Release Notes for Cisco XR 12000 Series Router for Cisco IOS XR Software Release 4.3.1

Text Part Number: OL-28941-01

Release Notes for Cisco XR 12000 Series Router for Cisco IOS XR Software Release 4.3.1

Note This product has reached end-of-life status. For more information see the End-of-Life and End-of-Sale Notices.

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 4.3.1 for the Cisco XR 12000 Series Router and are updated as needed.

Note For information on the Cisco XR 12000 Series Router running Cisco IOS XR Software Release 4.3.1, see the Important Notes, on page 39.

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

http://www.cisco.com/en/US/products/ps6342/tsd_products_support_series_home.html

This electronic documents may contain updates and modifications. For more information on obtaining Cisco documentation, see the Obtaining Documentation and Submitting a Service Request, on page 44 section.

For a list of software caveats that apply to Cisco IOS XR Software Release 4.3.1 see the Caveats section.

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 XR 12000 Series 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), 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.
- **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).
- **Craft Works Interface (CWI)—**CWI is a client-side application used to configure and manage Cisco routers. Management and configuration features include fault, configuration, security, and inventory, with an emphasis on speed and efficiency. The CWI provides a context-sensitive graphical representation of the objects in a Cisco router, simplifying the process of configuring and managing the router. The CWI allows you to log in to multiple routers and perform management tasks.
- **Availability—**This supports rich availability features such as fault containment, fault tolerance, fast switchover, link aggregation, nonstop routing for ISIS, LDP, BGP, 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.
- **6VPE over L2TPv3 support—**This delivers IPv6 VPN traffic over L2TPv3 core with 6VPE support. This feature is also available on Cisco IOS Software.
- **Enhanced core competencies:**
  - IP fast convergence with Fast Reroute (FRR) support for Intermediate System-to-Intermediate System (IS-IS) and OSPF
  - Path Computation Element (PCE) capability for traffic engineering
- **L2TPv3 Tunneling Mechanism—**Service Providers who do not use MPLS in the core, but want to offer VPN services can use the L2TPv3 tunneling mechanism. This feature support includes IPv4 (VPNv4) and IPv6 (6VPE) VPN services using L2TPv3 encapsulation. This L2TPv3 packet is encapsulated in an IPv4 delivery header and is carried across an IPv4 backbone. VPN prefixes are

advertised with BGP labels and resolved over L2TPv3 tunnels. This feature is supported only on the Cisco XR 12000 Series Router.

For more information about new features provided on the Cisco XR 12000 Series Router for Cisco IOS XR Software Release, see the Software Features Introduced in Cisco IOS XR Software Release 4.3.1 section in this document.

System Requirements

This section describes the system requirements for Cisco IOS XR Software Release supported on the Cisco XR 12000 Series Router.

Feature Set Table

Cisco IOS XR Software is packaged in *feature sets* (also called *software images*). Each feature set contains a specific set of Cisco IOS XR Software Release 4.3.1 features.

Table 1: Cisco IOS XR Software Release 4.3.1 PIE Files, on page 3 lists the Cisco IOS XR Software feature set matrix (PIE files) and associated filenames available for Cisco IOS XR Software Release 4.3.1, supported on the Cisco XR 12000 Series Router.

Table 1: Cisco IOS XR Software Release 4.3.1 PIE Files

Feature Set	Filename	Description
Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	c12k-mini-pie-4.3.1	Contains the required core packages, including OS, Admin, Base, Forwarding, Routing, SNMP Agent, and Alarm Correlation.
Cisco IOS XR IP Unicast Routing Core Bundle	c12k-mini-vm-4.3.1	Contains the required core packages including OS, Admin, Base, Forwarding, and Routing SNMP Agent, and Alarm Correlation. Contains the required core packages including OS, Admin, Base, Forwarding, and Routing SNMP Agent, and Alarm Correlation.
Optional Individual Packages (Packages are installed individually)		
Cisco IOS XR Manageability Package	c12k-mgbl.pie-4.3.1	Common Object Request Broker Architecture (CORBA) agent, Extensible Markup Language (XML) Parser, and HTTP server packages.

Cisco IOS XR MPLS Package	c12k-mpls.pie-4.3.1	MPLS Traffic Engineering (MPLS-TE), Label Distribution Protocol (LDP), MPLS Forwarding, MPLS Operations, Administration, and Maintenance (OAM), Link Manager Protocol (LMP), Optical User Network Interface (OUNI), Resource Reservation Protocol (RSVP), and Layer-3 VPN.
Cisco IOS XR Multicast Package	c12k-mcast.pie-4.3.1	Multicast Routing Protocols (PIM, Multicast Source Discovery Protocol [MSDP], Internet Group Management Protocol [IGMP], Auto-RP), Tools (SAP, MTrace), and Infrastructure [(Multicast Routing Information Base [MRIB], Multicast-Unicast RIB [MURIB], Multicast forwarding [MFWD]), and Bidirectional Protocol Independent Multicast (BIDIR-PIM).
Cisco IOS XR Security Package	c12k-k9sec.pie-4.3.1	Support for Encryption, Decryption, IP Security (IPSec), Secure Shell (SSH), Secure Socket Layer (SSL), and Public-key infrastructure (PKI) (Software based IPSec support—maximum of 500 tunnels)
Cisco IOS XR Standby RP Boot Image	mbiprp-rp.vm-4.3.1	Support for booting the Standby RP from ROMMON on a Cisco XR 12000 Series Router.
Cisco IOS XR FPD Package	c12k-fpd.pie-4.3.1	Firmware for shared port adapters (SPA) and for fixed port line cards supported in Cisco IOS XR.
Cisco IOS XR Diagnostic Package	c12k-diags.pie-4.3.1	Diagnostic utilities for Cisco IOS XR routers.
Cisco IOS XR Documentation Package	c12k-doc.pie-4.3.1	.man pages for Cisco IOS XR Software on the Cisco XR 12000 Series Router chassis.
Cisco IOS XR Service Package	c12k-service.pie-4.3.1	Includes binaries to support Booster daughter card.

Cisco IOS XR Video Package	c12k-video.pie-4.3.1	Includes firmware for the advanced video feature.
Cisco IOS XR Boothelper Package	c12kprp-boot-mz.120-32.SY5	Supports downloading the Cisco IOS XR image from tftp.
Cisco IOS XR Upgrade package	c12k-upgrade.pie-4.3.1	Supports a major release upgrade, such as 3.x to 4.x releases. Once the upgrade is completed, the upgrade pie must be deactivated and removed.

Table 2: Cisco IOS XR Software Release 4.3.1 TAR Files, on page 5 lists the Cisco XR 12000 Series Router TAR files.

Table 2: Cisco IOS XR Software Release 4.3.1 TAR Files

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software	XR12000-iosxr-4.3.1.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 IP/MPLS Core Software 3DES	XR12000-iosxr-k9-4.3.1.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

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 XR 12000 Series Router running Cisco IOS XR Software Release 4.3.1 consist of the following:

- 2 GB route memory on performance route processor 2 (PRP-2)

  However, a 4 GB route memory on PRP-2 is required if BGP is enabled or other applications are running on the router.
- 2 GB or greater ATA flash storage on PRP-2
- 4 GB route memory on performance route processor 3 (PRP-3)
- 2 GB or greater Compact flash storage on PRP-3
- 1 GB line card route memory on all Engine 3 line cards
- 1 GB line card memory on Engine 5-based SPA interface processor (SIP-600)
  - The default route memory on the 12000-SIP-600 is 1 GB
- 2 GB line card memory on all Engine 5-based SPA interface processors (SIPs)
  - The default route memory on the 12000-SIP-401, 501, and 601 is 2 GB.

