Release Notes for Cisco CRS-1 and Cisco CRS-3 for Cisco IOS XR Software Release

Cisco IOS XR Software is a distributed operating system designed for continuous system operation combined with service flexibility and higher performance.

These release notes describe the features provided in the Cisco IOS XR Software Release 4.2.1 for the Cisco CRS router and are updated as needed.

Note For information on the Cisco CRS router running Cisco IOS XR Software Release 4.2.1, see the "Important Notes on Cisco IOS XR Software and Cisco CRS Router, on page 54" section.

You can find the most current Cisco IOS XR software documentation at:

http://www.cisco.com/en/US/products/ps5763/tsd_products_support_series_home.html

These electronic documents may contain updates and modifications. For more information on obtaining Cisco documentation, see the "Obtaining Documentation and Submitting a Service Request".

For a list of software caveats that apply to Cisco IOS XR Software Release 4.2.1 , see the "Caveats" section. The caveats are updated for every release and are described at www.cisco.com.

We recommend that you view the field notices for this release located at the following URL to see if your software or hardware platforms are affected:
http://www.cisco.com/en/US/support/tsd_products_field_notice_summary.html

Cisco IOS XR Software running on the Cisco CRS Router provides the following features and benefits:

- **IP and Routing—**This supports a wide range of IPv4 and IPv6 services and routing protocols such as Border Gateway Protocol (BGP), Routing Information Protocol (RIPv2), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), IP Multicast, Routing Policy Language (RPL), Hot Standby Router Protocol (HSRP), and Virtual Router Redundancy Protocol (VRRP) features.
- **BGP Prefix Independent Convergence—**This provides the ability to converge BGP routes within sub seconds instead of multiple seconds. The Forwarding Information Base (FIB) is updated, independent of a prefix, to converge multiple 100K BGP routes with the occurrence of a single failure. This convergence is applicable to both core and edge failures and with or without MPLS. This fast convergence innovation is unique to Cisco IOS XR Software.

- **Multiprotocol Label Switching (MPLS)—**This supports MPLS protocols, including Traffic Engineering (TE), Resource Reservation Protocol (RSVP), Label Distribution Protocol (LDP), Virtual Private LAN Service (VPLS), Layer 2 Virtual Private Network (L2VPN), and Layer 3 Virtual Private Network (L3VPN).
- **Multicast—**This provides comprehensive IP Multicast software including Source Specific Multicast (SSM) and Protocol Independent Multicast (PIM) in Sparse Mode only, and Bidirectional Protocol Independent Multicast (BIDIR-PIM).
- **Quality of Service (QoS)—**This supports QoS mechanisms including policing, marking, queuing, random and hard traffic dropping, and shaping. Additionally, Cisco IOS XR Software also supports modular QoS command-line interface (MQC). MQC is used to configure QoS features.
- **Manageability—**This provides industry-standard management interfaces including modular command-line interface (CLI), Simple Network Management Protocol (SNMP), and native Extensible Markup Language (XML) interfaces. Includes a comprehensive set of Syslog messages.
- **Security—**This provides comprehensive network security features including access control lists (ACLs); routing authentications; Authentication, Authorization, and Accounting (AAA)/Terminal Access Controller Access Control System (TACACS+), Secure Shell (SSH), Management Plane Protection (MPP) for management plane security, and Simple Network Management Protocol version3 (SNMPv3). Control plane protections integrated into line card Application-Specific Integrated Circuits (ASICs) include Generalized TTL Security Mechanism (GTSM), RFC 3682, and Dynamic Control Plane Protection (DCPP).
- **Availability—**This supports rich availability features such as fault containment, fault tolerance, fast switchover, link aggregation, nonstop routing for ISIS, LDP, BGP, and OSPF, and nonstop forwarding (NSF).
- **Multicast service delivery in SP NGN—**MVPNv4 support carries multicast traffic over an ISP MPLS core network.
- **IPv6 Provider Edge Router support for IPv6 applications—**This delivers IPv6 traffic over an IPv4/MPLS core with IPv6 provider edge router (6PE) support.
- **IPv6 VPN over MPLS (6VPE) support—**This delivers IPv6 VPN over MPLS (IPv6) VPN traffic over an IPv4 or MPLS core with 6VPE support.
- **IPv6 VPN over IP —**This delivers IPv6 VPN over IP traffic.

Note IPv6 VPN over MPLS and IPv6 VPN over IP won't co-exist

- **Carrier Grade Network Address Translation (CGN)—**This enables services providers to execute orderly transitions to IPv6 through mixed IPv4 and IPv6 networks. CGN provides address family translation but is not limited to just translation within one address family. CGN delivers a comprehensive solution suite for IP address management and IPv6 transition.
- **Enhanced core competencies:**
  - IP fast convergence with Fast reroute (FRR) support for intermediate System-to-Intermediate System (IS-IS) and OSPF
  - Traffic engineering support for unequal load balancing

- Traffic engineering over generic routing encapsulation (GRE) tunnel interfaces—LDP, L2VPN, and L3VPN over TE over GRE are supported. VPN routes over TE and over GRE, require a labelled path for path resolution
- VRF support for GRE tunnel interfaces—This support includes GRE tunnel interfaces under a VRF, however the GRE tunnel source and destination are in the global table
- RSVP support over GRE tunnels
- Path Computation Element (PCE) capability for traffic engineering

For more information about new features provided on the Cisco CRS router for Cisco IOS XR Software Release 4.2.1 see the "New Cisco CRS Router Software Features" section in this document.

System Requirements

This section describes the system requirements for Cisco IOS XR Software Release 4.2.1 supported on the Cisco CRS Router.

To determine the software versions or levels of your current system, see the "Determining Your Software Version, on page 22" section.

The systems requirements include the following information:

Feature Set Table

Table 1: Cisco IOS XR Software Release 4.2.1 PIE Files, on page 4 lists the Cisco IOS XR Software feature set matrix (PIE files) and associated filenames available for the Cisco IOS XR Software Release 4.2.1 supported on the Cisco CRS router.

Table 1: Cisco IOS XR Software Release 4.2.1 PIE Files

Feature Set	Filename	Description
Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	hfr-mini-px-4.2.1	Contains the required core packages, including OS, Admin, Base, Forwarding, Modular Services Card, Routing, SNMP Agent, and Alarm Correlation.
Cisco IOS XR IP Unicast Routing Core Bundle	hfr-mini-px.vm-4.2.1	Contains the required core packages including OS, Admin, Base, Forwarding, Modular Services Card, Routing, SNMP Agent, and Alarm Correlation.
Optional Individual Packages[1]		
Cisco IOS XR Manageability Package	hfr-mgbl-px.pie-4.2.1	CORBA [2] agent, XML [3] Parser, and HTTP server packages.
Cisco IOS XR MPLS Package	hfr-mpls-px.pie-4.2.1	MPLS-TE [4], LDP [5], MPLS Forwarding, MPLS OAM [6], LMP [7], OUNI [8], RSVP [9], and Layer-2 VPN and Layer-3 VPN.
Cisco IOS XR Multicast Package	hfr-mcast-px.pie-4.2.1	Multicast Routing Protocols (PIM, MSDP[10], IGMP [11], Auto-RP), Tools (SAP, MTrace), and Infrastructure (MRIB [12], MURIB [13] , MFWD [14]), and BIDIR-PIM. [15]
Cisco IOS XR Security Package	hfr-k9sec-px.pie-4.2.1	Support for Encryption, Decryption, IPSec[16], SSH[17], SSL[18], and PKI[19] (Software based IPSec support—maximum of 500 tunnels)

Cisco IOS XR FPD Package	hfr-fpd-px.pie-4.2.1	Firmware for Fixed PLIM[20] and SPA[21] modules as well as ROMMON[22] images for Cisco CRS chassis.
Cisco IOS XR Diagnostic Package	hfr-diags-px.pie-4.2.1	Diagnostic utilities for Cisco IOS XR routers.
Cisco IOS XR Documentation Package	hfr-doc-px.pie-4.2.1	.man pages for Cisco IOS XR Software on the Cisco CRS chassis.
Cisco IOS XR Carrier Grade Services Engine Package	hfr-services-px.pie-4.2.1	Support for Carrier Grade NAT and Cloud Centric Networking on Cisco CRS routers.

1 Packages are installed individually
2 Common Object Request Broker Architecture
3 Extensible Markup Language
4 MPLS Traffic Engineering
5 Label Distribution Protocol
6 Operations, Administration, and Maintenance
7 Link Manager Protocol
8 Optical User Network Interface
9 Resource Reservation Protocol
10 Multicast Source Discovery Protocol
11 Internet Group Management Protocol
12 Multicast Routing Information Base
13 Multicast-Unicast RIB
14 Multicast forwarding
15 Bidirectional Protocol Independent Multicast
16 IP Security
17 Secure Shell
18 Secure Socket Layer
19 Public-key infrastructure
20 Physical layer interface module
21 Shared port adapters
22 ROM monitor

Table 2: Cisco IOS XR Software Release 4.2.1 TAR Files, on page 5 lists the Cisco CRS Router TAR files.

Table 2: Cisco IOS XR Software Release 4.2.1 TAR Files

Feature Set	Filename	Description

Cisco IOS XR IP/MPLS Core Software	CRS-iosxr-px-4.2.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR Diagnostic Package • Cisco IOS XR FPD Package
Cisco IOS XR IP/MPLS Core Software 3DES	CRS-iosxr-px-k9-4.2.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR Security Package • Cisco IOS XR Diagnostic Package • Cisco IOS XR FPD Package

Memory Requirements

Caution If you remove the media in which the software image or configuration is stored, the router may become unstable and fail.

The minimum memory requirements for a Cisco CRS running Cisco IOS XR Software Release 4.2.1 consist of the following:

- 4-GB memory on the route processors (RPs)
- 2-GB memory on Modular Services Card (MSC-40) and Forwarding Processor (FP-40)
- 4-GB memory on MSC-140 and FP-140
- 4-GB PCMCIA Flash Disk on the route processors (RPs)

- 6-GB memory on Performance Route Processors (PRPs)

Hardware Supported

All hardware features are supported on Cisco IOS XR Software, subject to the memory requirements specified in the "Memory Requirements, on page 6" section.

The following tables lists the supported hardware components on the Cisco CRS Router and the minimum required software versions. For more information, see the "Firmware Support, on page 17" section.

Table 3: Cisco CRS Supported Hardware and Minimum Software Requirements

Component	Part Number	Support from version
Cisco CRS Series 16-Slot Line Card Chassis		
Cisco CRS 16-Slot Line Card Chassis	CRS-16-LCC	3.2
Cisco CRS Fan Tray for 16-Slot LCC	CRS-16-LCC-FAN-TR	3.2
Cisco CRS Fan Controller for 16-Slot Line Card Chassis	CRS-16-LCC-FAN-CT	3.2
Cisco CRS 16-Slot Alarm Board	CRS-16-ALARM	3.2
Cisco CRS AC Delta Power Shelf for 16-Slot LCC	CRS-16-LCC-PS-ACD	3.2
Cisco CRS AC Wye Power Shelf for 16-Slot LCC	CRS-16-LCC-PS-ACW	3.2
Cisco CRS DC Power Shelf for 16-Slot LCC	CRS-1-LCC-PS-DC	3.2
Cisco CRS LCC Front AC Power Panel	CRS-16-ACGRILLE	3.2
Cisco CRS LCC Front DC Power Panel	CRS-16-DCGRILLE	3.2
Cisco CRS Line Card Chassis Front Doors	CRS-16-LCC-DRS-F	3.2
Cisco CRS Line Card Chassis Front Cable Mgmt	CRS-16-LCC-FRNT	3.2
Cisco CRS LCC Expanded Front Cable Mgmt	CRS-16-LCC-FRNT-E	3.2
Cisco CRS Line Card Chassis Rear Cable Mgmt	CRS-16-LCC-BCK-CM	3.2
Cisco CRS Line Card Chassis Rear Doors	CRS-16-LCC-DRS-R	3.2
Cisco CRS Lift for LCC 16 and FCC	CRS-16-LIFT/B	3.2
Cisco CRS DC PEM for 16 slot LCC and FCC	CRS-16-DC-PEM	3.2

Cisco CRS 16 Slot System Reduced-Noise DC PEM	CRS-16-DC-PEM-B	3.8
Cisco CRS 16 Slot System Reduced-Noise Fan Tray	CRS-16-LCC-FNTR-B	3.8
Cisco CRS Series LC Chassis Fan Controller	CRS-16-LCC-F-CT-B	4.0.1PX
Cisco CRS 16-Slot Enhanced Line Card Chassis	CRS-16-LCC-B	4.0.3
Cisco CRS Modular Power Alarm for 16 slots and FCC	CRS-16-ALARM-C	3.9
Cisco CRS Modular Power Grill For 16 Slots and FCC	CRS-16-PW-GRILL	3.9
Cisco CRS Modular DC Power Shelf for 16 slots LCC	CRS-16LCC-PSH-DC	3.9
Cisco CRS Modular AC Power Shelf for 16 slots LCC	CRS-16LCC-PSH-AC	3.9
Cisco CRS Modular AC Power Module	CRS-PM-AC	3.9
Cisco CRS Series 8-Slot Line Card Chassis		
Cisco CRS 8-Slot Install Kit	CRS-8-INSTALL-KT	N/A
Cisco CRS 8-Slot Fork Lift Tube	CRS-8-LIFT-TUBE	N/A
Cisco CRS 8-Slot Front Badge Panel	CRS-8-BDG-PANEL	N/A
Cisco CRS 8-Slot Front Inlet Grill	CRS-8-FRNT-GRILL	N/A
Cisco CRS 8-Slot Horizontal Install Rails	CRS-8-HRZ-RAILS	N/A
Cisco CRS 8-Slot Line Card Chassis	CRS-8-LCC	3.2
Cisco CRS Fan Tray for 8-Slot Line Card Chassis	CRS-8-LCC-FAN-TR	3.2
Cisco CRS Line Card Chassis Filter Pack	CRS-8-LCC-FILTER	3.2
Cisco CRS AC Pwr Rectifier for 8-Slot LCC	CRS-8-AC-RECT	3.2
Cisco CRS DC Power Entry Module for 8-Slot LCC	CRS-8-DC-PEM	3.2
Cisco CRS AC & DC Power Module Filter for 8-Slot LCC	CRS-8-PWR-FILTER	3.2

