Cisco XR 12000 Series Router SIP and SPA Software Configuration Guide, Release 3.2

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Preface

This preface describes the objectives and organization of this document and explains how to find additional information on related products and services. This preface contains the following sections:

Document Change History

Table 1 provides a list of the changes to this document.

Table 1 Document Change History Table

Release No.	Revision	Date	Change Summary
3.2	Release 3.2, OL-9177-01 Rev. A1, January 6, 2006	May 10, 2005	Initial Release and 1st publication. Provided the IOS XR commands and configuration procedures for the following SPAs when they are installed in a Cisco 12000 SIP-600: • 1-Port 10-Gigabit Ethernet SPA • 5-Port Gigabit Ethernet SPA • 10-Port Gigabit Ethernet SPA • 1-Port OC-192c/STM-64 POS/RPR XFP SPA

Objectives

This document describes the configuration and troubleshooting of SPA interface processors (SIPs) and shared port adapters (SPAs) that are supported on a Cisco XR 12000 Series Router.

Organization

This document contains the following chapters:

Chapter	Title	Description
Chapter 1	SIP and SPA Product Overview	Provides a brief introduction to the SIP and SPA architecture on Cisco 12000 Series Routers.
Chapter 2	Overview of the Cisco XR 12000 Series Router SIPs	Provides an overview of the release history, and feature and Management Information Base (MIB) support for the SIPs supported on Cisco 12000 Series Routers.
Part 1	Gigabit Ethernet Shared Port Adapters	Gigabit Ethernet Section
Chapter 3	Overview of the Gigabit Ethernet SPAs	Provides an overview of the Gigabit Ethernet SPAs.
Chapter 4	Configuring Ethernet SPAs on Cisco IOS XR Software	Provides information about configuring the Cisco 1-port 10 Gigabit Ethernet SPA and Cisco 10-port Gigabit Ethernet SPA on Cisco XR 12000 Series Routers.
Part 2	Packet over SONET Shared Port Adapters	Packet over SONET (POS) Section
Chapter 5	Overview of Packet over SONET SPAs	Provides an overview of the POS SPAs
Chapter 6	Configuring POS SPAs on Cisco IOS XR Software	Provides information about configuring POS SPAs on Cisco XR 12000 Series Routers running Cisco IOS XR software.
Part 3	Field-Programmable Devices	Field-Programmable Devices (FPD) Section
Chapter 7	Upgrading Field-Programmable Devices	Provides information about upgrading the Field-Programmable Gate Array (FPGA) on Cisco XR 12000 Series Routers.
Part 4	Shared Port Adapter Command Reference	Command Reference Section
Chapter 8	Command Summary for the Gigabit Ethernet SPA	Provides an alphabetical list of some of the related commands to configure, monitor, and maintain Gigabit Ethernet SPAs.
Chapter 9	Command Summary for the POS SPAs	Provides an alphabetical list of some of the related commands to configure, monitor, and maintain POS SPAs.
Chapter 10	Command Reference	Describes Cisco IOS-XR software command reference information including syntax, usage guidelines, and examples for all new and modified commands for SPAs on Cisco XR 12000 Series Routers.

Related Documentation

This section refers you to other documentation that also might be useful as you configure your Cisco XR 12000 Series Router. The documentation listed below is available online.

- *Cisco 12000 Series Router SIP and SPA Hardware Installation Guide*
- *Cisco 12000 Series Router SIP and SPA Software Configuration Guide (Cisco IOS)*
- *Cisco XR 12000 Series Router SIP and SPA Software Configuration Guide*
- *Cisco IOS Release Release Notes for Cisco 12000 Series Routers*
- *Regulatory Compliance and Safety Information for Cisco 12000 Series Routers*
- *Cisco IOS XR Getting Started Guide*

Cisco XR 12000 Series Router Documentation

As you configure SIPs and SPAs on your Cisco XR 12000 Series Router, you should also refer to the following companion publication for important hardware installation information:

- *Cisco 12000 Series Router SIP and SPA Hardware Installation Guide*

Some of the other Cisco XR 12000 Series Router publications might be useful to you as you configure your Cisco XR 12000 Series Router. The following URL provides a wide range of documentation for the various Cisco XR 12000 Series Routers and their accompanying field replaceable units (FRUs):

http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/

Several other publications are also related to the Cisco XR 12000 Series Router. For a complete reference of related documentation, refer to the various roadmap documents located at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/roadmap/

Cisco IOS-XR Software Publications

Your router, switch, or gateway and the Cisco IOS-XR software running on it contain extensive features. You can find documentation for Cisco IOS-XR software features at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/

Cisco IOS-XR Release 3.2.0 Software Publications

Documentation for Cisco IOS-XR Release 3.2.0, including release notes and system error messages, can be found at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/iosxr3/index.htm

Document Conventions

Within the SIP and SPA software configuration guides, the term *router* is generally used to refer to a variety of Cisco products (for example, routers, access servers, and switches). Routers, access servers, and other networking devices that support Cisco IOS-XR software are shown interchangeably within examples. These products are used only for illustrative purposes; that is, an example that shows one product does not necessarily indicate that other products are not supported.

This documentation uses the following conventions:

Convention	Description
^ or Ctrl	The ^ and Ctrl symbols represent the Control key. For example, the key combination ^D or Ctrl-D means hold down the Control key while you press the D key. Keys are indicated in capital letters but are not case sensitive.
string	A string is a nonquoted set of characters shown in italics. For example, when setting an SNMP *community* string to *public*, do not use quotation marks around the string or the string will include the quotation marks.

Command syntax descriptions use the following conventions:

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

Nested sets of square brackets or braces indicate optional or required choices within optional or required elements. For example:

Convention	Description
[x {y | z}]	Braces and a vertical line within square brackets indicate a required choice within an optional element.

Examples use the following conventions:

Convention	Description
`screen`	Examples of information displayed on the screen are set in Courier font.
`bold screen`	Examples of text that you must enter are set in Courier bold font.
< >	Angle brackets enclose text that is not printed to the screen, such as passwords.

Convention	Description
!	An exclamation point at the beginning of a line indicates a comment line. (Exclamation points are also displayed by the Cisco IOS-XR software for certain processes.)
[ ]	Square brackets enclose default responses to system prompts.

The following conventions are used to attract the attention of the reader:

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

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

Obtaining Documentation

Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation at this URL:

http://www.cisco.com/univercd/home/home.htm

You can access the Cisco website at this URL:

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You can access international Cisco websites at this URL:

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

Documentation DVD

Cisco documentation and additional literature are available in a Documentation DVD package, which may have shipped with your product. The Documentation DVD is updated regularly and may be more current than printed documentation. The Documentation DVD package is available as a single unit.

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Cisco Ordering tool:

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Cisco Marketplace:

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

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You can find instructions for ordering documentation at this URL:

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Documentation Feedback

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You can submit comments by using the response card (if present) behind the front cover of your document or by writing to the following address:

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170 West Tasman Drive
San Jose, CA 95134-9883

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Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:

http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html

From this site, you can perform these tasks:

- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

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

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

http://www.cisco.com/en/US/products/products_psirt_rss_feed.html

Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies—security-alert@cisco.com
- Nonemergencies—psirt@cisco.com

Tip We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.*x* through 8.*x*.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

Cisco Technical Support Website

The Cisco Technical Support Website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, 365 days a year, at this URL:

http://www.cisco.com/techsupport

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

http://tools.cisco.com/RPF/register/register.do

Note Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID

or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

http://www.cisco.com/techsupport/servicerequest

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)
EMEA: +32 2 704 55 55
USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

http://www.cisco.com/techsupport/contacts

Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

Severity 1 (S1)—Your network is “down,” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Severity 2 (S2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Severity 3 (S3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Severity 4 (S4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:

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

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:

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- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

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

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

  http://www.cisco.com/ipj

- World-class networking training is available from Cisco. You can view current offerings at this URL:

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

SIP and SPA Product Overview

This chapter provides an introduction to modular services cards (SIPs) and shared port adapters (SPAs). It includes the following sections:

For more hardware details for the specific SIP and SPAs that are supported on the Cisco XR 12000 Series Router, refer to the companion publication, *Cisco XR 12000 Series Router SIP and SPA Hardware Installation Guide, Release 3.2*.

Introduction to SIPs and SPAs

SIPs and SPAs are a new carrier card and port adapter architecture to increase modularity, flexibility, and density across Cisco Systems routers for network connectivity. This section describes the SIPs and SPAs and provides some guidelines for their use.

SPA Interface Processors

The following list describes some of the general characteristics of a SIP:

- A SIP is a carrier card that inserts into a router slot like a line card. It provides no network connectivity on its own.
- A SIP can contain two or more subslots, which are used to house one or more SPAs. The SPA provides interface ports for network connectivity.
- During normal operation the SIP should reside in the router fully populated either with functional SPAs in all subslots, or with a blank filler panel inserted in any empty subslots.
- SIPs support online insertion and removal (OIR) while SPAs are inserted in their subslots.

Shared Port Adapters

The following list describes some of the general characteristics of a SPA:

- A SPA is a modular type of port adapter that inserts into a subslot of a compatible SIP carrier card to provide network connectivity and increased interface port density. A SIP can hold one or more SPAs, depending on the SIP type.
- SPAs are available in the following sizes, as shown in Figure 1-1 and Figure 1-2:
  - Single-width, single-height SPA—Inserts into a single SIP subslot.
  - Single-width, double-height SPA—Inserts into two single, vertically aligned SIP subslots.
  - Double-width, single-height SPA—Inserts into a two single, horizontally aligned SIP subslots.
  - Double-width, double-height SPA—Inserts into all four SIP subslots, or the entire SPA enclosure.

Figure 1-1 Single-height and Double-height SPA Sizes

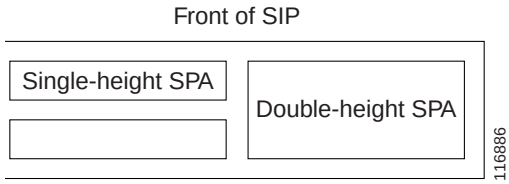
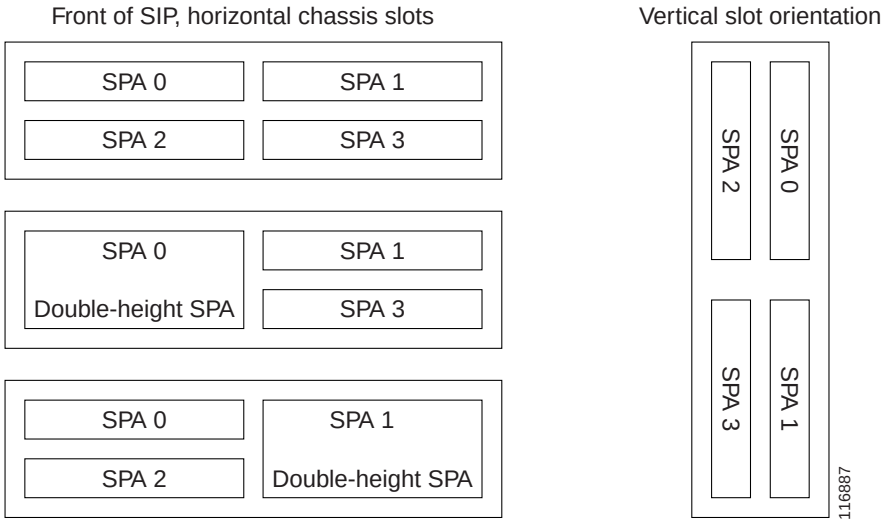


Figure 1-2 Horizontal and Vertical Chassis Slot Orientation for SPAs



- Each SPA provides a certain number of connectors, or ports, that are the interfaces to one or more networks. These interfaces can be individually configured within the Cisco IOS-XR command-line interface (CLI).
- Either a blank filler panel or a functional SPA should reside in every subslot of an SIP during normal operation.
- SPAs support online insertion and removal (OIR). They can be inserted or removed independently from the SIP. OIR of a SIP with installed SPAs is also supported.

SIP and SPA Compatibility

Table 1-1 shows the SIPs that are supported on the Cisco XR 12000 Series Router and the SPAs that they support:

Table 1-1 SIP and SPA Compatibility on the Cisco XR 12000 Series Router

SPA	10G SIP
1-Port 10-Gigabit Ethernet SPA	Yes
5-Port Gigabit Ethernet SPA	Yes
10-Port Gigabit Ethernet SPA	Yes
1-Port OC-192c/STM-64 POS/RPR XFP SPA	Yes

SPA Optics Compatibility

Table 1-2 shows the types of optics modules that have been qualified for use with a SPA:

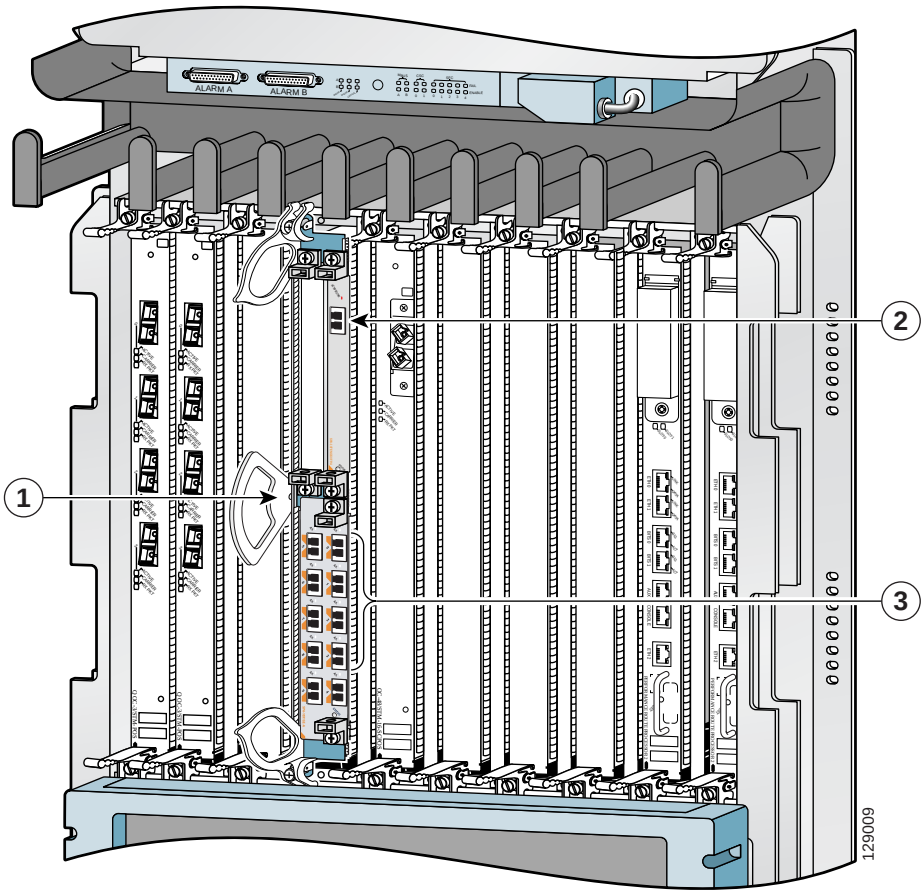
Table 1-2 SPA Optics Compatibility

SPA	Qualified Optics Modules
1-Port 10-Gigabit Ethernet SPA	• SFP-GE-S • SFP-GE-L • SFP-GE-Z
5-Port Gigabit Ethernet SPA	• SFP-GE-S • SFP-GE-L • SFP-GE-Z
10-Port Gigabit Ethernet SPA	• SFP-GE-S • SFP-GE-L • SFP-GE-Z
1-Port OC-192c/STM-64 POS/RPR XFP SPA	• XFP-10GLR-OC192SR

SPA Interface Addresses on Cisco XR 12000 Series Routers

A Cisco 12000 Series Router identifies a SPA interface address by its rack number, SIP slot number, SPA subslot, and port number on the SPA, in the format *rack/slot/subslot/port*. The rack number is always 0 for the Cisco 12000 Series Router. Slots, subslots and ports are numbered starting from 0, so each Cisco 12000 SIP-600 has two subslots 0 (left) and 1 (right). For example, the interface address of a 1-port SPA located in the second SIP subslot, where the SIP is inserted into router line card slot 3 is 0/3/2/0. Figure 1-3 shows the slot, subslot, and port locations for the 1-Port 10-Gigabit Ethernet SPA and the 10-Port Gigabit Ethernet SPA.

Figure 1-3 Slot, Subslot, and Port Locations for the 1-Port 10-Gigabit Ethernet SPA and 10-Port Gigabit Ethernet SPA



1	Slot 3
2	Subslot 0, Port 0/3/0/0
3	Subslot 1, Ports 0/3/1/0 to 0/3/1/9

SIP Software and Hardware Compatibility

For software configuration information, refer to the Cisco IOS XR software configuration and command reference publications for the installed Cisco IOS XR release. Also refer to the Cisco IOS XR software release notes for additional information. Table 1-3 lists the Cisco IOS XR releases that are compatible with supported SIPs.

To ensure compatibility with the software, your SIPs should have a specific hardware revision number. The number is printed on a label affixed to the component side of the card. The hardware revision number can be displayed by using the **show diags** *slot-number* command. Table 1-3 lists the hardware revision number for all supported SIPs.

Table 1-3 SIP Hardware and Software Compatibility

SIP	Part Number	Minimum Cisco IOS Software Release	Minimum Hardware Revision
Cisco 12000 SIP-600	12000-SIP-600	Release 3.2	1.0

The **show version** and **show platform** commands display the current hardware configuration of the router, including the system software version that is currently loaded and running. For complete descriptions of **show** commands, refer to the *Cisco CRS-1 Series Carrier Routing System Getting Started Guide* and the *Hardware Redundancy and Node Administration Commands on Cisco IOS XR Software* for the installed Cisco IOS XR release.

For instructions on getting started with Cisco IOS XR please refer to the *Cisco IOS XR Getting Started Guide* for the installed Cisco IOS XR release.

Overview of the Cisco XR 12000 Series Router SIPs

This chapter provides an overview of the release history, and feature and Management Information Base (MIB) support for the SPA interface processors (SIPs) supported on the Cisco XR 12000 Series Routers.

This chapter includes the following sections:

Release History

Table 2-1 describes the release history for the SIP hardware.

