Release Notes for Cisco ASR 9000 Series Aggregation Services Routers for Cisco IOS XR Software Release 4.1.2

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Cisco ASR 9000 Series Router Software Release 4.1.2

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Note For information on Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2, see the "Features Supported on the Cisco ASR 9000 Series Router" section on page 40.

These release notes describe the features provided on the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2 and are updated as needed.

For a list of software caveats that apply to the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2, see the "Caveats" section on page 91. The caveats are updated for every release and are described on the World Wide Web at www.cisco.com.

Contents

These release notes contain the following sections:

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Introduction

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

Cisco IOS XR Software running on the Cisco ASR 9000 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 features (VRRP).
- **Ethernet Services**—The Cisco IOS XR Software Release 4.1 running on the Cisco ASR 9000 Series Router supports the following Ethernet features:
  - Ethernet Virtual Connections (EVCs)
  - Flexible VLAN classification
  - Flexible VLAN translation
  - IEEE bridging
  - IEEE 802.1s Multiple Spanning Tree (MST)
  - MST Access Gateway
  - L2VPN
  - Virtual Private LAN Services (VPLS), Hierarchical VPLS (H-VPLS), Virtual Private Wire Service (VPWS), Ethernet over MPLS (EoMPLS), pseudo wire redundancy, and multi segment pseudo wire switching.
- **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), which includes TE-FRR and TE Preferred Path, Resource Reservation Protocol (RSVP), Label Distribution Protocol (LDP), Targeted LDP (T-LDP), Differentiated Services (DiffServ)-aware traffic engineering, 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. The Cisco ASR 9000 Series Router also supports Auto-Rendezvous Point (AutoRP), Multiprotocol BGP (MBGP), Multicast Source Discovery Protocol (MSDP), Internet Group Management Protocol Versions 2 and 3 (IGMPv2 and v3), and IGMPv2 and v3 snooping.
- **Quality of Service (QoS)—**This supports QoS mechanisms including policing, marking, queuing, random and hard traffic dropping, and shaping. Additionally, Cisco IOS XR supports modular QoS command-line interface (MQC). MQC is used to configure various QoS features on various Cisco platforms, including the Cisco ASR 9000 Series Router. MQC supports the following:
  - Class-Based Weighted Fair Queuing (CBWFQ)
  - Weighted Random Early Detection (WRED)
  - Priority Queuing with propagation

  - 2-rate 3-color (2R3C) Policing
  - Modular QoS CLI (MQC)
  - 4-level Hierarchical-QoS
  - Shared Policy Instances
- **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. It includes a comprehensive set of Syslog messaging.
- **Security—**This provides comprehensive network security features including Layer 2 and Layer 3 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 control plan security, and Simple Network Management Protocol version3 (SNMPv3). Control plane protections integrated into line card Application-Specific Integrated Circuits (ASICs) include Generalized TTL Security Mechanism (GTSM), RFC 3682, and Dynamic Control Plane Protection (DCPP).
- **Availability—**This supports rich availability features such as fault containment, fault tolerance, fast switchover, link aggregation, nonstop routing for ISIS, LDP, and OSPF, and nonstop forwarding (NSF).
- **Enhanced core competencies:**
  - IP fast convergence with Fast Reroute (FRR) support for Intermediate System-to-Intermediate System (IS-IS)
  - Path Computation Element (PCE) capability for traffic engineering

For more information about new features provided on the Cisco ASR 9000 Series Router platform for Cisco IOS XR Software Release 4.1.2, see the "Features Introduced in Cisco IOS XR Software Release 4.1.2" section on page 40 in this document.

System Requirements

This section describes the system requirements for Cisco ASR 9000 Series Router Software Release 4.1.2. The system requirements include the following information:

Feature Set Table

The Cisco ASR 9000 Series Router Software is packaged in *feature sets* (also called *software images*). Each feature set contains a specific set of Cisco ASR 9000 Series Router Software Release 4.1 features.

