flash** [*device:*]	(Optional) If you do not already know it, learn the exact spelling of the system image filename in flash memory. On the DSLAM, you can learn the spelling of the system image filename in embedded flash memory.
Step 2	DSLAM# **configure terminal**	Enter configuration mode from the terminal. This step is required only if you are going to override the default remote username in the next step.
Step 3	DSLAM(config)# **ip rcmd remote-username** *username*	Specify the remote username. This step is optional, but recommended.
Step 4	DSLAM(config)# **end**	Exit configuration mode.
Step 5	DSLAM# **copy flash rcp** DSLAM# **copy** *file_id* **rcp**	Using rcp, copy the system image in flash memory to a network server.
Step 6	*ip-address* or *name*	When prompted, enter the IP address or domain name of the rcp server.
Step 7	*filename*	When prompted, enter the filename of the system image in flash memory.

Examples

This example shows how to copy the system image file from flash memory to a network server using rcp:

```
DSLAM# configure terminal
DSLAM(config)# ip rcmd remote-username netadmin2
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy flash rcp
Enter source file name: 6260-wi-m_1.1(1)
Enter destination file name [6260-wi-m_1.1(1)]:
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Address or name of remote host [dirt.cisco.com]? 171.69.1.129
Writing 6260-wi-m_1.1(1) !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

The screen filled with exclamation points indicates that the process is working.

Copying Configuration Files from the DSLAM to a Network Server

You can copy configuration files from the DSLAM to an FTP server, a TFTP server, or an rcp server. You might do this task to back up a current configuration file to a server before changing its contents, thereby allowing you to later restore the original configuration file from the server.

Copying from the DSLAM to a TFTP Server

Usually, the configuration file that you copy to must already exist on the TFTP server and be globally writable before the TFTP server allows you to write to it.

To store configuration information on a TFTP network server, complete the following steps in privileged EXEC mode:

	Command	Task

Step 1	`DSLAM# copy running-config tftp`
	or
	`DSLAM# copy startup-config tftp`
		Specify that the running or startup configuration file will be stored on a network server.

Step 2	*ip-address*	Enter the IP address of the network server.
Step 3	*filename*	Enter the name of the configuration file to store on the server.
Step 4	**y**	Confirm the entry.

Example

This example shows how to copy a running configuration file from a DSLAM to a TFTP server:

```
DSLAM# copy running-config tftp
Remote host []? 171.69.1.129
Name of configuration file to write [dslam-confg]? backup-confg
Write file backup-confg on host 171.69.1.129? [confirm] y
Building configuration...

Writing backup-confg !!! [OK]
```

Copying from the DSLAM to an rcp Server

You can use rcp to copy configuration files from the local DSLAM to a network server. You can copy a running configuration file or a startup configuration file to the server.

The rcp protocol requires that a client send the remote username on each rcp request to a server. When you issue a command to copy a configuration file from the DSLAM to a server using rcp, the DSLAM sends a default remote username unless you override the default by configuring a remote username. By default, the DSLAM software sends the remote username associated with the current TTY (terminal) process, if that name is valid.

If the TTY remote username is invalid, the DSLAM software uses the DSLAM host name as both the remote and local user names. If the server has a directory structure, as do UNIX systems, the rcp protocol implementation writes the configuration file to the directory associated with the remote username on the server.

For the rcp copy request to execute successfully, an account must be defined on the network server for the remote username.

If you copy the configuration file to a personal computer used as a file server, the computer must support rcp.

This section describes how to copy a startup configuration file or a running configuration file from the DSLAM to an rcp server.

Copy a Running Configuration File to an rcp Server

You can copy the running configuration file to an rcp server. The copied file can serve as a backup configuration file.

To store a running configuration file on a server, complete the following steps, beginning in global configuration mode:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip rcmd remote-username` *username*	Specify the remote username. This step is optional, but recommended.
Step 3	`DSLAM(config)# end`	Exit from global configuration mode.
Step 4	`DSLAM# copy running-config rcp`	Specify that the DSLAM running configuration file will be stored on a network server.
Step 5	*ip-address*	Enter the IP address of the network server.

Example

This example shows how to copy the running configuration file named dslam-confg to the netadmin1 directory on the remote host with an IP address of 171.69.1.129:

```
DSLAM(config)# ip rcmd remote-username netadmin1
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy running-config rcp
Remote host []? 171.69.1.129
Name of configuration file to write [dslam-confg]?
Write file dslam-confg on host 171.69.1.129? [confirm] y
Building configuration...