Table 2-1 Release History for SIP Hardware

Release	Modification
Cisco IOS-XR Release 3.2	Support for the following SIP hardware was introduced on the Cisco XR 12000 Series Routers: • Cisco 12000 SIP-600

Cisco 12000 SIP-600 Features

The Cisco 12000 SIP-600 provides a common 10 Gbps forwarding and queuing engine responsible for packet classification, forwarding, queuing, and accounting without compromising performance. The Cisco 12000 SIP-600 has two forwarding engines, one for ingress and one for egress. This allows the user to implement different features and QoS policies for the ingress and egress interfaces. The multicast replication is done by the egress forwarding engine, hence a very scalable multicast with built-in QoS.

The Modular Physical Layer Interface Module (PLIM) front end hosts up to 2 SPAs. Each SPA has a dedicated 10 Gbps interface to the SPA controller. The SPA controller uses a fair bandwidth allocation algorithm to share available and excess bandwidth between the 2 SPAs. The oversubscribed SPA does not cause any packet-drop on the nonoversubscribed SPA, and any unused bandwidth from one SPA is used by the other SPA.

The Cisco 12000 SIP-600 supports any combination of the following pluggable SPAs and Layer 2 encapsulations:

- Concatenated OC-192 and OC-48
- Gigabit Ethernet and 10 Gigabit Ethernet Interfaces
- Point to Point Protocol (PPP)
- High Level Data Link Control (HDLC)
- Frame Relay
- Dynamic Packet Transport (DPT)
- Resilient Packet Ring (RPR)
- 802.17
- VLANs

The SPA controller adapts the user traffic flowing between the SPA interfaces for the Layer 3 forwarding engine. The SPA controller has two levels of priority queuing with Deficit Round Robin (DRR) and Strict Priority Servicing. Strict Priority Servicing protects higher-priority packets by dropping lower priority packets first, in an oversubscribed configuration (persistent incoming traffic rate of 20 Gbps.)

The Cisco 12000 SIP-600 provides the following key features:

- Dynamic allocation of 4096 input-shaped queues to any interface, subinterface, Frame Relay connection, VLAN.
- Ingress Queuing:
  - 2048 unicast Modified DRR (MDRR) queues
  - 16 high priority queues
  - 8 multicast queues
  - 2 fabric priority queues
- Egress Queuing:
  - 8192 Modified DRR (MDRR) queues dynamically shared across 4096 interfaces;
  - Hierarchical shaping (interface, queue)
- High number of IPv4, IPv6, Multiprotocol Label Switching (MPLS), and MPLS VKPN unicast and multicast routes: Up to 1M IPv4/MPLS routes and up to 512,000 IPv6 prefixes.
- Per-VLAN/source-destination MAC address filtering, trunking, accounting, QoS, match VLAN QoS, Hot Standby Router Protocol (HSRP)/Virtual Router Redundancy Protocol (VRRP) hierarchical rate limiting and policing, dynamic queuing, and traffic shaping.
- Input and output full NetFlow Version 8 in hardware.
- Input and output Sampled NetFlow, Versions 5, 8, and 9 in hardware.
- Building Integrated Timing Supply (BITS)
- Online Insertion Removal (OIR) of SPAs; OIR of one SPA does not effect the traffic on other SPA interfaces.
- Multi-router Automatic Protection Switching (MR-APS)
- Layer 2 VPNs over MPLS (Any transport over MPLS (AToM)) and Over IP Layer 2 Tunneling Protocol Version 3 (L2TPv3)

Supported MIBs

The following MIBs are supported in Cisco IOS-XR Release 3.2 for the Cisco 12000 SIP-600 on a Cisco XR 12000 Series Router:

- IPv6 MIB
- ICMPv6 MIB
- IPv6 TCP MIB
- IPv6 UDP MIB
- SNMP v1, v2c, v3 (RFC 1157, 1901-07)
- MIB II, including interface extensions (RFC 1213, 2011-13, 2233)
- Cisco GSR Manager
- CiscoView
- ifIndex persistence
- 64-bit counters
- APS Extensions MIB
- ATM CON MIB
- ATM Forum Address MIB
- ATM Forum MIB
- ATM MIB
- BGP-4 MIB
- CAR MIB
- Cisco AAL5 MIB
- Cisco APS MIB
- Cisco ATM Extensions MIB
- Cisco BGP Policy Accounting MIB
- Cisco Bulk File MIB
- Cisco CAR MIB
- Cisco CDP MIB
- Cisco Class-Based QoS MIB (aka MQC MIB)
- Cisco Config Copy MIB
- Cisco Config Man MIB
- Cisco Enhanced MemPool MIB
- Cisco EnvMon MIB
- Cisco Flash MIB
- Cisco Frame Relay MIB
- Cisco FRU MIB
- Cisco FTP Client MIB
- Cisco HSRP Extensions MIB

- Cisco HSRP MIB
- Cisco IETF ATM2 PVCTRAP MIB
- Cisco Image MIB
- Cisco IP Statistics MIB
- Cisco IP Mroute MIB
- Cisco MDRR MIB
- Cisco Memory Pool MIN
- Cisco Optical Monitoring MIB
- Cisco PIM MIB
- Cisco Ping MIB
- Cisco Process MIB
- Cisco Queue MIB
- Cisco RTT Monitor MIB (SAA)
- Cisco SRP MIB
- Cisco Syslog MIB
- Cisco TCP MIB
- Cisco VLAN IFTABLE Relationship MIB
- Cisco WRED MIB
- DPT MIB
- DS1/E1 MIB
- DS3/E3 MIB
- Entity MIB
- Entity II MIB
- Ethernet MIB
- Ethernet RMON MIB
- Ether-like MIB
- Event MIB
- Expression MIB
- Fabric MIB
- Frame Relay MIB (IETF)
- Frame Relay DTE MIB
- HSRP MIB
- IF MIB
- IF MIB for VLANs
- IGMP MIB
- Interfaces MIB
- Int-Serv MIB
- Int-Serv Guaranteed MIB

- IP Mroute MIB
- MPLS MIB
- MPLS LDP MIB
- MPLS LSR MIB
- MPLS-TE MIB
- MPLS-TE Topo MIB
- MPLS-VPN MIB
- MPLS-DE-TE MIB
- MQC MIB
- MSDP MIB
- Old Cisco Chassis MIB
- Old Cisco CPU MIB
- Old Cisco Interfaces MIB
- Old Cisco IP MIB
- Old Cisco Memory MIB
- Old Cisco System MIB
- Old Cisco TCP MIB
- Old Cisco TS MIB
- OSPFv2 MIB
- PIM MIB
- PSA Microcode MIB
- RFC1213 MIB
- RFC1253 MIB
- RFC1315 MIB
- RFC1406 MIB
- RFC1407 MIB
- RFC1398 MIB
- RFC1595 MIB
- RMON MIB
- RS232C MIB
- RSVP MIB
- SNMP Framework MIB
- SNMP Target MIB
- SNMP USM MIB
- SNMP VACM MIB
- SNMPv2 MIB
- SNMP v3 MIB
- SONET/SDH MIB

- SONET Traps
- Syslog Trap Alert on DLCI loss
- TCP MIB
- UDP MIB
- WRED MIB

To locate and download MIBs for selected platforms, Cisco IOS-XR releases, and feature sets, use Cisco MIB Locator found at the following URL:

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

If Cisco MIB Locator does not support the MIB information that you need, you can also obtain a list of supported MIBs and download MIBs from the Cisco MIBs page at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

To access Cisco MIB Locator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

http://www.cisco.com/register

Displaying the SPA Hardware Type

To verify the SPA hardware type that is installed in your Cisco XR 12000 Series Router, you can use the **show inventory** command.

Table 2-2 shows the hardware description that appears in the **show** command output for each type of SPA that is supported on the Cisco XR 12000 Series Router.

Table 2-2 SPA Hardware Descriptions in show Commands

SPA	Description in show inventory Command
1-Port 10-Gigabit Ethernet SPA	SPA-1XTENGE-XFP
5-Port Gigabit Ethernet SPA	SPA-5XTENGE-XFP
10-Port Gigabit Ethernet SPA	SPA-10XGE-XFP
1-Port OC-192c/STM-64 POS/RPR XFP SPA	SPA-OC192POS

Example of the show inventory Command

The following example shows output from the **show inventory** command on a Cisco XR 12000 Series Router with a Cisco 12000 SIP-600 installed in slot 3:

```
RP/0/0/CPU0:x-21# show inventory
NAME: "0/0/CPU0", DESCR: "Cisco 12000 Series Performance Route Processor 2"
PID: PRP-2             , VID: N/A, SN: SAD0826025M

NAME: "0/3/CPU0", DESCR: "Cisco 12000 Series SPA Interface Processor-600 "
PID: 12000-SIP-600     , VID: N/A, SN: SAD073303F8

NAME: "0/3/0", DESCR: "1-Port OC192/STM64 POS/RPR XFP Optics"
PID: SPA-OC192POS-XFP  , VID: V01, SN: PRTA1204185

NAME: "0/3/1", DESCR: "1-port 10GbE Shared Port Adapter XFP based"
PID: SPA-1XTENGE-XFP   , VID: V01, SN: PRTA2104133
```

Cisco Systems

PART 1

Gigabit Ethernet Shared Port Adapters

Overview of the Gigabit Ethernet SPAs

This chapter provides an overview of the release history, and feature and Management Information Base (MIB) support for the Gigabit Ethernet SPAs on the Cisco XR 12000 Series Router.

This chapter includes the following sections:

Release History

Table 3-1 provides the release and modification history for Ethernet SPA-related features and enhancements on the Cisco XR 12000 Series Router.

Table 3-1 Release History for Ethernet SPA

Release	Modification
Cisco IOS-XR Release 3.2	Support for the following SPAs was introduced on Cisco XR 12000 Series Routers: • 1-Port 10-Gigabit Ethernet SPA • 5-Port Gigabit Ethernet SPA • 10-Port Gigabit Ethernet SPA

Supported Features

This section provides a list of some of the primary features supported with the Gigabit Ethernet.

Gigabit Ethernet SPA Features

The following is a list of some of the significant hardware and software features supported by the Gigabit Ethernet SPAs on the Cisco XR 12000 Series Routers:

- Auto negotiation
- Full-duplex operation
- 802.1Q VLAN termination
- Jumbo frames support (9188 bytes)
- Support for command-line interface (CLI) controlled OIR
- 802.3x flow control
- Up to 4K VLAN per SPA
- Up to 5K Mac Accounting Entries per SPA (Source Mac Accounting on the ingress and Destination Mac Accounting on the egress)
- Up to 2K MAC address entries for destination MAC address filtering per SPA, and up to 1K MAC address filtering entries per port
- Per port byte and packet counters for policy drops, oversubscription drops, CRC error drops, packet sizes, Unicast, multicast, and broadcast packets
- Per VLAN byte and packet counters for policy drops, oversubscription drops, Unicast, multicast, and broadcast packets
- Per-port byte counters for good bytes and dropped bytes
- Ethernet over Multi-protocol Label Switching (EoMPLS)
- Quality of service (QoS)
- Hot Standby Router Protocol (HSRP)
- Virtual Router Redundancy Protocol (VRRP)

Supported MIBs

The following MIBs are supported by the Gigabit Ethernet SPAs on the Cisco XR 12000 Series Routers:

- Entity-MIB (RFC 2737)
- Cisco-entity-asset-MIB
- Cisco-entity-field-replaceable unit (FRU)-control-MIB
- Cisco-entity-alarm-MIB
- Cisco-entity-sensor-MIB
- IF-MIB
- Etherlike-MIB (RFC 2665)

- Remote Monitoring (RMON)-MIB (RFC 1757)
- Cisco-class-based-QoS-MIB
- MPLS-related MIBs
- Ethernet MIB/RMON

To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:

http://tools.cisco.com/ITDIT/MIBS/servlet/index

If Cisco MIB Locator does not support the MIB information that you need, you can also obtain a list of supported MIBs and download MIBs from the Cisco MIBs page at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

To access Cisco MIB Locator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

http://www.cisco.com/register

SPA Architecture

This section provides an overview of the architecture of the Gigabit Ethernet SPAs and describes the path of a packet in the ingress and egress directions. Some of these areas of the architecture are referenced in the SPA software and can be helpful to understand when troubleshooting or interpreting some of the SPA CLI and **show** command output.

Every incoming and outgoing packet on the Gigabit Ethernet SPAs goes through the physical (PHY) SFP optics, Media Access Control (MAC), and ASIC devices.

Path of a Packet in the Ingress Direction

The following steps describe the path of an ingress packet through the Gigabit Ethernet SPAs:

1. The PHY SFP optics device receives incoming frames on a per-port basis from one of the laser optic interface connectors.
2. The PHY laser optics device processes the frame and sends it over the XAUI path to the MAC device.
3. The MAC device receives the frame, strips the CRCs, and sends the packet via the SPI 4.2 bus to the ASIC.
4. The ASIC takes the packet from the MAC devices and classifies the ethernet information. CAM lookups based on etype, port, VLAN, and source and destination address information determine whether the packet is dropped or forwarded to the SPA interface. If the packet is forwarded to the SPA interface, an 8-byte SHIM header that is used for additional downstream packet processing is propounded to the packet.

Path of a Packet in the Egress Direction

The following steps describe the path of an egress packet from the SIP through the Gigabit Ethernet SPA:

1. The packet is sent to the ASIC using the SPI 4.2 Bus. The packets are received with layer 2 and layer 3 headers in addition to the packet data.
2. The ASIC uses port number, destination MAC address, destination address type, and VLAN ID to perform parallel CAM lookups. If the packet is forwarded, it is forwarded via the SPI 4.2 Bus to the MAC device.

The MAC device forwards the packets to the PHY laser optic interface, which transmits the packet.

Displaying the SPA Hardware Type

To verify the SPA hardware type that is installed in your Cisco XR 12000 Series Router, you can use the **show interfaces** command. For more information about these commands, see Chapter 10, "Command Reference."

To verify the SPA hardware type that is installed in your Cisco XR 12000 Series Router, use the following commands:

- **show inventory**
- **show hw-module subslot brief**

Table 3-2 shows the hardware description that appears in the **show** command output for each type of Gigabit Ethernet SPA that is supported on Cisco XR 12000 Series Routers.

Table 3-2 SPA Hardware Descriptions in show Commands

SPA	Description in show commands
1-Port 10-Gigabit Ethernet SPA	Hardware is GigMac 1 Port 10 GigabitEthernet
5-Port Gigabit Ethernet SPA	Hardware is FiveGigE
10-Port Gigabit Ethernet SPA	Hardware is TenGigE

Example of the show inventory Command

The following example shows output from the **show inventory** command on a Cisco XR 12000 Series Router with an 1-Port 10-Gigabit Ethernet SPA installed in subslot 1 of the SIP in slot 3:

```
RP/0/0/CPU0:x-21#show inventory
NAME: "0/0/CPU0", DESCR: "Cisco 12000 Series Performance Route Processor 2"
PID: PRP-2 , VID: N/A, SN: SAD0826025M

NAME: "0/3/CPU0", DESCR: "Cisco 12000 Series SPA Interface Processor-600 "
PID: 12000-SIP-600 , VID: N/A, SN: SAD073303F8

NAME: "0/3/0", DESCR: "1-Port OC192/STM64 POS/RPR XFP Optics"
PID: SPA-OC192POS-XFP , VID: V01, SN: PRTA1204185

NAME: "0/3/1", DESCR: "1-port 10GbE Shared Port Adapter XFP based"
PID: SPA-1XTENGE-XFP , VID: V01, SN: PRTA2104133
```

Table 3-3 describes the significant fields shown in the display.

Table 3-3 show inventory Field Descriptions

Field	Description
NAME	Identifies the hardware for which the inventory information is displayed. If you are displaying raw inventory, this field shows the node name. For a node, the NAME is expressed in *rack*/*slot*/*subslot* notation.
DESCR	Node description. The description "1-port 10GbE Shared Port Adapter XFP base" indicates the 1-Port 10-Gigabit Ethernet SPA.
PID	Physical model name of the node.
VID	Physical hardware revision of the node.
SN	Physical serial number for the node.

Example of the show hw-module subslot Command

The following example shows output from the **show hw-module subslot brief** command on a Cisco XR 12000 Series Router with an 1-Port 10-Gigabit Ethernet SPA installed in subslot 1 of the Cisco 12000 SIP-600 in slot 3:

```
RP/0/0/CPU0:x-21#show hw-module subslot 0/3/cpu0 brief
Subslot 0/3/0 brief info:
-----------------------
SPA inserted: YES
SPA type: 1xOC192 POS/RPR HHSPA with XFP
SPA operational state: READY
SPA cfg admin up: YES

Subslot 0/3/1 brief info:
-----------------------
SPA inserted: YES
SPA type: 1x10GE XFP SPA
SPA operational state: READY
SPA cfg admin up: YES
```

Use the format **show hw-module subslot 0/3/cpu0 brief** to display information regarding all SPAs installed in the card in slot 3.

Table 3-4 describes the significant fields shown in the display.

Table 3-4 show hw-module subslot brief Field Descriptions

Field	Description
SPA inserted	Indicates if a SPA is currently detected in the subslot.
SPA type	Description of SPA including the technology type, number of ports, height of SPA (HHSPA—single height, FHSPA—double height), and optics type.
SPA operational state	Current state of the SPA module.
SPA cfg admin up	Configured state of the SPA: YES—the SPA is not shut down, NO—the SPA is shut down.

Configuring Ethernet SPAs on Cisco IOS XR Software

This chapter provides information about configuring Ethernet SPAs on the Cisco XR 12000 Series Router running Cisco IOS XR software. It includes the following sections:

For information about managing your system images and configuration files, refer to the *Cisco IOS XR Getting Started Guide, Release 3.2* and the *Cisco IOS XR Commands Master List, Release 3.2* publications.

For more information about the commands used in this chapter, see Chapter 10, "Command Reference" which documents new and modified commands and the *Cisco IOS XR Interface and Hardware Component Command Reference, Release 3.0*. For more information about accessing these publications, see the "Related Documentation" section in the "Preface".

Configuration Tasks

This section describes how to configure the Gigabit Ethernet SPAs. It includes the following topics:

Required Configuration Steps

This section lists the required configuration steps to configure the Gigabit Ethernet SPAs. Some of the required configuration commands have default values that might be appropriate for your network. If the default value is correct for your network, then you do not need to configure the command. These commands are indicated by "(Optional)" in the purpose column.

Note See the "Configuring a Basic Ethernet Interface" section on page 4-5 for detailed information regarding the parameters that can be configured.