  Note The performance route processor 1 (PRP-1) is not supported in production environments.
- 2 GB PCMCIA Flash Disk

Supported Hardware

The following table lists the supported hardware components on the Cisco XR 12000 Series Router and the minimum required software release. For more information, see the *Firmware Support* section.

Table 3: Cisco XR 12000 Series Router Supported Hardware and Minimum Software Requirements

Component	Part Number	Support from version
Cisco XR 12000 Series Router Series Router Systems		
Cisco XR 12000 Series 4-slot chassis	XR-12000/4	3.3
Cisco XR 12000 Series 6-slot chassis	XR-12000/6	3.3
Cisco XR 12000 Series 10-slot chassis	XR-12000/10	3.3

Cisco XR 12000 Series 16-slot chassis	XR-12000/16	3.3
Cisco XR 12000 Series Router Chassis Hardware		
4-slot chassis & backplane, 1 Blower, 2 AC	12000/4-AC	3.3
4-slot chassis & backplane, 1 Blower, 2 DC	12000/4-DC	3.3
6-slot chassis & backplane, 2 Alarm, 1 Blower, 2 AC	12000/6-AC	3.3
6-slot chassis & backplane, 2 Alarm, 1 Blower, 2 DC	12000/6-DC	3.3
10-slot chassis & backplane, 2 Alarm, 1 Blower, 2 AC	12000/10-AC	3.3
10-slot chassis & backplane, 2 Alarm, 1 Blower, 2 DC	12000/10-DC	3.3
16-slot chassis & backplane, 2 Alarm, 2 Blower, 3 AC	12000/16-AC3	3.3
16-slot chassis & backplane, 2 Alarm, 2 Blower, 4 DC	12000/16-DC	3.3
16-slot chassis & backplane, 2 Alarm, 2 Blower, 4 AC	12000/16-AC4	3.3
Cisco XR12000 16-slots; 2 Alarms, Advanced 2 Blowers, up to 8 DC	12000E/16-DC	3.8
Cisco XR12000 16-slots; 2 Alarms, Advanced 2 Blowers, up to 8 AC	12000E/16-AC	3.8
Cisco XR 12000 Series Router Fabric Hardware		
Enhanced 20 Gbps Fabric & Alarm card for Cisco 12004	12004E/20	3.6
Enhanced 80 Gbps Fabric & Alarm card for Cisco 12404	12404E/80	3.6
Enhanced 30 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12006	12006E/30	3.6
Enhanced 120 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12406	12406E/120	3.6
Enhanced 50 Gbps Fabric (2xCSC and 5xSFC) for Cisco 12010	12010E/50	3.5.2
Enhanced 200 Gbps Fabric (2xCSC and 5xSFC) for Cisco 12410	12410E/200	3.5.2
Enhanced 800 Gbps Fabric (2xCSC and 5xSFC) for Cisco 12810	12810E/800	3.4

Enhanced 80 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12016	12016E/80	3.5.2
Enhanced 320 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12416	12416E/320	3.5.2
Enhanced 1280 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12816	12816E/1280	3.4
80 Gbps Fabric & Alarm card for Cisco 12404	12404/80	3.3
30 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12006	12006/30	3.3
120 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12406	12406/120	3.3
50 Gbps Fabric (2xCSC and 5xSFC) for Cisco 12010	12010/50	3.3
200 Gbps Fabric (2xCSC and 5xSFC) for Cisco 12410	12410/200	3.3
80 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12016	12016/80	3.3
320 Gbps Fabric (2xCSC and 3xSFC) for Cisco 12416	12416/320	3.3
Cisco XR 12000 Series Route Processor Hardware		
Cisco XR 12000 Series Performance Route Processor 2	PRP-2	3.2
Cisco XR 12000 Series Performance Route Processor 3	PRP-3	3.8
Cisco XR 12000 Series 40 GB Hard Drive Option	HD-PRP2-40G	3.2
Cisco XR 12000 Series PRP-3 80G Hard Drive	HD-PRP3	3.8
Cisco XR 12000 Series General Chassis Hardware		
Cisco XR 12000 Series PCMCIA Flash Disk 1 GB	MEM-FD1G	3.2
Cisco XR 12000 Series PCMCIA Flash Disk 2 GB	MEM-FD2G	3.2
Cisco XR 12000 Series PCMCIA Flash Disk 4 GB	MEM-FD4G	3.8
Cisco XR 12000 Series PRP-3 2GB Compact Flash	FLASH-PRP3-2G	3.8
Cisco XR 12000 Series PRP-3 4GB Compact Flash	FLASH-PRP3-4G	3.8
Cisco XR 12000 Series PRP-3 4GB Memory (2X2GB DIMM)	MEM-PRP3-4G	3.8

Cisco XR 12000 Series PRP-3 8GB Memory (2X4GB DIMM)	MEM-PRP3-8G	3.8
Cisco XR 12000 Series SPA Interface Processor Hardware		
Multirate 2.5G IP Services Engine (Modular)	12000-SIP-401	3.3
Multirate 5G IP Services Engine (Modular)	12000-SIP-501	3.3
Multirate 10G IP Services Engine (Modular)	12000-SIP-601	3.3
Cisco XR 12000 Series SPA Interface Processor 10G	12000-SIP-600	3.2
Cisco XR 12000 Series Router SONET Interface Modules and SPAs		
Cisco XR 12000 Series 4xOC12c/STM4c POS Intermediate Reach Single-Mode optics	4OC12X/POS-I-SC-B	3.2
Cisco XR 12000 Series 4xOC12c/STM4c POS Short Reach Multi-Mode optics	4OC12X/POS-M-SC-B	3.2
Cisco XR 12000 Series 16xOC3c/STM1c POS Short Reach Multi-Mode optics	16OC3X/POS-M-MJ-B	3.2
Cisco XR 12000 Series 16xOC3c/STM1c POS Intermediate Reach Single-Mode optics	16OC3X/POS-I-LC-B	3.2
Cisco XR 12000 Series 8xOC3c/STM1c POS Short Reach Multi-Mode optics	8OC3X/POS-MM-MJ-B	3.2
Cisco XR 12000 Series 8xOC3c/STM1c POS Intermediate Reach Single-Mode optics	8OC3X/POS-IR-LC-B	3.2
Cisco XR 12000 Series 4xOC3c/STM1c POS Short Reach Multi-Mode optics	4OC3X/POS-MM-MJ-B	3.2
Cisco XR 12000 Series 4xOC3c/STM1c POS Intermediate Reach Single-Mode optics	4OC3X/POS-IR-LC-B	3.2
Cisco XR 12000 Series 4xOC3c/STM1c POS Long Reach Single-Mode optics	4OC3X/POS-LR-LC-B	3.2
Cisco XR 12000 Series 1xOC48c/STM16c POS Short Reach Single-Mode optics	OC48X/POS-SR-SC	3.2
Cisco XR 12000 Series 1xOC48c/STM16c POS Long Reach Single-Mode optics	OC48X/POS-LR-SC	3.2
Cisco XR 12000 Series 4-Port OC-3c/STM-1c ATM ISE Line Card, multimode	4OC3X/ATM-MM-SC	3.4