Writing dslam-confg !! [OK]
```

Copying a Startup Configuration File to an rcp Server

You can copy the contents of the startup configuration file to an rcp server. The copied file can serve as a backup configuration file.

To copy a startup configuration file to a network server using rcp, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip rcmd remote-username` *username*	Specify the remote username. This step is optional, but recommended.
Step 3	`DSLAM(config)# end`	Exit from global configuration mode.

	Command	Task
Step 4	`DSLAM# copy startup-config rcp`	Copy the configuration file specified by the CONFIG_FILE environment variable to an rcp server.
Step 5	*ip-address*	Enter the IP address of the network server.
Step 6	*filename*	Enter the name of the configuration file to store on the server.
Step 7	`y`	Confirm the entry.

Example

This example shows how to store a startup configuration file on a server by using rcp to copy the file:

```
DSLAM# configure terminal
DSLAM(config)# ip rcmd remote-username netadmin2
DSLAM(config)# end
DSLAM#
%SYS-5-CONFIG_I: Configured from console by console
DSLAM# copy startup-config rcp
Remote host []? 171.69.1.129
Name of configuration file to write [dslam-confg]?
Write file dslam-confg on host 171.69.1.129? [confirm] y
Writing dslam-confg !! [OK]
```

Configuring a DSLAM as a TFTP Server

It is both costly and inefficient to have a dedicated TFTP server on every network segment. To cut costs and time delays in your network, you can configure a DSLAM as a TFTP server.

Typically, the DSLAM configured as a server forwards operating system images from its flash memory to other DSLAMs. You can also configure the DSLAM to respond to other types of service requests, such as Reverse Address Resolution Protocol (RARP) requests.

To configure the DSLAM as a server, perform either of these tasks. The tasks are not mutually exclusive.

- Designating a DSLAM as a TFTP Server, page 9-35
- Configuring Flash Memory as a TFTP Server, page 9-36

Designating a DSLAM as a TFTP Server

As a TFTP server host, the DSLAM responds to TFTP read request messages by sending a copy of the system image contained in ROM or one of the system images contained in flash memory to the requesting host. The TFTP read request message must use one of the filenames specified in the DSLAM configuration.

To specify TFTP server operation for a DSLAM, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# tftp-server rom alias` *filename1* [*access-list-number*] `DSLAM(config)# tftp-server flash` *device*`:`*filename*	Specify TFTP server operation.

	Command	Task
Step 3	`DSLAM(config)# end`	Exit configuration mode.
Step 4	`DSLAM# copy running-config startup-config`	Save the running configuration file to the startup configuration location specified by the CONFIG_FILE environment variable.

The TFTP session can sometimes fail. TFTP generates these special characters to help you determine why a TFTP session failed:

- An "E" character indicates that the TFTP server received an erroneous packet.
- An "O" character indicates that the TFTP server received an out-of-sequence packet.
- A period (.) indicates a timeout.

The transfer session might still succeed if TFTP generates these characters, but the output is useful for diagnosing the transfer problem.

Examples

In this example, the system uses TFTP to send a copy of the flash memory file *version-1.03* in response to a TFTP read request for that file. The requesting host is checked against access list 22.