Cisco CRS AC Delta PDU for CRS-8 LCC	CRS-8-LCC-PDU-ACD	3.2
Cisco CRS AC Wye PDU for CRS-8 LCC	CRS-8-LCC-PDU-ACW	3.2
Cisco CRS DC PDU for CRS-8 LCC	CRS-8-LCC-PDU-DC	3.2
Cisco CRS 8-Slot Enhanced Line Card Chassis	CRS-8-LCC-B	4.2.0
Cisco CRS Modular DC Power Shelf for 8 slots Chassis	CRS-8-PSH-DC	3.9
Cisco CRS Modular DC Power Module	CRS-PM-DC	3.9
Cisco CRS Modular AC Power Shelf for 8 slots Chassis	CRS-8-PSH-AC	3.9
Cisco CRS Modular AC Power Module	CRS-PM-AC	3.9
Cisco CRS Series 4-Slot Line Card Chassis		
Cisco CRS 4-Slot Line Card Chassis	CRS-4-CH	3.4
Cisco CRS Fabric Chassis Hardware		
CRS-FCC= Cisco CRS-1 Series Fabric Card Chassis Only	CRS-FCC=	3.2
CRS-1 Fabric Chassis AC Delta Power Kit	CRS-FCC-ACD-KIT	3.2
CRS-1 Fabric Chassis AC Grille	CRS-FCC-ACGRILLE	3.2
CRS-1 Fabric Chassis AC-Wye Power Kit	CRS-FCC-ACW-KIT	3.2
CRS Fabric Chassis DC Power Kit	CRS-FCC-DC-KIT	3.2
CRS-1 Fabric Chassis DC Power Grille	CRS-FCC-DCGRILLE	3.2
CRS Fabric Chassis Lift Bracket	CRS-FCC-LIFT-BRKT	3.2
CRS Fabric Chassis OIM Modules	CRS-FCC-OIM-1S=	3.2
Cisco CRS-1 Series FC Chassis Shelf/Fan/Enet cntr	CRS-FCC-SC-GE=	3.2
CRS-1 Fabric Chassis AC Intake Grille	CRS-FCC-ACGRILLE=	3.2
CRS-1 Fabric Chassis DC Intake Grille	CRS-FCC-DCGRILLE=	3.2
Cisco CRS-1 Series Fan Tray for FCC	CRS-FCC-FAN-TR=	3.2
CRS-1 Fabric Card Chassis Fan Tray Filters	CRS-FCC-FILTER=	3.2

CRS-1 Fabric Chassis Front Cosmetic Kit	CRS-FCC-FRNT-CM=	3.2
Cisco CRS-1 Series Fabric Card Chassis Fiber Module LED	CRS-FCC-LED=	3.2
Cisco CRS-1 Series DC Power Shelf for FCC	CRS-FCC-PS-DC=	3.2
CRS-1 Fabric Chassis Rear Cosmetic Kit	CRS-FCC-REAR-CM=	3.2
CRS-LIFT Brackets for Fabric Chassis	CRS-FCC-LIFT-BRKT=	3.2
CRS Fabric Chassis OIM Module	CRS-FCC-OIM-1S	3.2
CRS-1 Fabric Chassis AC Delta Power Supply	CRS-FCC-PS-ACD	3.2
CRS-1 Fabric Chassis AC Wye Option	CRS-FCC-PS-ACW	3.2
CRS-1 Fabric Chassis DC Power Option	CRS-FCC-PS-DC	3.2
Cisco CRS-1 Series Fabric Card Chassis Switch Fabric Card	CRS-FCC-SFC=	3.2
CRS-1 Fabric Chassis Integrated Switch Controller Card	CRS-FCC-SC-22GE Integrated Switch	3.4.1
Cisco CRS General Chassis Hardware		
Cisco CRS PCMCIA Flash Disk 4 GB	CRS-FLASH-DISK-4G	3.8
Cisco CRS Modular Services Card	CRS-MSC	3.2
Cisco CRS Modular Service Card B	CRS-MSC-B	3.6
Cisco CRS-1 Series Forwarding Processor 40G	CRS-FP40	3.8.1
Cisco CRS Series Modular Services Card 140G	CRS-MSC-140G	4.0.0 PX
Cisco CRS Series Forwarding Processor Card 140G	CRS-FP140	4.0.0 PX
Cisco CRS PCMCIA Flash Disk 16 GB	CRS-FLASH-DISK-16G	4.2
Cisco CRS 8-Slot Fabric Card/Single	CRS-8-FC/S	3.2
Cisco CRS 8-Slot Fabric Card Blank	CRS-8-FC-BLANK	3.2
Cisco CRS 8-Slot Fabric Handle	CRS-8-FC-HANDLE	3.2
Cisco CRS 16-Slot Fabric Card/Single	CRS-16-FC/S	3.2

Cisco CRS Series 4 Slots Fabric Card / Single (140G)	CRS-4-FC140/S	4.0.0 PX
Cisco CRS Series 8 Slots Fabric Card / Single (140G)	CRS-8-FC140/S	4.0.0 PX
Cisco CRS Series 16 Slots Fabric Card / Single (140G)	CRS-16-FC140/S	4.0.0 PX
Cisco CRS Interface and Route Processor Cards		
Cisco CRS 8-Slot Route Processor	CRS-8-RP	3.2
Cisco CRS 8-Slot Route Processor Blank	CRS-8-RP-BLANK	3.2
Cisco CRS 8-Slot Route Processor Handle	CRS-8-RP-HANDLE	3.2
Cisco Carrier 1 Series SPA Interface Processor 40G	CRS1-SIP-800	3.2
Cisco CRS-1 Distributed Route Processor	CRS-DRP	3.3
Cisco CRS-1 Distributed Route Processor CPU Module	CRS-DRP-B-CPU	3.4.1
Cisco CRS-1 Distributed Route Processor PLIM Module	CRS-DRP-B-PLIM	3.4.1
Cisco CRS-1 16-slot Route Processor, revision B	CRS-16-RP-B	3.3
Cisco CRS Series 14x10GbE LAN/WAN-PHY Interface Module	14X10GBE-WL-XFP	4.0.0 PX
Cisco CRS Series 20x10GbE LAN/WAN-PHY Interface Module	20X10GBE-WL-XFP	4.0.0 PX
Cisco CRS 1-port 100-GE CFP PLIM	1x100-GE CFP PLIM	4.0.1 PX
Cisco CRS-1 Series 8 Slots 6 Gb Performance Route Processor	CRS-8-PRP-6G	4.1
Cisco CRS-1 Series 8 Slots 12 Gb Performance Route Processor	CRS-8-PRP-12G	4.1
Cisco CRS-1 Series 16 Slots 6 Gb Performance Route Processor	CRS-16-PRP-6G	4.1
Cisco CRS-1 Series 16 Slots 12 Gb Performance Route Processor	CRS-16-PRP-12G	4.1

Cisco CRS Series 4x40GbE OTU3 Interface Module	4-40GE-L/OTN	4.2.3
Cisco CRS Series 2x40GbE OTU3 Interface Module	2-40GE-L/OTN	4.2.3
Cisco CRS Series 1x100GbE IPoDWDM Interface Module	1-100GE-DWDM/C	4.2.3
Cisco CRS SONET Interface Modules and SPAs		
Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/VS	4OC192-POS/DPT-VS	3.2
Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/SR	4OC192-POS/DPT-SR	3.2
Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/IR	4OC192-POS/DPT-IR	3.2
Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/LR	4OC192-POS/DPT-LR	3.2
Cisco CRS 16xOC-48c/STM16c POS/DPT Interface Module	16OC48-POS/DPT	3.2
Cisco CRS 1xOC-768c/STM256c POS Interface Module/SR	1OC768-POS-SR	3.2
Cisco CRS 8-Port OC-12c/STM-4c Shared Port Adapter	SPA-8XOC12-POS	3.3
Cisco CRS 2-Port OC-48c/STM-16c POS/RPR Shared Port Adapter	SPA-2XOC48-POS/RPR	3.4
Cisco CRS 4-Port OC-48c/STM-16c POS/RPR Shared Port Adapter	SPA-4XOC48-POS/RPR	3.4
Cisco CRS 1-Port OC-192c/STM-64c POS/RPR Shared Port Adapter with XFP Optics	SPA-OC192POS-XFP	3.2
Cisco CRS 4-Port OC-3c/STM-1c Shared Port Adapter	SPA-4XOC3-POS	3.2
Cisco CRS 1-Port OC-192/STM-64 POS/RPR SPA VSR Optics	SPA-OC192POS-VSR	3.4.1
Cisco CRS 1-Port OC-768c/STM-256c (C-band) DWDM PLIM	1OC768-ITU/C	3.3

Cisco CRS 1-Port OC-768c/STM-256c (C-band) DPSK+ DWDM PLIM	1OC768-DPSK/C	3.6
Cisco CRS ATM Modules and SPAs		
3-Port Clear Channel OC-3 ATM SPA	SPA-3XOC3-ATM-V2	3.7
1-Port Clear Channel OC-12 ATM SPA	SPA-1XOC12-ATM-V2	3.7
Cisco CRS Serial Interface Modules and SPAs		
Cisco CRS 4-Port Clear Channel T3/E3 Serial Shared Port Adapter	SPA-4XT3/E3	3.4.1
Cisco CRS 2-Port Clear Channel T3/E3 Serial Shared Port Adapter	SPA-2XT3/E3	3.4.1
Cisco CRS Ethernet Interface Modules and SPAs		
Cisco CRS 8x10 GbE Interface Module LR/ER	8-10GBE	3.2
Cisco 5-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-5X1GE-V2	3.4
Cisco 8-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-8X1GE-V2	3.4
Cisco 8-Port Gigabit Ethernet Shared Port Adapter	SPA-8X1GE	3.2
Cisco 10-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-10X1GE-V2	3.4
Cisco 1-Port Ten Gigabit Ethernet Shared Port Adapter, Version 2	SPA-1X10GE-L-V2	3.4
Cisco 4-Port Ten Gigabit Ethernet (C-band) DWDM PLIM	4-10GE-ITU/C	3.3
Cisco 1-port 10GbE SPA WAN/LAN PHY	SPA-1X10GE-WL-V2	3.5.2
Cisco CRS-1 Series 4x10GE Interface Module	4-10GE	3.8.1
Cisco CRS-1 Series 42x1GE Interface Module	42-1GE	3.8.1
Cisco CRS-1 Series 8-Port Ten Gigabit Ethernet Interface Module	8-10GBE-WL-XFP	3.9.1
Cisco CRS-1 Series 4-Port Ten Gigabit Ethernet Interface Module	4-10GBE-WL-XFP	3.8.4

Cisco CRS-1 Series 20x1GE Flexible Interface Module	20-1GE-FLEX	3.8.1
Cisco CRS-1 Series 2x10GE WAN/LAN Flexible Interface Module	2-10GE-WL-FLEX	3.8.1
Cisco CRS 10GE Optical to Electrical Modules		
10GBASE-LR XENPAK Module for Cisco CRS	XENPAK-10GB-LR+	3.4
10GBASE-DWDM XENPAK	XENPAK-10GB-DWDM	3.2.2
10GBASE-ER XENPAK Modular for Cisco CRS-1	XENPAK-10GB-ER	3.4
10GBASE-ER XENPAK Modular for Cisco CRS-1	XENPAK-10GB-ER+	3.4
Cisco 10GBASE-SR XFP Module for MMF	XFP-10G-MM-SR	3.8
Cisco Multirate 10GBASE-LR/-LW and OC-192/STM-64 SR-1 XFP Module for SMF	XFP-10GLR-OC192SR	3.4
Cisco Multirate 10GBASE-LR/-LW and OC-192/STM-64 SR-1 XFP Module for SMF, low power (1.5W)	XFP10GLR-192SR-L	3.8.4, 3.9.1
Cisco Multirate 10GBASE-ER/-EW and OC-192/STM-64 IR-2 XFP Module for SMF	XFP-10GER-192IR+	3.4
Cisco Multirate 10GBASE-ER/-EW and OC-192/STM-64 IR-2 XFP Module for SMF, low power (2.5W)	XFP10GER-192IR-L	3.8.4, 3.9.1
Cisco Multirate 10GBASE-ZR/-ZW and OC-192/STM-64 lR-2 XFP Module for SMF	XFP-10GZR-OC192LR	3.4
Cisco CRS SFPs and CFPs		
Cisco CRS 2.5 G SFP LR Optic	POM-OC48-LR2-LC-C	3.2
Cisco CRS 2.5 G SFP SR Optic	POM-OC48-SR-LC-C	3.2
GE SFP, LC connector LX/LH transceiver	GLC-LH-SM	3.2
1000BASE-SX SFP transceiver module, MMF, 850nm, DOM	GLC-SX-MMD	3.6
1000BASE-LX/LH SFP transceiver module, MMF/SMF, 1310nm, DOM	GLC-LH-SMD	3.6
1000BASE-LX/LH SFP	SFP-GE-L	3.4

1000BASE-SX SFP (DOM)	SFP-GE-S	3.4
1000BASE-T SFP (NEBS 3 ESD)	SFP-GE-T	3.4
1000BASE-ZX Gigabit Ethernet SFP (DOM)	SFP-GE-Z	3.4
100GBASE-LR4 CFP transceiver module for SMF, 1310-nm wavelength, SC duplex connector	CFP-100G-LR4	4.0
100 Gigabit Ethernet over 10 short-reach optical lanes (SR10) optics (multimode fiber)	CFP-100G-SR10	4.2.1
Cisco 10GBASE Dense Wavelength-Division Multiplexing XFP Module	DWDM-XFP-C	4.2.3
40-Gigabit Ethernet C Form-factor Pluggable (CFP) optics module - 40GBASE-LR4	CFP-40G-LR4	4.2.3
40-Gigabit Ethernet C Form-factor Pluggable (CFP) optics module - 40GBASE-SR4	CFP-40G-SR4	4.2.3
40-Gigabit Ethernet C Form-factor Pluggable (CFP) optics module - 40GBASE-FR	CFP-40G-FR	4.2.3

Cisco IOS XR Software Release 4.2.1 supports 10GE SFP+ ER optics with the following restrictions:

- **For all slots (except slots 1 & 6):** 24 ports of 10GE ER per 24x10GE LC
- **For slots 1 & 6**: 12 ports of 10GE ER and remaining 12 ports of SR/LR per 24x10GE LC

Note This is applicable at 40 degrees C.