Cisco XR 12000 Series 4-Port OC-3c/STM-1c ATM ISE Line Card, single-mode	4OC3X/ATM-IR-SC	3.4
Cisco XR 12000 Series 4-port OC-12/STM-4 ATM multimode ISE line card with SC connector	4OC12X/ATM-MM-SC	3.4
Cisco XR 12000 Series 4-port OC-12/STM-4 ATM single-mode, intermediate-reach ISE line card with SC Connector	4OC12X/ATM-IR-SC	3.4
Cisco 1-Port OC-192c/STM-64c POS/RPR Shared Port Adapter with VSR Optics	SPA-OC192POS-VSR	3.3
Cisco 1-Port OC-192c/STM-64c POS/RPR Shared Port Adapter with LR Optics	SPA-OC192POS-LR	3.2
Cisco 1-Port OC-192c/STM-64c POS/RPR Shared Port Adapter with XFP Optics	SPA-OC192POS-XFP	3.2
2-Port OC-48/STM16 POS/RPR Shared Port Adapters	SPA-2XOC48POS/RPR	3.3
1-Port Channelized OC-12/DS0 Shared Port Adapters	SPA-1XCHOC12/DS0	3.5
1-Port Channelized STM-1/OC-3 to DS0 Shared Port Adapter	SPA-1XCHSTM1/OC3	3.5
1-Port OC-48c/STM-16 POS/RPR Shared Port Adapter	SPA-1XOC48POS/RPR	3.5
2-Port OC-12c/STM-4 POS Shared Port Adapter	SPA-2XOC12-POS	3.5
4-Port OC-12c/STM-4 POS Shared Port Adapter	SPA-4XOC12-POS	3.5
4-Port OC-3c/STM-1 POS Shared Port Adapter	SPA-4XOC3-POS-V2	3.5
8-Port OC-12c/STM-4 POS Shared Port Adapter	SPA-8XOC12-POS	3.5
8-Port OC-3c/STM-1 POS Shared Port Adapter	SPA-8XOC3-POS	3.5
Cisco 8-Port Channelized T1/E1 Shared Port Adapter	SPA-8XCHT1/E1	3.6
Cisco 1-Port Channelized OC-48/DS3 Optical Packet Processor Shared Port Adapter	SPA-1XCHOC48/DS3	3.6
1-Port Clear Channel OC-3 ATM SPA	SPA-1XOC3-ATM-V2	3.7
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
2-Port Channelized T3/E3 ATM CEoP SPA	SPA-2CHT3-CE-ATM	3.7

24-Port Channelized T1/E1 ATM CEoP SPA	SPA-24CHT1-CE-ATM	4.0.1
1-Port Channelized OC-3 ATM CEoP SPA	SPA-1CHOC3-CE-ATM	4.1.1
Ethernet Interface Modules and SPAs		
Cisco XR 12000 Series 4xGE with SFP optics	4GE-SFP-LC	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 10BASE-T/100BASE-TX Fast Ethernet Shared Port Adapter, Version 2	SPA-8X1FE-TX-V2	3.4
Cisco 8-Port 100BASE-TX Fast Ethernet Shared Port Adapter	SPA-8XFE-TX	3.3
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 5-Port Gigabit Ethernet Shared Port Adapter with SFP optics	SPA-5X1GE	3.2
Cisco 10-Port Gigabit Ethernet Shared Port Adapter with SFP optics	SPA-10X1GE	3.2
Cisco 1-Port 10 Gigabit Ethernet Shared Port Adapter with XFP optics	SPA-1XTENGE-XFP	3.2
Cisco 2-Port Gigabit Ethernet Shared Port Adapter, Version 2	SPA-2X1GE-V2	3.4.1
Cisco XR 12000 Series Router T3 and E3 Interface Modules and SPAs		
2-port Channelized T3 to DS0 Shared Port Adapter	SPA-2XCT3/DS0	3.3
4-port Channelized T3 to DS0 Shared Port Adapter	SPA-4XCT3/DS0	3.3
2-port Clear Channel T3/E3 Shared Port Adapter	SPA-2XT3/E3	3.3
4-port Clear Channel T3/E3 Shared Port Adapter	SPA-4XT3/E3	3.3
Cisco XR 12000 Series Router Channelized Line Cards		

Cisco 1-Port Channelized OC-48 line card	CHOC48/DS3-SR-SC	3.6
Cisco 1-Port Channelized OC-12 line card	CHOC12/DS1-SR-SC	3.8
Cisco 4-Port Channelized OC-12 line card	4CHOC12/DS3-I-SCB	3.8

Software Compatibility

Cisco IOS XR Software Release 4.3.14.3.2 is compatible with the following Cisco XR 12000 Series Router systems:

- Cisco XR 12004 Router
- Cisco XR 12006 Router
- Cisco XR 12010 Router
- Cisco XR 12016 Router
- Cisco XR 12404 Router
- Cisco XR 12406 Router
- Cisco XR 12410 Router
- Cisco XR 12416 Router
- Cisco XR 12810 Router
- Cisco XR 12816 Router

The following chassis are supported for an existing installed base:

- Cisco XR 12008 Router
- Cisco XR 12010 Router
- Cisco XR 12012 Router

Note If you are running Cisco IOS XR Software on a Cisco XR120xx system with SIP 600, 401, 501, or 601, you must upgrade the fabric cards. For ROMMON, MBUS, and Fabric Downloader versions, see the "Other Firmware Support" section.

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

```
RP/0/0/CPU0:router#LC/0/0/CPU0:Dec 15 17:57:53.653 : rsi_agent[247]:
%LICENSE-ASR9K_LICENSE-2-INFRA_VRF_NEEDED : 5 VRF(s) are configured without license
A9K-iVRF-LIC in violation of the Software Right To Use Agreement. This feature may be
disabled by the system without the appropriate license. Contact Cisco to purchase the
license immediately to avoid potential service interruption.
```

Firmware Support

To check the firmware code running on the Cisco XR 12000 Series Router, run the **show fpd package** command in admin mode.

```
RP/0/0/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
==================== ========================== ==== ======= =========== ========  =========
E3-OC12-ATM-4        Mickey FPGA                lc   fpga2   40971.00        0.00       0.0

                     IOB FPGA                   lc   fpga3   41091.00        0.00       0.0

                     SAF 0 FPGA                 lc   fpga4   45586.00        0.00       0.0

                     Mouse FPGA                 lc   fpga1   40977.00        0.00       0.0

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E3-OC3-ATM-4         Mickey FPGA                lc   fpga2   40971.00        0.00       0.0

                     IOB FPGA                   lc   fpga3   41091.00        0.00       0.0

                     SAF 0 FPGA                 lc   fpga4   45586.00        0.00       0.0

                     Mouse FPGA                 lc   fpga1   40977.00        0.00       0.0

--------------------------------------------------------------------------------------------
12000-ServEngCard    TREX FPGA                  lc   fpga2     162.45        0.00       0.0

                     TREX FPGA                  lc   fpga1       0.41257     0.00       0.0

--------------------------------------------------------------------------------------------
12000-SIP            HABANERO FPGA              lc   fpga2     240.03        0.00       0.0

                     JALAPENO FPGA              lc   fpga5     240.13        0.00       0.0

                     JALAPENO FPGA              lc   fpga5     240.13        0.00       0.0

                     JALAPENO FPGA              lc   fpga1     255.23        0.00       0.0

--------------------------------------------------------------------------------------------
E3-OC12-CH-1         Shiver FPGA                lc   fpga1       1.02        0.00       0.0

--------------------------------------------------------------------------------------------
SPA-IPSEC-2G         Sequoia                    spa  fpga2       1.01        0.00       1.0

                     Lodi                       spa  fpga1       1.22        0.00       1.0

                     SPA PROM                   spa  rommon      1.01        0.00       1.0

--------------------------------------------------------------------------------------------
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       1.01        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       1.01        0.00       0.0
```

