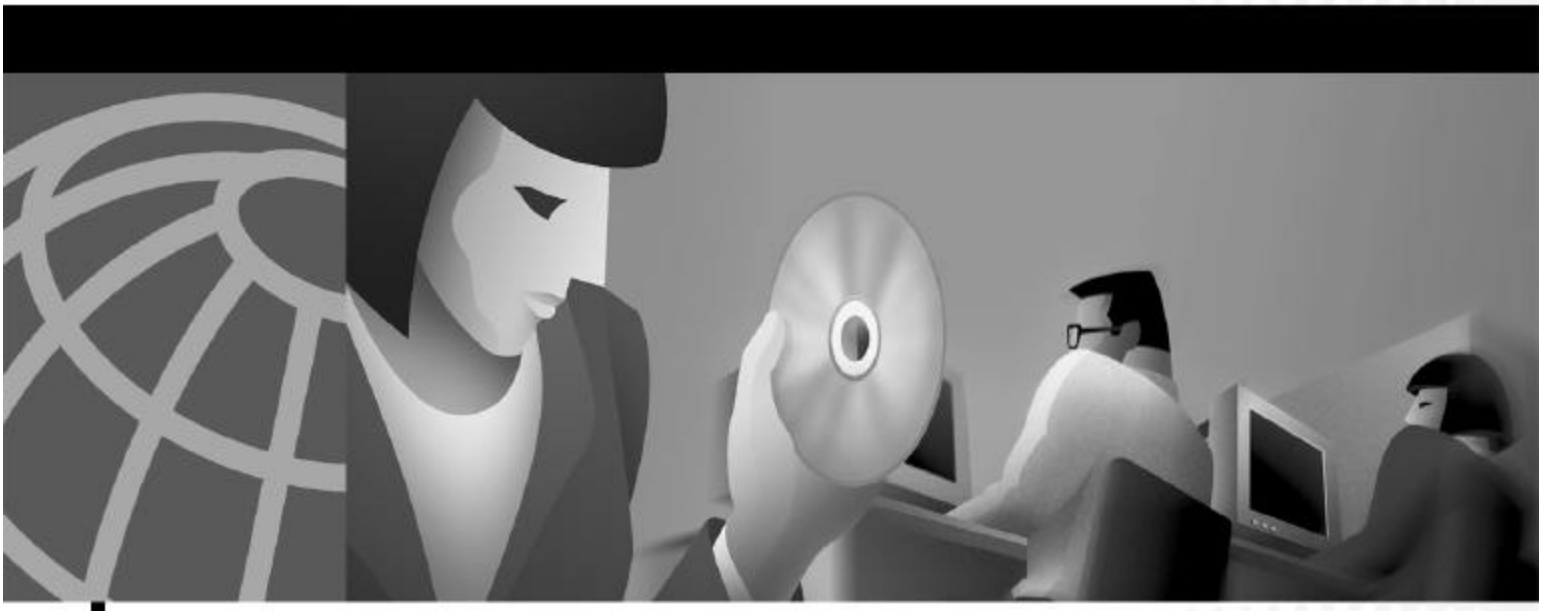

Cisco 6400 Software Setup Guide

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Preface

This chapter describes the objectives, organization, and audience of this guide, as well as conventions and related documentation.

Document Objectives

The purpose of this guide is to help you set up your Cisco 6400 carrier-class broadband aggregator with a basic configuration and connectivity among the Cisco 6400 components. For external connectivity and information on deploying the many features supported by the Cisco 6400, see the *Cisco 6400 Feature Guide* for your software release.

Related Documentation

To complement the software information provided in this guide, refer to the following documents:

Document	Description
Cisco 6400 Feature Guide	Lists the features supported by the Cisco 6400, provides references to cross-platform feature documentation, and describes deployment of features that are unique to the Cisco 6400.
Cisco 6400 Command Reference	Describes commands that are unique to the Cisco 6400 command-line interface (CLI).
ATM Switch Router Software Configuration Guide	Describes additional ATM features and functionality that are supported by the Cisco 6400 node switch processor (NSP).
ATM and Layer 3 Switch Router Command Reference	Describes additional commands supported by the Cisco 6400 NSP.
Cisco IOS Configuration Guides and Command References	Describes extensive Cisco IOS features and commands that apply to the Cisco6400.

Audience

This guide is designed for the system administrator who will be responsible for setting up the CiscoIOS software on the Cisco6400. The system administrator should be familiar with the installation of high-end networking equipment.

This guide is intended primarily for the following audiences:

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

Organization

The *Cisco 6400 Software Setup Guide* is organized into the following chapters and appendixes:

Chapter 1	Product Overview	Describes the Cisco 6400 system and network management options.
Chapter 2	Basic NSP Configuration	Describes how to perform basic configuration for the NSP.
Chapter 3	Basic NRP Configuration	Describes how to perform basic configuration for the NRP-1, NRP-2, and NRP-2SV.
Chapter 4	Node Line Card Interface Configuration	Describes how to manually configure the ATM interfaces for the NLCs.
Chapter 5	Redundancy and SONET APS Configuration	Describes how to configure redundancy among the NSP, NRP, and NLC components.
Chapter 6	SNMP, RMON, and Alarm Configuration	Describes how to use SNMP, RMON, and alarms on the Cisco 6400.
Appendix A	Web Console	Describes how to install and use the Web Console application.
Appendix B	Upgrading Software on the Cisco 6400	Describes how to upgrade software images on the Cisco 6400.
Appendix C	Optimizing the Number of Virtual Connections on the Cisco 6400	Describes how to optimize the number of virtual connections on the Cisco 6400.
Glossary	—	Defines the acronyms and terms used in this guide.

Conventions

This section describes the following conventions used by this guide:

- Command Syntax
- Examples
- Keyboard
- Notes, Timesavers, Tips, Cautions, and Warnings

Command Syntax

Descriptions of command syntax use the following conventions:

Convention	Description
boldface	Indicates commands and keywords that are entered literally as shown.
italics	Indicates arguments for which you supply values; in contexts that do not allow italics, arguments are enclosed in angle brackets (< >).
[**x**]	Keywords or arguments that appear within square brackets are optional.
{**x** | **y** | **z**}	A choice of required keywords (represented by **x**, **y**, and **z**) appears in braces separated by vertical bars. You must select one.
[**x** {**y** | **z**}]	Braces and vertical bars within square brackets indicate a required choice within an optional element. You do not need to enter the optional element. If you do, you have some required choices.

Examples

Examples use the following conventions:

Convention	Description
`screen`	Shows an example of information displayed on the screen.
`boldface screen`	Shows an example of information that you must enter.
`<  >`	Nonprinting characters, such as passwords, appear in angled brackets.
`!`	Exclamation points at the beginning of a line indicate a comment line. Exclamation points are also displayed by the Cisco IOS software for certain processes.
`[  ]`	Default responses to system prompts appear in square brackets.
`prompt>` `prompt#`	Examples that contain system prompts denote interactive sessions, indicating the commands that you should enter at the prompt. The system prompt indicates the current level of the EXEC command interpreter. For example, the prompt `router>` indicates that you should be at the user level, and the prompt `router#` indicates that you should be at the privileged level. Access to the privileged level usually requires a password.

Keyboard

This guide uses the following conventions for typing keys:

Convention	Description
Z	Keys are indicated in capital letters but are not case sensitive.
^ orCtrl	Represents the Control key. For example, when you read *^D or Ctrl-D*, you should hold down the Control key while you press the D key.

Notes, Timesavers, Tips, Cautions, and Warnings

The following conventions are used to attract the reader's attention:

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

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

Tip Means *the following information might help you solve a problem*.

Caution Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

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

Obtaining Documentation

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

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

- http://www.cisco.com

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

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San Jose, CA 95134-9883

We appreciate your comments.

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To access Cisco.com, go to the following website:

http://www.cisco.com

Technical Assistance Center

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

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

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

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

To register for Cisco.com, go to the following website:

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

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

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

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

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

P1 and P2 level problems are defined as follows:

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

CHAPTER 1

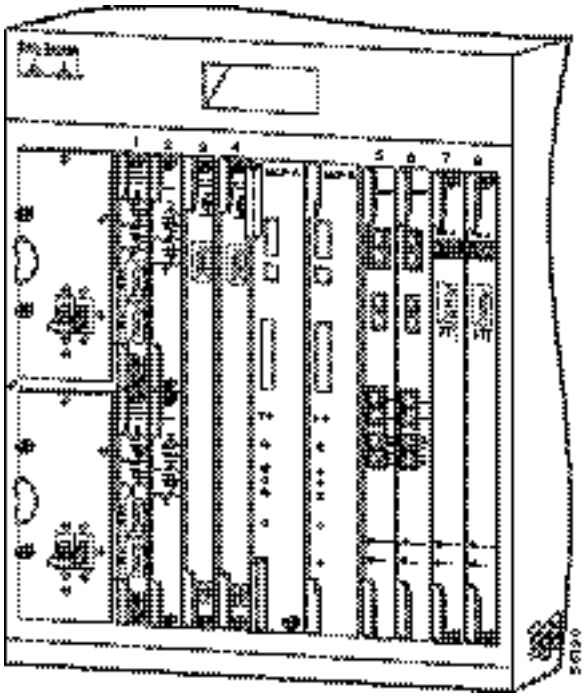
Product Overview

The Cisco 6400 carrier-class broadband aggregator is a high-performance, scalable service gateway that enables the selection and delivery of broadband network services, virtual private networks (VPNs), and voice- and entertainment-driven traffic over the full suite of access media. The Cisco 6400 combines the richness of Cisco IOS software, ATM switching and routing capabilities, and value-added service selection in a modular, scalable, redundant, Network Equipment Building Systems (NEBS) certified and ETSI form factor.

The Cisco 6400 consists of a fault-tolerant midrange ATM switching core and multiple fault-tolerant routing engines. The ATM switch, based on Catalyst 8500 + Per-Flow Queuing (PFQ) technology, provides the necessary ATM switching and traffic management capabilities, while the router modules enable the service provider to offer scalable Layer 3 services. ATM interfaces connect the Cisco 6400 to dial access servers, digital subscriber line access multiplexers (DSLAMs), and Cisco IP DSL switches, and ATM and packet interfaces connect to the network core. The Cisco 6400 is designed for use in high-availability environments such as operating companies' central offices (directly or via co-location), Internet service provider (ISP) offices, and corporate premises. As such, it includes switch, router, and line card redundancy, as well as 12-inch packaging (key for central office deployment).

The Cisco 6400 can reside within the operating company's infrastructure (directly or via co-location) to aggregate access media (DSL, cable, wireless, and dial), serving as the intelligent equal access point that allows a multitude of operating companies and service providers access to the end users. In addition, the Cisco 6400 can reside at the network edge between the operating companies and ISP or corporation, providing the aggregation of sessions and tunnels as well as service and network selection capabilities required in the delivery of advanced broadband services.

Figure1-1 Cisco 6400 Carrier-Class Broadband Aggregator

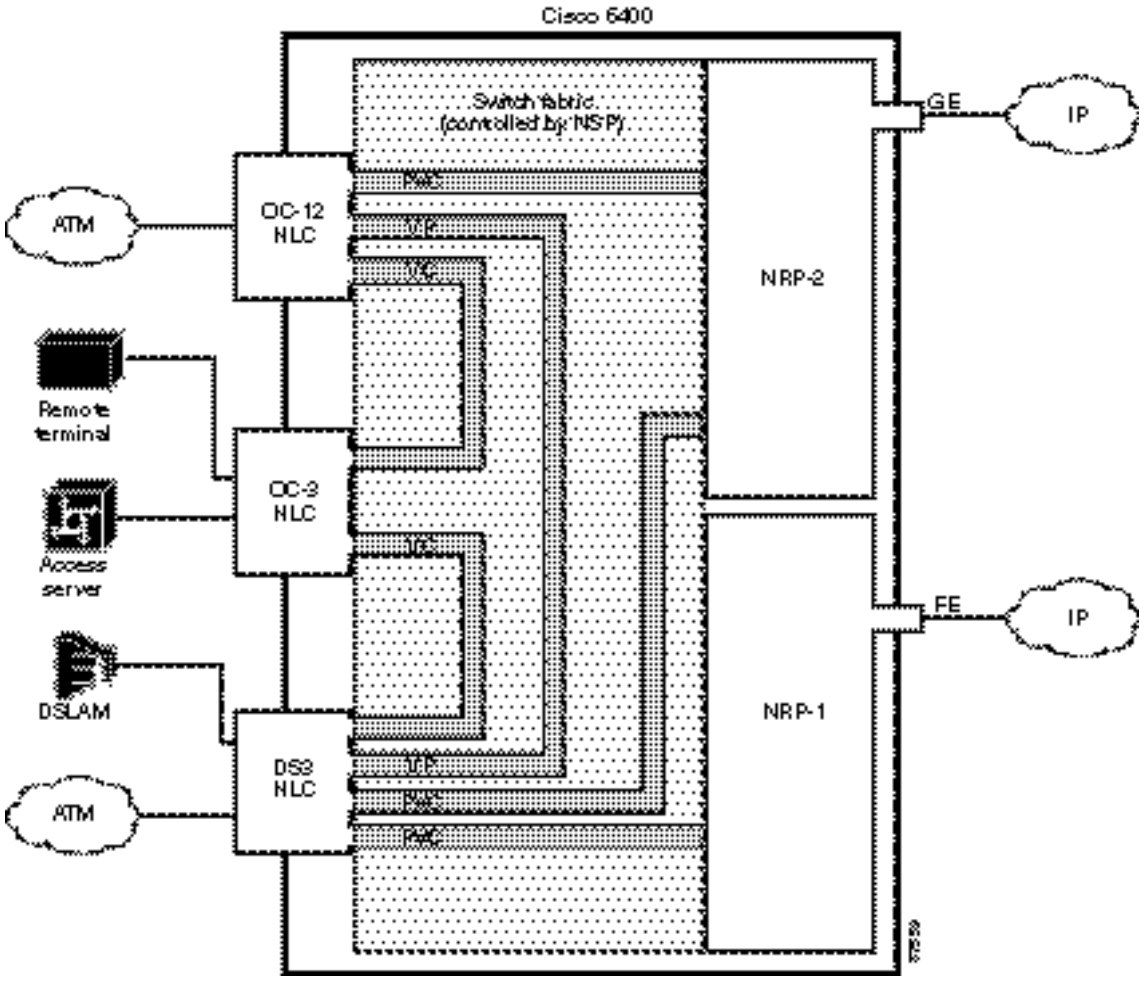


Cisco 6400 System

The Cisco6400 uses a ten-slot, modular chassis featuring the option of half-height and full-height card and slot redundancy, along with dual, fault-tolerant, load-sharing AC or DC power supplies. The two central slots (slot 0A and 0B) in the Cisco6400 are dedicated to redundant, field-replaceable NSP modules that support the 5-Gbps shared memory, fully nonblocking switch fabric. The NSP also supports the feature card and high-performance reduced instruction set computing (RISC) processor that provides the central intelligence for the device. The NSP supports a variety of backbone and wide-area interfaces.

The remaining slots support up to eight node route processors (NRPs), full-height node line cards (NLCs), or carrier modules for half-height NLCs. NRPs and NLCs can be configured for redundant operation. As a result, you can have multiple redundant pairs of NRPs and NLCs, or any combination of nonredundant NRPs and NLCs. The NRPs are fully functional router modules capable of terminating PPP sessions delivered over OC-12, OC-3, or DS3 node line cards.

Figure1-2 Simple Schematic of Cisco 6400 Internal and External Connectivity



Node Switch Processor

The Cisco 6400 NSP provides ATM switching functionality. The NSP uses permanent virtual circuits (PVCs) or permanent virtual paths (PVP) to direct ATM cells between the NRP and ATM interface. The NSP also controls and monitors the Cisco 6400 system, including component NLCs and NRPs.

Node Route Processor

The Cisco 6400 supports three node route processors, designated as NRP-1, NRP-2, and NRP-2SV (see Table1-1 for major differences):

- NRP-1—Incorporates a 100-Mbps Fast Ethernet interface for connecting into an IP network and has processing capability for OC-3 rate of user traffic.
- NRP-2 and NRP-2SV —Provides a Gigabit Ethernet interface and sufficient processing capability for handling OC-12 rate of user traffic.

The Cisco6400 can contain multiple NRP modules, configured to operate independently or as 1+1 redundant pairs. The NRP receives traffic from NLC interface ports through the NSP ATM switch, reassembles the ATM cells into packets, processes (for example, routes or bridges) the packets, and then does one of the following:

- Segments the packets into ATM cells and sends them back to the NSP for transmission out of another NLC interface
- Sends the traffic out the Fast Ethernet (NRP-1) or Gigabit Ethernet (NRP-2) interface

Table1-1 Differences Between NRP-1 and NRP-2 or NRP-2SV

Feature or Capability	NRP-1	NRP-2 and NRP-2SV[1]
Session scalability	Hardware supports as many as 2000sessions per NRP-1.	Hardware supports as many as 16,000sessions per NRP-2.
Physical interfaces	Faceplate interfaces: • Console port • Auxiliary port • Ethernet port • Fast Ethernet port Backplane interfaces: • 155-Mbps ATM interface • Backplane Ethernet (BPE)	Faceplate interfaces: • Gigabit Ethernet interface Backplane interfaces: • 622-Mbps ATM interface • PAM mailbox serial interface[2]
Location of startup configurations and crash information	NRP-1 memory (built-in or internal Flash)	PCMCIA[3] disk on NSP.
Message logging	Messages are logged on the NRP-1 as a local message.	NRP-2 messages are logged on both the NSP and NRP-2. NRP-2 messages on the NSP include the NRP-2 slot number.
Console line access	Direct external connection to NRP-1 console port or auxiliary port.	Indirect external connection via the NSP. NSP contains a virtual communication server to access NRP-2 console.
ROMMON[4]	ROMMON not upgradable; NRP-1 ROM state information stored locally on NRP-1.	ROMMON is upgradable; NRP-2 ROM state information is stored on the NSP PCMCIA disk.
SNMP[5]	Standard SNMP services.	Standard SNMP services, or the NSP can be used as the proxy forwarder.
LED display	None.	On faceplate.

1. Differences between the NRP-2 and NRP-2SV vary by software release. See the release notes for your specific software images.
2. The PAM mailbox serial interface is used for internal system communication. Do not attempt to configure serial interfaces on the Cisco 6400.
3. PCMCIA = Personal Computer Memory Card International Association
4. ROMMON = ROM monitor
5. SNMP = Simple Network Management Protocol

Node Line Card

NLCs provide ATM interfaces for the Cisco 6400 system and are controlled by the NSP. The three types of NLC available for the Cisco 6400 each offer a different interface type, as shown in Table1-2.

Table1-2 Supported Cisco 6400 NLCs

NLC	Bandwidth	Cable	Height	Number of Ports
OC-12/STM-4	622 Mbps	SONET[1] single-mode fiber-optic cable	Full-height	1
OC-3/STM-1 SM	155 Mbps	SONET single-mode fiber-optic cable	Half-height[2]	2
OC-3/STM-1 MM	155 Mbps	SONET multimode fiber-optic cable	Half-height	2
DS3	45 Mbps	Coaxial cable	Half-height	2

1. SONET = Synchronous Optical Network
2. Half-height NLCs require carrier modules, each of which hold two half-height NLCs with covers for empty slots.

Redundancy and SONET Automatic Protection Switching

Redundancy for both the NSP and NRP is based on enhanced high system availability (EHSA). If the NRP fails, no virtual connections from the NSP need to be reconfigured. The NRP blades also support online insertion and removal (OIR). When operating in nonredundant mode, the NRPs appear as separate network management and routing entities and can be accessed through individual management ports.

SONET automatic protection switching (APS) provides a mechanism to support redundant transmission circuits between SONET devices. Automatic switchover from the primary or working circuit to the backup or protection circuit happens when the working circuit fails or degrades. The Cisco 6400 supports 1+1, linear, unidirectional, nonreverting APS operation on its redundant OC-3 and OC-12 NLC interfaces. SONET APS does not apply to DS3 NLCs.

Network Management—Cisco 6400 SCM

The Cisco 6400 Service Connection Manager (SCM) software provides simplified ATM and Layer 2 and Layer 3 IP services to access servers and DSLAMs through network and service management of the Cisco 6400 carrier-class broadband aggregator.

The Cisco 6400 SCM assists you in making network connections by eliminating the need to have technical knowledge of SNMP and Cisco IOS commands required to establish these connections. It also streamlines the deployment process for the Cisco6400 aggregator. The Cisco 6400 SCM provides a service-oriented management view of the Cisco6400 aggregator's inbound and outbound connections.

The Cisco 6400 SCM is based on the common Cisco Element Management Framework (CEMF), which is a Sun Solaris UNIX-based element management foundation for many Cisco service provider products. The Cisco 6400 SCM Element Manager software adds custom windows and modeling behavior to the standard CEMF to improve management of the Cisco 6400 aggregator hardware.

For more information, see theCisco 6400 SCM documentation on Cisco.com at
http://www.cisco.com/en/US/products/sw/netmgtsw/ps2142/

Basic NSP Configuration

This chapter describes how to perform basic configuration for the Cisco 6400 node switch processor (NSP). The Cisco6400 can contain two NSPs configured for redundancy. This chapter contains the following sections:

Methods Available for Configuring the NSP

The following methods are available for configuring the NSP:

- From a local console or workstation—Connect to the console port of the NSP. This connection allows you to issue command-line interface (CLI) commands directly to the NSP.
- From a remote console or workstation—Initiate a Telnet connection to the NSP.
- From the Web Console application—See AppendixA, “Web Console.”
- From the Cisco 6400 Service Connection Manager—See theCisco 6400 SCM documentation.

Note If your Telnet station or Simple Network Management Protocol (SNMP) network management workstation and the Cisco 6400 are on different networks, you must add a static routing table entry to the routing table. For information on configuring static routes, see the "Configuring ATM Routing and PNNI" chapter of the *ATM Switch Router Software Configuration Guide*.

For general information on basic Cisco IOS configuration, see the *Cisco IOS Configuration Fundamentals Configuration Guide* associated with your software release level.

Checking the Software Release Version

To check the software release version, connect a console terminal or a terminal server to the NSP console port on the NSP faceplate. After you boot the NSP, the following information is displayed to verify that the NSP has booted successfully.

Take note of the software release version included in the display. For information on upgrading to a higher release version, see AppendixB, "Upgrading Software on the Cisco 6400."

```
             Restricted Rights Legend

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           San Jose, California 95134-1706



Cisco Internetwork Operating System Software
IOS (tm) C6400 Software (C6400S-WP-M), Version 12.3
Copyright (c) 1986-2002 by Cisco Systems, Inc.
Compiled Tue 18-Sep-02 15:00 by jdoe
Image text-base: 0x60010908, data-base: 0x6069A000


FPGA VERSION: 97/11/25 22:11:51 1383107375 /rhino/fpga/fc_abr_fc3/xil/abr_fpga_r.bit
98/02/24 17:11:36 1332837880 /rhino/fpga/fc_stat_fpga/xilinx/stat_fpga_r.bit
97/11/13 10:03:51 1059421866 /rhino/fpga/fc_traffic_fc3/xil/upc_fpga.bit
97/08/06 13:09:19  288278431 /rhino/fpga/fc_netclk/xilinx/pll_cntl_r.bit

Initializing FC-PFQ hardware ... done.
cisco C6400S (R4600) processor with 131072K bytes of memory.
R4700 CPU at 100Mhz, Implementation 33, Rev 1.0
Last reset from s/w peripheral
2 Ethernet/IEEE 802.3 interface(s)
11 ATM network interface(s)
507K bytes of non-volatile configuration memory.

107520K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).


Press RETURN to get started!
```

DHCP

Dynamic Host Configuration Protocol (DHCP) is the default IP assignment protocol for a new NSP, or for an NSP that has had its configuration file cleared by means of the **erase nvram:startup-config** command. For DHCP, an Ethernet IP address, subnet mask, and the default route are retrieved from the DHCP server for any interface set with the **ip address negotiated** command. To configure the DHCP server, add an entry in the DHCP database using the instructions that came with the server.

Note The Cisco 6400 performs a DHCP request *only* if the NME interface is configured with the **ip address negotiated** interface configuration command.

Verifying DHCP

Use the **show dhcp lease** command to confirm the IP address, subnet mask, default gateway, and static route information obtained from a DHCP server:

```
Switch# show dhcp lease
Temp IP addr: 10.1.1.3  for peer on Interface: unknown
Temp  sub net mask: 255.255.0.0
   DHCP Lease server: 172.18.254.254, state: 3 Bound
   DHCP transaction id: 18D9
   Lease: 86400 secs,  Renewal: 43200 secs,  Rebind: 75168 secs
Temp default-gateway addr: 10.1.0.1
Temp ip static route0: dest 172.18.254.254 router 10.1.0.1
   Next timer fires after: 00:29:59
   Retry count: 0   Client-ID: cisco-0010.7ba9.c600-Ethernet0/0/0
```

Configuring the System Clock and Hostname

Although they are not required, several system parameters should be set as part of the initial system configuration. To set the system clock and hostname, complete the following steps beginning in privileged EXEC mode:

	Command	Purpose
Step1	`Switch# clock set hh:mm:ss day_of_month month year`	Sets the system clock.
Step2	`Switch# configure terminal`	Enters global configuration mode.
Step3	`Switch(config)# hostname name_string`	Sets the system hostname.

Example

In the following example, the system clock and hostname are configured:

```
Switch# clock set 15:01:00 17 October 2002
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# hostname Publications
Publications(config)#
```

Verifying the System Clock and Hostname Configuration

To confirm the system clock setting, use the **show clock** command:

```
Publications# show clock
.15:03:12.015 UTC Fri Oct 17 2002
Publications#
```

To confirm the hostname, check the CLI prompt. The new hostname will appear in the prompt.

ATM Address

The Cisco 6400 NSP ships with the ATM address autoconfigured, which enables the switch to automatically configure attached end systems using the Integrated Local Management Interface (ILMI) protocol. Autoconfiguration also enables the NSP to establish itself as a node in a single-level Private Network-Network Interface (PNNI) routing domain.

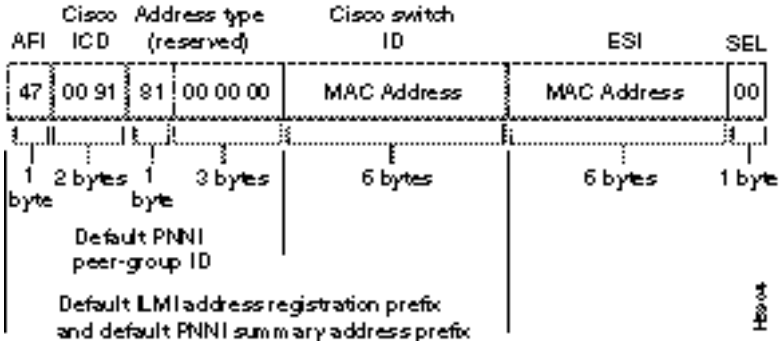
To manually configure the ATM address, see the "Configuring the ATM Address Manually" section on page2-5.

Note If you chose to manually change any ATM address, it is important to maintain the uniqueness of the address across large networks. Refer to the "Configuring ATM Routing and PNNI" chapter in the *ATM Switch Router Software Configuration Guide* for PNNI address considerations and for information on obtaining registered ATM addresses.

Understanding the Autoconfigured ATM Addressing Scheme

During the initial startup, the NSP generates an ATM address using the defaults shown in Figure2-1 .

Figure2-1 ATM Address Format



The autoconfigured ATM address includes the following components:

- 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)

Note The first 13 bytes of the address make up a switch prefix used by ILMI in assigning addresses to end stations connected to User-Network Interface (UNI) ports.

- MAC address of the NSP—6 bytes (used to distinguish multiple end system identifier [ESI] addresses)

Note Both MAC address fields in the ATM address are the same, but they will not be the same as the address printed on the chassis label.

- Selector equals 0—1 byte

Configuring the ATM Address Manually

Manually configuring the ATM address is required:

- To connect to another system using Interim Interswitch Signaling Protocol (IISP). Using IISP requires disabling PNNI, which results in no ILMI support.
- To configure a new ATM address that replaces the previous ATM address and generates a new PNNI node ID and peer group ID for migrating from flat to hierarchical PNNI.
- To connect to multiple levels of a PNNI hierarchy.
- To connect to a service provider network that requires you to use the addressing scheme for that network.
- To use a particular style of addressing. For instance, in some circumstances a mnemonic scheme might be useful for identifying nodes in an ATM network.

To configure a new ATM address, refer to the chapter "Configuring ATM and PNNI" in the *ATM Switch Router Software Configuration Guide*.

Caution ATM addressing can lead to conflicts if not configured correctly. If you are configuring a new ATM address, the old one must be completely removed from the configuration.

Example

The following example shows how to change the active ATM address, create a new address, verify that it exists, and then delete the current active address. Using the ellipses (...) adds the default Media Access Control (MAC) address as the last six bytes.

```
Switch(config)# atm address 47.0091.8100.5670.0000.0ca7.ce01...
Switch(config)# end
Switch# show atm addresses

Switch Address(es):

  47.00918100000000410B0A1081.00410B0A1081.00 active
  47.00918100567000000CA7CE01.00410B0A1081.00

Soft VC Address(es):
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.0000.00 ATM0/0/0
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.0000.63 ATM0/0/0.99
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.0010.00 ATM0/0/1
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.0020.00 ATM0/0/2
```

```
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.0030.00 ATM0/0/3
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.1000.00 ATM0/1/0
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.1010.00 ATM0/1/1
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.1020.00 ATM0/1/2
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.1030.00 ATM0/1/3
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.8000.00 ATM1/0/0
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.8010.00 ATM1/0/1
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.8020.00 ATM1/0/2
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.8030.00 ATM1/0/3
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.9000.00 ATM1/1/0
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.9010.00 ATM1/1/1
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.9020.00 ATM1/1/2
  47.0091.8100.0000.0041.0b0a.1081.4000.0c80.9030.00 ATM1/1/3

ILMI Switch Prefix(es):
  47.0091.8100.0000.0041.0b0a.1081
  47.0091.8100.0000.0060.3e5a.db01

ILMI Configured Interface Prefix(es):

LECS Address(es):

Switch# configure terminal
Switch(config)# no atm address 47.0091.8100.0000.0041.0b0a.1081...
```

Verifying the ATM Address

Use the **show atm addresses** EXEC command to confirm correct configuration of the ATM address for the NSP.

Network Management Ethernet Interface

As of Cisco IOS Release 12.0(5)DB and later releases, including 12.3, the Cisco 6400 system can use the Ethernet port on the NSP as a combined network management Ethernet (NME) interface for all cards in the Cisco 6400 chassis. This is called “NME consolidation.” Before Cisco IOS Release 12.0(5)DB, each NRP and NSP used a separate NME interface.

The Cisco IOS software version on your NSP determines the type of NME interface supported by your Cisco 6400 system:

- Enabling NME Consolidation on the NSP—Cisco IOS Release 12.0(5)DB and later
- Enabling a Separate NME Interface—Cisco IOS Release 12.0(4)DB and earlier, optional task for later releases

Enabling NME Consolidation on the NSP

The method used to enable the combined NME interface on the NSP depends on whether or not the NSP was *upgraded* to or preloaded with Cisco IOS Release 12.0(5)DB or later.

Enabling NME Consolidation on a New NSP Preloaded with Cisco IOS Release 12.0(5)DB or Later

On an NSP that is preloaded with a Cisco IOS Release 12.0(5)DB or later software image, NME consolidation is already included in the default configuration.

If your NSP does not use a DHCP server to obtain an IP address, you must configure a static IP address. Complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface BV11`	Selects the interface used for NME consolidation.
Step2	`Switch(config-if)# ip address address subnet`	Configures the static IP and subnetwork address.

Example—NME Consolidation

```
!
interface BVI1
  ip address 172.20.40.93 255.255.255.0
!
```

Enabling NME Consolidation on an NSP Upgraded to Cisco IOS Release 12.0(5)DB or Later

To enable NME consolidation on an NSP upgraded from a Cisco IOS Release 12.0(4)DB or earlier software image, complete the following tasks:

- Task 1: Removing the IP Addresses from the Ethernet 0/0/0 and Ethernet 0/0/1 Interfaces
- Task 2: Setting up the Bridge Group
- Task 3: Configuring the NME Interface

Task 1: Removing the IP Addresses from the Ethernet 0/0/0 and Ethernet 0/0/1 Interfaces

To remove the IP addresses from the Ethernet 0/0/0 and Ethernet 0/0/1 interfaces, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface ethernet 0/0/0`	Selects the Ethernet 0/0/0 interface.
Step2	`Switch(config-if)# no ip address`	Removes the IP address from the interface.
Step3	`Switch(config-if)# interface ethernet 0/0/1`	Selects the Ethernet 0/0/1 interface.
Step4	`Switch(config-if)# no ip address`	Removes the IP address from the interface.
Step5	`Switch(config-if)# exit`	Returns to global configuration mode

Task 2: Setting up the Bridge Group

To set up the bridge group, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# bridge irb`	Enables integrated routing and bridging.
Step2	`Switch(config)# bridge 1 protocol ieee`	Selects the IEEE Ethernet Spanning-Tree Protocol for bridge group 1.
Step3	`Switch(config)# bridge 1 route ip`	Enables IP routing in bridge group 1.
Step4	`Switch(config-if)# interface ethernet 0/0/1`	Selects the Ethernet 0/0/1 interface.
Step5	`Switch(config-if)# bridge-group 1`	Assigns the Ethernet 0/0/1 interface to bridge group 1.

Task 3: Configuring the NME Interface

To configure the NME interface, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface BVI1`	Creates or selects the interface used for NME consolidation.
Step2	`Switch(config-if)# ip address` *`address subnet`* or, if using DHCP, `Switch(config-if)# ip address negotiated`	Configures a static IP address and subnetwork address. Enables the interface to obtain an IP address, subnet mask, router address, and static routes from a DHCP server.

Example—NME Consolidation Configuration on the NSP

```
!
bridge irb
!
bridge 1 protocol ieee
bridge 1 route ip
!
interface ethernet 0/0/0
 no ip address
!
interface ethernet 0/0/1
 no ip address
 bridge-group 1
!
interface BVI1
  ip address 172.20.40.93 255.255.255.0
!
```

Enabling NME Consolidation on the NRP

In addition to configuring the NSP for NME consolidation, you must configure the NRP Ethernet interfaces to also support NME consolidation. Complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# interface ethernet 0/0/0`	Selects the Ethernet 0/0/0 interface.
Step2	`Router(config-if)# no ip address`	Removes the IP address from the interface.
Step3	`Router(config-if)# interface ethernet 0/0/1`	Selects the Ethernet 0/0/1 interface.
Step4	`Router(config-if)# ip address` *address subnet*	Configures a static IP address and subnetwork address. Use the same subnet from the Ethernet0/0/1 interface on the NSP.

Example—NME Consolidation Configuration on the NRP

```
!
interface ethernet 0/0/0
 no ip address
!
interface ethernet 0/0/1
 ip address 172.20.40.10 255.255.255.0
!
```

Enabling a Separate NME Interface

Cisco IOS Release 12.0(4)DB and earlier images do not support NME consolidation. You must configure the NSP Ethernet interface as a separate NME interface that is unable to handle network management of the NRPs in the Cisco 6400 system.

Enabling the NME on an NSP Running Cisco IOS Release 12.0(4)DB or Earlier

Complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface ethernet 0/0/0`	Selects the NME interface to be configured.
Step2	`Switch(config-if)# ip address` *address subnet* or, if using DHCP, `Switch(config-if)# ip address negotiated`	Configures a static IP address and subnetwork address. Enables the interface to obtain an IP address, subnet mask, router address, and static routes from a DHCP server.

Example—Separate NME

In the following example, the NSP is configured to use the separate NME interface:

```
!
interface ethernet 0/0/0
  ip address negotiated
```

```
!
```

Verifying the NME Interface Configuration

Use the **show interface** EXEC command to verify successful configuration of the NME interface on the NSP. If the NSP is configured for NME consolidation, use **show interface BVI 1**. On an NSP configured to use a separate NME interface, use **show interface ethernet 0/0/0**. Check that the output shows:

- That the NME interface and line protocol is "up"
- A valid IP address
- That packets are input and output

```
Switch# show interface BVI 1
BVI1 is up, line protocol is up
  Hardware is BVI, address is 0050.736f.5756 (bia 0000.0000.0000)
  Internet address is 172.194.71.11/24
  MTU 4470 bytes, BW 10000 Kbit, DLY 5000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 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
     53 packets input, 3180 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     57 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out

Switch#
```

Internal Cross-Connections

The following sections describe minimal procedures for creating virtual circuits (VCs) and virtual paths (VPs).

Note Soft VCs between the NRP and NSP are not supported.

For more information, see the following chapters of the *ATM Switch Router Software Configuration Guide*:

- "Configuring Virtual Connections" (VCs)
- "Configuring ATM Network Interfaces" (VPs, including shared and hierarchical VP tunnels)

Configuring PVCs (VC Switching)

A permanent virtual circuit (PVC) is a permanent logical connection that you must configure manually, from source to destination, through the ATM network. Once configured, the ATM network maintains the connection at all times, regardless of traffic flow. That is, the connection is always up whether or not there is traffic to send.

The Cisco 6400 uses PVCs to pass traffic between the node line card (NLC) ATM interfaces and node route processors (NRPs). Typically, when VC switching is used, each subscriber is bound to a specific NRP and should be configured as a separate PVC. If the Cisco 6400 is used as an ATM switch, VCs are simply connected between the ATM interfaces.

To create a PVC between an ATM interface and an NRP, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the NLC interface to be configured.
Step2	`Switch(config-if)# atm pvc vpi vci interface atm slot/subslot/port vpi vci`	Configures the PVC, using the slot/subslot/port of the NRP to which you want to connect the NLC.

You must also configure the PVC on the NRP side. For instructions on configuring PVCs on the NRP, see the "Permanent Virtual Circuits" section on page3-20.

Example—Internal PVC

In the following example, an internal PVC is configured between the NLC ATM interface 1/0/0 and an NRP in slot 5. Both the NRP and NSP must be configured to create the PVC.

Configuration fragment on the NSP:

```
!
interface atm 1/0/0
  atm pvc 0 50 interface atm 5/0/0 2 100
!
```

Configuration fragment on the NRP:

```
!
interface atm 0/0/0
  pvc 2/100
!
```

Configuring PVPs (VP Switching)

A permanent virtual path (PVP) allows you to connect two ATM switch routers at different locations across a public ATM network that does not support ATM signaling. Signaling traffic is mapped into the PVP, and the switches allocate a virtual channel connection (VCC) on that VP, instead of the default VP0. This mapping allows the signaling traffic to pass transparently through the public network. VP switching also provides NSP redundancy at the ATM layer.

To create a PVP between an ATM interface and an NRP, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the NLC interface to be configured.
Step2	`Switch(config-if)# atm pvp vpi interface atm slot/subslot/port vpi`	Configures the PVP, using the slot/subslot/port of the NRP to which you want to connect the NLC.

You must also configure PVCs on the NRP that will use the VP switch. For instructions on configuring PVCs on the NRP, see the "Permanent Virtual Circuits" section on page3-20.

Example—Internal PVP

In the following example, an internal PVP is configured between the NLC ATM interface at 1/0/0 and an NRP in slot 5. Both the NRP and NSP must be configured to create the PVP.