Hardware Not Supported

The following hardware are not supported in Cisco IOS XR Software Release 4.2.1 :

Component	Part Number
Cisco CRS-1 16-Slot Line-Card Chassis Route Processor	CRS-16-RP
Cisco CRS PCMCIA Flash Disk 2 GB	CRS-FLASH-DISK-2G

Note RP-B with CRS-3 is not supported for Multichassis systems; only PRP is supported for such systems. Cisco highly recommends PRP for all CRS-1, CRS-3 Single chassis and Multichassis configurations, due to its significant advantages in improving boot time, performance, and scale. For information on End-of-Sale and End-of-Life Announcement for the Cisco CRS 8-Slot and 16-slot Line Card Chassis Route Processors:

http://www.cisco.com/en/US/prod/collateral/routers/ps5763/end_of_life_notice_c51-695816.html

http://www.cisco.com/en/US/prod/collateral/routers/ps5763/end_of_life_notice_c51-695817.html

Note Cisco Session Border Controller (SBC) is not supported. Cisco IOS XR Software Release 3.7 is the last release that supports SBC.

CRS FP-140 Licenses

The following licenses apply to the CRS FP-140:

Licence	Description
XC-ENH-NF-140G	Cisco CRS Series Enhanced Netflow Performance License 140G
XC-L2L3VPN-140G	Cisco CRS Series L2 and L3 VPN Peering Edge License 140G
XC-RTE-SCL-140G	Cisco CRS Series Route Scale License 140G
XC-TE-SCL-140G	Cisco CRS Series Traffic Engineering Scale License 140G
XC-MC-LIC-140G	Cisco CRS Series Multichassis License 140G

CRS FP-140 also supports eDelivery licenses, which can be downloaded as the License Certificates in PDF format.

For further information or questions, please visit http://www.cisco.com/web/partners/tools/edelivery.html.

eDelivery PID	Description
L-XC-ENH-NF-140G=	Cisco CRS Series Enhanced NetFlow License 140G
L-XC-RTE-SCL-140G=	Cisco CRS Series Route Scale License 140G
L-XC-MC-LIC-140G=	Cisco CRS Series Multichassis License 140G

L-XC-TE-SCL-140G=	Cisco CRS Series Traffic Engineering Scale License 140G
L-XC-L2L3VPN-140G=	Cisco CRS Series L2 L3 VPN Peering Edge License 140G

Software Compatibility

Cisco IOS XR Software Release 4.2.1 is compatible with the following Cisco CRS-1 and CRS-3 systems:

- Cisco CRS 4-Slot Line Card Chassis
- Cisco CRS 8-Slot Line Card Chassis
- Cisco CRS 16-Slot Line Card Chassis
- Cisco CRS Multichassis Systems

Cisco IOS XR Software Release 4.2.1 is compatible with the following Cisco CRS-3 system:

- Cisco CRS Back-to-Back System

Firmware Support

The Cisco CRS Router supports the following firmware code:

- The bundled ROMMON version is 2.07.
- For details about minimum required firmware versions please refer to **"admin show fpd package"** (see below).
- To upgrade firmware use the **"admin upgrade hw-module fpd"** command. Alternatively, refer to the "fpd auto-upgrade" feature.

Check the firmware needed by running the **show fpd package** command in admin mode.

Cisco CRS show fpd package output

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

================================ ============================================
                                       Field Programmable Device Package
                                 ============================================
                                                          SW      Min Req   Min Req
Card Type            FPD Description            Type Subtype   Version   SW Ver    HW Vers
==================== ========================== ==== ======= =========== ========  =========
PRP                  FPGA ZJF uBlaze            lc   fpga2       0.01        0.00      0.0
                     S-8 FPGA Nirvana           lc   fpga3      13.00        0.00      0.0
                     FPGA BCM 8727              lc   fpga4       0.01        0.00      0.0
                     FPGA MCU                   lc   fpga5       0.01        0.00      0.0
                     FPGA CPU ZJF               lc   fpga1       7.00        0.00      0.0
                     ROMMONA swv2.06 x86mp      lc   rommonA     2.06        2.03      0.0
                     ROMMONB swv2.06 x86mp      lc   rommon      2.06        2.06      0.0
-------------------------------------------------------------------------------------------
PRP                  FPGA ZJF uBlaze            lc   fpga2       0.01        0.00      0.0
                     S-16 FPGA Nirvana          lc   fpga3      13.00        0.00      0.0
                     FPGA BCM 8727              lc   fpga4       0.01        0.00      0.0
```

	FPGA MCU	lc	fpga5	0.01	0.00	0.0
	ZJF FPGA CPU	lc	fpga1	7.00	0.00	0.0
	ROMMONA swv2.06 x86mp	lc	rommonA	2.06	2.03	0.0
	ROMMONB swv2.06 x86mp	lc	rommon	2.06	2.06	0.0
S2	FPGA 4.02	lc	fpga2	4.02	0.00	0.0
	FPGA 5.00	lc	fpga3	5.00	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
140G-S1S2S3	FPGA 4.01	lc	fpga2	4.01	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
Fabric HS123 Superst	FPGA 4.00	lc	fpga2	4.00	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
140G-4-S1S2S3	FPGA 4.01	lc	fpga2	4.01	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
140G-S1S3	FPGA 4.01	lc	fpga2	4.01	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
140G-S1S2S3-2	FPGA 4.01	lc	fpga2	4.01	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
140G-S1S3-2	FPGA 4.01	lc	fpga2	4.01	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
	RXPOD swvF034 spb	lc	rxpod	240.52	0.00	0.0
	TXPOD swvF039 spb	lc	txpod	240.57	0.00	0.0
140G-S2-2	FPGA 4.02	lc	fpga2	4.02	0.00	0.0
	FPGA 16.00	lc	fpga3	16.00	0.00	0.0
	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
	RXPOD swvF034 spb	lc	rxpod	240.52	0.00	0.0
	TXPOD swvF039 spb	lc	txpod	240.57	0.00	0.0
140G-MSC	FPGA Linecard 0.36	lc	fpga2	0.36	0.00	0.0
	FPGA CPU 0.8	lc	fpga1	0.08	0.00	0.0
	ROMMONA swv2.06 kensho	lc	rommonA	2.06	2.04	0.0
	ROMMONB swv2.06 kensho	lc	rommon	2.06	2.06	0.0
FP-140G	FPGA Linecard 0.36	lc	fpga2	0.36	0.00	0.0
	FPGA CPU 0.8	lc	fpga1	0.08	0.00	0.0
	ROMMONA swv2.06 kensho	lc	rommonA	2.06	2.04	0.0
	ROMMONB swv2.06 kensho	lc	rommon	2.06	2.06	0.0
CRS-LSP	FPGA Linecard 0.36	lc	fpga2	0.36	0.00	0.0
	FPGA CPU 0.8	lc	fpga1	0.08	0.00	0.0
	ROMMONA swv2.06 kensho	lc	rommonA	2.06	2.04	0.0
	ROMMONB swv2.06 kensho	lc	rommon	2.06	2.06	0.0
1OC768-ITU/C	OPTICS FIRMWARE 110B10	lc	fpga2	110.10	0.00	0.0
1OC768-DWDM-L	OPTICS FIRMWARE 110B10	lc	fpga2	110.10	0.00	0.0
1OC768-DPSK/C	OPTICS FIRMWARE 110B14	lc	fpga2	110.14	0.00	0.0
1OC768-DPSK/C-O	OPTICS FIRMWARE 110B14	lc	fpga2	110.14	0.00	0.0

1OC768-DPSK/C-E	OPTICS FIRMWARE 110B14	lc	fpga2	110.14	0.00	0.0
CRS-CGSE-PLIM	FPGA mCPU0 0.559	lc	fpga2	0.559	0.00	0.0
	FPGA sCPU0 0.559	lc	fpga3	0.559	0.00	0.0
	FPGA mCPU1 0.559	lc	fpga4	0.559	0.00	0.0
	FPGA sCPU1 0.559	lc	fpga5	0.559	0.00	0.0
	FPGA PLIM_SVC 0.41014	lc	fpga1	0.41014	0.00	0.0
1-100GBE-DWDM	PLIM FPGA 17.0	lc	fpga3	17.00	0.00	0.20
	EAGLE FIRMWARE 3.01	lc	fpga4	3.01	0.00	0.0
4-40GBE-OTN	PLIM FPGA 22	lc	fpga3	22.00	0.00	0.16
20-10GBE	PLIM FPGA 42.0	lc	fpga3	42.00	0.00	0.0
12-10GBE	PLIM FPGA 42.0	lc	fpga3	42.00	0.00	0.0
1-100GBE	PLIM FPGA 19.0	lc	fpga3	19.00	0.00	0.0
	RX MAC FPGA 49.0	lc	fpga4	49.00	0.00	0.0
	TX MAC FPGA 38.0	lc	fpga5	38.00	0.00	0.0
14-10GBE	PLIM FPGA 42.0	lc	fpga3	42.00	0.00	0.0
DRP_B	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
MSC_B	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
FP40	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
CRS1-SIP-800	JACKET FPGA swv6.0	lc	fpga1	6.00	5.00	0.0
	FPGA swv6.0 hwv80	lc	fpga1	6.00	5.00	0.80
8-10GBE	FPGA swvA.0	lc	fpga1	10.00	0.00	0.0
OC48-POS-16-ED	FPGA PLIM_OC48 9.0	lc	fpga1	9.00	0.00	0.0
4-10GBE	FPGA sw_4p_v15.0	lc	fpga1	15.00	0.00	0.0
8-10GBE	FPGA sw_8p_v15.0	lc	fpga1	15.00	0.00	0.0
4-10GE	SQUIRREL FPGA 10.0	lc	fpga1	10.00	0.00	0.0
42-1GE	FPGA swv6.0	lc	fpga1	6.00	0.00	0.0
	FPGA swv6.0 hwv0.80	lc	fpga1	6.00	0.00	0.80
20-1GE-FLEX	FPGA swv6.0	lc	fpga1	6.00	0.00	0.0
	FPGA swv6.0 hwv0.80	lc	fpga1	6.00	0.00	0.80

2-10GE-WL-FLEX	FPGA swv6.0	lc	fpga1	6.00	0.00	0.0
	FPGA swv6.0 hwv0.80	lc	fpga1	6.00	0.00	0.80
CRS-16-ALARM-C	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
CRS-16-ALARM-B	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
CRS-16-FAN-CT	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
CRS-16-LCC-F-CT-B	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
CRS-FCC-LED	FPGA 6.04 spb	lc	fpga1	6.04	0.00	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 spb	lc	rommonA	2.06	2.05	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 spb	lc	rommon	2.06	2.06	0.0
Route Processor	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
SC	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
RP	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
Shelf Controller GE	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
RP	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
Shelf Controller GE2	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
DRP	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
S1S2S3	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
S1S3	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
S2	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0

Fabric HS123	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
Fabric QQS123	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
LED	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
40G-MSC	ROMMONA swv2.06 asmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 dsmp	lc	rommonA	2.06	2.01	0.0
	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 asmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 dsmp	lc	rommon	2.06	2.06	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
CRS-16-ALARM	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
CRS-16-LCC-FAN-CT	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
FC Fan Controller	ROMMONA swv2.06 sp	lc	rommonA	2.06	2.01	0.0
	ROMMONB swv2.06 sp	lc	rommon	2.06	2.06	0.0
SPA-4XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.00	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.00	0.0
	SPA I/O FPGA	spa	fpga1	1.00	0.00	0.0
	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-2XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.00	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.00	0.0
	SPA I/O FPGA	spa	fpga1	1.00	0.00	0.0
	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-1XCHOC48/DS3	SPA I/O FPGA	spa	fpga2	1.00	0.00	0.49
	SPA I/O FPGA	spa	fpga3	1.00	0.00	0.52
	SPA I/O FPGA	spa	fpga1	1.36	0.00	0.49
	SPA ROMMON	spa	rommon	2.02	0.00	0.49
SPA-1XCHOC12/DS0	SPA I/O FPGA	spa	fpga2	1.00	0.00	0.49
	SPA I/O FPGA	spa	fpga1	1.36	0.00	0.49
	SPA ROMMON	spa	rommon	2.02	0.00	0.49
SPA-OC192POS	SPA FPGA swv1.3	spa	fpga1	1.03	0.00	0.0
SPA-8XOC12-POS	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-4XOC3-POS	SPA FPGA swv3.4	spa	fpga1	3.04	0.00	0.0
SPA-OC192POS-XFP	SPA FPGA swv1.2	spa	fpga1	1.02	0.00	0.0
SPA-8X1GE	SPA FPGA swv1.8	spa	fpga1	1.08	0.00	0.0
SPA-2XOC48POS/RPR	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.0
SPA-4XOC48POS/RPR	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.0
SPA-8XOC3-POS	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-2XOC12-POS	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-4XOC12-POS	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-10X1GE-V2	SPA FPGA swv1.10	spa	fpga1	1.10	0.00	0.0