SUMMARY STEPS

1. **show version**
2. **show interface**
3. **configure**
4. **interface** *type number*
5. **ipv4 address** *ip-address mask*
   or
   ipv6 address *ipv6-prefix/prefix-length*
6. **flow-control** {**bidirectional | egress | ingress**}
7. **negotiation auto**
8. **mac-accounting** {**egress** | **ingress**}
9. **mtu** *value*
10. **mac-address** *value1.value2.value3*
11. **no shutdown**
12. **end**
    or
    commit

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show version** **Example:** `RP/0/0/CPU0:Router> show version`	(Optional) Displays the current software version, and can also be used to confirm that the router recognizes the line card.
Step 2	**show interfaces** **Example:** `RP/0/0/CPU0:Router> show interface`	(Optional) Displays the configured interface and checks the status of each interface port.
Step 3	**configure** **Example:** `RP/0/0/CPU0:Router> configure terminal`	Enters global configuration mode.
Step 4	**interface** *type number* **Example:** `RP/0/0/CPU0:Router(config)# interface gigabitethernet 0/2/0/1`	Enters interface configuration mode, where: • *type*—Specifies **gigabitethernet** for the Gigabit Ethernet SPAs. • *number*—Specifies the Ethernet interface in the notation *rack*/*slot*/*module*/*port*. The example indicates Gigabit Ethernet interface 1, on a SPA in subslot 0, in line card slot 2.

	Command or Action	Purpose
Step 5	**ipv4 address** *ip-address mask* or **ipv6 address** *ipv6-prefix/prefix-length* **Example:** `RP/0/0/CPU0:Router(config-if)# ipv4 address 172.18.189.38 255.255.255.224` or `RP/0/0/CPU0:Router(config-if)# ipv6 address 3000:1116::1:3:300:1/112`	Assigns an IP address to the interface, where: • *ip-address mask*—Specifies an IPv4 IP address and subnet mask. • *ipv6-prefix/prefix-length*—Specifies an IPv6 network address and prefix length.
Step 6	**flow-control** {**bidirectional** | **egress** | **ingress**} **Example:** `RP/0/0/CPU0:Router(config-if)# flow control ingress`	(Optional) Enables the sending of flow control pause frames.
Step 7	**negotiation auto** **Example:** `RP/0/0/CPU0:Router(config-if)# negotiation auto`	(Optional) Enables autonegotiation of the interface with the connected interface.
Step 8	**mac-accounting** {**egress** | **ingress**} **Example:** `RP/0/0/CPU0:Router(config-if)# mac-accounting egress`	(Optional) Generates accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces. • To disable MAC accounting, use the **no** form of this command.
Step 9	**mtu** *value* **Example:** `RP/0/0/CPU0:Router(config-if# mtu 1448`	(Optional) Sets the MTU value for the interface. • The default is 1514 for normal frames and 1518 for 802.1Q tagged frames.
Step 10	**mac-address** *value1.value2.value3* **Example:** `RP/0/0/CPU0:Router(config-if)# mac address 0001.2468.ABCD`	(Optional) Sets the MAC layer address of the management Ethernet interface. • The values are the high, middle, and low 2 bytes, respectively, of the MAC address in hexadecimal. The range of each 2-byte value is 0 to ffff.

	Command or Action	Purpose
Step 11	**no shutdown** **Example:** `RP/0/0/CPU0:Router(config-if)# no shutdown`	Removes the shutdown configuration, which forces an interface administratively down. • The **no shutdown** command passes an **enable** command to the SPA, which then returns to an up or a down state depending on the configuration and state of the link.
Step 12	**end** or **commit** **Example:** `RP/0/0/CPU0:Router(config-if)# end` or `RP/0/0/CPU0:Router(config-if)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

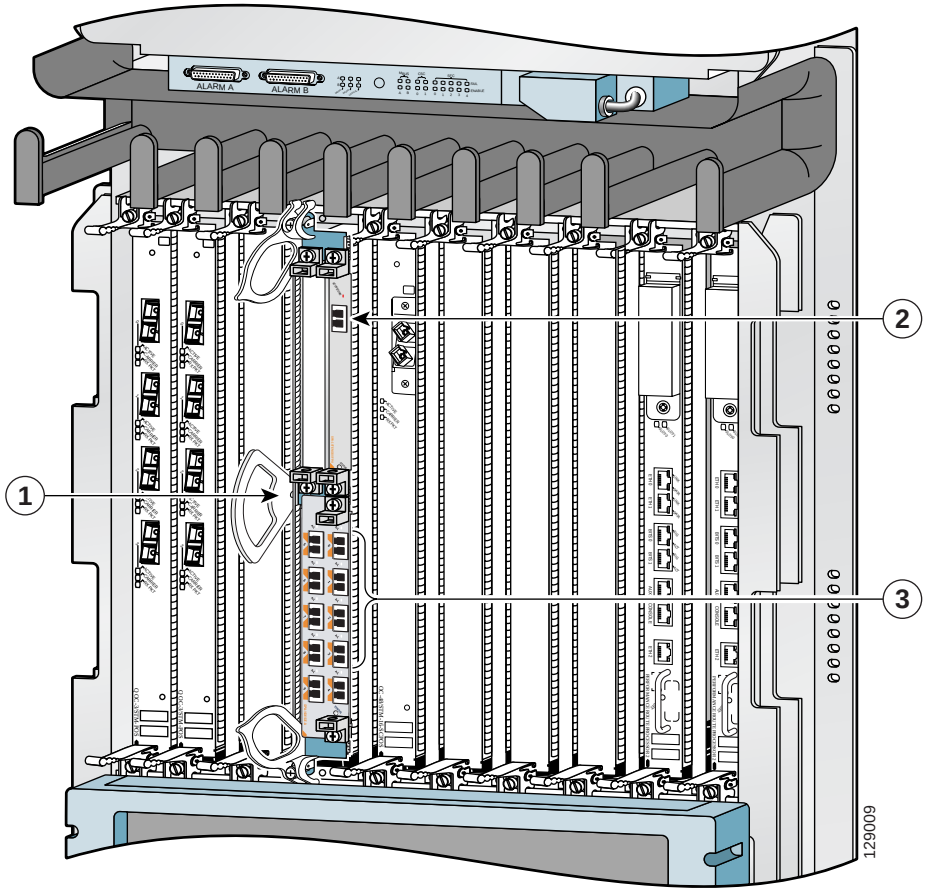
Specifying the Interface Address

SPAs on Cisco XR 12000 Series Routers running Cisco IOS XR software use an addressing format that specifies the physical location of the SIP, SPA, and interface. The interface address format is *rack*/*slot*/*subslot*/*port*:

- *rack*—Specifies the rack number, 0 for the Cisco XR 12000 Series Router.
- *slot*—Specifies the slot number in the Cisco XR 12000 Series Router in which the MSC that contains the SPA is installed.
- *subslot*—Specifies the secondary slot on the MSC where the SPA that you want to select is installed.
- *port*—Specifies the interface number that you want to select on the SPA:
  - For the 1-Port 10-Gigabit Ethernet SPA—0 is the only option.
  - For the 10-Port Gigabit Ethernet SPA—0 through 9
  - For the 5-Port Gigabit Ethernet SPA—0 through 4

Figure 4-1 shows the slot, subslot, and interface port locations of the 1-Port 10-Gigabit Ethernet SPA and 10-Port Gigabit Ethernet SPA installed in the SIP located in slot 3.

Figure 4-1 Slot, Subslot, and Port Locations on the Cisco 12000 SIP-600



1	Router slot number 3	**3**	SPA subslot 1 with ports 0/3/1/0 to 0/3/1/9
2	SPA subslot number 0 with port 0/3/0/0		

For more information about the installation of cards on the Cisco XR 12000 Series Router, refer to the *Cisco 12000 Series Router SIP and SPA Hardware Installation Guide*.

Configuring a Basic Ethernet Interface

To configure Gigabit Ethernet interfaces you need to understand the following concepts:

- Ethernet Technology Overview, page 4-6
- Default Configuration Values, page 4-6
- Gigabit Ethernet Protocol Standards Overview, page 4-6
- MAC Accounting, page 4-7
- Ethernet MTU, page 4-7

Ethernet Technology Overview

Ethernet was developed in the mid-1970s as a 10-Mbps networking protocol operating over a heavy coax cable.

Today, although many networks have migrated to Fast Ethernet (100 Mbps), Gigabit Ethernet (1000 Mbps), and 10-Gigabit Ethernet (10 Gbps), 10-Mbps Ethernet is still in widespread use and forms the basis of most networks.

Ethernet is defined by the IEEE 802.3 international standard. It enables the connection of up to 1024 nodes over coax, twisted-pair, or fiber-optic cable.

Default Configuration Values

When an interface is enabled on an Ethernet SPA and associated SIP, the following default interface configuration parameters are present. See Table 4-1.

Note You must specifically configure the **shutdown** command to bring an interface administratively down. The interface default is **no shutdown**. When a SPA and SIP are first inserted into the router, if there is no established preconfiguration for it, the configuration manager adds a shutdown item to its configuration. This shutdown can be removed only by entering the **no shutdown** command.

Table 4-1 Ethernet SPA Default Configuration Values

Parameter	Configuration File Entry	Default Value
MAC Accounting	mac-accounting	off
Flow Control		off
MTU	mtu	1514 for normal interfaces, 1518 for 802.1Q VLAN
MAC Address	mac address	Hardware burned in address (BIA)

Gigabit Ethernet Protocol Standards Overview

IEEE 802.3ab 1000BASE-T Gigabit Ethernet

The IEEE 802.3ab protocol standards, or Gigabit Ethernet over copper (also known as 1000BaseT) is an extension of the existing Fast Ethernet standard. It specifies Gigabit Ethernet operation over the Category 5e/6 cabling systems already installed, making it a highly cost-effective solution. As a result, most copper-based environments that run Fast Ethernet can also run Gigabit Ethernet over the existing network infrastructure in order to dramatically boost network performance for demanding applications.

IEEE 802.3z 1000 Mbps Gigabit Ethernet

Gigabit Ethernet builds on top of the Ethernet protocol, but increases speed tenfold over Fast Ethernet to 1000 Mbps, or 1 Gbps. Gigabit Ethernet allows Ethernet to scale from 10 or 100 Mbps at the desktop to 100 Mbps up to 1000 Mbps in the data center. Gigabit Ethernet conforms to the IEEE 802.3z protocol standard.

By leveraging the current Ethernet standard and the installed base of Ethernet and Fast Ethernet switches and routers, network managers do not need to retrain and relearn a new technology in order to provide support for Gigabit Ethernet.

IEEE 802.3ae 10 Gbps Ethernet

Under the International Standards Organization's Open Systems Interconnection (OSI) model, Ethernet is fundamentally a Layer 2 protocol. 10-Gigabit Ethernet uses the IEEE 802.3 Ethernet MAC protocol, the IEEE 802.3 Ethernet frame format, and the minimum and maximum IEEE 802.3 frame size. 10 Gbps Ethernet conforms to the IEEE 802.3ae protocol standards.

Just as 1000BASE-X and 1000BASE-T (Gigabit Ethernet) remained true to the Ethernet model, 10-Gigabit Ethernet continues the natural evolution of Ethernet in speed and distance. Because it is a full-duplex only and fiber-only technology, it does not need the carrier-sensing multiple-access with collision detection (CSMA/CD) protocol that defines slower, half-duplex Ethernet technologies. In every other respect, 10-Gigabit Ethernet remains true to the original Ethernet model.

MAC Accounting

The MAC address accounting feature provides accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces. This feature calculates the total packet and byte counts for a LAN interface that receives or sends IP packets to or from a unique MAC address. It also records a time stamp for the last packet received or sent.

Ethernet MTU

A maximum transmission unit (MTU) is the largest size packet or frame, specified in octets (eight-bit bytes), that can be sent in a packet- or frame-based network such as the Internet. The Internet's TCP uses the MTU to determine the maximum size of each packet in any transmission. Too large an MTU size may mean retransmissions if the packet encounters a router that can't handle the large packet. Too small an MTU size means relatively more header overhead and more acknowledgements that have to be sent and handled. Most computer operating systems provide a default MTU value that is suitable for most users. The default value is 1514 for standard frames and 1518 for 802.1Q tagged frames. These numbers exclude the 4 byte frame check sequence (FCS).

Flow Control on Ethernet Interfaces

The flow control used on Gigabit Ethernet interfaces consists of periodically sending flow control pause frames. It is fundamentally different from the usual full- and half-duplex flow control used on standard management interfaces. Flow control can be activated for either ingress traffic, egress traffic or bi-directional traffic. Flow control by default is not activated on SPA Gigabit Ethernet interfaces.

Some hardware has restrictions on how flow-control can be configured. If you attempt to configure a method of flow-control that is not supported, an error is returned at configuration verification. The current operational flow control settings can be displayed using the **show interfaces** command.

MAC Address

A MAC address is a 6-byte-long hardware address that uniquely identifies each node of a network.

802.1Q VLAN

A VLAN is a group of devices on one or more LANs that are configured so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. Because VLANs are based on logical instead of physical connections, it is very flexible for user and host management, bandwidth allocation, and resource optimization.

The IEEE's 802.1Q protocol standard addresses the problem of breaking large networks into smaller parts so broadcast and multicast traffic does not consume more bandwidth than necessary. The standard also helps provide a higher level of security between segments of internal networks.

The 802.1Q specification establishes a standard method for inserting VLAN membership information into Ethernet frames.

VRRP

The Virtual Router Redundancy Protocol (VRRP) eliminates the single point of failure inherent in the static default routed environment. VRRP specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the VPN concentrators on a LAN. The VRRP VPN concentrator controlling the IP addresses associated with a virtual router is called the Master, and forwards packets sent to those IP addresses. When the master becomes unavailable, a backup VPN concentrator takes the place of the master.

For more information on VRRP, refer to the *"Implementing VRRP on Cisco IOS XR Software"* module of the *Cisco IOS XR IP Addresses and Services Configuration Guide.*

HSRP

Hot Standby Routing Protocol (HSRP) is a proprietary protocol from Cisco. HSRP is a routing protocol that provides backup to a router in the event of failure. Several routers are connected to the same segment of an Ethernet, FDDI, or token-ring network and work together to present the appearance of a single virtual router on the LAN. The routers share the same IP and MAC addresses and therefore, in the event of failure of one router, the hosts on the LAN are able to continue forwarding packets to a consistent IP and MAC address. The transfer of routing responsibilities from one device to another is transparent to the user.

HSRP is designed to support non disruptive failover of IP traffic in certain circumstances and to allow hosts to appear to use a single router and to maintain connectivity even if the actual first hop router they are using fails. In other words, HSRP protects against the failure of the first hop router when the source host cannot learn the IP address of the first hop router dynamically. Multiple routers participate in HSRP and in concert create the illusion of a single virtual router. HSRP ensures that one and only one of the routers is forwarding packets on behalf of the virtual router. End hosts forward their packets to the virtual router.

The router forwarding packets is known as the *active router.* A standby router is selected to replace the active router should it fail. HSRP provides a mechanism for determining active and standby routers, using the IP addresses on the participating routers. If an active router fails a standby router can take over without a major interruption in the host's connectivity.

HSRP runs on top of User Datagram Protocol (UDP), and uses port number 1985. Routers use their actual IP address as the source address for protocol packets, not the virtual IP address, so that the HSRP routers can identify each other.

For more information on HSRP, refer to the *"Implementing HSRP on Cisco IOS XR Software"* module of the *Cisco IOS XR IP Addresses and Services Configuration Guide.*

Verifying the Interface Configuration

Use the following task to display your router configuration settings.

SUMMARY STEPS

1. **show interfaces** *type number*
2. **show mac-accounting** *type number* [**location** *node-id*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show interfaces** *type number* **Example:** `RP/0/0/CPU0:Router# show interfaces gigabitethernet 0/2/0/0`	(Optional) Displays statistics for an interface, where: • *type*—Specifies **gigabitethernet** for the Gigabit Ethernet SPAs. • *number*—Specifies the Ethernet interface in the notation *rack*/*slot*/*module*/*port*.
Step 2	**show mac-accounting** *type number* [**location** *node-id*] **Example:** `RP/0/0/CPU0:Router# show mac-accounting gigabitethernet 0/2/0/0`	Displays MAC accounting statistics for an interface, where: • *type*—Specifies **gigabitethernet** for the Gigabit Ethernet SPA. • *number*—Specifies the Ethernet interface in the notation *rack*/*slot*/*module*/*port*.