Configuration fragment on the NSP:

```
!
interface atm 1/0/0
  atm pvp 0 interface atm 5/0/0 2
!
```

Configuration fragment on the NRP:

```
!
interface atm 0/0/0
  pvc 2/100
  pvc 2/101
  pvc 2/102
!
```

Verifying Internal Cross-Connections

Use the **show atm vc** EXEC command to confirm the status of ATM virtual channels:

```
Switch# show atm vc
Interface         VPI   VCI    Type    X-Interface       X-VPI X-VCI   Encap  Status
ATM0/0/0           0     35     PVC     ATM1/0/0            0     16    ILMI   DN
ATM0/0/0           0     36     PVC     ATM1/0/0            0     5     QSAAL  DN
ATM0/0/0           0     37     PVC     ATM1/0/1            0     16    ILMI   DN
ATM0/0/0           0     38     PVC     ATM1/0/1            0     5     QSAAL  DN
ATM0/0/0           0     39     PVC     ATM5/0/0            0     16    ILMI   DN
ATM0/0/0           0     40     PVC     ATM5/0/0            0     5     QSAAL  DN
ATM0/0/0           0     41     PVC     ATM6/0/0            0     16    ILMI   DN
ATM0/0/0           0     42     PVC     ATM6/0/0            0     5     QSAAL  DN
ATM0/0/0           0     43     PVC     ATM7/1/0            0     16    ILMI   UP
ATM0/0/0           0     44     PVC     ATM7/1/0            0     5     QSAAL  UP
ATM0/0/0           0     45     PVC     ATM7/1/1            0     16    ILMI   DN
Interface         VPI   VCI    Type    X-Interface       X-VPI X-VCI   Encap  Status
ATM0/0/0           0     46     PVC     ATM7/1/1            0     5     QSAAL  DN
ATM0/0/0           0     47     PVC     ATM8/1/0            0     16    ILMI   UP
ATM0/0/0           0     48     PVC     ATM8/1/0            0     5     QSAAL  UP
ATM0/0/0           0     49     PVC     ATM8/1/1            0     16    ILMI   DN
ATM0/0/0           0     50     PVC     ATM8/1/1            0     5     QSAAL  DN
ATM0/0/0           0     51     PVC     ATM7/0/0            0     16    ILMI   UP
ATM0/0/0           0     52     PVC     ATM7/0/0            0     5     QSAAL  UP
ATM0/0/0           0     53     PVC     ATM7/0/1            0     16    ILMI   DN
```

```
ATM0/0/0          0     54     PVC     ATM7/0/1          0     5     QSAAL  DN
ATM0/0/0          0     55     PVC     ATM7/1/0          0     18    PNNI   UP
ATM0/0/0          0     56     PVC     ATM8/1/0          0     18    PNNI   UP
ATM0/0/0          0     57     PVC     ATM7/0/0          0     18    PNNI   UP
ATM1/0/0          0     5      PVC     ATM0/0/0          0     36    QSAAL  DN
ATM1/0/0          0     16     PVC     ATM0/0/0          0     35    ILMI   DN
ATM1/0/1          0     5      PVC     ATM0/0/0          0     38    QSAAL  DN
Interface         VPI   VCI    Type    X-Interface       X-VPI X-VCI   Encap  Status
ATM1/0/1          0     16     PVC     ATM0/0/0          0     37    ILMI   DN
ATM5/0/0          0     5      PVC     ATM0/0/0          0     40    QSAAL  DN
ATM5/0/0          0     16     PVC     ATM0/0/0          0     39    ILMI   DN
ATM6/0/0          0     5      PVC     ATM0/0/0          0     42    QSAAL  DN
ATM6/0/0          0     16     PVC     ATM0/0/0          0     41    ILMI   DN
ATM7/0/0          0     5      PVC     ATM0/0/0          0     52    QSAAL  UP
ATM7/0/0          0     16     PVC     ATM0/0/0          0     51    ILMI   UP
ATM7/0/0          0     18     PVC     ATM0/0/0          0     57    PNNI   UP
ATM7/0/1          0     5      PVC     ATM0/0/0          0     54    QSAAL  DN
ATM7/0/1          0     16     PVC     ATM0/0/0          0     53    ILMI   DN
ATM7/1/0          0     5      PVC     ATM0/0/0          0     44    QSAAL  UP
ATM7/1/0          0     16     PVC     ATM0/0/0          0     43    ILMI   UP
ATM7/1/0          0     18     PVC     ATM0/0/0          0     55    PNNI   UP
ATM7/1/1          0     5      PVC     ATM0/0/0          0     46    QSAAL  DN
Interface         VPI   VCI    Type    X-Interface       X-VPI X-VCI   Encap  Status
ATM7/1/1          0     16     PVC     ATM0/0/0          0     45    ILMI   DN
ATM8/1/0          0     5      PVC     ATM0/0/0          0     48    QSAAL  UP
ATM8/1/0          0     16     PVC     ATM0/0/0          0     47    ILMI   UP
ATM8/1/0          0     18     PVC     ATM0/0/0          0     56    PNNI   UP
ATM8/1/1          0     5      PVC     ATM0/0/0          0     50    QSAAL  DN
ATM8/1/1          0     16     PVC     ATM0/0/0          0     49    ILMI   DN

Switch#
```

Use the **show atm vc interface atm** EXEC command to confirm the status of ATM virtual channels on a specific interface:

```
Switch# show atm vc interface atm 7/0/0
Interface         VPI   VCI    Type    X-Interface       X-VPI X-VCI   Encap  Status
ATM7/0/0          0     5      PVC     ATM0/0/0          0     52    QSAAL  UP
ATM7/0/0          0     16     PVC     ATM0/0/0          0     51    ILMI   UP
ATM7/0/0          0     18     PVC     ATM0/0/0          0     57    PNNI   UP
Switch#
```

Use the **show atm vc interface atm** EXEC command to confirm the status of a specific ATM interface and virtual channel:

```
Switch# show atm vc interface atm 7/0/0 0 16

Interface: ATM7/0/0, Type: oc3suni
VPI = 0  VCI = 16
Status: UP
Time-since-last-status-change: 2d20h
Connection-type: PVC
Cast-type: point-to-point
Packet-discard-option: enabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 15
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/0/0, Type: CPU card
Cross-connect-VPI = 0
Cross-connect-VCI = 51
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
```

```
Cross-connect OAM-state:  Not-applicable
Encapsulation: AAL5ILMI
Threshold Group: 6, Cells queued: 0
Rx cells: 35, Tx cells: 35
Tx Clp0:35,  Tx Clp1: 0
Rx Clp0:35,  Rx Clp1: 0
Rx Upc Violations:0, Rx cell drops:0
Rx pkts:16, Rx pkt drops:0
Rx connection-traffic-table-index: 3
Rx service-category: VBR-RT (Realtime Variable Bit Rate)
Rx pcr-clp01: 424
Rx scr-clp01: 424
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: 50
Tx connection-traffic-table-index: 3
Tx service-category: VBR-RT (Realtime Variable Bit Rate)
Tx pcr-clp01: 424
Tx scr-clp01: 424
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: 50
AAL5 statistics:
Crc Errors:0, Sar Timeouts:0, OverSizedSDUs:0
BufSzOvfl:  Small:0, Medium:0, Big:0, VeryBig:0, Large:0

Switch#
```

Network Clocking

This section describes the network clocking configuration of the Cisco 6400. Each port has a transmit clock that is derived from the receive data. The transmit clock can be configured for each port in one of the following ways:

- Free-running—The transmit clock on the interface is derived from the port adapter's local oscillator, if one exists. If the port adapter does not have a local oscillator, the oscillator from the NSP is used. In this mode, the transmit clock is not synchronized with any receive clocks in the system. This mode should be used only if synchronization is not required, as in some LAN environments.
- Network derived—The transmit clock is derived from the highest priority configured network clock source—the system clock (the local oscillator on the NSP), the Building Integrated Timing Supply (BITS), or the public network.
- Loop-timed—The transmit clock is derived from the clock source received on the same interface. This mode can be used when connecting to a device with a very accurate clock source.

Any NLC in a Cisco 6400 chassis capable of receiving and distributing a network timing signal can propagate that signal to any similarly capable module in the chassis. Using the **network-clock-select** global configuration command, you can cause a particular port in a Cisco 6400 chassis to serve as the primary reference source (PRS) for the entire chassis or for other devices in the networking environment. In other words, you can designate a particular port in a Cisco 6400 chassis to serve as a “master clock” source for distributing a single clocking signal throughout the chassis or to other network devices. This reference signal can be distributed wherever needed in the network and can globally synchronize the flow of constant bit rate (CBR) data.

For more information on network clocking, see the chapter “Initially Configuring the ATM Switch” in the *ATM Switch Router Software Configuration Guide*.

Configuring the Transmit Clock Source

By default, the interface uses a network-derived clock source. To modify how an interface derives its transmit clock, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the interface to be configured.
Step2	`Switch(config-if)# clock source {free-running | loop-timed | network-derived}`	Specifies how the interface derives its transmit clock.

Example

In the following example, ATM interface 4/0/0 is configured to derive its transmit clock from the clock source received on the same interface:

```
!
interface atm 4/0/0
  clock source loop-timed
!
```

Configuring Network Clock Priorities and Sources

You can configure multiple network clock sources and assign priority values to each source. The system uses the highest priority clock source available as the "network-derived" clock source for the transmit clock.

To configure the network clock priorities and sources, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# network-clock-select priority {system | atm slot/subslot/port}`	Configures a network clock priority and source. *Priority*[1] values range from 1 (highest) to 4 (lowest). **System** selects the local oscillator on the NSP.

1. Priorities 1 to 4 initially default to "no clock." Priority 5 is a pseudo-priority that defaults to "system clock" and is not configurable. If priorities 1 to 4 are not configured, the priority 5 system (NSP) clock is used as the derived clock.

Example

In the following example, interface ATM 2/0/0 is configured as the highest priority network clock source:

```
!
network-clock-select 1 atm 2/0/0
network-clock-select 2 atm 2/0/1
network-clock-select 3 atm 1/0/0
!
interface atm 1/0/0
 clock source network-derived
 !
```

As long as interface ATM 2/0/0 is available, all transmit clocking on ATM 1/0/0 will be derived from ATM 2/0/0. If the ATM 2/0/0 clock source fails, the system will attempt to use the next highest priority clock source, which in this case is ATM 2/0/1.

Configuring Network Clock Revertive Behavior

Revertive behavior enables the network clock to automatically switch to the highest priority clock source available. When a clock failure is detected, the next highest priority clock source is selected. If revertive behavior is not configured, the clock source will not switch back even when the failed (but higher priority) clock source is restored.

To enable network clock revertive behavior on the NSP, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# network-clock-select revertive`	Configures revertive behavior on the network clock.

Example

In the following example, the network clock reverts to the highest priority clock source after a failure:

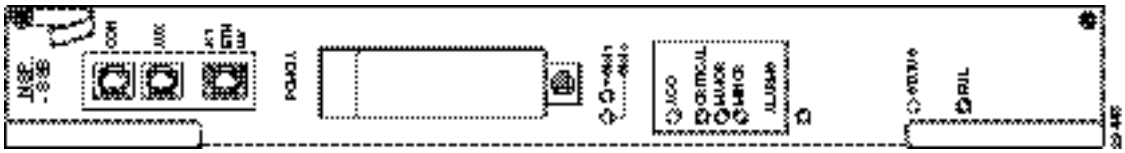
```
!
network-clock-select 1 atm 2/0/0
network-clock-select 2 atm 2/0/1
network-clock-select 3 atm 1/0/0
network-clock-select revertive
!
```

Configuring Building Integrated Timing Supply Network Clocking

BITS network clocking enables the Cisco 6400 to derive network timing from the central office (CO) BITS as well as from a clock recovered from a specified NLC interface. The Cisco 6400 can also distribute the BITS network timing with stratum level 3 accuracy to other network devices.

The BITS Network Clocking feature requires the NSP with stratum 3/BITS (NSP-S3B) module. Figure2-2 shows the NSP-S3B module faceplate.

Figure2-2 NSP-S3B Module Faceplate



In addition to enabling the BITS Network Clocking feature, the NSP-S3B allows the Cisco 6400 to serve as a stratum 3 network clock source for other network devices. When no external clock source is available, the NSP-S3B provides stratum level 3 internal timing on the Cisco 6400. Otherwise, the NSP-S3B is identical to the default NSP.

For information about installing the NSP-S3B, see the *Cisco 6400 UAC Hardware Installation and Maintenance Guide*.To see if the NSP-S3B is installed in the Cisco 6400 chassis, use the **showhardware** EXEC command. The output will contain an “NSP-NC” controller type (Ctrlr-Type) for each NSP-S3B in the chassis.

```
NSP# show hardware

6400 named NSP, Date:16:59:29 UTC Wed Feb 28 2001
Feature Card's FPGA Download Version:0

Slot  Ctrlr-Type    Part No.  Rev  Ser No  Mfg Date   RMA No. Hw Vrs  Tst EEP
----- ------------  ---------- -- -------- --------- -------- ------- --- ---
1/0   NRP2          00-0000-00 01 00000000 Jan 01 00 00-00-00   1.0     0   2
2/0   622SM NLC     73-3868-02 A0 16097980 Feb 04 00 00-00-00   1.0     0   2
3/0   NRP2          UNKNOWN    01 UNKNOWN  Jul 00 00 00-00-00   1.0     0   2
4/0   NRP2          UNKNOWN    01 UNKNOWN  Jul 00 00 00-00-00   1.0     0   2
5/0   155SM NLC     73-2892-03 01 09156394 Aug 28 98 00-00-00   3.1     0  FF
6/0   NRP2          UNKNOWN    01 UNKNOWN  Jul 00 00 00-00-00   1.0     0   2
7/0   622SM NLC     73-3868-02 A0 14327654 Oct 15 99 00-00-00   1.0     0   2
8/0   NRP2          00-0000-00 01 00000000 Jan 01 00 00-00-00   1.0     0   2
5/1   155SM NLC     73-2892-02 02 09690988 Jul 20 98 00-00-00   1.0     0   2
0A/PC NSP-PC        73-2996-02 02 09702853 Sep 01 98 00-00-00   1.0     0   2
0A/FC FC-PFQ        73-2281-04 A0 09694957 Aug 20 98 00-00-00   4.1     0   2
0A/SC NSP-SC        73-2997-02 07 12345678 Aug 27 98 00-00-00   1.0     0   2
0A/NC NSP-NC        73-3243-01 00 14012804 Jul 01 99 00-00-00   1.0     0   2
0B/PC NSP-PC        73-2996-02 02 09702826 Sep 01 98 00-00-00   1.0     0   2
0B/FC FC-PFQ        73-2281-04 A0 09694884 Aug 06 98 00-00-00   4.1     0   2
0B/SC NSP-SC        73-2997-02 07 12345678 Aug 28 98 00-00-00   1.0     0   2
0B/NC NSP-NC        73-3243-01 00 14012806 Jul 01 99 00-00-00   1.0     0   2

Primary NSP:Slot 0A

DS1201 Backplane EEPROM:
 Model  Ver.  Serial  MAC-Address  MAC-Size  RMA  RMA-Number   MFG-Date
------- ---- -------- ------------ --------  ---  ----------  -----------
C6400    2   10036118 00107BB9B600   128     0    0           Aug 26 1998

NSP#
```

Note To derive network clocking from the CO BITS, the BITS input must be less than 9.2 parts per million (ppm) off center. Otherwise, the NSP-S3B declares the clock source invalid.

To derive network clocking from the BITS signal, use the following commands on the NSP-S3B in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# network-clock-select` *priority* `BITS`	Selects the BITS network clock and specifies the priority.
Step2	`Switch(config)# network-clock-select BITS {T1|E1}`	Specifies BITS port as either T1 or E1.

Example

In the following example, the CO BITS is selected as the priority 1 network clock source. Lower priority clock sources are also configured for redundancy, and revertive behavior is selected.

```
!
network-clock-select revertive
network-clock-select bits e1
network-clock-select 1 bits
network-clock-select 2 ATM1/0/0
network-clock-select 3 ATM5/0/0
network-clock-select 4 ATM7/0/0
!
```

Verifying the Network Clock Configuration

To verify the switch network clocking configuration, use the **show network-clocks** EXEC command:

```
Switch# show network-clocks
clock configuration is NON-Revertive
Priority 1 clock source: ATM2/0/0 up
Priority 2 clock source: ATM7/0/0 down
Priority 3 clock source: ATM6/0/0 up
Priority 4 clock source: unconfigured
Priority 5 clock source: system

Current clock source: ATM2/0/0, priority: 1

Switch#
```

To verify BITS network clocking, make sure the **show network-clocks** command output includes the following lines:

```
Priority 1 clock source: bits up
Current clock source: bits, priority: 1
```

Network Routing

The default software image for the Cisco 6400 contains the PNNI routing protocol. The PNNI protocol provides the route dissemination mechanism for complete plug-and-play capability. The following section, "Configuring ATM Static Routes for IISP or PNNI," describes modifications that can be made to the default PNNI or IISP routing configurations.

For more routing protocol configuration information, see the chapters "Configuring ILMI" and "Configuring ATM Routing and PNNI" in the *ATM Switch Router Software Configuration Guide*.

Configuring ATM Static Routes for IISP or PNNI

Static route configuration allows ATM call setup requests to be forwarded on a specific interface if the addresses match a configured address prefix. To configure a static route, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# atm route` *addr-prefx* `atm` *slot/subslot/port*	Specifies a static route to a reachable address prefix.

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

Example

In the following example, the **atm route** command is used to configure the 13-byte peer group prefix 47.0091.8100.567.0000.0ca7.ce01 at interface 3/0/0:

```
!
atm route 47.0091.8100.567.0000.0ca7.ce01 atm 3/0/0
!
```

Verifying ATM Static Routes for IISP or PNNI

To verify successful configuration of an ATM static route, use the **show atm route** and **showatmpnnitopology** EXEC commands.

NRP-2 and NRP-2SV Support

The NSP provides the following functions for the NRP-2 and NRP-2SV:

- Image and File Storage, page 2-19
- System Logging, page 2-21
- Console and Telnet Access, page 2-21
- SNMPv3 Proxy Forwarder, page 2-22
- Troubleshooting and Monitoring the NRP-2, page 2-22

Note Unless a clear distinction is made, all references to the NRP-2 also apply to the NRP-2SV.

Image and File Storage

The NRP-2 has no local image or file storage. The NSP stores the following NRP-2 files on the Personal Computer Memory Card International Association (PCMCIA) disk:

- NRP-2 images
- NRP-2 system configuration files
- NRP-2 ROM state information
- Crash information

Note A PCMCIA disk must be in NSP disk slot 0.

Whenever the NSP reloads, a PCMCIA disk is inserted, or the PCMCIA disk is formatted, the NSP checks for the following directories on the PCMCIA disk and automatically creates those that are missing:

- images—One directory for storing NRP-2 images.
- slot1, slot2,..., slot8—Eight directories for storing files for specific NRP-2 slots. Each slot directory normally contains the following files when an NRP-2 is present in the slot:
  - Startup configuration file (nrp2-startup-config)
  - ROMMON variables (nrp2_rommon_nv.0)
  - Crash information (crashinfo_*yyyymmdd-hhmmss*)

Note Do not remove the image and slot directories. Also, make sure that you understand the consequences before you delete any files in these directories.

You can create additional directories on the PCMCIA disk with the **mkdir** command. See the "Cisco IOS File Management" chapter in the *Cisco IOS Configuration Fundamentals Configuration Guide*.

Configuring NRP-2 Image Management on the NSP

The NSP controls and manages the NRP-2 image download process. Cisco recommends that you store all NRP-2 images on the NSP PCMCIA disk, but you can also store NRP-2 images on a TFTP, FTP, or rcp server.

You can also assign priority values to each NRP-2 image and path. This allows you to enter multiple **hw-module** (**image**) commands in any order, while still having control over how they are executed.

For each NRP-2 in your Cisco 6400 system, enter the following command on the NSP in global configuration mode:

Command	Purpose
`Switch(config)# hw-module slot` *slot* **image** *image-path* **priority** *priority*	Assigns an image filename and path to the specified NRP-2 processor in the selected slot. Priority range is from 1 (highest) to 4 (lowest).

Without the **hw-module** (**image**) command in the NSP configuration, the NRP-2 attempts to load the default image (c6400r2sp-g4p5-mz) from the disk0:/images/ directory.

Timesaver If you do not use all the priority values for NRP-2 images, leave priority 1 free for new or temporary images. Otherwise, you will have to adjust the priority levels of the other images for your NRP-2 to accommodate the new image.

Example

In the following example, the NRP-2 in slot 2 of the Cisco 6400 chassis has three images assigned with different priorities, while the NRP-2 in slot 3 has only one image assigned:

```
!
hw-module slot 2 image c6400r2sp-g4p5-mz.121-4.DC.bin priority 2
hw-module slot 2 image tftp://10.1.1.1/c6400r2sp-g4p5-mz.121-4.DC.bin priority 3
hw-module slot 2 image disk0:MyDir/c6400r2sp-g4p5-mz.121-4.DC.bin priority 4
hw-module slot 3 image c6400r2sp-g4p5-mz.121-4.DC.bin priority 2
!
```

In the first and last entries of the example, the system tries to find the images (with no specified path) in the disk0:/images/ directory.

Changing the NRP-2 Configuration Register Setting

The configuration register defaults to the correct setting for normal operation. You should not change this setting unless you want to enable the break sequence or switch ROMMON devices.

To change the NRP-2 configuration register setting, enter the following command in global configuration mode:

Command	Purpose
`Switch(config)# hw-module slot slot config-register value`[1]	Changes the configuration register setting of the NRP-2 in the specified slot.

1. For specific configuration register values, see "hw-module" in the *Cisco 6400 Command Reference*.

Example

In the following example, an NRP-2 in slot 3 is set to boot to ROMMON, where ROMMON runs from the image found in BootFROM1. If you enter the **boot** ROMMON command, the NRP-2 loads the specified image from the disk0:/images/ directory.

```
hw-module slot 3 config-register 0x2100
hw-module slot 3 image c6400r2sp-g4p5-mz.121-4.DC.bin priority 2
```

System Logging

By default, each system log message created by the NRP-2 appears on the NSP as a local message, and the message is labeled with the slot number of the NRP-2 that created the message. If console logging is enabled, each system log message also appears on the NRP-2 console.

For more information on NRP-2 console and system logging, see the "Using NRP-2 Console and System Logging" section on page3-15.

Disabling NRP-2 System Logging on the NSP

To disable the appearance of NRP-2 system log messages on the NSP, use the following EXEC command:

Command	Purpose
`Switch# no logging console`	Stops NRP-2 system log messages from appearing on the NSP.

Console and Telnet Access

The NSP has been equipped with an internal communication server to access the NRP-2 console lines. The NSP also has alias commands for using Telnet to connect to the NRP-2. For more information, see the "Methods Available for Configuring the NRP-2" section on page3-9.

SNMPv3 Proxy Forwarder

The NSP and NRP-2 support SNMPv1, SNMPv2c, and SNMPv3. The NSP can use the SNMPv3 Proxy Forwarder feature to:

- Route the SNMPv3 messages destined for NRP-2
- Forward NRP-2 traps to the Network Element Manager

For general information on using SNMP, see the "Configuring Simple Network Management Protocol (SNMP)" section in the "System Management" part of the *Cisco IOS Configuration Fundamentals Configuration Guide*. For information on the Proxy Forwarder feature, see the "Using the NSP as the SNMPv3 Proxy Forwarder for the NRP-2" section on page6-1.

Troubleshooting and Monitoring the NRP-2

Use the following NSP commands to troubleshoot or monitor the NRP-2:

Command	Purpose
Switch# **clear line** *slot*	Clears NRP-2 console connections from the NSP.
Switch> **who**	Displays the console and Telnet connections.
Switch> **show line** [*line-type*] *number*	Displays the parameters of a terminal line.
Switch# **debug config-download**	Displays debug messages for the configuration download protocol.
Switch# **debug image-download** [**tftp**]	Displays debug messages for the image download protocol. With optional **tftp** keyword, displays TFTP monitoring information as well.
Switch# **debug pmbox**	Displays debug messages for traffic flowing on the NRP-2 PAM mailbox serial interface.

More troubleshooting and monitoring commands can be entered on the NRP-2. See the "Troubleshooting and Monitoring the NRP-2" section on page3-16.

Examples

In the following example, the **who** EXEC command is used to identify the connection from the NSP to the NRP-2 console, and the **clear** privileged EXEC command is used to close the NRP-2 console session:

```
NSP# who
     Line       User       Host(s)              Idle       Location
*   0 con 0                 idle                 00:00:00
➔    6 tty 6                incoming             00:03:03   20.1.0.254
   18 vty 0                 10.6.0.2             00:02:59   20.1.5.1

   Interface  User      Mode                    Idle Peer Address

NSP# clear line 6
[confirm]
  [OK]
NSP# who
     Line       User       Host(s)              Idle       Location
*  0 con 0                 idle                 00:00:00
   18 vty 0                 10.6.0.2             00:03:07   20.1.5.1
```

```
   Interface  User      Mode                    Idle Peer Address

NSP#
```

In the following example, the **show line** EXEC command is entered on the NSP to look at the console connection to the NRP-2:

```
NSP# show line 6
    Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
*    6 TTY      0/0      -    -      -    -    -      7       0     0/0       -

Line 6, Location:"", Type:"XTERM"
Length:24 lines, Width:80 columns
Status:Ready, Connected, Active
Capabilities:EXEC Suppressed, Software Flowcontrol In,
   Software Flowcontrol Out
Modem state:Ready
Modem hardware state:CTS DSR  DTR RTS
Special Chars:Escape  Hold  Stop  Start  Disconnect  Activation
                ^^x    none   ^S     ^Q      none
Timeouts:     Idle EXEC    Idle Session   Modem Answer  Session   Dispatch
                00:10:00        never                      none     not set
                             Idle Session Disconnect Warning
                               never
                             Login-sequence User Response
                              00:00:30
                             Autoselect Initial Wait
                               not set
Modem type is unknown.
Session limit is not set.
Time since activation:00:03:26
Editing is enabled.
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed transports are telnet.  Preferred is telnet.
No output characters are padded
No special data dispatching characters
NSP#
```

Storing the NSP Configuration

When autoconfiguration and any manual configurations are complete, you should copy the configuration into nonvolatile random-access memory (NVRAM). If you reload the NSP before you save the configuration in NVRAM, you will lose all manual configuration changes.

To save your running configuration as the startup configuration in NVRAM, use the **copysystem:running-config** EXEC command:

```
Switch# copy system:running-config nvram:startup-config
Building configuration...
[OK]
Switch#
```

Verifying the NSP Configuration

To view the running configuration, use the **more system:running-config** EXEC command.

To view the startup configuration in NVRAM, use the **more nvram:startup-config** EXEC command.

Using the NSP File Systems and Memory Devices

File systems on the NSP include read-only memory (NVRAM, or system), Flash memory (such as PCMCIA disks 0 and 1, and boot flash), and remote file systems (such as TFTP or rcp servers). Use the **showfilesystems** privileged EXEC command to display the valid file systems on your NSP:

```
Switch# show file systems

File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
           -           -     flash     rw   sec-slot0:
           -           -     flash     rw   sec-slot1:
           -           -     flash     rw   sec-disk0:
           -           -     flash     rw   sec-disk1:
           -           -     flash     rw   sec-bootflash:
           -           -     nvram     rw   sec-nvram:
*   20819968    10022912     flash     rw   disk0:flash:
   109760512   109760512     flash     rw   disk1:
           -           -     flash     rw   slot0:
           -           -     flash     rw   slot1:
     7602176     2363376     flash     rw   bootflash:
           -           -    opaque     rw   null:
           -           -    opaque     rw   system:
           -           -   network     rw   tftp:
      520184      515975     nvram     rw   nvram:
    20819968    10022912     flash     rw   mir-disk0:
   109760512   109760512     flash     rw   mir-disk1
           -           -   network     rw   rcp:
           -           -   network     rw   ftp:
     5242880           0    opaque     ro   atm-acct-ready:
     5242880     5242880    opaque     ro   atm-acct-active:

Switch#
```

Use the **dir** privileged EXEC command to show the contents of a file system. Remember to include the trailing colon in the name of the file system:

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

  1  -rw-     3728308   Jan 01 2000 00:02:44  c6400s-wp-mz.120-5.DB

7602176 bytes total (3873740 bytes free)
Switch#
```

If your Cisco 6400 system contains an additional (secondary) NSP, use the **dir** command with file systems that begin with **sec-** to show file systems on the secondary NSP. For example, **dir sec-nvram:** will show the contents of the NVRAM on the secondary NSP.

Caution Do not use **slot0:** and **slot1:** to refer to the NSP PCMCIA disks. Use **disk0:** and **disk1:** instead.

Example—Disk0: versus Slot0:

```
Switch# dir disk0:
Directory of disk0:/

  3  -rw-      628224   Jan 01 2000 00:08:55  c6400s-html.tar.120-4.DB
157  drw-           0   Jan 01 2000 00:11:01  nsp-html
376  -rw-        2134   Jan 05 2000 22:05:27  startup.config

109760512 bytes total (108228608 bytes free)

Switch# dir slot0:
%Error opening slot0:/ (Device not ready)
Switch#
```

In Cisco IOS Release 12.1(5)DB, the PCMCIA Disk Mirroring feature introduced the **mir-disk0:** and **mir-disk1:** labels. These labels enable you to perform any integrated file system (IFS) operation (such as **copy**, **rename**, and **delete**) on the same file on both the primary and secondary PCMCIA disks. For more information, see the "Performing Mirrored IFS Operations" section on page 5-11.

Basic NRP Configuration

This chapter describes how to perform a basic configuration for the node route processors (NRP-1, NRP-2, and NRP-2SV). The Cisco6400 can contain multiple NRP modules, configured to operate independently or as 1+1 redundant pairs (NRP-1 only at this time). This chapter contains the following sections:

For information on differences among the NRP types, see the release notes for your specific software images. Also see Table1-1 on page1-4.

NRP-1 Configuration

This section describes configuration information specific to the NRP-1, including:

Methods Available for Configuring the NRP-1

The following methods are available for configuring the NRP-1:

- From a local console or workstation—Connect to the console port of the NRP-1.
- From a remote console or workstation—Initiate a Telnet connection to the NRP-1 over the NME interface.
- From the Cisco 6400 Service Connection Manager—See theCisco 6400 SCM documentation.

For general information on basic Cisco IOS configuration, see the *Cisco IOS Configuration Fundamentals Configuration Guide*.

Note If your Telnet station or Simple Network Management Protocol (SNMP) network management workstation and the Cisco 6400 are on different networks, you must either use Dynamic Host Configuration Protocol (DHCP) to provide a default route, or add a static routing table entry to the routing table. To assign a static IP route, use the **ip route** global configuration command.

Initial NRP-1 Configuration

An NRP-1 running Cisco IOS Release 12.0(5)DC or later comes preinstalled with a default configuration and does not require initial configuration.

The following sections describe how to configure the NRP-1 for the first time:

Using DHCP

If you plan to configure a DHCP server to inform the NRP-1 of its IP address and mask, write down the Media Access Control (MAC) address of the server's Ethernet port.

Optionally, take note of a default gateway address and static routes to the DHCP server.

Note The Cisco 6400 performs a DHCP request *only* if the NME interface is configured with the **ipaddress negotiated** interface configuration command.

DHCP is the default IP assignment protocol for a new NRP-1, or for an NRP-1 that has had its configuration file cleared by means of the **erase nvram:startup-config** command. For DHCP, an Ethernet IP address, subnet mask, and the default route are retrieved from the DHCP server for any interface set with the **ip address negotiated** command. To configure DHCP, add an entry in the DHCP database using the instructions that came with your DHCP server.

Checking the Software Release Version and Choosing the Configuration Method

Complete the following steps to check the software release version and prepare for initial configuration:

Step 1 Connect a console terminal or a terminal server to the NRP-1 console port on the NRP-1 faceplate.

After the NRP-1 autoboots, the following information appears to verify that the router has booted successfully.

Take note of the software release version included in the display. For information on upgrading to a higher release version, see Upgrading Software on the Cisco 6400.

```
                Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
```

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

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

Cisco Internetwork Operating System Software
IOS (tm) C6400R Software (C6400R-G4P5-M), Version 12.3
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Thu 14-Oct-02 2314 by jdoe
Image text-base 0x60008960, data-base 0x60D2A000

Cisco NRP (NRP1) processor with 94208K/36864K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 1024KB L2 Cache
Last reset from BOOTFLASH
X.25 software, Version 3.0.0.
Bridging software.
2 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
1 ATM network interface(s)
125K bytes of non-volatile configuration memory.

4096K bytes of Boot flash ROM (Sector size 256K).
8192K bytes of Flash SIMM (Sector size 256K).


Press RETURN to get started!
```

Step 2 Press **Return**. After a few seconds, the user EXEC prompt `Router>` appears. Use the **enable** EXEC command to enter privileged EXEC mode:

```
Router> enable
Router#
```

The prompt changes to the privileged EXEC prompt, from which you can manually configure the NRP-1. Proceed to the "Configuring the NRP-1" section on page3-3.

Configuring the NRP-1

To perform an initial basic NRP-1 configuration, complete the following steps:

Step 1 Use the **configure terminal** privileged EXEC command to enter global configuration mode:

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

The prompt changes to the global configuration mode prompt.

Step 2 Enter the enable secret (which is a secure encrypted password) and the enable password (which is a nonencrypted password). The passwords should be different for maximum security. The following example sets the enable secret to "walnut" and the enable password to "pecan":

```
Router(config)# enable secret walnut
Router(config)# enable password pecan
```

An enable secret can contain from 1 to 25 uppercase and lowercase alphanumeric characters; an enable password or virtual terminal password can contain any number of uppercase and lowercase alphanumeric characters. In all cases, a number cannot be the first character. Spaces are also valid password characters. Leading spaces are ignored; trailing spaces are recognized.

Step 3 Enter a host name for the NRP-1. The default host name is `Router`. The host name appears in the CLI prompt.

```
Router(config)# hostname NRP-1
NRP-1(config)#
```

Step 4 If you are upgrading the NRP-1 from an earlier software version to Cisco IOS Release 12.0(5)DC or later, you can configure the NRP-1 to support network management Ethernet (NME) consolidation with the NSP. Complete the following steps to enable NME consolidation:

a. Enter interface configuration mode for Ethernet 0/0/0:

```
NRP-1(config)# interface ethernet 0/0/0
```

b. Remove any IP address and subnet mask associated with Ethernet 0/0/0:

```
NRP-1(config-if)# no ip address
```

c. Enter interface configuration mode for Ethernet 0/0/1:

```
NRP-1(config-if)# interface ethernet 0/0/1
```

d. Choose one of the following methods of assigning the IP address to Ethernet 0/0/1:

- Enable the DHCP server to obtain an IP address for Ethernet 0/0/1:

```
NRP-1(config-if)# ip address negotiated
```

or

- Assign a static IP address to Ethernet 0/0/1:

```
NRP-1(config-if)# ip address 172.26.94.158 255.255.255.0
```

e. Return to privileged EXEC mode:

```
NRP-1(config-if)# ^Z
```

Step 5 Store the running configuration in NVRAM as the startup configuration:

```
NRP-1# copy system:running-config nvram:startup-config
Destination filename [nrp-startup-config]? <cr>
847927 bytes copied in 280.48 secs (3028 bytes/sec)
NRP-1#
```

When the NRP-1 reloads, it runs the startup configuration. If you do not perform Step 5, your configuration changes will be lost the next time you reload the NRP-1.

Your NRP-1 is now minimally configured and will reload with the configuration you have entered. To see a list of the configuration commands available to you, enter **?** at the prompt or press the **help** key while you are in configuration mode.

Verifying the Initial NRP-1 Configuration

To check the running configuration, use the **more system:running-config** EXEC command.

To check the startup configuration in NVRAM, use the **more nvram:startup-config** EXEC command.

Segmentation and Reassembly Buffer Management

In Cisco IOS Release 12.1(1)DC, the following segmentation and reassembly (SAR) buffer management enhancements were introduced:

- Reduced Segmentation Buffer Size—Prior to this release, the default size of the PVC segmentation buffer was 256 packets. This meant that each PVC could queue up to 256 packets to be segmented and sent. Now the default size is 32 packets, and a new command allows you to manually change the segmentation buffer size.
- Increased Input/Output Memory Size—Prior to this release, the default input/output (I/O) memory size was 16 MB for NRP-1s with 64 MB or 128 MB DRAM. Now the default I/O memory size is 18 MB for an NRP-1 with 64 MB DRAM, and 36MB for an NRP-1 with 128 MB DRAM. You can also manually set the I/O memory size with an environment variable under ROM monitor (ROMMON).
- Reserved Segmentation Buffer Slot for High-Priority Packets—For each PVC, a segmentation buffer slot is reserved for high-priority packets.

These SAR buffer management enhancements reduce the amount of memory resources that can be held by congested PVCs. This prevents a small group of congested PVCs from using all available memory resources and adversely affecting the performance of other PVCs. The enhancements also improve high-priority packet transmission. With a segmentation buffer slot reserved for high-priority packets, each PVC accommodates high-priority packets even when the segmentation buffer is full.

Note Because of process memory usage, setting the I/O memory size to a larger value might reduce the number of sessions that your NRP-1 can handle.

Setting the Segmentation Buffer Size

Caution Entering the **atm vc tx** command can cause service disruption. Only enter this command during maintenance windows.

To manually set the size of all PVC segmentation buffers, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# interface atm 0/0/0`	Specifies the ATM interface.
Step2	`Router(config-if-atm-vc)# atm vc tx` *queue-depth*	Sets the maximum number of packets in the PVC segmentation buffers.

Example

In the following example, the PVC segmentation buffer size is set to 64 packets.

```
!
interface atm 0/0/0
 atm vc tx 64
 !
```

Verifying the PVC Segmentation Buffer Size

To verify successful configuration of the segmentation buffer size, use the **show running-config** EXEC command.

Setting the I/O Memory Size

To manually set the size of I/O memory, enter the following command in ROMMON mode:

Command	Purpose
Rommon> **IOMEM=***size*	Sets the size, in MB, of I/O memory. Allowed values depend on the amount of DRAM on your NRP, and they are listed in Table3-1.

Table3-1 Allowed Values of I/O Memory on the Cisco 6400 NRP-1

Main Memory on NRP-1	Allowed I/O Memory Range	Default IOMEM Setting
64 MB DRAM	18 MB to 24 MB	18 MB
128 MB DRAM	18 MB to 60 MB	36 MB

Note IOMEM entries must be an even number. If you enter an odd number, the NRP-1 will round it down to an even number. If you enter a number outside of the allowed I/O memory range, the NRP-1 will use the default IOMEM setting. You can also enter **unset IOMEM** in ROMMON to return to the default setting.

Example

In the following example, the I/O memory size is set to 20 MB.

```
Rommon> IOMEM=20
```

Verifying the I/O Memory Size

To verify that you successfully set the I/O memory size, use the **show memory** EXEC command. The following example shows an NRP-1 with an I/O memory size of 16 MB:

```
Router# show memory
              Head   Total(b)    Used(b)    Free(b)   Lowest(b)  Largest(b)
Processor  60E27540   35490496    5517076   29973420   14919296   29838876
    I/O     3000000   16777216    6006460   10770756    5385388   10770108
```

Using the NRP-1 File Systems and Memory Devices

File systems on the NRP-1 include read-only memory (system), read-write memory (NVRAM), Flash memory (boot flash), and remote file systems (such as TFTP, FTP, and rcp servers). Use the **showfilesystems** privileged EXEC command to display the valid file systems on your NRP-1:

```
Router# show file systems
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
           -           -     flash     rw   sec-flash:
```

```
            -           -     flash     rw   sec-bootflash:
            -           -     nvram     rw   sec-nvram:
*     3407872      249884     flash     rw   bootflash:
      7602176     3905620     flash     rw   flash:
            -           -    opaque     rw   null:
            -           -    opaque     rw   system:
            -           -   network     rw   tftp:
       129016      128049     nvram     rw   nvram:
            -           -    opaque     wo   lex:
            -           -   network     rw   rcp:
            -           -   network     rw   ftp:

Router#
```

Use the **dir** command to show the contents of a file system. Remember to include the trailing colon in the name of the file system:

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

  1  -rw-     3157860   Jul 15 2000 03:45:14  c6400r-boot-mz.120-5.DC

3407872 bytes total (249884 bytes free)
Router#
```

If your Cisco 6400 system is configured with redundant NRP-1s, use the **dir** command with file systems that begin with **sec-** to show file systems on the secondary (redundant) NRP-1. For example, **dirsec-nvram:** will show the contents of the NVRAM on the secondary NRP-1.

NRP-2 and NRP-2SV Configuration

This section describes information specific to the NRP-2 and NRP-2SV. This section includes the following topics:

Note Unless a clear distinction is made, all references to the NRP-2 also apply to the NRP-2SV.

Restrictions

For a complete list of restrictions, limitations, and supported features, see the release notes for the software version running on your NRP-2.

This section describes the following limitations:

- Soft PVCs Between the NRP-2 and NSP
- Maximum Transmission Unit
- VPI and VCI Limitation

Soft PVCs Between the NRP-2 and NSP

Soft PVCs between the NRP-2 and NSP are not supported.

Maximum Transmission Unit

The maximum transmission unit (MTU) of the NRP-2 ATM interface to the backplane is 1900 bytes. Any incoming ATM packet larger than 1900 bytes is dropped by the NRP-2. To make sure that no incoming packets are larger than the NRP-2 MTU, see the "Matching the MTU Size of the NRP-2 and Its Network Neighbors" section on page3-11.

VPI and VCI Limitation

Note For Cisco IOS Releases 12.2(4)B, 12.2(13)T, 12.3, and later releases, the NRP-2SV supports 16 bits of VPI and VCI values. The 14-bit VPI and VCI limitation described in this section applies to the NRP-2 and to the NRP-2SV running CiscoIOS Release 12.2(2)B and earlier releases.

VPI and VCI values on the NRP-2 must share 14 bits. By default, VPI values are limited to 4 bits (0–15), and VCI values are limited to 10 bits (0–1023). You can change the VPI and VCI ranges, but together the VPI and VCI values cannot exceed 14 bits. To change the allowed VPI and VCI values, see the "Modifying VPI and VCI Ranges on the NRP-2" section on page3-13.

Prerequisites

- A Personal Computer Memory Card International Association (PCMCIA) disk must be in NSP disk slot 0. If using redundant NSPs, make sure that the secondary NSP also has a PCMCIA disk in disk slot 0.
- Use the same release versions for the system images on the NRP-2 and the NSP.
- Copy the NRP-2 image to a TFTP server on the local management network or to the PCMCIA disk in NSP disk slot 0.
- Complete the NSP configuration tasks in the "NRP-2 and NRP-2SV Support" section on page2-19.

Methods Available for Configuring the NRP-2

There are two methods available for accessing the NRP-2:

- Accessing the NRP-2 Console Through the NSP
- Using Telnet to Connect to the NRP-2 from the NSP

You can also configure the NRP-2 with the Cisco 6400 Service Connection Manager, Release 2.2(1) and later. For more information, see theCisco 6400 SCM documentation.

Accessing the NRP-2 Console Through the NSP

The NSP is equipped with an internal communication server for accessing the NRP-2 console line. To access the NRP-2 console line, use Telnet to connect to the NSP as a communication server, using the port numbers shown in Table3-2 to select the NRP-2.

Table3-2 Internal NSP Communication Server Port-Slot Associations

NSP Communication Server Port Numbers	Associated Cisco 6400 Chassis Slot
2001, 4001, 6001	Slot 1
2002, 4002, 6002	Slot 2
2003, 4003, 6003	Slot 3
2004, 4004, 6004	Slot 4
2005, 4005, 6005	Slot 5
2006, 4006, 6006	Slot 6
2007, 4007, 6007	Slot 7
2008, 4008, 6008	Slot 8

To exit the NRP-2 console line without closing the console connection, use the escape sequence **Ctrl-Shift-6 x**. To close the NRP-2 console line connection, use the **exit** command.

Example

Suppose the NSP in your Cisco 6400 system has the management IP address 10.1.5.4. To access the console line of the NRP-2 in Slot 6 of the same Cisco 6400 chassis, use the **telnet** command from another router:

```
device# telnet 10.1.5.4 2006
Trying 10.1.5.4, 2006 ... Open

NRP-2#
```

To return to the device prompt without closing the NRP-2 console line connection, enter the escape sequence **Ctrl-Shift-6** at the NRP-2 prompt. Notice that the full escape sequence does not appear as you enter it in the command-line interface (CLI):

```
NRP-2# Ctrl^ x
device#
```

To return to the connected NRP-2 console line, enter a blank line at the device prompt:

```
device#
[Resuming connection 1 to 10.1.5.4 ... ]

NRP-2#
```

To close the NRP-2 console line connection, use the escape sequence to return to the device prompt, and then use the **exit** command.