```
SPA-8X1GE-V2          SPA FPGA swv1.10            spa  fpga1       1.10         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-5X1GE-V2          SPA FPGA swv1.10            spa  fpga1       1.10         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-1X10GE-L-V2       SPA FPGA swv1.11            spa  fpga1       1.11         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-4XOC3-POS-V2      SPA FPGA swv1.0             spa  fpga1       1.00         0.00       0.5
-------------------------------------------------------------------------------------------------
SPA-1X10GE-WL-V2      SPA FPGA swv1.11            spa  fpga1       1.11         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-1XOC3-ATM-V2      SPA FPGA swv1.2             spa  fpga1       2.02         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-2XOC3-ATM-V2      SPA FPGA swv1.2             spa  fpga1       2.02         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-3XOC3-ATM-V2      SPA FPGA swv1.2             spa  fpga1       2.02         0.00       0.0
-------------------------------------------------------------------------------------------------
SPA-1XOC12-ATM-V2     SPA FPGA swv1.2             spa  fpga1       2.02         0.00       0.0
-------------------------------------------------------------------------------------------------
```

Minimum Firmware Requirement

The following table provides the procedures and resources for minimum firmware requirements:

After completing an RMA, upgrade the firmware as per the matrix in this link, which also links to PDF copies of the IOS XR Firmware Upgrade Guides	http://www.cisco.com/web/Cisco_IOS_XR_Software/index.html
For the upgrade CLI, refer to the *Hardware Redundancy and Node Administration Commands* on *Cisco IOS XR Software* chapter of the *Cisco IOS XR System Management Command Reference for the Cisco CRS router*	http://www.cisco.com/en/US/docs/routers/crs/software/crs_r4.2/system_management/command/reference/b_sysman_cr42crs.html

Determining Your Software Version

Note P image is discontinued from Cisco IOS XR Software Release 4.2 onwards. For more information about this, see the discontinuation of P image for Cisco CRS in Cisco IOS XR Software Release 4.2 and later at

http://www.cisco.com/en/US/prod/collateral/routers/ps5763/product_bulletin_c25-663499.html.

To determine the version of Cisco IOS XR Software running on your router, log in to the router and enter the **show version** command:

Procedure

Step 1 Establish a Telnet session with the router.

Step 2 Enter **show version** command from EXEC mode.

```
RP/0/RP0/CPU0:router#show version

Cisco IOS XR Software, Version 4.2.1[Default]
Copyright (c) 2012 by Cisco Systems, Inc.

ROM: System Bootstrap, Version 2.06(20110916:145933) [CRS ROMMON],

PE1-A81 uptime is 2 hours, 9 minutes
System image file is "disk0:hfr-os-mbi-4.2.1/0x100008/mbihfr-rp-x86e.vm"

cisco CRS-16/S (Intel 686 F6M14S4) processor with 12582912K bytes of memory.
Intel 686 F6M14S4 processor at 2133Mhz, Revision 2.174
Cisco CRS Series 16 Slots Line Card Chassis

2 Management Ethernet
48 GigabitEthernet
27 SONET/SDH
19 Packet over SONET/SDH
4 Asynchronous Transfer Mode
48 TenGigE
2 SRP over SONET
42 WANPHY controller(s)
1019k bytes of non-volatile configuration memory.
14712M bytes of hard disk.
10449904k bytes of disk0: (Sector size 512 bytes).
10449904k bytes of disk1: (Sector size 512 bytes).

Boot device on node 0/0/CPU0 is lcdisk0:
Package active on node 0/0/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie
```

```
iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/1/CPU0 is lcdisk0:
Package active on node 0/1/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
```

```
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie
```

```
Boot device on node 0/2/CPU0 is mem:
Package active on node 0/2/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
```

```
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/3/CPU0 is lcdisk0:
Package active on node 0/3/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
```

```
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/4/CPU0 is mem:
Package active on node 0/4/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie
```

```
hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/5/CPU0 is mem:
Package active on node 0/5/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie
```

```
iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/6/CPU0 is mem:
Package active on node 0/6/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
```

```
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie
```

```
Boot device on node 0/7/CPU0 is mem:
Package active on node 0/7/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
```

```
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Boot device on node 0/9/CPU0 is mem:
Package active on node 0/9/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
```

```
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Configuration register on node 0/RP0/CPU0 is 0x102
Boot device on node 0/RP0/CPU0 is disk0:
Package active on node 0/RP0/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-doc-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-doc-supp-4.2.1
    Built on Sun May 27 04:01:35 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-security, V 4.2.1[00], Cisco Systems, at disk0:iosxr-security-4.2.1
    Built on Sun May 27 04:00:29 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mgbl, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mgbl-4.2.1
    Built on Sun May 27 03:43:08 PST 2012
```

```
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-k9sec-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-k9sec-supp-4.2.1
    Built on Sun May 27 04:00:29 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mgbl-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mgbl-supp-4.2.1
    Built on Sun May 27 03:43:08 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

Configuration register on node 0/RP1/CPU0 is 0x102
```

```
Boot device on node 0/RP1/CPU0 is disk0:
Package active on node 0/RP1/CPU0:
iosxr-ce, V 4.2.1[00], Cisco Systems, at disk0:iosxr-ce-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-doc-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-doc-supp-4.2.1
    Built on Sun May 27 04:01:35 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-ce, V 4.2.1[00], Cisco Systems, at disk0:hfr-ce-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-service-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-service-supp-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-service, V 4.2.1[00], Cisco Systems, at disk0:iosxr-service-4.2.1
    Built on Sun May 27 04:01:45 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-security, V 4.2.1[00], Cisco Systems, at disk0:iosxr-security-4.2.1
    Built on Sun May 27 04:00:29 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mpls, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mpls-4.2.1
    Built on Sun May 27 03:43:19 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mgbl, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mgbl-4.2.1
    Built on Sun May 27 03:43:08 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-mcast, V 4.2.1[00], Cisco Systems, at disk0:iosxr-mcast-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-routing, V 4.2.1[00], Cisco Systems, at disk0:iosxr-routing-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

iosxr-infra, V 4.2.1[00], Cisco Systems, at disk0:iosxr-infra-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
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hfr-fwding, V 4.2.1[00], Cisco Systems, at disk0:hfr-fwding-4.2.1
    Built on Sun May 27 03:43:54 PST 2012
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iosxr-fwding, V 4.2.1[00], Cisco Systems, at disk0:iosxr-fwding-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
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iosxr-diags, V 4.2.1[00], Cisco Systems, at disk0:iosxr-diags-4.2.1
```

```
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hfr-fpd, V 4.2.1[00], Cisco Systems, at disk0:hfr-fpd-4.2.1
    Built on Sun May 27 04:01:09 PST 2012
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hfr-diags-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-diags-supp-4.2.1
    Built on Sun May 27 04:00:38 PST 2012
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hfr-k9sec-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-k9sec-supp-4.2.1
    Built on Sun May 27 04:00:29 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mgbl-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mgbl-supp-4.2.1
    Built on Sun May 27 03:43:08 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-mcast-supp, V 4.2.1[00], Cisco Systems, at disk0:hfr-mcast-supp-4.2.1
    Built on Sun May 27 03:43:33 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-base, V 4.2.1[00], Cisco Systems, at disk0:hfr-base-4.2.1
    Built on Sun May 27 03:43:51 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

hfr-os-mbi, V 4.2.1[00], Cisco Systems, at disk0:hfr-os-mbi-4.2.1
    Built on Sun May 27 03:46:12 PST 2012
    By iox-bld3 in /auto/srcarchive6/production/4.2.1/all/workspace for pie