	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-4XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.00	0.200
	SPA I/O FPGA	spa	fpga1	2.08	0.00	0.100
	SPA ROMMON	spa	rommon	2.12	0.00	0.100
SPA-2XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.00	0.200
	SPA I/O FPGA	spa	fpga1	2.08	0.00	0.100
	SPA ROMMON	spa	rommon	2.12	0.00	0.100
SPA-1XCHSTM1/OC3	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.00	0.0
	SPA I/O FPGA	spa	fpga1	1.08	0.00	0.0
	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-24CHT1-CE-ATM	SPA T3 Subrate FPGA	spa	fpga2	1.10	0.00	1.0
	SPA I/O FPGA	spa	fpga1	2.32	0.00	1.0
	SPA ROMMON	spa	rommon	1.03	0.00	1.0
SPA-2CHT3-CE-ATM	SPA T3 Subrate FPGA	spa	fpga2	1.11	0.00	1.0
	SPA I/O FPGA	spa	fpga1	2.22	0.00	1.0
	SPA ROMMON	spa	rommon	1.04	0.00	1.0
SPA-1CHOC3-CE-ATM	SPA OC3 Subrate FPGA	spa	fpga2	2.23	0.00	2.0
	SPA I/O FPGA	spa	fpga1	2.23	0.00	2.0
	SPA ROMMON	spa	rommon	1.04	0.00	2.0
SPA-IPSEC-2G-2	Sequoia	spa	fpga2	1.01	0.00	1.0
	Lodi	spa	fpga1	1.22	0.00	1.0
	SPA PROM	spa	rommon	1.01	0.00	1.0
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 swv1.2	spa	fpga1	1.02	0.00	0.0
SPA-8XOC12-POS	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-8XCHT1/E1	SPA I/O FPGA	spa	fpga1	2.08	0.00	0.0

	SPA ROMMON	spa	rommon	2.12	0.00	0.140
SPA-OC192POS-XFP	SPA FPGA swv1.2	spa	fpga1	1.02	0.00	0.0
	SPA FPGA swv1.2 hwv2	spa	fpga1	1.02	0.00	2.0
SPA-10X1GE	SPA FPGA swv1.10	spa	fpga1	1.10	0.00	0.0
SPA-5X1GE	SPA FPGA swv1.10	spa	fpga1	1.10	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-1XTENGE-XFP	SPA FPGA swv1.11	spa	fpga1	1.11	0.00	0.0
SPA-8X1FE	SPA FPGA swv1.1	spa	fpga1	1.01	0.00	0.0
SPA-1XOC48POS/RPR	SPA FPGA swv1.2	spa	fpga1	1.02	0.00	0.0
SPA-8XOC3-POS	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-2X1GE-V2	SPA FPGA swv1.1	spa	fpga1	1.01	0.00	0.0
SPA-1X10GE-L-V2	SPA FPGA swv1.11	spa	fpga1	1.11	0.00	0.0
SPA-8X1FE-V2	SPA FPGA swv1.1	spa	fpga1	1.01	0.00	0.0
SPA-4XOC3-POS-V2	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.5
SPA-1X10GE-L-IT	SPA FPGA swv1.0	spa	fpga1	1.00	0.00	0.0
SPA-1X10GE-WL-V2	SPA FPGA swv1.11	spa	fpga1	1.11	0.00	0.0
SPA-1XOC3-ATM-V2	TATM SPA IOFPGA	spa	fpga1	2.02	0.00	0.0
SPA-2XOC3-ATM-V2	SPA TATM IOFPGA	spa	fpga1	2.02	0.00	0.0
SPA-3XOC3-ATM-V2	SPA TATM IOFPGA	spa	fpga1	2.02	0.00	0.0

```
---------------------------------------------------------------------------------------------
SPA-1XOC12-ATM-V2    SPA TATM IOFPGA            spa  fpga1       2.02        0.00      0.0
---------------------------------------------------------------------------------------------
```

- Line cards (LCs)

  For Engine 3 line card:

  - Maintenance Bus (MBUS) Agent Software-RAM version 4.7, ROM version 4.7
  - ROM Monitor version 19.0
  - Fabric Downloader - RAM version 10.1, ROM version 10.1 (The ROM version will be the same as the RAM version if upgraded.)

  For Engine 5 line card:

  - Maintenance Bus (MBUS) Agent Software-RAM version 4.7, ROM version 4.7
  - ROM Monitor version 19.0
  - Fabric Downloader - RAM version 6.1, ROM version 6.1 (The ROM version will be the same as the RAM version if upgraded.)

- Router processors (RPs)

  For Performance Route Processor 2 (PRP-2):

  - Maintenance Bus (MBUS) Agent Software-RAM version 4.7, ROM version 4.7
  - ROM Monitor version 1.24

  For Performance Route Processor 3 (PRP-3):

  - Maintenance Bus (MBUS) Agent Software-RAM version 4.7, ROM version 4.7
  - ROM Monitor version 1.4.0

Minimum Firmware Requirement

- After completing an RMA the newly-received linecard may not have appropriate IOS XR firmware installed.

  Depending on the type of firmware that needs upgrading the symptoms can vary as follows:

  - ROMMON needs updating the linecard will not boot up
  - MBUS needs updating the line card may fail to boot or keeps reloading
  - Fabric Loader needs updating the line card will take long time to boot
  - FPD needs updating the line card experiences packet corruption / drop

Note The FPD PIE has to be installed in order to upgrade to the latest FPD image. Refer to the *Upgrading FPD on Cisco IOS XR Software* chapter of the *Cisco IOS XR System Management Command Reference for the Cisco XR 12000 Router* online.

RMA Card Firmware Upgrade Procedure

To upgrade the fabric-downloader, ROMMON, Mbus, and current field-programmable device (FPD) image package on a single RMA linecard or on all modules installed in a router, use the **upgrade all** command in the admin mode.

upgrade all location {*node-id* | **all**} [**force**]

Where **location** *node-id* specifies that all ROM images will be upgraded on the physical location of the line card received through RMA defined by the *node-id* argument. The *node-id* argument is entered in the rack/slot/module notation.

The **upgrade all location all** command upgrades all ROM images on all line cards (LCs) that are installed in the router.

For an RMA linecard firmware upgrade you'll want to use the **upgrade all location** {*node-id*} command

The optional force parameter skips the version check and forces an upgrade.

- The list of minimum supported firmware versions is available online in this matrix which contains links to PDF copies of the IOS XR Firmware Upgrade Guides which are available online here :

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

- 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 XR 12000 Router* for the **upgrade all** command syntaxhttp://www.cisco.com/en/US/docs/routers/xr12000/software/xr12k_r4.0/system_management/command/reference/b_yr40xr12k_chapter_0111.html.

Requirement of Cisco IOS Image Level and Boot Helper Version for Migration

If you are migrating from Cisco IOS to Cisco IOS XR Software on the Cisco XR 12000 Series Router, you must have the following minimum Cisco IOS image level and Boothelper version to support Release :

- Cisco IOS image—12.0(32)S
- Cisco IOS Boothelper—12.0(32)S0a

If you have an earlier version of this system, you must upgrade to the minimum supported level before performing a migration. Otherwise, your migration fails. For more information, see *Migrating from Cisco IOS to Cisco IOS XR Software on the Cisco XR 12000 Series Router* document.

Determining Your Software Version

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

SUMMARY STEPS

1. Establish a Telnet session with the router.
2. Enter **show version** command from EXEC mode.

DETAILED STEPS

Step 1 Establish a Telnet session with the router.

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

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

Cisco IOS XR Software, Version 4.3.1[Default]
Copyright (c) 2013 by Cisco Systems, Inc.