```
DSLAM(config)# tftp-server flash version-1.03 22
```

Configuring Flash Memory as a TFTP Server

Flash memory can be used as a TFTP file server for other DSLAMs on the network. This feature allows you to boot a remote DSLAM with an image that resides in the flash memory.

The DSLAM allows you to specify one of the different flash memory devices as the TFTP server.

In the following sections, one DSLAM is referred to as the *Flash server*, and all other DSLAMs are referred to as *client DSLAMs*. Sample configurations for the flash server and client DSLAMs include commands, as necessary.

Performing Prerequisite Tasks

The flash server and client DSLAM must be able to reach each other before the TFTP function can be implemented. Verify this connection by pinging between the flash server and the client DSLAM (in either direction) with the **ping** command.

An example of the **ping** command follows:

```
DSLAM# ping 131.152.1.129

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 131.152.1.129, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

In this example, the IP address of 131.152.1.129 belongs to the client DSLAM. Connectivity is indicated by a series of exclamation points (!), while a series of periods (.) plus "*timed out" or "failed"* indicates no connection. If the connection fails, reconfigure the interface, check the physical connection between the flash server and the client DSLAM, and ping again.

After you verify the connection, ensure that a TFTP-bootable image is present in flash memory. This is the system software image the client DSLAM boots. Note the name of this software image so you can verify it after the first client boot.

Note The filename used must represent a software image that is present in flash memory.

Configuring the Flash Server

To configure the flash server, use this command in global configuration mode:

Command	Task
DSLAM(config)# **tftp-server flash** *device*:*filename*	Specify the TFTP server operation for a DSLAM.

Example

This example shows how to configure the flash server. This example gives the filename of the software image in the flash server and one access list (labeled "1"). The access list must include the network where the client DSLAM resides. Thus, in the example, the network 131.108.101.0 and any client DSLAMs on it can access the flash server file 6260-m_1.9.17.

```
Enter configuration commands, one per line.
Edit with DELETE, CRTL/W, and CRTL/U; end with CTRL/Z
Server(config)# tftp-server flash 6260-m_1.9.17 1
Server(config)# access-list 1 permit 131.108.101.0 0.0.0.255
Server(config)# end
Server# copy running-config startup-config
[ok]
```

Configuring the Client DSLAM

You can configure the client DSLAM to first load a system image from the flash server, and then, as a backup, configure the client DSLAM to load its own ROM image if the load from a flash server fails. To do so, complete the following steps:

	Command	Task
Step 1	DSLAM# **configure terminal**	Go to global configuration mode.
Step 2	DSLAM(config)# **no boot system**	Remove all previous **boot system** statements from the configuration file.
Step 3	DSLAM(config)# **boot system** [**tftp**] *filename* [*ip-address*]	Specify that the client DSLAM loads a system image from the flash server.
Step 4	DSLAM(config)# **config-register** *value*	Set the configuration register to enable the client DSLAM to load a system image from a network server.
Step 5	DSLAM(config)# **end**	Exit configuration mode.
Step 6	DSLAM# **copy running-config startup-config**	Save the running configuration file to the startup configuration location specified by the CONFIG_FILE environment variable.
Step 7	DSLAM# **reload**	Reload the DSLAM to make your changes take effect.

Caution Using the **no boot system** command, as in this example, invalidates *all* other boot system commands currently in the client DSLAM system configuration. Before proceeding, determine whether or not the system configuration stored in the client DSLAM first requires saving (uploading) to a TFTP file server so that you have a backup copy.

Example

This example shows how to use the preceding commands:

```
Client(config)# no boot system
Client(config)# boot system 6260-m_1.9.17 131.131.111.111
Client(config)# config-register 0x010F
Client(config)# end
Client# copy running-config startup-config
[ok]
Server# reload
```

In this example, the **no boot system** command invalidates all other boot system commands currently in the configuration memory, and any boot system command entered after this command is executed first. The second command, **boot system** *filename address*, tells the client DSLAM to look for the file 6260-m_1.9.17 in the (flash) server with an IP address of 131.131.111.111. The **copy running-config startup-config** command copies the configuration to NVRAM to the location specified by the CONFIG_FILE environment variable, and the **reload** command boots the system.

Caution The system software (6260-m_1.9.17 in the example) to be booted from the flash server (131.131.111.111 in the example) must reside in flash memory on the server.

Verifying the Client DSLAM

To verify that the software image booted from the flash server is the image in flash memory, use the following EXEC command.

Command	Task
DSLAM# **show version**	Verify that the software image booted from the flash server is the image present in flash memory of the client DSLAM.