Table 1 lists the Cisco ASR 9000 Series Router Software feature set matrix (PIE files) and associated filenames available for the Release 4.1.2 supported on the Cisco ASR 9000 Series Router.

Table 1 Cisco ASR 9000 Series Router Supported Feature Sets (Cisco IOS XR Software Release 4.1.2 PIE Files)

Feature Set	Filename	Description
Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	asr9k-mini-p.pie-4.1.2	Contains the required core packages, including OS, Admin, Base, Forwarding, Forwarding Processor Card 40G, FPD, Routing, SNMP Agent, Diagnostic Utilities, and Alarm Correlation.
Cisco IOS XR IP Unicast Routing Core Bundle	asr9k-mini-p.vm-4.1.2	Contains the required core packages including OS, Admin, Base, Forwarding, Forwarding Processor Card 40G, FPD, Routing, SNMP Agent, Diagnostic Utilities, and Alarm Correlation.
Optional Individual Packages[1]		
Cisco IOS XR Manageability Package	asr9k-mgbl-p.pie-4.1.2	CORBA[2] agent, XML[3] Parser, and HTTP server packages. This PIE also contains some SNMP MIB infrastructure. Certain MIBs won't work if this PIE is not installed.
Cisco IOS XR MPLS Package	asr9k-mpls-p.pie-4.1.2	MPLS-TE,[4] LDP,[5] MPLS Forwarding, MPLS OAM,[6] LMP,[7] OUNI,[8] RSVP,[9] and Layer-3 VPN.
Cisco IOS XR Multicast Package	asr9k-mcast-p.pie-4.1.2	Multicast Routing Protocols (PIM, MSDP,[10] IGMP,[11] Auto-RP), Tools (SAP, MTrace), and Infrastructure (MRIB,[12] MURIB[13], MFWD[14]), and BIDIR-PIM.[15]
Cisco IOS XR Security Package	asr9k-k9sec-p.pie-4.1.2	Support for Encryption, Decryption, SSH,[16] and SSL[17]

Table 1 Cisco ASR 9000 Series Router Supported Feature Sets (Cisco IOS XR Software Release 4.1.2 PIE Files) (continued)

Feature Set	Filename	Description
Cisco IOS XR Advanced Video Package	asr9k-video-p.pie-4.1.2	Firmware for the advanced video feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Optics Package	asr9k-optic-p.pie-4.1.2	Firmware for the optics feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Upgrade Package	asr9k-upgrade-p.pie-4.1.2	Firmware for the upgrade feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Documentation Package	asr9k-doc-p.pie-4.1.2	.man pages for Cisco IOS XR software on the Cisco ASR 9000 Series Router chassis.

1. Packages are installed individually
2. Common Object Request Broker Architecture
3. Extensible Markup Language
4. MPLS Traffic Engineering
5. Label Distribution Protocol
6. Operations, Administration, and Maintenance
7. Link Manager Protocol
8. Optical User Network Interface
9. Resource Reservation Protocol
10. Multicast Source Discovery Protocol
11. Internet Group Management Protocol
12. Multicast Routing Information Base
13. Multicast-Unicast RIB
14. Multicast forwarding
15. Bidirectional Protocol Independent Multicast
16. Secure Shell
17. Secure Socket Layer

Table 2 lists the Cisco ASR 9000 Series Router TAR files.

Table 2 Cisco ASR 9000 Series Router Supported Feature Sets (Cisco IOS XR Software Release 4.1.2 TAR Files)

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software	asr9k-iosxr-4.1.2.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 FPD Package • Cisco IOS XR Diagnostic Package • Cisco IOS XR Advanced Video Package • Cisco IOS XR Optics Package • Cisco IOS XR Upgrade Package • Cisco IOS XR Documentation Package
Cisco IOS XR IP/MPLS Core Software 3DES	asr9k-iosxr-k9-4.1.2.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR Security Package • Cisco IOS XR FPD Package • Cisco IOS XR Diagnostic Package • Cisco IOS XR Advanced Video Package • Cisco IOS XR Optics Package • Cisco IOS XR Upgrade Package • Cisco IOS XR Documentation 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 Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2 consist of the following:

- minimum 4-GB memory on the route switch processors (RSPs) [maximum is 8-GB]
- minimum 2-GB compact flash on route switch processors (RSPs)
- minimum 4-GB memory on the line cards (LCs)

These minimum memory requirements are met with the base board design.