Configuration Examples

This section contains the following examples:

Configuring an Ethernet Interface Example

The following example indicates how to configure an interface for the Gigabit Ethernet SPA:

```
RP/0/0/CPU0:Router# configure
RP/0/0/CPU0:Router(config)# interface gigabitethernet 0/2/0/0
RP/0/0/CPU0:Router(config-if)# ipv4 address 172.18.189.38 255.255.255.224
RP/0/0/CPU0:router(config-if)# flow-control ingress
RP/0/0/CPU0:Router(config-if)# mtu 1448
RP/0/0/CPU0:Router(config-if)# mac-address 0000.0c00.e8bb
RP/0/0/CPU0:Router(config-if)# no shutdown
RP/0/0/CPU0:Router(config-if)# end
Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:yes
LC/0/2/CPU0:Feb 13 03:47:44.622 : ifmgr[137]: %PKT_INFRA-LINK-3-UPDOWN : Interface
GigabitEthernet0/2/0/0, changed state to Up
RP/0/0/CPU0:Feb 13 03:47:45.010 : config[65730]: %MGBL-LIBTARCFG-6-COMMIT : Configuration
committed by user 'xxx'.   Use 'show commit changes 1000012264' to view the changes.
RP/0/0/CPU0:Feb 13 03:47:45.091 : config[65730]: %MGBL-SYS-5-CONFIG_I : Configured from
console by xxx
RP/0/0/CPU0:Router# show interfaces gigabitethernet 0/2/0/0

GigabitEthernet0/2/0/0 is up, line protocol is up

  Hardware is GigabitEthernet, address is 0000.0c00.e8bb (bia 0000.0c00.e8bb)
  Internet address is 172.18.189.38/27
  MTU 1448 bytes, BW 1000000 Kbit
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA,
  Full-duplex, 1000Mb/s, SX, link type is force-up
  output flow control is off, input flow control is on
  loopback not set
  Last clearing of "show interface" counters never
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 0 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1 packets output, 46 bytes, 0 total output drops
     Output 0 broadcast packets, 0 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Configuring MAC Accounting Example

The following example indicates how to configure MAC-accounting on an Ethernet interface:

```
RP/0/0/CPU0:Router# config
RP/0/0/CPU0:Router(config)# gigabitethernet 0/0/0/2
RP/0/0/CPU0:Router(config-if)# ipv4 address 172.18.189.38 255.255.255.224
RP/0/0/CPU0:Router(config-if)# mac-accounting egress
RP/0/0/CPU0:Router(config-if)# commit
RP/0/0/CPU0Sep 19 20:21:11.330 : config[65726]: %LIBTARCFG-6-COMMIT : Configuration
committed by user 'unknown'.   Use 'show commit changes 1000003461' to view the changes.
RP/0/0/CPU0:Router(config-if)# exit
RP/0/0/CPU0:Router(config)# exit
```

PART 2

Packet over SONET Shared Port Adapters

Overview of Packet over SONET SPAs

This chapter provides an overview of the release history, and feature and Management Information Base (MIB) support for a Cisco XR 12000 Series Router with the 1-Port OC-192c/STM-64 POS/RPR XFP SPA.

This chapter includes the following sections:

Release History

Table 5-1 describes the hardware release history for the Cisco XR 12000 Series Router.

Table 5-1 Hardware Release History

Release	Modification
Cisco IOS Release 3.2	Support for the following hardware was introduced on the Cisco XR 12000 Series Router: • Cisco 12000 SIP-600 • 1-Port OC-192c/STM-64 POS/RPR XFP SPA

Supported Features

This section provides a list of some of the primary features supported by the SIP and SPA hardware and software.

Cisco 12000 SIP-600 Features

- Online insertion and removal (OIR)
- High Availability (HA) support—Route Processor Redundancy (RPR) mode support

Although the default HA mode is Stateful Switchover (SSO) on a Cisco XR 12000 Series Router, the router automatically falls back to RPR mode for unsupported devices. Therefore, RPR is used with the SIP on a Cisco XR 12000 Series Router, and no additional configuration is required to implement HA with a SIP on a Cisco XR 12000 Series Router.

More information about HA on the Cisco 7304 router can be found at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios122s/122snwft/release/122s18/12e_rpr.htm

- Field Programmable Gate Array (FPGA) upgrade support

  The Cisco 12000 SIP-600 supports the standard FPGA upgrade methods for the Cisco XR 12000 Series Router. For more information about FPGA support, see Chapter 7, "Upgrading Field-Programmable Devices."
- Hot Standby Router Protocol (HSRP) and Virtual Router Redundancy Protocol (VRRP) support
- NetFlow switching
- QoS features supported by the NSE-100 and NPE-G100
- Network-Based Application Recognition (NBAR) with the NPE-G100
- Access control lists (ACLs)
- IPv4 and PCv6 support.

1-Port OC-192c/STM-64 POS/RPR XFP SPA Features

The following is a list of some of the significant hardware and software features supported by the 1-Port OC-192c/STM-64 POS/RPR XFP SPA:

- Terminates and generates SONET/SDH section, line, and path overheads
- Supports HDLC/PPP framed packets
- Packet mapping conforms to RFC 1619 and RFC 1662 for Packet-over-SONET applications
- Internal buffering to absorb short bursts of data traffic at the bus interface
- IPv4 and IPv6 support
- Counter and alarm capabilities for management support
- Local (internal) and external loopback
- Per interface port counters
- Multiprotocol label switching (MPLS)
- Simple Network Management Protocol (SNMP) Management Information Base (MIB) counters
- Field Programmable Gate Array (FPGA) upgrade support

Restrictions

As of Cisco IOS Release 12.0S, the 1-Port OC-192c/STM-64 POS/RPR XFP SPA does not support the following features:

- RSP/SRP

Supported MIBs

The following MIBs are supported in Cisco IOS Release 12.2(20)S1 for the 1-Port OC-192c/STM-64 POS/RPR XFP SPA on the Cisco XR 12000 Series Router:

- CISCO-ENTITY-ASSET-MIB
- CISCO-EXTENDED ENTITY-MIB
- CISCO-OPTICAL-MIB
- ENTITY-MIB
- IF-MIB
- SONET-MIB RFC 2558

To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:

http://tools.cisco.com/ITDIT/MIBS/servlet/index

If Cisco MIB Locator does not support the MIB information that you need, you can also obtain a list of supported MIBs and download MIBs from the Cisco MIBs page at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

To access Cisco MIB Locator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

http://www.cisco.com/register

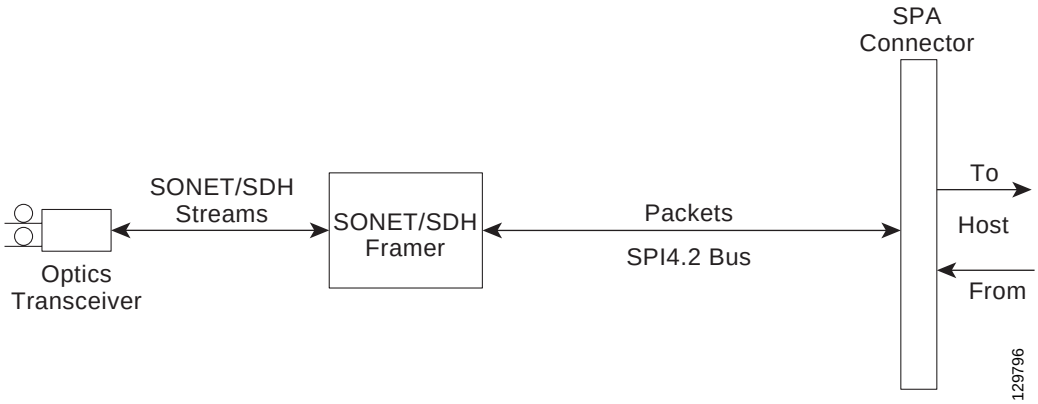
SPA Architecture

This section provides an overview of the architecture of the POS SPAs and describes the path of a packet in the ingress and egress directions. Some of these areas of the architecture are referenced in the SPA software and can be helpful to understand when troubleshooting or interpreting some of the SPA CLI and **show** command output.

1-Port OC-192c/STM-64 POS/RPR XFP SPA Architecture

Figure 5-1 identifies the primary hardware devices that are part of the POS 1-Port OC-192c/STM-64 POS/RPR XFP SPA architecture.

Figure 5-1 1-Port OC-192c/STM-64 POS/RPR XFP SPA Architecture



In POS mode, every incoming and outgoing packet on the 1-Port OC-192c/STM-64 POS/RPR XFP SPA goes through the SONET/SDH framer, and the SPI4.2 interface.

Path of a Packet in the Ingress Direction

The following steps describe the path of an ingress packet through the 1-Port OC-192c/STM-64 POS/RPR XFP SPA (see Figure 5-1):

1. The framer receives SONET/SDH streams from the XFP optics, extracts clocking and data, and processes the section, line, and path overhead.
2. The framer extracts the POS frame payload and verifies the frame size and frame check sequence (FCS).
3. The framer passes valid frames to the System Packet Level Interface 4.2 (SPI4.2) interface on the SPA.
4. The SPI4.2 interface transfers frames to the host through the SPI4.2 bus for further processing and switching.

Path of a Packet in the Egress Direction

The following steps describe the path of an egress packet through the 1-Port OC-192c/STM-64 POS/RPR XFP SPA (see Figure 5-1):

1. The host sends packets to the SPA using the SPI4.2 bus.
2. The SPA stores the data in the appropriate channel's first-in first-out (FIFO) queue.
3. The SPA passes the packet to the framer.
4. The framer accepts the data and stores it in the appropriate channel queue.
5. The framer adds the FCS and SONET/SDH overhead.
6. The framer sends the data to the XFP optics for transmission onto the network.

Displaying the SPA Hardware Type

To verify the SPA hardware type that is installed in your Cisco XR 12000 Series Router, you can use the **show interfaces** command or the **show controllers** command. There are several other commands on the Cisco XR 12000 Series Router that also provide SPA hardware information.

To verify the SPA hardware type that is installed in your Cisco XR 12000 Series Router, you can use the following commands:

- **show inventory**
- **show hw-module subslot brief**

Table 5-2 shows the hardware description that appears in the **show** command output for each type of SPA that is supported on the Cisco XR 12000 Series Router.

Table 5-2 SPA Hardware Description in show Commands

SPA	Description in show commands
1-Port OC-192c/STM-64 POS/RPR XFP SPA	"Hardware is Packet over Sonet"

Example of the show inventory Command

The following example shows output from the **show inventory** command on a Cisco XR 12000 Series Router with a 1-Port OC-192c/STM-64 POS/RPR XFP SPA installed in subslot 0 of the SIP in slot 3:

```
RP/0/0/CPU0:x-21#show inventory
NAME: "0/0/CPU0", DESCR: "Cisco 12000 Series Performance Route Processor 2"
PID: PRP-2 , VID: N/A, SN: SAD0826025M

NAME: "0/3/CPU0", DESCR: "Cisco 12000 Series SPA Interface Processor-600 "
PID: 12000-SIP-600 , VID: N/A, SN: SAD073303F8

NAME: "0/3/0", DESCR: "1-Port OC192/STM64 POS/RPR XFP Optics"
PID: SPA-OC192POS-XFP , VID: V01, SN: PRTA1204185

NAME: "0/3/1", DESCR: "1-port 10GbE Shared Port Adapter XFP based"
PID: SPA-1XTENGE-XFP , VID: V01, SN: PRTA2104133
```

Table 5-3 describes the significant fields shown in the display.

Table 5-3 show inventory Field Descriptions

Field	Description
NAME	Identifies the hardware for which the inventory information is displayed. If you are displaying raw inventory, this field shows the node name. For a node, the NAME is expressed in *rack*/*slot*/*subslot* notation.
DESCR	Node description. The description "1-Port OC192/STM64 POS/RPR XFP Optics" indicates the 1-Port OC-192c/STM-64 POS/RPR XFP SPA.
PID	Physical model name of the node.
VID	Physical hardware revision of the node.
SN	Physical serial number for the node.

Example of the show hw-module Command

The following example shows output from the **show hw-module subslot brief** command on a Cisco XR 12000 Series Router with a 1-Port OC-192c/STM-64 POS/RPR XFP SPA installed in subslot 0:

```
RP/0/0/CPU0:x-21#show hw-module subslot 0/3/cpu0 brief
Subslot 0/3/0 brief info:
-------------------------
SPA inserted: YES
SPA type: 1xOC192 POS/RPR HHSPA with XFP
SPA operational state: READY
SPA cfg admin up: YES