This example shows output of the **show version** command:

```
DSLAM# show version
Cisco Internetwork Operating System Software
IOS (tm) NI2 Software (NI2-DSL-M), Experimental Version 12.2(20010716:133437) []
Copyright (c) 1986-2001 by cisco Systems, Inc.
Compiled Mon 16-Jul-01 09:57 by chrel
Image text-base: 0x80008308, data-base: 0x814CC000

ROM: System Bootstrap, Version 12.0(5)DA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc)
BOOTLDR: NI2 Software (NI2-DBOOT-M), Experimental Version 12.2(20010716:133437)]

6160-143 uptime is 2 weeks, 6 days, 21 hours, 7 minutes
System returned to ROM by power-on
System image file is "flash:ni2-dsl-mz.v122_1_da.20010716"
Host configuration file is "tftp://172.21.186.180/6160-143-confg"
```

```
cisco 6160 (NI2) processor with 60416K/5120K bytes of memory.
RC64475 CPU at 100Mhz, Implementation 48, Rev 0.0
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
36 DMT DSL Port interface(s)
4 ATM network interface(s)

4096K bytes of Boot Flash (Sector size 128K).
16384K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
```

The important information in this example is contained in the second line “IOS (tm)...,” which shows the version of the operating system in the client DSLAM RAM.

Verify that the software shown in the first line of the **show version** output is the software residing in the flash server memory.

Configuring the DSLAM for Other Types of Servers

You can configure the DSLAM to work with various types of servers. Specifically, you can configure the DSLAM to forward different types of service requests.

Specifying Asynchronous Interface Extended BOOTP Requests

The Boot Protocol (BOOTP) server for asynchronous interfaces supports the extended BOOTP requests specified in RFC 1084. This command is helpful in conjunction with using the auxiliary port as an asynchronous interface.

To configure extended BOOTP requests for asynchronous interfaces, use this command in global configuration mode:

Command	Task
DSLAM(config)# **async-bootp** *tag* [:*hostname*] *data*	Configure extended BOOTP requests for asynchronous interfaces.

To display the extended BOOTP requests, use this privileged EXEC command:

Command	Task
DSLAM# **show async bootp**	Show parameters for BOOTP requests.

Configuring the Remote Shell and Remote Copy Functions

You can optionally configure your DSLAM for remote shell (rsh) and rcp functions. This feature allows you to execute commands on remote DSLAMs and to remotely copy system images and configuration files to and from a network server or a DSLAM.

This section provides a description of the Cisco implementation of rsh and rcp and describes the tasks to configure the DSLAM for rsh and rcp:

Cisco Implementation of rsh and rcp Protocols

One of the first attempts to use the network as a resource in the UNIX community resulted in the design and implementation of the rsh protocol, which included the rsh and rcp functions. Rsh and rcp give you the ability to execute commands remotely and copy files to and from a file system residing on a remote host or server on the network. The Cisco implementation of rsh and rcp interoperates with standard implementations.

Using the rsh Protocol

From the DSLAM, you can use rsh protocol to execute commands on remote systems to which you have access. When you issue the rsh command, a shell is started on the remote system. The shell allows you to execute commands on the remote system without having to log in to the target host.

You do not need to connect to the system or DSLAM and then disconnect after you execute a command when using rsh. For example, you can use rsh to remotely look at the status of other DSLAMs without connecting to the target DSLAM, executing the command, and then disconnecting from the DSLAM. This is useful for looking at statistics on many different DSLAMs.

Maintaining rsh Security

To gain access to a remote system running rsh, such as a UNIX host, there must be an entry in the system .rhosts file or its equivalent to identify you as a trusted user who is authorized to execute commands remotely on the system. On UNIX systems, the .rhosts file identifies trusted users who can remotely execute commands on the system.

You can enable rsh support on a Cisco DSLAM to allow users on remote systems to execute commands on the DSLAM. However, the Cisco implementation of rsh does not support an .rhosts file. Instead, you configure a local authentication database to control access to the DSLAM by users attempting to execute commands remotely using rsh. A local authentication database is similar in concept and use to a UNIX .rhosts file. Each entry that you configure in the authentication database identifies the local user, the remote host, and the remote user.