RP/0/RP0/CPU0:router#
```

Features Introduced in Cisco IOS XR Software Release 4.2.1

Multicast and MVPNv4 over v4GRE Interfaces

Different types of networks rely on the third party network security to attain a secure IP multicast service, which encrypts and decrypts IP unicast traffic across untrusted core network through point-to-point tunnel. Therefore, the customer multicast traffic must be delivered as unicast traffic with encryption across untrusted core network. This is obtained by using generic routing encapsulation (GRE) tunneling to deliver multicast traffic as unicast through tunnel interfaces. Both Multicast and MVPN-v4 over GRE is supported.

- Multicast over v4-GRE Interfaces: Customer networks which are transporting Native IP Multicast across un-trusted core via IPv4 unicast GRE tunnels and encryption.
- MVPN-v4 over GRE Interfaces: Customer networks which are transporting L3VPN multicast services (mVPN-GRE) across an un-trusted core via IPv4 unicast GRE tunnels and encryption.

Note IPv6 Multicast and MVPNv6 over GRE are not supported.

Multicast interface features for GRE tunnels are applied when the inner packet is forwarding through multicast forwarding chain. However, the unicast interface features for GRE underlying interface are applied when the outer transport packet is forwarding through unicast forwarding chain. Thus, multicast interface features such as boundary ACL and TTL threshold are applicable and supported for unicast GRE tunnel just as other multicast main or sub interfaces. However, QoS for unicast GRE tunnel are applied at its underlying physical interface instead of applied on tunnel interface itself.

After setting up unicast routing protocol, the unicast GRE tunnels are treated as interfaces similar to that of a main or sub interface. The unicast GRE tunnels can participate in multicast routing when these are added to multicast routing protocols as multicast enabled interfaces. The unicast GRE tunnels are also used as the accepting or the forwarding interfaces of a multicast route.

Concatenation of Unicast GRE Tunnels for Multicast Traffic

This concatenation of unicast GRE tunnels refers to connecting trusted network islands by terminating one unicast GRE tunnel and relaying multicast forwarding to olist that includes different unicast GRE tunnels.

TTL Threshold

GRE enables to workaround networks containing protocols that have limited hop counts. Multicast traffic of mVPN-GRE from encapsulation provider edge (PE) router to decapsulation PE router is considered one hop, and customer packet TTL should be decremented by one number, irrespective of mid-point P routers between these PE routers.

The TTL on GRE transport header is derived from the configuration of GRE tunnel interface, and is decremented when traffic travels from encapsulation PE to decapsulation PE router via P routers. However, for concatenated unicast GRE tunnels, TTL on GRE transport header is reset when the router terminates one unicast GRE tunnel and forwards multicast packet to another unicast GRE tunnel.

Note GRE keep-alive message and the frequency of keep-alive message generation is1 pps. Static police rate in LC remain 1000 pps to accommodate max 500 unicast GRE tunnel. However, the GRE key is not supported.

BGP 3107 PIC Updates for Global Prefixes

The BGP 3107 PIC Updates for Global Prefixes feature supports Prefix Independent Convergence (PIC) updates for global IPv4 and IPv6 prefixes in an MPLS VPN provider network. This feature is based on RFC 3107 that describes using BGP to distribute MPLS labels for global IPv4 or IPv6 prefixes. This enables IGP to scale better and also provides PIC updates for fast convergence.

BGP 3107 PIC is supported on CRS-1 and CRS-3 line cards.

RFC 3107 enables routes and labels to be carried in BGP. When BGP is used to distribute a particular route, it can also be used to distribute an MPLS label that is mapped to that route. The label mapping information for a particular route is piggybacked in the same BGP Update message that is used to distribute the route itself. RFC 3107 allows filtering of Next-Hop Loops from OSPF and reduces labels advertised by LDP. This implementation significantly reduces OSPF and LDP database.

The 3107 PIC implementation supports the following address-families with additional-path configuration.

- address-family ipv4 unicast
- address-family ipv6 unicast
- address-family vpnv4 unicast
- address-family vpnv6 unicast

Note The address-family l2vpn vpls-vpws does not support additional-path. Hence, the l2vpn service that uses address-family l2vpn vpls-vpws does not guarantee PIC convergence time.

The 3107 PIC implementation supports these Cisco IOS XR features:

- PIC Edge for 3107
- Traffic Engineering Fast-reroute (TE FRR)—Traffic convergence for core link failure is guaranteed within 50 milliseconds using verbatim tunnel.
- L2VPN Service
- L3VPN VPNv4 Service
- 6 PE Service
- 6 VPE Service
- VPLS Service

BGP 3107 PIC Updates for Global Prefixes implementation uses a shared recursive Load Info (RLDI) forwarding object in place of a Light-Weight recursive (LW-RLDI) object. The RLDI is shared between multiple leaves, while the LW-RLDI is instantiated per leaf. Sharing helps in handling PIC updates since it will be prefix independent.

Locator/ID Separation Protocol on Cisco IOS XR

Locator/ID Separation Protocol (LISP) is a simple, incremental, network-based protocol designed to implement separation of Internet addresses into Endpoint Identifiers (EIDs) and Routing Locators (RLOCs).

LISP stands for Locator/ID Separation Protocol and is a next-generation IP routing feature that creates a new paradigm in how IP addressing is assigned and interpreted by splitting the device identity, known as an endpoint identifier (EID), and its location, known as its routing locator (RLOC), into two different namespaces. Creating separate IP addresses for EID and RLOC functions yields several advantages, including improved scalability of the routing system through greater aggregation of RLOCs and improved multihoming efficiency and ingress traffic engineering. Hosts do not have to change IP addresses and therefore, no IP address numbering costs are involved with the LISP implementation.

LISP sites use IP addresses in the EID namespace to address hosts and in Domain Name System (DNS) in exactly the same way they are currently used. These addresses are not advertised within the non-LISP RLOC namespace (that is, the Internet), but instead are advertised by the LISP mapping services. The LISP site router supports the LISP functionality of Ingress Tunnel Router (ITR) and Egress Tunnel Router (ETR).

LISP creates a Level of indirection with two namespaces: EID and RLOC. The EID (Endpoint Identifier) is the IP address of a host. The RLOC (Routing Locator) is the IP address of the LISP router for the host.

EID-to-RLOC mapping is the distributed architecture that maps EIDs to RLOCs. The LISP Map Lookup is analogous to a DNS lookup. DNS resolves IP addresses for URLs. LISP resolves locators for queried identifiers or EID prefix.

LISP in Cisco IOS XR supports:

- Proxy Ingress Tunnel Router (PITR) and Proxy Egress Tunnel Router (PETR). PITR must be configured using map resolver (no ALT support).
- Default table support for EID and RLOC space.
- CRS-3 hardware supports IPv4 over IPv4 and IPv6 over IPv4 topologies.
- The **router lisp** command in global configuration mode enables LISP configuration mode.

Note The LISP command line interface, show commands output, and schema is to be changed in Cisco IOS XR Release 4.3.1 to be similar to the LISP command line interface on Cisco IOS.

For information on LISP Commands, see the *LISP Commands on Cisco IOS XR* module in the *Cisco IOS XR Routing Command Reference for the Cisco CRS Router*

Pseudowire Headend Support

Cisco IOS XR Release 4.2.1 expands pseudowire headend (PWHE) support on Cisco CRS-3 router. This release also support s IPv6 packets over PWHE interfaces hosting on Cisco CRS routers.

For more information on PWHE, refer to the *Implementing Virtual Private LAN Services* module of the *Cisco IOS XR Virtual Private Network Configuration Guide for the Cisco CRS Router*.

BFD Multipath Sessions

BFD can be applied over virtual interfaces such as GRE tunnel interfaces, PWHE interfaces or between interfaces that are multihops away as described in the BFD for Multihop Paths section. These types of BFD sessions are referred to BFD Multipath sessions.

As long as one path to destination is active, the following events may or may not cause the BFD Multipath session to fail as it depends on the interval negotiated versus the convergence time taken to update forwarding plane:

- Failure of a path
- Online insertion or removal (OIR) of a line card which hosts one or more paths
- Removal of a link (by configuration) which constitutes a path
- Shutdown of a link which constitutes a path

You must configure bfd mutlipath include location <location-id> command to enable at least one line card for the underlying mechanism that can be used to send and receive packets for the multipath sessions.

If a BFD Multipath session is hosted on a line card that is being removed from the bfd multipath include configuration, online removed, or brought to maintenance mode, BFD tries to migrate all BFD Multipath

sessions hosted on that line card to another one. In that case, static routes are removed from RIB then the BFD session reestablished and readded to RIB.

BFD for Multihop Paths

BFD multihop (BFD-MH) is a BFD session between two addresses that are not on the same subnet. An example of BFD-MH is a BFD session between PE and CE loopback addresses or BFD sessions between routers that are several TTL hops away. The applications that support BFD multihop are external and internal BGP. BFD multihop supports BFD on arbitrary paths, which can span multiple network hops.

The BFD Multihop feature provides sub-second forwarding failure detection for a destination more than one hop, and up to 255 hops. The bfd multihop ttl-drop-threshold command can be used to drop BFD packets coming from neighbors exceeding a certain number of hops. BFD multihop is supported on all currently supported media-type for BFD singlehop.

10X (mixed) Bandwidth Bundle Support

Cisco IOS XR Software Release 4.2.1 introduces the 10X (mixed) Bandwidth Bundle support on CRS interfaces. A link bundle is a group of one or more ports that are aggregated together and treated as a single link. The Link Bundling feature allows you to group multiple point-to-point links together into one logical link and provide higher bidirectional bandwidth, redundancy, and load balancing between two routers. Cisco CRS Router allows mixed member link bandwidth of up to ten times in the same bundle interface. This means that GigE/10GigE interfaces or 10GigE/40GigE/100GigE interfaces can be aggregated in a bundle ethernet interface. The total cumulative relative bandwidth of the bundle members in any single bundle has to be within 255 for active:active mode. For example, 25x 100GE links with 5x 10GE links in a bundle will give relative bandwidth of 250+5 = 255. Any additional links will be put in standby.

Dual Stack Lite

The Dual Stack Lite (DS-Lite) feature enables legacy IPv4 hosts and server communication over both IPv4 and IPv6 networks. Also, IPv4 hosts may need to access IPv4 internet over an IPv6 access network. The IPv4 hosts will have private addresses which need to have network address translation (NAT) completed before reaching the IPv4 internet. The Dual Stack Lite application has these components:

- **Basic Bridging BroadBand Element (B4):** This is a Customer Premises Equipment (CPE) router that is attached to the end hosts. The IPv4 packets entering B4 are encapsulated using a IPv6 tunnel and sent to the Address Family Transition Router (AFTR).
- **Address Family Transition Router(AFTR):** This is the router that terminates the tunnel from the B4. It decapsulates the tunneled IPv4 packet, translates the network address and routes to the IPv4 network. In the reverse direction, IPv4 packets coming from the internet are reverse network address translated and the resultant IPv4 packets are sent the B4 using a IPv6 tunnel.

The Dual Stack Lite feature helps in these functions:

1. Tunnelling IPv4 packets from CE devices over IPv6 tunnels to the CGSE blade.
2. Decapsulating the IPv4 packet and sending the decapsulated content to the IPv4 internet after completing network address translation.

3 In the reverse direction completing reverse-network address translation and then tunnelling them over IPv6 tunnels to the CPE device.

IPv6 traffic from the CPE device is natively forwarded.

Syslog Support

The NAT44, Stateful NAT64, and DS Lite features support Netflow for logging of the translation records. Logging of the translation records can be mandated by for Lawful Intercept. The Netflow uses binary format and hence requires software to parse and present the translation records.

In Cisco IOS XR Software Release 4.2.1 and later, the DS Lite and NAT44 features support Syslog as an alternative to Netflow. Syslog uses ASCII format and hence can be read by users. However, the log data volume is higher in Syslog than Netflow.

Attributes of Syslog Collector

1 Syslog is supported in ASCII format only.

2 Logging to multiple syslog collectors (or relay agents) is not supported.

3 Syslog is supported for DS-Lite and NAT44 in the Cisco IOS XR Software Release 4.2.1.

Bulk Port Allocation

The creation and deletion of NAT sessions need to be logged and these create huge amount of data. These are stored on Syslog collector which is supported over UDP. In order to reduce the volume of data generated by the NAT device, bulk port allocation can be enabled. When bulk port allocation is enabled and when a subscriber creates the first session, a number of contiguous outside ports are pre-allocated. A bulk allocation message is logged indicating this allocation. Subsequent session creations will use one of the pre-allocated port and hence does not require logging.

QoS Accounting

Configured Accounting controls the type of overhead and packet length for statistics, policing shaping and queuing. The account option can be specified with a service-policy when applying a policy to an interface. For bundle interfaces, the configured accounting option is applied to all member interfaces.

The configured accounting option is available on ingress and egress policing, queuing and statistics for CRS-MSC-140G. In CRS-MSC-40G, the configured accounting option is not available for queuing.

BGP Prefix Origin Validation Based on RPKI

A BGP route associates an address prefix with a set of autonomous systems (AS) that identify the interdomain path the prefix has traversed in the form of BGP announcements. This set is represented as the AS_PATH attribute in BGP and starts with the AS that originated the prefix.

To help reduce well-known threats against BGP including prefix mis-announcing and monkey-in-the-middle attacks, one of the security requirements is the ability to validate the origination AS of BGP routes. The AS

number claiming to originate an address prefix (as derived from the AS_PATH attribute of the BGP route) needs to be verified and authorized by the prefix holder.

The Resource Public Key Infrastructure (RPKI) is an approach to build a formally verifiable database of IP addresses and AS numbers as resources. The RPKI is a globally distributed database containing, among other things, information mapping BGP (internet) prefixes to their authorized origin-AS numbers. Routers running BGP can connect to the RPKI to validate the origin-AS of BGP paths.

BGP Prefix Independent Convergence for RIB and FIB

BGP PIC for RIB and FIB adds support for static recursive as PE-CE and faster backup activation by using fast re-route trigger.

The BGP PIC for RIB and FIB feature supports:

- FRR-like trigger for faster PE-CE link down detection, to further reduce the convergence time (Fast PIC-edge activation).
- PIC-edge for static recursive routes.
- BFD single-hop trigger for PIC-Edge without any explicit /32 static route configuration.
- Recursive PIC activation at third level and beyond, on failure trigger at the first (IGP) level.
- BGP path recursion constraints in FIB to ensure that FIB is in sync with BGP with respect to BGP next-hop resolution.

OSPF SPF Prefix Prioritization

The OSPF SPF Prefix Prioritization feature enables an administrator to converge, in a faster mode, important prefixes during route installation.

When a large number of prefixes must be installed in the Routing Information Base (RIB) and the Forwarding Information Base (FIB), the update duration between the first and last prefix, during SPF, can be significant.

In networks where time-sensitive traffic (for example, VoIP) may transit to the same router along with other traffic flows, it is important to prioritize RIB and FIB updates during SPF for these time-sensitive prefixes.

The OSPF SPF Prefix Prioritization feature provides the administrator with the ability to prioritize important prefixes to be installed, into the RIB during SPF calculations. Important prefixes converge faster among prefixes of the same route type per area. Before RIB and FIB installation, routes and prefixes are assigned to various priority batch queues in the OSPF local RIB, based on specified route policy. The RIB priority batch queues are classified as "critical," "high," "medium," and "low," in the order of decreasing priority.

When enabled, prefix alters the sequence of updating the RIB with this prefix priority:

Critical > High > Medium > Low

As soon as prefix priority is configured, /32 prefixes are no longer preferred by default; they are placed in the low-priority queue, if they are not matched with higher-priority policies. Route policies must be devised to retain /32s in the higher-priority queues (high-priority or medium-priority queues).

Priority is specified using route policy, which can be matched based on IP addresses or route tags. During SPF, a prefix is checked against the specified route policy and is assigned to the appropriate RIB batch priority queue.

These are examples of this scenario:

- If only high-priority route policy is specified, and no route policy is configured for a medium priority:
  - Permitted prefixes are assigned to a high-priority queue.
  - Unmatched prefixes, including /32s, are placed in a low-priority queue.
- If both high-priority and medium-priority route policies are specified, and no maps are specified for critical priority:
  - Permitted prefixes matching high-priority route policy are assigned to a high-priority queue.
  - Permitted prefixes matching medium-priority route policy are placed in a medium-priority queue.
  - Unmatched prefixes, including /32s, are moved to a low-priority queue.
- If both critical-priority and high-priority route policies are specified, and no maps are specified for medium priority:
  - Permitted prefixes matching critical-priority route policy are assigned to a critical-priority queue.
  - Permitted prefixes matching high-priority route policy are assigned to a high-priority queue.
  - Unmatched prefixes, including /32s, are placed in a low-priority queue.
- If only medium-priority route policy is specified and no maps are specified for high priority or critical priority:
  - Permitted prefixes matching medium-priority route policy are assigned to a medium-priority queue.
  - Unmatched prefixes, including /32s, are placed in a low-priority queue.

Use the **[no] spf prefix-priority route-policy** *rpl* command to prioritize OSPF prefix installation into the global RIB during SPF.

SPF prefix prioritization is disabled by default. In disabled mode, /32 prefixes are installed into the global RIB, before other prefixes. If SPF prioritization is enabled, routes are matched against the route-policy criteria and are assigned to the appropriate priority queue based on the SPF priority set. Unmatched prefixes, including /32s, are placed in the low-priority queue.

If all /32s are desired in the high-priority queue or medium-priority queue, configure this single route map:

```
prefix-set ospf-medium-prefixes
  0.0.0.0/0 ge 32
  end-set
```

Management Information Base (MIB) for OSPFv3

Cisco IOS XR supports full MIBs and traps for OSPFv3, as defined in RFC 5643. The RFC 5643 defines objects of the Management Information Base (MIB) for use with the Open Shortest Path First (OSPF) Routing Protocol for IPv6 (OSPF version 3).

The OSPFv3 MIB implementation is based on the IETF draft *Management Information Base for OSPFv3 (draft-ietf-ospf-ospfv3-mib-8)*. Users need to update the NMS application to pick up the new MIB when upgraded to RFC 5643.

Refer to the *Cisco Carrier Routing System and Cisco XR 12000 Series Router MIB Support Guide* for more information on Cisco IOS XR MIB support.

Multiple OSPFv3 Instances

SNMPv3 supports "contexts" that can be used to implement MIB views on multiple OSPFv3 instances, in the same system.

Nested Wildcard Apply Policy

The hierarchical constructs of Routing Policy Language (RPL) allows one policy to refer to another policy. The referred or called policy is known as a child policy. The policy from which another policy is referred is called calling or parent policy. A calling or parent policy can nest multiple child policies for attachment to a common set of BGP neighbors. The nested wildcard apply policy allows wildcard (*) based apply nesting. The wildcard operation permits declaration of a generic apply statement that calls all policies that contain a specific defined set of alphanumeric characters, defined on the router.

A wildcard is specified by placing an asterisk (*) at the end of the policy name in an apply statement. Passing parameters to wildcard policy is not supported. The wildcard indicates that any value for that portion of the apply policy matches.

To illustrate nested wildcard apply policy, consider this policy hierarchy:

```
route-policy Nested_Wilcard
apply service_policy_customer*
end-policy

route-policy service_policy_customer_a
if destination in prfx_set_customer_a  then
set extcommunity rt (1:1) additive
endif
end-policy

route-policy service_policy_customer_b
if destination in prfx_set_customer_b then
set extcommunity rt (1:1) additive
endif
end-policy

route-policy service_policy_customer_c
if destination in prfx_set_customer_c then
set extcommunity rt (1:1) additive
endif
end-policy
```

Here, a single parent apply statement (apply service_policy_customer*) calls (inherits) all child polices that contain the identified character string "service_policy_customer". As each child policy is defined globally, the parent dynamically nests the child policies based on the policy name. The parent is configured once and inherits each child policy on demand. There is no direct association between the parent and the child policies beyond the wildcard match statement.

InterAS Support on Multicast VPN

The Multicast VPN Inter-AS Support feature enables service providers to provide multicast connectivity to VPN sites that span across multiple autonomous systems. This feature enables Multicast Distribution Trees (MDTs), used for Multicast VPNs (MVPNs), to span multiple autonomous systems.

There are two types of MVPN inter-AS deployment scenarios:

- Single-Provider Inter-AS—A service provider whose internal network consists of multiple autonomous systems.
- Intra-Provider Inter-AS—Multiple service providers that need to coordinate their networks to provide inter-AS support.

To establish a Multicast VPN between two autonomous systems, a MDT-default tunnel must be setup between the two PE routers. The PE routers accomplish this by joining the configured MDT-default group. This MDT-default group is configured on the PE router and is unique for each VPN. The PIM sends the join based on the mode of the groups, which can be PIM SSM, or sparse mode.

For more information about the InterAS Support on MVPN, see the *Cisco IOS XR Multicast Configuration Guide for the Cisco CRS Router*.

Enhanced Object Tracking for HSRP and IP Static

A failure between the active router and the core network cannot be detected using standard HSRP failure detection mechanisms. Object tracking is used to detect such failures. When such a failure occurs, the active router applies a priority decrement to its HSRP session. If this causes its priority to fall below that of the standby router, it will detect this from the HSRP control traffic, and then use this as a trigger to preempt and take over the active role.

The enhanced object tracking for HSRP and IP Static feature provides first-hop redundancy as well as default gateway selection based on IP Service Level Agreement (IPSLA).

See the *Cisco IOS XR Routing Configuration Guide for the Cisco CRS Router*, for more information about enhanced object tracking for static routes.

Updating Software Images Without a Router Reload

In-service software upgrade (ISSU) is a user initiated and controlled process that upgrades a stateful switchover/nonstop forwarding (SSO/NSF)-capable Cisco IOS XR image from a lower to a higher version, or installs ISSU software maintenance updates (SMUs). ISSU upgrades a SSO/NSF-capable image with minimal downtime, degradation of service, or loss of packets.

Note ISSU is supported on Cisco CRS single-shelf systems only.

ISSU involves a route processor (RP) switchover followed by line card upgrades performed via an ISSU minimum disruption restart (MDR) [iMDR]. ISSU consists of three phases:

1 *Load* is the first phase of the ISSU process. The new image is downloaded to all nodes in the router. The new image is checked for compatibility to ensure the router can be upgraded. If the image is found to be incompatible, or an outage is warranted, you are notified.

Standby RPs and shelf controllers (SCs) are reloaded with the new version of the software. Each fabric card is also reloaded with the new software one at a time to minimize the impact to traffic. Each plane is brought down, fabric cards in this plane are reloaded with the new image and then the plane is added back before proceeding to the next plane.

At the end of this stage, all standby nodes are running the new software and all active nodes (including all line cards) are still running the original software images. Any abort of the upgrade process during the

load phase, either intentional (user abort) or due to failures, results in a hitless rollback and each standby/upgraded node is reloaded with the original software. The load phase is completed once all standby nodes are ISSU-ready.

2 *Run* is the second phase of the ISSU process. Each RP/SC pair completes an active to standby switchover. In parallel, each line card undergoes an iMDR to complete the software upgrade.

   Any abort of the upgrade process during the run phase results in a router reload with the original software. The ISSU run phase is completed once all iMDR and switchover operations are completed.

3 *Complete* is the final step of the ISSU process. This concludes the ISSU process and the new software is running on all nodes in the system. Since this is the conclusion of the ISSU process, the system cannot be reverted back to the original software from this point onwards.

The ISSU process can be performed in prompted mode, to ensure and verify that there is no degradation of the service throughout the process. Or the ISSU process can be performed unprompted, where the phases are executed automatically with no user intervention.

ISSU Release Information

For Cisco IOS XR Release 4.2.1, only Software Maintenance Upgrades (SMUs) that are identified and tagged as ISSU SMUs can be activated using ISSU.

Note Only an SMU marked as *ISSU* can be activated using ISSU.

The following table provides information regarding supported hardware for the ISSU process in Cisco IOS XR Release 4.2.1.

Table 4: ISSU-Supported Hardware

Type	Component	Part number
Chassis	Cisco CRS 16-Slot Line Card Chassis	CRS-16-LCC
Chassis	Cisco CRS 16-Slot Line Card Chassis 140G/M-Enhanced	CRS-16LCC140-B
Chassis	Cisco CRS 8-Slot Line Card Chassis	CRS-8-LCC
Chassis	Cisco CRS 8-Slot Enhanced Line Card Chassis	CRS-8-LCC-B
Chassis	Cisco CRS 4-Slot Line Card Chassis	CRS-4-CH
RP	Cisco CRS 8-Slot Route Processor	CRS-8-RP
RP	Cisco CRS 16-Slot Route Processor, revision B	CRS-16-RP-B
RP	Cisco CRS 16-Slot Router Processor	CRS-16-RP
PRP	Cisco CRS-1 Series 8-Slot 6 GB Performance Router Processor	CRS-8-PRP-6G

Type	Component	Part number
PRP	Cisco CRS-1 Series 8-Slot 12 Gb Performance Router Processor	CRS-8-PRP-12G
PRP	Cisco CRS-1 Series 16-Slot 6 Gb Performance Router Processor	CRS-16-PRP-6G
PRP	Cisco CRS-1 Series 16-Slot 12 Gb Performance Router Processor	CRS-8-PRP-12G
Flash	Cisco CRS PCMCIA Flash Disk 4 GB	CRS-FLASH-DISK-4G
MSC	Cisco CRS Modular Services Card	CRS-MSC
MSC	Cisco CRS Modular Services Card B	CRS-MSC-B
MSC	Cisco CRS-1 Series Forwarding Processor 40G	CRS-FP40
MSC	Cisco CRS Modular Services Card 140G	CRS-MSC-140G
MSC	Cisco CRS Series Forwarding Processor Card 140G	CRS-FP-140
Fabric cards	Cisco CRS Series 4-Slot Fabric Card / Single (140G)	CRS-4-FC140/S
Fabric cards	Cisco CRS 8-Slot Fabric Card/Single (140G)	CRS-8-FC140/S
Fabric cards	Cisco CRS Series 16-Slot Fabric Card/Single (140G)	CRS16-FC140/S
PLIM	Cisco CRS Series 14x10GbE LAN/WAN-PHY Interface Module	14X10GBE-WL-XFP
PLIM	Cisco CRS Series 20x10GbE LAN/WAN-PHY Interface Module	20X10GBE-WL-XFP
PLIM	Cisco CRS 1-Port 100-GE CFP PLIM	1X100GBE
PLIM	Cisco Carrier 1 Series SPA Interface Processor 40G (Jacket card)	CRS1-SIP-800
PLIM	Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/VS	4OC192-POS/DPT-VS
PLIM	Cisco CRS 8x10 GbE Interface Module LR/ER	8-10GBE
PLIM	Cisco CRS-1 Series 4x10GE Interface Module	4-10GE
PLIM	Cisco CRS-1 Series 42x1 GE Interface Module	42-1GE

Type	Component	Part number
PLIM	Cisco CRS-1 Series 20x1GE Flexible InterfaceModule	20-1GE-FLEX
PLIM	Cisco CRS-1 Series 2x10GE WAN/LAN Flexible Interface Module	2-10GE-WL-FLEX
PLIM	Cisco CRS-1 Series 4-Port Ten Gigabit Ethernet Interface Module	4-10GBE-WL-XFP
PLIM	Cisco CRS-1 Series 8-Port Ten Gigabit Ethernet Interface Module	8-10GBE-WL-XFP
SPA	Cisco CRS 1-Port OC-192/STM-64 POS/RPR SPA VSR Optics	SPA-OC192POS-VSR
SPA	2-Port OC-12c/STM-4 POS SPA	SPA-2XOC12-POS
SPA	1-Port OC-48c/STM-16 POS/RPR SPA	SPA-1XOC48-POS/RPR
SPA	Cisco CRS 8-Port OC-12c/STM-4c Shared Port Adapter	SPA-8XOC12-POS
SPA	Cisco CRS 2-Port OC-48c/STM-16c POS/RPR Shared Port Adapter	SPA-2XOC48-POS/RPR
SPA	Cisco CRS 4-Port OC-48c/STM-16c POS/RPR Shared Port Adapter	SPA-4XOC48-POS/RPR
SPA	Cisco CRS 1-Port OC-192c/STM-64c POS/RPR Shared Port Adapter with XFP Optics	SPA-OC192POS-XFP
SPA	Cisco CRS 4-Port OC-3c/STM-1c Shared Port Adapter	SPA-4XOC3-POS
SPA	Cisco 5-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-5X1GE-V2
SPA	Cisco 8-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-8X1GE-V2
SPA	Cisco 8-Port Gigabit Ethernet Shared Port Adapter	SPA-8X1GE
SPA	Cisco 10-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-10X1GE-V2
SPA	Cisco 1-Port Ten Gigabit Ethernet Shared Port Adapter, Version 2	SPA-1X10GE-L-V2

Type	Component	Part number
SPA	Cisco 1-Port 10 Gigabit Ethernet SPA WAN/LAN PHY	SPA-1X10GE-WL-V2
SPA	4-Port OC-3C/STM-1c POS SPA	SPA-4XOC3-POS-V2
PLIM	Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/SR	4OC192-POS/DPT-SR
PLIM	Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/IR	4OC129-POS/DPT-IR
PLIM	Cisco CRS 4xOC-192c/STM64c POS/DPT Interface Module/LR	4OC192-POS/DPT-LR
PLIM	Cisco CRS 16xOC-48c/STM16c POS/DPT Interface Module	16OC48-POS/DPT
PLIM	Cisco CRS 1xOC-768c/STM256c POS Interface Module/SR	1OC768-POS-SR

Table 5: Hardware Not Supported by ISSU

Type	Component	Part number
Chassis	Cisco CRS Multishelf System	—
DRP	Cisco CRS-1 Distributed Router Processor	CRS-DRP
DRP	Cisco CRS-1 Distributed Router Processor CPU Module	CRS-DRP-B-CPU
DRP	Cisco CRS-1 Distributed Router Processor PLIM Module	CRS-DRP-B-PLIM
DRP	Cisco CRS-1 Distributed Router Processor CPU Module	CRS-DRP-CPU
PLIM	Cisco CRS 1-Port OC-768c/STM-245c (C-band) DWDM PLIM	1OC768-ITU/C
PLIM	Cisco CRS 1-Port OC-768c/STM-256c (C-band) DPSK +DWDM PLIM	1OC768-DPSK/C
PLIM	Cisco 4-Port Ten Gigabit Ethernet (C-band) DWDM PLIM	4-10GE-ITU/C

Type	Component	Part number
CGSE	Cisco CRS-1 Series Carrier Grade Serivce Engine PLIM	CRS-CGSE-PLIM
SPA	Cisco CRS 4-Port Clear Channel T3/E3 Serial Shared Port Adapter	SPA-4XT3/E3
SPA	2-Port OC-12c/STM-4c POS Shared Port Adapter	SPA-2XOC12-POS
SPA	1-Port OC-48c/STM-16c POS/RPR Shared Port Adapter	SPA-1XOC48-POS/RPR
SPA	3-Port Clear Channel OC-3 ATM Shared Port Adapter	SPA-3XOC3-ATM-V2
SPA	1-Port Clear Channel OC-12 ATM Shared Port Adapter with XFP Optics	SPA-1XOC12-ATM-V2
SPA	1-Port Channelized OC12 to DS0 Shared Port Adapter	SPA-1XCHOC12/DS0
SPA	Cisco CRS 2-Port Clear Channel T3/E3 Serial Shared Port Adapter	SPA-4XT3/E3

During the ISSU orchestration (from the load process till the complete process), ISSU disables all unsupported line cards, SPAs and service engine cards (CGSEs) and holds them in the MBI run state. After the ISSU process is complete, the unsupported line cards, SPAs and CGSEs boot with the new software.

Caution If the users have DRPs (Distributed Route Processors) in the router, then they must shut down the DRPs manually to start ISSU. If this is not done, ISSU is aborted. Also, SDR configurations must be avoided or removed before starting ISSU.

An SMU delivers a software change to the user in the least possible time. Prior to ISSU support, SMU installations resulted in either restart of one or more processes, or reload of one or more nodes. ISSU minimizes the operational impact that a user experiences. As ISSU does not support software downgrade, SMU upgrades installed using ISSU can only be uninstalled by means of parallel reload method.

To perform an ISSU SMU upgrade, use the **issu** keyword with the **install activate** command. There are three types of SMUs:

- ISSU SMU—This is installed using the ISSU method. These SMUs can also be installed using the parallel reload method by omitting the **issu** keyword in the **install activate** command.
- Reload SMU—This SMU requires parallel reloads during its installation.
- Restart SMU—This SMU requires process restarts during its installation.

The type of SMU can be identified by viewing output of the **show install pie-info** *pie* **detail** command. ISSU SMUs are identified by *ISSU (quick) warm-reload* in the Restart information field.