ROM: ROMMON System Bootstrap, Version 1.05(0), DEVELOPMENT SOFTWARE

irace-c12k1-r4 uptime is 23 hours, 41 minutes
System image file is "disk0:c12k-os-mbi-4.3.1/mbiprp-rp.vm"

cisco 12416/PRP (8641D) processor with 4194304K bytes of memory.
8641D processor at 1330Mhz, Revision 2.1
Cisco 12416 320 Gbps

2 Cisco 12000 Series Performance Route Processor 3s
1 4 Port ISE Packet Over SONET OC-12c/STM-4 Controller (4 POS)
1 1 Port ISE Packet Over SONET OC-48c/STM-16 Controller (1 POS)
2 Cisco 12000 Series SPA Interface Processor-601/501/401
1 8 port ISE OC3 Controller (8 POS)
2 Cisco 12416 320 Gbps GSR Clock Scheduler Cards
3 Cisco 12416 320 Gbps Switch Fabric Cards
2 GSR Blower Modules
4 Management Ethernet
13 SONET/SDH
13 Packet over SONET/SDH
8 PLIM_QOS
6 T3
1 MgmtMultilink
4 Serial network interface(s)
28 T1
42 Serial network interface(s)
28 Multilink network interface(s)
1 WANPHY controller(s)
1 TenGigE
8 GigabitEthernet/IEEE 802.3 interface(s)
895k bytes of non-volatile configuration memory.
1560M bytes of compact flash card.
76170M bytes of hard disk.
1597532k bytes of disk0: (Sector size 512 bytes).

Configuration register on node 0/0/CPU0 is 0x102
Boot device on node 0/0/CPU0 is disk0:
Package active on node 0/0/CPU0:
```

```
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mgbl, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.1
    Built on Sun May 12 01:31:16 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mgbl-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mgbl-supp-4.3.1
    Built on Sun May 12 01:31:16 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mgbl-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mgbl-p-4.3.1
```

```
    Built on Sun May 12 01:31:21 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
Configuration register on node 0/1/CPU0 is 0x102
Boot device on node 0/1/CPU0 is disk0:
Package active on node 0/1/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mgbl, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.1
    Built on Sun May 12 01:31:16 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mgbl-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mgbl-supp-4.3.1
```

```
    Built on Sun May 12 01:31:16 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mgbl-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mgbl-p-4.3.1
    Built on Sun May 12 01:31:21 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/2/CPU0 is mem:
Package active on node 0/2/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/3/CPU0 is mem:
Package active on node 0/3/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1
```

```
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/4/CPU0 is mem:
Package active on node 0/4/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/5/CPU0 is mem:
Package active on node 0/5/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
```

```
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/6/CPU0 is mem:
Package active on node 0/6/CPU0:
iosxr-infra-test-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-test-testfiles-4.3.1

    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr_os-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:iosxr_os-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k_os_supp-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k_os_supp-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
c12k-fwding-testfiles, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-testfiles-4.3.1
    Built on Sun May 12 01:49:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-infra-test, V 4.3.1[Default], Cisco Systems, at disk0:c12k-infra-test-4.3.1
    Built on Sun May 12 01:49:30 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sun May 12 01:30:52 UTC 2013
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c12k-mpls-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mpls-p-4.3.1
    Built on Sun May 12 01:31:00 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-supp-4.3.1
    Built on Sun May 12 01:31:02 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mcast-p, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mcast-p-4.3.1
    Built on Sun May 12 01:31:14 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:c12k-os-mbi-4.3.1
    Built on Sun May 12 00:43:31 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-base, V 4.3.1[Default], Cisco Systems, at disk0:c12k-base-4.3.1
    Built on Sun May 12 00:41:40 UTC 2013
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:c12k-fwding-4.3.1
    Built on Sun May 12 00:41:41 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-ce, V 4.3.1[Default], Cisco Systems, at disk0:c12k-ce-4.3.1
    Built on Sun May 12 00:41:42 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

c12k-mini, V 4.3.1[Default], Cisco Systems, at disk0:c12k-mini-4.3.1
    Built on Sun May 12 00:44:10 UTC 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

Software Features Introduced in Cisco IOS XR Software Release 4.3.1

BFD over MPLS Traffic Engineering LSPs

Bidirectional Forwarding Detection (BFD) over MPLS Traffic Engineering Label Switched Paths (LSPs) feature in Cisco IOS XR Software detects MPLS Label Switched Path LSP data plane failures. Since the control plane processing required for BFD control packets is relatively smaller than the processing required for LSP Ping messages, BFD can be deployed for faster detection of data plane failure for a large number of LSPs.

The BFD over MPLS TE LSPs implementation in Cisco IOS XR Software is based on *RFC 5884: Bidirectional Forwarding Detection (BFD) for MPLS Label Switched Paths (LSPs)*. LSP Ping is an existing mechanism for detecting MPLS data plane failures and for verifying the MPLS LSP data plane against the control plane. BFD can be used for for detecting MPLS data plane failures, but not for verifying the MPLS LSP data plane against the control plane. A combination of LSP Ping and BFD provides faster data plane failure detection on a large number of LSPs.

For more information on configuring BFD over MPLS Traffic Engineering LSPs, see the *Implementing Bidirectional Forwarding Detection* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the BFD over MPLS Traffic Engineering LSPs commands, see the *Bidirectional Forwarding Detection Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

BGP VRF Dynamic Route Leaking

The Border Gateway Protocol (BGP) dynamic route leaking feature provides the ability to import routes between the default-vrf (Global VRF) and any other non-default VRF, to provide connectivity between a global and a VPN host. The import process installs the Internet route in a VRF table or a VRF route in the Internet table, providing connectivity.

Note Directly connected routes cannot be leaked using BGP VRF Dynamic Route Leaking from default VRF to non-default VRF.

The dynamic route leaking is enabled by:

- Importing from default-VRF to non-default-VRF, using the **import from default-vrf route-policy** *route-policy-name* [**advertise-as-vpn**] command in VRF address-family configuration mode.

  If the **advertise-as-vpn** option is configured, the paths imported from the default-VRF to the non-default-VRF are advertised to the PEs as well as to the CEs. If the **advertise-as-vpn** option is not configured, the paths imported from the default-VRF to the non-default-VRF are not advertised to the PE. However, the paths are still advertised to the CEs.

- Importing from non-default-VRF to default VRF, using the **export to default-vrf route-policy** *route-policy-name* command in VRF address-family configuration mode.

For more information on configuring VRF Dynamic Route Leaking, see the *Implementing BGP* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the commands used for configuring and displaying Dynamic Route Leaking, see the *BGP Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

Flexible L3VPN Label Allocation Mode

The flexible L3VPN label allocation feature provides the ability to set label allocation mode using a route-policy, where different allocation modes can be used for different sets of prefixes. Thus, label mode can be chosen based on arbitrary match criteria such as prefix value and community.

Use the **label mode** command to set the MPLS/VPN label mode based on prefix value. The Label-Mode attach point enables you to choose label mode based on any arbitrary criteria.

For more information on Label-Mode attachpoint, see the Implementing Routing Policy chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the **set label-mode** command, see the *Routing Policy Language Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*. For complete command reference of the **label mode** and **label-allocation-mode** commands, see the *BGP Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

IS-IS IPv6 Loop Free Alternate Fast Re-route

The IPv6 Loop Free Alternate fast Re-route (IPv6 LFA FRR) feature supports fast re-route (FRR) for IPv6 unicast in Cisco IOS XR Software . IPv6 FRR helps to minimize traffic loss during convergence for pure IPv6 unicast prefixes. The IPv6 LFA FRR supports both per-prefix LFA and per-link LFA modes. IPv6 LFA FRR for IS-IS is enabled by configuring the fast re-route commands under the IS-IS IPv6 address family configuration mode.