```
NRP-2# Ctrl^
device# exit
  (You have open connections) [confirm]
Closing:10.1.5.4 !


device con0 is now available



Press RETURN to get started.



device>
```

Using Telnet to Connect to the NRP-2 from the NSP

The NSP is equipped with command aliases for using Telnet to connect to an NRP-2 in the same Cisco6400 chassis. To use Telnet to connect to the NRP-2, use the following NSP command alias in EXEC mode:

Command	Purpose
Switch# **nrps***slot*	Uses Telnet to connect to the NRP-2 in the specified slot.

Note Set the enable password for the NSP before you use Telnet to connect to the NRP-2.

To exit the NRP-2 VTY line without closing the Telnet session, use the escape sequence **Ctrl**-**Shift**-**6**. To close the NRP-2 Telnet session, use the **exit** command.

Example

Suppose you want to use Telnet to connect to the NRP-2 from a device outside your Cisco 6400 system, and the NSP in the Cisco 6400 has the management IP address 10.1.5.4.

To use Telnet to connect to the NRP-2, first connect to the NSP, and then use the **nrps** command alias to connect to the NRP-2:

```
device# telnet 10.1.5.4
Trying 10.1.5.4 ... Open


User Access Verification
```

```
Password:
NSP>
NSP> nrps6
Trying 10.6.0.2 ... Open

NRP-2>
```

To close the Telnet session to the NRP-2 and return to the NSP prompt, use the **exit** command.

```
NRP-2> exit

[Connection to 10.6.0.2 closed by foreign host]
NSP>
```

Matching the MTU Size of the NRP-2 and Its Network Neighbors

The NRP-2 ATM interface to the backplane supports a maximum packet size, or maximum transmission unit (MTU), of 1900 bytes. The ATM interface drops any incoming packet larger than 1900 bytes. To prevent packets from being dropped, make sure that the MTU sizes match for both ends of virtual connections.

Displaying the MTU for the Main ATM Interface

To check the current MTU size on the NRP-2 ATM main interface, use the **show interface atm 0/0/0** EXEC command, which displays the following fields:

- MTU—Largest MTU setting among all subinterfaces and the main ATM interface
- sub MTU—MTU setting on the main ATM interface

Example—Main ATM Interface

```
NRP-2# show interface atm 0/0/0
...
  MTU 1870 bytes, sub MTU 1850, BW 599040 Kbit, DLY 60 usec,
...
```

Displaying the MTU for a Subinterface

To display the current MTU size on the NRP-2 ATM subinterface, use the **showinterfaceatm0/0/0.***subinterface* EXEC command. This command displays only one MTU field that represents the MTU setting for the subinterface.

Example—ATM Subinterface

```
NRP-2# show interface atm 0/0/0.100
...
  MTU 1870 bytes, BW 599040 Kbit, DLY 60 usec,
...
```

Displaying the MTU for a Network Neighbor

To check the current MTU size on the network neighbor, use the **show interface atm** EXEC command for the interface used to terminate the virtual connection from the NRP-2.

Example—Cisco 7200

```
7200# show interface atm 1/0
ATM1/0 is up, line protocol is up
  Hardware is ENHANCED ATM PA
  MTU 4470 bytes, sub MTU 4470, BW 149760 Kbit, DLY 80 usec,
...
```

Example—Cisco 6400 NRP-1

```
NRP-1# show interface atm 0/0/0
ATM0/0/0 is up, line protocol is up
  Hardware is ATM-SAR
  MTU 4470 bytes, sub MTU 4470, BW 156250 Kbit, DLY 80 usec,
...
```

Changing the MTU on the NRP-2

To adjust the MTU size on the NRP-2, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# interface atm 0/0/0`	Selects the ATM interface on the NRP-2.
Step2	`Router(config-if)# mtu` *bytes*	Specifies the maximum packet size, in bytes, for the interface. The maximum value is 1900.

Changing the MTU on a Network Neighbor

To adjust the MTU size on the network neighbor, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# interface atm` *slot/subslot/port* [*.subinterface* [**point-to-point** | **multipoint**]]	Selects the interface used to terminate the VC from the NRP-2.
Step2	`Router(config-if)# mtu` *bytes*	Specifies the maximum packet size, in bytes, for the interface. If the interface is used to terminate PVCs from the NRP-2, do not exceed 1900.

Example

Suppose that the **show interface atm 0/0/0** EXEC command displayed the MTU size of 1900bytes on the NRP-2, and the MTU size of 4470 bytes on a neighboring NRP-1.

```
NRP-2# show interface atm 0/0/0
ATM0/0/0 is up, line protocol is up
  Hardware is NRP2 ATM SAR
  MTU 1900 bytes, sub MTU 1900, BW 599040 Kbit, DLY 60 usec,
...

NRP-1-neighbor# show interface atm 0/0/0
ATM0/0/0 is up, line protocol is up
  Hardware is ATM-SAR
  MTU 4470 bytes, sub MTU 4470, BW 156250 Kbit, DLY 80 usec,
...
```

In the following example, the network neighbor MTU size is reduced to 1900 to match the MTU size of the NRP-2.

```
!
interface ATM0/0/0
 mtu 1900
 no ip address
 atm vc-per-vp 2048
 no atm ilmi-keepalive
!
```

Verifying the MTU Size of the NRP-2 and Its Network Neighbors

To verify that the MTU size matches for the NRP-2 and its network neighbors, complete the following steps for each network neighbor:

Step 1 Use the **show interface atm 0/0/0**[*.subinterface*] EXEC command on the NRP-2 to view the NRP-2 MTU size.

Step 2 Use the **show interface** EXEC command on the network neighbor to view the neighbor's MTU size.

Step 3 Make sure that the MTU sizes for the NRP-2 and the network neighbor are identical.

Modifying VPI and VCI Ranges on the NRP-2

To change the VPI and VCI ranges, use the following commands beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# interface atm 0/0/0`	Selects the ATM interface on the NRP-2.
Step2	`Router(config-if)# atm vc-per-vp` *number*	Sets the maximum number of allowed VCIs. The number of allowed VPIs is adjusted accordingly. See Table3-3 for the allowed values for *number*.

Note Entering the **atm vc-per-vp** command in interface configuration mode resets the ATM interface.

Table3-3 Allowed Entries for the number Argument

number[1]	VCI Range	VCI Bits	NRP-2SV[2]		NRP-2	
			VPI Range	VPI Bits	VPI Range	VPI Bits
64	0–63	6	0–255	8	0–255	8
128	0–127	7	0–255	8	0–127	7
256	0–255	8	0–255	8	0–63	6
512	0–511	9	0–127	7	0–31	5
1024 (default)	0–1023	10	0–63	6	0–15	4

Table3-3 Allowed Entries for the *number* Argument

number[1]	VCI Range	VCI Bits	NRP-2SV[2]		NRP-2	
			VPI Range	VPI Bits	VPI Range	VPI Bits
2048	0–2047	11	0–31	5	0–7	3
4096	0–4095	12	0–15	4	0–3	2
8192	0–8191	13	0–7	3	0–1	1

1. Notice that the smallest allowed *number* entry is 64. The next possible value would be 32 (VCI range 0–31), but VCI values 0 through 31 are reserved by the ATM Forum for particular functions (such as ILMI).
2. The VPI ranges and number of bits shown for the NRP-2SV apply to Cisco IOS Release 12.2(4)B, 12.2(13)T, 12.3, and later releases. For the NRP-2SV running Cisco IOS Release 12.2(2)B, refer to the VPI ranges and number of bits shown for the NRP-2.

Example

In the following example, the VCI range is set to 2048 values (0–2047):

```
!
interface ATM0/0/0
 no ip address
 atm vc-per-vp 2048
 no atm ilmi-keepalive
!
```

Verifying the VPI and VCI Ranges

To verify successful configuration of the VPI and VCI ranges, complete one or both of the following steps:

Step 1 Use the **more system:running-config** command in EXEC mode to check for successful configuration:

```
Router# more system:running-config
...
interface ATM0/0/0
 no ip address
 atm vc-per-vp 2048
...
```

Step 2 Use the **show controller atm 0/0/0** command in privileged EXEC mode:

```
Router# show controller atm 0/0/0
...
*** SE64 General Data ***

  SE64_MAX_TX_PTYPE_HOLDER = 49152
  SE64_PARTICLE_POOL       = 32255

  VPI bits                 = 5

  VCI bits                 = 11

  SAR revision E
....
```

Saving the NRP-2 Startup Configuration

To save the NRP-2 running configuration to NVRAM as the startup configuration, use the **copy** EXEC command:

```
NRP-2# copy system:running-config nvram:startup-config
Destination filename [nrp-startup-config]? <cr>
847927 bytes copied in 280.48 secs (3028 bytes/sec)
NRP-2#
```

Note Although the prompt displays the destination filename of `nrp-startup-config`, the NRP-2 uses the filename `nrp2-startup-config` and saves it in the NSP PCMCIA disk0:/slot*n*/ directory, where *n* is the slot in which the NRP-2 is installed.

When the NRP-2 reloads, it runs the startup configuration. If you do not save to the startup configuration, your configuration changes will be lost the next time you reload the NRP-2.

Using NRP-2 Console and System Logging

By default, each system log message created by the NRP-2 appears on the NSP as a local message, and the message is labeled with the slot number of the NRP-2 that created the message. Each system log message also appears on the NRP-2 console.

To control console and system logging, use the following commands:

Command	Entered On	Purpose
`Router(config)# logging rate-limit` *rate*	NRP-2	Limits the number of messages logged per second. Cisco recommends setting the rate limit to 25 messages per second.
`Router(config)# logging buffered` *size*	NRP-2	Expands logging buffer size.
`Router# show logging`	NRP-2	Shows the contents of logging buffers.
`Router(config)# no logging console`	NRP-2	Stops NRP-2 system log messages from appearing on the NSP and NRP-2 consoles. Messages are still logged on the NSP.
`Switch(config)# no logging console`	NSP	Stops NRP-2 system log messages from appearing on the NSP.

For more information on system and console logging, see the “Redirecting Debug and Error Message Output” section in the “Using Debug Commands” chapter in the *Cisco IOS Debug Command Reference*.

Troubleshooting and Monitoring the NRP-2

Use the following debug commands to troubleshoot the NRP-2:

Debug Command (Entered on the NRP-2)	Purpose
`Router# debug se64 {detail | errors}`	Displays debug messages for the NRP-2 ATM SAR.
`Router# debug xconn`	Tracks the requests and responses for the cross-connect information protocol.
`Router# debug pmbox`	Displays debug messages for traffic flowing on the NRP-2 PAM mailbox serial interface.

Debug Command (Entered on the NSP)	Purpose
`Switch# debug config-download`	Displays debug messages for the configuration download protocol.
`Switch# debug image-download [tftp]`	Displays debug messages for the image download protocol. With optional **tftp** keyword, displays TFTP monitoring information as well.
`Switch# debug pmbox`	Displays debug messages for traffic flowing on the NRP-2 PAM mailbox serial interface.

Use the following commands to monitor and maintain the NRP-2:

Command	Purpose
`NRP-2> who` `NSP> who`	Displays the console and telnet connections on either the NSP or NRP-2.
`NSP# clear line slot`	Clears NRP-2 console connections from the NSP.
`NSP> show line [line-type] number` `NRP-2> show line [line-type] number`	Displays the parameters of a terminal line on either the NSP or NRP-2.
`NRP-2> show controller async`	Displays information specific to the NRP-2 PAM mailbox serial interface.

Example—Using the who and clear Commands on the NSP

In the following example, the **who** EXEC command is used to identify the connection from the NSP to the NRP-2 console, and the **clear** privileged EXEC command is used to close the NRP-2 console session:

```
NSP# who
     Line       User       Host(s)              Idle       Location
*  0 con 0                idle                 00:00:00
➔     6 tty 6               incoming             00:03:03 20.1.0.254
   18 vty 0               10.6.0.2             00:02:59 20.1.5.1

   Interface  User      Mode                    Idle Peer Address

NSP# clear line 6
[confirm]
  [OK]
```

```
NSP# who
     Line       User       Host(s)              Idle       Location
*  0 con 0                idle                 00:00:00
   18 vty 0                10.6.0.2             00:03:07 20.1.5.1

   Interface  User      Mode                     Idle Peer Address

NSP#
```

Example—Using the show line Command on the NSP

In the following example, the **show line** EXEC command is entered on the NSP to look at the console connection to the NRP-2:

```
NSP# show line 6
    Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
*    6 TTY      0/0      -    -      -    -    -      7       0     0/0       -

Line 6, Location:"", Type:"XTERM"
Length:24 lines, Width:80 columns
Status:Ready, Connected, Active
Capabilities:EXEC Suppressed, Software Flowcontrol In,
   Software Flowcontrol Out
Modem state:Ready
Modem hardware state:CTS DSR  DTR RTS
Special Chars:Escape  Hold  Stop  Start  Disconnect  Activation
                ^^x    none   ^S     ^Q      none
Timeouts:     Idle EXEC    Idle Session   Modem Answer  Session   Dispatch
                00:10:00       never                      none     not set
                            Idle Session Disconnect Warning
                              never
                            Login-sequence User Response
                             00:00:30
                            Autoselect Initial Wait
                              not set
Modem type is unknown.
Session limit is not set.
Time since activation:00:03:26
Editing is enabled.
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed transports are telnet.  Preferred is telnet.
No output characters are padded
No special data dispatching characters
NSP#
```

Example—Using the show line Command on the NRP-2

In the following example, the **show line** EXEC command is used to view the NRP-2 console line parameters from the NRP-2:

```
NRP-2> show line con 0
    Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
*     0 CTY              -    -      -    -    -      0       0     0/0       -

Line 0, Location:"", Type:""
Length:24 lines, Width:80 columns
Status:PSI Enabled, Ready, Active, Automore On
Capabilities:Software Flowcontrol In, Software Flowcontrol Out
Modem state:Ready
Special Chars:Escape  Hold  Stop  Start  Disconnect  Activation
                ^^x    none   ^S     ^Q      none
Timeouts:     Idle EXEC    Idle Session   Modem Answer  Session   Dispatch
                never         never                        none     not set
                            Idle Session Disconnect Warning
                              never
                            Login-sequence User Response
                             00:00:30
                            Autoselect Initial Wait
                              not set
Modem type is unknown.
Session limit is not set.
Time since activation:00:09:09
Editing is enabled.
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed transports are pad telnet rlogin.  Preferred is telnet.
No output characters are padded
No special data dispatching characters
NRP-2>
```

Example—Using the show controller async Command on the NRP-2

In the following example, the **show controller async** EXEC command is used to monitor the NRP-2 PAM mailbox serial interface:

```
NRP-2> show controller async
Pam bus async console controller
PAM bus data for mailbox at 0x1C00FFC0
   magic1 = 0xDEADBABE, magic2 = 0x21524541
   in_data = 0x0000000D, out_data = 0x0000000A
   in_status.received_break = 0
   out_status.received_break = 0
   tx_owned = TRUE, rx_owned = FALSE
Buffer information
   Rx ttycnt 0
   Tx ttycnt 16B
   Rx Buffs:inpk 0/0 inheadpk 0 dataq 0 0 0
            pakq 0 0 0
   Tx Buffs:outpk 0  txpkq 0 0 0
   Rx totalin 325 Tx totalout 7933
NRP-2>
```

Example—Using the show controller async Command on the NSP

In the following example, the **show controller async** EXEC command is entered on the NSP to view the PAM mailbox serial interface for the NRP-2 in slot 6:

```
NSP# show controller async
Async NRP2 Pam bus controller
TTY line 1 not available
TTY line 2 not available
TTY line 3 not available
TTY line 4 not available
TTY line 5 not available
TTY line 6
PAM bus data for mailbox at 0xA8A8FFC0
   magic1 = 0xDEADBABE, magic2 = 0x21524541
   in_data = 0x0000000D, out_data = 0x0000003E
   in_status.received_break = 0
   out_status.received_break = 0
   tx_owned = TRUE, rx_owned = FALSE
Buffer information
   Rx ttycnt 0
   Tx ttycnt 0
   Rx Buffs:inpk 0/0 inheadpk 0 dataq 0 0 0
             pakq 0 0 0
   Tx Buffs:outpk 0  txpkq 0 0 0
   Rx totalin 1302 Tx totalout 69
TTY line 7 not available
TTY line 8 not available
TTY line 9 not available
TTY line 10 not available
TTY line 11 not available
TTY line 12 not available
TTY line 13 not available
TTY line 14
PAM bus data for mailbox at 0xA8E8FFC0
   magic1 = 0xDEADBABE, magic2 = 0x21524541
   in_data = 0x00000000, out_data = 0x00000000
   in_status.received_break = 0
   out_status.received_break = 0
   tx_owned = TRUE, rx_owned = FALSE
Buffer information
   Rx ttycnt 0
   Tx ttycnt 0
   Rx Buffs:inpk 0/0 inheadpk 0 dataq 0 0 0
             pakq 0 0 0
   Tx Buffs:outpk 0  txpkq 0 0 0
   Rx totalin 0 Tx totalout 0
TTY line 15 not available
TTY line 16 not available
NSP#
```

Transferring an NRP-1 Configuration to an NRP-2 or NRP-2SV

This section describes how to properly transfer an existing NRP-1 configuration to an NRP-2 or NRP-2SV. Unless a clear distinction is made, all references to the NRP-2 also apply to the NRP-2SV. Complete the following steps:

Step 1 Copy the existing NRP-1 configuration to a location where you can edit the file:

```
Router# copy flash:my.cfg tftp://10.1.1.1/my.cfg
```

Step 2 Edit the configuration file so that:

a. All VPI and VCI values are accepted by the NRP-2 default ranges (VPI range is 0–15, and VCI range is 0–1023).

b. The ATM MTU settings are less than 1900 bytes and match the MTU settings on the network neighbors.

This edited file is the new NRP-2 configuration file.

Step 3 In the NSP configuration, remove all VCs to the NRP-1 that you are replacing.

Step 4 From the NSP, copy the NRP-2 configuration to the appropriate slot directory in the PCMCIA disk in NSP disk slot 0. Make sure that the filename is “nrp2-startup-config.”

```
Switch# copy tftp://10.1.1.1/my.cfg disk0:/slot4/nrp2-startup-config
```

Step 5 Verify that:

a. The NRP-2 image is in the desired location.

b. The NSP is configured to boot the NRP-2 image.

For details, see the “Configuring NRP-2 Image Management on the NSP” section on page2-20.

Step 6 On the NRP-1, shut down the ATM interface.

```
Router(config)# interface atm 0/0/0
Router(config-if)# shutdown
```

Step 7 Remove the NRP-1 from the Cisco 6400 chassis, and replace it with the NRP-2.

Step 8 On the NSP, reconfigure the VCs that you removed in Step 3.

Step 9 If the NRP-2 did not boot upon insertion, reload the NRP-2 from the NSP.

```
Switch# hw-module slot 4 reset
```

Permanent Virtual Circuits

Permanent virtual circuits (PVCs) are used to connect the NRP to the ATM interfaces of the NSP and node line cards (NLCs) in the Cisco 6400 chassis. Typically, each subscriber is bound to a specific NRP and should be configured as a separate PVC.

Note Soft VCs between the NRP and NSP are not supported.

The following sections describe common methods of configuring PVCs:

- Configuring PVCs on the ATM Interface, page 3-21
- Configuring PVCs on ATM Subinterfaces, page 3-22
- Configuring VC Classes, page 3-24
- Configuring PVC Discovery, page 3-26
- Configuring PVC Traffic Shaping, page 3-28

For more general information on configuring PVCs, refer to the "Configuring ATM" chapter in the *CiscoIOS Wide-Area Networking Configuration Guide* associated with your software release version.

Note Any PVC configured on the NRP must also be configured for the corresponding ATM interface on the NSP. See the "Internal Cross-Connections" section on page2-10.

Configuring PVCs on the ATM Interface

To configure a PVC on the ATM interface, complete the following steps beginning in global configuration mode:

	Command	Description
Step1	`Router(config)# interface atm 0/0/0`	Specifies the NRP ATM interface and enters interface configuration mode.
Step2	`Router(config-if)# pvc [name] vpi/vci`	Configures a new ATM PVC by assigning a name (optional) and VPI/VCI values. Enters ATM VC configuration mode.

Step3	`Router(config-if-atm-vc)# encapsulation {aal5snap | aal5nlpid}`
	or
	`Router(config-if-atm-vc)# encapsulation {aal5mux ppp | aal5autoppp | aal5ciscoppp} virtual-template number`
		Configures the ATM adaptation layer (AAL) and encapsulation type for a PVC. May configure a PVC to use a virtual template[1] as the default PPP interface configuration.

1. A virtual template assigns PPP features (such as authentication and IP address assignment method) to a PVC. Virtual templates are used when configuring PPP over ATM (PPPoA), PPP over Ethernet (PPPoE), and Layer 2 Tunneling Protocol (L2TP).

Example—PVC with AAL5 SNAP Encapsulation on an ATM Interface

The following example shows a typical PVC configuration using the ATM adaptation layer 5 (AAL5) Subnetwork Access Protocol (SNAP) encapsulation. AAL5 SNAP is commonly used in IP routing and bridging. For information on IP routing and bridging, see the"RFC1483 Bridging Baseline Architecture"tech notes on Cisco.com.

```
!
interface atm 0/0/0
  pvc 0/40
   encapsulation aal5snap
!
```

Example—PVC with PPPoA on an ATM Interface

The following example shows a typical PVC configuration for PPP over ATM (PPPoA). For information on configuring PPPoA, see the“PPPoA Baseline Architecture”white paper on Cisco.com.

```
!
interface atm 0/0/0
 pvc 0/41
  encapsulation aal5mux ppp virtual-Template 1
!
interface virtual-template 1
 ip unnumbered fastethernet 0/0/0
 ppp authentication pap
!
```

Verifying PVCs on the ATM Interface

To verify successful configuration of PVCs on the main ATM interface, use the **show atm vc** EXEC command. Check that the status (Sts) is up, and that the encapsulation type is correct.

```
NRP# show atm vc
VCD /                                  Peak  Avg/Min Burst
Interface  Name   VPI  VCI  Type   Encaps  SC   Kbps   Kbps   Cells  Sts
0/0/0      1      103  100   PVC    MUX    UBR  155000               UP
0/0/0      2      103  101   PVC    MUX    UBR  155000               UP
0/0/0      3      103  110   PVC    SNAP   UBR  155000               UP
NRP#
```

Configuring PVCs on ATM Subinterfaces

The NRP allows the configuration of multiple virtual interfaces, or subinterfaces, on a single physical interface. The ATM interface on the NRP (interface atm 0/0/0) can be configured with subinterfaces to allow greater flexibility and connectivity when working with subscriber sessions.

A subinterface must be classified as either point-to-point or multipoint. A point-to-point interface supports only a single PVC; a multipoint interface can be configured with multiple PVCs. Because of the standard rule of bridging, a PVC on a multipoint subinterface configured for RFC 1483 bridging cannot send data to another PVC on the same subinterface. This means that an RFC 1483 bridged multipoint interface can offer greater security than a point-to-point interface, but only at the expense of flexibility.

By default, all PVCs use AAL5 SNAP encapsulation. When you specify an encapsulation type for the main ATM interface (ATM 0/0/0), all PVCs on its subinterfaces inherit this encapsulation type. You can, however, override the inherited encapsulation type by specifying the encapsulation type in ATM VC configuration mode.

To configure a PVC on an ATM subinterface, complete the following steps beginning in global configuration mode:

	Command	Description
Step1	`Router(config)# interface atm 0/0/0.`*subinterface* {**multipoint** | **point-to-point**}	Specifies the NRP ATM subinterface. Also selects multipoint or point-to-point subinterface type.
Step2	`Router(config-subif)# pvc` [*name*] *vpi/vci*	Configures a new ATM PVC by assigning a name (optional) and VPI/VCI values.
Step3	`Router(config-if-atm-vc)# encapsulation` {**aal5snap** | **aal5nlpid**} or `Router(config-if-atm-vc)# encapsulation` {**aal5mux ppp** | **aal5autoppp** | **aal5ciscoppp**} **virtual-template** *number*	Configures the ATM adaptation layer (AAL) and encapsulation type for a PVC. May configure a PVC to use a virtual template[1] as the default PPP interface configuration.

1. A virtual template assigns PPP features (such as authentication and IP address assignment method) to a PVC. Virtual templates are used when configuring PPP over ATM (PPPoA), PPP over Ethernet (PPPoE), and Layer 2 Tunneling Protocol (L2TP).

Example—PVC on a Point-to-Point Subinterface

In the following example, the ATM 0/0/0.20 subinterface is configured as a point-to-point interface. Attempting to configure a second PVC results in the "`P2P Interface already has VC`" message.

```
Router(config)# interface atm 0/0/0.20 point-to-point
Router(config-subif)# pvc 0/40
Router(config-if-atm-vc)# exit
Router(config-subif)# pvc 0/41
P2P Interface already has VC
Router(config-subif)# exit
```

The previous example results in the following configuration fragment:

```
!
interface atm 0/0/0.20 point-to-point
 pvc 0/40
!
```

Example—PVCs on a Multipoint Subinterface

In the following example, the ATM 0/0/0.21 subinterface is a multipoint interface, so it accepts multiple PVCs.

```
Router(config)# interface atm 0/0/0.21 multipoint
Router(config-subif)# pvc 0/50
Router(config-if-atm-vc)# exit
Router(config-subif)# pvc 0/51
Router(config-if-atm-vc)# exit
```

The previous example results in the following configuration fragment:

```
!
interface atm 0/0/0.21 multipoint
 pvc 0/50
 !
 pvc 0/51
 !
!
```

Example—PVCs on Subinterfaces with Encapsulation Type Inherited from the Main ATM Interface

In the following example, PVCs 0/70 and 0/71 on ATM subinterface 0/0/0.40 inherit the AAL5 multiplex (MUX) encapsulation type from the main ATM interface. PVC 0/72 is specifically configured for AAL5 SNAP, overriding the inherited encapsulation type.

```
Router(config)# interface atm 0/0/0
Router(config-if)# encapsulation aal5mux ppp virtual-template 1

Router(config)# interface atm 0/0/0.40 multipoint
Router(config-subif)# pvc 0/70
Router(config-if-atm-vc)# exit
Router(config-subif)# pvc 0/71
Router(config-if-atm-vc)# exit
Router(config-subif)# pvc 0/72
Router(config-if-atm-vc)# encapsulation aal5snap
Router(config-if-atm-vc)# ^z
```

The previous example results in the following configuration fragment:

```
!
interface atm 0/0/0
 encapsulation aal5mux ppp virtual-template 1
!
interface atm 0/0/0.40 multipoint
 pvc 0/70
 !
 pvc 0/71
 !
 pvc 0/72
  encapsulation aal5snap
 !
!
```

Verifying PVCs on ATM Subinterfaces

To verify successful configuration of PVCs on ATM subinterfaces, use the **show atm vc** EXEC command. Check that the status (Sts) is up, and that the encapsulation type is correct.

```
NRP# show atm vc
           VCD /                                    Peak  Avg/Min Burst
Interface  Name   VPI  VCI  Type   Encaps  SC   Kbps   Kbps   Cells  Sts
0/0/0.1    1      101  100   PVC    MUX    UBR  155000               UP
0/0/0.2    2      101  101   PVC    MUX    UBR  155000               UP
0/0/0.3    3      101  110   PVC    SNAP   UBR  155000               UP
NRP#
```

Configuring VC Classes

VC classes allow you to define a template for a particular VC. You can then apply this template directly to a PVC, or to an interface or subinterface whose PVCs inherit the VC class properties.

To configure and apply a VC class directly to a PVC, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# vc-class atm name`	Creates or selects a map class.
Step2	`Router(config-vc-class)# encapsulation aal-encap [ppp virtual-template number]`	Configures the ATM adaptation layer (AAL) and encapsulation type. Optionally configures a PVC to use a virtual-template as the default PPP interface configuration.
Step3	`Router(config-vc-class)# exit`	Returns to global configuration mode.
Step4	`Router(config)# interface atm 0/0/0 [.subinterface-number {multipoint | point-to-point}]`	Specifies the ATM interface and optional subinterface.
Step5	`Router(config-if)# pvc [name] vpi/vci`	Configures a PVC on the ATM interface or subinterface.
Step6	`Router(config-atm-vc)# class-vc vc-class-name`	Associates a VC class with the PVC.

To configure and apply a VC class to an interface or subinterface, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# vc-class atm name`	Creates or selects a map class.
Step2	`Router(config-vc-class)# encapsulation aal-encap [ppp virtual-template number]`	Configures the ATM adaptation layer (AAL) and encapsulation type. Optionally configures a PVC to use a virtual-template as the default PPP interface configuration.
Step3	`Router(config-vc-class)# exit`	Returns to global configuration mode.
Step4	`Router(config)# interface atm 0/0/0 [.subinterface-number {multipoint | point-to-point}]`	Specifies the ATM interface and optional subinterface.
Step5	`Router(config-if)# class-int vc-class-name`	Associates a VC class to the interface or subinterface.
Step6	`Router(config-if)# pvc [name] vpi/vci`	Configures a PVC on the ATM interface or subinterface. All PVCs configured on the interface or subinterface will inherit the VC class properties.

Example—VC Classes

In the following example, ATM 0/0/0 is assigned the VC class “snap.” PVC0/40 and PVC0/41 inherit the properties of VC class “snap.” PVC 0/42 is configured to override the VC class properties by assigning a static IP address. ATM subinterface 0/0/0.2 inherits the properties of ATM 0/0/0, so PVC0/43 also inherits the properties of VC class “snap.” By assigning a different VC class, “ppp-atm,” PVC0/44 overrides the properties of the “snap” VC class.

```
!
vc-class atm snap
 encapsulation aal5snap
 ip address unnumbered fastethernet 0/0/0
!
vc-class atm ppp-atm
 encapsulation aal5mux ppp virtual-template 1
!
```

```
interface atm 0/0/0
 class-int snap
 pvc 0/40
 !
 pvc 0/41
 !
 pvc 0/42
  ip address 172.25.14.198 255.255.255.0
 !
!
interface atm 0/0/0.2 multipoint
 pvc 0/43
 !
 pvc 0/44
  class-vc ppp-atm
 !
!
```

Verifying VC Classes

To verify successful configuration of VC classes, use the **show atm vc** EXEC command. Check that the VC class properties (encapsulation) are inherited by the appropriate PVCs.

Configuring PVC Discovery

You can configure the NRP to automatically discover internal PVCs that are configured on the NSP. The discovered PVCs and their traffic parameters are configured on the ATM main interface or on the subinterface that you specify. The NRP Interim Local Management Interface (ILMI) receives the PVC parameter information from the NSP.

Configuring PVC discovery on subinterfaces allows you to sort PVCs on a per-VP basis. The subinterface PVC discovery configuration associates all VCs with non-zero VPI values with the subinterface of the same number. For example, if the NSP reports PVC 2/123, the NRP associates that PVC with ATM0/0/0.2, and the PVC inherits parameters applied to the subinterface.

To configure the NRP for PVC discovery, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Router(config)# vc-class atm` *name*	Creates or selects a map class.
Step2	`Router(config-vc-class)# encapsulation` *aal-encap* [**ppp virtual-template** *number*]	Configures the ATM adaptation layer (AAL) and encapsulation type. Optionally configures a PVC to use a virtual-template as the default PPP interface configuration.
Step3	`Router(config-vc-class)# exit`	Returns to global configuration mode.
Step4	`Router(config)# interface atm 0/0/0`	Specifies the main ATM interface.
Step5	`Router(config-if)# pvc [name] 0/16 ilmi`	Configures an ILMI PVC on the main ATM interface. PVC 0/16 is reserved for the ILMI.
Step6	`Router(config-if-atm-vc)# exit`	Returns to configuration mode.
Step7	`Router(config-if)# atm ilmi-pvc-discovery [subinterface]`	Enables PVC discovery on the main interface, and optionally specifies that discovered PVCs will be assigned to a subinterface.

	Command	Purpose
Step8	`Router(config-if)# interface atm 0/0/0.`*subinterface-number* {**multipoint** | **point-to-point**}	(Optional) Specifies the ATM subinterface. Also selects multipoint or point-to-point subinterface type.
Step9	`Router(config-if)# class-int` *vc-class-name* or `Router(config-subif)# class-int` *vc-class-name*	Associates a VC class with the interface or subinterface.

Example—PVC Discovery on the Main ATM Interface

The following example shows a typical PVC discovery configuration for the Cisco 6400 NRP:

```
!
vc-class atm ppp-atm
 encapsulation aal5mux ppp virtual-Template 1
!
interface atm 0/0/0
 pvc 0/16 ilmi
 atm ilmi-pvc-discovery
 class-int ppp-atm
!
```

Example—PVC Discovery on ATM Subinterfaces

In the following example, PVC discovery is applied to two subinterfaces: ATM0/0/0.1 and ATM0/0/0.2. Discovered PVCs with VPI value of 1 are associated with ATM0/0/0.1 and inherit properties from the “ppp-atm-General” VC class. Discovered PVCs with VPI value of 2 are associated with ATM0/0/0.2 and inherit properties from the “ppp-atm-Admin” VC class.

```
!
vc-class atm ppp-atm-General
 encapsulation aal5mux ppp virtual-template 1
!
vc-class atm ppp-atm-Admin
 encapsulation aal5mux ppp virtual-template 2
!
interface atm 0/0/0
 pvc 0/16 ilmi
 atm ilmi-pvc-discovery subinterface
!
interface ATM 0/0/0.1 multipoint
 class-int ppp-atm-General
!
interface ATM 0/0/0.2 multipoint
 class-int ppp-atm-Admin
!
```

Note PVCs with VPI values that do not match a configured ATM subinterface will not be discovered.

Verifying PVC Discovery

To verify successful configuration of PVC discovery, use the **show atm vc interface atm 0/0/0** EXEC command. Discovered interfaces appear with the "PVC-D" type.

```
Router# show atm vc interface atm 0/0/0
           VCD /                                        Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells    Sts
0/0/0      1           0    16   PVC    ILMI     UBR  155000                 UP
0/0/0.1    2           1    32   PVC-D  MUX      UBR  155000                 UP
0/0/0.1    3           1    33   PVC-D  MUX      UBR  155000                 UP
0/0/0.2    4           2    32   PVC-D  MUX      UBR  155000                 UP
0/0/0.2    5           2    33   PVC-D  MUX      UBR  155000                 UP
Router#
```

Configuring PVC Traffic Shaping

The NRP-1 supports the unspecified bit rate (UBR) and variable bit rate nonreal time (VBR-NRT) quality of service (QoS) classes.

Note Only one QoS class can be specified per PVC. When you enter a new QoS class, it replaces the existing one.

The NRP-2SV supports the VBR-NRT QoS class. When using VBR-NRT on the NRP-2SV, you may need to modify the ATM SAR transmission ring limit to provide more buffering space and time for packets on one or more VCs. For more information, see the **tx-ring-limit** command reference entry in the *Cisco 6400 Command Reference.*

Note The NRP-2 does not support traffic shaping. The NRP-2SV supports only the VBR-NRT QoS class.

To configure PVC traffic shaping and a QoS class for a PVC, use one of the following commands in VC configuration mode or VC class mode:

Command (VC or VC class)	Purpose
ubr *peak*	(NRP-1 only) Specifies the UBR QoS. Also sets the peak cell rate in kbps.
vbr-nrt *peak sustain burst*	Configures the nonreal-time VBR QoS. Also sets the peak cell rate, sustained cell rate, and burst rate, in kbps.

Note If you do not specify a QoS class for a PVC, the PVC defaults to UBR, with a peak rate set to the maximum physical line speed.

Example—Traffic Shaping a PVC with UBR QoS

In the following example, PVC 0/40 is configured with the UBR QoS class, at a peak cell rate of 512kbps:

```
!
interface atm 0/0/0
  pvc 0/40
    encapsulation aal5snap
    ubr 512
!
```

Example—Traffic Shaping a PVC with VBR-NRT

In the following example, PVC 103/100 is configured with the VBR-NRT QoS class, with a peak cell rate of 512 kbps, a sustained cell rate of 16 kbps, and a burst rate of 10 kbps:

```
!
interface ATM0/0/0.1 point-to-point
  pvc 103/100
   vbr-nrt 512 16 10
   encapsulation aal5mux ppp Virtual-Template1
  !
!
```

Verifying PVC Traffic Shaping

To verify successful configuration of PVC traffic shaping, use the **show atm vc** EXEC command. Check that the traffic shaping parameters are displayed correctly.