```
RP/0/RP0/CPU0:ROUTER(admin)# show install pie-info tftp://223.255.254.254/hfrp-
4.2.1.02I.issu.pie detail
Mon Jul 11 12:32:27.114 PST
Contents of pie file '/tftp://223.255.254.254/hfr-p-4.2.1.02I.issu.pie':
Expiry date : Oct 16, 2015 17:51:47 PST
Uncompressed size : 727056
Compressed size : 316258
hfr-p-4.2.1.02I.CSCea12345-1.0.0
hfr-p-4.2.1.02I.CSCea12345 V1.0.0[SMU] User specified bundle hfrbase-
4.2.1.02I.CSCea12345.pi.pie.
[composite package]
[root package, grouped contents]
Vendor : Cisco Systems
Desc : User specified bundle hfr-base-4.2.1.02I.CSCea12345.pi.pie.
Build : Built on Fri Jul 8 16:25:25 PST 2011
Source : By sjc-lds-773 in /nobackup/ryeh/smu-test-issu for pie
Card(s): RP, RP-B, HRP, DRP, 40G-MSC, SP, SC
Restart information:
Default:
parallel impacted processes restart
Size Compressed/Uncompressed: 308KB/710KB (43%)
Components in package hfr-p-4.2.1.02I.CSCea12345-1.0.0, package hfrp-
4.2.1.02I.CSCea12345:
hfr-base-4.2.1.02I.CSCea12345-1.0.0

hfr-base-4.2.1.02I.CSCea12345 V1.0.0[SMU] HFR base Package
Vendor : Cisco Systems
Desc : HFR base Package
Build : Built on Fri Jul 8 16:25:24 PST 2011
Source : By sjc-lds-773 in /nobackup/ryeh/smu-test-issu for pie
Card(s): RP, RP-B, HRP, DRP, 40G-MSC, SP, SC
Restart information:
Default:
ISSU (quick) warm reload
Specific:
ISSU (quick) warm reload to and from ***-*
Size Compressed/Uncompressed: 308KB/710KB (43%)
Components in package hfr-base-4.2.1.02I.CSCea12345-1.0.0,
package hfr-base-4.2.1.02I.CSCea12345:
hfr-lcplatform-mgr V[r412/3] LC only version of HFR
platform-mgr.
hfr-base-4.2.1.02I.CSCea12345-package-compatibility
V[Default] Package Compatibility information for package hfr-base-
4.2.1.02I.CSCea12345
hfr-base-4.2.1.02I.CSCea12345-package V[Default] Manifest
information for package hfr-base-4.2.1.02I.CSCea12345
```

Mixed SMU types can only be combined in the same activation if parallel reload is used as the activation type. ISSU cannot be used to activate parallel-process-restart SMUs. However, if the user wants to install both parallel-process-restart and ISSU SMUs, the following two options are provided:

- Use parallel-reload to install the SMUs.
- Install the parallel-process-restart SMU(s) as a first operation, and then install the ISSU SMU(s) as a separate operation.

You can use the following commands outside the maintenance window since there is no traffic impact:

- **install add**

  Example: `install add tftp://223.255.254.254/hfr-px-4.2.1.CSCzz99999.pie`

- **install activate—**This command is used to initiate the ISSU and specify the prompt mode.

  Example: `install activate id 1 issu prompt-level all issu`

It is recommend to use the following command within the maintenance window in run phase:

- ISSU Run Phase

  Example: `install operation 70 run`

- ISSU Complete Phase

  Example: `install operation 70 complete`

Available ISSU process syslog events are:

- The event that is logged upon execution of each phase (Load, Run and Complete) of the ISSU process.
- The event that is logged when the ISSU process is completed.
- The event that is logged when the Rollback process is kicked off.
- The event that is logged for all abnormal cases.

SMU Installation Combinations

The three types of maintenance upgrades (SMUs), process restart SMUs, ISSU SMUs, and reload SMUs, can be combined in various combinations in an upgrade procedure. Not all combinations of SMUs can be installed in one step. This table lists the installation behavior when the SMU activation is done both with and without the **issu** keyword:

SMU Type	With issu Keyword	Without issu Keyword
Restart SMU	User is prompted to continue operation as Parallel Process Restart	Parallel Process Restart
ISSU SMU	In-service upgrade	Parallel Reload
Reload SMU	User is prompted to continue operation as Parallel Reload	Parallel Reload
Restart and ISSU SMUs	Not supported, but allowed. The recommended procedure is to install the SMUs in two steps: first install the restart SMUs using the Parallel Process Restart method, then perform the in-service upgrade of the ISSU SMUs.	Parallel Reload
ISSU and Reload SMUs	User is prompted to continue the operation as a Parallel Reload	Parallel Reload
Restart, ISSU and Reload SMUs	User is prompted to continue operation as a Parallel Reload	Parallel Reload

Hardware Features Introduced in Cisco IOS XR Software Release 4.2.1 for the Cisco CRS Router

The following new hardware features were introduced in Cisco IOS XR Software Release 4.2.1 on the Cisco CRS Router:

CRS Back-to-Back System

The Back-to-Back System comprises of two CRS 16-slot chassis connected together acting as a single routing entity thus expanding the CRS system from 16 to 32 slots.

The CRS Back-to-Back System uses the same Line Card Chassis used in the Single chassis or Multichassis systems. Compared to a 2+1 Multichassis system, the Back-to-Back System connects two Line Card Chassis without the Fabric Card Chassis (FCC) S2 cards. Instead, two Line Card Chassis are connected via S13 fabric cards using a set of back-to-back cables. The Back-to-Back System provides the same functionality and scale as of a 2+1 Multichassis system. The CRS Back-to-Back System allows seamless migration to the larger Multichassis system.

Note The CRS Back-to-Back System is only supported on CRS-3 with PRP.

Additional Optics

Cisco IOS XR Software Release 4.2.1 introduces support for the CFP-100G-SR10 optical module on the Cisco CRS-3 Series Router platform.

This CFP-100G-SR10 optical module enables connections to the Cisco CRS-3 Series Router card using multimode fiber rather than only single mode fiber.

For more information about this newly introduced optical module, refer to the *Cisco CRS Carrier Routing System Ethernet Physical Layer Interface Module Installation Note* online.

Important Notes on Cisco IOS XR Software and Cisco CRS Router

- **Default timestamp setting—**The timestamp prompt that precedes console output is enabled by default. To disable the timestamp prompt, use the **no service timestamp** command. For more information, refer to the *Cisco IOS XR System Management Command Reference for the Cisco CRS Router* .
- From Cisco IOS XR Software Release 3.6.0, WRED statements are collapsed in that if different random-detect statements using the same match types (EXP, DSCP, Prec, and so forth) are entered with identical minimum and maximum threshold values, a single configuration line is shown in the output of **show running config**. This reduces the length of the configuration but creates a problem with backward compatibility with previous releases. In such a situation, on rollback, the QoS policy is rejected and must be manually entered again.

  Configuration prior to Cisco IOS XR Software Release 3.6.0:

```
Policy-map wred_example
   Class class-default
        random-detect exp 0 384 packets 484 packets
        random-detect exp 1 384 packets 484 packets
        random-detect exp 2 384 packets 484 packets
```

```
       random-detect exp 3 484 packets 584 packets
       random-detect exp 4 484 packets 584 packets
       random-detect discard-class 0 384 packets 484 packets
      random-detect discard-class 1 384 packets 484 packets
      random-detect discard-class 2 484 packets 584 packets
      bandwidth remaining percent 20
```

Cisco IOS XR Software Release 3.6.0 and later releases:

```
 policy-map wred_example
 class class-default
  random-detect exp 0,1,2 384 packets 484 packets
  random-detect exp 3,4 484 packets 584 packets
  random-detect discard-class 0,1 384 packets 484 packets
  random-detect discard-class 2 484 packets 584 packets
  bandwidth remaining percent 20
 !
 end-policy-map
!
end
```

In Cisco IOS XR Software Release 3.6.0 and later releases, the implicitly assigned QoS class class-default must have at least 1 percent bandwidth made available to it. This can be done either by assigning at least 1 percent explicitly (bandwidth remaining percent 1) or by ensuring that the total bandwidth assigned to all other classes in the policy is a maximum of 99 percent, leaving 1 percent available for the class-default. A QoS policy that does not have any bandwidth for class-default is rejected when upgrading to Cisco IOS XR Software Release 3.6.0 or later releases.

- **Country-specific laws, regulations, and licenses—**In certain countries, use of these products may be prohibited and subject to laws, regulations, or licenses, including requirements applicable to the use of the products under telecommunications and other laws and regulations; customers must comply with all such applicable laws in the countries in which they intend to use the products.
- **Card fan controller, and RSP removal—**For all card removal and replacement (including fabric cards, line cards, fan controller, and RSP) follow the instructions provided by Cisco to avoid impact to traffic. See the *Cisco IOS XR Getting Started Guide for the Cisco CRS Router*for procedures.
- **Exceeding Cisco testing—**If you intend to test beyond the combined maximum configuration tested and published by Cisco, contact your Cisco Technical Support representative to discuss how to engineer a large-scale configuration maximum for your purpose.
- **mpls traffic engineering igp-intact** command**—**This command must be used only when policy based tunnel selection is configured for all tunnels originating on the device. This CLI needs to be turned on under IGP (OSPF/ISIS) under the respective AFI.
- The following TE Path option attribute commands are not supported on the Cisco CRS-1 Series Router:
  - affinity locatio nset
  - affinity location type
  - affinity program
  - affinity self
- BFD IPv6 UDP Checksum Calculation**—**In Cisco IOS XR Software Release 3.9, you turn the BFD IPv6 UDP checksum calculation on and off:
  - To disable the BFD IPv6 UDP checksum calculation:

```
RP/0/RP0/CPU0:router(config)#bfd

RP/0/RP0/CPU0:router(config-bfd)#ipv6 checksum disable
```

```
RP/0/RP0/CPU0:router(config-bfd)#end
```

- To enable BFD IPv6 UDP checksum calculation:

```
RP/0/RP0/CPU0:router(config)#bfd
RP/0/RP0/CPU0:router(config-bfd)#no ipv6 checksum disable
RP/0/RP0/CPU0:router(config-bfd)#end
```

- On upgrading Cisco IOS XR Software from 3.6.2 to 4.0.0 the MAC address assigned to physical interfaces changes. This is required because prior to Cisco IOS XR Software Release 3.8.4 the MAC address assigned to the bundle interface was taken from the first member's MAC address. If this bundle member is removed from the bundle, the bundle gets a new MAC address, which results in traffic loss due to ARP resolution. Beginning in Cisco IOS XR Software Release 3.8.4, a pool of MAC addresses are assigned to the bundle interfaces by the bundlemgr process during bundle interface creation.
- Deactivation of os-mbi dependent (Nonreload) SMU fails—Backing out the non reload os-mbi SMU fails because deactivation runs out of memory (activation did not release some memory, which stayed at 38 MB). This failure to activate or deactivate the SMU due to insufficient SP resources impacts SP cards on CRS.
- When configuring the Label Distribution Protocol (LDP) graceful restart (GR) process in a network with multiple [link and/or targeted] LDP hello adjacencies with the same neighbor, make sure that GR is activated on the session before any hello adjacency times out due to neighbor control plane failures. One way of achieving this is by configuring a lower session hold time between neighbors such that session time out always occurs before hello adjacency can time out. Cisco recommends setting LDP session hold time using the following formula:

  LDP session hold time <= (Hello hold time - Hello interval) * 3

  This means that for default values of 15/5 seconds respectively for the link Hello hold time and the Hello interval, the LDP session hold time should be set to 30 seconds or less.

  For more information, refer to the *Implementing MPLS Label Distribution Protocol* on *Cisco IOS XR Software* section of the *Cisco IOS XR MPLS Configuration Guide for the Cisco CRS Router*.
- For information about upgrading from a Cisco CRS-1 to a Cisco CRS-3 chassis, refer to the *Cisco CRS-1 Carrier Routing System to Cisco CRS-3 Carrier Routing System Upgrade Guide* at the following URL:

  http://www.cisco.com/en/US/products/ps5763/prod_installation_guides_list.html
- The following commands have been modified to support Cisco CRS-3 router:
  - **show environment**
  - **hw-module reload**
  - **show controllers egressq client location**
  - **show controllers egressq queue drr [max | min] location <>**
  - **show controllers egressq queue drr [max | min] location <>**
  - **show controllers egressq group ntb [max | min] location <>**
  - **show controllers egressq port bpmap location <>**
  - **show controllers egressq statistics detail location <>**
  - **show controllers egressq resources location <>**

For information about these commands, refer to the *Commands* section of the *Cisco CRS-1 Carrier Routing System to Cisco CRS-3 Carrier Routing System Upgrade Guide*:

http://www.cisco.com/en/US/products/ps5763/prod_installation_guides_list.html

- For Cisco IOS XR Software Release 4.0.0 and above, after upgrading, the FPGA upgrade using the **auto-fpd upgrade** command as a part of the auto-fpd upgrade process fails for the SPA-1X10GE-L-V2 SPA. The workaround is to perform a manual FPGA upgrade on the SPA-1X10GE-L-V2 SPA using the **upgrade hw-module fpd fpga1 location 0/0/1** command in admin mode after the **auto-fpd upgrade** command execution completes.
- The minimum timer configuration value for the BFD on Bundle Members feature (BoB) increases from 30 to 60 seconds in Cisco IOS XR Software Release 4.2. The timer value can be left as default or modified as follows:
  - **int bundle-(ether|pos) <num>**
  - **bfd address-family ipv4 timers start <30-3600>**
  - **bfd address-family ipv4 timers nbr-unconfig <30-3600>**
- This release supports the following fixed DWDM XFPs with CRS-3 and certain CRS-1 10GE interface modules:
  - DWDM-XFP-30.33
  - DWDM-XFP-60.61
  - DWDM-XFP-50.92
  - DWDM-XFP-50.12
  - DWDM-XFP-31.12
  - DWDM-XFP-31.90
  - DWDM-XFP-32.68
  - DWDM-XFP-34.25
  - DWDM-XFP-35.04
  - DWDM-XFP-35.82
  - DWDM-XFP-36.61
  - DWDM-XFP-38.19
  - DWDM-XFP-38.98
  - DWDM-XFP-39.77
  - DWDM-XFP-40.56
  - DWDM-XFP-42.14
  - DWDM-XFP-42.94
  - DWDM-XFP-43.73
  - DWDM-XFP-44.53
  - DWDM-XFP-46.12

- DWDM-XFP-46.92
- DWDM-XFP-47.72
- DWDM-XFP-48.51
- DWDM-XFP-51.72
- DWDM-XFP-52.52
- DWDM-XFP-54.13
- DWDM-XFP-54.94
- DWDM-XFP-55.75
- DWDM-XFP-56.55
- DWDM-XFP-58.17
- DWDM-XFP-58.98
- DWDM-XFP-59.79

Reference caveat, CSCtk96820. Please contact your Cisco representative for more information on dates by which this will be available.

- Starting from Cisco IOS XR Software Release 4.0.0, the **hw-module location <LOC> reload warm** command is disabled. As a result, the warm reload feature also has been disabled.

- On rare occasions, during Cisco IOS XR Software Release 4.2.0 testing, we have observed issues while making bulk configuration changes (1000+ lines) in a single configuration (Using copy (remote) running, commit replace and rollback.) We recommend that you archive configurations before executing bulk configuration changes on this scale in Cisco IOS XR Software Release 4.2.0. This way you can easily retry or compare results.

- The following error messages appear when one or multiple SDRs are configured on the chassis