For more information on configuring IS-IS IPv6 Loop Free Alternate Fast Re-route, see the *Implementing IS-IS* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the IS-IS IPv6 Loop Free Alternate Fast Re-route commands, see the *BGP Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

IS-IS Link-group

The IS-IS link-group feature allows operators to define a set of links belonging to a group. The group is identified by a link-group profile. In that group, when the total number of 'UP' links falls below a certain value, the IS-IS will raise the link metric by a pre-defined 'offset' value for all the links in this group. Thus it discourages the traffic going over the set of links where the total physical bandwidth is reduced during the

network operation. When the total number of 'UP' links is back to above certain number, the IS-IS will restore the link metric to corresponding configured value for all the links in this group.

For more information on configuring IS-IS link-group, see the *Implementing IS-IS* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of IS-IS link-group commands, see the *IS-IS Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

IS-IS LDP Remote Loop Free Alternate Fast Re-route

The LDP remote loop free alternate fast re-route (rLFA FRR) feature enables computation of non-directly connected neighbor (more than one hop away) as LFA backup path to protect a given prefix's primary path, and setting up of labeled [backup] LSP with the remote next-hop for the protected prefix. The rLFA FRR helps to minimize traffic loss in some topologies (example: ring topology) during convergence after a failure triggered topology change.

The use of a non-directly connected neighbor as LFA backup/next-hop is termed as Remote LFA or Extended LFA. For a given protected link, the IGP computes remote LFA backup by means of PQ algorithm. The IGP updates the routing information base (RIB) [per-prefix] with LFA protection information [per-path]. The LDP initiates/establishes a targeted session with the remote LFA [PQ] node to exchange labels for prefixes. The LDP also sets up MPLS forwarding for protected prefixes along with their remote LFA/PQ backup paths, if any. Upon FRR trigger, pre-programmed remote LFA backup path is activated to achieve convergence (within 50 milliseconds) and is used until the IGP converges to new primary path(s).

For more information on configuring IS-IS LDP Remote Loop Free Alternate Fast Re-route, see the *Implementing IS-IS* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the IS-IS LDP Remote Loop Free Alternate Fast Re-route commands, see the *IS-IS Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

LISP Common Control Plane

Locator/ID Separation Protocol (LISP) common control plane feature introduces a LISP control plane that is same as the IOS control plane. Cisco IOS XR Software and Cisco IOS XR and Cisco IOS platforms share a common LISP control plane.

OSPF LDP Remote Loop Free Alternate Fast Re-route

The LDP remote loop free alternate fast re-route (rLFA FRR) feature enables computation of non-directly connected neighbor (more than one hop away) as LFA backup path to protect a given prefix's primary path, and setting up of labeled [backup] LSP with the remote next-hop for the protected prefix. The rLFA FRR helps to minimize traffic loss in some topologies (example- ring topology) during convergence after a failure triggered topology change.

The use of a non-directly connected neighbor as LFA backup/next-hop is termed as Remote LFA or Extended LFA. For a given protected link, the IGP computes remote LFA backup by means of PQ algorithm. The IGP updates the routing information base (RIB) [per-prefix] with LFA protection information [per-path]. The LDP initiates/establishes a targeted session with the remote LFA [PQ] node to exchange labels for prefixes. The LDP also sets up MPLS forwarding for protected prefixes along with their remote LFA/PQ backup paths, if any. Upon FRR trigger, pre-programmed remote LFA backup path is activated to achieve convergence (within 50 milliseconds) and is used until the IGP converges to new primary path(s).

For more information on configuring OSPF LDP Remote Loop Free Alternate Fast Re-route, see the *Implementing OSPF* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the OSPF LDP Remote Loop Free Alternate Fast Re-route commands, see the *OSPF Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

OSPF Local Uloop Avoidance

The OSPF local uloop avoidance feature helps to avoid local uloop that happens between the node where link UP/DOWN event happened and its neighbor. Configure the **microloop avoidance {protected}** and the **microloop avoidance rib-update-delay** *delay in ms* commands to configure local uloop avoidance mechanism.

If **microloop avoidance** is enabled, new primary paths are not added to the RIB during SPF, but the installation is delayed. This mechanism is activated only for a first adjacency DONW event following the stable condition. Specify the **protected** keyword uloop avoidance is only applied to prefixes which have a valid backup path for each primary path.

Configure **microloop avoidance rib-update-delay** to specify the interval after which the new primary paths will be installed in RIB.

For complete command reference of the OSPF uloop avoidance commands, see the *OSPF Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

OSPFv2 Autoroute Exclude

The OSPFv2 Autoroute Exclude feature allows specific destinations and prefixes to exclude TE tunnels in their path. Prefixes that are excluded will never use a TE tunnel path. Only native, non-TE paths will be downloaded to RIB for such routes. Use the **mpls traffic-eng autoroute-exclude** command to enable autoroute exclude.

OSPFv2 Unequal Cost Load Balancing

Unequal Cost Load Balancing feature in Cisco IOS XR OSPFv2 feature enables Unequal Cost Multipath (UCMP) calculation based on configured prefix-list and based on variance factor. UCMP path can be calculated for all prefixes or only for selected prefixes based on the configuration. Selected interfaces can be excluded to be used as a candidate for UCMP paths. The calculated UCMP paths are then installed in the routing information base (RIB) subject to the max-path limit.

Match tag Support for OSPF distribute-list in

The Cisco IOS XR Software Route-policy extends match tag support of OSPF **distribute-list in** command. The "if tag..." statements can be used in distribute-list in route-policy. The matching on route tag supports operators "eq/ge/is/le". Operator "in" is not supported.

For more information on distribute-list in attachpoint, see the *Implementing Routing Policy* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the **distribute-list in** command, see the *OSPF Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

VPN Route Limit

The VPN route limit feature provides the ability to set a limit on the number of prefixes to be accepted from a BGP "customer" (a BGP neighbor) for VPNv4 or VPNv6 address families. Once the limit is reached, all subsequent routes received from the customer are dropped, no session-reset is established, and route refresh information are not sent. VPN route limit ensures that the route-reflector (RR) retains only a specified number of unique network entries for each VPN, where VPN is defined by a set of route-targets (RTs). BGP keeps a route count per unique set of RTs . The count indicates the number of prefixes (nets) that has one or more paths with the given RT-set. When a VPN exceeds the configured limit, all subsequent routes learned from that VPN are dropped. The drop action is restricted to the VPN that exceeds the limit.

Non-stop routing (NSR) is not supported with the VPN route limit feature. When VPN route limit is enabled, Active and Standby RPs will have different prefixes and paths because both the RPs receive the updates independently and do not guarantee the sequence of the prefixes. So, NSR is not supported as traffic is lost when RP fail over happens.

For more information on configuring VPN Route Limit, see the *Implementing BGP* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the VPN Route Limit commands, see the *BGP Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

VRF Import Policy Enhancement

The VRF RPL based import policy feature provides the ability to perform import operation based solely on import route-policy, by matching on route-targets (RTs) and other criteria specified within the policy. No need to explicitly configure import RTs under global VRF-address family configuration mode. If the import RTs and import route-policy is already defined, then the routes will be imported from RTs configured under import RT and then follows the route-policy attached at import route-policy.

Use the **source rt import-policy** command under VRF sub-mode of VPN address-family configuration mode to enable this feature.

For more information on configuring VRF Import Policy Enhancement, see the *Implementing Routing Policy* chapter in the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*. For complete command reference of the VRF RPL Based Import Policy, see the *Routing Policy Language Commands* chapter in the *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*.

Virtual Connection Type 4 Support with BGP Auto-discovery

Support has been added for VC type 4 in VPLS with BGP Autodiscovery. A new command **transport-mode vlan passthrough** has been added to support this feature. This command is configured in the bridge domain configuration submode.