```
NRP# show atm vc
           VCD /                                    Peak  Avg/Min Burst
Interface  Name   VPI  VCI  Type   Encaps  SC   Kbps   Kbps   Cells  Sts
0/0/0.1    1      103  100   PVC    MUX    VBR  512    16     10     UP
0/0/0.2    2      101  101   PVC    MUX    UBR  155000                UP
0/0/0.3    3      101  110   PVC    SNAP   UBR  155000                UP
NRP#
```

Node Line Card Interface Configuration

The plug-and-play mechanisms of the Cisco 6400 allow it to come up automatically. All configuration information for node line cards (NLCs) can be saved between hot swaps and switch reboots, while interface types are automatically discovered by the switch, eliminating mandatory manual configuration.

This chapter describes how to manually configure ATM interfaces for the Cisco 6400 NLC, as opposed to using Interim Local Management Interface (ILMI) autoconfiguration (which senses the peer interface type and appropriately configures the system interfaces).

The network configuration modifications described in this chapter are used to explicitly specify your ATM network operation. Although the Cisco 6400 defaults to a working configuration suitable for most networks, you might need to customize the configuration for your network.

This chapter contains the following sections:

NLC Interface Identification

In the Cisco 6400, NLC interface addresses specify the physical location of each port on the system. The address is composed of a three-part number in the format slot/subslot/port:

- Slot—Identifies the chassis slot in which the card is installed. Card slots are numbered 1 to 8 from left to right when facing the front of the chassis.
- Subslot—Identifies the top or bottom half of a card slot. Sublots are numbered 0 to1 from top to bottom. Full-height NLCs are always identified with subslot0.
- Port—Identifies the physical port number on the card. Port numbers always begin at 0 and are numbered from top to bottom.

Interfaces maintain the same address, even while other cards are installed in or removed from the chassis. If, however, you move an NLC to a different slot or subslot, the address changes to reflect the new slot and subslot.

Autoconfiguration

Enabled by default, autoconfiguration determines the interface type each time an interface initially comes up. To manually configure an NLC interface, you must disable autoconfiguration.

Disabling Autoconfiguration

Autoconfiguration is enabled by default, but can be disabled to manually configure an NLC interface.

To disable autoconfiguration on an interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the NLC interface.
Step2	`Switch(config-if)# no atm auto-configuration`	Disables autoconfiguration on the interface.

Example

In the following example, autoconfiguration is disabled on the interface ATM 1/0/0:

```
!
interface atm 1/0/0
  no atm auto-configuration
!
```

Default NLC Interface Configuration

When autoconfiguration is disabled, the NLC interface assumes the default configuration shown in Table4-1 .

Table4-1 Default Configuration for Node Line Cards

Configuration Parameter	OC-3 Default	OC-12 Default	DS3 Default
ATM interface type	UNI	UNI	UNI
UNI version	3.0	3.0	3.0
Maximum VPI bits	8	8	8
Maximum VCI bits	14	14	14
ATM interface side	network	network	network
ATM UNI type	private	private	private
Clock source	network-derived	network-derived	network-derived
Framing	sts-3c	sts-12c	cbit-adm
Cell payload scrambling	on	on	off
Synchronous Transport Signal (STS) stream scrambling	on	on	—
Line buildout	—	—	short
Auto-FERF (all)	—	—	on

Verifying Autoconfiguration

To check if autoconfiguration is enabled or disabled on an NLC interface, use the **show atm interface** EXEC command.

In the following example, autoconfiguration is disabled on the OC-3 ATM interface 1/0/0:

```
Switch# show atm interface atm 1/0/0

Interface:      ATM1/0/0        Port-type:    oc3suni
IF Status:      UP              Admin Status: up
Auto-config:    disabled        AutoCfgState: not applicable
IF-Side:        Network         IF-type:      NNI
Uni-type:       not applicable  Uni-version:  not applicable
Max-VPI-bits:   8               Max-VCI-bits: 14
Max-VP:         255             Max-VC:       16383
Svc Upc Intent: pass            Signalling:   Enabled
ATM Address for Soft VC: 47.0091.8100.0000.0040.0b0a.2b81.4000.0c80.8000.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   PVPLs SoftVPLs   SVPLs  Total-Cfgd  Installed-Conns
      3        0       0       0        0       0           3                3
Logical ports(VP-tunnels):     0
Input cells:    234663          Output cells: 235483
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 153211, Output AAL5 pkts: 153626, AAL5 crc errors: 0

Switch#
```

ATM Interface Types

This section describes how to configure NLC interfaces of the following types:

- User-Network Interfaces, page 4-3
- Network-to-Network Interfaces, page 4-5
- Interim Interswitch Signaling Protocol Interfaces, page 4-6

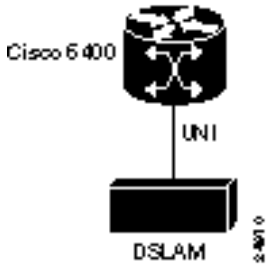
Note Whenever a change in the interface protocol (such as UNI, NNI, or IISP), side, or version is configured, ATM signaling and ILMI are restarted on the interface. When ATM signaling is restarted, all switched virtual connections (SVCs) across the interface are cleared; permanent virtual connections are not affected.

User-Network Interfaces

The User-Network Interface (UNI) specification defines communications between ATM-based products (a router or an ATM switch) located in a private network and the ATM switches located within the public carrier networks.

Figure4-1 shows example UNIs configured between the Cisco 6400 and a digital subscriber line access multiplexer (DSLAM).

Figure4-1 UNI Example



Note The UNI interface is the default for NLCs designed for the Cisco 6400. See Table4-1 for the other parameters of the default NLC interface configuration.

Configuring UNIs

To manually configure an interface as UNI, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies the ATM interface and enters interface configuration mode.
Step2	`Switch(config-if)# no atm auto-configuration`	Disables autoconfiguration on the interface.
Step3	`Switch(config-if)# atm uni [side {private | public} type {network | user} version {3.0 | 3.1 | 4.0}]`	Configures the ATM UNI.
Step4	`Switch(config-if)# atm maxvpi-bits bits`	(Optional) 0–8. Modifies the maximum VPI[1] bits configuration.
Step5	`Switch(config-if)# atm maxvci-bits bits`	(Optional) 0–14. Modifies the maximum VCI[2] bits configuration.

1. VPI = virtual path identifier
2. VCI = virtual channel identifier

Example

In the following example, ATM 3/0/0 is configured as the private side of a UNI connection:

```
!
interface atm 3/0/0
  no atm auto-configuration
  atm uni side user type private version 4.0
  !
```

Verifying UNI Configuration

To verify UNI configuration for an ATM interface, use the **show atm interface** EXEC command:

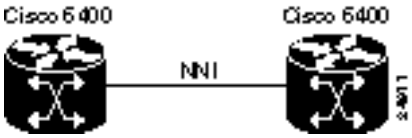
```
Switch# show atm interface atm 3/0/0

Interface:      ATM0/1/0        Port-type:      oc3suni
IF Status:      UP              Admin Status:   up
Auto-config:    disabled        AutoCfgState:   not applicable
IF-Side:        Network         IF-type:        UNI


Uni-type:       private         Uni-version:    V3.0
...
```

Network-to-Network Interfaces

The Network-to-Network Interface (NNI) standard defines communication between two ATM switches that are both located in a private network or are both located in a public network. The interface between a public switch and private one is defined by the UNI standard.

Figure4-2 shows example NNIs configured between two central office (CO) Cisco 6400 systems.

Figure4-2 Private NNI Interface Example



Note You must configure private NNI connections between the ATM switches to allow for route discovery and topology analysis between the switches.

Configuring NNIs

To manually configure an interface as an NNI, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies an ATM interface and enters interface configuration mode.
Step2	`Switch(config-if)# no atm auto-configuration`	Disables autoconfiguration on the interface.
Step3	`Switch(config-if)# atm nni`	Configures the ATM NNI.
Step4	`Switch(config-if)# atm maxvpi-bits bits`	(Optional) 0–8. Modifies the maximum VPI bits configuration.
Step5	`Switch(config-if)# atm maxvci-bits bits`	(Optional) 0–14. Modifies the maximum VCI bits configuration.

Example

In the following example, ATM 3/0/0 is configured as an NNI:

```
!
interface atm 3/0/0
  no atm auto-configuration
  atm nni
  !
```

Verifying NNI Configuration

To verify NNI configuration for an ATM interface, use the **show atm interface** EXEC command:

```
Switch# show atm interface atm 3/0/0

Interface:      ATM3/0/0        Port-type:    oc3suni
IF Status:      UP              Admin Status: up
Auto-config:    disabled        AutoCfgState: not applicable


IF-Side:        Network         IF-type:      NNI
Uni-type:       not applicable  Uni-version:  not applicable

...
```

Interim Interswitch Signaling Protocol Interfaces

The Interim Interswitch Signalling Protocol (IISP) defines a static routing protocol (using manually configured prefix tables) for communication between ATM switches. IISP provides support for switched virtual circuits (SVCs) on ATM switches that do not support the Private Network-to-Network Interface (PNNI) protocol. For more information, see the “Configuring ATM Routing and PNNI” chapter in the *ATM Switch Router Software Configuration Guide*.

Figure4-3 shows an example IISP interface that connects the Cisco 6400 to a switch in the ATM cloud.

Figure4-3 IISP Interface Example

Configuring IISP Interfaces

To manually configure an IISP interface, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies an ATM interface and enters interface configuration mode.
Step2	`Switch(config-if)# no atm auto-configuration`	Disables autoconfiguration on the interface.
Step3	`Switch(config-if)# atm iisp [side {network | user}] [version {3.0 | 3.1 | 4.0}]`	Configures the ATM IISP interface.
Step4	`Switch(config-if)# atm maxvpi-bits bits`	(Optional) 0–8. Modifies the maximum VPI bits configuration.
Step5	`Switch(config-if)# atm maxvci-bits bits`	(Optional) 0–14. Modifies the maximum VCI bits configuration.
Step6	`Switch(config-if)# exit` `Switch(config)#`	Returns to global configuration mode.
Step7	`Switch(config)# atm route prefix atm-address-prefix atm slot/subslot/port[.subinterface#]`	Configures an ATM route address prefix.

Example

In the following example, ATM 3/0/0 is configured as the user side of an IISP connection:

```
!
interface atm 3/0/0
  no atm auto-configuration
  atm iisp side user
  !
atm route 47.0091.8100.0000.0000.0ca7.ce01 atm 3/0/0
!
```

Verifying IISP Interface Configuration

To verify IISP interface configuration, use the **show atm interface** EXEC command:

```
Switch# show atm interface atm 3/0/0

Interface:      ATM3/0/0        Port-type:      oc3suni
IF Status:      UP              Admin Status:   up
Auto-config:    disabled        AutoCfgState:   not applicable


IF-Side:        User            IF-type:        IISP
Uni-type:       not applicable  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: 47.0091.8100.0000.00e0.4fac.b401.4000.0c80.8000.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      3        0       0       0       0        0       0          3          2
Logical ports(VP-tunnels):     0
```

```
Input cells:    264089          Output cells:   273253
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 172421, Output AAL5 pkts: 176993, AAL5 crc errors: 0
```

NLC Interface Clocking

Each NLC port can be configured to support the following clocking options:

- Free-running—Transmit clock is derived from the local oscillator on the NLC port, with stratum level 4 accuracy.
- Loop-timed—Transmit clock is derived from the receive (rx) clock.
- Network-derived (default)—Transmit clock is derived from the port system clock specified at highest priority by the **network-clock-select** global configuration command.

For detailed information on network clocking, see the "Network Clocking" section on page2-14.

Configuring the NLC Interface Clock

To select the transmit clock source for a port, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the interface to be configured.
Step2	`Switch(config-if)# clock source {free-running | loop-timed | network-derived}`	Configures the interface network clock source.

Example

In the following example, ATM 4/0/0 is configured with a network-derived transmit clock source:

```
!
network-clock-select 1 atm 2/0/0
network-clock-select 2 atm 2/0/1
network-clock-select 3 atm 1/0/0
!
interface atm 4/0/0
 clock source network-derived
 !
```

OC-3 NLC and OC-12 NLC Interface Options

The OC-3 NLC and OC-12 NLC support the following Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) framing modes:

- STM-1—Synchronous Transport Module level 1. One of a number of SDH formats that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells.
- STS-3c—Synchronous Transport Signal level 3, concatenated. SONET format that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells. (Default for OC-3 NLC.)
- STM-4—Synchronous Transport Module level 4. SDH/STM-4 operation (ITU-T specification).

- STS-12c—Synchronous Transport Signal level 12, concatenated (12 x 51.84 Mbps). SONET format that specifies the frame structure for the 5184-Mbps lines used to carry ATM cells. (Default for OC-12 NLC.)

The OC-3 NLC and OC-12 NLC support the following scrambling modes, both turned on by default:

- STS-stream—Scrambles the SONET/SDH Layer 1 stream
- Cell-payload—Scrambles only the payload of the cell (not the header)

Configuring the OC-3 and OC-12 Interface Options

To configure framing and scrambling on the OC-3 NLC and OC-12 NLC, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies an OC-3 or OC-12 ATM interface and enters interface configuration mode.
Step2	`Switch(config-if)# sonet {stm-1 | sts-3c | stm-4 | sts-12c}`	Configures the SONET framing mode.
Step3	`Switch(config-if)# [no] scrambling {cell-payload | sts-stream}`	Enables or disables the scrambling modes.

Example

In the following example, both cell-payload scrambling and STS-stream scrambling are disabled for the OC-3 interface ATM 1/0/0. Also, the SONET mode of operation is set to SDH/STM-1.

```
!
interface atm 1/0/0
  no scrambling cell-payload
  no scrambling sts-stream
  sonet sts-3c
  !
```

Verifying the OC-3 and OC-12 Interface Configuration

To verify successful configuration of OC-3 or OC-12 interfaces, use the **show controller atm** EXEC command. Check that the output displays the correct interface options.

```
Switch# show controller atm 7/0/0
Redundancy NOT Enabled on interface
IF Name: ATM7/0/0    Chip Base Address(es): A8B08000, 0 Port type: OC3    Port rate: 155
Mbps    Port medium: SM Fiber
Port status:Good Signal    Loopback:None    Flags:8308
TX Led: Traffic Pattern    RX Led: Traffic Pattern  TX clock source:  network-derived
Framing mode:  sts-3c
Cell payload scrambling on
Sts-stream scrambling on

...
```

DS3 NLC Interface Options

The DS3 NLC supports the following framing modes:

- cbitadm—C-bit with ATM direct mapping (default framing mode)
- cbitplcp—C-bit with physical layer convergence procedure (PLCP) framing
- m23adm—M23 ATM direct mapping
- m23plcp—M23 with PLCP framing

The DS3 NLC supports the cell payload scrambling mode, which scrambles only the payload of the cell (not the header). Cell payload scrambling is turned off by default.

The DS3 NLC defaults to a short line buildout, which supports cables less than 50 feet long. If the cable attached to the DS3 interface is longer than 50 feet, you must configure the long line buildout.

The DS3 NLC automatic far-end receive failure (FERF) alarms support the following values, all turned on by default:

- los—Loss of signal
- oof—Out of frame
- red—Indicates a major alarm
- ais—Alarm indication signal
- lcd—Loss of cell delineation

Configuring the DS3 Interface Options

To manually change any of the default configuration values, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies an ATM interface and enters interface configuration mode.
Step2	`Switch(config-if)# framing {cbitadm | cbitplcp | m23adm | m23plcp}`	Modifies the framing mode.
Step3	`Switch(config-if)# [no] scrambling cell-payload`	Enables or disables the scrambling mode.
Step4	`Switch(config-if)# lbo {long | short}`	Modifies the line buildout.
Step5	`Switch(config-if)# [no] auto-ferf {ais | lcd | los | oof | red}`	Modifies the automatic FERF configuration.

Example

In the following example, the DS3 interface ATM 3/0/0 is configured for C-bit with the ATM direct mapping framing mode and a short line buildout.

```
!
interface atm 3/0/0
  framing cbitadm
  lbo short
  !
```

Verifying the DS3 Interface Configurations

To verify successful configuration of DS3 interfaces, use the **show controllers atm** EXEC command. Check that the output displays the interface options you configured.

```
Switch# show controllers atm 1/1/0
IF Name:ATM1/1/0, Chip Base Address:A8C08000
Port type:DS3    Port rate:45000 Kbps    Port medium:Coax
Port status:Good Signal    Loopback:None    Flags:8108
TX Led:Traffic Pattern    RX Led:Traffic Pattern  TX clock source:
network-derived
DS3 Framing Mode: cbit plcp
FERF on AIS is on
FERF on LCD is on (n/a in PLCP mode)
FERF on RED is on
FERF on OOF is on
FERF on LOS is on
LBO:<= 225'
Cell payload scrambling on
...
```

Troubleshooting the NLC Interface Configuration

Table4-2 describes commands that you can use to confirm proper configuration of the hardware, software, and interfaces for the Cisco 6400. Unless otherwise specified, all of the commands can be used in EXEC mode.

For more information on these commands, see the *ATM and Layer 3 Switch Router Command Reference*.

Table4-2 NLC Interface Troubleshooting Commands

Command	Purpose
show version	Displays the version and type of software installed on the NSP.
show hardware	Displays the type of hardware installed in the Cisco 6400 system.
show atm addresses	Displays the ATM addresses configured in the system.
show atm interface	Displays ATM-specific information about an ATM interface.
show atm status	Displays current information about ATM interfaces and the number of installed connections.
show atm vc	Displays the ATM layer connection information about the virtual connections.
show controller atm	Displays information about the physical ATM port device.
more system:running-config	Displays the running configuration.
more nvram:startup-config	Displays the startup configuration.
ping atm interface atm	(Privileged EXEC command) Tests connectivity between the NSP and a host.

Redundancy and SONET APS Configuration

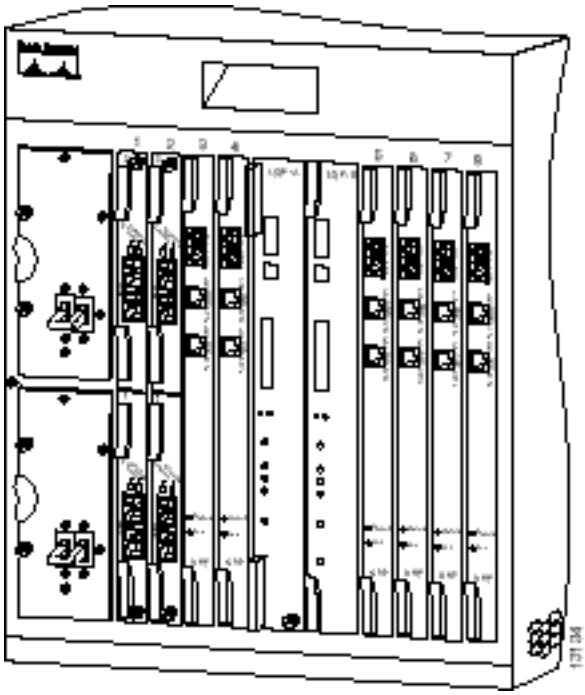
The Cisco 6400 contains two slots for node switch processors (NSPs) and eight slots for node line cards (NLCs) or node route processors (NRPs), as shown in Figure5-1. Each slot can contain one full-height or two half-height cards. NRPs and NSPs support enhanced high system availability (EHSA) redundancy, and NLCs support SONET automatic protection switching (APS) redundancy at the port-level.

Redundancy can be configured between:

- NSPs (always assumed when two NSPs are installed in the chassis)
- NRPs and full-height NLCs installed in the following slot pairs:
  - Slots 1 and 2, 3 and 4, 5 and 6, or 7 and 8
- Half-height NLCs installed in adjacent subslot pairs:
  - Subslots 0 (top) in slots 1 and 2, 3 and 4, 5 and 6, or 7 and 8
  - Subslots 1 (bottom) in slots 1 and 2, 3 and 4, 5 and 6, or 7 and 8

This chapter contains the following sections:

Figure5-1 Cisco 6400 Carrier-Class Broadband Aggregator



Memory Requirements

When configuring redundancy between two NRPs or two NSPs, the two cards must have identical hardware configurations. Check each card in a redundant pair, and make sure they share the following parameters:

- DRAM size
- Flash memory size
- PCMCIA disk size (NSP only)
- Hardware version (module part number)

If redundancy is configured between two cards with different amounts of memory or disk capacity, the Cisco 6400 will display a warning message. Depending on which card is identified as the primary card, the Cisco 6400 will perform the following actions:

- Primary card has more memory than secondary card—The Cisco 6400 shuts down the secondary card.
- Secondary card has more memory than primary card—The Cisco 6400 displays a message, indicating that the secondary card has more memory than the primary card. This configuration will cause redundancy to be disabled if the secondary card is activated.

Note This approach allows for memory upgrades on a redundant pair of NRPs or NSPs. For information about performing memory upgrades, see the *Cisco 6400 UAC FRU Installation and Replacement* document.

NSP Redundancy

Both NSP slots are numbered slot 0 for consistent interface identification between primary and secondary devices. Nevertheless, the left NSP slot is labeled slot A and the right slot is labeled slot B to distinguish between the two slots, when required.

You can use EHSA redundancy for simple hardware backup or for software error protection. Hardware backup protects against NSP card failure because you configure both NSP cards with the same software image and configuration information. Additionally, you configure the system to automatically synchronize configuration information on both cards when changes occur.

Software error protection protects against critical Cisco IOS software errors in a particular release because you configure the NSP cards with different software images, but use the same configuration. If you are using new or experimental Cisco IOS software, consider using the software error protection method.

This section includes:

Configuring Redundant NSPs

If two NSPs are installed in the Cisco 6400, they automatically act as a redundant pair. No configuration is necessary.

Verifying NSP Redundancy

To verify NSP redundancy, use the **show redundancy** EXEC command:

```
Switch# show redundancy
NSP A:Primary
NSP B:Secondary

Secondary NSP information:
Secondary is up
Secondary has 131072K bytes of memory.

User EHSA configuration (by CLI config):
secondary-console = off
keepalive     = on
config-sync modes:
  standard   = on
  start-up   = on
  boot-var   = on
  config-reg = on
  calendar   = on

Debug EHSA Information:
```

```
Primary   (NSP A) ehsa state:SANTA_EHSA_PRIMARY
Secondary (NSP B) ehsa state:SANTA_EHSA_SECONDARY

EHSA pins:
peer present = 1
peer state   = SANTA_EHSA_SECONDARY
crash status:this-nsp=NO_CRASH(0x1) peer-nsp=NO_CRASH(0x1)

EHSA related MAC addresses:
this bpe mac-addr = 0000.0c00.0003
peer bpe mac-addr = 0000.0c00.0004


Switch#
```

Synchronizing Redundant NSPs

To ensure that the configuration is consistent between redundant NSPs or NRPs, you can configure automatic synchronization between the two devices. You have the option of synchronizing just the startup configuration, the boot variables, the configuration register, or all three configurations (standard). When configuration is complete, you can disable autoconfiguration using the **no** command.

To automatically synchronize the configurations between redundant NSPs, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters redundancy configuration mode.
Step2	`Switch(config-r)# main-cpu`	Enters main-cpu configuration mode.
Step3	`Switch(config-r-mc)# auto-sync [standard | bootvar | config-register | startup-config]`	Synchronizes the configuration between redundant NSPs.

Boot variables are ROM monitor (ROMMON) environment variables used to control the booting process. The configuration register, stored in NVRAM, contains startup time parameters for the system. For more information about the booting process, see the *Cisco IOS Configuration Fundamentals Configuration Guide*.

Example

In the following example, the configuration is synchronized between redundant NSPs:

```
!
redundancy
 main-cpu
  auto-sync standard
  !
```

Verifying Synchronized NSPs

To verify that NVRAM and sec-NVRAM contain identical startup configurations, compare the output of the following command entries:

Switch# **cd nvram:** Switch# **dir** Switch# **more startup-config**	Switch# **cd sec-nvram:** Switch# **dir** Switch# **more startup-config**

The displayed output should be identical.

Erasing Startup Configurations on Redundant NSPs

To erase the startup configuration on redundant NSPs, complete the following steps beginning in EXEC mode:

	Command	Purpose
Step1	Switch# **erase nvram:**	Erases the primary NSP's startup configuration.
Step2	Switch# **erase sec-nvram:**	Erases the secondary NSP's startup configuration.

Note If you only erase the startup configuration on the primary NSP, and the primary and secondary NSPs reverse roles, the new primary NSP will use the old startup configuration.

Verifying Erased Startup Configurations

To verify that you erased the startup configuration on redundant NSPs, use the **dir nvram:** and **dirsec-nvram:** EXEC commands and check that the startup-config size is zero:

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

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

129016 bytes total (129016 bytes free)
```

You can also use the **show startup** EXEC command and make sure that a valid configuration file does not appear:

```
NSP# show startup
%% Non-volatile configuration memory is being written, Try again later
```

PCMCIA Disk Mirroring

Introduced in Cisco IOS Release 12.1(5)DB, the PCMCIA disk mirroring enables automatic data synchronization between the PCMCIA disks of two redundant NSPs. Disk synchronization is the act of copying data from one disk to another.

Disk mirroring provides full NSP redundancy for the NRP-2, which depends on the NSP for image and file storage. Without disk mirroring, there is no guarantee of NRP-2 support after an NSP failover (user intervention might be required to restore the NRP2 state to that prior to the failover). With disk mirroring enabled, NRP-2 has continued support from the NSP, except during the relatively short NSP failover period.

When PCMCIA disk mirroring is enabled, as it is by default, disk synchronization is initiated each time that:

- The primary or secondary NSP boots or reloads
- The secondary NSP is inserted into the Cisco 6400 chassis
- A PCMCIA disk is inserted into disk slot 0 of the primary or secondary NSP
- The PCMCIA disk in disk slot 0 of either NSP is formatted
- A command is entered to:
  - Re-enable disk mirroring (**mirror**)
  - Explicitly initiate disk synchronization (**redundancy sync**)
  - Modify or reorganize the files on the disks (**copy**, **rename**, **delete**, **mkdir**, **format**)

Note PCMCIA disk mirroring is not supported in Cisco IOS Release 12.1(4)DB and earlier releases. Use the **dir**, **mkdir**, and **copy** EXEC commands to manually copy files from the primary NSP's PCMCIA disks to the secondary NSP's PCMCIA disks.

PCMCIA disk mirroring also introduced new labels for pairs of mirrored disks:

- **mir-disk0**—PCMCIA disks in disk slot 0 of both NSPs
- **mir-disk1**—PCMCIA disks in disk slot 1 of both NSPs

The **mir-disk0** and **mir-disk1** labels enable you to perform any integrated file system (IFS) operation (such as **copy**, **rename**, and **delete**) on the same file on both the primary and secondary disks.

Restrictions and Recommendations

- If an NSP failover occurs during disk synchronization, the file that is being copied is deleted from the receiving disk, instead of only partially copied. This means that the file is no longer available to the NRP-2. The amount of time it takes to complete disk synchronization varies for each system, but depends on the number and sizes of files being copied.
- Disk mirroring (automatic data synchronization between a pair of disks) is not supported between:
  - Two disks on a single NSP
  - Two disks with mismatched slot numbers (disk0: and disk1:)

  You can, however, initiate disk synchronization between disk0: and disk1: on the active NSP, even in a single-NSP system.
- Cisco recommends that you use PCMCIA disks of the same memory capacity.

Disabling PCMCIA Disk Mirroring

Disk mirroring is enabled by default. To disable disk mirroring, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters redundancy configuration mode.
Step2	`Switch(config-r)# main-cpu`	Enters main-cpu configuration mode.
Step3	`Switch(config-r-mc)# no mirror`	Disables data synchronization between the NSP PCMCIA disks.

Example

In the following example, PCMCIA disk mirroring is disabled:

```
!
redundancy
 main-cpu
  auto-sync standard
  no mirror
  !
```

Verifying that Disk Mirroring is Disabled

To verify that disk mirroring is disabled, use the **show redundancy sync-status** EXEC command:

```
Switch# show redundancy sync-status
 Disk Mirror is disabled in configuration
 Peer Secondary NSP is present
 disk1 or sec-disk1 is wrong or missing

Switch#
```

Enabling PCMCIA Disk Mirroring

If disk mirroring is disabled, and you want to re-enable it, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters redundancy configuration mode.
Step2	`Switch(config-r)# main-cpu`	Enters main-cpu configuration mode.
Step3	`Switch(config-r-mc)# mirror`	Enables data synchronization between the NSP PCMCIA disks.

Example

In the following example, PCMCIA disk mirroring is enabled:

```
!
redundancy
 main-cpu
  auto-sync standard
  mirror
  !
```

Verifying that Disk Mirroring is Enabled

To verify that disk mirroring is enabled, complete one or both of the following steps:

Step 1 Use the **show redundancy sync-status** EXEC command to check that disk mirroring is enabled:

```
Switch# show redundancy sync-status
 Disk Mirror is enabled in configuration:proper sync
(Mirror threshold is 0 MB:smaller files will be copied blindly)

 Peer Secondary NSP is present
 disk1 or sec-disk1 is wrong or missing

 mir-disk0 (disk0 -> sec-disk0):in sync.
 mir-disk1 (disk1 -> sec-disk1):out of sync.

Switch#
```

Step 2 Use the **dir** command to verify matching file names and file sizes on the mirrored PCMCIA disks.

```
Switch# dir disk0:
Switch# dir sec-disk0:

Switch# dir disk1:
Switch# dir sec-disk1:
```

Specifying the File Size Threshold

By default, when performing disk synchronization (either through disk mirroring or user initiation), the system compares files between the PCMCIA disks. The system does not copy files with matching file names, sizes, and time stamps. You can, however specify a file size threshold below which files are copied without comparison.

To specify the file size threshold, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters redundancy configuration mode.
Step2	`Switch(config-r)# main-cpu`	Enters main-cpu configuration mode.
Step3	`Switch(config-r-mc)# mirror threshold` *size*	Specifies the file size threshold below which files are copied without comparison.

Example—File Size Threshold

In the following example, PCMCIA disk mirroring is enabled with a specified file size threshold of 2MB:

```
!
redundancy
 main-cpu
  auto-sync standard

  mirror threshold 2
  !
```

Verifying the File Size Threshold

To verify the file size threshold, use the **show redundancy sync-status** EXEC command, and check the Mirror Threshold field:

```
Switch# show redundancy sync-status
Disk Mirror is enabled in configuration:proper sync
 (Mirror threshold is 2 MB:smaller files will be copied blindly)

 Peer Secondary NSP is present
 disk1 or sec-disk1 is wrong or missing

 mir-disk0 (disk0 -> sec-disk0):out of sync.
 mir-disk1 (disk1 -> sec-disk1):out of sync.

 Disk Mirror full sync is in progress (disk0 to sec-disk0, 23%)

Switch#
```

Specifying to Copy All Files Blindly

Instead of specifying a file size threshold below which files are copied without comparison, you can choose to copy *all* files blindly (without comparing sizes or time stamps).

To copy all files blindly, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters redundancy configuration mode.
Step2	`Switch(config-r)# main-cpu`	Enters main-cpu configuration mode.
Step3	`Switch(config-r-mc)# mirror all`	Specifies to copy all files blindly when performing disk synchronization.

Example—Copying Blindly

In the following example, PCMCIA disk mirroring is enabled and set to copy all files blindly:

```
!
redundancy
 main-cpu
  auto-sync standard

  mirror all
  !
```

Verifying Blind Copying

To verify blind copying, use the **show redundancy sync-status** EXEC command to check the configured synchronization type. The first line displayed should end with “full sync” instead of “proper sync.”

```
Switch# show redundancy sync-status
Disk Mirror is enabled in configuration:full sync
 (Mirror threshold is 0 MB:smaller files will be copied blindly)

 Peer Secondary NSP is present
 disk1 or sec-disk1 is wrong or missing

 mir-disk0 (disk0 -> sec-disk0):out of sync.
```

```
 mir-disk1 (disk1 -> sec-disk1):out of sync.

 Disk Mirror full sync is in progress (disk0 to sec-disk0, 23%)

Switch#
```

Initiating PCMCIA Disk Synchronization

Disk synchronization copies the data from one PCMCIA disk to another. To initiate disk synchronization, use one of the following commands in global configuration mode:

Command	Purpose
`Switch# redundancy sync disk0 [all]`[1]	Copies data from disk0:[2] of the primary NSP to disk0: of the secondary NSP.
`Switch# redundancy sync disk1 [all]`	Copies data from disk1:[3] of the primary NSP to disk1: of the secondary NSP.
`Switch# redundancy sync disk0 reverse [all]`	Copies data from disk0: of the secondary NSP to disk0: of the primary NSP.
`Switch# redundancy sync disk1 reverse [all]`	Copies data from disk1: of the secondary NSP to disk1: of the primary NSP.
`Switch# redundancy sync local [all]`	Copies data from disk0: of the primary NSP to disk1: of the primary NSP. Can be used with single-NSP systems.

1. Optional **all** keyword specifies to copy all files blindly (without comparing file sizes and time stamps).
2. disk0: = PCMCIA disk in NSP disk slot 0
3. disk1: = PCMCIA disk in NSP disk slot 1

Example—Disk Synchronization

```
Switch# redundancy sync disk0

00:29:52:%DISKMIRROR-6-PROGRS:Disk Sync in Progress (disk0 to sec-disk0, 0%)
Switch#
```

Example—Reverse Disk Synchronization

```
Switch# redundancy sync disk0 reverse

00:32:13:%DISKMIRROR-6-PROGRS:Disk Sync in Progress (sec-disk0 to disk0, 0%)
Switch#
```

Example—Local Disk Synchronization

```
Switch# redundancy sync local

00:32:13:%DISKMIRROR-6-PROGRS:Disk Sync in Progress (disk0 to disk1, 0%)
Switch#
```

Verifying Disk Synchronization

To verify disk synchronization, complete one or both of the following steps:

Step 1 Use the **show redundancy sync-status** EXEC command to check that the disk content is synchronized:

```
Switch# show redundancy sync-status
Disk Mirror is enabled in configuration:proper sync
 (Mirror threshold is 0 MB:smaller files will be copied blindly)

 Peer Secondary NSP is present
 disk1 or sec-disk1 is wrong or missing

 mir-disk0(disk0/sec-disk0):in sync.
 mir-disk1(disk1/sec-disk1):out of sync.
```

Step 2 Use the **dir** command to verify matching file names and file sizes on the mirrored PCMCIA disks.

```
Switch# dir disk0:
Switch# dir sec-disk0:

Switch# dir disk1:
Switch# dir sec-disk1:
```

Performing Mirrored IFS Operations

When disk mirroring is enabled and disk synchronization is complete, avoid performing IFS operations (such as **copy**, **rename**, and **delete**) using the labels **disk0:**, **disk1:**, **sec-disk0:**, or **sec-disk1:**. Modifying a file using these labels can break disk synchronization without affecting the output of the **showredundancy sync-status** EXEC command. In other words, the **showredundancy sync-status** command output can declare disks to be "in sync," even after disk synchronization is broken using the improper labels.

Because the **dir** command does not *modify* any files, you can use the **dir** command with the **disk0:**, **disk1:**, **sec-disk0:**, or **sec-disk1:** labels at any time to check disk contents, as shown in the previous sections.

Cisco recommends that you perform *mirrored* IFS operations by using the labels **mir-disk0:** and **mir-disk1:**. These new labels target the PCMCIA disks in the specified slot of both NSPs, and ensure that the files affected by the IFS operations are still mirrored.

Note If you want to save a file on only one PCMCIA disk and not have that file mirrored, use the [**sec-**]**disk0:/non-mirror** or [**sec-**]**disk1:/non-mirror** directory.

Examples

The following examples show mirrored IFS operations:

```
Switch# copy tftp://10.1.1.1/test-config mir-disk0:test-config
Switch# rename mir-disk0:test-config mir-disk0:test-config1
Switch# delete mir-disk0:test-config1
```

The following example shows an intentional nonmirrored IFS operation:

```
Switch# copy tftp://10.1.1.1/test-config2 sec-disk0:/non-mirror/test-config2
```

Troubleshooting and Monitoring PCMCIA Disk Mirroring

Use the **show redundancy sync-status** EXEC command to display all status information on disk mirroring and synchronization.

Use the **debug disk-mirror** EXEC command to display debug messages for IFS call events, disk write events, and disk synchronization events.

Using NSP Redundancy for Hardware Backup

For simple hardware backup, the redundant NSPs must have the same system image.To ensure that the redundant NSPs run the same image, complete the following steps:

Step 1 Use the **show bootvar** EXEC command to display the current booting parameters for the primary and secondary NSPs. Check that the secondary NSP is up.

```
Switch# show bootvar
BOOT variable =
CONFIG_FILE variable =
Current CONFIG_FILE variable =
BOOTLDR variable does not exist
Configuration register is 0x0

Secondary is up.
Secondary BOOT variable =
Secondary CONFIG_FILE variable =
Secondary BOOTLDR variable does not exist
Secondary Configuration register is 0x0
```

Step 2 Use the **dir** {**bootflash:** | **disk0:** | **disk1:** | **sec-bootflash:** | **sec-disk0:** | **sec-disk1:**} EXEC command to verify the location and version of the primary and secondary NSP software image.

```
Switch# dir disk0:
Directory of disk0:/

  3  -rw-      628539   Jan 01 2000 00:08:55  c6400s-wp-mz.120-5.DB

109760827 bytes total (108228293 bytes free)

Switch# dir sec-disk0:
Directory of sec-disk0:/

  8  -rw-      628224   Jul 01 1999 00:08:55  c6400s-wp-mz.120-4.DB

109760512 bytes total (108228608 bytes free)
```

Step 3 If the primary and secondary NSPs contain the same image version in the same location, the NSPs are already configured for hardware backup. Do not proceed to the next step.

Step 4 If the secondary NSP does not contain the same image in the same location, use the **delete** and **squeeze** EXEC commands to delete the secondary NSP software image.

```
Switch# delete sec-disk0:c6400s-wp-mz.120-4.DB
Switch# squeeze sec-disk0:
```

Step 5 Copy the primary NSP image to the same location on the secondary NSP.

```
Switch# copy disk0:c6400s-wp-mz.120-5.DB sec-disk0:c6400s-wp-mz.120-5.DB
```

Verifying NSP Redundancy for Hardware Backup

To verify that the NSP redundancy is configured for hardware backup, use the **show bootvar** and **dir** EXEC commands from Step 1 and Step 2. Check that both NSPs use the same system image and store the image in identical locations.

Using NSP Redundancy for Software Error Protection

For software error protection, the primary and secondary NSPs should have different system images. Cisco recommends using NSP redundancy for software error protection when you are using new or experimental Cisco IOS software.

To specify different startup images for the primary and secondary NSPs, complete the following steps, beginning in EXEC mode:

Step 1 Use the **dir** {**bootflash:** | **disk0:** | **disk1:** | **sec-bootflash:** | **sec-disk0:** | **sec-disk1:**} EXEC command to verify the locations and versions of the primary and secondary NSP software images.

```
Switch# dir disk0:
Directory of disk0:/

  3  -rw-      628539   Jan 01 2000 00:08:55  c6400s-wp-mz.120-5.DB
376  -rw-        2134   Jan 05 2000 22:05:27  startup.config

109760827 bytes total (108228293 bytes free)

Switch# dir sec-disk0:
Directory of sec-disk0:/

  8  -rw-      628224   Jul 01 1999 00:08:55  c6400s-wp-mz.120-5.DB
184  -rw-        2134   Jan 05 2000 22:05:27  startup.config

109760512 bytes total (108228608 bytes free)
```

Step 2 If necessary, copy the desired system images to the primary and secondary NSPs. Make sure the primary and secondary NSPs use different image versions.

```
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.120-7.DB disk0:c6400s-wp-mz.120-7.DB
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.120-5.DB sec-disk0:c6400s-wp-mz.120-5.DB
```

Step 3 From global configuration mode, use the **boot system** global configuration command to boot the images from the appropriate locations. Enter the image for the primary NSP first.

```
Switch# configure terminal
Switch(config)# boot system flash disk0:c6400s-wp-mz.120-7.DB
Switch(config)# boot system flash disk0:c6400s-wp-mz.120-5.DB
```

Step 4 Set the configuration register to load the system image from Flash.

```
Switch (config)# config-register 0x2101
```

Step 5 Enable automatic synchronization of the redundant NSPs.

```
Switch(config)# redundancy
Switch(config-r)# main-cpu
Switch(config-r-mc)# auto-sync standard
Switch(config-r-mc)# end
```

Step 6 Save the configuration file to the startup configuration in NVRAM. Because automatic synchronization is enabled, this step saves the **boot system** commands to both NSP startup configurations.

```
Switch# copy system:running-config nvram:startup-config
```

Step 7 If the primary NSP is not running the correct image, reset both NSPs.

```
Switch# hw-module nsp A reset
Switch# hw-module nsp B reset
```

Step 8 If the primary NSP is running the earlier software version, perform a switchover from the current primary to the secondary NSP.

```
Switch# redundancy force-failover main-cpu
```

Verifying NSP Redundancy for Software Error Protection

To verify that NSP redundancy is configured for software error protection, use the **show bootvar** EXEC command. Check that the secondary NSP is up, that the BOOT variables identify different software images, and that all other variables match.

```
Switch# show bootvar
BOOT variable = tftp:dir/c6400s-wp-mz.121-5.DC.bin 10.255.254.254,12;
CONFIG_FILE variable =
BOOTLDR variable =
Configuration register is 0x2000 (will be 0x1 at next reload)

Secondary is up.
Secondary BOOT variable = tftp:dir/c6400s-wp-mz.121-4.DC.bin 10.255.254.254,12;
Secondary CONFIG_FILE variable =
Secondary BOOTLDR variable =
Secondary Configuration register is 0x1
```

Booting Redundant NSPs from a Network Server

To boot a dual-NSP system from a network server (also called *netbooting*), the network management interface (Ethernet 0/0/0 on the NSP) must be configured for Dynamic Host Configuration Protocol (DHCP) IP address acquisition. To do this, complete the following steps beginning in global configuration mode:

	Command	Purpose

Step1	`Switch(config)# redundancy`
	`Switch(config-r)# main-cpu`
	`Switch(config-r-mc)# auto-sync standard`
		Enables automatic synchronization between the redundant NSPs.

Step2	`Switch(config-r-mc)# exit` `Switch(config-r)# exit`	Returns to global configuration mode.
Step3	`Switch(config)# interface ethernet0/0/0` `Switch(config-if)# ip address negotiated`	Configures the NSP network management interface for DHCP IP address acquisition.
Step4	`Switch(config-if)# end`	Returns to privileged EXEC mode.
Step5	`Switch# copy system:running-config nvram:startup-config`	Saves the configuration to the startup configuration.

Note Make sure the DHCP server is properly set up with appropriate dynamic and static pools of IP addresses.

Example

In the following example, the NSP network management interface is configured for DHCP IP address acquisition. This allows you to boot redundant NSPs from a network server.

```
!
redundancy
 main-cpu
  auto-sync standard
  !
interface ethernet0/0/0
 ip address negotiated
 !
```

Verifying Booting Redundant NSPs from a Network Server

To verify that the NSPs are prepared for netbooting, use the **more sec-nvram:startup-config** EXEC command. The presence of the correct commands in the secondary startup configuration confirms that both NSPs are configured properly.

NRP Redundancy

For two NRPs to act as a redundant pair, they must be installed in one the following slot pairs:

- 1 and 2
- 3 and 4
- 5 and 6
- 7 and 8

Configuring Redundant NRPs

To configure NRP redundancy, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters the redundancy configuration submode.
Step2	`Switch(config-r)# associate slot` *slot* [*slot*]	Configures the two slots as a redundant pair. You need specify only the first slot of the redundant pair. The second slot is assumed to be the adjacent slot.

Example

In the following example, the NRPs in slots 1 and 2 are configured as a redundant pair.

```
!
redundancy
 associate slot 1 2
 main-cpu
  auto-sync standard
```

Verifying NRP Redundancy

To verify NRP redundancy, use the **show redundancy** EXEC command on the NRP:

```
Router# show redundancy
Primary   NRP in slot 2, system configured non redundant

User EHSA configuration (by CLI config):
slave-console = off
keepalive     = on
config-sync modes:
standard   = on
start-up   = on
boot-var   = on
config-reg = on

NSP EHSA configuration (via pam-mbox):
redundancy         = off
preferred (slot 2) = yes

Debug EHSA Information:
NRP specific information:
Backplane resets       = 0
NSP mastership changes = 0

print_pambox_config_buff: pmb_configG values:
valid            = 1
magic            = 0xEBDDBE1 (expected 0xEBDDBE1)
nmacaddrs        = 1
run_redundant    = 0x0
preferred_master = 0x1
macaddr[0][0]    = 0010.7b79.af93
macaddr[1][0]    = 0000.0000.0000

EHSA pins:
peer present = 0
peer state   = SANTA_EHSA_SECONDARY
crash status: this-nrp=NO_CRASH(1) peer-nrp=NO_CRASH(1)

EHSA related MAC addresses:
peer bpe mac-addr = 0010.7b79.af97
my   bpe mac-addr = 0010.7b79.af93
```

Erasing Startup Configurations on Redundant NRPs

To erase the startup configuration on redundant NRPs, complete the following steps beginning in EXEC mode:

	Command	Purpose
Step1	`Router# erase nvram:`	Erases the primary NRP's startup configuration.
Step2	`Router# erase sec-nvram:`	Erases the secondary NRP's startup configuration.

Note If you erase the startup configuration on the primary NRP only, and the primary and secondary NRPs reverse roles, the new primary NRP will use the old startup configuration.

Verifying Erased Startup Configurations

To verify that you erased the startup configuration on redundant NRPs, use the **dir nvram:** and **dirsec-nvram:** EXEC commands and check that the startup-config size is zero:

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

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

129016 bytes total (129016 bytes free)
```

You can also use the **show startup** EXEC command and make sure that a valid configuration file does not appear:

```
NRP# show startup
%% Non-volatile configuration memory is being written, Try again later
```

NLC Redundancy

When a node line card (NLC) is configured for redundancy, all ports on that card are automatically configured to operate in redundant mode using SONET automatic protection switching (APS). For more information on SONET APS, see the "SONET APS for NLC Port Redundancy" section on page5-19.

Configuring Redundant Full-Height NLCs

For two full-height NLCs to act as a redundant pair, they must be installed in one the following slot pairs:

- 1 and 2
- 3 and 4
- 5 and 6
- 7 and 8

Note By default, the NLC in the lower slot number is the working device, and the NLC in the higher slot number is the protection device.

To configure redundant full-height NLCs, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters the redundancy configuration submode.
Step2	`Switch(config-r)# associate slot` *slot* [*slot*]	Configures the two slots as a redundant pair. You need specify only the first slot of the redundant pair. The second slot is assumed to be the adjacent slot.

Example

In the following example, the OC-12s in slots 5 and 6 are configured for redundancy:

```
!
redundancy
 associate slot 5 6
!
```

Configuring Redundant Half-Height NLCs

For two half-height NLCs to act as a redundant pair, they must be installed in one of the following slot/subslot pairs:

- 1/0 and 2/0, or 1/1 and 2/1
- 3/0 and 4/0, or 3/1 and 4/1
- 5/0 and 6/0, or 5/1 and 6/1
- 7/0 and 8/0, or 7/1 and 8/1

Note By default, the NLC in the lower slot number is the working device, and the NLC in the higher slot number is the protection device.

To configure redundant half-height NLCs, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# redundancy`	Enters the redundancy configuration submode.
Step2	`Switch(config-r)# associate subslot` *slot/subslot* [*slot/subslot*]	Configures the two subslots as a redundant pair. You need only specify the first subslot of the redundant pair. The second subslot is assumed to be the adjacent slot.

Example

In the following example, the OC-3s in subslots 3/0 and 4/0 are configured as a redundant pair:

```
!
redundancy
 associate subslot 3/0 4/0
 !
```

Verifying NLC Redundancy

To verify NLC redundancy, use the **show aps** EXEC command on the NSP. The **show aps** command displays the status for all NLCs configured for port redundancy.