Using the rcp Protocol

The rcp copy commands rely on the rsh server (or daemon) on the remote system. To copy files using rcp, you do not need to create a server for file distribution, as you do with TFTP. You only need to have access to a server that supports the remote shell (rsh). (Most UNIX systems support rsh.) Because you are copying a file from one place to another, you must have read permission on the source file and write permission on the destination file. If the destination file does not exist, rcp creates it for you.

Although the Cisco rcp implementation emulates the behavior of the UNIX rcp implementation (copying files among systems on the network) the command syntax differs from the UNIX rcp command syntax. Cisco rcp support offers a set of copy commands that use rcp as the transport mechanism. These rcp copy commands are similar to the Cisco TFTP copy commands, but they offer faster performance and reliable delivery of data. These improvements are possible because the rcp transport mechanism is built on and uses the TCP/IP stack, which is connection oriented. You can use rcp commands to copy system images and configuration files from the DSLAM to a network server, and vice versa.

You can also enable rcp support on the DSLAM to allow users on remote systems to copy files to and from the DSLAM.

Configuring a DSLAM to Support Incoming rcp Requests and rsh Commands

You can configure a local authentication database to control access to the DSLAM by remote users. To allow remote users to execute rcp or rsh commands on the DSLAM, configure entries for those users in the authentication database of the DSLAM.

Each entry configured in the authentication database identifies the local user, the remote host, and the remote user. You can specify the DSLAM host name as the local username. To be allowed to remotely execute commands on the DSLAM, the remote user must specify all three values—the local username, the remote host name, and the remote username—and must be able to identify the local username. For rsh users, you can also grant a user permission to execute privileged EXEC commands remotely.

To make the local username available to remote users, you must communicate the username to the network administrator or the remote user. To allow a remote user to execute a command on the DSLAM, the Cisco rcp implementation requires that the local username sent by the remote user match the local username configured in the database entry.

The DSLAM software uses Domain Name System (DNS) to authenticate the remote host name and address. Because DNS can return several valid IP addresses for a host name, the DSLAM software checks the address of the requesting client against all IP addresses for the named host returned by DNS. If the address sent by the requester is invalid because it does not match any address listed with DNS for the host name, then the DSLAM software rejects the remote command execution request.

If no DNS servers are configured for the DSLAM, then the DSLAM cannot authenticate the host in this manner. In this case, the DSLAM software sends a broadcast request to attempt to gain access to DNS services on another server. If DNS services are not available, you must use the **no ip domain-lookup** command to disable the attempt of the DSLAM to gain access to a DNS server by sending a broadcast request.

If DNS services are not available and, therefore, you bypass the DNS security check, the DSLAM software accepts the request to remotely execute a command *only if* all three values sent with the request match exactly the values configured for an entry in the local authentication file.

If DNS is enabled but you do not want to use DNS for rcmd (remote command) queries, use the **no ip rcmd domain-lookup** command.

To ensure security, the DSLAM is *not* enabled to support rcp requests from remote users by default. When the DSLAM is not enabled to support rcp, the authorization database has no effect.

To configure the DSLAM to allow users on remote systems to copy files to and from the DSLAM and execute commands on the DSLAM, perform the tasks in either of the first two sections and, optionally, the task in the third section:

- Configuring the DSLAM to Accept rcp Requests from Remote Users, page 9-42
- Configuring the DSLAM to Allow Remote Users to Execute Commands Using rsh, page 9-43
- Turning Off DNS Lookups for rcp and rsh, page 9-43

Configuring the DSLAM to Accept rcp Requests from Remote Users

To configure the DSLAM to support incoming rcp requests, complete the following steps in global configuration mode:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip rcmd remote-host` *local-username* {*ip-address* | *host*} *remote-username*	Create an entry in the local authentication database for each remote user who is allowed to execute **rcp** commands on the DSLAM.
Step 3	`DSLAM(config)# ip rcmd rcp-enable`	Enable the DSLAM to support incoming rcp requests.