For more information on enabling VC type 4 for BGP autodiscovery, see the Implementing Multipoint Layer 2 Services module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to enable VC type 4, see the *Cisco IOS XR Virtual Private Network Command Reference for the Cisco XR 12000 Series Router*.

Auto-IP Configuration for nV Satellite System

The Auto IP feature improves the plug-and-play set up of an nV satellite system. With the Auto IP feature, IP connectivity to the satellite is automatically provisioned. As a result:

- The nV Satellite Loopback interface is created on the host
- Loopback interface is given an IP address from a private satellite VRF
- Satellite fabric links are unnumbered to the loopback interface
- The IP address assigned to satellite is auto-generated from the satellite VRF

Hence, in the case of Auto IP, you do not need to provide IP address on the nv satellite global configuration and on the ICL. But in the case of manual IP, you need to provide IP address on the nV satellite global configuration and on ICL.

Note You can also override the Auto IP feature by using the standard IP configuration.

Boothelper for PRP-2 Cards

From Cisco IOS XR Software Release 4.3.1 and later, it is required to have the boothelper, c12kprp-boot-mz.120-33.S11, to ensure the successful installation of Cisco IOS XR Software from a TFTP server.

For more information, see the *Router Recovery with ROM Monitor* and *Upgrading and Downgrading ROM Monitor and Boothelper* chapters in *Cisco IOS XR ROM Monitor Guide for the Cisco XR12000 Series Router*.

Label Security for BGP Inter-AS Option-B

Option-B is a method to exchange VPNv4/VPNv6 routes between Autonomous Systems (AS), as described in RFC-4364. When a router configured with Option-B, peers with a router from another confederation, or an autonomous system, and receives a labeled packet from such an external peer, the router ensures the following:

- the top label is advertised to the source of traffic
- label stack on the packet received from the external peer contains at least one label (explicit null label is not included)

For more information on configuring label security, refer to Implementing MPLS Label Distribution Protocol chapter of the *Cisco IOS XR MPLS Configuration Guide for the Cisco XR 12000 Series Router*. For more information on commands to configure label security, refer to the MPLS Label Distribution Protocol Commands chapter in the *Cisco IOS XR MPLS Command Reference for the Cisco XR 12000 Series Router*.

MPLS OAM Support for BGP 3107

The MPLS OAM Support for BGP 3107 feature provides support for ping, traceroute and treetrace (traceroute multipath) operations for LSPs signaled via BGP for the IPv4 unicast prefix FECs in the default VRF, according to the *RFC 3107 - Carrying Label Information in BGP-4*. This feature adds support for MPLS OAM operations in the seamless MPLS architecture deployments, i.e., combinations of BGP and LDP signaled LSPs.

For more information about ping and traceroute, see *Implementing MPLS OAM* chapter in the *Cisco IOS XR MPLS Configuration Guide for the Cisco XR 12000 Series Router*. For more information about ping and traceroute commands, see *MPLS OAM Commands* chapter in the *Cisco IOS XR MPLS Command Reference for the Cisco XR 12000 Series Router*.

SSHv2 Client Keyboard-Interactive Authentication

An authentication method in which the authentication information is entered using a keyboard is known as keyboard-interactive authentication. This method is an interactive authentication method in the SSH protocol. This type of authentication allows the SSH client to support different methods of authentication without having to be aware of their underlying mechanisms.

Currently, the SSHv2 client supports the keyboard-interactive authentication. This type of authentication works only for interactive applications.

For more information about the SSHv2 Client Keyboard-Interactive Authentication feature, see the *Implementing Secure Shell* module in the *Cisco IOS XR System Security Configuration Guide for the Cisco XR 12000 Series Router*.For complete command reference of SSHv2 Client Keyboard-Interactive Authentication commands, see the *Secure Shell Commands*chapter in the *Cisco IOS XR System Security Command Reference for the Cisco XR 12000 Series Router*

PPPoE Session Limit and Throttle

PPPoE Session Limit

The PPPoE Session Limit support limits the number of PPPoE sessions that can be created on a BNG router. As a result, it reduces excessive memory usage by the BNG router for virtual access.

This offers additional configuration flexibility on the BNG router by limiting the number of PPPoE sessions for each:

- Line card
- Parent interface
- Peer MAC address
- Peer MAC address under individual access interface
- Circuit-ID
- Remote-ID
- Combination of Circuit-ID and Remote ID
- Access interface using the same Inner VLAN tag
- Access interface using the same Outer VLAN tag.
- Access interface using the same Inner and Outer VLAN tags

The PPPoE Session Limit support also limits the number of Inter Working Function (IWF) sessions for each peer MAC address and for each peer MAC address under individual access interface.

PPPoE Session Throttle

The PPPoE Session Throttle support on BNG limits the number of PPPoE session requests coming to BNG within a specified period of time. This, in turn, ensures that the session establishment of other client requests coming to the BNG server is not impacted.

This offers configuration flexibility in the BNG router by throttling the number of session requests based on one of these:

- Peer MAC address
- Peer MAC address under individual access interface
- Circuit-ID
- Remote-ID
- A combination of Circuit-ID and Remote ID
- Inner VLAN tag under individual access interface
- Outer VLAN tag under individual access interface
- Inner and Outer VLAN tag under individual access interface

The PPPoE session throttle support also throttles the number of Inter Working Function (IWF) session requests for each peer MAC address under an individual access interface.

For more information about the PPPoE Session Limit and Throttle, see the *Establishing Subscriber Sessions* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference of the PPPoE commands, see the *PPPoE Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

New Hardware Features on the Cisco XR 12000 Series Router

There is no new hardware feature added in the Cisco IOS XR Software Release 4.3.1 for the Cisco XR 12000 Series Router platform.

Important Notes

- 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 XR 12000 Series Router*.
- 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.
- **Migrating from Cisco IOS to Cisco IOS XR Software on the Cisco XR 12000 Series Router—**When migrating a Cisco XR 12000 Series Router from Cisco IOS to Cisco IOS XR Software, follow the instructions provided in *Migrating from Cisco IOS to Cisco IOS XR Software on the Cisco XR 12000 Series Router*.
- **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 XR 12000 Series 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 for your purpose.

- **More power required for Cisco SIP line cards (SIP-401/501/600/601) on the Cisco XR 12000 Series Router—**These line cards draw more power than previous generation line cards. Depending on the exact configuration of power entry modules (PEMs) and other cards in the chassis, there may not be enough power available when inserting a new card or removing a PEM. Before you insert a new card or remove a PEM, run the following command in **admin** mode:

```
RP/0/4/CPU0:router(admin)#show environment power-supply table
Mon Sep 24 00:56:28.054 UTC
                   48V       Current
R/S/I     Module   (V)         (A)
0/24/*    PEM1       0          0       12000/6-AC-PEM= Intelligent AC PS
          PEM2      52         11       12000/6-AC-PEM= Intelligent AC PS
0/25/*    PEM1       0          0       12000/6-AC-PEM= Intelligent AC PS
          PEM2      52          9       12000/6-AC-PEM= Intelligent AC PS
```

To display the power used or total power or remaining power in chassis. Use the command **show power-mgr detail** command in EXEC mode.

```
RP/0/4/CPU0:router#show power-mgr detail
Mon Sep 24 00:53:54.518 UTC


Power management summary
------------------------
Powershelf type: AC Power Supplies
Operating phase: RUNNING_PHASE
Feature state  : Enabled
Operating mode : NON-REDUNDANT

       Total supply power: 1900 W
         Route processors: 60   W
                Linecards: 240  W
       Chassis components: 477  W
        Total inuse power: 777  W
                Remaining: 1123 W


PEM1 present, but unpowered
PEM2 present, supplying up to 1900 watts: uptime 0d01h39m

Slot   Cardtype                  Watts  Status
----   --------                 -----  ------
  1    12000-SIP-601=             240  powered
  4    PRP=                        60  powered
  16   GSR6-CSC=                   56  powered
  17   GSR6-CSC=                   56  powered
  18   GSR6-SFC=                   45  powered
  19   GSR6-SFC=                   45  powered
  20   GSR6-SFC=                   45  powered
  24   GSR6-ALRM=                  26  powered
  25   GSR6-ALRM=                  26  powered
  28   GSR6-BLOWER=               178  powered
```

If you plan to insert a new card, locate the entry for the card to be inserted and note the power consumed by it. If this power is less than the figure given in Worst Case Redundant Power Available (the figure is displayed in the **show environment power-supply table** command output), the card can be safely inserted. As long as the Worst Case Redundant Power Available is not zero, a PEM can be powered down for replacement without impact.