```
Switch# show aps
ATM7/0/0: APS Lin NR Uni, Failure channel: Protection
          Active Channel: CHANNEL7/0/0, Channel stat: Good
          Port stat (w,p): (Good, Good)
ATM7/0/1: APS Lin NR Uni, Failure channel: Protection
          Active Channel: CHANNEL7/0/1, Channel stat: Good
          Port stat (w,p): (Good, Good)
```

SONET APS for NLC Port Redundancy

SONET automatic protection switching (APS) provides a mechanism to support redundant transmission interfaces (circuits) between SONET devices. Automatic switchover from the working (primary) circuit to the protection (secondary) circuit happens when the working circuit fails or degrades.

The Cisco 6400 supports SONET APS operation that is:

- 1+1— There is one working interface and one protection interface, and the same payload from the transmitting end is sent to both the receiving ends. The receiving end decides which interface to use. The line overhead (LOH) bytes (K1 and K2) in the SONET frame indicate both status and action.
- Linear—Back-to-back connection (as opposed to a ring topology), as defined in the *Telcordia GR-253-CORE* document.
- Unidirectional—Transmit and receive channels are switched independently.
- Nonreverting—Nonreverting channels continue to operate after a failure has been corrected, thus preventing data from flowing back to the working channel.

Note By default, the NLC in the lower slot number is the working device, and the NLC in the higher slot number is the protection device.

Enabling and Disabling SONET APS

In the Cisco 6400, a pair of redundant ports is represented as a single interface. APS commands are accepted only for an interface that represents a pair of redundant ports.

For APS operation, the APS mode must be specified for each interface associated with a redundant pair of ports. To enable SONET APS, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies the interface (that represents a pair of redundant NLC ports).
Step2	`Switch(config-if)# aps mode linear 1+1 nonreverting unidirectional`	Enables SONET APS on the interface. This command must be entered before the other **aps** commands.

Note SONET APS is enabled by default when you install an NLC in a slot already configured for redundancy.

If the redundant NLC configuration is disabled by using the **no associate slot** or **no associate subslot** redundancy configuration commands, two interface configuration sections are created, one for each port, but all of the APS configuration commands are removed.

Example—Enabling SONET APS

In the following example, SONET APS is enabled for ATM interface 1/0/0:

```
!
interface atm 1/0/0
 aps mode linear 1+1 nonreverting unidirectional
 !
```

Example—Disabling Redundancy and SONET APS

The following table shows example configurations before and after redundancy is turned off:

Redundancy On	After Redundancy Is Turned Off
redundancy associate slot 1 2 ! interface ATM1/0/0 no ip address no ip redirects no ip proxy-arp no atm auto-configuration no atm ilmi-keepalive atm uni version 4.0 aps mode linear 1+1 nonreverting unidirectional aps signal-fail BER threshold 3 !	interface ATM1/0/0 no ip address no ip redirects no ip proxy-arp no atm auto-configuration no atm ilmi-keepalive atm uni version 4.0 ! interface ATM2/0/0 no ip address no ip redirects no ip proxy-arp no atm auto-configuration no atm ilmi-keepalive atm uni version 4.0 !

Verifying SONET APS

To verify the that SONET APS is enabled or to determine if a switchover has occurred, use the **show aps** EXEC command or the **show controller atm** *slot/subslot/port* command.

In the following example, slot 7 contains the working (primary) card, and slot 8 contains the protection (secondary) card:

```
Switch# show aps
ATM7/0/0: APS Lin NR Uni, Failure channel: Protection
          Active Channel: CHANNEL7/0/0, Channel stat: Good
          Port stat (w,p): (Good, Good)
ATM7/0/1: APS Lin NR Uni, Failure channel: Protection
          Active Channel: CHANNEL7/0/1, Channel stat: Good
          Port stat (w,p): (Good, Good)
```

In the following example, the OC-3 interface ATM 5/0/0 is not configured for redundancy:

```
Switch# show controller atm 5/0/0
Redundancy NOT Enabled on interface
IF Name: ATM5/0/0    Chip Base Address(es): A8B08000, 0 Port type: OC3    Port rate: 155
Mbps    Port medium: SM Fiber
Port status:Good Signal    Loopback:None    Flags:8308
TX Led: Traffic Pattern    RX Led: Traffic Pattern  TX clock source:  network-derived
Framing mode:  sts-3c
Cell payload scrambling on
Sts-stream scrambling on
```

Setting SONET APS Priority Requests

APS priority requests are used to manually control the relationship between two APS ports from the EXEC mode. The APS priority levels, lockout (1), force (2), and manual (5) are defined in the *Telcordia GR-253-CORE* document.

To set the APS priority requests, use the following commands in EXEC mode:

Command	Purpose
Switch# **aps lockout atm** *slot/subslot/port*	APS priority level 1 request. Prevents a working interface from switching to a protection interface.
Switch# **aps force atm** *slot/subslot/port* **from** [**protection** | **working**]	APS priority level 2 request. Manually forces the specified interface to the protection or working interface, unless a request of equal or higher priority is in effect. Use the **working** option to force operation from the working channel to the protection channel. Use the **protection** option to force operation from the protection channel to the working channel.
Switch# **aps manual atm** *slot/subslot/port* **from** [**protection** | **working**]	APS priority level 5 request. Manually switches an interface to the protection or working interface, unless a request of equal or higher priority is in effect. Use the **working** option to manually switch operation from the working channel to the protection channel. Use the **protection** option to manually switch operation from the protection channel to the working channel.
Switch# **aps clear atm** *slot/subslot/port*	Manually clears all posted APS priority requests created by any of the APS priority commands.

Example

In the following example, the system is forced to use the protection channel associated with ATM interface 1/0/0:

```
Switch# aps force atm 1/0/0 from working
```

Verifying the APS Priority Requests

To verify that you successfully set the APS priority requests, use the **show aps** EXEC command:

```
Switch# aps force atm 5/1/0 from working
Switch# show aps

ATM5/1/0:APS Lin NR Uni, Failure channel:Working
          Active Channel:CHANNEL6/1/0, Channel stat:Force Switch
          Port stat (w,p):(Good, Good)
```

Setting SONET APS Signal Thresholds

You can configure the APS signal bit error rate (BER) thresholds at which the system announces signal degradation or signal failure.

The **aps signal-degrade BER threshold** command controls the BER value at which a signal degrade is announced, indicating an unstable or error-prone connection. This BER threshold can be in the range of 10^{-5} to 10^{-9}, and there is no default threshold.

The **aps signal-fail BER threshold** command controls the BER value at which a signal failure is announced, indicating a broken connection. This BER threshold can be in the range of 10^{-3} to 10^{-5}, with a default threshold of 10^{-3}.

To configure the thresholds, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Selects the NLC interface.
Step2	`Switch(config-if)# aps signal-degrade BER threshold value`	Sets the BER threshold value for signal degradation for the interface.
Step3	`Switch(config-if)# aps signal-fail BER threshold value`	Sets the BER threshold value for signal failure for the interface.

The *value* argument represents the exponent of the BER threshold. For instance, a value of 5 would set the threshold to 10^{-5}.

Example

The following example shows how to set the APS signal degradation and signal failure thresholds for ATM interface 1/0/0:

```
Switch(config)# interface atm 1/0/0
Switch(config-if)# aps signal-degrade BER threshold 7
Switch(config-if)# aps signal-fail BER threshold 5
```

Verifying SONET APS Signal Thresholds

To display the current BER threshold settings for an interface, use the **show interface atm** command:

```
Switch# show interface atm 1/0/0
interface ATM1/0/0
 description la1
 no ip address
 no ip redirects
 no ip proxy-arp
 no atm auto-configuration
 no atm ilmi-keepalive
 atm uni version 4.0
 aps mode linear 1+1 nonreverting unidirectional
 aps signal-fail BER threshold 3
 aps signal-degrade BER threshold 9
```

Primary and Secondary Role Switching

The Cisco 6400 allows you to manually force the primary and secondary devices in a redundant pair to switch roles. This capability can be important for upgrade or debug activities.

Reversing NSP and NRP Redundancy Roles

To reverse the primary and secondary roles in a redundant pair of NSPs or NRPs, use the following command in EXEC mode:

Command	Purpose
`Switch# redundancy force-failover {slot | slot/subslot | main-cpu}`	Forces the system to switch the current primary and secondary devices of the redundant pair.

Reversing NLC Redundancy Roles

To reverse the primary and secondary roles in a redundant pair of NLCs, use the **aps force** or **apsmanual** EXEC commands described in the "Setting SONET APS Priority Requests" section on page5-20.

Resetting Cards, Slots, and Subslots

On the Cisco 6400 it is often useful to reset a card in a particular slot or subslot in a redundant pair. The reset function described here is different from resetting an interface. In general, the **hw-module (reset)** command simulates card removal and insertion of the specified device. If the specified card is the primary device in a redundant pair, operation will automatically switch to the other card.

To reset a card, use the following command in EXEC mode:

Command	Purpose
`Switch# hw-module {slot slot | subslot slot/subslot | main-cpu | sec-cpu | nsp {A | B}} reset`	Simulates removal and insertion of a device installed in the Cisco 6400 chassis.

When entered in EXEC mode, this command causes an immediate reset of the device installed in the specified slot or subslot. When a port is reset, all of the input/output hardware associated with the port is reset. If a slot is reset, both of the cards installed in the associated subslots are reset. The **main-cpu** and **sec-cpu** options allow you to reset the desired NSP regardless of the one to which you are currently connected.

Note The **hw-module** command is not supported for ports. The command only supports slots and subslots.

SNMP, RMON, and Alarm Configuration

This chapter contains information on the following system management topics:

Simple Network Management Protocol

Simple Network Management Protocol (SNMP) is an application-layer protocol that allows an SNMP manager, such as a network management system (NMS), and an SNMP agent on the managed device to communicate. Remote Monitoring (RMON) allows you to see the activity on network nodes. By using RMON in conjunction with the SNMP agent on the Cisco 6400, you can monitor traffic through network devices, segment traffic that is not destined for the Cisco 6400, and create alarms and events for proactive traffic management.

For a complete description of SNMP, SNMP Management Information Bases (MIBs), and how to configure SNMP, see the "Configuring Simple Network Management Protocol (SNMP)" chapter of the "Cisco IOS System Management" part of the *Cisco IOS Configuration Fundamentals Configuration Guide*.

Identifying and Downloading MIBs

To identify and download MIBs supported by the Cisco 6400, go to the Cisco MIB website on Cisco.com at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

Using the NSP as the SNMPv3 Proxy Forwarder for the NRP-2

The SNMPv3 Proxy Forwarder feature enables all NSP and NRP-2 components of the Cisco 6400 system to be managed as one functional entity. With the Proxy Forwarder feature enabled, the NSP:

- Forwards all SNMPv3 formatted messages (such as manager requests to get or set data) destined for the NRP-2s
- Routes the SNMPv3 formatted traps from NRP-2s to the NSP combined network management Ethernet (NME) interface

Note The SNMPv3 Proxy Forwarder feature was introduced in Cisco IOS Releases 12.1(4)DB and 12.1(4)DC for the node route processor 2 (NRP-2). The feature is not supported in earlier releases or by the node route processor 1 (NRP-1).

To configure the Proxy Forwarder feature, complete the following tasks:

- Task 1: Configuring the NSP as the Proxy Forwarder
- Task 2: Configuring the NRP-2 to Use the NSP as the Proxy Forwarder

Task 1: Configuring the NSP as the Proxy Forwarder

To enable the NSP to act as the proxy forwarder for the NRP-2s in the Cisco 6400 chassis, enter the following NSP commands in global configuration mode:

	Command (Entered on the NSP)	Purpose
Step1	`Switch(config)# snmp-server group` *groupname* `v3 noauth`	Configures a new SNMPv3 group.
Step2	`Switch(config)# snmp-server user` *username groupname* `v3`	Configures a new user to an SNMPv3 group. Make sure that you use the same *groupname* in Steps 1 and 2.
Step3	`Switch(config)# snmp-server forwarder`	Enables the NSP SNMPv3 proxy forwarder.
Step4	`Switch(config)# snmp-server host` *host-address* `vrf 6400-private version 3 noauth` *username*	Specifies the recipient of NRP-2 SNMPv3 trap messages.

When you complete the previous steps, the NSP automatically generates **snmp-server user** and **snmp-server group** commands in the configuration.

Each time the NSP reloads or you insert an NRP-2 into the chassis, the NSP automatically generates **snmp-server engineID** commands in the configuration.

Note Do not modify or delete the automatically generated commands, because doing so may prevent SNMP from working properly.

Example

In the following example, the NSP is configured to act as the proxy forwarder:

```
snmp-server group usmgrp v3 noauth
snmp-server user usmusr usmgrp v3
snmp-server forwarder
snmp-server host 10.100.100.100 vrf 6400-private version 3 noauth trapusr
```

The previous commands cause the NSP to automatically generate the following commands:

```
snmp-server engineID remote 10.3.0.2 vrf 6400-private 800000090300000107BA9C7A0
snmp-server user trapusr trapusr v3
snmp-server user trapusr trapusr remote 10.3.0.2 vrf 6400-private v3
snmp-server user usmusr usmgrp remote 10.3.0.2 vrf 6400-private v3
snmp-server group trapusr v3 noauth notify *tv.FFFFFFFF.FFFFFFFF
```

Task 2: Configuring the NRP-2 to Use the NSP as the Proxy Forwarder

To configure the NRP-2 to communicate with the NSP as the proxy forwarder, complete the following steps in global configuration mode:

	Command (Entered on the NRP-2)	Purpose
Step1	`Router(config)# snmp-server group` *groupname* `v3 noauth`	Configures a new SNMPv3 group. Make sure that the *groupname* argument entry matches that entered on the NSP in Task1.
Step2	`Router(config)# snmp-server user` *username groupname* `v3`	Configures a new user to an SNMPv3 group. Make sure that the *username* and *groupname* argument entries match those entered on the NSP in Task 1.
Step3	`Router(config)# snmp-server enable traps [config | syslog | bgp | ipmulticast | rsvp | frame-relay | rtr | snmp authentication linkdown linkup coldstart]`	Enables the NRP-2 to send traps. Optionally, you can select from specific types of traps.
Step4	`Router(config)# snmp-server host 10.`*nrp2-slot*`.0.1 vrf 6400-private version 3 noauth` *username*	Specifies the NSP as the recipient of SNMPv3 trap messages. The **10.***nrp2-slot***.0.1** IP address is the private address for the internal NSP interface to the NRP-2 PAM mailbox serial interface.

When you complete the previous steps, the NRP-2 automatically generates **snmp-server user** and **snmp-server group** commands in the configuration.

If you do not select any specific types of traps, the NRP-2 also automatically generates **snmp-server enable traps** commands to specify all available types of traps.

Note Do not modify or delete the automatically generated commands, because doing so may prevent SNMP from working properly.

Example

In the following example, the NRP-2 is configured to allow the NSP to act as the proxy forwarder:

```
snmp-server group usmgrp v3 noauth
snmp-server user usmusr usmgrp v3
snmp-server enable traps
snmp-server host 10.3.0.1 vrf 6400-private version 3 noauth trapusr
```

The previous commands cause the NRP-2 to automatically generate the following commands:

```
snmp-server user trapusr trapusr v3
snmp-server group trapusr v3 noauth notify *tv.FFFFFFFF.FFFFFFFF
snmp-server enable traps snmp authentication linkdown linkup coldstart
snmp-server enable traps config
snmp-server enable traps syslog
snmp-server enable traps bgp
snmp-server enable traps ipmulticast
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
```

Verifying the SNMPv3 Proxy Forwarder

To verify successful configuration of the SNMPv3 Proxy Forwarder feature, use the **moresystem:running-config** EXEC command. On both the NSP and NRP-2, check that you properly configured the commands described in the previous tasks.

Also check that the automatically generated commands correctly appear on both the NSP and NRP-2 running configurations. On the NSP, the three automatically generated commands that include an IP address are generated for every active NRP-2 in the chassis. The other automatically generated commands are created only once, regardless of the number of active NRP-2s installed in the chassis.

Remote Monitoring

The Remote Monitoring (RMON) option makes individual nodal activity visible and allows you to monitor all nodes and their interaction on a LAN segment. RMON, used in conjunction with the SNMP agent in the NSP, allows you to view traffic that flows through the switch as well as segment traffic not necessarily destined for the switch. Combining RMON alarms and events with existing MIBs allows you to choose where proactive monitoring will occur.

RMON can be very data and processor intensive. Users should measure usage effects to ensure that router performance is not degraded by RMON and to minimize excessive management traffic overhead. Native mode is less intensive than promiscuous mode.

The Cisco 6400 supports both RMON and ATM RMON.

For a complete description of the RMON MIB agent specification, and how it can be used in conjunction with SNMP to monitor traffic using alarms and events, see the “Configuring RMON Support” section of the “Cisco IOS System Management” part of the *Cisco IOS Configuration Fundamentals Configuration Guide*.

For a complete description and configuration information for ATM RMON on the NSP, see the “Configuring ATM Accounting and ATM RMON” chapter of the *ATM Switch Router Software Configuration Guide*.

Alarms

Alarms on the NSP help to monitor equipment and identify the cause of physical system problems within the central office (CO). There are three levels of alarms: minor, major, and critical, and there are many sources of alarm conditions. Temperature thresholds are the only alarm source that you can configure, but alarms can be triggered by card failure, SONET APS failures, and NRP failures.

Configuring Temperature Threshold Alarms

The Cisco 6400 includes environmental monitoring hardware and a digital thermometer that measures the temperature of the intake airflow and the temperature at the hottest part of the chassis. Temperature thresholds for each alarm type and location are automatically set, based on empirically determined values that vary depending on the number and type of boards inserted in the chassis. In addition to the automatically set thresholds, you can set your own thresholds for minor and major temperature alarms. You can also disable the minor and major temperature alarms. You cannot, however, change the threshold for or disable critical alarms.

To set thresholds for the minor and major temperature alarms at the two monitored locations, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# facility-alarm [intake-temperature | core-temperature] [minor °C | major °C]`	Specifies thresholds for the intake and core major and minor alarms in degrees Celsius.

To disable the minor or major temperature alarms for either monitored location, use the **no** form of the **facility-alarm** command.

Example—Setting the Threshold

In the following example, the major core temperature alarm is set to 35°C:

```
Switch(config)# facility-alarm core-temperature major 35
```

Example—Disabling the Alarm

In the following example, the minor intake temperature alarm is disabled:

```
Switch(config)# no facility-alarm intake-temperature minor
```

Verifying Temperature Alarms

To check the temperature thresholds, use the **show facility-alarm status** EXEC command, described in the next section.

Displaying Alarm Status and Thresholds

To display the status of current major and minor alarms and the settings of all user-configurable alarm thresholds, use the following EXEC command:

Command	Purpose
`Switch# show facility-alarm status`	Display all alarm thresholds and the status of current alarms.

Example

```
Switch# show facility-alarm status
Thresholds:
Intake minor 40 major 50 Core minor 55 major 53
SOURCE:Network Clock TYPE:Network clock source, priority level 2 down
SEVERITY:Minor ACO:Normal
SOURCE:NSP EHSA TYPE:Secondary failure SEVERITY:Minor ACO:Normal
SOURCE:ATM2/0/1 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
SOURCE:ATM6/0/1 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
SOURCE:ATM7/0/1 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
SOURCE:ATM6/1/0 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
SOURCE:ATM6/1/1 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
SOURCE:ATM7/1/1 TYPE:Sonet major line failure SEVERITY:Major ACO:Normal
```

Clearing Alarms

You can use the **clear facility-alarm** EXEC command to reset the external alarm relays and stop an auditory alarm indication. However, the alarm cause and LED indication may still be in effect, and the alarm can be viewed with the **show facility-alarm status** EXEC command until the alarm is cleared at the source. To clear the source of an alarm, you must specify the source as either the secondary CPU, one of the power entry modules (PEMs), or any device installed in the specified slot or subslot.

Clearing the source of an alarm is useful for:

- Removing a card from the chassis permanently or for an extended period of time
- Replacing a card with a different type of card in the same slot or subslot

The Cisco 6400 remembers the type of card originally installed in each slot or subslot, and removing a card activates an alarm.

To clear the specified alarm, reset the alarm contacts, and remove the source of the alarm, use the following EXEC command:

Command	Purpose
Switch# **clear facility-alarm** [**minor** | **major** | **critical**] [**source** {**sec-cpu** | **pem** {**0** | **1**} | **cardtype** {*slot* | *slot/subslot*}}]	Clears all alarms of the specified level, or clears the specified alarm source.

Note If all interfaces on an NLC or NRP are shut down prior to card removal (using the **shutdown** interface command), the Cisco 6400 will not generate an alarm.

Example—Clearing All Alarms

The following example shows how to clear all current external alarm relays:

```
Switch# clear facility-alarm
```

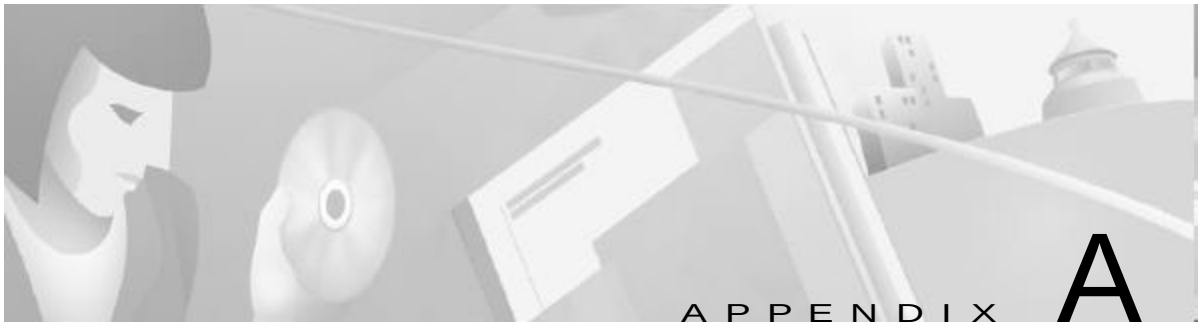
Example—Clearing a Specified Alarm Source

Suppose you have an NRP-1 in slot 2. Removing the NRP-1 and inserting an OC-12 NLC will generate an alarm. The following example shows how to clear the alarm:

```
Switch# clear facility-alarm source cardtype 2
```

Verifying Cleared Alarms

To verify that you cleared the alarms, use the **show facility-alarm status** EXEC command.



Web Console

This chapter tells you how to use the online Web Console, a graphical user interface (GUI), to set or change the system configuration and monitor system activity. The Web Console application communicates with the system by translating HTML pages into Cisco IOS commands. You can enter similar configuration parameters for your system using the command-line interface (CLI).

The Cisco 6400 ships with the Asynchronous Transfer Mode (ATM) address autoconfigured by Cisco Systems, allowing the switch to automatically configure attached end systems using the Interim Local Management Interface (ILMI) protocol and to establish itself as a node in a single-level Private Network-Network Interface (PNNI) routing domain.

The ILMI and PNNI protocols, when used with an IP address autoconfiguration mechanism such as Dynamic Host Configuration Protocol (DHCP) or Bootstrap Protocol (BOOTP), allow the Cisco 6400 to be entirely self-configured. Before using the Web Console to configure your Cisco 6400, you must assign an IP address or use DHCP to obtain an address for the system.

This chapter discusses the following topics:

Note For a description of the commands mentioned in this chapter, refer to the *Cisco 6400 Command Reference*, the *ATM and Layer 3 Switch Router Command Reference*, and the Cisco IOS Command Reference documentation.

Web Console Installation

Before you can use the Web Console to configure your Cisco 6400, you must install the Web Console HTML pages. You can install the Web Console from the PCMCIA disk in the node switch processor (NSP) disk slot 0 (disk0:) or from a TFTP server. After the HTML pages are installed, they can be updated at any time using the procedure described in the "Loading New Web Console Pages" section on page A-24.

Using Automatic Installation of the Web Console

Automation installation of the Web Console requires a PCMCIA disk with a Web Console software image of Cisco IOS Release 12.0(5)DB or later. If you plan to use an earlier Web Console software release, proceed to the "Installing the Web Console from the PCMCIA Disk" or "Installing the Web Console from a TFTP Server" sections.

To let the NSP install the Web Console application automatically, complete the following steps beginning in EXEC mode:

Step 1 Insert the PCMCIA disk with the Web Console image into disk slot 0 of the NSP.

Step 2 Use the **dir disk0:** command to see if the Web Console image (indicated with the arrow below) is on disk0:. If the image is not on disk0:, proceed to Step 3. If you successfully locate the image on disk0:, skip to Step 4.

```
Switch# dir disk0:
Directory of disk0:/

  3  -rw-      628224   Jan 01 2000 00:08:55  c6400s-html.tar.120-5.DB
376  -rw-        2134   Jan 05 2000 22:05:27  startup.config

109760512 bytes total (109130154 bytes free)
Switch#
```

Step 3 Download the Web Console image (Cisco IOS Release 12.0(5)DB or later) from Cisco.com to disk0:. You might have to first download the image to an interim site on the local network, and then copy the image to disk 0:.

Step 4 Type **reload**. This will reboot the NSP.

```
Switch# reload
```

After rebooting, the NSP checks disk0: for a Web Console image. If the Web Console image is present, the NSP automatically extracts the HTML pages from the image.

Installing the Web Console from the PCMCIA Disk

To install the Web Console pages from the PCMCIA disk, complete the following steps in EXEC mode:

Step 1 Insert the PCMCIA disk with the Web Console image into disk slot 0 of the NSP.

Step 2 Create a directory, **nsp-html**, for the Web Console files on disk0:.

```
Switch# mkdir disk0:/nsp-html
```

Step 3 Extract the Web Console pages from disk0: to the **nsp-html** directory:

```
Switch# archive tar /xtract disk0:c6400s-html.tar disk0:/nsp-html
```

Installing the Web Console from a TFTP Server

To install the Web Console pages from a TFTP server, complete the following steps:

Step 1 Insert the PCMCIA disk with the Web Console image into disk slot 0 of the NSP.

Step 2 Set the HTTP path by entering the following command. You must supply the TFTP server name and directory.

```
Switch(config)# ip http path tftp://tftpservername/yourdir/nsp-html
```

Step 3 Copy the Web Console image to the TFTP server (choose one of the following):

a. From disk slot 0 of the NSP:

```
Switch# copy disk0:c6400s-html.tar tftp://tftpservername/yourdir
```

b. From Cisco.com—Download the Web Console image to the TFTP server and directory.

Step 4 In the directory with the Web Console image on the TFTP server, uncompress the image by using the **tar-xvf c6400s-html.tar** UNIX command:

```
tar -xvf c6400s-html.tar
x 6400.html, 15446 bytes, 31 tape blocks
x 6400_bottom.gif, 2881 bytes, 6 tape blocks
x 6400_left.gif, 8018 bytes, 16 tape blocks
x 6400_left_bottom.gif, 2545 bytes, 5 tape blocks
x 6400_left_left.gif, 1014 bytes, 2 tape blocks
....
x subscribervp.gif, 3855 bytes, 8 tape blocks
x subscribervp.html, 12580 bytes, 25 tape blocks
x subscribervphlp.html, 6965 bytes, 14 tape blocks
x sysadvancehlp.html, 8765 bytes, 18 tape blocks
x system.gif, 3809 bytes, 8 tape blocks
```

Running the Web Console

After you have installed Web Console on the NSP, open a browser (Netscape Navigator 4.x or above or Microsoft Internet Explorer 4.x or above) on any other workstation, using the following settings:

- Enable the JavaScript option.
- Set the browser memory and disk cache sizes to a minimum or 4096 kilobytes.
- Set the browser cache to local disk.

Enter the IP address of the network management Ethernet (NME) on the Cisco 6400 as the URL and press **Enter** to run the Web Console.

Note Netscape Navigator 4.6 or 4.7 is required to use the Web Console image from CiscoIOSRelease12.0(7)DB1.

Using the Web Console

The Cisco 6400 Web Console is an embedded HTML website residing on PCMCIA disk0: or on your TFTP server. You can assign a bookmark to the Web Console access page and use the other browser functions as you would with any website. You can also use the live image of the switch on the Web Console Status page to monitor switch activity and confirm configuration changes without having to go into the wiring closet. Online help is available on all pages.

Note Web Console uses HTTP, which is an in-band form of communication: you access the switch through one of its Ethernet ports. Therefore, you should ensure that you do not disable or otherwise misconfigure the port that you are using to communicate with the switch. As a system administrator, you might want to write down the number of the port you are connected to. For the same reason, changes to the switch IP information should be done with care.

Making Changes with the Web Console

Web Console pages function much like other GUIs. When you display a Web Console page, it contains the current settings that have been defined for the switch. You change the system configuration by entering information into fields, adding and removing list items, or selecting check boxes.

Changes made by entering information into fields become part of the running (current) configuration when you click **Apply**, a button that appears on every page. If you make a mistake and want to retype an entry, click **Reset** to undo the information you entered. The exception to this procedure occurs when you are making changes to lists. Items added or removed from lists immediately become part of the running configuration, and you do not need to click **Apply**.

TableA-1 lists the parameters that you can configure using Web Console.

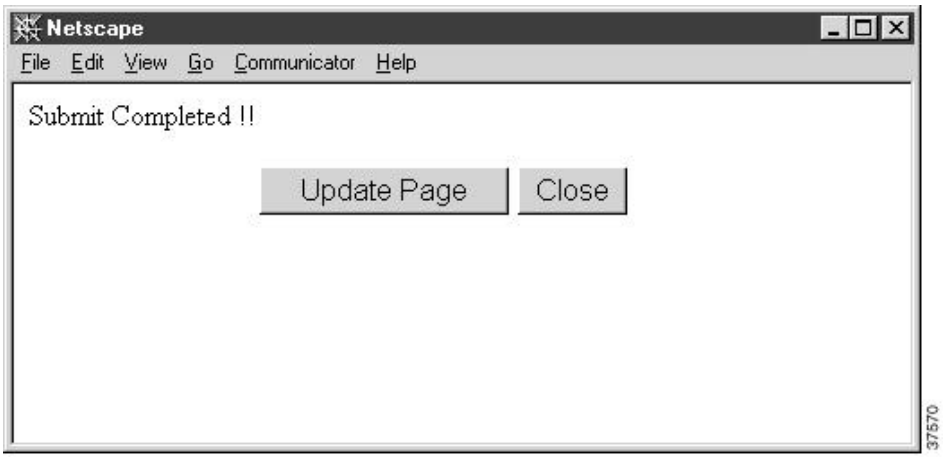
TableA-1 Features, Default Settings, and Web Console Pages

Feature	Default Setting	Web Console Page
Management		
Switch IP address, subnet mask, domain, and default gateway	0.0.0.0	Management IP
IP static route	None	Management IP
DNS server identification	Enabled	Management IP
NRP Configuration		
NRP configuration information	None	NRP
Redundancy		
Active CPU and autosynchronization characteristics	Disabled	Redundancy
Slot redundancy, primary/secondary configuration	Disabled	Redundancy
Subslot redundancy, primary/secondary configuration	Disabled	Redundancy
Subscriber		
Set up new subscribers, list current subscribers	Enabled	Subscriber
Diagnostics		
System monitoring	Enabled	Status
Security		
Switch name, password, domain, and ATM address	None	System
System reload and core dump options	None	Advanced System Configuration
SNMP contact information	None	SNMP Management
Trap manager	0.0.0.0	SNMP Management
Community strings	public/private	SNMP Management

Changing the Current Configuration

You can apply the changes you make using the Web Console to the current system configuration by clicking **Apply** on any of the Web Console pages. When you click **Apply**, the Update page is displayed. (See FigureA-1.)

FigureA-1 Update Page



The Update page allows you to confirm the changes you just made to the system configuration, before actually applying them to the running configuration of your switch. This page also indicates whether or not any errors occurred when the information was transferred to the operating system. If you are sure that you want to apply the changes to the running configuration, click **Update Page**. If you want to discard your changes, click **Close**.

Saving Changes to the Startup Configuration

The startup configuration file contains the IP addresses, passwords, and any other parameters you entered when you first configured the system. The system maintains the configuration by reloading this file when it restarts. However, the startup configuration file might not have the configuration that is currently operating the system. Changes made through the Web Console or the CLI take effect immediately but must be explicitly saved to be included in the startup configuration.

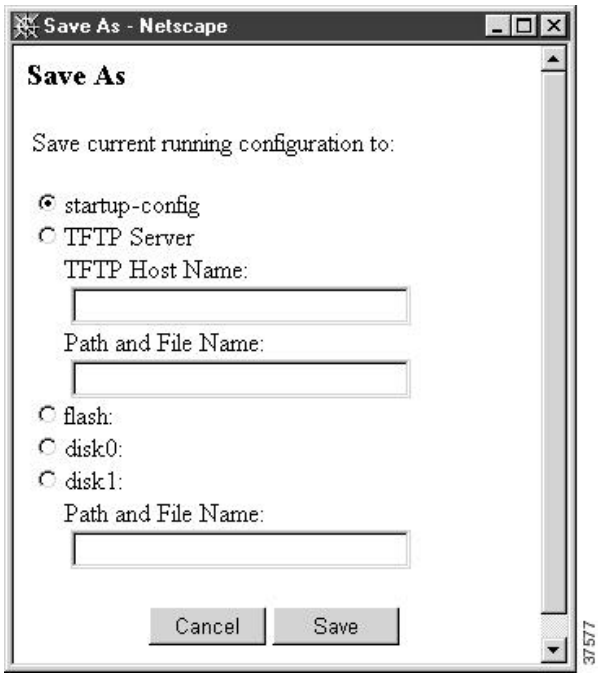
The configuration file that loads when the switch is restarted is not necessarily the same as the running configuration. If you want the running configuration to be the configuration used when the switch restarts, use the **Save As** button on each Web Console page to save the running configuration to the startup configuration file in memory.

To save the configuration to boot flash, the startup-config, the TFTP server, or one of the PCMCIA disks, follow these steps:

Step 1 Click the **Save As** button in the left frame on any of the Web Console pages.

The Save As window is displayed. (See FigureA-2.)

FigureA-2 Save As Window



Step 2 Click the button that corresponds to where you want the configuration you just entered to be stored.

Step 3 Enter a filename if you are saving to a file.

Step 4 Click the **Save** button.

Accessing the Web Console

The switch must have an IP address before you can access the Web Console. Follow the prompts when you install the switch to assign an IP address and other IP information. See the *Cisco 6400 UAC Hardware Installation and Maintenance Guide* for more information.

Follow these steps to access the Web Console:

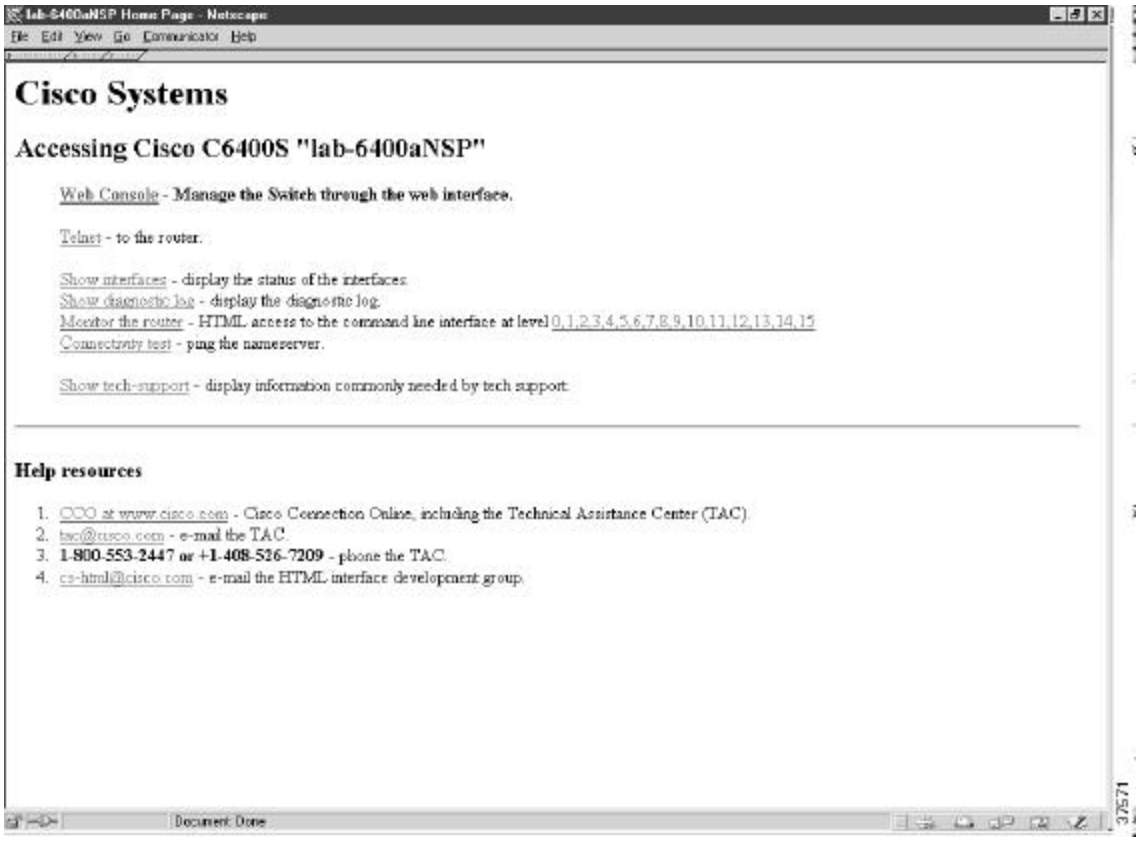
Step 1 Install the Web Console. Refer to the "Web Console Installation" section on pageA-2.

Step 2 Enter the IP address of the NSP management Ethernet in the URL field.

Step 3 Click **Enter**. The Cisco Systems Access page is displayed. (See FigureA-3.)

Step 4 Click **Web Console** to display the Cisco 6400 Basic System Configuration page. (See FigureA-4.)

FigureA-3 Cisco Systems Access Page



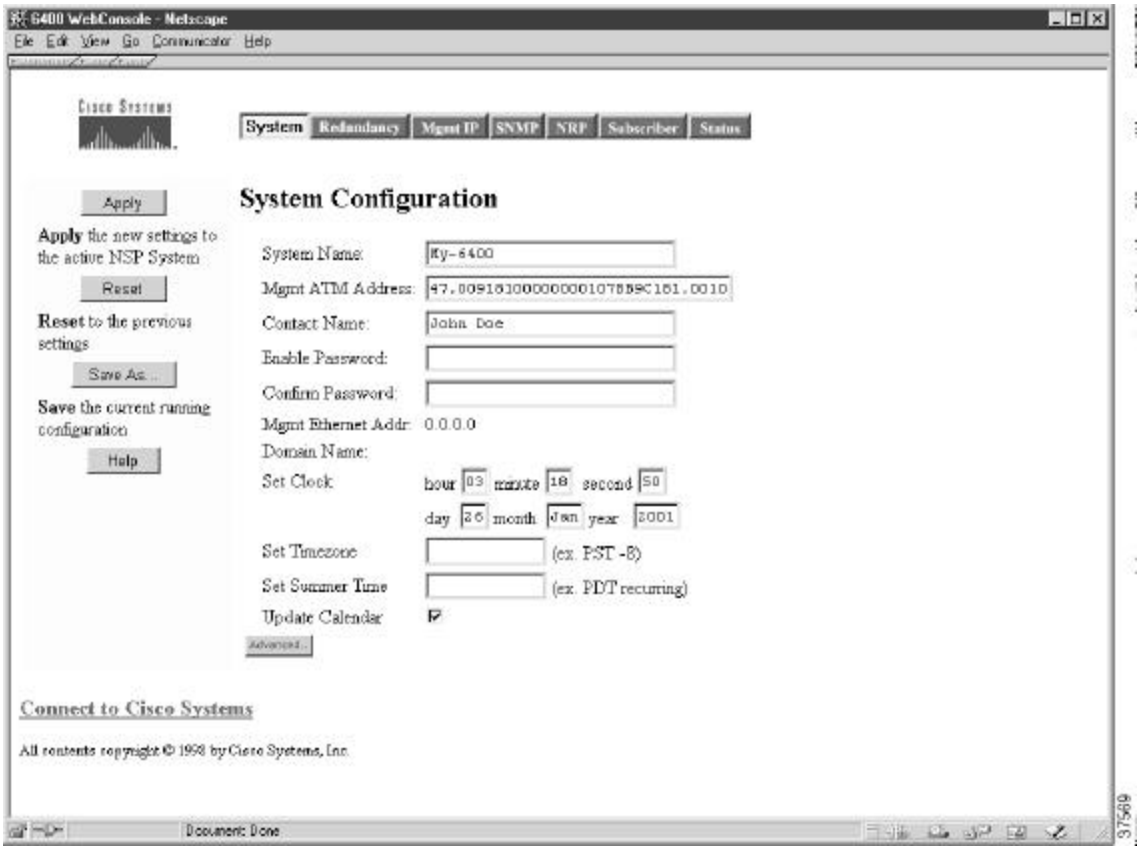
From the Access page, you can also open a Telnet connection to the NSP, show interfaces, show diagnostics, monitor the NSP, and display technical support information.

You can also access Cisco.com, the Cisco Systems customer website, from the Web Console home page. From Cisco.com, you can download the latest software and display the latest Cisco 6400 carrier-class broadband aggregator documentation.

Basic System Configuration Page

The Basic System Configuration page acts as the system home page. (See FigureA-4.) To display this page, click **Web Console** on the Cisco Systems Access page. To display the main page in Web Console, click **System** on the action bar.

FigureA-4 Basic System Configuration



Navigating in Web Console

After you have started the Web Console and displayed the Cisco 6400 home page (FigureA-4), you can use the action bar at the top of each page to move between pages. TableA-2 lists the functions that are available for each action bar selection.

TableA-2 Web Console Action Bar Options

Action Bar Option	Description
System	Allows basic system configuration
Redundancy	Allows configuration of redundant pairs of slots and subslots
Mgmt IP	Allows configuration of NME
SNMP	Allows configuration of SNMP characteristics
NRP	Shows status of NRPs
Subscriber[1]	Allows configuration of subscribers
Status	Shows status of chassis components

1. In Cisco IOS Release 12.0(7)DB1, the Subscriber option is separated into two: VC Subscriber and VP Subscriber.

Entering Basic Configuration Parameters

This information is usually entered once and not changed. Click **Apply** after entering information in the fields, **Revert** to return values to the previous settings, or **Save As** to save the configuration. Each of the fields is described in TableA-3.

TableA-3 System Configuration Field Descriptions

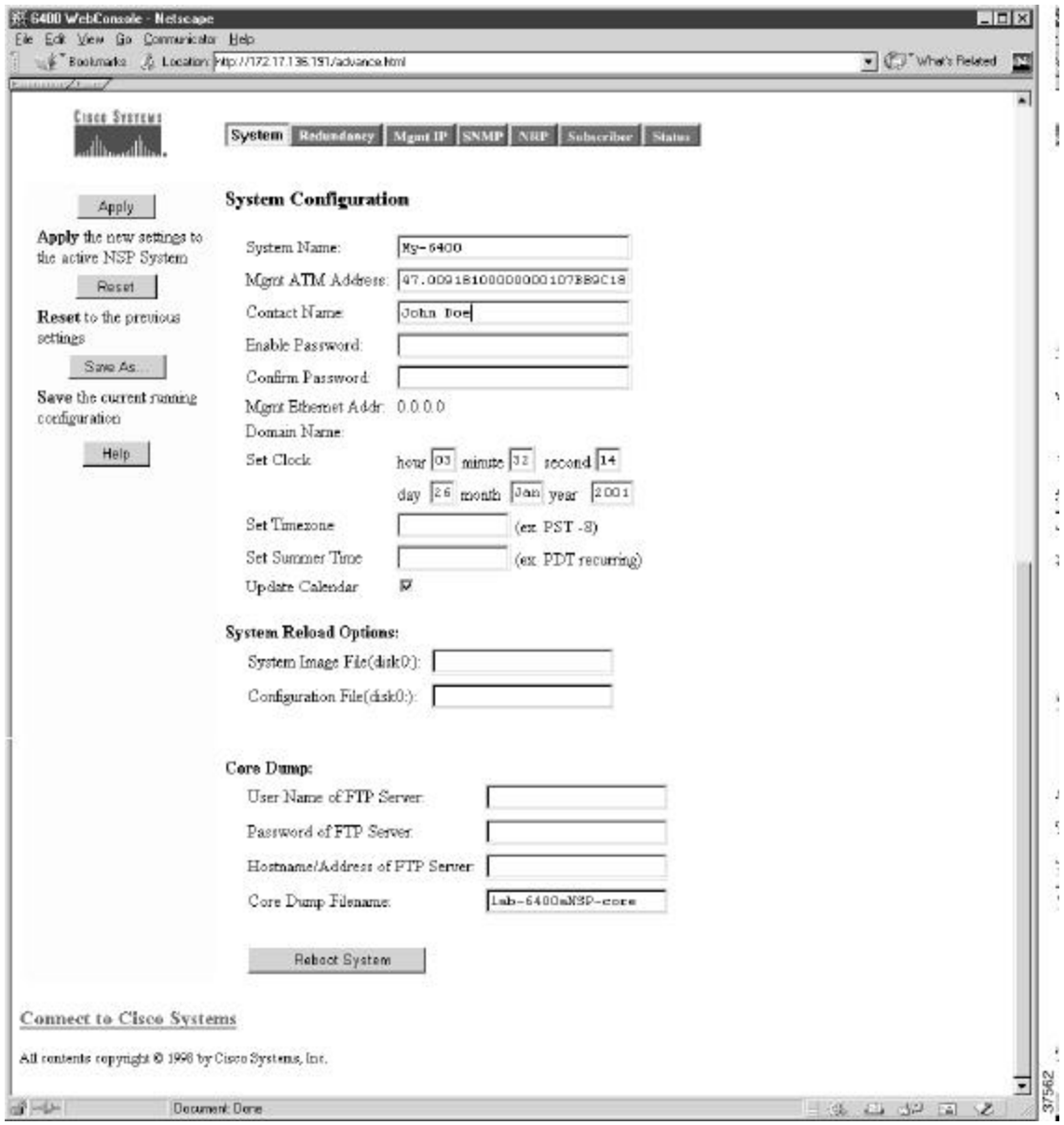
Field	Description
System Name	Enter a name for the Cisco 6400 system.
Mgmt ATM Address	Pre-assigned ATM address is entered automatically.
Contact Name	Enter a name.
Enable Password	Enter the enable password for the system.
Confirm Password	Reenter the enable password for the system.
Mgmt Ethernet Addr.	Displays the Ethernet address for the CPU. (Display only, use the Mgmt IP page to change the IP address.)
Domain Name	Displays the domain name of the system. (Display only, use the Mgmt IP page to change the domain name.)

For more information about setting your basic configuration, see Chapter 2, "Basic NSP Configuration."

Entering Advanced Configuration Parameters

Access the advanced configuration parameters by clicking the **Advanced** button on the System Configuration page. The Advanced parameters are displayed below the basic parameters. (See FigureA-5.)

FigureA-5 Advanced System Configuration



Note To return to the System Configuration page, click **System** in the Action bar.

Enter the System Reload Options and Core Dump parameters described in TableA-4 and then click **Apply**.

TableA-4 Advanced System Configuration Field Descriptions

Field	Description
System Reload Options	
System Image File	Enter the path and name of the Cisco IOS image file to be loaded when the system reboots.
Configuration File	Enter the path and the name of the configuration file that the image file reads to configure the system.
Core Dump	
User Name of FTP Server	Enter a valid user name for the FTP server where you want the core dump file sent.
Password of FTP Server	Enter a valid password for the FTP server where you want the core dump file sent.
Hostname/Address of FTP Server	Enter the host name and address for the FTP server where you want the core dump file sent.
Core Dump Filename	Enter the name you want used for the core dump file.

Use the **Reboot System** button on this page to reboot the system at any time.

Note Cisco recommends that core dumps be turned off to ensure enhanced high system availability (EHSA) performance. If core dumps are turned on, NSP failovers will only occur after the core dump is complete.

System Reload Options

This section describes the files used by the system when it reloads its software. Some of these files reside in memory, either boot flash or disk. To determine the names of the files to use, enter the **dir** command at the CLI. Here is an example of the display that results:

```
Switch# dir bootflash:

Directory of bootflash:

  2  -rwx      843947   Mar 01 1993 00:02:18  6400-h-mz-112.8-SA
  4  drwx        3776   Mar 01 1993 01:23:24  nsp-html
 66  -rwx         130   Jan 01 1970 00:01:19  env_vars
 68  -rwx        1296   Mar 01 1993 06:55:51  config.text

1728000 bytes total (456704 bytes free)
```

To view the system reload settings, use the **show bootvar** command as follows:

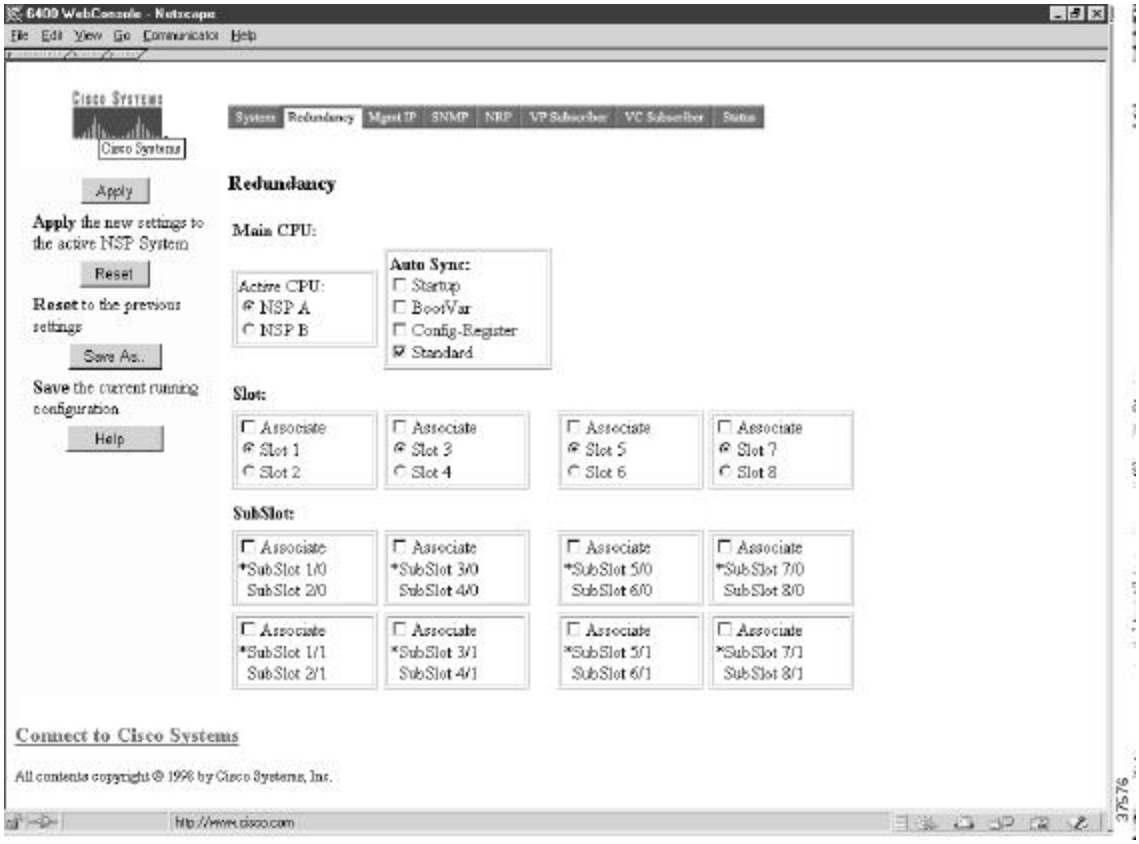
```
Switch# show bootvar
BOOT variable = disk0:c6400-wp-mz,12;
CONFIG_FILE variable does not exist
BOOTLDR variable does not exist
Configuration register is 0x2101
```

Configuring Redundancy

Use the Redundancy page to set up redundant CPUs, slots, and subslots. This page also allows you to set the primary/secondary relationship between redundant pairs. To display this page, click **Redundancy** on the action bar.

FigureA-6 shows the slots and subslots listed on the redundancy page.

FigureA-6 Redundancy Page



For more information about configuring redundancy, see Chapter 5, “Redundancy and SONET APS Configuration.”

Enabling CPU, Slot, and Subslot Redundancy

To set redundancy for a pair of CPUs, slots, or subslots, do the following:

Step 1 Click the **Associate** check box for the pair.

Step 2 Choose the primary slot or subslot by clicking the appropriate button.

Step 3 Click **Apply.**

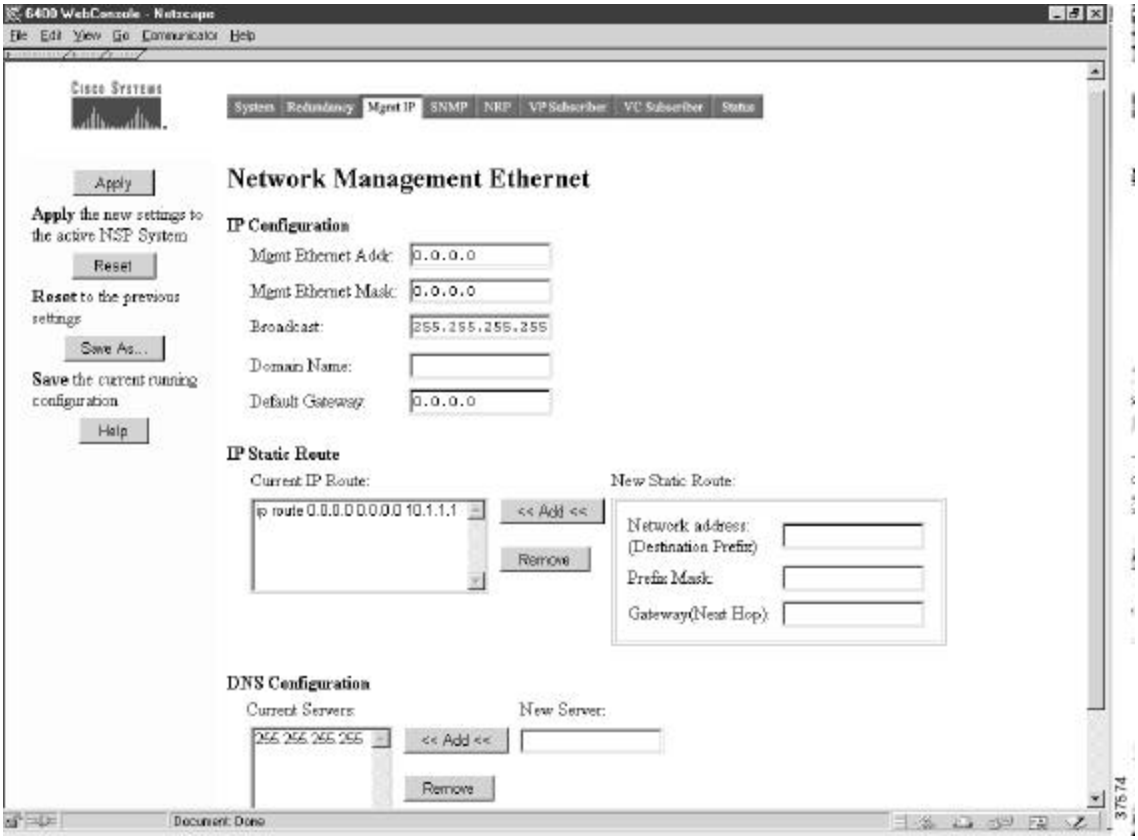
For the CPU, you can also set the configuration synchronization option as described in the "Synchronizing Redundant NSPs" section on page5-4.

IP Address Management

To manage the IP address used for the NME port, static IP routes, and DNS servers, use the Mgmt IP page. (See FigureA-7.) To display this page, click **Mgmt IP** on the action bar.

Caution Changing the switch IP address on this page will end your Web Console session. If this occurs, you can restart Web Console by entering the new IP address in the browser URL field.

FigureA-7 Mgmt IP Page



Setting the Management IP Configuration

The IP address of the switch is entered or changed through the Setup program or the CLI. If you change it on this page, the new value takes effect when you click **Apply** and could cause you to lose contact with the switch. When entering data in the IP Configuration fields, you can always select **Revert** to return the page to its previous state. You might need to contact a network administrator to obtain the IP address information.

Note If the Cisco 6400 is configured for NME consolidation, do not use the Web Console to configure management information. See the "Network Management Ethernet Interface" section on page 2-6 for more information.

Follow these steps to enter the IP parameters for the management Ethernet:

Step 1 Enter the subnet mask (Mgmt Ethernet Mask) for the switch.

Step 2 Enter the broadcast address for the switch.

Step 3 Enter the domain name of the NME.

Step 4 Enter the IP address of the default gateway, or router. This field is filled automatically if a discovery protocol finds a router connected to a switch port.

Step 5 Click **Apply** to save the current information to your running configuration.

Step 6 Click **Save As** to save the current information to your configuration file, Flash memory, disk, or TFTP server.

Setting Static Routes

Static routes for the NME are manually entered into the Static Address table. They are not aged (dropped) from the table when not in use, and they are not lost when the system resets. To set IP static routes used on the Ethernet management network, follow these steps:

Step 1 Enter the destination network Ethernet address for the new static route in the Network Address field.

Step 2 Enter the subnet mask for the static route in the Prefix Mask field.

Step 3 Enter the IP address for the next hop router in the Gateway (Next Hop) field.

Step 4 Click **Add**.

To remove static routes, follow these steps:

Step 1 Select the static route you want to remove from the list of current IP routes.

You must remove the last static route entry unless you have a default gateway specified. Otherwise, you will no longer be able to access the Web Console on this system.

Step 2 Click **Remove**.

Adding and Removing Domain Name Servers

A Domain Name Server (DNS) converts domain names into their corresponding IP addresses. To define DNS servers that are used on the NME, follow these steps:

Step 1 Enter the Ethernet address of a new DNS in the New Server field.

Step 2 Click **Add**.

To remove a DNS, follow these steps:

Step 1 Select the DNS you want to remove from the list of current servers.

Step 2 Click **Remove**.

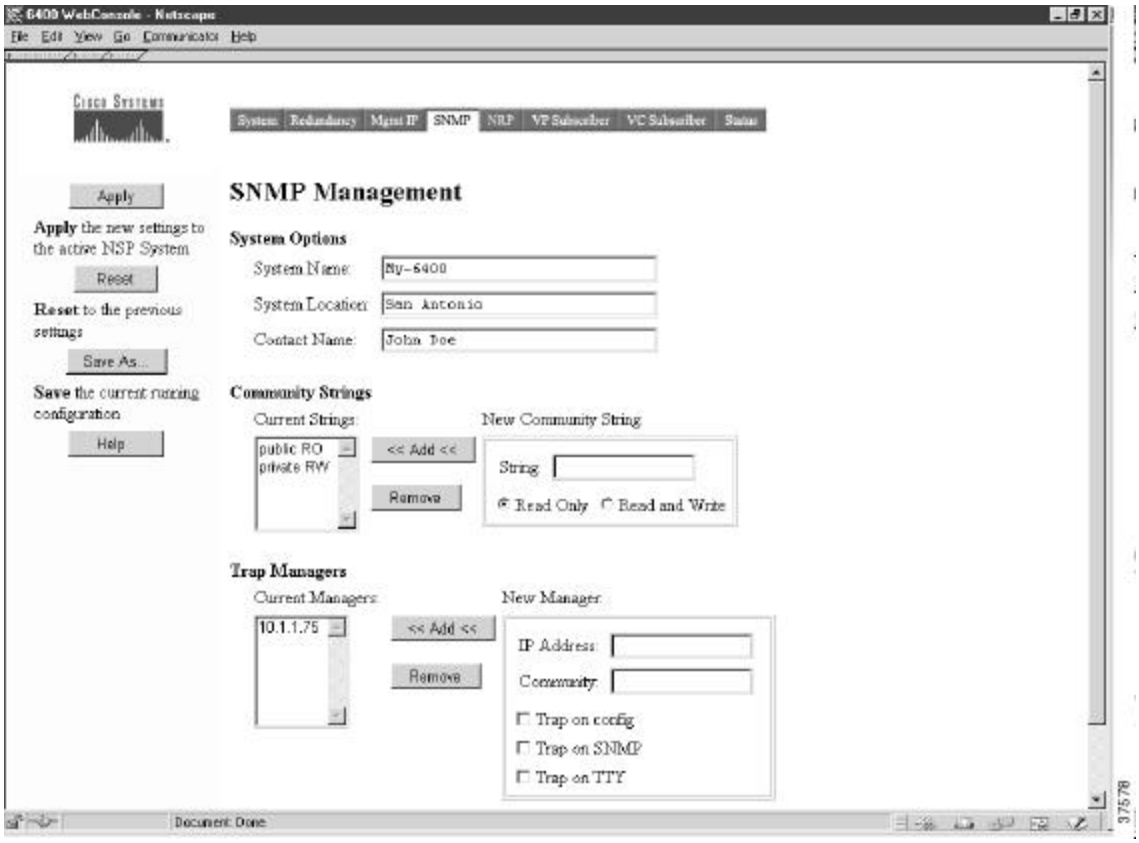
SNMP Management

Use the SNMP page (see FigureA-8) to perform the following tasks:

- Enter information about the switch (System Options)
- Enter community strings that serve as passwords for SNMP messages
- Enter trap managers and their community strings to receive traps (alerts) about switch activity
- Set the classes of traps that a trap manager receives

For more information about configuring SNMP management options, see the "Simple Network Management Protocol" section on page6-1. Also see the "Configuring Simple Network Management Protocol (SNMP)" chapter of the "Cisco IOS System Management" part of the *Cisco IOS Configuration Fundamentals Configuration Guide*.

FigureA-8 SNMP Page



Entering System Options

System Option information is used by network management applications to identify the switch on a topology map. To begin entering the information, proceed as follows:

Step 1 Enter a name to be used for the system.

Step 2 Enter the location of the system.

Step 3 Enter the name of a person or organization associated with the system.

Step 4 Click **Apply** to save the current information to your running configuration.

Step 5 Click **Save As** to save the current information to your configuration file, Flash memory, disk, or TFTP server.

Entering Community Strings

Community strings serve as passwords for SNMP messages. You can enter them with either of the following characteristics:

- Read Only—Enables requests accompanied by the string to display MIB-object information
- Read and Write—Enables requests accompanied by the string to display MIB-object information and to set MIB objects

To supply a community string, proceed as follows:

Step 1 Enter a character string in the String field.

Step 2 Click **Read Only** or **Read and Write**.

Step 3 Click **Add**.

To remove community strings, select a string from the Current Strings list and click **Remove**.

Adding Trap Managers

A trap manager is a management station that receives and processes traps.

Follow these steps to add a trap manager:

Step 1 Enter the IP address or name of the station in the IP Address field.

Step 2 Enter a character string in the Community field. This string can be any length.

Step 3 Select the class of traps that the trap manager is to receive. Select a check box to enable one or all of the following:

- Trap on config—Generate traps on all changes to the switch configuration.
- Trap on SNMP—Generate the supported SNMP traps.
- Trap on TTY—Generate the serial-port-related TTY traps.

Step 4 Click **Add**.

To remove trap managers, follow these steps:

Step 1 Select a manager from the Current Managers list and click **Remove**.

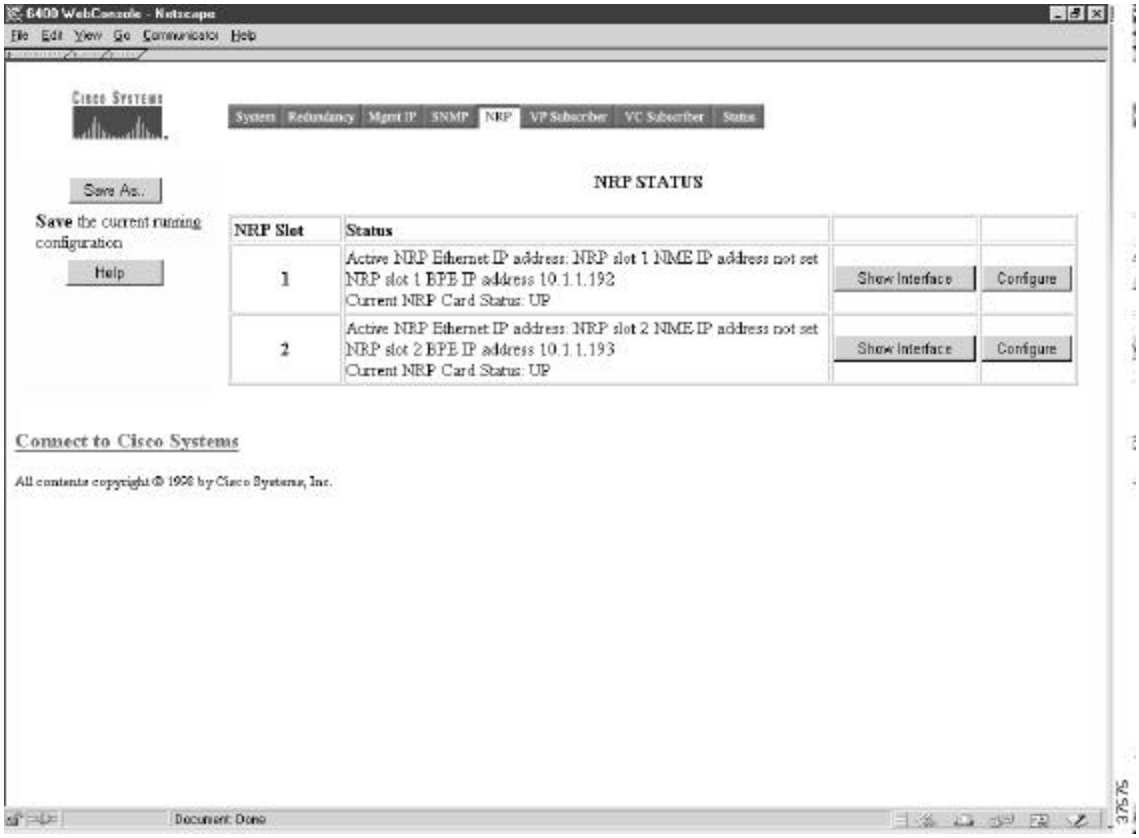
Step 2 Click **Apply** to save the current information to your running configuration.

Step 3 Click **Save As** to save the current information to your configuration file, Flash memory, disk, or TFTP server.

NRP Status

The NRP page allows you to display information about any of the node route processors (NRPs) installed in the Cisco 6400 chassis. To display the NRP page (FigureA-9), click **NRP** in the action bar.

FigureA-9 NRP Page



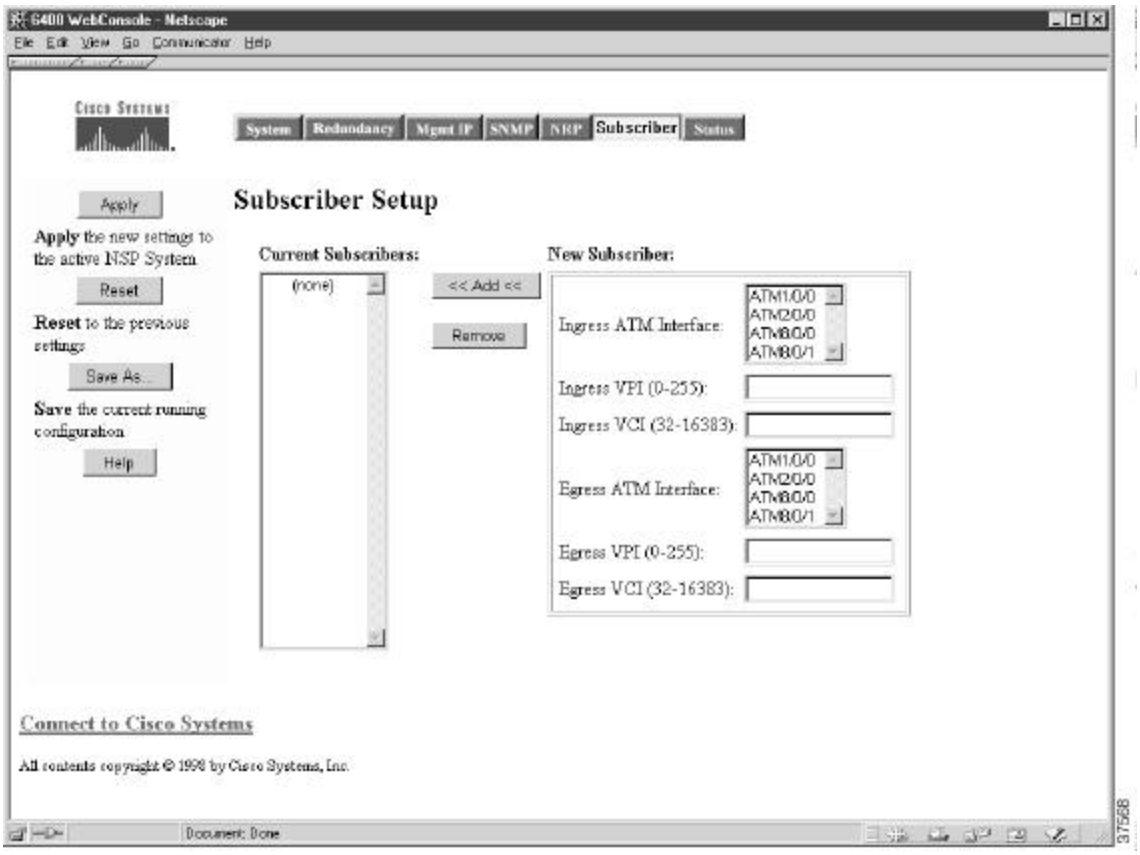
Subscriber Management

Use the Subscriber Setup page (see FigureA-10) to set and display the cross-connections for each of your current system subscribers. Subscribers are defined according to the ingress and egress ports, the virtual path identifier (VPI), and virtual channel identifier (VCI). To display the Subscriber page, click **Subscriber** in the action bar.

In Cisco IOS Release 12.0(7)DB1, the subscriber page is split into two pages: VC Subscriber Setup (see FigureA-11) and VP Subscriber Setup (see FigureA-12).

For more information about configuring virtual circuits for your subscribers, see the "Internal Cross-Connections" section on page2-10.

FigureA-10 Subscriber Setup Page



Adding and Removing Subscribers

To add new subscribers and set up the virtual circuits, follow these steps:

Step 1 Select the ATM interface into which the subscriber packets arrive at the switch.

Step 2 Enter the incoming VPI.

Step 3 Enter the incoming VCI.

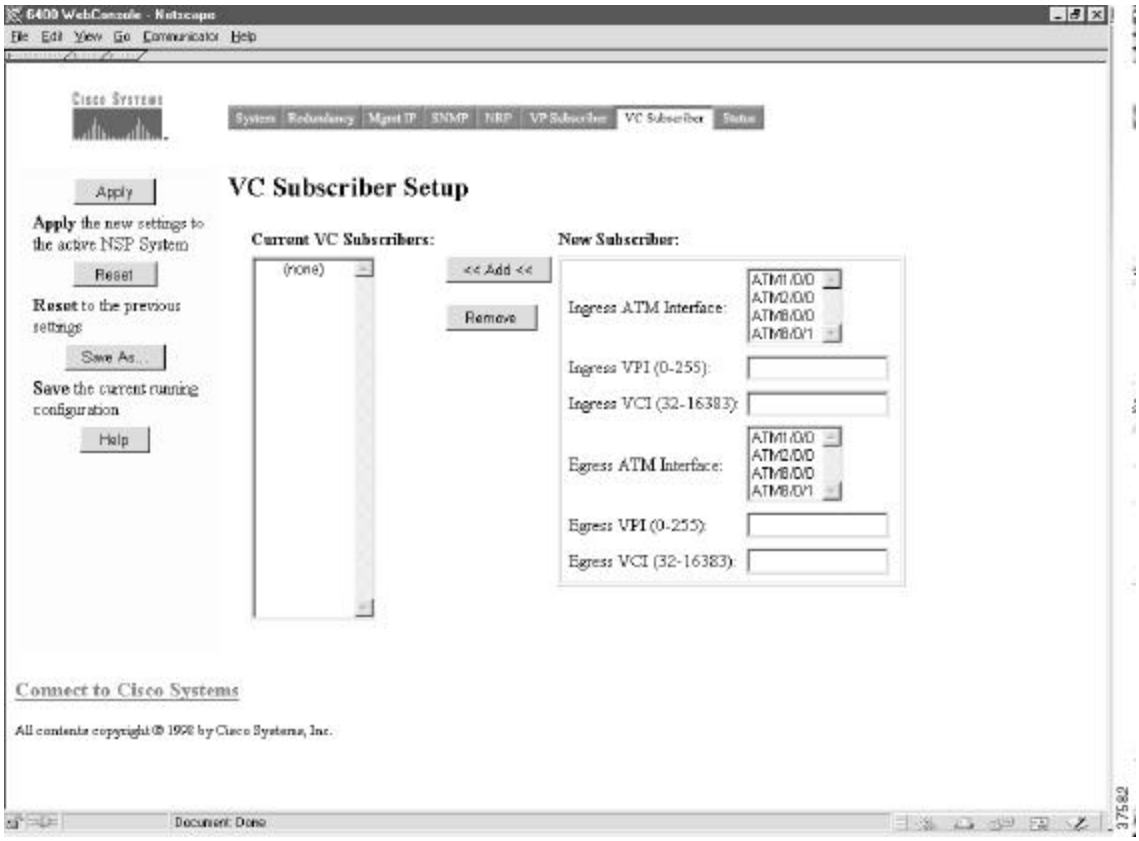
Step 4 Enter the outgoing (egress) ATM interface. This is the other side of the cross-connection.

Step 5 Enter the outgoing VPI and VCI.

Step 6 Click **Add**.

The new subscriber information is displayed in the Current Subscriber list.

FigureA-11 VC Subscriber Setup Page—Cisco IOS Release 12.0(7)DB1



To remove subscribers, follow these steps:

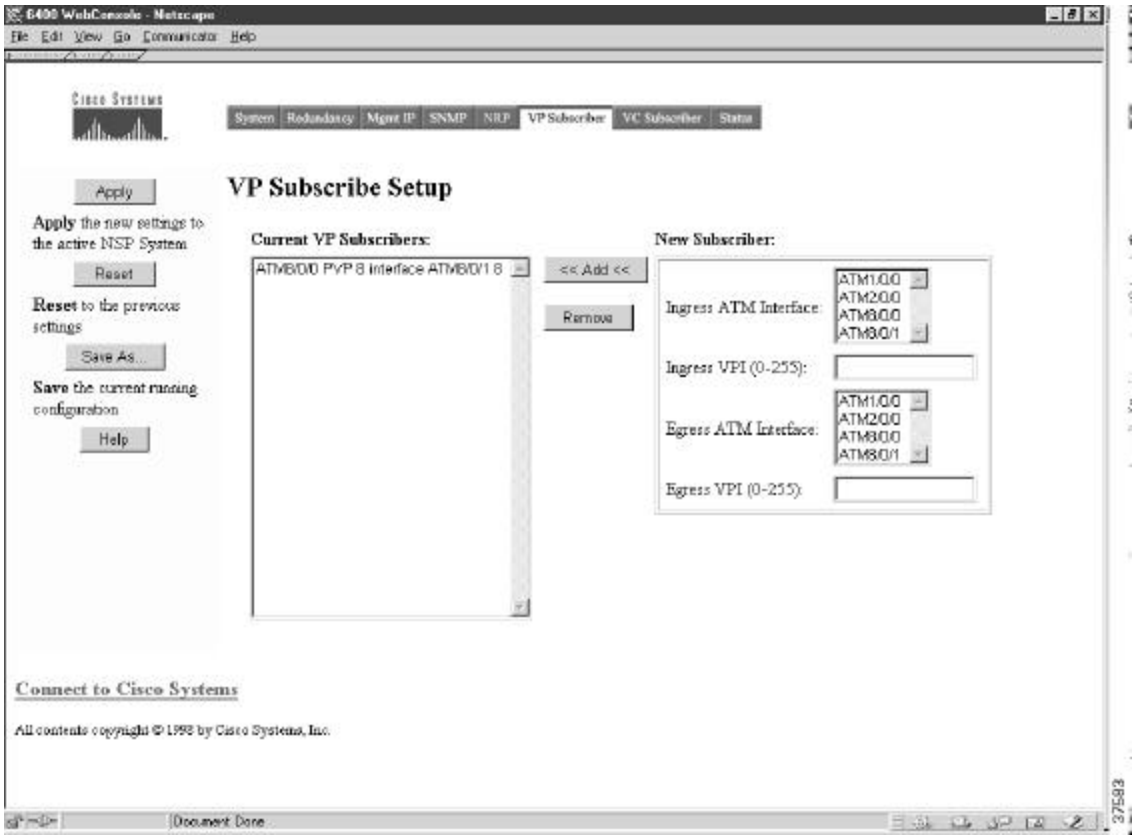
Step 1 Select a subscriber from the list of subscribers.

Step 2 Click **Remove.**

Step 3 Click **Apply** to save the current subscribers to your running configuration.

Step 4 Click **Save As** to save the current subscribers to your configuration file, Flash memory, disk, or TFTP server.

FigureA-12 VP Subscriber Setup Page—Cisco IOS Release 12.0(7)DB1

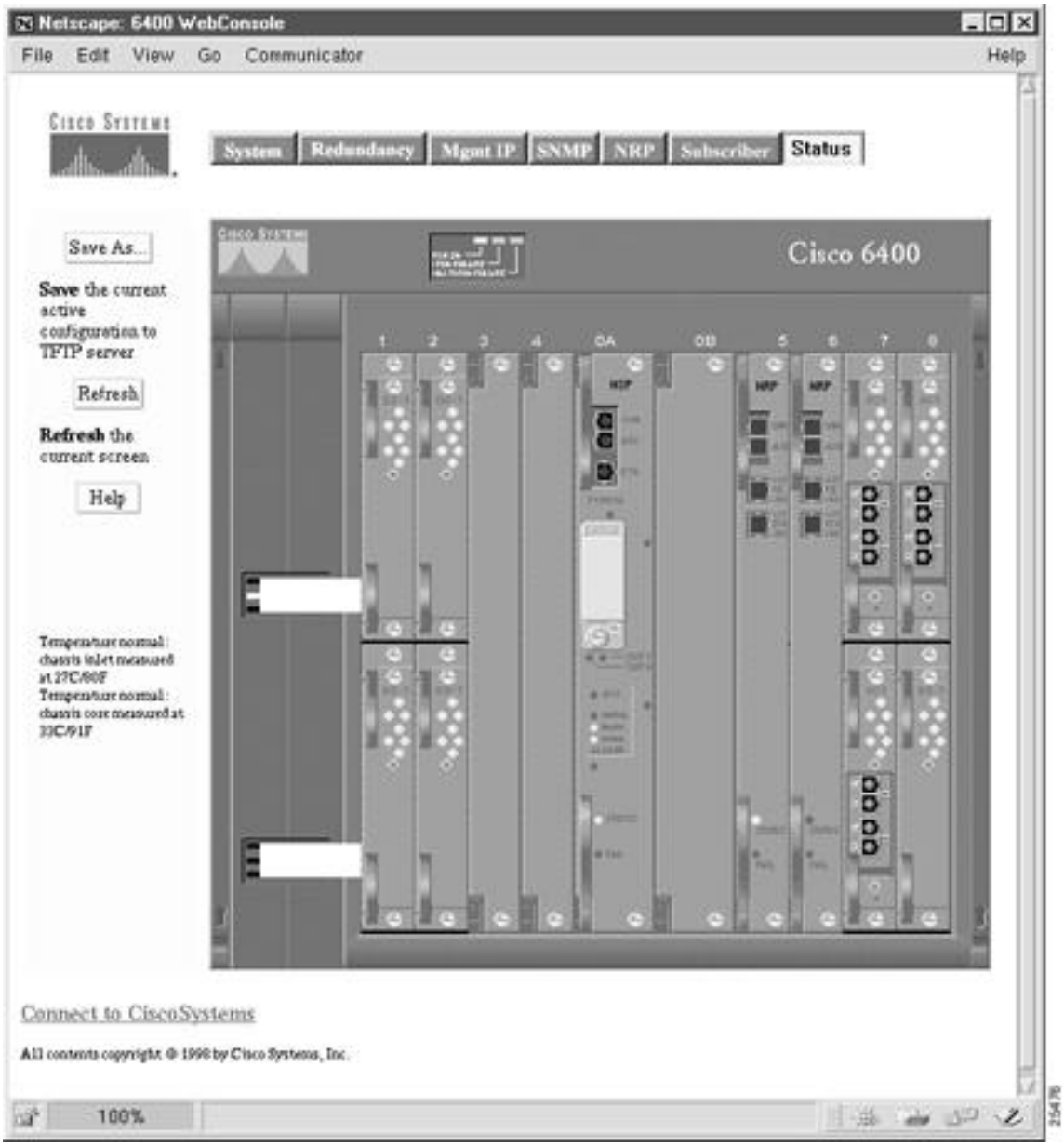


System Status

This page has a *live* image (see FigureA-13) of the system that displays much of the same information as the LEDs on the front of the system. You can use this image in the following ways:

- Display the status of ports. Colors indicate the status.
- Display the status and redundancy configuration of the NSPs.

FigureA-13 System Status



Loading New Web Console Pages

Cisco 6400 systems are shipped with the Web Console pages described in this chapter. However, from time to time, you might want to load updated Web Console pages into local memory (either Flash memory or Flash disk) on your system.

To load new Web Console pages onto your system, perform the following tasks from the privileged EXEC mode:

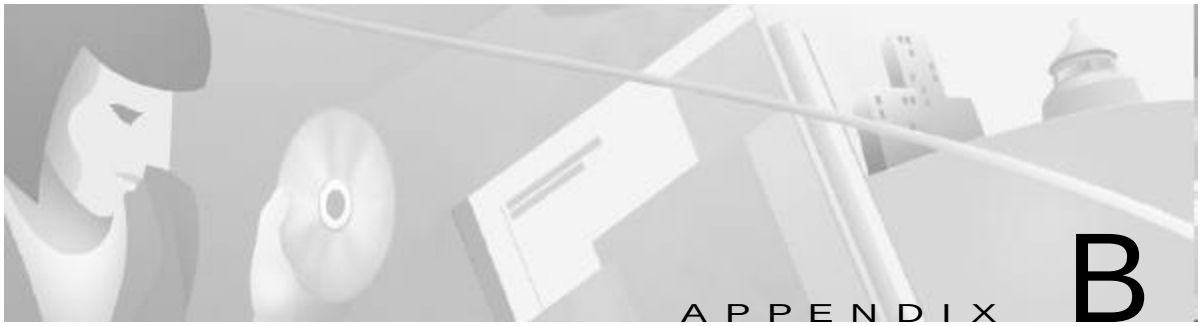
	Command	Purpose
Step1	**copy** *tftp://tftpservername/../c6400s-html.tar* **disk0:***c6400s-html.tar*	Copy the new tar file with the Web Console pages to disk0:.
Step2	**rename disk0:***nsp-html* **disk0:***nsp-html.old*	Rename the existing Web Console directory to save the current pages before extracting the new pages.
Step3	**archive tar /table** *URL*	List the contents of the tar archive accessible at the URL shown.
Step4	**archive tar /xtract** *source destination*	Unpack the Web Console pages and store them in the specified location.

After you have verified that the new Web Console pages are working properly, you can delete the old Web Console directory *(nsp-html.old).* Commonly, this procedure is performed at the same time that a new Cisco IOS image is downloaded. The Cisco IOS image is typically stored in Flash memory, and the HTML pages are usually stored on the PCMCIA disk in disk slot 0 (disk0:). Nevertheless, the operating system allows you to specify any valid file system location as the destination.

Example

The following example shows how to extract files on a TFTP server and install them on disk0: of the NSP:

```
Switch# archive tar /xtract tftp://tftpservername/directory/c6400s-html.tar disk0:
```



Upgrading Software on the Cisco 6400

This appendix describes how to upgrade the software images on the Cisco 6400 carrier-class broadband aggregator, and contains the following sections:

For general information on Cisco IOS software, see the "Cisco IOS File Management" chapter of the *Cisco IOS Configuration Fundamentals Configuration Guide* for your software release level.

Recommendations

Cisco highly recommends that all images used on your Cisco 6400 system have the same version level, specifically:

- Use the same release versions for the system images on the NRP and the NSP.
- Use the same version level for the system and boothelper images for both the NRP and NSP.

  The NSP uses the same file (c6400s-wp-mz) as both the system image and boothelper image. Make sure you download the new NSP image to boot flash and a PCMCIA disk (disk0: or disk1:).

  The NRPs use two separate images for the system and boothelper images:

  – c6400r-boot-mz—Boothelper image to load in boot flash
  – c6400r-g4p5-mz—NRP-1 system image to load in Flash
  – c6400r2sp-g4p5-mz—NRP-2 system image to load in Flash

- If you are using the Web Console, use the same version level for the NSP system image and the Web Console image.

Upgrading Software on Nonredundant NRP-1s

This section describes how to upgrade software on an NRP-1 that is not configured for redundancy. To upgrade software on redundant NRP-1s, see the "Upgrading Software on Redundant NRP-1s" section on pageB-8.

To upgrade the software images on the NRP-1, complete the following steps:

Step 1 Use the **dir** EXEC command to locate and identify the system and boothelper images you will replace.