Subslot 0/3/1 brief info:
-------------------------
SPA inserted: YES
SPA type: 1x10GE XFP SPA
SPA operational state: READY
SPA cfg admin up: YES
```

Table 5-4 describes the significant fields shown in the display.

Table 5-4 show hw-module subslot brief Field Descriptions

Field	Description
SPA inserted	Indicates if a SPA is currently detected in the subslot.
SPA type	Description of SPA including the technology type, number of ports, height of SPA (HHSPA—single height, FHSPA—double height), and optics type.
SPA operational state	Current state of the SPA module.
SPA cfg admin up	Configured state of the SPA: YES—the SPA is not shut down, NO—the SPA is shut down.

Configuring POS SPAs on Cisco IOS XR Software

This chapter provides information about configuring POS SPAs on the Cisco XR 12000 Series Router running Cisco IOS XR software. It includes the following sections:

For information about managing your system images and configuration files, refer to the *Cisco IOS XR Getting Started Guide* and the *Cisco IOS XR Commands Master List* publications.

For more information about the commands used in this chapter, see first Chapter 10, "Command Reference," which documents new and modified commands and the *Cisco IOS XR Interface and Hardware Component Command Reference*. For more information about accessing these publications, see the "Related Documentation" section in the "Preface".

Configuration Tasks

On Cisco IOS XR software, all physical POS ports are configured using a SONET controller. Therefore, the first step in a POS interface configuration is to configure the SONET controller.

All SONET-related configurations of a SONET-based physical port are grouped under the command-line interface (CLI) SONET controller configuration command mode prompt (config-sonet). All SONET path-related configuration commands are grouped under the CLI SONET path command mode (config-sonet-path).

When the SONET controller configuration is complete, the POS interfaces can be configured in interface configuration mode.

The following tasks are available for configuring POS interfaces:

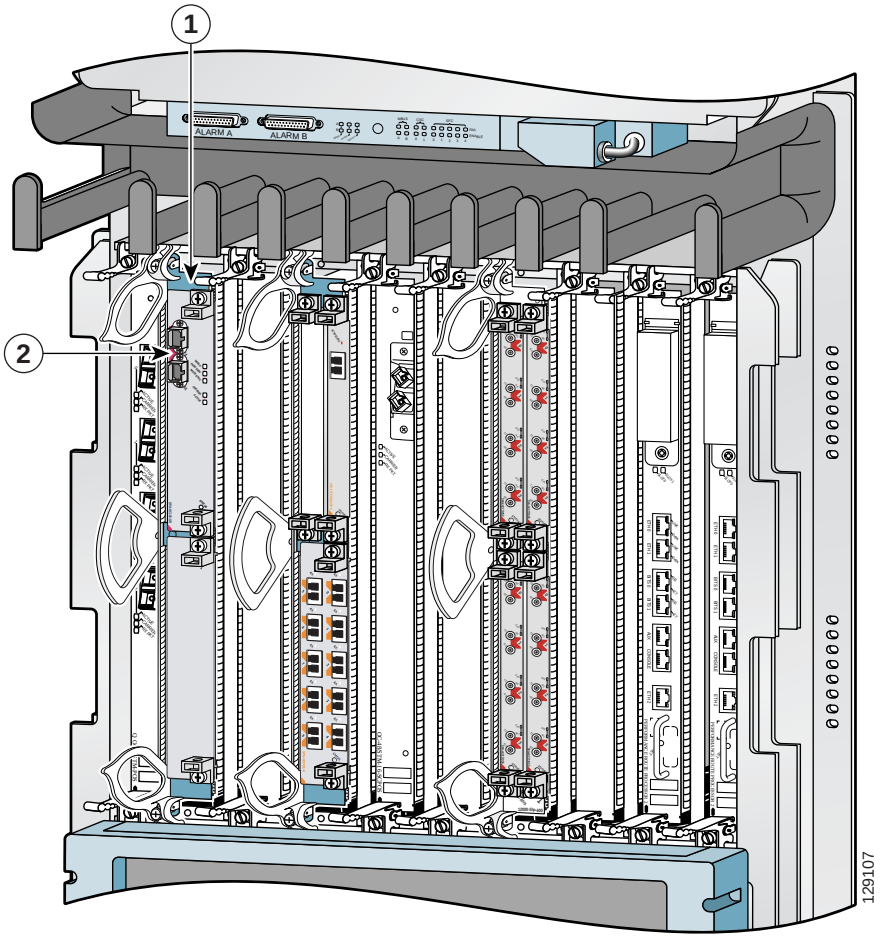
Specifying the Interface Address

SPAs on Cisco XR 12000 Series Routers running Cisco IOS XR software use an addressing format that specifies the physical location of the SPA interface processor (SIP), SPA, and interface. The interface address format is *rack*/*slot*/*subslot*/*port*:

- *rack*—Specifies the rack number, 0 for the Cisco XR 12000 Series Router.
- *slot*—Specifies the slot number in the Cisco XR 12000 Series Router in which the MSC that contains the SPA is installed.
- *subslot*—Specifies the secondary slot on the MSC where the SPA that you want to select is installed.
- *port*—Specifies the interface number that you want to select on the SPA:
  - For the 1-Port OC-192c/STM-64 POS/RPR XFP SPA—0 is the only option.

Figure 6-1 shows the slot, subslot, and interface port locations of the 1-Port OC-192c/STM-64 POS/RPR XFP SPA.

Figure 6-1 Slot, Subslot, and Port Locations for the 1-Port OC-192c/STM-64 POS/RPR XFP SPA



1	Router slot number 1	**2**	SPA subslot 0 with port 0/1/0/0

For more information about the installation of cards on the Cisco XR 12000 Series Router, refer to the *Cisco 12000 Series Router SIP and SPA Hardware Installation Guide*.

Configuring a SONET Controller

This task explains how to configure SONET controllers, as a prerequisite to configuring POS interfaces.

Summary Steps

1. **configure**
2. **controller sonet** *number*
3. **clock source** {**internal** | **line**}
4. **delay trigger line** *value*
5. **framing** {**sdh** | **sonet**}
6. **loopback** {**internal** | **line**}
7. **overhead** {**j0** | **s1s0e**} *byte-value*
8. **ais-shut**
9. **threshold** {**b1-tca** | **b2-tca** | **sd-ber** | **sf-ber**} *bit-error-rate*
10. **path** *keyword values*
11. **end**
    or
    commit
12. **show controllers sonet** *number*

Detailed Steps

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**controller sonet** *number* **Example:** `RP/0/0/CPU0:router(config)# controller sonet 0/4/1/0`	Enters SONET controller configuration submode, where: • *number*—Specifies the SONET controller number, which is the same as the associated POS interface, in the notation *rack*/*slot*/*module*/*port*.

	Command or Action	Purpose
Step 3	**clock source** {**internal** | **line**} **Example:** `RP/0/0/CPU0:router(config-sonet)# clock source internal`	(Optional) Configures the SONET port TX clock source, where: • **internal**—Sets the internal clock. Use this option when two routers are connected back-to-back or over fiber for which no clocking is available. • **line**—Sets the clock to be recovered from the line (default). Use this option whenever clocking is derived from the network.
Step 4	**delay trigger line** *value* **Example:** `RP/0/0/CPU0:router(config-sonet)# delay trigger line 0`	(Optional) Configures the SONET port delay trigger line value, where the trigger *value* can be 0–511 milliseconds and the default is 0.
Step 5	**framing** {**sdh** | **sonet**} **Example:** `RP/0/0/CPU0:router(config-sonet)# framing sonet`	(Optional) Configures the controller framing, where: • **sdh**—Specifies Synchronous Digital Hierarchy (SDH) framing. • **sonet**—Specifies SONET framing (default).
Step 6	**loopback** {**internal** | **line**} **Example:** `RP/0/0/CPU0:router(config-sonet)# loopback internal`	(Optional) Configures the SONET controller for loopback where • **internal**—Selects internal (terminal) loopback. • **line**—Selects line (facility) loopback.
Step 7	**overhead** {**j0** | **s1s0**} *byte-value* **Example:** `RP/0/0/CPU0:router(config-sonet)# overhead s1s0`	(Optional) Configures the controller's overhead where • **j0**—Specifies the synchronous transfer signal (STS) identifier (J0/C1) byte (default is 0xcc). • **s1s0**—Specifies bits s1 and s0 of H1 byte (default is 0).
Step 8	**ais-shut** **Example:** `RP/0/0/CPU0:router(config-sonet)# ais-shut`	(Optional) Configures the automatic insertion of a line alarm indication signal (LAIS) in the sent SONET signal whenever the SONET port enters the administrative shutdown state.
Step 9	**threshold** {**b1-tca** | **b2-tca** | **sd-ber** | **sf-ber**} *bit-error-rate* **Example:** `RP/0/0/CPU0:router(config-sonet)# threshold b1-tca 4`	(Optional) Configures the bit-error rate (BER) threshold values of the specified alarms for a SONET controller.

	Command or Action	Purpose
Step 10	**path** *keyword* [*values*] **Example:** `RP/0/0/CPU0:router(config-sonet)# path delay trigger 25`	(Optional) Configures SONET controller path values. Keyword definitions are as follows: • **ais-shut**—Sets sending path alarm indication signal (PAIS) when shut down. • **delay trigger**—Sets SONET path delay trigger value, which can be 0–511 milliseconds (default 0). • **overhead**—Sets SONET POH byte or bit values where **c2** specifies STS synchronous payload envelope (SPE) content (C2) byte, and **j1** configures the SONET path trace (J1) buffer. • **report**—Sets SONET path alarm reporting. Specifies which alarms are reported and which bit error rate (BER) thresholds will signal an alarm. The following keywords can be used: – **b3-tca** sets B3 BER threshold crossing alert (TCA) reporting status – **pais** sets PAIS reporting status – **plop** sets path loss of pointer reporting status – **prdi** sets path remote defect indication reporting status – **puneq** sets path unequipped defect indication reporting status • **scrambling**—Disables SPE scrambling with keyword **disable**. • **threshold**—Sets SONET path BER threshold value to 3–9; bit error rate (10 to the minus *x*) (where the default is 6). • **uneq-shut—**Sets sending unequipped (UNEQ) when shut down.

	Command or Action	Purpose
Step 11	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-sonet)# end` or `RP/0/0/CPU0:router(config-sonet)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 12	**show controllers sonet** *number* **Example:** `RP/0/0/CPU0:router# show controllers sonet 0/1/0/0`	Verifies the SONET controller configuration.

Configuring SONET APS

This task explains how to configure basic automatic protection switching (APS) on the router and how to configure more than one protect or working interface on a router by using the **aps group** command.

The SONET APS is a feature offering recovery from fiber (external) or equipment (interface and internal) failures at the SONET line layer.

Note The loopback interface in the example is used as the interconnect. The **aps group** command is used even when a single protect group is configured.

To verify the configuration or to determine if a switchover has occurred, use the **show aps** command.

Summary Steps

1. **configure**
2. **aps group** *number*
3. **channel** {**0** | **1**} **local** {**sonet** | **preconfigure**} *number*
4. Repeat Step 3 for each channel in the group.
5. **exit**
6. **interface loopback** *number*

7. **ipv4 address** *ip-address mask*
8. **exit**
9. **interface** *type number*
10. **ipv4 address** *ip-address mask*
11. **pos crc** {**16** | **32**}
12. **keepalive** [*seconds* | **disable**]
13. **no shutdown**
14. **exit**
15. Repeat Step 9 through Step 14 for each channel in the group.
16. **controller** {**sonet** | **preconfigure**} *number*
17. **ais-shut**
18. **no path scrambling disable**
19. **clock source** {**internal** | **line**}
20. Repeat Step 16 through Step 19 for each channel of the group.
21. **end**
    or
    commit
22. **show aps**
23. **show aps group** [*number*]

Detailed Steps

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**aps group** *number* **Example:** `RP/0/0/CPU0:router(config)# aps group 1`	Adds an APS group with a specified number and enters APS group configuration mode. • Use the **aps group** command in global configuration mode. • To remove a group, use the **no** form of this command, as in: **no aps group** *number,* where the value range is from 1–255. **Note** To use the **aps group** command, you must be a member of a user group associated with the proper task IDs for APS commands.

	Command or Action	Purpose
Step 3	**channel** {**0** | **1**} **local** {**sonet** | **preconfigure**} *number* **Example:** `RP/0/0/CPU0:router(config-aps)# channel 0 local SONET 0/0/0/1`	Creates a channel for the APS group, where: • 0 designates a protect channel • 1 designates a working channel **Note** If the protect channel is local, it must be assigned using a **channel** command *before* any of the working channels are assigned.
Step 4	Repeat Step 3 for each channel in the group.	—
Step 5	**exit** **Example:** `RP/0/0/CPU0:router(config-aps)# exit`	Exits APS group configuration mode.
Step 6	**interface loopback** *number* **Example:** `RP/0/0/CPU0:router(config)# interface loopback 1`	(Optional) Configures a loopback interface if a two-router APS is desired and enters interface configuration mode.
Step 7	**ipv4 address** *ip-address mask* **Example:** `RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.0.1 255.255.255.224`	Assigns an IPv4 address and subnet mask to the interface.
Step 8	**exit** **Example:** `RP/0/0/CPU0:router(config-aps)# exit`	Exits loopback interface configuration mode.
Step 9	**interface pos** *number* **Example:** `RP/0/0/CPU0:router(config-if)# interface pos 0/2/0/0`	Connects the interface for the each channel selected in Step 3, where: • *number*—Specifies the POS interface, in the notation *rack*/*slot*/*module*/*port*. The example indicates POS interface 0, on a SPA in subslot 0, in line card slot 2.
Step 10	**ipv4 address** *ip-address mask* **Example:** `RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.0.1 255.255.255.224`	Assigns an IPv4 address and subnet mask to the interface.
Step 11	**pos crc** (**16** | **32**) **Example:** `RP/0/0/CPU0:router(config-if)# pos crc 32`	Selects a CRC value for the channel. The default CRC value is 32.

	Command or Action	Purpose
Step 12	**keepalive** [*seconds* | **disable**] **Example:** `RP/0/0/CPU0:router(config-if)# keepalive disable`	Sets the keepalive timer for the channel.
Step 13	**no shutdown** **Example:** `RP/0/0/CPU0:router(config-if)# no shutdown`	Removes the shutdown configuration. The removal of the shutdown configuration removes the forced administrative down on the interface, enabling it to move to an up or down state (assuming the parent SONET layer is not configured administratively down).
Step 14	**exit** **Example:** `RP/0/0/CPU0:router(config-if)# exit`	Exits interface configuration mode.
Step 15	Repeat Step 9 through Step 14 for each channel in the group.	—
Step 16	**controller sonet** *number* **Example:** `RP/0/0/CPU0:router(config)# controller sonet 0/1/0/0`	Enters SONET controller configuration submode, where: *number*—Specifies the SONET controller number, which is the same as the associated POS interface, in the notation *rack*/*slot*/*module*/*port*.
Step 17	**ais-shut** **Example:** `RP/0/0/CPU0:router(config-sonet)# ais-shut`	Configures line alarm indication signal (LAIS) at shutdown.
Step 18	**no path scrambling disable** **Example:** `RP/0/0/CPU0:router(config-sonet)# no path scrambling disable`	(Optional) Enables synchronous payload envelope (SPE) scrambling. Scrambling is enabled by default; you only need to enable it if you have previously disabled it.
Step 19	**clock source** {**internal** | **line**} **Example:** `RP/0/0/CPU0:router(config-sonet)# clock source internal`	(Optional) Configures the SONET port TX clock source, where: • **internal**—Sets the internal clock. Use this option when two routers are connected back-to-back or over fiber for which no clocking is available. • **line**—Sets the clock to be recovered from the line (default). Use this option whenever clocking is derived from the network.
Step 20	Repeat Step 16 to Step 19 for each channel in the group.	—

	Command or Action	Purpose
Step 21	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-sonet)# end` or `RP/0/0/CPU0:router(config-sonet)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 22	**show aps** **Example:** `RP/0/0/CPU0:router# show aps`	(Optional) Displays operational status for all configured SONET APS groups.
Step 23	**show aps group** [*number*] **Example:** `RP/0/0/CPU0:router# show aps group 3`	(Optional) Displays operational status for configured SONET APS groups. • The **show aps group** command is more useful than the **show aps** command when there are multiple groups defined.

Configuring Fast Reroute and SONET APS

When APS is configured on a router, it does not offer protection for tunnels; because of this limitation, fast reroute (FRR) still remains the protection mechanism for Multiprotocol Label Switching (MPLS) traffic-engineering.

When APS is configured in a SONET core network, an alarm might be generated toward a router downstream. If this router is configured with FRR, you may want to configure a hold-off timer at the SONET level in order to prevent FRR from being triggered while the core network is doing a restoration. Perform this task to configure the delay.

Summary Steps

1. **configure**
2. **controller sonet** *number*

3. **delay trigger line** *value*
   or
   path delay trigger *value*
4. **end**
   or
   commit

Detailed Steps

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**controller sonet** *number* **Example:** `RP/0/0/CPU0:router(config)# controller sonet 0/6/0/0`	Enters SONET controller configuration submode, where: • *number*—Specifies the SONET controller number, which is the same as the associated POS interface, in the notation *rack*/*slot*/*module*/*port*.
Step 3	**delay trigger line** *value* or **path delay trigger** *value* **Example:** `RP/0/0/CPU0:router(config-sonet)# delay trigger line 250` or `RP/0/0/CPU0:router(config-sonet)# path delay trigger 300`	Configures SONET port delay trigger values in milliseconds. **Tip** The commands in Step 1 and Step 2 can be combined in one command string and entered from global configuration mode like this: **controller sonet** *rack/slot/subslot/port* **delay trigger line** or **controller sonet** *rack/slot/subslot/port* **path delay trigger.**
Step 4	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-sonet)# end` or `RP/0/0/CPU0:router(config-sonet)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Configuring a POS Interface

This task explains how to create a basic POS configuration. There are many other possible parameters that can be set. Only the most basic are illustrated. Not all configuration steps are required.

Default Settings for POS Interface Configurations

When an interface is enabled on a POS SPA and its associated SIP with no additional configuration commands applied, the default interface settings shown in Table 6-1 are present. These default settings can be changed by configuration. Default settings do not appear in the output of the **show running-config** command.

Table 6-1 POS SPA and SIP Default Interface Settings

Parameter	Configuration File Entry	Default Settings
Keepalive	keepalive [disable] no keepalive [disable]	keepalive 10 seconds
Encapsulation	encapsulation [hdlc | ppp]	hdlc
Maximum Transmission Unit (MTU)	mtu *bytes*	4474 bytes
Cyclic Redundancy Check (CRC)	crc [16 | 32]	32

Keepalive Timer

The high-level data-link control (HDLC) usage of the keepalive timer also applies to PPP encapsulation to control how often echo request (ECHOREQ) packets are sent out.

Use the **keepalive** command in interface configuration mode to set how frequently Link Control Protocol (LCP) should send out ECHOREQ packets to its peer. To restore the system to the default keepalive interval of 10 seconds, use the **keepalive** command with no argument. To disable keepalives, use the **no keepalive** or **keepalive disable** commands. For both PPP and HDLC, a keepalive of 0 disables keepalives and is reported in the **show running-config** command as **keepalive disable**.

When LCP is running on the peer and receives an ECHOREQ packet, it should respond with an echo reply (ECHOREP) packet, regardless of whether keepalives are enabled on the peer.

Keepalives are independent between the two peers. One peer end can have keepalives enabled, the other end can have them disabled. Even if keepalives are disabled locally, LCP will still respond with ECHOREP packets to the ECHOREQ packets it receives. Similarly, it will also work if the period of keepalives at each end is different.

When the interface has PPP encapsulation, if LCP sends three ECHOREQ packets without an ECHOREP being received then it declares the link down and initiates full LCP negotiation again. If the interface has HDLC encapsulation, the number of resends is only three before the link is taken down. Only when LCP negotiation is complete (for example, when LCP is open) are ECHOREQ packets sent out.

Summary Steps

1. **show interfaces**
2. **configure**
3. **interface** *type number*
4. **ipv4 address** *ip-address*
5. **encapsulation** [**hdlc** | **ppp**]
6. **pos crc** {**16** | **32**}
7. **keepalive** [*seconds* | **disable**]
8. **mtu** *value*
9. **no shutdown**
10. **end**
    or
    commit
11. **show interfaces** *type number*
12. **show running-config**

Detailed Steps

	Command or Action	Purpose
Step 1	**show interfaces** **Example:** `RP/0/0/CPU0:router# show interfaces`	(Optional) Displays configured interfaces.
Step 2	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `RP/0/0/CPU0:router(config)# interface POS 0/4/1/0`	Enters interface configuration mode, where: • *type*—Specifies **pos** for the 1-Port OC-192c/STM-64 POS/RPR XFP SPA. • *number*—Specifies the POS interface in the notation *rack*/*slot*/*module*/*port*. The example indicates POS interface 0, on a SPA in subslot 1, in line card slot 4.
Step 4	**ipv4 address** *ip-address* **Example:** `RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.189.38 255.255.255.224`	Assigns an IP address and subnet mask to the interface.

	Command or Action	Purpose
Step 5	**encapsulation** [**hdlc** | **ppp**] **Example:** `RP/0/0/CPU0:router(config-if)# encapsulation hdlc`	(Optional) Configures the interface encapsulation parameters and details such as HDLC or PPP.
Step 6	**pos crc** {**16** | **32**} **Example:** `RP/0/0/CPU0:router(config-if)# pos crc 32`	(Optional) Configures the value of cyclic redundancy check (**crc**). The default CRC value is 32.
Step 7	**keepalive** [*seconds* | **disable**] **Example:** `RP/0/0/CPU0:router(config-if)# keepalive 10`	(Optional) Configures the value of **keepalive**.
Step 8	**mtu** *value* **Example:** `RP/0/0/CPU0:router(config-if)# mtu 4474`	(Optional) Configures the value of MTU. • Default is 4474; range is 64–65535 on the Cisco XR 12000 Series Router.
Step 9	**no shutdown** **Example:** `RP/0/0/CPU0:router(config-if)# no shutdown`	Removes the shutdown configuration. • The removal of the shutdown configuration removes the forced administrative down on the interface, enabling it to move to an up or down state (assuming the parent SONET layer is not configured administratively down).
Step 10	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-if)# end` or `RP/0/0/CPU0:router(config-if)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

	Command or Action	Purpose
Step 11	**show interfaces** *type number* **Example:** `RP/0/0/CPU0:router# show interfaces pos 0/1/0/0`	(Optional) Displays the interface configuration.
Step 12	**show running-config** **Example:** `RP/0/0/CPU0:router# show running-config`	(Optional) Displays the configuration information currently running on the router.

Configuring Cisco HDLC on a POS Interface

Cisco High-Level Data Link Controller (HDLC) is Cisco's proprietary protocol for sending data over synchronous serial links using HDLC. Cisco HDLC also provides a simple control protocol called Serial Line Address Resolution Protocol (SLARP) to maintain serial link keepalives. HDLC is the default encapsulation for POS interfaces under Cisco IOS XR software.

Perform this task to configure the Cisco HDLC encapsulation type on a POS interface.

Prerequisites

To use the **keepalive** command, you must be in a user group associated with a task group that includes the proper task IDs for HDLC commands. To use the **encapsulation hdlc** command, you must be in a user group associated with a task group that includes the proper task IDs for interface and HDLC commands.

Task IDs for commands are listed in the *Cisco IOS XR Task ID Reference Guide*.

Note Cisco HDLC is enabled by default for POS configurations on the Cisco XR 12000 Series Router.

Cisco HDLC keepalives are useful for monitoring the link state. Periodic keepalives are sent to and received from the peer at a frequency determined by the keepalive value. If an acceptable keepalive response is not received from the peer, the link makes the transition to the down state. As soon as an acceptable keepalive response is obtained from the peer or if keepalive is disabled, the link makes the transition to the up state.

If three keepalives are sent to the peer and no response is received from peer, then the link makes the transition to the down state.

The Serial Line Address Resolution Protocol (SLARP) packets sent to the peer after keepalive has been configured can be displayed using the **debug chdlc slarp packet** and other Cisco HDLC **debug** commands.

Summary Steps

1. **configure**
2. **interface** *type number*
3. **ipv4 address** *ip-address*
4. **encapsulation** [**hdlc** | **ppp**]

5. **keepalive** [*seconds* | **disable**]
   or
   no keepalive
6. **no shutdown**
7. **end**
   or
   commit
8. **show interfaces pos** *number*
9. **show running-config**

Detailed Steps

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**interface** *type number* **Example:** `RP/0/0/CPU0:router(config)# interface pos 0/4/1/0`	Enters interface configuration mode, where: • *type*—Specifies **pos** for POS SPAs. • *number*—Specifies the POS interface in the notation *rack*/*slot*/*module*/*port*. The example indicates POS interface 0, on a SPA in subslot 1, in line card slot 4.
Step 3	**ipv4 address** *ip-address* **Example:** `RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.189.38 255.255.255.224`	Assigns an IP address and subnet mask to the interface.
Step 4	**encapsulation** [**hdlc** | **ppp**] **Example:** `RP/0/0/CPU0:router(config-if)# encapsulation hdlc`	Configures the interface encapsulation parameter for HDLC or PPP.
Step 5	**keepalive** [*seconds* | **disable**] or **no keepalive** **Example:** `RP/0/0/CPU0:router(config-if)# keepalive 3` or `RP/0/0/CPU0:router(config-if)# no keepalive`	Specifies the number of seconds between keepalive messages. • Use the **keepalive disable** command, the **no keepalive** command, or the **keepalive** command with an argument of 0 to disable the keepalive feature.

	Command or Action	Purpose
Step 6	**no shutdown** **Example:** `RP/0/0/CPU0:router(config-if)# no shutdown`	Removes the shutdown configuration. • The removal of the shutdown configuration removes the forced administrative down on the interface, enabling it to move to an up or down state (assuming the parent SONET layer is not configured administratively down).
Step 7	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-if)# end` or `RP/0/0/CPU0:router(config-if)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 8	**show interfaces pos** *number* **Example:** `RP/0/0/CPU0:router# show interfaces POS 0/4/1/0`	(Optional) Displays the interface configuration for the POS interface, where: • *number*—Specifies the POS interface in the notation *rack*/*slot*/*module*/*port*. The example indicates POS interface 0, on a SPA in subslot 1, in line card slot 4.
Step 9	**show running-config** **Example:** `RP/0/0/CPU0:router# show running-config`	(Optional) Displays the configuration information currently running on the router.

Configuring PPP on a POS Interface

Note The default encapsulation type for the POS SPA configurations is Cisco HDLC.

PPP is a standard protocol used to send data over synchronous serial links. PPP also provides a Link Control Protocol (LCP) for negotiating properties of the link. LCP uses echo requests and responses to monitor the continuing availability of the link.

PPP provides Network Control Protocols (NCPs) for negotiating properties of data protocols that will run on the link: IP Control Protocol (IPCP) to negotiate IP properties, Multiprotocol Label Switching control processor (MPLSCP) to negotiate MPLS properties, Cisco Discovery Protocol control processor (CDPCP) to negotiate CDP properties, IPv6CP to negotiate IP Version 6 (IPv6) properties, and Open Systems Interconnection control processor (OSICP) to negotiate OSI properties.

Perform this task to configure PPP on POS interfaces.

Prerequisites

To use the **encapsulation ppp** command, you must be in a user group associated with a task group that includes the proper task IDs for interface and PPP commands. To use the **ppp authentication** command, you must be in a user group associated with a task group that includes the proper task IDs for AAA and PPP commands.

Task IDs for commands are listed in the *Cisco IOS XR Task ID Reference Guide*.

PPP Encapsulation

Use the **encapsulation ppp** command to enable PPP encapsulation on an interface.

To enable Challenge Handshake Authentication Protocol (CHAP) or Password Authentication Protocol (PAP) or both, and to specify the order in which CHAP, MS-CHAP, and PAP authentication is selected on the interface, use the **ppp authentication** command in interface configuration mode.

When you enable CHAP or PAP authentication (or both), the local router requires the remote device to prove its identity before allowing data traffic to flow. PAP authentication requires the remote device to send a name and a password, which are checked against a matching entry in the local username database or in the remote security server database. CHAP authentication sends a challenge message to the remote device. The remote device encrypts the challenge value with a shared secret and returns the encrypted value and its name to the local router in a response message. The local router attempts to match the remote device's name with an associated secret stored in the local username or remote security server database; it uses the stored secret to encrypt the original challenge and verify that the encrypted values match.

You can enable CHAP, MS-CHAP, or PAP in any order. If you enable all three methods, the first method specified is requested during link negotiation. If the peer suggests using the second method, or refuses the first method, the second method is tried. Some remote devices support only one method. Base the order in which you specify methods on the remote device's ability to correctly negotiate the appropriate method, and on the level of data line security you require. PAP usernames and passwords are sent as clear text strings, which can be intercepted and reused.

Enabling or disabling PPP authentication does not affect the local router's ability to authenticate itself to the remote device.

MS-CHAP is the Microsoft version of CHAP. Like the standard version of CHAP, MS-CHAP is used for PPP authentication; in this case, authentication occurs between a personal computer using Microsoft Windows NT or Microsoft Windows 95 and a Cisco router or access server acting as a network access server.

Enabling or disabling PPP authentication does not affect the local router's willingness to authenticate itself to the remote device.

Caution If you use a *list-name* value that was not configured with the **aaa authentication ppp** command, you will disable PPP on the interface. For details on implementing the **aaa authentication** command with the **ppp** keyword, see the *Authentication, Authorization, and Accounting Commands on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Command Reference* and the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Summary Steps

1. **configure**
2. **interface** *type number*
3. **encapsulation ppp**
4. **ppp authentication** *protocol list-name*
5. **end**
   or
   commit

Detailed Steps

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**interface** *type number* **Example:** `RP/0/0/CPU0:router(config)# interface pos 0/4/1/0`	Enters interface configuration mode, where: • *type*—Specifies **pos** for POS SPAs. • *number*—Specifies the POS interface in the notation *rack*/*slot*/*module*/*port*. The example indicates POS interface 0, on a SPA in subslot 1, in line card slot 4.
Step 3	**encapsulation ppp** **Example:** `RP/0/0/CPU0:router(config-if)# encapsulation ppp`	Configures the interface encapsulation parameter for PPP.

	Command or Action	Purpose
Step 4	**ppp authentication** *protocol list-name* **Example:** `RP/0/0/CPU0:router(config-if)# ppp authentication chap MIS-access`	Enables CHAP, MS-CHAP, or PAP and specifies the order of selection on the interface. • The allowed values for protocol are: – chap—Enables CHAP on a serial interface – ms-chap—Enables Microsoft's CHAP on a serial interface – pap—Enables PAP on a serial interface
Step 5	**end** or **commit** **Example:** `RP/0/0/CPU0:router(config-if)# end` or `RP/0/0/CPU0:router(config-if)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: `Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]:` – Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Verifying the Interface Configuration

Besides using the **show running-configuration** command to display your Cisco XR 12000 Series Router configuration settings, you can use the **show interfaces pos** and the **show controllers pos** commands to get detailed information on a per-port basis for your SPA. The use of these commands is indicated at the end of each configuration task.

Configuration Examples

This section contains the following examples:

SONET Controller Configuration Example

The following example shows the commands and output generated when you are performing the configuration of a SONET controller interface following the steps outlined in the "Configuring a SONET Controller" section on page 6-3. This example shows the usage of every optional command, along with listings of options within commands where relevant. An actual configuration may or may not include all of these commands.