To prevent the DSLAM from supporting incoming rcp requests, use the **no ip rcmd rcp-enable** command.

Note When the DSLAM support for incoming rcp requests is disabled, you can still use the **rcp** commands to copy images from remote servers. The DSLAM support for incoming rcp requests is distinct from its ability to handle outgoing rcp requests.

Example

This example shows how to add two entries for remote users to the authentication database of the DSLAM, and then enable the DSLAM to support remote copy requests from remote users. Users *netadmin1* is on the remote host at IP address 131.108.15.55 and user *netadmin3* is on the remote host at IP address 131.108.101.101. Both are allowed to connect to the DSLAM and remotely execute rcp commands after the DSLAM is enabled to support rcp. Both authentication database entries give the DSLAM host name *DSLAM1* as the local username. The last command enables the DSLAM to support rcp requests from remote users.

```
DSLAM(config)# ip rcmd remote-host DSLAM1 131.108.15.55 netadmin1
DSLAM(config)# ip rcmd remote-host DSLAM1 131.108.101.101 netadmin3
DSLAM(config)# ip rcmd rcp-enable
```

Configuring the DSLAM to Allow Remote Users to Execute Commands Using rsh

To configure the DSLAM as an rsh server, complete the following steps:

	Command	Task
Step 1	`DSLAM# configure terminal`	Go to global configuration mode.
Step 2	`DSLAM(config)# ip rcmd remote-host` *local-username* {*ip-address* | *host*} *remote-username* `[enable]`	Create an entry in the local authentication database for each remote user who is allowed to execute rsh commands on the DSLAM.
Step 3	`DSLAM(config)# ip rcmd rsh-enable`	Enable the DSLAM to support incoming rsh commands.

To disable the DSLAM from supporting incoming rsh commands, use the **no ip rcmd rsh-enable** command.

Note When the DSLAM is disabled, you can still issue rsh commands to be executed on other DSLAMs that support the rsh protocol and on UNIX hosts on the network.

Example

This example shows how to add two entries for remote users to the authentication database of the DSLAM, and enable the DSLAM to support rsh commands from remote users. Users *rmtnetad1* and *netadmin4* are both on the remote host at IP address 131.108.101.101. Although both users are on the same remote host, you must include a unique entry for each user. Both users are allowed to connect to the DSLAM and remotely execute rsh commands after the DSLAM is enabled for rsh. User *netadmin4* is allowed to execute privileged EXEC mode commands on the DSLAM. Both authentication database entries give the DSLAM host name *DSLAM1* as the local username. The last command enables the DSLAM to support rsh commands issued by remote users.

```
DSLAM(config)# ip rcmd remote-host DSLAM1 131.108.101.101 rmtnetad1
DSLAM(config)# ip rcmd remote-host DSLAM1 131.108.101.101 netadmin4 enable
DSLAM(config)# ip rcmd rsh-enable
```

Turning Off DNS Lookups for rcp and rsh

To bypass the DNS security check when DNS services are configured but not available, use this command in global configuration mode:

Command	Task
`DSLAM(config)# no ip rcmd domain-lookup`	Bypass the DNS security check.

The DSLAM software accepts the request to remotely execute a command only if all three values sent with the request match exactly the values configured for an entry in the local authentication file.

Configuring the Remote Username for rcp Requests

From the DSLAM, you can use rcp to remotely copy files to and from network servers and hosts if those systems support rcp. You do not need to configure the DSLAM to issue rcp requests from the DSLAM using rcp. However, to prepare to use rcp from the DSLAM for remote copying, you can perform an optional configuration process to specify the remote username to be sent on each rcp request.

The rcp protocol requires that a client send the remote username on an rcp request. By default, the DSLAM software sends the remote username associated with the current TTY (terminal) process, if that name is valid, for rcp commands.

If the username for the current TTY process is not valid, the DSLAM software sends the host name as the remote username. For **boot** commands using rcp, the DSLAM software sends the DSLAM host name by default. You cannot explicitly configure the remote username.