```
Router# dir flash:
Router# dir bootflash:
```

Step 2 Use the **copy** EXEC command to back up the system and boothelper images to a TFTP server.

```
Router# copy flash:c6400r-g4p5-mz.120-7.DC tftp://10.1.1.1/c6400r-g4p5-mz.120-7.DC
Router# copy bootflash:c6400r-boot-mz.120-7.DC tftp://10.1.1.1/c6400r-boot-mz.120-7.DC
```

Step 3 Use the **delete** EXEC command to mark the images you want to replace for deletion.

```
Router# delete flash:c6400r-g4p5-mz.120-7.DC
Router# delete bootflash:c6400r-boot-mz.120-7.DC
```

Step 4 Use the **squeeze** EXEC command to permanently delete the images marked for deletion.

```
Router# squeeze flash:
Router# squeeze bootflash:
```

Step 5 Use the **copy** EXEC command to load the new images.

```
Router# copy tftp://10.1.1.1/c6400r-g4p5-mz.122-13.T flash:c6400r-g4p5-mz.122-13.T
Router# copy tftp://10.1.1.1/c6400r-boot-mz.122-13.T bootflash:c6400r-boot-mz.122-13.T
```

Step 6 Use the **no boot system** global configuration command to remove the old startup image configuration.

```
Router(config)# no boot system flash:c6400r-g4p5-mz.120-7.DC
```

Step 7 Use the **boot system** global configuration command to add the new startup image configuration.

```
Router(config)# boot system flash:c6400r-g4p5-mz.122-13.T
```

Step 8 Use the **config-register** global configuration command to do one of the following:

a. Set the config register to 0x2 for automatic boot.

```
Router(config)# config-register 0x2
```

b. Set the config register to 0x0 to boot manually from the ROM monitor (ROMMON) prompt.

```
Router(config)# config-register 0x0
```

Step 9 Use the **copy system:running-config nvram:startup-config** EXEC command to save the running configuration.

```
Router# copy system:running-config nvram:startup-config
```

Step 10 Use the **reload** EXEC command to reload the NRP-1. This will automatically reboot the NRP-1 if you set the config register to 0x2 in Step 8.

```
Router# reload
```

Step 11 If you set the config register to 0x0 in Step 8, you will see the `rommon` prompt after completion of the NRP-1 reload. Complete the following steps to manually boot the NRP-1 and set it up for automatic reboot.

a. Use the **dir** command to locate and identify the new image.

```
rommon 1 > dir flash:
```

b. Use the **boot** command to manually boot the NRP-1.

```
rommon 2 > boot flash:c6400r-g4p5-mz.122-13.T
```

Example—Upgrading the Nonredundant NRP-1

In the following example, the NRP-1 system image is upgraded from Cisco IOS Release 12.0(7)DC to CiscoIOS Release 12.2(13)T:

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

  1  -rw-       94074   Jul 26 2000 17:11:46  lns.cfg
  2  -rw-       96278   Jul 26 2000 17:14:46  ip_route.cfg
  3  -rw-      190480   Jul 27 2000 10:14:08  work.cfg
  4  -rw-     5018040   Aug 08 2000 15:23:34  c6400r-g4p5-mz.120-7.DC

15990784 bytes total (10591396 bytes free)
Router# ping 10.2.16.99

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.16.99, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/2/4 ms
Router# delete flash:c6400r-g4p5-mz.120-7.DC
Delete filename [c6400r-g4p5-mz.120-7.DC]?
Delete flash:c6400r-g4p5-mz.120-7.DC? [confirm]
Router# squeeze  flash:
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]
Squeezing...Erasing squeeze bufferWriting squeeze bufferErasing sector:2     Writing
sector:2Erasing squeeze log
Squeeze of flash complete
Router# copy tftp:flash:
Address or name of remote host []? 10.2.16.99
Source filename []? c6400r-g4p5-mz.122-13.T
Destination filename [c6400r-g4p5-mz.122-13.T]?
Accessing tftp://10.2.16.99/c6400r-g4p5-mz.122-13.T...
Loading c6400r-g4p5-mz.122-13.T from 10.2.16.99 (via
Ethernet0/0/1):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[snip]
!!!!!!!!
[OK - 5215272/10430464 bytes]

5215272 bytes copied in 87.740 secs (59945 bytes/sec)
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# no boot system flash c6400r-g4p5-mz.120-7.DC
Router(config)# boot system flash c6400r-g4p5-mz.122-13.T
Router(config)# config-register 0x2
```

```
Router(config)# end
Router# copy system:running-config nvram:startup-config
00:03:03:%SYS-5-CONFIG_I:Configured from console by console mem
Warning:Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
Router# reload
Proceed with reload? [confirm]

00:03:16:%SYS-5-RELOAD:Reload requested
System Bootstrap
Copyright (c) 1998 by cisco Systems, Inc.

Reset Reason Register = REASON_WARM (0x2)
C6400R platform with 131072 Kbytes of main memory


Self decompressing the image [snip]

Press RETURN to get started!
```

Upgrading Software on Nonredundant NRP-2s and NRP-2SVs

This section describes how to upgrade software on nonredundant NRP-2s and NRP-2SVs.

Note Unless a clear distinction is made, all references to the NRP-2 also apply to the NRP-2SV.

Remember that the NSP controls and manages the NRP-2 image download process. Although Cisco recommends that you store all NRP-2 images on the NSP PCMCIA disk, you can also store NRP-2 images on a TFTP, FTP, or rcp server.

To upgrade the software images on the NRP-2, complete the following steps, beginning in EXEC mode on the NSP:

Step 1 (Optional) Use the **copy** EXEC command to back up the NRP-2 images to a TFTP server.

```
Switch# copy disk0:c6400r2sp-g4p5-mz.121-4.DC1 tftp://10.1.1.1/c6400r2sp-g4p5-mz.121-4.DC1
Switch# copy bootflash:c6400r-boot-mz.121-4.DC1 tftp://10.1.1.1/c6400r-boot-mz.121-4.DC1
```

Step 2 (Optional but recommended) Use the **copy** EXEC command to load the NRP-2 images to the "images" directory on the PCMCIA disk in NSP disk slot 0.

```
Switch# copy tftp://10.2.2.2/c6400r2sp-g4p5-mz.122-13.T
disk0:/images/c6400r2sp-g4p5-mz.122-13.T
Switch# copy tftp://10.2.2.2/c6400r-boot-mz.122-13.T disk0:/images/c6400r-boot-mz.122-13.T
```

Step 3 Use the **more system:running-config** EXEC command to view the current NRP-2 image configuration.

```
Switch# more system:running-config
...
hw-module slot 2 image c6400r2sp-g4p5-mz.121-4.DC1 priority 2
hw-module slot 2 image tftp://10.1.1.1/c6400r2sp-g4p5-mz.121-4.DC1 priority 3
hw-module slot 2 image disk0:MyDir/c6400r2sp-g4p5-mz.121-4.DC1 priority 4
hw-module slot 3 image c6400r2sp-g4p5-mz.121-4.DC1 priority 2
...
```

Step 4 Use the **hw-module (image)** global configuration command to add to, replace, or delete the NRP-2 image configuration.

```
Switch# configure terminal
Switch(config)# hw-module slot 2 image c6400r2sp-g4p5-mz.122-13.T priority 2
Switch(config)# no hw-module slot 2 image tftp://10.1.1.1/c6400r2sp-g4p5-mz.122-13.T
Switch(config)# hw-module slot 2 image disk0:MyDir/c6400r2sp-g4p5-mz.122-13.T priority 4
```

Without the **hw-module (image)** command in the NSP configuration, the NRP-2 attempts to load the default image (c6400r2sp-g4p5-mz) from the disk0:/images/ directory.

Step 5 Use the **hw-module (reset)** EXEC configuration command to reload the NRP-2.

```
Switch(config)# end
Switch# hw-module slot 2 reset
```

Timesaver If you do not use all the priority values for NRP-2 images, leave priority 1 free for new or temporary images. Otherwise, you will have to adjust the priority levels of the other images for your NRP-2 to accommodate the new image.

Upgrading Software on Nonredundant NSPs

This section describes how to upgrade software on an NSP that is not configured for redundancy. To upgrade software on redundant NSPs, see the "Upgrading Software on Redundant NSPs" section on pageB-14.

To upgrade the software images on the NSP, complete the following steps:

Step 1 Use the **dir** EXEC command to locate and identify the images you will replace.

```
Switch# dir disk0:
Switch# dir disk1:
Switch# dir bootflash:
```

Step 2 Use the **copy** EXEC command to back up the images to a TFTP server.

```
Switch# copy disk0:c6400s-wp-mz.120-7.DB tftp://10.1.1.1/c6400s-wp-mz.120-7.DB
Switch# copy disk0:c6400s-html.tar.120-5.DB tftp://10.1.1.1/c6400s-html.tar.120-5.DB
Switch# copy bootflash:c6400s-wp-mz.120-5.DB tftp://10.1.1.1/c6400s-wp-mz.120-5.DB
```

Step 3 Use the **delete**, and for boot flash, the **squeeze** EXEC commands to delete the old images.

```
Switch# delete disk0:c6400s-wp-mz.120-7.DB
Switch# delete disk0:c6400s-html.tar.120-5.DB
Switch# delete bootflash:c6400s-wp-mz.120-5.DB
Switch# squeeze bootflash
```

Step 4 Use the **copy** EXEC command to load the new images.

```
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.DB1 disk0:c6400s-wp-mz.DB1
Switch# copy tftp://10.1.1.1/c6400s-html.tar.DB1 disk0:c6400s-html.tar.DB1
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.DB1 bootflash:c6400s-wp-mz.DB1
```

Step 5 Use the **no boot system** global configuration command to remove the old startup image configuration.

```
Switch(config)# no boot system flash:c6400s-wp-mz.120-7.DB
```

Step 6 Use the **boot system** global configuration command to add the new startup image configuration.

```
Switch(config)# boot system flash:c6400s-wp-mz.122-13.T
```

Step 7 Use the **config-register** global configuration command to do one of the following:

a. Set the config register to 0x2 for automatic boot.

```
Switch(config)# config-register 0x2
```

b. Set the config register to 0x0 to boot manually from the ROMMON prompt.

```
Switch(config)# config-register 0x0
```

Step 8 Use the **copy** EXEC command to save the running configuration as the startup configuration.

```
Switch# copy system:running-config nvram:startup-config
```

Step 9 Use the **reload** EXEC command to reload the NSP. This will automatically reboot the NSP if you set the config register to 0x2 in Step 7.

```
Switch# reload
```

Step 10 If you set the config register to 0x0 in Step 7, you will see the `rommon` prompt after completion of the NSP reload. Complete the following steps to manually boot the NSP and set it up for automatic reboot:

a. Use the **dir** command to locate and identify the new image.

```
rommon 1 > dir flash:
```

b. Use the **boot** command to manually boot the NSP.

```
rommon 2 > boot flash:c6400s-wp-mz.122-13.T
```

Example—Upgrading the Nonredundant NSP

In the following example, the NSP image is upgraded from Cisco IOS Release 12.0(7)DB to CiscoIOSRelease 12.2(13)T:

```
Switch# ping 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
Switch# dir disk0:
Directory of disk0:/

2222  -rw-        1944   Jul 27 2000 09:41:45  pvp-config
2254  -rw-       91833   Jul 27 2000 10:24:47  running-config
```

```
2277  -rw-       91833   Jul 27 2000 10:25:19  pvc-config
2223  -rw-     4504276   Aug 03 2000 09:44:01  c6400s-wp-mz.120-7.DB

20819968 bytes total (16121856 bytes free)
Switch# show version
Cisco Internetwork Operating System Software
IOS (tm) C6400 Software (C6400S-WP-M), Version 12.0(7)DB, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 22-Mar-00 11:47 by beliu
Image text-base:0x60010908, data-base:0x6081E000

ROM:System Bootstrap, Version 12.0(1)DB [gmgreen-fcs 102], RELEASE SOFTWARE
ROM:C6400 Software (C6400S-WP-M), Version 12.0(7)DB, EARLY DEPLOYMENT RELEASE SOFTWARE
(fc1)

nsp uptime is 2 minutes
System returned to ROM by reload
System image file is "disk0:c6400s-wp-mz.120-7.DB"

cisco C6400S (R4600) processor with 131072K bytes of memory.
R4700 CPU at 100Mhz, Implementation 33, Rev 1.0
Last reset from s/w peripheral
Bridging software.
2 Ethernet/IEEE 802.3 interface(s)
8 ATM network interface(s)
507K bytes of non-volatile configuration memory.
 --More--
20480K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0

2254  -rw-       91833   Jul 27 2000 10:24:47  running-config
2277  -rw-       91833   Jul 27 2000 10:25:19  pvc-config
2223  -rw-     4504276   Aug 03 2000 09:44:01  c6400s-wp-mz.120-7.DB

20819968 bytes total (16121856 bytes free)
Switch# copy tftp:disk0:
Address or name of remote host []? 10.1.1.1
Source filename []? c6400s-wp-mz.122-13.T
Accessing tftp://10.1.1.1/c6400s-wp-mz.DB1...
Loading c6400s-wp-mz.121-1.DB1 from 10.1.1.1 (via
BVI1):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[snip]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!
[OK - 4575296/9150464 bytes]
4575296 bytes copied in 141.700 secs (32448 bytes/sec)
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# no boot system disk0:c6400s-wp-mz.120-7.DB
Switch(config)# boot system disk0:c6400s-wp-mz.122-13.T
Switch(config)# config-register 0x2
Switch(config)# end

Switch# copy system:running-config nvram:startup-config
Building configuration...
[OK]
Switch# reload
Proceed with reload? [confirm]
```

Upgrading Software on Redundant NRP-1s

This section describes how to upgrade software on redundant NRP-1s. To upgrade software on a nonredundant NRP-1, see the "Upgrading Software on Nonredundant NRP-1s" section on pageB-2.

To upgrade the software images on redundant NRP-1s, perform the following tasks in the specified order. Each task in the list identifies the device used to perform the task:

1. Upgrade the Images on the Secondary NRP-1 (primary NRP-1)
2. Identify the New System Image as the Startup Image for the Secondary NRP-1 (primary NRP-1)
3. Reload the Secondary NRP-1 (NSP)
4. Upgrade the Images on the Primary NRP-1 (primary NRP-1)
5. Identify the New System Image as the Startup Image for the Primary NRP-1 (primary NRP-1)
6. Switch the Primary and Secondary NRP-1s (NSP)

In the following instructions and examples, NRPslot5 is the device in slot 5 of the Cisco 6400 chassis, and NRP slot6 is the device in slot 6.

Upgrade the Images on the Secondary NRP-1

Complete the following steps from the primary NRP-1 to upgrade the secondary NRP-1 images. NRPslot5 is currently the primary device, and NRPslot6 is currently the secondary device.

Step 1 Use the **dir** EXEC command to locate and identify the system and boothelper images you will replace on the secondary NRP-1.

```
NRPslot5# dir sec-flash:
NRPslot5# dir sec-bootflash:
```

Step 2 Use the **copy** EXEC command to back up the secondary NRP-1's system and boothelper images to a TFTP server.

```
NRPslot5# copy sec-flash:c6400r-g4p5-mz.120-7.DC tftp://10.1.1.1/c6400r-g4p5-mz.120-7.DC
NRPslot5# copy sec-bootflash:c6400r-boot-mz.120-7.DC
tftp://10.1.1.1/c6400r-boot-mz.120-7.DC
```

Step 3 Use the **delete** EXEC command to mark the secondary NRP-1's old images for deletion.

```
NRPslot5# delete sec-flash:c6400r-g4p5-mz.120-7.DC
NRPslot5# delete sec-bootflash:c6400r-boot-mz.120-7.DC
```

Step 4 Use the **squeeze** EXEC command to permanently delete the secondary NRP-1's images marked for deletion.

```
NRPslot5# squeeze sec-flash:
NRPslot5# squeeze sec-bootflash:
```

Step 5 Use the **copy** EXEC command to load the new images to the secondary NRP-1.

```
NRPslot5#copy tftp://10.1.1.1/c6400r-g4p5-mz.122-13.T sec-flash:c6400r-g4p5-mz.122-13.T
NRPslot5#copy tftp://10.1.1.1/c6400r-boot-mz.122-13.T
sec-bootflash:c6400r-boot-mz.122-13.T
```

Identify the New System Image as the Startup Image for the Secondary NRP-1

To ensure that the new image is used upon system reload, choose one of the following methods:

- Ensuring That the New System Image Is the First File in the Flash Memory , page B-9

  or

- Updating the Boot System Variable, page B-10

Ensuring That the New System Image Is the First File in the Flash Memory

Complete the following steps to make sure that the new image is the first file in the secondary NRP-1's Flash memory. NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **dir** EXEC command to list all files in the secondary NRP-1's Flash memory.

```
NRPslot5# dir sec-flash:
```

Step 2 If the new system image is the first file listed, the image is already the startup image. Continue with the "Reload the Secondary NRP-1" section on pageB-10.

If the new system image is not at the top of the list, and you want to save the files that are listed above the new image, continue with Step 3.

If you want to delete the files listed above the new image, continue with Step 4.

Step 3 Use the **copy** EXEC command to back up the secondary NRP-1 Flash files to a TFTP server.

```
NRPslot5# copy sec-flash:filename tftp://10.1.1.1/filename1
NRPslot5# copy sec-flash:filename tftp://10.1.1.1/filename2
NRPslot5# copy sec-flash:filename tftp://10.1.1.1/filename3
...
```

Step 4 Use the **delete** EXEC command to mark the unwanted secondary NRP-1 files for deletion.

```
NRPslot5# delete sec-flash:filenames
```

Step 5 Use the **squeeze** EXEC command to permanently delete the secondary NRP-1 images that are marked for deletion.

```
NRPslot5# squeeze sec-flash:
NRPslot5# squeeze sec-bootflash:
```

Step 6 If you performed Step 3, use the **copy** EXEC command to transfer the files back from the TFTP server to the secondary NRP-1's Flash memory.

```
NRPslot5# copy tftp://10.1.1.1/filename1 sec-flash:filename1
NRPslot5# copy tftp://10.1.1.1/filename2 sec-flash:filename2
NRPslot5# copy tftp://10.1.1.1/filename3 sec-flash:filename3
...
```

Step 7 Use the **dir** EXEC command to verify that the new system image is the first file listed in the secondary NRP-1 Flash memory.

```
NRPslot5# dir sec-flash:
```

Updating the Boot System Variable

If you completed the steps described in the "Ensuring That the New System Image Is the First File in the Flash Memory" section on pageB-9, skip this section and continue with the "Reload the Secondary NRP-1" section on pageB-10.

Complete the following steps from the primary NRP-1 to update both the primary and secondary NRP-1 configurations to reflect the new startup image. NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **no boot system** global configuration command to remove the old startup image configuration from the primary NRP-1.

```
NRPslot5# no boot system flash:c6400r-g4p5-mz.120-7.DC
```

Step 2 Use the **boot system** global configuration command to add the new startup image configuration to the primary NRP-1.

```
NRPslot5# boot system flash:c6400r-g4p5-mz.122-13.T
```

Step 3 Use the **copy** EXEC command to save the primary NRP-1 running configuration as the startup configuration. This step also updates the startup configuration on the secondary NRP-1.

```
NRPslot5# copy system:running-config nvram:startup-config
```

Reload the Secondary NRP-1

Complete the following step from the NSP to reload the secondary NRP-1. NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **hw-module** EXEC or global configuration command to reload the secondary NRP-1.

```
Switch# hw-module slot 6 reset
```

The secondary NRP-1 is now running the new image in standby mode.

Upgrade the Images on the Primary NRP-1

Complete the following steps from the primary NRP-1 to upgrade the primary NRP-1 images. NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **dir** EXEC command to locate and identify the system and boothelper images you will replace.

```
NRPslot5# dir flash:
NRPslot5# dir bootflash:
```

Step 2 Use the **copy** EXEC command to back up the system and boothelper images to a TFTP server.

```
NRPslot5# copy flash:c6400r-g4p5-mz.120-7.DC tftp://10.1.1.1/c6400r-g4p5-mz.120-7.DC
NRPslot5# copy bootflash:c6400r-boot-mz.120-7.DC tftp://10.1.1.1/c6400r-boot-mz.120-7.DC
```

Step 3 Use the **delete** EXEC command to mark the old images for deletion.

```
NRPslot5# delete flash:c6400r-g4p5-mz.120-7.DC
NRPslot5# delete bootflash:c6400r-boot-mz.120-7.DC
```

Step 4 Use the **squeeze** EXEC command to permanently delete the images marked for deletion.

```
NRPslot5# squeeze flash:
NRPslot5# squeeze bootflash:
```

Step 5 Use the **copy** EXEC command to load the new images from the secondary NRP-1.

```
NRPslot5# copy sec-flash:c6400r-g4p5-mz.122-13.T flash:c6400r-g4p5-mz.122-13.T
NRPslot5# copy sec-bootflash:c6400r-boot-mz.122-13.T bootflash:c6400r-boot-mz.122-13.T
```

Identify the New System Image as the Startup Image for the Primary NRP-1

To ensure that the new image is used at system reload, choose the same method that you used in the "Identify the New System Image as the Startup Image for the Secondary NRP-1" section on pageB-9, specifically:

- Ensuring That the New System Image Is the First File in Flash Memory, page B-11

  or

- Updating the Boot System Variable, page B-12

Ensuring That the New System Image Is the First File in Flash Memory

Complete the following steps to make sure that the new image is the first file in the primary NRP-1's Flash memory. NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **dir** EXEC command to list all files in the primary NRP-1's Flash memory.

```
NRPslot5# dir flash:
```

Step 2 If the new system image is the first file listed, the image is already the startup image. Continue with the "Switch the Primary and Secondary NRP-1s" section on pageB-12.

If the new system image is not at the top of the list, and you want to save the files that are listed above the new image, continue with Step 3.

If you want to delete the files listed above the new image, continue with Step 4.

Step 3 Use the **copy** EXEC command to back up the primary NRP-1 Flash files to a TFTP server.

```
NRPslot5# copy flash:filename tftp://10.1.1.1/filename1
NRPslot5# copy flash:filename tftp://10.1.1.1/filename2
NRPslot5# copy flash:filename tftp://10.1.1.1/filename3
...
```

Step 4 Use the **delete** EXEC command to mark the unwanted primary NRP-1 files for deletion.

```
NRPslot5# delete flash:filename1
NRPslot5# delete flash:filename2
NRPslot5# delete flash:filename3
...
```

Step 5 Use the **squeeze** EXEC command to permanently delete the primary NRP-1 images that are marked for deletion.

```
NRPslot5# squeeze flash:
NRPslot5# squeeze bootflash:
```

Step 6 If you performed Step 3, use the **copy** EXEC command to transfer the files back from the TFTP server to the primary NRP-1's Flash memory.

```
NRPslot5# copy tftp://10.1.1.1/filename1 flash:filename1
NRPslot5# copy tftp://10.1.1.1/filename2 flash:filename2
NRPslot5# copy tftp://10.1.1.1/filename3 flash:filename3
...
```

Step 7 Use the **dir** EXEC command to verify that the new system image is the first file listed in the primary NRP-1's Flash memory.

```
NRPslot5# dir flash:
```

Updating the Boot System Variable

If you completed the instructions in the "Updating the Boot System Variable " section on pageB-10, then both the primary and secondary NRP-1 configurations already reflect the new startup image.

Switch the Primary and Secondary NRP-1s

Complete the following step from the NSP to switch the primary and secondary NRP-1s. Before you begin this task, NRPslot5 is still the primary device, and NRPslot6 is still the secondary device.

Step 1 Use the **redundancy force-failover** EXEC command to switch the primary and secondary devices.

```
Switch# redundancy force-failover slot 5
```

NRPslot5 is now the secondary device, and NRPslot6 is the primary device. NRPslot5 automatically resets itself, and runs the new image in standby mode. Both the primary and secondary NRP-1s are now running the new image.

Example—Upgrading Redundant NRP-1s

This section presents an example of upgrading redundant NRP-1 images from CiscoIOSRelease12.0(7)DC to CiscoIOS Release 12.1(1)DC1.

The example is broken up into the following tasks:

1. Upgrading the Images on the Secondary NRP-1
2. Identifying the New Image as the Startup Image
3. Reloading the Secondary NRP-1
4. Upgrading the Images on the Primary NRP-1
5. Switching the Primary and Secondary NRP-1s

Upgrading the Images on the Secondary NRP-1

In the following example, the secondary NRP-1 system image is upgraded from CiscoIOSRelease12.0(7)DC to CiscoIOS Release 12.2(13)T. NRP slot5 is the primary device in slot 5 of the Cisco 6400 chassis, and NRP slot6 is the secondary device in slot 6.

```
NRPslot5# dir sec-flash:
Directory of sec-flash:/

  1  -rw-     5018040   Aug 09 2000 12:47:44  c6400r-g4p5-mz.120-7.DC

7602176 bytes total (2584008 bytes free)

NRPslot5# delete sec-flash:c6400r-g4p5-mz.120-7.DC
Delete filename [c6400r-g4p5-mz.120-7.DC]?
Delete sec-flash:c6400r-g4p5-mz.120-7.DC? [confirm]
NRPslot5# copy tftp:sec-flash:
Address or name of remote host []? 10.1.1.1
Source filename []? c6400r-g4p5-mz.122-13.T
Destination filename [c6400r-g4p5-mz.122-13.T]?
Accessing tftp://10.1.1.1/c6400r-g4p5-mz.122-13.T...
Loading c6400r-g4p5-mz.122-13.T from 10.1.1.1 (via
Ethernet0/0/1):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[snip]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!
[OK - 5215184/10429440 bytes]

5215184 bytes copied in 125.792 secs (41721 bytes/sec)
```

Identifying the New Image as the Startup Image

In the following example, the boot system variable is updated to reflect the new startup image.

```
NRPslot5(config)# no boot system flash:c6400r-g4p5-mz.120-7.DC
NRPslot5(config)# boot system flash:c6400r-g4p5-mz.122-13.T
NRPslot5(config)# config-register 0x2
NRPslot5(config)# end
NRPslot5#
NRPslot5# copy system:running-config nvram:startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Reloading the Secondary NRP-1

In the following example, the secondary NRP-1 is reset from the NSP. NRP slot5 is the primary device, and NRP slot6 is the secondary device.

```
Switch# hw-module slot 6 reset

20:21:05:%NSP_OIR-6-FULL_CREM:Card NRP removed from slot:6
Switch#
20:21:06:%NSP_OIR-6-FULL_CINS:Card NRP inserted into slot:6
20:21:06:%NSP_OIR-6-FULL_ONLINE:Card NRP, slot:6, being brought online
20:21:08:%LINK-3-UPDOWN:Interface ATM6/0/0, changed state to down
```

Upgrading the Images on the Primary NRP-1

In the following example, the primary NRP-1 system image is upgraded from CiscoIOSRelease12.0(7)DC to CiscoIOS Release 12.2(13)T. NRP slot5 is the primary device, and NRP slot6 is the secondary device.

```
NRPslot5# dir sec-flash:
Directory of sec-flash:/
  1  -rw-     5215184   Aug 09 2000 13:09:38  c6400r-g4p5-mz.122-13.T

7602176 bytes total (2386864 bytes free)
NRPslot5# dir flash:
Directory of flash:/

  1  -rw-       94074   Jul 26 2000 17:11:46  lns.cfg
  2  -rw-       96278   Jul 26 2000 17:14:46  ip_route.cfg
  3  -rw-      190480   Jul 27 2000 10:14:08  work.cfg
  4  -rw-     5018040   Aug 09 2000 12:55:27  c6400r-g4p5-mz.120-7.DC

15990784 bytes total (10591396 bytes free)
NRPslot5# delete flash:c6400r-g4p5-mz.120-7.DC
Delete filename [c6400r-g4p5-mz.120-7.DC]?
Delete flash:c6400r-g4p5-mz.120-7.DC? [confirm]

NRPslot5# squeeze flash:
All deleted files will be removed. Continue? [confirm]
Squeeze operation may take a while. Continue? [confirm]

Squeeze of flash complete
NRPslot5# copy sec-flash:c6400r-g4p5-mz.122-13.T flash:
Destination filename [c6400r-g4p5-mz.122-13.T]?
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
[snip]
CCCCCCCCCCCCCCC
5215184 bytes copied in 67.228 secs (77838 bytes/sec)
```

Switching the Primary and Secondary NRP-1s

In the following example, the primary and secondary NRP-1s are switched. NRP slot5 is now the secondary device, and NRP slot6 is now the primary device.

```
Switch# redundancy force-failover slot 5
Switch#
```

Upgrading Software on Redundant NSPs

This section describes how to upgrade software on redundant NSPs. To upgrade software on an NSP that is not configured for redundancy, see the "Upgrading Software on Nonredundant NSPs" section on pageB-5.

To upgrade the software images on redundant NSPs, perform the following tasks in the specified order. Each task in the list must be performed on the primary NSP.

1. Upgrade the Secondary NSP Images
2. Reload the Secondary NSP
3. Upgrade the Primary NSP Images
4. Switch the Primary and Secondary NSPs

Prerequisites

Make sure that automatic configuration synchronization is enabled before you follow these procedures.

```
Switch# configure terminal
Switch(config)# redundancy
Switch(config-r)# main-cpu
Switch(config-r-mc)# auto-sync standard
```

Upgrade the Secondary NSP Images

Complete the following steps to upgrade the secondary NSP images. The NSP in slot 0A is the primary device, and the NSP in slot 0B is the secondary device.

Step 1 Use the **dir** EXEC command to locate and identify the images you want to replace on the secondary NSP.

```
Switch# dir sec-disk0:
Switch# dir sec-disk1:
Switch# dir sec-bootflash:
```

Step 2 Use the **copy** EXEC command to back up the secondary NSP images to a TFTP server.

```
Switch# copy sec-disk0:c6400s-wp-mz.120-7.DB tftp://10.1.1.1/c6400s-wp-mz.120-7.DB
Switch# copy sec-disk0:c6400s-html.tar.120-5.DB tftp://10.1.1.1/c6400s-html.tar.120-5.DB
Switch# copy sec-bootflash:c6400s-wp-mz.120-5.DB tftp://10.1.1.1/c6400s-wp-mz.120-5.DB
```

Step 3 Use the **delete**, and for boot flash, the **squeeze** EXEC commands to delete the secondary NSP's old images.

```
Switch# delete sec-disk0:c6400s-wp-mz.120-7.DB
Switch# delete sec-disk0:c6400s-html.tar.120-5.DB
Switch# delete sec-bootflash:c6400s-wp-mz.120-5.DB
Switch# squeeze sec-bootflash
```

Step 4 Use the **copy** EXEC command to load the new images onto the secondary NSP.

```
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.122-13.T sec-disk0:c6400s-wp-mz.122-13.T
Switch# copy tftp://10.1.1.1/c6400s-html.tar.122-13.T sec-disk0:c6400s-html.tar.122-13.T
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.122-13.T sec-bootflash:c6400s-wp-mz.122-13.T
```

Reload the Secondary NSP

Complete the following step to reload the secondary NSP. The NSP in slot 0A is still the primary device, and the NSP in slot 0B is still the secondary device.

Step 1 Use the **hw-module** EXEC or global configuration command to reload the secondary NSP.

```
Switch# hw-module nsp B reset
```

The secondary NSP is now running the new image.

Upgrade the Primary NSP Images

Complete the following steps to upgrade the software images on the primary NSP. The NSP in slot 0A is still the primary device, and the NSP in slot 0B is still the secondary device.

Step 1 Use the **dir** EXEC command to locate and identify the images you want to replace on the primary NSP.

```
Switch# dir disk0:
Switch# dir disk1:
Switch# dir bootflash:
```

Step 2 Use the **copy** EXEC command to back up the primary NSP images to a TFTP server.

```
Switch# copy disk0:c6400s-wp-mz.120-7.DB tftp://10.1.1.1/c6400s-wp-mz.120-7.DB
Switch# copy disk0:c6400s-html.tar.120-5.DB tftp://10.1.1.1/c6400s-html.tar.120-5.DB
Switch# copy bootflash:c6400s-wp-mz.120-5.DB tftp://10.1.1.1/c6400s-wp-mz.120-5.DB
```

Step 3 Use the **delete**, and for boot flash, the **squeeze** EXEC commands to delete the old images.

```
Switch# delete disk0:c6400s-wp-mz.120-7.DB
Switch# delete disk0:c6400s-html.tar.120-5.DB
Switch# delete bootflash:c6400s-wp-mz.120-5.DB
Switch# squeeze bootflash
```

Step 4 Use the **copy** EXEC command to load the new images.

```
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.122-13.T disk0:c6400s-wp-mz.122-13.T
Switch# copy tftp://10.1.1.1/c6400s-html.tar.122-13.T disk0:c6400s-html.tar.122-13.T
Switch# copy tftp://10.1.1.1/c6400s-wp-mz.DB1 bootflash:c6400s-wp-mz.122-13.T
```

Step 5 Use the **no boot system** global configuration command to remove the old startup image configuration.

```
Switch(config)# no boot system flash:c6400s-wp-mz.120-7.DB
```

Step 6 Use the **boot system** global configuration command to add the new startup image configuration.

```
Switch(config)# boot system flash:c6400s-wp-mz.122-13.T
```

Step 7 Use the **config-register** global configuration command to do one of the following:

a. Set the config register to 0x2 for automatic boot.

```
Switch(config)# config-register 0x2
```

b. Set the config register to 0x0 to boot manually from the ROMMON prompt.

```
Switch(config)# config-register 0x0
```

Step 8 Use the **copy** EXEC command to save the running configuration as the startup configuration.

```
Switch# copy system:running-config nvram:startup-config
```

Switch the Primary and Secondary NSPs

Complete the following steps to switch the primary and secondary NSPs. Before this task is completed, the NSP in slot 0A is the primary device, and the NSP in slot 0B is the secondary device.

Step 1 Use the **redundancy force-failover** EXEC command to switch the primary and secondary devices.

```
Switch# redundancy force-failover main-cpu
```

The NSP in slot 0A is now the secondary device, and the NSP in slot 0B is now the primary device. Both devices are running the new image.

Example—Upgrading Redundant NSPs

This section presents an example of upgrading redundant NSP images from CiscoIOSRelease12.0(7)DB to CiscoIOS Release 12.2(13)T.

The example is broken up into the following tasks:

1. Upgrading the Secondary NSP Images
2. Reloading the Secondary NSP
3. Upgrading the Primary NSP Images
4. Switching the Primary and Secondary NSPs

Upgrading the Secondary NSP Images

In the following example, the secondary NSP image is upgraded from Cisco IOS Release 12.0(7)DB to CiscoIOS Release 12.2(13)T. The NSP in slot 0A is the primary device, and the NSP in slot 0B is the secondary device.

```
NSP# show redundancy
NSP A              :Primary
NSP B              :Secondary

NSP# dir sec-disk0:
Directory of sec-disk0:/

1151  -rw-     4504276   Aug 07 2000 17:32:28  c6400s-wp-mz.120-7.DB

20819968 bytes total (16314368 bytes free)

NSP# delete sec-disk0:c6400s-wp-mz.120-7.DB
Delete sec-disk0:c6400s-wp-mz.120-7.DB? [confirm]

NSP# copy tftp:sec-disk0:
Address or name of remote host []? 10.1.1.1
Source filename []? c6400s-wp-mz.122-13.T
Accessing tftp://10.1.1.1/c6400s-wp-mz.122-13.T...
Loading c6400s-wp-mz.122-13.T from 10.1.1.1 (via
BVI1):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[snip]
```

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!
[OK - 4575296/9150464 bytes]

4575296 bytes copied in 256.468 secs (17872 bytes/sec)
```

Reloading the Secondary NSP

In the following example, the secondary NSP is reset from the primary NSP. The NSP in slot 0A is the primary device, and the NSP in slot 0B is the secondary device.

```
NSP# hw-module nsp B reset
NSP#
00:19:47:%EHSA-5-PEER_MONITOR_EVENT:Master detected a secondary crash
(raw-event=PEER_DOWN(2))

00:19:47:%EHSA-5-PEER_MONITOR_EVENT:Master detected a secondary removal
(raw-event=PEER_EHSA_STATE_CHANGE(5))

00:19:48:%EHSA-5-PEER_MONITOR_EVENT:Master detected a secondary insertion
(raw-event=PEER_EHSA_STATE_CHANGE(5))
```

Upgrading the Primary NSP Images

In the following example, the primary NSP image is upgraded from Cisco IOS Release 12.0(7)DB to CiscoIOS Release 12.2(13)T. The NSP in slot 0A is the primary device, and the NSP in slot 0B is the secondary device.

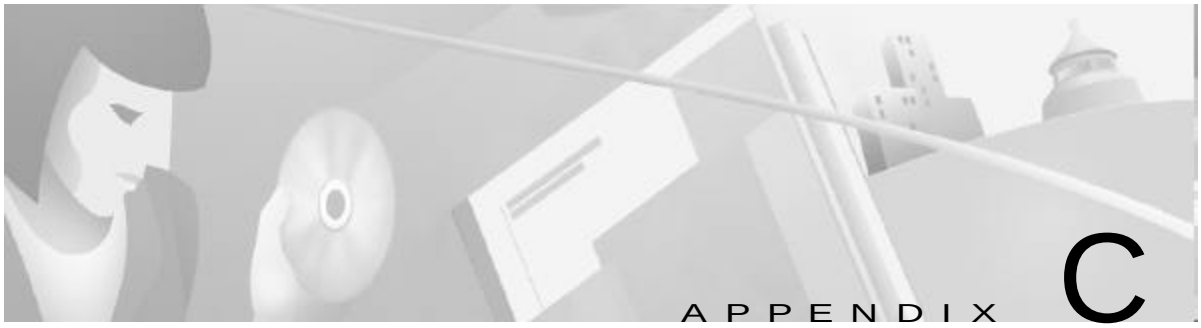
```
NSP# ping 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
NSP# dir disk0:
Directory of disk0:/

2222  -rw-        1944   Jul 27 2000 09:41:45  pvp-config
2254  -rw-       91833   Jul 27 2000 10:24:47  running-config
2277  -rw-       91833   Jul 27 2000 10:25:19  pvc-config
2223  -rw-     4504276   Aug 03 2000 09:44:01  c6400s-wp-mz.120-7.DB

20819968 bytes total (16121856 bytes free)
NSP# show version
Cisco Internetwork Operating System Software
IOS (tm) C6400 Software (C6400S-WP-M), Version 12.0(7)DB, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-2000 by Cisco Systems, Inc.
Compiled Wed 22-Mar-00 11:47 by beliu
Image text-base:0x60010908, data-base:0x6081E000

ROM:System Bootstrap, Version 12.0(1)DB [gmgreen-fcs 102], RELEASE SOFTWARE
ROM:C6400 Software (C6400S-WP-M), Version 12.0(7)DB, EARLY DEPLOYMENT RELEASE SOFTWARE
(fc1)

nsp uptime is 2 minutes
System returned to ROM by reload
System image file is "disk0:c6400s-wp-mz.120-7.DB"
```

```
cisco C6400S (R4600) processor with 131072K bytes of memory.
R4700 CPU at 100Mhz, Implementation 33, Rev 1.0
Last reset from s/w peripheral
Bridging software.
2 Ethernet/IEEE 802.3 interface(s)
8 ATM network interface(s)
507K bytes of non-volatile configuration memory.
 --More--
20480K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0

2254  -rw-       91833   Jul 27 2000 10:24:47  running-config
2277  -rw-       91833   Jul 27 2000 10:25:19  pvc-config
2223  -rw-     4504276   Aug 03 2000 09:44:01  c6400s-wp-mz.120-7.DB

20819968 bytes total (16121856 bytes free)
NSP# copy tftp:disk0:
Address or name of remote host []? 10.1.1.1
Source filename []? c6400s-wp-mz.122-13.T
Accessing tftp://10.1.1.1/c6400s-wp-mz.122-13.T...
Loading c6400s-wp-mz.122-13.T from 10.1.1.1 (via
BVI1):!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[snip]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!
[OK - 4575296/9150464 bytes]
4575296 bytes copied in 141.700 secs (32448 bytes/sec)
NSP# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NSP(config)# no boot system disk0:c6400s-wp-mz.120-7.DB
NSP(config)# boot system disk0:c6400s-wp-mz.122-13.T
NSP(config)# config-register 0x2
NSP(config)# end

NSP# copy system:running-config nvram:startup-config
Building configuration...
[OK]
NSP#
```

Switching the Primary and Secondary NSPs

In the following example, the NSP in slot 0A becomes the secondary device and the NSP in slot 0B becomes the primary device. Both NSPs now run the new image.

```
NSP# redundancy force-failover main-cpu

00:33:38:%SYS-5-RELOAD:Reload requested
```



Optimizing the Number of Virtual Connections on the Cisco 6400

This appendix describes how to optimize the number of supported virtual connections on the Cisco 6400 carrier-class broadband aggregator by:

- Properly assigning virtual path identifier (VPI) and virtual channel identifier (VCI) values
- Reducing Input Translation Table (ITT) memory fragmentation

For general information on configuring virtual connections, see the "Configuring Virtual Connections" chapter of the *ATM Switch Router Software Configuration Guide.*

Note The method of assigning VPIs and VCIs can affect how you configure virtual connections on network devices that are connected to the Cisco 6400.