Note No alerts are issued if more cards are inserted than the PEMs can support. It is your responsibility to determine your power budget for the chassis before making any changes to it. Exceeding the power budget may result in the PEM being overloaded and cards powering down due to insufficient power being provided.

- **Per-interface Internet Control Message Protocol (ICMP) disable** feature is not supported on the Cisco XR 12000 Series Router.
- **Online Diagnostics is not supported on the Cisco XR 12000 Series Router—** If you execute the diagnostic command, an error appears stating that there is no online diagnostics process running on the router.
- The **rp mgmtethernet forwarding** command is not supported on the Cisco XR 12000 Series Router.
- Enabling the Lawful Interface feature triggers the L2-PRECAM-2-HW_RESOURCE_FAILURE message on Engine-3 linecards. This error reflects that your configuration has used up all available look-up registers (LUREGs).

  There is no direct workaround for this issue as its a hardware limitation. Only way to recover from this issue is to reduce feature scale. You need to identify the features which use LUREG at PreCAM1 and remove one or more of the features depending on LUREG requirements of the feature being added.

- **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.

- **Disable/Enable RSVP Message Checksum** Starting with C isco IOS XR Software Release 4.0.2, RSVP will, by default, compute and set the checksum field in all outgoing RSVP messages. Also, RSVP will verify the checksum field on all RSVP messages received to insure RSVP message integrity.

  A CLI is provided to override this Cisco IOS XR Software Release 4.0.2 default behavior and go back to pre Cisco IOS XR Software Release 4.0.2 behavior such that RSVP neither computes/sets the RSVP checksum on outgoing RSVP messages, nor verifies the checksum on received RSVP messages. The command to execute to revert to the pre- Cisco IOS XR Software Release 4.0.2 behavior is:

```
Router(config)#rsvp signalling checksum disable
```

Note When the rsvp signalling checksum disable command is configured, RSVP sets a zero checksum in all outgoing RSVP messages, and ignores the checksum field on all received RSVP incoming messages.

Minimum Flash Disk Requirements When Upgrading to Release 4.3.1

Cisco IOS XR Software Release 4.3.1 requires a 2-GB Flash Disk as a minimum. If your Cisco XR 12000 Series Router currently uses a 1-GB Flash Disk, you must upgrade it to 2-GB before upgrading to Cisco IOS XR Software Release 4.3.1. The PCMCIA 1-GB Flash Disk was the default size for the Cisco XR 12000 Series Router running Cisco IOS XR Software Release 3.6 and earlier.

In Cisco IOS XR Software Release 3.6 and later releases, disk partitioning is supported. Partitioning of a 2-GB disk is possible but not required. Partitioning of a 4-GB disk is required.

A 4-GB Flash Disk can be installed instead of the 2-GB for greater disk storage.

To upgrade from a 1-GB flash disk to a 2-GB or greater flash disk, refer to the Flash Disk Upgrade Tasks link on the following Cisco XR 12000 Series Router Installation and Upgrade URL:

http://www.cisco.com/en/US/products/ps6342/prod_installation_guides_list.html

Caveats

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

This section contains caveats that are generic to the Cisco IOS XR Release 4.3.1 software and those specific to the Cisco XR 12000 Series Router.

Cisco IOS XR Caveats

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

- **CSCud77196**

  Basic Description:

  BFD Bundle interface goes down after performing shut/noshut operation.

  Symptom

  The status of the Bidirectional Forwarding Detection (BFD) sessions on the bundle is up and immediately goes down on all member links. It happens, when the bundle interface shuts BFD sessions or continues to operate on it without shutting it down.

  Conditions:

  The issue exists due to BFD timeout, only for few scenarios. The BFD packets drop occurs due to delays in Forwarding Information Base (FIB) route install.

  Workaround:

  The status of the bundle is up again when the bundle interface repeatedly shuts down the BFD sessions or continues to operate on it.

- **CSCuf83074**

  Basic Description:

  sysmgr reports multiple process restarts post RPFO.

  Symptom

  Multiple processes restart.

  Conditions:

  The issue persists during Route Processing (RP) fail over.

  Workaround:

  None.

- **CSCug47099**

  Basic Description:

  install add operation fails, node fails to respond when completing disk checks.

  Symptom

  Install add operation fails and displays the following messages:

  - Error: ERROR: Process insthelper has been performing an operation for a period of time so that the node failed to respond when completing the installation of packages within the system.

Error: AFFECTED NODE(S): 0/RP1/CPU0 1/RP0/CPU0 1/RP1/CPU0.

- Node failed to respond when completing the disk checks.

  AFFECTED NODE(S): 0/RP0/CPU0 0/RP1/CPU0.

Conditions:

The procedure is not available to reproduce the scenario.

Workaround:

Restart insthelper process by using the command **process restart** *JID*.

- **CSCug72731**

  Basic Description:

  TI-MoFRR do not switch to Active after shutting (S1,G) RPF interface.

  Symptom

  Reverse Path Forwarding (RPF) interface does not cause switch overs in the following two conditions:

  - When using **explicit-rpf-vector** command for finding the RPF path.
  - When using **no router pim** command, followed by rollback and thereafter shutting down on primary stream's RPF interface.

  Conditions:

  Execute any one of the following commands to cause RPF interface switch over:

  - **explicit-rpf-vector** command to find out the RPF path
  - **no router pim** command, followed by rollback and thereafter shutting down on primary stream's RPF interface.

  Workaround:

  Install Software Maintenance Upgrades (SMU).

- **CSCug78374**

  Basic Description:

  mpls_lsd process memory leak on standby RP.

  Symptom

  mpls_lsd process memory leak on standby RP.

  Conditions:

  The memory leak issue on mpls_lsd process would be observed on scaled environments.

  Workaround:

  None.

- **CSCug59485**

  Basic Description:

  Packets are sent even if the LPTS rates are set to 0 for some policers.

  Symptom

Packets are sent even if the LPTS rates are set to 0 for some policers.

Conditions:

LPTS policing is configured.

Workaround:

None.

Caveats Specific to the Cisco XR 12000 Series Router

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

Troubleshooting

For information on troubleshooting Cisco IOS XR Software, see the *Cisco IOS XR Troubleshooting Guide for the Cisco XR 12000 Series Router* and the *Cisco IOS XR Getting Started Guide for the Cisco XR 12000 Series Router.*

Related Documentation

The most current Cisco XR 12000 Series Router hardware documentation is located at the following URL:

http://www.cisco.com/en/US/products/ps6342/prod_installation_guides_list.html

The Cisco IOS XR Software documentation set includes the Cisco IOS XR software configuration guides and command references.

The most current Cisco XR 12000 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, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the What's New in Cisco Product Documentation RSS feed. RSS feeds are a free service.