```
SP/0/3/SP:May  1 14:28:49.073 : sysmgr[79]: %OS-SYSMGR-7-DEBUG :
sysmgr_admin_plane_check:SYSMGR_PLANE_ADMIN Notification sent.
SP/0/SM6/SP:May  1 14:29:35.092 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM6/SP/0 HP NQ Err: msc-dest: M1- 4;
SP/0/SM7/SP:May  1 14:29:35.096 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM7/SP/1 HP NQ Err: msc-dest: M1- 4;
SP/0/SM3/SP:May  1 14:29:37.392 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM3/SP/2 HP NQ Err: msc-dest: M3- 14;
SP/0/SM2/SP:May  1 14:29:37.392 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM2/SP/2 HP NQ Err: msc-dest: M3- 14;
SP/0/SM0/SP:May  1 14:29:39.108 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM0/SP/1 HP NQ Err: msc-dest: M1- 4;
SP/0/SM1/SP:May  1 14:29:39.103 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM1/SP/0 HP NQ Err: msc-dest: M1- 4;
RP/0/RP1/CPU0:May  1 14:29:42.334 : online_diag_rp[341]: %DIAG-XR_DIAG-3-ERROR :
(U) Fabric Ping Failure, 2 of 7 nodes failed(L): 0/0/CPU0, 0/1/CPU0
SP/0/SM5/SP:May  1 14:29:47.143 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
s3/0/SM5/SP/1 HP NQ Err: msc-dest: M1- 4;
SP/0/SM4/SP:May  1 14:29:47.136 : sfe_drvr[130]:
%FABRIC-FABRIC_DRVR-3-ERRRATE_EXCEED_SLOW :
 s3/0/SM4/SP/0 HP NQ Err: msc-dest: M1- 4;
```

```
RP/0/RP1/CPU0:May  1 14:29:47.670 : online_diag_rp[341]: %DIAG-XR_DIAG-3-ERROR :
(U) Fabric Ping Failure - destination node (Level 2) in 0/0/CPU0
RP/0/RP1/CPU0:May  1 14:29:47.673 : online_diag_rp[341]: %DIAG-XR_DIAG-3-ERROR :
(U) Fabric Ping Failure - destination node (Level 2) in 0/1/CPU0
RP/0/RP1/CPU0:May  1 14:29:48.061 : online_diag_rp[341]: %DIAG-XR_DIAG-3-ERROR :
(U) FIM: multi-nodes failure detected
```

DWDM Configuration Management

Note This section describes the new DWDM configuration requirements in Cisco IOS XR 3.9.0 and later releases. It does not describe all updates to the DWDM feature. For more information about DWDM configuration, refer to the *Configuring Dense Wavelength Division Multiplexing Controllers on Cisco IOS XR Software* module in the *Cisco IOS XR Interface and Hardware Component Configuration Guide for the Cisco CRS Router*.

Cisco IOS XR Software Release 3.9.0 introduced new commands in addition to an important change to the default laser state for all of the DWDM physical layer interface modules (PLIMs) supported on the Cisco CRS-1 and CRS-3 routers, which impacts the required configuration to support those cards.

This change affects all models of the following hardware on the Cisco CRS-1 router:

- Cisco 1-Port OC-768c/STM-256c DWDM PLIM
- Cisco 4-Port 10-Gigabit Ethernet DWDM PLIM

This change affects all models of the following hardware on the Cisco CRS-3 router:

- Cisco 1-Port 100GE OTU4 IPoDWDM PLIM
- Cisco 4-Port 40-GE OTU3 OTN/LAN PLIM
- Cisco 2-Port 40-GE OTU3 OTN/LAN PLIM

The **g709 fec high-gain** and **g709 fec long-haul** commands are added under DWDM configuration to configure the new high-gain FEC mode and long-haul FEC mode for Cisco 1-Port 100GE OTU4 IPoDWDM PLIM.

The following is an example of configuring the **g709 fec high-gain** command under DWDM configuration to configure the new high-gain FEC mode:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller dwdm <>
RP/0/RP0/CPU0:router(config)# g709 fec high-gain
RP/0/RP0/CPU0:router(config)# commit
```

The following is an example of configuring the **g709 fec long-haul** command under DWDM configuration to configure the new long-haul FEC mode:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# g709 fec long-haul
RP/0/RP0/CPU0:router(config)# commit
```

Important DWDM Changes in Cisco IOS XR Software Release 3.9.0 and Later Releases

- The **laser off** and **shutdown (DWDM)** commands are replaced by the **admin-state-out-of-service** command.
- The default state of the laser has changed from "On" to "Off" for all PLIMs. Therefore, the laser for all DWDM controllers must explicitly be turned on using the **admin-state in-service** command in DWDM configuration mode

Configuration Examples in Cisco IOS XR Software Release 3.9.0 and Later Releases

This section provides configuration examples for turning on and off the laser on a DWDM PLIM.

Turning On the Laser: Example

Note This is a required configuration beginning in Cisco IOS XR Software Release 3.9.0. The DWDM PLIMs will not operate without this configuration.

The following example shows how to turn on the laser and place a DWDM port in In Service (IS) state:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:router(config-dwdm)# admin-state in-service
RP/0/RP0/CPU0:router(config-dwdm)# commit
```

Turning Off the Laser: Example

Note This configuration replaces the **laser off** and **shutdown (DWDM)** configuration commands.

The following example shows how to turn off the laser, stop all traffic and place a DWDM port in Out of Service (OOS) state:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:router(config-dwdm)# admin-state out-of-service
RP/0/RP0/CPU0:router(config-dwdm)# commit
```

Minimum Flash Disk Requirements When Upgrading to Release 4.2.1

Cisco IOS XR Software Release 4.2.1 requires a minimum of 4-GB Flash Disk. This release also provides an upgrade option to 16-GB Flash Disk. 1-GB and 2-GB Flash Disks are no longer supported with this release. For information on End-of-Sale and End-of-Life Announcement for the Cisco CRS-1 PCMCIA Flash Disk 2 GB, refer to: http://www.cisco.com/en/US/prod/collateral/routers/ps5763/end_of_life_notice_c51-681333.html

To upgrade from a 1-GB or 2-GB to a greater Flash Disk, refer to the Flash Disk Upgrade Tasks link on the following Cisco CRS router Installation and Upgrade URL: http://www.cisco.com/en/US/products/ps5763/prod_installation_guides_list.html

For Cisco CRS routers, change to FAT32 in order to partition a 4 GB Flash Disk as a 3.5 GB and 0.5 GB partition. This type of partition is recommended in order to create a partition with more than 2 GB of flash space. Disk partitioning has been supported from Cisco IOS XR Software Release 3.6 onwards. For more information, refer to the *Turbo Boot Appendix* of the *Cisco CRS-1 Carrier Routing System to Cisco CRS-3 Carrier Routing System Migration Guide* .

Additional upgrade instructions for the Cisco CRS router are available from http://www.cisco.com/web/Cisco_IOS_XR_Software/pdf/ReplacingPCMCIACardOnCRS-1.pdf.

Caveats

Caveats describe unexpected behavior in Cisco IOS XR Software releases. Severity-1 caveats are the most serious caveats; severity-2 caveats are less serious.

This section contains caveats that are generic to the Cisco IOS XR Software Release 4.2.1 and those specific to the Cisco CRS-1 router and the Cisco CRS-3 router.

Cisco IOS XR Caveats

The following open caveats apply to Cisco IOS XR Software Release and are not platform specific:

- **CSCtz92323**

  Basic Description:

  dllmgr crashes continuously when the text segment limit is reached.

  Symptom

  The problem is hit when 1100+ dlls are loaded in the system. Dllmgr text segment memory (64MB) is getting exhausted due to the large number of dlls being loaded.

  Workaround:

  Contact Cisco TAC when the problem appears.

- **CSCtx28724**

  Basic Description:

  ICL Change in Single commit results in configuration failure.

  Symptom

  - Scenario 1: When user tries to change Inter Chassis Link from one physical interface to the other in a single commit, configuration will not be applied due to internal race condition.
  - Scenario 2: User tries to delete Inter Chassis Link without removing satellite interface configuration. System Impact for this is configuration commit timeout or apply failures for satellite configuration and ICL configuration.
  - Reason: Race condition between sysdb_svr_local, cfgmgr_lc, ifo_ma and ifmgr.

  Workaround:

Step 1: User needs to take the backup of all satellite interface configuration manually.

Step 2: Remove all the satellite interface which are configured.

Step 3: Change the ICL configuration from one physical interface to the other.

Step 4: Apply the satellite configuration from the backup file which was done in step 1.

- **CSCua01836**

  Basic Description:

  Commit fails when child policy of a wildcard policy is deleted.

  Symptom:

  Commit fails on deleting child policy matching wildcard policy attached on some attach-point.

  Conditions:

  Deleting policy matching wildcard policy.

  Workaround:

  Instead of deleting the child policy, customer can rewrite the policy with empty body.

- **CSCtz87361**

  Basic Description:

  Huge mibd_interface memleak on mib walk: Component: ethernet-lldp.

  Symptom:

  Memory leak could be seen for the mibd_interface process.

  Conditions:

  Memory leak is seen when LLDB-MIB is polled and the size of the memory leak is 450KB per polling iteration.

  Workaround:

  Restart the mibd_interface process.

- **CSCtx81095**

  Basic Description:

  Incorrect behaviour of traceroute ipv6.

  Symptom:

  When loopack is configured between two end points with ipv6 address and traceroute to the remote loopback address is sent, traceroute brings the ipaddress of loopback interface as against the interface ip address. In the case of ipv4, the traceroute fetches egress interface ip address and the "icmp ipv6 source vrf/rfc" command has no effect .

  Conditions:

  Not specified.

  Workaround

  None

Caveats Specific to the Cisco CRS Router

The following open caveats are specific to the Cisco CRS platform:

- **CSCtr06459**

  Basic Description:

  DRP fails to come up on upgrade.

  Symptom:

  DRP is stuck in IN-RESET state since one of the CPU nodes is stuck in Rommon.
  Error reading motherboard id eeprom ... If this is an MSC or DRP this is expected, now sending ID EEPROM read request to obtain board info from the SP. Error reading motherboard id eeprom ... If this is an MSC or DRP this is expected, now sending ID EEPROM read request to obtain board info from the SP. Initializing DDR SDRAM...found 4096 MB Initializing ECC on bank 0 Initializing ECC on bank 1 Initializing ECC on bank 2 Initializing ECC on bank 3 Turning off data cache, using DDR for first time Error reading motherboard id eeprom ... If this is an MSC or DRP this is expected, now sending ID EEPROM read request to obtain board info from the SP. Error reading motherboard id eeprom ... If this is an MSC or DRP this is expected, now sending ID EEPROM read request to obtain board info from the SP. Initializing DDR SDRAM...found 4096 MB Initializing ECC on bank 0 Initializing ECC on bank 1 Initializing ECC on bank 2 Initializing ECC on bank 3 Turning off data cache, using DDR for first time

  Conditions:

  This is found during system reload or single board reload.

  Workaround:

  Replace the affected CPU module.

Upgrading Cisco IOS XR Software

Cisco IOS XR Software is installed and activated from modular packages, allowing specific features or software patches to be installed, upgraded, or downgraded without affecting unrelated processes. Software packages can be upgraded or downgraded on all supported card types, or on a single card (node).

Software packages are installed from package installation envelope (PIE) files that contain one or more software components.

The following URL contains links to information about how to upgrade Cisco IOS XR Software:

http://www.cisco.com/web/Cisco_IOS_XR_Software/index.html

Migrating Cisco CRS-1 to CRS-3

For information about migrating from a Cisco CRS-1 to a Cisco CRS-3 chassis, refer to the *Cisco CRS-1 Carrier Routing System to Cisco CRS-3 Carrier Routing System Migration Guide* at the URL http://www.cisco.com/en/US/products/ps5763/prod_installation_guides_list.html

Troubleshooting

For information on troubleshooting Cisco IOS XR Software, see the *Cisco IOS XR Troubleshooting Guide for the Cisco CRS router* and the *Cisco IOS XR Getting Started Guide for the Cisco CRS router*

Related Documentation

The most current Cisco CRS router hardware documentation is located at the following URL:

http://www.cisco.com/en/US/products/ps5763/tsd_products_support_series_home.html

The Cisco IOS XR Software documentation set includes the Cisco IOS XR software configuration guides and command references, as well as a getting started guide.

The most current Cisco CRS router software documentation is located at the following URL:

http://www.cisco.com/en/US/products/ps5763/tsd_products_support_series_home.html

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

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