This appendix includes the following sections:

An Overview of the ITT and Virtual Connection Limitations

The Cisco 6400 supports a maximum of 32K virtual connections, a limit determined by a hardware data structure in the node switch processor (NSP) called the ITT. The ITT consists of two banks (Bank 0 and Bank 1), each of which can hold a maximum of 32K entries. Each configured virtual connection occupies two ITT entries (one for each direction of cell flow). Unidirectional connections (such as point-to-multipoint connections) occupy only one ITT entry.

ITT entries are *not* maintained for:

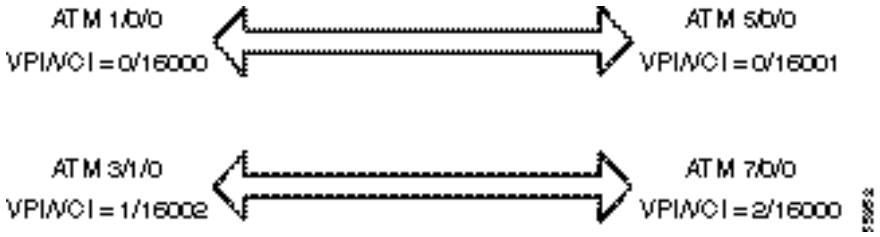
- Permanent virtual circuit (PVC) legs that are not connected
- Connection legs on ATM 0/0/0
- PVCs with one or both interfaces in the down state
- Any connection that does not receive cells (such as point-to-multipoint leaves)

How VCI Values Limit the Number of Virtual Connections

Each ATM interface supports VPIs as large as 8 bits (0 to 255) and VCIs as large as 14 bits (0 to16,383). While these ranges provide a broad selection of VPI/VCI combinations per interface (up to 4,194,304), the method that you use to select these combinations can affect how many virtual connections you can configure on the Cisco 6400.

The ITT allocates resources in blocks of adjacent entries where each block size, in bits, must be a power of 2. Each VPI and ATM port combination requires a dedicated ITT block, and the block size must be greater than the largest VCI. As a result, using unnecessarily large VCI values can dramatically reduce the number of supported virtual connections.

FigureC-1 Example of Two PVCs Using Extremely High VCI Values



In FigureC-1, two PVCs are configured between four ATM ports. In this example, all VCIs are close to the maximum allowed VCI value of 16383. Because the ITT block size must be a power of 2, each of the four ATM port/VPI/VCI combinations require 16K of allocated ITT resources. As a result, these two PVCs exhaust all possible ITT resources, and additional ATM port and VPI combinations cannot be configured.

How ITT Fragmentation Limits the Number of Virtual Connections

Each VPI and ATM port combination requires a dedicated ITT block, and the block size must be greater than the largest VCI. If you configure a VCI greater than the current size of an existing ITT block, the block must expand to the next power of 2 block size that can accommodate the new VCI. The method of ITT block expansion, however, often results in many small and unusable fragments, and further limits the number of virtual connections configurable on the Cisco 6400.

For an existing ITT block to expand in size:

1. The ITT allocates a new block within the same bank. The block size is determined by the largest VCI value, rounded up to the next power of 2.
2. The ITT copies the entries from the original block to the new block.
3. The ITT frees the original block from allocation.

As the ITT allocates, expands, and frees its blocks, the total memory breaks into fragments of used memory and free memory. The total free memory can be larger than the size of any single block, but the fragments might be too small to use.

Guidelines for Maximizing the Number of Virtual Connections

Use the following methods to maximize the number of virtual connections on the Cisco 6400:

- Assigning VCI Values to Maximize the Number of Entries per Block
- Specifying the Minimum ITT Block Size
- Using Automatic Determination of the Minimum ITT Block Size
- Shrinking ITT Blocks
- Displaying ITT Allocation

Assigning VCI Values to Maximize the Number of Entries per Block

For each ATM port and VPI combination, assign VCIs using the following guidelines:

Step 1 Begin configuring virtual connections with VCI value 32. VCI values 0 through 31 are reserved by the ATM Forum for particular functions, such as the Interim Local Management Interface (ILMI).

Step 2 Incrementally assign VCI values for additional virtual connections for the ATM port and VPI combination. Avoid skipping any numbers. This incremental assignment prevents the ITT from allocating a larger block than is necessary for the virtual connections.

Example

Suppose you want to configure five virtual connections between ATM 1/0/1 (VPI = 0) and ATM 8/0/0 (VPI = 5). Configure the virtual connections in the order shown in TableC-1. Notice that the VCI values increase without skipping any numbers.

TableC-1 Virtual Connections Between ATM 1/0/1 (VPI = 0) and ATM 8/0/0 (VPI = 5)

VPI/VCI Values on ATM 1/0/1	VPI/VCI Values on ATM 8/0/0
0/32	5/32
0/33	5/33
0/34	5/34
0/35	5/35
0/36	5/36

Verifying VCI Values

To verify that you optimally configured virtual connections on a particular ATM interface, use the **showatm vc interface atm** *slot/subslot/port* EXEC command. Check that for each VPI value, the VCI values start at 32 and do not skip any numbers.

Specifying the Minimum ITT Block Size

If you know the maximum VCI that will be used for a particular ATM port and VPI combination, you can use the highest VCI to determine the minimum ITT block size for that ATM port and VPI combination. Specifying the minimum block size reduces fragmentation by avoiding block expansion as virtual connections are created.

Note This functionality is available in Cisco IOS Release 12.1(4)DB and later releases.

To specify the minimum ITT block size for an ATM port and VPI combination, complete the following steps beginning in global configuration mode:

	Command	Purpose
Step1	`Switch(config)# interface atm slot/subslot/port`	Specifies the ATM interface.
Step2	`Switch(config-if)# atm input-xlate-table minblock vpi vpi-value block-size force`	Specifies the VPI and minimum ITT block size. The block size is rounded up to the smallest power of 2. The **force** keyword enables the specified block size to override the size determined by the **autominblock** keyword.

Note If the system cannot accommodate the specified minimum ITT block size, the system tries to allocate a block large enough to accommodate the VCI of the virtual connection being created.

Example

In the following example, the minimum ITT block sizes are specified for virtual connections on ATM 1/0/0 with VPI values 0, 1, and 4:

```
!
interface atm 1/0/0
  atm input-xlate-table minblock vpi 0 1024 force
  atm input-xlate-table minblock vpi 1 2048 force
  atm input-xlate-table minblock vpi 4 1024 force
  !
```

Verifying the Minimum ITT Block Size

To verify successful configuration of the minimum ITT block size, use the **moresystem:running-config** EXEC command. Make sure that the **atm input-xlate-table minblock** command appears for the correct interfaces and VPI values.

To verify that the minimum block size was allocated, use the **show atm input-xlate-table inuse** EXEC command. Check the Size field for the ATM port and VPI combinations that you configured.

Using Automatic Determination of the Minimum ITT Block Size

The NSP can automatically track the size of the required ITT block as virtual connections are created and deleted. The required block size is stored in the running configuration and is used to optimally allocate ITT resources after an interface flap. When you enter the **copy system:running-config nvram:startup-config** EXEC command, the required block size is also saved to the startup configuration, so that optimal ITT allocation occurs at the next reload.

Note This functionality is available in Cisco IOS Release 12.1(4)DB and later releases.

To enable automatic determination of the minimum ITT block size, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# atm input-xlate-table autominblock`	Enables the system to determine the optimal ITT block size for every ATM port and VPI on which PVCs or Soft PVC source legs are configured. Automatically inserts the **minblock** keyword version of the command with the optimal block size for each ATM port and VPI combination.

Note The **no** version of the **atm input-xlate-table autominblock** command deletes all manually or automatically configured **minblock** keyword entries, except the entries that include the **force** keyword.

Example

In the following example, the system determines the optimal ITT block size for all ATM port and VPI combinations in the configuration. The system automatically inserts the **minblock** keyword version of the command for every ATM port and VPI combination, except when manually entered with the **force** keyword.

```
!
atm input-xlate-table autominblock
!
interface atm 1/0/0
  atm input-xlate-table minblock vpi 0 1024 force
  atm input-xlate-table minblock vpi 1 2048 force
  !
```

Verifying Automatic Determination of the Minimum ITT Block Size

To verify that you successfully enabled automatic determination of the minimum ITT block size, use the **more system:running-config** EXEC command. Make sure that the **atminput-xlate-tableautominblock** command appears in the running configuration.

To verify that the minimum block size is allocated globally, use the **show atm input-xlate-table inuse** EXEC command. Check the Size field for every ATM port and VPI on which PVCs or Soft PVC source legs are configured.

Shrinking ITT Blocks

Once an ITT block expands, it does not automatically shrink if the block becomes larger than necessary for the ATM port and VPI combination. The unused portion of the block, especially when adjacent to an unused fragment of ITT memory, can instead be used to create another ITT block.

Note This functionality is available in Cisco IOS Release 12.1(4)DB and later releases.

To enable ITT blocks to shrink in place when they are larger than necessary for the current virtual connections, use the following command in global configuration mode:

Command	Purpose
`Switch(config)# atm input-xlate-table autoshrink`	Enables ITT blocks to shrink in place when they are larger than necessary to accommodate the configured virtual connections.

Note Enable block shrinking only when you actively remove virtual connections or high VCI values. Block shrinking significantly increases processor and memory resource usage, and can affect system performance.

Example

In the following example, block shrinking is enabled while PVCs with high VCIs are deleted. Then block shrinking is disabled to prevent draining processor and memory resources.

```
Switch(config)# atm input-xlate-table autoshrink
Switch(config)# interface atm 1/0/0
Switch(config-if)# no atm pvc 0 1010
Switch(config-if)# no atm pvc 0 1011
Switch(config-if)# exit
Switch(config)# no atm input-xlate-table autoshrink
```

Verifying ITT Block Shrinking

To verify ITT block shrinking, use the **show atm input-xlate-table inuse** EXEC command in combination with the **show atm vc interface atm** *slot/subslot/port* EXEC command. The displayed size of the blocks in use should be just large enough to accommodate the displayed VCIs.

Displaying ITT Allocation

To display ITT allocation, use the following command in EXEC mode:

Command	Purpose
`Switch> show atm input-xlate-table [inuse]`	Displays ITT allocation, including both used and unused ITT memory. Optionally, with the **inuse** keyword, displays only the allocated ITT blocks and the ATM interfaces and VPI values associated with each block.

Note This functionality is available in Cisco IOS Release 12.1(4)DB and later releases.

Examples

In the following example, the **inuse** keyword is used to display all allocated ITT blocks and their associated ATM interfaces and VPIs:

```
Switch> show atm input-xlate-table inuse
Interface        VPI  VP/VC Address Size
ATM0/1/0         0      VC  17472   64
ATM0/1/0         2      VP  32768   1
ATM0/1/2         0      VC  49216   32
ATM0/1/2         2      VP  0       1
ATM1/0/0         0      VC  49280   64
ATM1/0/0         9      VC  16384   1024
```

In the following example, the **inuse** keyword is excluded to display both the used and free ITT blocks:

```
Switch> show atm input-xlate-table
Input Translation Table Free Blocks:
Block-start   Size     Bank
1             1         0
2             2         0
4             4         0
8             8         0
16            16        0
32            32        0
64            64        0
17408         64        0
128           128       0
17536         128       0
256           256       0
17664         256       0
512           512       0
17920         512       0
1024          1024      0
2048          2048      0
18432         2048      0
4096          4096      0
20480         4096      0
8192          8192      0
24576         8192      0
32769         1         1
32770         2         1
32772         4         1
32776         8         1
32784         16        1
32800         32        1
49248         32        1
32832         64        1
49152         64        1
49344         64        1
32896         128       1
33024         256       1
49408         256       1
33280         512       1
49664         512       1
33792         1024      1
50176         1024      1
34816         2048      1
51200         2048      1
36864         4096      1
```

```
53248         4096      1
40960         8192      1
57344         8192      1

Input Translation Table Total Free = 64350

Input Translation Table In Use (display combines contiguous blocks):
 Inuse-start   Inuse-end   Size
0             0            1
16384         17407        1024
17472         17535        64
32768         32768        1
49216         49247        32
49280         49343        64
```

A

AAA authentication, authorization, and accounting (pronounced "triple a").

AAL ATM adaptation layer. Service-dependent sublayer of the data link layer. The AAL accepts data from different applications and presents it to the ATM layer in the form of 48-byte ATM payload segments. AALs consist of two sublayers, CS and SAR. AALs differ on the basis of the source-destination timing used, whether they use CBR or BVR, and whether they are used for connection-oriented or connectionless mode data transfer. See AAL5.

AAL5 ATM adaptation layer 5. One of four AALs recommended by the ITU-T. AAL5 is used predominantly for the transfer of packet-based traffic.

ABR available bit rate. QoS class defined by the ATM Forum for ATM networks. ABR is used for connections that do not require timing relationships between source and destination. ABR provides no guarantees in terms of cell loss or delay, providing only best-effort service. Traffic sources adjust their transmission rate in response to information they receive describing the status of the network and its capability to successfully deliver data. Compare with CBR, UBR, and VBR.

ACR allowed cell rate. Parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

address mask Bit combination used to describe which portion of an address refers to the network or subnet and which part refers to the host.

ADM add drop multiplexer. In an operations support system, a multiplexer that allows a signal to be added into or dropped out of a Synchronous Optical Network (SONET) span.

ADSL asymmetric digital subscriber line. One type of DSL technology. ADSL is designed to deliver more bandwidth downstream (from the central office to the customer site) than upstream. Downstream rates range from 1.5 to 9 Mbps, while upstream bandwidth ranges from 16 to 640 kbps. ADSL transmissions work at distances up to 18,000 feet (5488 meters) over a single copper twisted pair.

AFI authority and format identifier. Portion of an NSAP-format ATM address that identifies the type and format of the IDI portion of an ATM address. See also IDI and NSAP.

AIS alarm indication signal. In a T1 transmission, an all-ones signal transmitted in lieu of the normal signal to maintain transmission continuity and to indicate to the receiving terminal that there is a transmission fault that is located either at, or upstream from, the transmitting terminal.

APS automatic protection switching. SONET switching mechanism that routes traffic from working lines to protect them in case of a line card failure or fiber cut.

ATM Asynchronous Transfer Mode. International standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is used in high-speed transmission media such as E3, SONET, and T3.

B

bandwidth The difference between the highest and lowest frequencies available for network signals. The term is also used to describe the rated throughput capacity of a given network medium or protocol.

Bellcore Bell Communications Research, Inc., now known as Telcordia Technologies, Inc. Organization that performs research and development on behalf of the RBOCs and sets telephony standards (in the United States).

BER bit error rate. Ratio of received bits that contain errors.

BITS Building Integrated Timing Supply. A single building master timing supply that supplies DS1 and DS0 level timing throughout an office.

boot flash Separate Flash memory device used primarily to store the Cisco IOS boot helper image, operational Cisco IOS images, and system configuration information.

boot helper Minimum-function Cisco IOS image that serves only to boot the full-function, operational Cisco IOS image. Also referred to as “rxboot.”

BOOTP Bootstrap protocol. Protocol used by a network node to determine the IP address of its Ethernet interfaces, so that network booting can proceed.

BPE Backplane Ethernet.

bps bits per second.

bridge-group A group of interfaces bridged together to emulate a multiport bridge.

buffer Storage area used for handling data in transit. Buffers are used in internetworking to compensate for differences in processing speed between network devices. Bursts of data can be stored in buffers until they can be handled by slower processing devices. Sometimes referred to as a packet buffer.

BVI Bridge Group Virtual Interface. The logical Layer 3-only interface associated with a bridge group when IRB is configured.

C

CBOS Cisco Broadband Operating System. The common operating system for DSL CPE, including the Cisco 675, the Cisco 675e, the Cisco 676, and the Cisco 677.

CBR constant bit rate. QoS class defined by the ATM Forum for ATM networks. CBR is used for connections that depend on precise clocking to ensure undistorted delivery. Compare with ABR, UBR, and VBR.

CEF Cisco Express Forwarding. Advanced Layer 3 IP switching technology that optimizes network performance and scalability for networks with large and dynamic traffic patterns, such as the Internet, on networks characterized by intensive Web-based applications, or interactive sessions.

CEMF Cisco Element Management Framework.

CHAP Challenge Handshake Authentication Protocol. Security feature supported on lines using PPP encapsulation that prevents unauthorized access. CHAP does not itself prevent unauthorized access; it merely identifies the remote end. The router or access server then determines whether that user is allowed access. Compare to PAP.

CiscoFusion Cisco internetworking architecture that “fuses” together the scalability, stability, and security advantages of the latest routing technologies with the performance benefits of ATM and LAN switching, and the management benefits of VLANs. See also Cisco IOS.

Cisco IOS Cisco system software that provides common functionality, scalability, and security for all products under the CiscoFusion architecture. Cisco IOS allows centralized, integrated, and automated installation and management of internetworks, while ensuring support for a wide variety of protocols, media, services, and platforms. See also CiscoFusion.

CLEC competitive local exchange carrier. Company that builds and operates communication networks in metropolitan areas and provides its customers with an alternative to the local telephone company.

CLI command-line interface. An interface that allows you to interact with the operating system by entering commands and optional arguments. Compare with GUI.

CO central office. Local telephone company office to which all local loops in a given area connect and in which circuit switching of subscriber lines occurs.

CPE customer premises equipment. Terminating equipment, such as terminals, telephones, and modems, supplied by the telephone company, installed at customer sites, and connected to the telephone company network.

CRC cyclic redundancy check. Error-checking technique in which the frame recipient calculates a remainder by dividing frame contents by a prime binary divisor and compares the calculated remainder to a value stored in the frame by the sending node.

D

DCC Data Country Code. One of two ATM address formats developed by the ATM Forum for use by private networks. Adapted from the subnetwork model of addressing in which the ATM layer is responsible for mapping network layer addresses to ATM addresses. Compare with ICD.

DHCP Dynamic Host Configuration Protocol. Provides a mechanism for allocating IP addresses dynamically so that addresses can be reused when hosts no longer need them.

DMA direct memory access. DMA transfers data into memory at high speeds with no processor overhead.

DNIS dialed number identification service. Method for delivery of automatic number identification that uses out-of-band signaling

DNS Domain Name Server. The part of the distributed database system for resolving a fully qualified domain name into the four-part IP (Internet Protocol) number used to route communications across the Internet.

downlink A network connection between the Cisco 6400 chassis and an aggregated modem shelf.

DRAM dynamic random-access (read/write) memory.

DS0 digital signal level 0. Framing specification used in transmitting digital signals at 64 kbps. Twenty-four DS0s equal one DS1.

DS1 digital signal level 1. Framing specification used in transmitting digital signals at 1.544 Mbps on a T1 facility.

DS3 digital signal level 3. Framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility.

DSL digital subscriber line. A public network technology that delivers high bandwidth over conventional copper wiring at limited distances. There are various types of DSL, including ADSL, HDSL, SDSL, and VDSL. All are provisioned via modem pairs, with one modem located at a central office and the other at the customer site. Because most DSL technologies don't use the whole bandwidth of the twisted pair, there is room left for a voice channel.

DSLAM DSL access multiplexer.

DTE data terminal equipment. Device at the user end of a user-network interface that serves as a data source, destination, or both. DTE includes such devices as computers, protocol translators, and multiplexers.

E

EHSA enhanced high system availability. This processor redundancy scheme reduces switchover time by requiring that the redundant processor be running in hot standby mode.

EIA Electronic Industries Association. Group that specifies electrical transmission standards. The EIA and TIA have developed numerous well-known communications standards, including EIA/TIA-232 and EIA/TIA-449. See also TIA.

Ethernet Baseband LAN specification originated by Xerox Corporation and developed jointly by Xerox, Intel, and Digital Equipment Corporation. Ethernet networks use CSMA/CD and run over a variety of cable types at 10 Mbps. Ethernet is similar to the IEEE 802.3 series of standards. See also 10BaseT and Fast Ethernet.

ETSI European Telecommunications Standards Institute.

EXEC Interactive command processor of Cisco IOS.

F

Fast Ethernet Any of a number of 100-Mbps Ethernet specifications. Fast Ethernet offers a speed ten times that of the 10BaseT Ethernet specification, while preserving frame format, MAC mechanisms, and MTU. Based on an extension of the IEEE 802.3 specification. See also 100BaseT.

FERF far-end receive failure.

FTP File Transfer Protocol. Application protocol, part of the TCP/IP protocol stack, used for transferring files between network nodes. FTP is defined in RFC 959.

FRU field-replaceable unit. Term applied to the Cisco 6400 components that can be replaced in the field, including the NLC, NSP, NRP, and PEM units, plus the blower fans.

G

GBIC gigabit interface converter.

GCRA generic cell rate algorithm. In ATM, an algorithm that defines conformance with respect to the traffic contract of the connection. For each cell arrival, the GCRA determines whether the cell conforms to the traffic contract.

GE gigabit Ethernet.

GUI graphical user interface. User environment that uses pictorial as well as textual representation of the input and output of applications and the data structure in which information is stored. Conventions such as buttons, icons, and windows are typical, and many actions are performed by means of a pointing device (such as a mouse).

H

home gateway A router or access server that terminates tunnels and PPP sessions.

HTML Hypertext Markup Language. Simple hypertext document formatting language that uses tags to indicate how a given part of a document should be interpreted by a viewing application, such as a Web browser.

HTTP Hypertext Transfer Protocol. The protocol used by Web browsers and Web servers to transfer files, such as text and graphic files.

I

ICD International Code Designator. One of two ATM address formats developed by the ATM Forum for use by private networks. Adapted from the subnetwork model of addressing in which the ATM layer is responsible for mapping network layer addresses to ATM addresses. Compare with DCC.

ICMP Internet Control Message Protocol. Network layer Internet protocol that reports errors and provides other information relevant to IP packet processing. Documented in RFC 792.

IDI initial domain identifier. Portion of an NSAP or NSAP-format ATM address that specifies the address allocation and administration authority. See also NSAP.

IETF Internet Engineering Task Force. Task force consisting of over 80 working groups responsible for developing Internet standards. The IETF operates under the auspices of ISOC. See also ISOC.

IFS integrated file system, such as PCMCIA disks, TFTP, FTP, or rcp servers.

IISP Interim Interswitch Signaling Protocol. Formerly known as PNNI Phase 0, IISP is an ATM signaling protocol for interswitch communication by means of manually configured prefix tables. In the Cisco6400, the software image can be configured to use IISP (C6400-WI-M) or PNNI (C6400-WP-M) for signaling connections.

ILEC Incumbent Local Exchange Carrier. The traditional local telephone service provider in the United States.

ILMI Interim Local Management Interface. ATM specification for incorporating network-management capabilities into the ATM UNI.

I/O input/output.

IOS See Cisco IOS.

IP Internet Protocol. Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security. Documented in RFC 791.

IP over ATM Suite used to send IP datagram packets between nodes on the Internet.

IPCP IP Control Protocol. Protocol that establishes and configures IP over PPP.

IRB integrated routing and bridging. The process of routing between a number of bridge-groups.

ISOC Internet Society. International nonprofit organization, founded in 1992, that coordinates the evolution and use of the Internet. In addition, ISOC delegates authority to other groups related to the Internet, such as the IAB. ISOC is headquartered in Reston, Virginia (United States).

ITT Input Translation Table. Data structure used in MMC chipsets for the Cisco 6400 NSP.

ITU-T International Telecommunications Union Telecommunication Standardization Sector. International body that develops worldwide standards for telecommunications technologies. The ITU-T carries out the functions of the former CCITT.

K

kbps kilobits per second.

L

L2F Layer 2 Forwarding. Protocol that supports the creation of secure virtual private dial-up networks over the Internet.

L2TP Layer 2 Tunneling Protocol. An Internet Engineering Task Force (IETF) standards track protocol defined in RFC 2661 that provides tunneling of PPP. Based upon the best features of L2F and PPTP, L2TP provides an industry-wide interoperable method of implementing VPDN.

LAC L2TP access concentrator. A node that acts as one side of an L2TP tunnel endpoint and is a peer to the L2TP network server (LNS). The LAC sits between an LNS and a remote system and forwards packets to and from each. Packets sent from the LAC to the LNS requires tunneling with the L2TP protocol as defined in this document. The connection from the LAC to the remote system is either local or a PPP link.

LAN local-area network. High-speed, low-error data network covering a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area. LAN standards specify cabling and signaling at the physical and data link layers of the OSI model. Ethernet, FDDI, and Token Ring are widely used LAN technologies.

LATA local access and transport area. A geographic territory used primarily by local telephone companies to determine charges for intrastate calls. As a result of the Bell divestiture, switched calls that both begin and end at points within the LATA (intraLATA) are generally the sole responsibility of the local telephone company, while calls that cross outside the LATA (interLATA) are passed on to an Inter eXchange Carrier (IXC).

LED light emitting diode. Semiconductor device that emits light produced by converting electrical energy. Status lights on hardware devices are typically LEDs.

leg The endpoint of an internal connection. A cross-connect connects two legs together. For SVCs and soft PVCs, a leg can be a source leg or a destination leg. Also referred to as a “connection leg” or “half-leg.”

LEC local exchange carrier. Local or regional telephone company that owns and operates a telephone network and the customer lines that connect to it.

LNS L2TP network server. A node that acts as one side of an L2TP tunnel endpoint and is a peer to the L2TP access concentrator (LAC). The LNS is the logical termination point of a PPP session that is being tunneled from the remote system by the LAC. Analogous to the Layer 2 Forwarding (L2F) home gateway (HGW).

M

M23 A method of multiplexing four DS1 signals into a DS2 signal, then multiplexing seven DS2 signals into a DS3 signal.

MAC Media Access Control. Lower of the two sublayers of the data link layer defined by the IEEE. The MAC sublayer handles access to shared media.

Mbps megabits per second.

MBS maximum burst size. In an ATM signaling message, burst tolerance is conveyed through the MBS, which is coded as a number of cells. The burst tolerance together with the SCR and the GCRA determine the MBS that can be transmitted at the peak rate and still be in conformance with the GCRA. See also SCP and GCRA.

MCR minimum cell rate. Parameter defined by the ATM Forum for ATM traffic management. MCR is defined only for ABR transmissions, and specifies the minimum value for the ACR.

MIB Management Information Base. Database of network management information that is used and maintained by a network management protocol such as SNMP or CMIP. The value of a MIB object can be changed or retrieved using SNMP or CMIP commands, usually through a GUI network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.

MTU maximum transmission unit. Maximum packet size, in bytes, that a particular interface can handle.

multimode fiber Optical fiber supporting propagation of multiple frequencies of light. See also single-mode fiber.

mux multiplexing device. Combines multiple signals for transmission over a single line. The signals are demultiplexed, or separated, at the receiving end.

N

NAS network access server. A device providing local network access to users across a remote access network such as the PSTN.

NCP Network Control Protocol. Series of protocols for establishing and configuring different network layer protocols, such as for AppleTalk over PPP.

NEBS Network Equipment Building Systems. A standard set of physical and electrical requirements for telecommunications equipment intended for installation in the telephone company central office environment. NEBS requirements are specified in various Bellcore documents.

NLC node line card. One of the component cards used in the Cisco 6400. These cards provide the interfaces for moving data into and out of the Cisco 6400 system. They can be used as either uplink or downlink interfaces. Different types of node line cards support different transmission protocols and data rates.

NME network management Ethernet. The local area network used to control and manage equipment in a central office and branch locations. The NME connection on the Cisco 6400 is an RJ-45 connector for a 10BaseT port on the NSP module.

NMS network management system. System responsible for managing at least part of a network. An NMS is generally a reasonably powerful and well-equipped computer such as an engineering workstation. NMSs communicate with agents to help keep track of network statistics and resources.

NNI Network-to-Network Interface. ATM Forum standard that defines the interface between two ATM switches that are both located in a private network or are both located in a public network. The interface between a public switch and private one is defined by the UNI standard.

NRP node route processor. One of the component modules used in the Cisco 6400. This module is the Layer3 element for the Cisco 6400 responsible for implementing the routing function.

NRP-1 Node route processor that incorporates a 100-Mbps Fast Ethernet interface for connecting into an IP network and has processing capability for OC-3 rate of user traffic. Compare with NRP-2.

NRP-2 Node route processor that provides a Gigabit Ethernet interface and sufficient processing capability for handling OC-12 rate of user traffic. Compare with NRP-1.

NSNAP network service access point. Network addresses, as specified by ISO. An NSAP is the point at which OSI Network Service is made available to a transport layer (Layer 4) entity.

NSP node switch processor. One of the component modules used in the Cisco 6400. This module is responsible for all ATM switching and control functions within the Cisco 6400.

NVRAM Nonvolatile RAM. RAM that retains its contents when a unit is powered off.

O

OC optical carrier. A series of physical protocols (OC-3, OC-12, and so on), defined for SONET optical signal transmissions.

OIR online insertion and removal. Feature that permits the addition, replacement, or removal of cards without interrupting the system power, entering console commands, or causing other software or interfaces to shut down. Sometimes called hot swapping or power-on servicing.

P

PAM mailbox serial interface Backplane interface that connects the NSP and the NRP-2. Used for internal communication only, the PAM mailbox serial interface is not intended to carry user data.

PAP Password Authentication Protocol. Authentication protocol that allows PPP peers to authenticate one another. The remote router attempting to connect to the local router is required to send an authentication request. Unlike CHAP, PAP passes the password and host name or username in the clear (unencrypted). PAP does not itself prevent unauthorized access, but merely identifies the remote end. The router or access server then determines if that user is allowed access. PAP is supported only on PPP lines. Compare with CHAP.

PCMCIA Personal Computer Memory Card International Association. Refers to a standard used for credit-card-sized computer peripherals. Type I devices are very thin memory cards: Type 2 devices include most modems and interfaces; and Type 3 devices are used for disk drives and thicker components.

PCR peak cell rate. Parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

PEM power entry module. The PEM converts the -48 VDC power voltage into the voltages used internally by the Cisco 6400. The Cisco 6400 is designed to operate on one or two PEM units.

ping packet internet groper. ICMP echo message and its reply. Often used in IP networks to test whether a network device destination can be reached from the source.

PLCP physical layer convergence procedure. Specification that maps ATM cells into physical media, such as T3 or E3, and defines certain management information.

PNNI 1. Private Network-Network Interface. ATM Forum specification for distributing topology information between switches and clusters of switches that is used to compute paths through the network. The specification is based on well-known link-state routing techniques and includes a mechanism for automatic configuration in networks in which the address structure reflects the topology.

2. Private Network Node Interface. ATM Forum specification for signaling to establish point-to-point and point-to-multipoint connections across an ATM network. The protocol is based on the ATM Forum UNI specification with additional mechanisms for source routing, crankback, and alternate routing of call setup requests.

point-to-multipoint connection One of two fundamental connection types. In ATM, a point-to-multipoint connection is a unidirectional connection in which a single-source end system (known as a root node) connects to multiple destination end systems (known as leaves). Compare with point-to-point connection.

point-to-point connection One of two fundamental connection types. In ATM, a point-to-point connection is a connection between two endpoints. Compare with point-to-multipoint connection.

POP point of presence. Physical location within a LATA where a long distance carrier or cellular provider interfaces with the network of the local exchange carrier (LEC), also called the local telephone company.

POTS plain old telephone service. See PSTN.

power-on servicing Feature that allows faulty components to be diagnosed, removed, and replaced while the rest of the device continues to operate normally. Sometimes abbreviated POS. Sometimes called hot swapping. See also OIR.

PPP Point-to-Point Protocol. A protocol that encapsulates network layer protocol information over point-to-point links. PPP is defined in RFC 1661.

PPPoA PPP over ATM.

PPPoE PPP over Ethernet.

PPTP Point-to-Point Tunneling Protocol. Microsoft's Point-to-Point Tunneling Protocol. Some of the features in L2TP were derived from PPTP.

precloning Cloning a specified number of virtual access interfaces from a virtual template at system startup or when the command is configured.

PSTN Public Switched Telephone Network. General term referring to the variety of telephone networks and services in place worldwide. Sometimes called POTS.

PTA PPP Termination Aggregation.

PVC permanent virtual circuit or connection. Virtual circuit that is permanently established. PVCs save bandwidth associated with circuit establishment and tear down in situations where certain virtual circuits must exist all the time. In ATM terminology, called a permanent virtual connection. Compare with SVC. See also virtual circuit (VC).

PVP permanent virtual path. Virtual path that consists of PVCs. See also PVC and virtual path.

Q

QoS quality of service. Measure of performance for a transmission system that reflects its transmission quality and service availability.

R

RADIUS Remote Authentication Dial-In User Service. Database for authenticating dial-in connections and for tracking connection time.

RBE routed bridge encapsulation. The process by which a stub-bridged segment is terminated on a point-to-point routed interface. Specifically, the router is routing on an IEEE 802.3 or Ethernet header carried over a point-to-point protocol such as PPP, RFC 1483 ATM, or RFC 1490 Frame Relay.

RBOC regional Bell operating company. One of the regional phone companies that resulted from the breakup of the old AT&T. The RBOCs are still primarily limited to providing local access, although this is changing.

rcp remote copy protocol. Protocol that allows users to copy files to and from a file system residing on a remote host or server on the network. The rcp protocol uses TCP to ensure the reliable delivery of data.

RFC Request For Comments. Document series used as the primary means for communicating information about the Internet. Some RFCs are designated by the IAB as Internet standards. Most RFCs document protocol specifications such as Telnet and FTP, but some are humorous or historical. RFCs are available online from numerous sources.

RISC reduced instruction set computing.

RMON Remote Monitoring. MIB agent specification described in RFC 1271 that defines functions for the remote monitoring of networked devices. The RMON specification provides numerous monitoring, problem detection, and reporting capabilities.

ROMMON ROM monitor.

S

SAR segmentation and reassembly.

SCM Service Connection Manager.

SCR sustainable cell rate. Parameter defined by the ATM Forum for ATM traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted. See also VBR.

SDH Synchronous Digital Hierarchy. European standard that defines a set of rate and format standards that are transmitted using optical signals over fiber. SDH is similar to SONET, with a basic SDH rate of 155.52 Mbps, designated at STM-1. See also SONET and STM-1.

SIMM single in-line memory module. Used for Flash internal memory in the Cisco 6400.

single-mode fiber Fiber-optic cabling with a narrow core that allows light to enter only at a single angle. Such cabling has higher bandwidth than multimode fiber, but requires a light source with a narrow spectral width (for example, a laser). Also called monomode fiber. See also multimode fiber.

SNAP Subnetwork Access Protocol. Internet protocol that operates between a network entity in the subnetwork and a network entity in the end system. SNAP specifies a standard method of encapsulating IP datagrams and ARP messages on IEEE networks.

SNMP Simple Network Management Protocol. Network management protocol used almost exclusively in TCP/IP networks. SNMP provides a means to monitor and control network devices, and to manage configurations, statistics collection, performance, and security.

soft PVC A PVC-SVC hybrid in which only the two terminating virtual connection links (VCLs) at either end are permanent and the rest of the VCLs are switched (SVC). Like the PVC, a soft PVC is permanent and the called party cannot drop the connection. Like the SVC, a soft PVC is automatically rerouted if a switch or link in the path fails.

SONET Synchronous Optical Network. High-speed (up to 2.5 Gbps) synchronous network specification developed by Bellcore and designed to run on optical fiber. STS-1 is the basic building block of SONET. Approved as an international standard in 1988. See also SDH, STS-1, and STS-3c.

SSD The Service Selection Dashboard (SSD) server is a customizable Web-based application that works with the Cisco SSG to allow end customers to log on to and disconnect from proxy and passthrough services through a standard Web browser. After the customer logs in to the service provider's network, an HTML Dashboard is populated with the services authorized for that user.

SSG Service Selection Gateway. The Cisco SSG offers service providers a means for menu-based service selection. End users can select services from the Dashboard menu, and the Cisco SSG will set up and tear down proxy and passthrough network connections based on a user's selection. The Cisco SSG will account for the services selected so that service providers can bill for individual services.

Stratum 3 A precision timing reference that provides a free-run accuracy of +/- 4.6 PPM (parts per million), pull-in capability of 4.6 PPM, and holdover stability of less than 255 slips during first day. Thorough descriptions can be found in ANSI T1.101-1994 and the Bellcore document GR-1244-CORE.

STS-1 Synchronous Transport Signal level 1. Basic building block signal of SONET, operating at 51.84 Mbps. Faster SONET rates are defined as STS-*n*, where *n* is a multiple of 51.84 Mbps. See also SONET.

STS-3c Synchronous Transport Signal level 3, concatenated. SONET format that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells. See also SONET.

subnet mask 32-bit address mask used in IP to indicate the bits of an IP address that are being used for the subnet address.

SVC switched virtual circuit. Virtual circuit that is dynamically established on demand and is torn down when transmission is complete. SVCs are used in situations where data transmission is sporadic. Called a switched virtual connection in ATM terminology. Compare with PVC.

T

TCP Transmission Control Protocol. Connection-oriented transport layer protocol that provides reliable full-duplex data transmission. TCP is part of the TCP/IP protocol stack. See also TCP/IP.

TCP/IP Transmission Control Protocol/Internet Protocol. Common name for the suite of protocols developed by the U.S. Department of Defense (DoD) in the 1970s to support the construction of worldwide internetworks. TCP and IP are the two best-known protocols in the suite.

telco Abbreviation for telephone company.

Telnet Standard terminal emulation protocol in the TCP/IP protocol stack. Telnet is used for remote terminal connections, enabling users to log into remote systems and use resources as if they were connected to a local system.

TFTP Trivial File Transfer Protocol. Simplified version of FTP that allows files to be transferred from one computer to another over a network.

TIA Telecommunications Industry Association. Organization that develops standards relating to telecommunications technologies. See also EIA.

transmission ring A hardware first-in, first-out (FIFO) queue on the NRP-2 ATM port adapter that stores packets before they are segmented into cells for transmission. When the queue is full, the NRP-2 stops sending packets to the transmission ring and stores the packets in the Cisco IOS software until the transmission ring is no longer congested.

trunk Physical and logical connection between two switches across which network traffic travels. A backbone is composed of a number of trunks.

TTY teletype.

tunneling Architecture providing the services necessary to implement any standard point-to-point data encapsulation scheme.

U

UAC universal access concentrator.

UBR unspecified bit rate. QoS class defined by the ATM Forum for ATM networks. UBR allows any amount of data up to a specified maximum to be sent across the network, but there are no guarantees in terms of cell loss rate and delay. Compare with ABR, CBR, and VBR.

UDP User Datagram Protocol. Connectionless transport layer protocol in the TCP/IP protocol stack. UDP is a simple protocol that exchanges datagrams without acknowledgments or guaranteed delivery, requiring that error processing and retransmission be handled by other protocols. UDP is defined in RFC 768.

UNI User-to-Network Interface. ATM Forum specification that defines an interoperability standard for the interface between ATM-based products (a router or an ATM switch) located in a private network and the ATM switches located within the public carrier networks.

uplink A network connection between the Cisco 6400 system chassis and a WAN. Also known as a trunk.

V

VBR variable bit rate. QoS class defined by the ATM Forum for ATM networks. VBR is subdivided into a real time (RT) class and nonreal time (NRT) class. VBR-RT is used for connections in which there is a fixed timing relationship between samples. VBR-NRT is used for connections in which there is no fixed timing relationship between samples, but that still need a guaranteed QoS. Compare with ABR, CBR, and UBR.

VC virtual circuit. Logical circuit created to ensure reliable communication between two network devices. A VC is defined by a VPI/VCI pair and can be either permanent (PVC) or switched (SVC). In ATM, a virtual circuit is called a virtual channel.

VCC virtual channel connection. Logical circuit, made up of VCLs, that carries data between two end points in an ATM network. Sometimes called a virtual circuit connection. See also VCD, VCL, and VPI.

VCD virtual circuit descriptor. When you create a PVC, you create a VCD and attach it to the VPI and VCI. A VCD identifies which VPI/VCI to use for a particular packet. The number chosen for the VCD is independent of the VPI/VCI used.

VCI virtual channel identifier. A 16-bit field in the header of an ATM cell. The VCI, together with the VPI, is used to identify the next destination of a cell as it passes through a series of ATM switches on its way to its destination. The Cisco 6400 supports VCIs as large as 14 bits (0 to 16383).

VCL virtual channel link. Connection between two ATM devices. A VCC is made up of one or more VCLs. See also VCC.

virtual access interface Instance of a unique virtual interface that is created dynamically and exists temporarily. Virtual access interfaces can be created and configured differently by different applications, such as virtual profiles and virtual private dialup networks. Virtual access interfaces are cloned from virtual template interfaces.

virtual circuit Logical circuit created to ensure reliable communication between two network devices. A virtual circuit is defined by a VPI/VCI pair, and can be either permanent (PVC) or switched (SVC). Virtual circuits are used in Frame Relay and X.25. In ATM, a virtual circuit is called a virtual channel. Sometimes abbreviated VC.

virtual path Logical grouping of virtual circuits that connect two sites. See also virtual circuit.

virtual template interface A logical interface configured with generic configuration information for a specific purpose or configuration common to specific users, plus router-dependent information. The template takes the form of a list of Cisco IOS interface commands that are applied to virtual access interfaces, as needed.

VP virtual path. One of two types of ATM circuits identified by a VPI. A virtual path is a bundle of virtual channels, all of which are switched transparently across an ATM network based on a common VPI. See also VPI.

VPI virtual path identifier. An 8-bit field in the header of an ATM cell.

VPDN Virtual Private Dial-Up Networking. A system that permits dial-in networks to exist remotely to home networks, while giving the appearance of being directly connected. VPDNs use L2TP and L2F to terminate the Layer 2 and higher parts of the network connection at the home gateway, instead of the NAS.

VPN virtual private network. A secure IP-based network that shares resources with one or more physical networks. A VPN can contain one or more geographically dispersed sites that can communicate securely over a shared backbone.

W

WAN wide-area network. Data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers.

Web Console A graphical user interface (GUI) application that communicates with the system by translating HTML pages into Cisco IOS commands.

X

xDSL Various types of digital subscriber lines. Examples include ADSL, HDSL, and VDSL.

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