```
RP/0/0/CPU0:router# configure
RP/0/0/CPU0:router(config)# controller sonet 0/1/0/0
RP/0/0/CPU0:router(config-sonet)# ais-shut
RP/0/0/CPU0:router(config-sonet)# clock source internal
RP/0/0/CPU0:router(config-sonet)# framing sonet
RP/0/0/CPU0:router(config-sonet)# loopback internal
RP/0/0/CPU0:router(config-sonet)# overhead s1s0 2
RP/0/0/CPU0:router(config-sonet)# path ais-shut
RP/0/0/CPU0:router(config-sonet)# path delay trigger 0
RP/0/0/CPU0:router(config-sonet)# path overhead j1 transmit-message
RP/0/0/CPU0:router(config-sonet)# path report b3-tca
RP/0/0/CPU0:router(config-sonet)# path threshold b3-tca 6
RP/0/0/CPU0:router(config-sonet)# path uneq-shut
RP/0/0/CPU0:router(config-sonet)# report lais
RP/0/0/CPU0:router(config-sonet)# threshold b2-tca 4
```

SONET APS Group Configuration Example

The following example shows how to configure a two-router SONET APS group:

```
RP/0/0/CPU0:router# configure
RP/0/0/CPU0:router(config)# aps group 1
RP/0/0/CPU0:router(config-aps)# channel 0 local sonet 0/0/0/1
RP/0/0/CPU0:router(config-aps)# channel 1 local sonet 0/0/0/2
RP/0/0/CPU0:router(config-aps)# interface loopback0
RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.23.169 255.255.255.0
RP/0/0/CPU0:router(config-if)# interface pos 0/0/0/2
RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.69.123 255.255.255.0
RP/0/0/CPU0:router(config-if)# pos crc 32
RP/0/0/CPU0:router(config-if)# keepalive disable
RP/0/0/CPU0:router(config-if)# no shutdown
RP/0/0/CPU0:router(config-if)# interface pos 0/0/0/1
RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.69.123 255.255.255.0
RP/0/0/CPU0:router(config-if)# keepalive disable
RP/0/0/CPU0:router(config-if)# no shutdown
RP/0/0/CPU0:router(config-if)# controller sonet 0/0/0/2
RP/0/0/CPU0:router(config-sonet)# ais-shut
RP/0/0/CPU0:router(config-sonet)# path
RP/0/0/CPU0:router(config-sonet-path)# scrambling disable
RP/0/0/CPU0:router(config-sonet-path)# clock source internal
RP/0/0/CPU0:router(config-sonet)# controller sonet 0/0/0/1
RP/0/0/CPU0:router(config-sonet)# ais-shut
RP/0/0/CPU0:router(config-sonet)# path
RP/0/0/CPU0:router(config-sonet-path)# scrambling disable
RP/0/0/CPU0:router(config-sonet-path)# clock source internal
RP/0/0/CPU0:router(config-sonet)# end
Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]: yes

RP/0/0/CPU0:router# show aps

APS Group 1
  Protect ch 0 (SONET0_0_0_1): Disabled
```

```
    SONET framing, SONET signalling, bidirectional, non-revertive
    Rx K1: 0x00 (No Request - Null)
       K2: 0x05 (bridging Null, 1+1, bidirectional)
    Tx K1: 0x00 (No Request - Null)
       K2: 0x05 (bridging Null, 1+1, bidirectional)
  Working ch 1 (SONET0_0_0_2): Enabled
    Rx K1: 0x00 (No Request - Null)
       K2: 0x00 (bridging Null, 1+1, non-aps)
    Tx K1: 0x00 (No Request - Null)
       K2: 0x00 (bridging Null, 1+1, non-aps)

RP/0/0/CPU0:router# show aps group 1

APS Group 1
  Protect ch 0 (SONET0_0_0_1): Disabled
    SONET framing, SONET signalling, bidirectional, non-revertive
    Rx K1: 0x00 (No Request - Null)
       K2: 0x05 (bridging Null, 1+1, bidirectional)
    Tx K1: 0x00 (No Request - Null)
       K2: 0x05 (bridging Null, 1+1, bidirectional)
  Working ch 1 (SONET0_0_0_2): Enabled
    Rx K1: 0x00 (No Request - Null)
       K2: 0x00 (bridging Null, 1+1, non-aps)
    Tx K1: 0x00 (No Request - Null)
       K2: 0x00 (bridging Null, 1+1, non-aps)
```

Configuring Basic POS Example

The following example indicates how to configure a basic POS interface with Cisco HDLC:

```
RP/0/0/CPU0:router# configure
RP/0/0/CPU0:router(config)# interface pos 0/3/0/0
RP/0/0/CPU0:router(config-if)# ipv4 address 172.18.189.38 255.255.255.224
RP/0/0/CPU0:router(config-if)# encapsulation hdlc
RP/0/0/CPU0:router(config-if)# pos crc 32
RP/0/0/CPU0:router(config-if)# keepalive 10
RP/0/0/CPU0:router(config-if)# no shutdown
RP/0/0/CPU0:router(config-if)# end
Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]: yes
RP/0/0/CPU0:router# show interfaces pos 0/3/0/0

POS0/3/0/0 is down, line protocol is down
  Hardware is Packet over SONET
  Internet address is 172.18.189.38/27
  MTU 4474 bytes, BW 2488320 Kbit
     reliability 0/255, txload Unknown, rxload Unknown
  Encapsulation HDLC, crc 32, controller loopback not set, keepalive set
(10 sec)
  Last clearing of "show interface" counters never
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 0 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 total output drops
     Output 0 broadcast packets, 0 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Configuring PPP Example

The following example illustrates PPP encapsulation on a POS interface:

```
RP/0/0/CPU0:router# configure
RP/0/0/CPU0:router(config)# interface pos 0/3/0/0
RP/0/0/CPU0:router(config-if)# encapsulation ppp
RP/0/0/CPU0:router(config-if)# ppp authentication chap MIS-access
RP/0/0/CPU0:router(config-if)# end
Uncommitted changes found. Commit them before exiting (yes/no/cancel)? [cancel]: yes
RP/0/0/CPU0:router# show interfaces pos 0/3/0/0

POS0/3/0/0 is down, line protocol is down
  Hardware is Packet over SONET
  Internet address is 172.18.189.38/27
  MTU 4474 bytes, BW 2488320 Kbit
     reliability 0/255, txload Unknown, rxload Unknown
  Encapsulation PPP, crc 32, controller loopback not set, keepalive set (
10 sec)
  LCP Closed
  Closed: IPCP
  Last clearing of "show interface" counters never
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 0 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 total output drops
     Output 0 broadcast packets, 0 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Cisco Systems

PART 3

Field-Programmable Devices

Upgrading Field-Programmable Devices

In general terms, field-programmable devices (FPDs) are hardware devices implemented on router cards that support separate software upgrades. A field-programmable gate array (FPGA) is a type of programmable memory device that exists on most hardware components of a Cisco XR 12000 Series Router. The term “FPD” has been introduced to collectively and generically describe any type of programmable hardware device on SPAs, including FPGAs. Cisco IOS XR software Release 3.2 introduces the Cisco FPD upgrade feature to manage the upgrade of FPD images on SPAs.

This chapter describes the information that you need to know to verify image versions and to perform an upgrade for SPA FPD images when incompatibilities arise.

This chapter includes the following sections:

Overview of SPA FPD Image Upgrade Support

FPGA versions must be compatible with the Cisco IOS XR software that is running on the router; if an incompatibility exists between an FPGA version and the Cisco IOS XR software, the device with the FPGA will not operate properly until the incompatibility is resolved.

The Cisco XR 12000 Series Router supports upgrades for FPGA devices on its SPAs. FPGA software upgrades are part of an FPD image package that corresponds to a Cisco IOS XR software image. The SPA supports manual upgrades for its FPGA device using the Cisco FPD upgrade feature that is further described in this chapter.

Upgrading SPA FPD Images

This section describes information about SPA FPD image packages and the tasks to perform an FPD image upgrade on a SPA, for upgrading the software for an FPGA device or other FPDs. This section includes the following topics:

Verifying SPA FPD Image Compatibility

An up-to-date SPA FPD image is required to properly run any SPA. The FPD image on each SPA must be compatible with the Cisco IOS XR software release that is running on the router of the installed SPA. If an incompatibility exists between the FPD image on the SPA and the Cisco IOS XR software release on the router, the SPA will be disabled until the incompatibility is addressed.

An FPD image package is used to upgrade FPD images. Whenever a Cisco IOS XR software image is released that supports SPAs, a companion SPA FPD image package is bundled with the Cisco IOS XR software release. However, the FPD image is not automatically upgraded unless you manually issue the upgrade command.

You can use the following **show** commands to monitor information related to SPA FPD images and determine if an FPD upgrade is required:

- **show hw-module fpd**—Displaying Current and Minimum Required FPD Image Versions, page 7-2
- **show fpd packages**—Displaying Information About the FPD Image Package, page 7-4

Displaying Current and Minimum Required FPD Image Versions

To display the current version of FPD images on the SPAs installed on your router, use the **show hw-module fpd location** [**all** | *node-id*] command, where *node-id* is the location of the SPA in the *rack*/*slot*/*module* notation.

Note This command can be used to identify information about FPDs on any SPA. If you enter the location of a line card that is not a SPA, the output displays information about any programmable devices on that line card.

The following examples show the output when using this command.

The output display in this example shows that FPD versions on the SPA in the system do not meet the minimum requirements. The output contains a “NOTES” section that states how to upgrade the SPA’s FPD image.

```
RP/0/0/CPU0:ios# show hw-module fpd location all

============================== ===============================================
                                    Existing Field Programmable Devices
                               ===============================================
                                                          Current SW    HW    Upg/
Location     Card Type                Type Subtype Inst   Version   Version Dng?
============ ======================== ==== ======= ==== =========== ======= ====
0/2/CPU0     Jacket Card              lc   fpga    0        0.1       0.34  Yes
------------------------------------------------------------------------------
0/2/0        SPA-8X1GE                spa  fpga    0        0.16      1.0   Yes
------------------------------------------------------------------------------
0/2/4        SPA-4XOC3POS             spa  fpga    4        3.4       1.0   Yes
------------------------------------------------------------------------------
0/2/1        SPA-4XOC3POS             spa  fpga    1        3.4       1.0   Yes
------------------------------------------------------------------------------
0/2/3        SPA-OC192POS-XFP         spa  fpga    3        1.2       2.1   Yes
------------------------------------------------------------------------------
0/3/CPU0     Jacket Card              lc   fpga    0        0.1       0.34  Yes
------------------------------------------------------------------------------
0/3/1        SPA-8X1GE                spa  fpga    1        0.16      1.0   Yes
------------------------------------------------------------------------------
NOTES:
1.  One or more FPD needs an upgrade or a downgrade.  This can be accomplished
    using the "admin upgrade hw-module fpd" CLI.
```

Table 7-1 describes the significant fields shown in the display.

Table 7-1 show hw-module fpd Field Descriptions

Field	Description
Location	Location of the module in the *rack*/*slot*/*module* notation.
Card Type	Module part number.
Type	Hardware type can be: spa—shared port adapter; lc—line card.
Subtype	FPD type can be: fabldr—fabric downloader; fpga—field-programmable gate array; rommon—read-only memory monitor
Inst	Instance—A unique identifier that is used by the FPD process to register an FPD.
Current SW Version	Currently running FPD image version.
Min Req HW Vers	Minimum required hardware version for the associated FPD image.
Upg/Dng	Specifies whether an FPD upgrade or downgrade is required. A downgrade will be required in rare cases when the version of the FPD image has a higher major revision than the version of the FPD image in the current Cisco IOS XR software package.

Displaying Information About the FPD Image Package

You can use the **show fpd package** command to find out which SPAs are supported with your current Cisco IOS XR software release, which FPD image package you need for each SPA and what the minimum hardware requirements are for the SPA modules.