If the remote server has a directory structure, as do UNIX systems, rcp performs its copy operations as follows:

- When copying from the remote server, rcp searches for the system image or configuration file to be copied to the directory of the remote username.
- When copying to the remote server, rcp writes the system image or configuration file to be copied to the directory of the remote username.
- When booting an image, rcp searches the directory of the remote username for the image file on the remote server.

To override the default remote username sent on rcp requests, use this command in global configuration mode:

Command	Task
`DSLAM(config)# ip rcmd remote-username` *username*	Specify the remote username.

To remove the remote username and return to the default value, use the **no ip rcmd remote-username** command.

Remotely Executing Commands Using rsh

You can use the rsh command to execute commands remotely on network servers that support the remote shell protocol. For you to use this command, the .rhosts files on the network server must include an entry that permits you to remotely execute commands on that host.

If the remote server has a directory structure, as do UNIX systems, the rsh command that you issue is remotely executed from the directory of the account for the remote user that you specify through the **/user** *username* keyword and argument pair.

If you do not specify a username, the DSLAM sends a default remote username. By default, the DSLAM software sends the remote username associated with the current TTY process, if that name is valid. If the TTY remote username is invalid, the DSLAM software uses the DSLAM host name as both the remote and local user names.

To execute a command remotely on a network server using rsh, perform the following steps:

	Command	Task
Step 1	DSLAM# **enable** [*password*]	Enter privileged EXEC mode.
Step 2	DSLAM# **rsh** {*ip-address* | *host*} [**/user** *username*] *remote-command*	Enter the command to be executed remotely.

Example

This example shows how to execute a command remotely using rsh:

```
DSLAM> enable
DSLAM# rsh mysys.cisco.com /u sharon ls -a
.
..
.alias
.cshrc
.emacs
.exrc
.history
.login
.mailrc
.newsrc
.oldnewsrc
.rhosts
.twmrc
.xsession
jazz
DSLAM#
```

Manually Loading a System Image from ROM Monitor

If your DSLAM does not find a valid system image, or if its configuration file is corrupted at startup and the configuration register is set to enter ROM monitor mode, the system might enter ROM monitor mode. From this mode, you can manually load a system image from flash memory, from a network server file, or from ROM. You can also enter ROM monitor mode by restarting the DSLAM and then pressing the **Break** key during the first 60 seconds of startup.

These sections describe how to manually load a system image from ROM monitor mode:

- Manually Booting from Flash Memory, page 9-46
- Manually Booting from a Network File, page 9-47

Manually Booting from Flash Memory

To manually boot from flash memory, complete these tasks in privileged EXEC mode:

	Command	Task
Step 1	DSLAM# **reload**	Restart the DSLAM.
Step 2	**Break**	Press the **Break** key during the first 60 seconds while the system is starting up.
Step 3	rommon> **boot** [**flash:** | **bootflash:**][*filename*]	Manually boot the DSLAM from flash.

Examples

In this example, the DSLAM is manually booted from flash memory. Because the optional *filename* argument is absent, the first file in flash memory is loaded.

```
>boot
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Uncompressing file:  ##################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
#########

<information deleted>

%SYS-5-RESTART: System restarted --
Cisco Internetwork Operating System Software

<information deleted>
```

In this example, the **boot bootflash** command is used with the filename 6260-m_1, the name of the file that is loaded:

```
>boot bootflash: 6260-m_1
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Uncompressing file:  ##################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
################################################################################
#########

<information deleted>

%SYS-5-RESTART: System restarted --

<information deleted>
```

Manually Booting from a Network File

To manually boot from a network file, complete these tasks in privileged EXEC mode:

	Command	Task
Step 1	`DSLAM# reload`	Restart the DSLAM.
Step 2	`Break`	Press the **Break** key during the first 60 seconds while the system is starting up.
Step 3	`DSLAM# boot` *filename* [*ip-address*]	Manually boot the DSLAM from a network file.

Note The BOOTLDR variable must be configured to bootflash: *filename* to allow manually booting from a network file. See the "BOOTLDR Environment Variable" section on page 9-10.

Example

In this example, the DSLAM is manually booted from the network file network1:

```
>boot network1 172.16.255.255
```

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