```
RP/0/0/CPU0:ios(admin)# show fpd package

================================ ==============================================
                                        Field Programmable Device Package
                                 ==============================================
                                                                    SW      Min Req
Card Type            FPD Description            Type Subtype   Version   HW Vers
==================== ========================== ==== ======= =========== =======
Jacket Card          SPA FPGA swv13             lc   fpga        0.13      0.0
--------------------------------------------------------------------------------
SPA-4XOC3POS         SPA FPGA swv13             spa  fpga        0.13      0.0
                     SPA FPGA swv13 hwv2        spa  fpga        0.13      2.0
--------------------------------------------------------------------------------
SPA-OC192POS-XFP     SPA FPGA swv13             spa  fpga        0.13      0.0
                     SPA FPGA swv13 hwv2        spa  fpga        0.13      2.0
--------------------------------------------------------------------------------
SPA-8X1GE            SPA FPGA swv1.8            spa  fpga        1.8       0.0
--------------------------------------------------------------------------------
```

Table 7-2 describes the significant fields shown in the display.

Table 7-2 show fpd package Field Descriptions

Field	Description
Card Type	Module part number.
FPD Description	Description of all FPD images available for the SPA.
Type	Hardware type can be: spa—shared port adapter; lc—line card.
Subtype	FPD type can be: fabldr—fabric downloader; fpga—field-programmable gate array; rommon—read-only memory monitor
SW Version	FPD software version required for the associated module running the current Cisco IOS XR software.
Min Req HW Vers	Minimum required hardware version for the associated FPD image.

SPA FPD Image Upgrade

To determine which FPD images on a SPA require an upgrade, the system compares the current FPD image version for each individual SPA in the router with the minimum required FPD version required by the current Cisco IOS software release. An FPD upgrade is required if at least one FPD image on one of the SPAs in the router does not meet the minimum version requirements for that particular Cisco IOS XR software image.

Typical reasons to upgrade FPD images include:

- Migrating to a newer Cisco IOS XR software release

  After you migrate to a new Cisco IOS XR software release, the system notifies you to if it is necessary to perform an upgrade.

- Swapping SPAs

  If you are swapping SPAs from another platform or from the same platform that is running a different Cisco IOS XR software release, the system notifies you to if it is necessary to perform an upgrade.

- Inserting a new SPA

SPA FPD Image Upgrade Task List

This section describes the guidelines and tasks to perform an FPD image upgrade on a SPA for FPGA version upgrades, or other supported FPD version upgrades. This section includes the following topics:

- SPA FPD Image Upgrade Guidelines, page 7-5
- Upgrading FPD Images for SPAs in a Production System, page 7-5
- Upgrading SPA FPD Images, page 7-5

SPA FPD Image Upgrade Guidelines

- The SPA will probably be in the FAILED state if you do not have the required FPD image downloaded on it.
- Upgrading the FPD image on a SPA places the SPA offline and interrupts traffic. An image upgrade requires approximately 30 seconds to complete depending on the SPA.

Upgrading FPD Images for SPAs in a Production System

When the FPD image is upgraded on the SPA, the SPA is shutdown and traffic through the SPA interfaces is rerouted. Therefore some packets may get dropped if the upgrade is performed on a production system. The performance impact will vary depending on the type of processing engine used and the type of service configured.

Because of the potential problems, we highly recommend that one of the following alternatives be used to perform the upgrade if possible.

- Upgrade the FPD image on SPAs on a non-production system that is running the same Cisco IOS XR software image that you are running on the production system that the SPAs will be inserted into.
- Upgrade the FPD image on SPAs during a maintenance window when there is no traffic passing through the system.

If you are not sure whether the SPA requires an FPD upgrade, you can install the SPA and use the **show hw-module fpd** command to determine if the FPD image on the SPA is compatible with the currently running Cisco IOS XR software release.

Upgrading SPA FPD Images

To upgrade the current FPD version on a SPA card, use the following command in admin EXEC mode:

upgrade hw-module fpd {**all** | **fpga**} [**force**] **location** [**all** | *node-id*]

The *node-id* refers to the location of the module in the *rack*/*slot*/*module* notation. Currently only the FPGA image can be upgraded on your SPA. If the SPA you want to upgrade is already in the shutdown state, then you must use the **force** option to upgrade it. You can also use the **force** option to perform the upgrade even if there is no image version incompatibility.

Caution Upgrading the FPD image on a SPA places the SPA offline and interrupts traffic. An image upgrade can require 30 seconds or longer to complete depending on the SPA.

SPA FPD Image Upgrade Example

The following example displays the output from the **upgrade hw-module fpd** command:

```
RP/0/0/CPU0:ios(admin)# upgrade hw-module fpd fpga force location 0/3/1
SP/0/3/SP:Feb 25 17:13:21.349 : upgrade_daemon[124]: Start Upgrade...
SP/0/3/SP:Feb 25 17:13:21.356 : upgrade_daemon[124]: programming...with file
/net/node0_RP1_CPU0/hfr-lc-3.2.80/fpd/ucode/espam_damselfly_isp1.xsvf
SP/0/3/SP:Feb 25 17:13:22.925 : upgrade_daemon[124]: ...continue programming...
SP/0/3/SP:Feb 25 17:13:22.931 : upgrade_daemon[124]: ...it will take a while...
SP/0/3/SP:Feb 25 17:13:23.029 : upgrade_daemon[124]: ...it does take a while...
SP/0/3/SP:Feb 25 17:13:48.286 : upgrade_daemon[124]: ...continue programming...
SP/0/3/SP:Feb 25 17:13:48.292 : upgrade_daemon[124]: ...it will take a while...
SP/0/3/SP:Feb 25 17:13:48.314 : upgrade_daemon[124]: almost...done
Successfully upgraded spa fpga instance 1 on location 0/3/1.
```

Troubleshooting Problems with SPA FPD Image Upgrades

This section contains information to help troubleshoot problems that can occur during the upgrade process.

Power Failure or Removal of a SPA During an FPD Image Upgrade

If the FPD upgrade operation is interrupted by a power failure or the removal of the SPA, it could corrupt the FPD image. This corruption of the FPD image file makes the SPA unusable by the router and the system will display the following messages when it tries to power up the SPA. When it cannot successfully power up the SPA, it places it in the FAILED state.

```
LC/0/3/CPU0:Feb  4 08:23:16.672 : spa_192_jacket[188]: %L2-SPA-5-OIR_INSERTED : SPA
discovered in bay 0
LC/0/3/CPU0:Feb  4 08:23:23.349 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR : SPA (0): An
error occurred (0x1002), error recovery action: reset SPA
LC/0/3/CPU0:Feb  4 08:23:26.431 : spa_192_jacket[188]: %L2-SPA-5-OIR_INSERTED : SPA
discovered in bay 0
LC/0/3/CPU0:Feb  4 08:23:32.593 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR : SPA (0): Too
many retries, error recovery stopped
LC/0/3/CPU0:Feb  4 08:23:32.593 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR : SPA (0): An
error occurred (0x1002), error recovery action: hold SPA in reset
```

When a SPA is in the FAILED state, it may not register itself with the FPD upgrade mechanism. In this case, you will not see the SPA listed when you use the **show hw-module fpd** command. In order to verify the state of a SPA, use the **show hw-module subslot error** command and the **show hw-module subslot status** command.

Performing a SPA FPD Recovery Upgrade

To recover a SPA from the FAILED state due to a corrupted FPD image, you must manually shutdown the SPA. Use the **hw-module subslot** *subslot-id* **shutdown powered** command in global configuration mode to administratively shutdown the SPA. Once the SPA is shutdown, then you can use the **upgrade hw-module fpd** command in admin EXEC mode, with the **force** option in order to restart the FPD upgrade process.

Verifying a Successful Upgrade

After the upgrade process is complete, you can use the **show hw-module fpd** command to verify that the FPD image on the SPA has been successfully upgraded.

Use the **show hw-module subslot status** command to verify that the SPA is up and running:

```
RP/0/0/CPU0:Router# show hw-module subslot status

BAY 0/3/0 status info:
-----------------------
SPA inserted: YES
SPA type:     5xGE SPA
SPA operational state: READY
SPA powered: YES
SPA in reset: NO
SPA insertion time:  Mon Feb 28 13:44:23 2005
SPA last time ready: Mon Feb 28 13:45:10 2005
SPA uptime [HH:MM:SS]: 19:04:47

BAY 0/3/1 status info:
-----------------------
SPA inserted: YES
SPA type:     1xOC192 POS/RPR HHSPA with XFP
SPA operational state: READY
SPA powered: YES
SPA in reset: NO
SPA insertion time:  Mon Feb 28 13:44:25 2005
SPA last time ready: Mon Feb 28 13:45:05 2005
SPA uptime [HH:MM:SS]: 19:04:52
```

FPD Command Summary

Table 7-3 provides an alphabetical list of the related commands to configure, monitor, and upgrade FPD images for SPAs on the Cisco XR 12000 Series Router. For more information about the commands, see Chapter 10, "Command Reference" in this book.

Table 7-3 FPD Command Summary

Command	Purpose
Router# **show hw-module fpd** [*slot-number*/*subslot-number*]	Displays all current versions of FPD image files for all of the active SPAs on a router.
Router(admin)# **show fpd package**	Displays the FPD image package requirements for the router to properly support the SPAs running on the Cisco IOS XR software release.
Router(admin)# **upgrade hw-module fpd** {**all** | **fabldr** | **fpga** | **rommon**} [**force**] **location** [**all** | *node-id*]	Upgrades the current FPD image package on a SPA.

PART 4

Shared Port Adapter Command Reference

Command Summary for the Gigabit Ethernet SPA

Table 8-1 provides an alphabetical list of some of the related commands to configure, monitor, and maintain Gigabit Ethernet SPAs. For more information about the commands, see Chapter 10, "Command Reference" in this book and the Cisco IOS XR software command reference publications.

Table 8-1 Command Summary

Command	Purpose
`RP/0/0/CPU0:Router# configure`	Enters global configuration mode.
`RP/0/0/CPU0:Router(config)# interface gigabitethernet` *rack/slot/subslot/port*	Specifies the Gigabit Ethernet interface to configure.
`RP/0/0/CPU0:Router(config-if)# ipv4 address` *ip-address mask* or `RP/0/0/CPU0:Router(config-if)# ipv6 address` *ipv6-prefix/prefix-length*	Sets a primary or secondary IP address for an interface.
`RP/0/0/CPU0:Router(config-if)# flow control {bidirectional | egress | ingress}`	Enables the sending of flow-control pause frames.
`RP/0/0/CPU0:Router(config-if)# mac-accounting {egress | ingress}`	Generates accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces.
`RP/0/0/CPU0:Router(config-if)# mtu` *value*	Sets the maximum transmission unit (MTU) value for the interface.
`RP/0/0/CPU0:Router(config-if)# negotiation auto`	Enables advertisement of speed, duplex mode, and flow control on a Gigabit Ethernet interface.
`RP/0/0/CPU0:Router(config-if)# no shutdown`	Enables an interface.
`RP/0/0/CPU0:Router(config-if)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.
`RP/0/0/CPU0:Router(config-if)# end`	Prompts you to save the configuration changes and exits the configuration session.
`RP/0/0/CPU0:Router# show interfaces`	Displays the configured interface and checks the status of each interface port.
`RP/0/0/CPU0:Router# show version`	Displays the current software version, and can also be used to confirm that the router recognizes the line card.

Command Summary for the POS SPAs

Table 9-1 provides an alphabetical list of some of the related commands to configure, monitor, and maintain POS SPAs. For more information about the commands, see Chapter 10, "Command Reference" in this book and the Cisco IOS XR software command reference and master index publications.

Table 9-1 Command Summary

Command	Purpose
`RP/0/0/CPU0:router(config-sonet)# ais-shut`	Configures the automatic insertion of a line alarm indication signal (LAIS) in the sent SONET signal whenever the SONET port enters the administrative shutdown state.
`RP/0/0/CPU0:router(config)# aps group` *number*	Adds an APS group with a specified number and enters APS group configuration mode.
`RP/0/0/CPU0:router(config-aps)# channel {0 | 1} local {sonet | preconfigure}` *number*	Creates a channel for the APS group.
`RP/0/0/CPU0:router(config-sonet)# clock source {internal | line}`	Configures the SONET port TX clock source.
`RP/0/0/CPU0:router(config-sonet)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.
`RP/0/0/CPU0:Router# configure`	Enters global configuration mode.
`RP/0/0/CPU0:router(config)# controller sonet` *number*	Enters SONET controller configuration submode.
`RP/0/0/CPU0:router(config-sonet)# delay trigger line` *value*	Configures the SONET port delay trigger line value.
`RP/0/0/CPU0:router(config-if)# encapsulation [hdlc | ppp]`	Configures the interface encapsulation parameters and details such as HDLC or PPP.
`RP/0/0/CPU0:Router(config-sonet)# end`	Prompts you to save the configuration changes and exits the configuration session.
`RP/0/0/CPU0:router(config-sonet)# framing {sdh | sonet}`	Configures the controller framing.
`RP/0/0/CPU0:router(config)# interface loopback` *number*	Configures a loopback interface if a two-router APS is desired and enters interface configuration mode.
`RP/0/0/CPU0:Router(config)# interface pos` *number*	Specifies the POS interface to configure, where *number* is in the format *rack/slot/subslot/port*.

Table 9-1 Command Summary (continued)

Command	Purpose
RP/0/0/CPU0:Router(config-if)# **ipv4 address** *ip-address mask* or RP/0/0/CPU0:Router(config-if)# **ipv6 address** *ipv6-prefix/prefix-length*	Sets a primary or secondary IP address for an interface.
RP/0/0/CPU0:router(config-if)# **keepalive** [*seconds* | **disable**]	Sets the keepalive timer for the channel.
RP/0/0/CPU0:router(config-sonet)# **loopback** {**internal** | **line**}	Configures the SONET controller for loopback.
RP/0/0/CPU0:Router(config-if)# **mtu** *value*	Sets the maximum transmission unit (MTU) value for the interface.
RP/0/0/CPU0:Router(config-if)# **no shutdown**	Enables an interface.
RP/0/0/CPU0:router(config-sonet)# **overhead** {**j0** | **s1s0e**} *byte-value*	Configures the controller's overhead.
RP/0/0/CPU0:router(config-sonet)# **path** *keyword values*	Configures SONET controller path values.
RP/0/0/CPU0:router(config-sonet)# **path delay trigger** *value*	Configures SONET port delay trigger values in milliseconds.
RP/0/0/CPU0:router(config-if)# **pos crc** {**16** | **32**}	Selects a cyclic redundancy check (CRC) value for the channel.
RP/0/0/CPU0:router(config-if)# **ppp authentication** *protocol list-name*	Enables Challenge Handshake Authentication Protocol (CHAP), MS-CHAP, or Password Authentication Protocol (PAP) and specifies the order of selection on the interface.
RP/0/0/CPU0:router# **show controllers sonet** *number*	Verifies the SONET controller configuration., where *number* specifies the interface ID in the format *rack*/*slot*/*subslot*/*port*.
RP/0/0/CPU0:router(config-sonet)# **threshold** {**b1-tca** | **b2-tca** | **sd-ber** | **sf-ber**} *bit-error-rate*	Configures the bit-error rate (BER) threshold values of the specified alarms for a SONET controller.
RP/0/0/CPU0:router# **show aps**	Displays operational status for all configured SONET APS groups.
RP/0/0/CPU0:router# **show aps group** [*number*]	Displays operational status for configured SONET APS groups.
RP/0/0/CPU0:Router# **show interfaces**	Displays the configured interface and checks the status of each interface port.
RP/0/0/CPU0:Router# **show running-config**	Displays the configuration information currently running on the router.

Command Reference

This chapter documents new and modified commands. All other commands used with this feature are documented in the *Cisco IOS XR Commands Master List, Release 3.2* publication.

New Commands

- hw-module subslot power-cycle
- hw-module subslot reload
- hw-module subslot shutdown
- show fpd package
- show hw-module fpd
- show hw-module subslot brief
- show hw-module subslot config
- show hw-module subslot counters
- show hw-module subslot errors
- show hw-module subslot registers
- show hw-module subslot status
- upgrade hw-module fpd

hw-module subslot power-cycle

To power-cycle the subslot and reload Cisco IOS XR software, use the **hw-module subslot power-cycle** command in EXEC mode.

hw-module subslot *subslot-id* **power-cycle**

Syntax Description

subslot-id	Specifies the subslot to be power-cycled. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

The **hw-module subslot power-cycle** command power-cycles the subslot (including the installed SPA).

Examples

The following example shows how to power-cycle the SPA in slot 2, subslot 1:

```
RP/0/RP0/CPU0:router# hw-module subslot 0/2/1 power-cycle
```

Related Commands

Command	Description
hw-module subslot reload	Reloads the Cisco IOS XR software on a specific SPA module.

hw-module subslot reload

To reload Cisco IOS XR software on a specific subslot, use the **hw-module subslot reload** command in EXEC mode.

hw-module subslot *subslot-id* **reload**

Syntax Description

subslot-id	Specifies the subslot to be restarted. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

The **hw-module subslot reload** command reloads Cisco IOS XR software on the specified SPA and restarts the SPA interfaces. The SPA reloads with the current running configuration and active software set for the SPA.

Examples

The following example shows how to restart the SPA in slot 2, subslot 1:

```
RP/0/RP0/CPU0:GRP-7-TOP# hw-module subslot 0/2/1 reload
```

Related Commands

Command	Description
hw-module subslot power-cycle	Power-cycles a SPA module.

hw-module subslot shutdown

To administratively shut down a specified SPA, use the **hw-module subslot shutdown** command in global configuration mode. To return a SPA to the up state, use the **no** form of this command.

hw-module subslot *subslot-id* **shutdown** [**powered** | **unpowered**]

no hw-module subslot *subslot-id* **shutdown**

Syntax Description

subslot-id	Specifies the subslot to be shut down. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
powered	(Optional) Retains power to the specified subslot.
unpowered	(Optional) Powers down completely the specified subslot.

Defaults

Shutdown is powered if no option is specified.

Command Modes

Global configuration

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

The **hw-module subslot shutdown** command administratively shuts down the SPA in the specified subslot. Subslots that are shut down still have power, but cannot load or operate Cisco IOS XR software.

Examples

The following example shows how to shut down the SPA in subslot 1 of the SIP in slot 2:

```
RP/0/RP0/CPU0:GRP-7-TOP(config)# hw-module subslot 0/2/1 shutdown powered
```

Related Commands

Command	Description
shutdown	Disables an interface (forces an interface to be administratively down).

show fpd package

To display which field-programmable device (FPD) image package is needed for the router to properly support the modules for the running Cisco IOS XR software release, use the **show fpd package** command in admin EXEC mode.

show fpd package

Syntax Description

This command has no arguments or keywords.

Defaults

No default behavior or values

Command Modes

Admin EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Use the **show fpd package** command to determine which FPD image should be running on the module installed in your system.

Examples

The following example shows how to display FPD image information:

```
RP/0/RP0/CPU0:Router(admin)# show fpd package

================================ ================================================
                                        Field Programmable Device Package
                                 ================================================
                                                                      SW      Min Req
Card Type            FPD Description            Type Subtype   Version   HW Vers
==================== ========================== ==== ======= =========== =======
SPA-OC192RPR-XFP     SPA FPGA swv1.2            spa  fpga        1.2       0.0
-------------------------------------------------------------------------------
SPA-OC192POS-XFP     SPA FPGA swv1.2            spa  fpga        1.2       0.0
                     SPA FPGA swv1.2 hwv2       spa  fpga        1.2       2.0
-------------------------------------------------------------------------------
SPA-10X1GE           SPA FPGA swv1.6            spa  fpga        1.6       0.0
-------------------------------------------------------------------------------
SPA-5X1GE            SPA FPGA swv1.6            spa  fpga        1.6       0.0
-------------------------------------------------------------------------------
SPA-1XTENGE-XFP      SPA FPGA swv1.6            spa  fpga        1.6       0.0
-------------------------------------------------------------------------------
```

Table 10-1 describes the significant fields shown in the display.

Table 10-1 show fpd package Field Descriptions

Field	Description
Card Type	Module part number.
FPD Description	Description of all FPD images available for the SPA.
Type	Hardware type can be: spa—shared port adapter; lc—line card.
Subtype	FPD type can be: fabldr—fabric downloader; fpga—field-programmable gate array; rommon—read-only memory monitor
SW Version	FPD software version required for the associated module running the current Cisco IOS XR software.
Min Req HW Vers	Minimum required hardware version for the associated FPD image.

Related Commands

Command	Description
show hw-module fpd	Displays the FPD compatibility for all moduless or a specific module.
upgrade hw-module fpd	Manually upgrades the current FPD image package on a module.

show hw-module fpd

To display field-programmable device (FPD) compatibility for all modules or a specific module, use the **show hw-module fpd** command in EXEC mode.

show hw-module fpd location [**all** | *node-id*]

Syntax Description

location	Specifies the location of the module.
all	Upgrades the FPD image of all modules in the router.
node-id	Location of the module. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Examples

The following example shows how to display FPD compatibility for a specific module. Because the current field-programmable gate array (FPGA) image needs to be upgraded, a note is displayed at the end of the output:

```
RP/0/RP0/CPU0:Router# show hw-module fpd location 0/3/1

================================ ==============================================
                                      Existing Field Programmable Devices
                                 ==============================================
                                                                  Current SW    HW    Upg/
Location     Card Type                Type Subtype Inst   Version   Version Dng?
============ ======================== ==== ======= ==== =========== ======= ====
0/3/1        SPA-1XTENGE-XFP          spa  fpga    1        0.17      2.0   Yes
--------------------------------------------------------------------------------
NOTES:
```

```
1.  One or more FPD needs an upgrade or a downgrade.  This can be accomplished using the
"admin upgrade hw-module fpd" CLI.
```

Table 10-2 describes the significant fields shown in the display.

Table 10-2 show hw-module fpd Field Descriptions

Field	Description
Location	Location of the module in the *rack*/*slot*/*module* notation.
Card Type	Module part number.
Type	Hardware type can be: spa—shared port adapter; lc—line card.
Subtype	FPD type can be: fabldr—fabric downloader; fpga—field-programmable gate array; rommon—read-only memory monitor
Inst	Instance—A unique identifier that is used by the FPD process to register an FPD.
Current SW Version	Currently running FPD image version.
Min Req HW Vers	Minimum required hardware version for the associated FPD image.
Upg/Dng	Specifies whether an FPD upgrade or downgrade is required. A downgrade is required in rare cases in which the version of the FPD image has a higher major revision than the version of the FPD image in the current Cisco IOS XR software package.

Related Commands

Command	Description
show fpd package	Displays which FPD image package is needed for the router to properly support the modules for the running Cisco IOS XR software release.
upgrade hw-module fpd	Manually upgrades the current FPD image package on a module.

show hw-module subslot brief

To display summary diagnostic information about internal hardware devices for a SPA, use the **show hw-module subslot brief** command in EXEC mode.

show hw-module subslot [*node-id*] **brief** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device, if there are multiple devices of the same type.
device-subindex	Subindex of the specific device, if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot brief** command to obtain summary diagnostic information about an interface on the SPA.

Examples

The following is sample output from the **show hw-module subslot brief** command:

```
RP/0/RP0/CPU0:GRP-7-TOP# show hw-module subslot brief

BAY 0 brief info:
-------------------
SPA inserted: YES
SPA type:     1xOC192 POS/RPR HHSPA with XFP
SPA operational state: READY
SPA cfg admin up: YES

BAY 1 brief info:
-------------------
SPA inserted: YES
SPA type:     1xOC192 POS/RPR FHSPA
SPA operational state: READY
SPA cfg admin up: YES
```

Table 10-3 describes the significant fields shown in the display.

Table 10-3 show hw-module subslot brief Field Descriptions

Field	Description
SPA inserted	Indicates if a SPA is currently detected in the subslot.
SPA type	Description of SPA including the technology type, number of ports, height of SPA (HHSPA—single-height, FHSPA—double-height), and optics type.
SPA operational state	Current state of the SPA module.
SPA cfg admin	Configured state of the SPA: YES—the SPA is not shut down, NO—the SPA is shut down.

The following is sample output from the **show hw-module subslot brief** command with the **c2w** option:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 brief c2w

 SPA device c2w index 0 subindex 0 info:

Auxiliary C2W (0x0803bfbc), name AUX C2W (busywait), state 4

SPA device c2w index 0 subindex 0 info:

Auxiliary C2W (0x080638c4), name AUX C2W (busywait), state 4
```

Related Commands

Command	Description
show controllers	Displays the controller type and other information.

show hw-module subslot config

To display information related to configuration of the specified internal hardware device on a SPA, use the **show hw-module subslot config** command in EXEC mode.

show hw-module subslot [*node-id*] **config** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device if there are multiple devices of the same type.
device-subindex	Subindex of the specific device if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can also enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot config** command to obtain diagnostic information about the configuration of an interface on the SPA.

Examples

The following is sample output for the **show hw-module subslot config** command:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 config

BAY 0 config info:
------------------
SPA inserted: YES
SPA cfg admin up: YES
SPA cfg power up: YES

BAY 1 config info:
------------------
SPA inserted: YES
SPA cfg admin up: YES
SPA cfg power up: YES
```

Table 10-4 describes the significant fields shown in the display.

Table 10-4 show hw-module subslot config Field Descriptions

Field	Description
SPA inserted	Indicates if a SPA is currently detected in the subslot.
SPA cfg admin up	Configured state of the SPA: YES—the SPA is not shut down, NO—the SPA is shut down.
SPA cfg power up	Indicates whether or not the subslot is currently configured as powered.

Related Commands

Command	Description
show controllers	Displays the controller type and other information.

show hw-module subslot counters

To display statistics related to the processing of internal hardware devices for a SPA, use the **show hw-module subslot counters** command in EXEC mode.

show hw-module subslot [*node-id*] **counters** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device if there are multiple devices of the same type.
device-subindex	Subindex of the specific device if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can also enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot counters** command to display statistics related to the processing by the specified internal hardware device.

Examples

The following is sample output from the **show hw-module subslot counters** command:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 counters

BAY 0 counts info:
------------------
SPA inserted: YES
SPA type:     5xGE SPA
SPA operational state: READY
SPA insertion time:  Fri Nov 19 01:49:07 2004
SPA last time ready: Fri Nov 19 01:49:42 2004
SPA uptime [HH:MM:SS]: 49:49:29

BAY 1 counts info:
------------------
SPA inserted: YES
SPA type:     1xOC192 POS/RPR HHSPA with XFP
SPA operational state: READY
SPA insertion time:  Fri Nov 19 01:49:08 2004
SPA last time ready: Fri Nov 19 01:49:35 2004
SPA uptime [HH:MM:SS]: 49:49:36
```

Table 10-5 describes the significant fields shown in the display.

Table 10-5 show hw-module subslot counters Field Descriptions

Field	Description
SPA inserted	Indicates if a SPA is currently detected in the subslot.
SPA type	Description of SPA including the technology type, number of ports, height of SPA (HHSPA—single-height, FHSPA—double-height), and optics type.
SPA operational state	Current state of the SPA module.
SPA insertion time	Time the SPA module was last physically inserted or power-cycled.

Table 10-5 show hw-module subslot counters Field Descriptions (continued)

Field	Description
SPA last time ready	Time the SPA module last changed state to up or ready (the last time the module was loaded or reloaded).
SPA uptime	The time in service or amount of time since the module was last out of service due to a reload, power-cycle, or configuration event.

The following is sample output from the **show hw-module subslot counters** command with the **framer** keyword:

```
RP/0/RP0/CPU0:ios# show hw-module subslot counters framer

SPA device framer index 0 subindex 0 info:

Milan Framer counters:
STREAM 0
Rx Bytes (48-bit) (#0x381fa078-0x883c): 163857232569448
Rx Good Bytes (48-bit) (#0x381fa080-0x8840): 1964924
Rx Good Packets (48-bit) (#0x381fa040-0x8820): 26234
Tx Byte Cnt Reg (48-bit) (#0x381fe070-0xa838): 9375380
Tx Good Bytes Cnt Reg (48-bit) (#0x381fe068-0xa834): 8909442
Tx Transmitted Packet Cnt Reg (48-bit) (#0x381fe040-0xa820): 114692
```

show hw-module subslot errors

To display error information about internal hardware devices for a SPA, use the **show hw-module subslot errors** command in EXEC mode.

show hw-module subslot [*node-id*] **errors** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device, if there are multiple devices of the same type.
device-subindex	Subindex of the specific device, if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can also enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot errors** command to display error information related to the specified internal hardware device on a SPA.

Examples The following is sample output from the **show hw-module subslot errors** command with the **pluggable-optics** keyword:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 errors pluggable-optics

 SPA device pluggable-optics index 0 subindex 0 info:

Phased Initialization
        Phase Reached: 4
        Phase Exit Code: 0
        Phase Read Offset: 256

Socket Verification
        Not supported

 SPA device pluggable-optics index 0 subindex 0 info:

Phased Initialization
        Phase Reached: 2
        Phase Exit Code: 3
        Phase Read Offset: 256

Socket Verification
        Not supported
```

Related Commands

Command	Description
show controllers	Displays the controller type and other information.

show hw-module subslot registers

To display register information about internal hardware devices for a SPA, use the **show hw-module subslot registers** command in EXEC mode.

show hw-module subslot [*node-id*] **registers** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device, if there are multiple devices of the same type.
device-subindex	Subindex of the specific device, if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can also enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot registers** command to display register information for the specified internal hardware device on the SPA.

Examples The following example shows sample output from the **show hw-module subslot registers** command:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 registers

BAY 0 registers info:
-----------------------
SPA hardware ID : 0x1
SPA SW FPGA rev.: 0x10

BAY 1 registers info:
-----------------------
SPA hardware ID : 0x90000000
SPA SW FPGA rev.: 0xD
```

Related Commands

Command	Description
show controllers	Displays the controller type and other information.

show hw-module subslot status

To display status information about internal hardware devices for a SPA, use the **show hw-module subslot status** command in EXEC mode.

show hw-module subslot [*node-id*] **status** *device device-index device-subindex*

Syntax Description

node-id	(Optional) Specifies the location for which to display the specified information. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
device	Specifies the internal hardware device for which to display the specified information. Valid devices include: • **analog-digital-converter**—Displays analog-to-digital converter information. • **c2w**—Displays Cisco-to-wire bus device information. • **fpga**—Displays SPA field-programmable gate array information. • **framer**—Displays SONET framer information. (Not applicable to Ethernet SPAs.) • **l2-tcam**—Displays SPA Layer 2 ternary content addressable memory information. (Not applicable to POS SPAs.) • **mac**—Displays SPA MAC information. (Not applicable to POS SPAs.) • **pluggable-optics**—Displays pluggable-optics module information. • **power-margining**—Displays power-margining device information. • **sdcc**—Displays section data communications channel device information. (Not applicable to Ethernet SPAs.) • **serdes**—Displays SPA serializer/deserializer information. • **spi4.2**—Displays system packet interface level 4.2 bus device information. • **temperature-sensor**—Displays temperature sensor information.
device-index	Index of the specific device, if there are multiple devices of the same type.
device-subindex	Subindex of the specific device, if there are multiple devices of the same device index.

Defaults

No default behavior or values

Command Modes EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

Enter the command **show platform** to display the nodes on the router.

You can also enter a partially qualified location specifier by using the wildcard (*) character. For example, 0/1/* would display information for all modules on slot 1 in rack 0.

Use the **show hw-module subslot status** command to obtain status information about an interface on the SPA.

Examples The following example shows sample output from the **show hw-module subslot status** command with the **temperature-sensor** keyword:

```
RP/0/RP0/CPU0:ios# show hw-module subslot 0/2/cpu0 status temperature-sensor

 SPA device temperature-sensor index 0 subindex 0 info:

DS1631 (0x0803c2e4) device status:
temperature = 0x1c80 (28.5 degree C)


 SPA device temperature-sensor index 0 subindex 0 info:

DS1631 (0x08063bec) device status:
temperature = 0x1e00 (30.0 degree C)
```

Related Commands

Command	Description
show controllers	Displays the controller type and other information.

upgrade hw-module fpd

To manually upgrade the current field-programmable device (FPD) image package on a module, use the **upgrade hw-module fpd** command in admin EXEC mode.

upgrade hw-module fpd {**all** | **fabldr** | *fpga-type* | **rommon**} [**force**] **location** [**all** | *node-id*] [**reload**]

Syntax Description

all	Upgrades all FPD images on the selected module.
fabldr	Upgrades the fabric-downloader image on the module.
fpga-type	Upgrades a specific field-programmable gate array (FPGA) image on the module. Use the **show fpd package** command to view all available FPGA images available for a specific module.
rommon	Upgrades the rommon on the module.
force	(Optional) Forces the update of the indicated FPD image package on a SPA that meets the minimum version requirements. Without this option, the manual upgrade upgrades only incompatible FPD images.
location	Specifies the location of the module.
all	(Optional) Upgrades the FPD image of all modules in the router.
node-id	(Optional) Location of the module. Naming notation is *rack*/*slot*/*subslot* and a slash between values is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the SPA interface processor (SIP). • *subslot*: Subslot number of the SPA. For more information about the syntax for the router, use the question mark (?) online help function.
reload	Reloads the module after the FPD image has been updated. If you do not use the **reload** keyword, you must manually reload the module before the FPD upgrade is complete. Use the **hw-module node reload** or **hw-module subslot reload** EXEC command to reload the module.

Defaults

No default behavior or values

Command Modes

Admin EXEC

Command History

Release	Modification
Release 3.2	This command was introduced on the Cisco XR 12000 Series Router and the Cisco 12000 Series Router.
Release 3.3	The **reload** keyword was added. Support for multiple FPGA images was added.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. For detailed information about user groups and task IDs, refer to the *Configuring AAA Services on Cisco IOS XR Software* module of the *Cisco IOS XR System Security Configuration Guide*.

During the upgrade procedure, the module needs to be offline (shut down but powered).

Examples

The following example shows how to upgrade the default FPGA on a SPA in the Cisco CRS-1 and the output generated:

```
RP/0/RP0/CPU0:Router# admin
RP/0/RP0/CPU0:Router(admin)# upgrade hw-module fpd fpga force location 0/1/4

% RELOAD REMINDER:
  - The upgrade operation of the target module will not interrupt its normal
    operation. However, for the changes to take effect, the target module
    will need to be manually reloaded after the upgrade operation. This can
    be accomplished with the use of "hw-module <target> reload" command.
  - If automatic reload operation is desired after the upgrade, please use
    the "reload" option at the end of the upgrade command.
  - The output of "show hw-module fpd location" command will not display
    correct version information after the upgrade if the target module is
    not reloaded.
Continue? [confirm] y

SP/0/1/SP:Dec 22 05:41:17.920 : upgrade_daemon[125]: programming...with file /ne
t/node0_RP1_CPU0/hfr-lc-3.3.83/fpd/ucode/fpga_gladiator_sw0.6.xsvf
SP/0/1/SP:Dec 22 05:41:28.900 : upgrade_daemon[125]: ...programming...
SP/0/1/SP:Dec 22 05:41:28.906 : upgrade_daemon[125]: ...it will take a while...
SP/0/1/SP:Dec 22 05:41:29.004 : upgrade_daemon[125]: ...it will take a while...
SP/0/1/SP:Dec 22 05:43:03.432 : upgrade_daemon[125]: ...programming...
SP/0/1/SP:Dec 22 05:43:03.438 : upgrade_daemon[125]: ...it will take a while...
Successfully upgraded spa fpga instance 4 on location 0/1/4.
```

The following example shows how to upgrade the default FPGA on a SPA in the Cisco 12000 Series Router and the output generated:

```
RP/0/0/CPU0:Router# admin
RP/0/0/CPU0:Router(admin)# upgrade hw-module fpd fpga force location 0/3/0

% RELOAD REMINDER:
  - The upgrade operation of the target module will not interrupt its normal
    operation. However, for the changes to take effect, the target module
    will need to be manually reloaded after the upgrade operation. This can
    be accomplished with the use of "hw-module <target> reload" command.
  - If automatic reload operation is desired after the upgrade, please use
    the "reload" option at the end of the upgrade command.
  - The output of "show hw-module fpd location" command will not display
    correct version information after the upgrade if the target module is
    not reloaded.
Continue? [confirm] y

LC/0/3/CPU0:Dec 22 06:46:59.732 : spa_192_jacket_v2[203]: %SPA_FPD-6-UPDATE_STAR
T : SPA-4XCT3/DS0[0]: Starting update of FPD 'fpga' image
LC/0/3/CPU0:Dec 22 06:47:23.518 : spa_192_jacket_v2[203]: %SPA_FPD-6-UPDATE_PASS
ED : SPA-4XCT3/DS0[0]: Successfully updated FPD 'fpga' image
Successfully upgraded spa fpga instance 0 on location 0/3/0.
```

Related Commands

Command	Description
show fpd package	Displays which FPD image package is needed for the router to properly support the modules for the running Cisco IOS XR software release. It also indicates all available FPD images that are available for a specific module.
show hw-module fpd	Displays the FPD compatibility for all modules or a specific module.

D

double height Describes the dimension of a SPA that occupies two, vertically-aligned SIP subslots.

F

FPD Field-programmable device. General term for any hardware component implemented on router cards that supports separate software upgrades. SIPs and SPAs must have the right FPD version to function properly; an FPD incompatibility will disable all interfaces on the SPA or all SPAs within the SIP.

FPD image package An FPD image package is used to upgrade FPD images. Whenever a Cisco IOS image is released that supports SPAs, a companion SPA FPD image package is also released for that Cisco IOS software release.

O

OIR Online insertion and removal. Feature supported by SIPs and SPAs allowing removal of the cards while the router and the cards are activated, without affecting the operation of other cards or the router. Although this removal can be done while the SIP or SPA is activated, it is generally recommended that you gracefully deactivate the hardware using the appropriate commands for your platform prior to removal of the hardware.

S

SFP Small form-factor pluggable optical transceiver. A type of fiber optic receptacle device that mounts flush with the front panel to provide network connectivity.

single height Describes the dimension of a SPA that occupies a single SIP subslot, or half of the SIP.

SIP SPA interface processor. A SIP is a platform-specific carrier card that inserts into a router slot like a line card. A SIP can hold one or more SPAs in its subslots, depending on the SIP type. The SPA provides the network interface. The SIP provides the connection between the route processor (RP) and the SPA.

SPA Shared Port Adapter. A SPA is a modular line card that inserts into the subslot of a SIP (carrier card) to provide network connectivity and increased interface port density on a router. The SPA provides the interface between the network and the SIP.

subslot Secondary slot on a SIP where a SPA is installed. The primary slot is the chassis slot on the router.

Symbols

A

B

C

D

E

F

H

I

J

K

L

M

N

O

P

R

S

T

U