RSP Memory Upgrade

This section describes the process to upgrade the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2 from a small memory model (ASR9k-RSP-4G) RSP card to a large memory model (ASR9k-RSP-8G) RSP card.

The upgrade sequence is as follows:

Step 1 Remove the standby small memory (ASR9k-RSP-4G) RSP card.

Step 2 Insert the large memory (ASR9k-RSP-8G) RSP card.

Step 3 Boot up the large memory (ASR9k-RSP-8G) RSP card so that it comes up as standby.

Step 4 Failover from the active small memory (ASR9k-RSP-4G) RSP card to the standby large memory (ASR9k-RSP-8G) RSP card.

Step 5 Remove the standby small memory (ASR9k-RSP-4G) RSP card.

Step 6 Insert the second large memory (ASR9k-RSP-8G) RSP card. Boot up this second large memory (ASR9k-RSP-8G) RSP card so that it comes up as standby.

.

RSP Memory Downgrade

This section describes the process to downgrade the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2 from a large memory model (ASR9k-RSP-8G) RSP card to a small memory model (ASR9k-RSP-4G) RSP card.

Caution Before attempting an RSP memory downgrade, measure the memory consumption of the current system configuration using the large memory model (ASR9k-RSP-8G) RSP card. You need to ensure that the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.1.2 is still able to run the system configuration using the small memory model (ASR9k-RSP-4G) RSP card.

The RSP memory downgrade sequence is as follows:

Step 1 Verify that the memory consumption on the active large memory model (ASR9k-RSP-8G) RSP card can fit within the memory constraints of the small memory model (ASR9k-RSP-4G) RSP card.

Step 2 Remove the standby large memory model (ASR9k-RSP-8G) RSP card.

Step 3 Insert the small memory model (ASR9k-RSP-4G) RSP card. The system does not boot up the small memory model (ASR9k-RSP-4G) RSP card by default. Send user command to boot up the small memory model (ASR9k-RSP-4G) RSP card as standby.

Step 4 Failover from the active large memory model (ASR9k-RSP-8G) RSP card to the standby small memory model (ASR9k-RSP-4G) RSP card.

Step 5 Remove the standby large memory model (ASR9k-RSP-8G) RSP card.

Step 6 Insert the small memory model (ASR9k-RSP-4G) RSP card. Boot up this second small memory model (ASR9k-RSP-4G) RSP card as standby.

Hardware Supported

Cisco IOS XR Software Release 4.1.2 supports Cisco ASR 9000 Series Routers. All hardware features are supported on Cisco IOS XR Software, subject to the memory requirements specified in the "Memory Requirements" section on page 7.

Table 3 lists the supported hardware components on the Cisco ASR 9000 Series Router and the minimum required software versions. For more information, see the "Other Firmware Support" section on page 12.

Table 3 Cisco ASR 9000 Series Router Supported Hardware and Minimum Software Requirements

Component	Part Number	Support from Version
Cisco ASR 9000 Series Router 6-Slot		
Cisco ASR 9000 Series 6-Slot System	ASR-9006	Release 3.7.2
Cisco ASR 9000 Series 6-Slot Fan Tray	ASR-9006-FAN	Release 3.7.2
Cisco ASR 9000 Series 6-Slot Door Kit	ASR-9006-DOOR	NA
Cisco ASR 9000 Series 6-Slot AC Chassis	ASR-9006-AC	Release 3.7.2
Cisco ASR 9000 Series 6-Slot DC Chassis	ASR-9006-DC	Release 3.7.2
Cisco ASR 9000 Series Router 6-Slot Air		
Cisco ASR 9000 Series 6-Slot Air Filter	ASR-9006-FILTER	Release 3.7.2
Cisco ASR 9000 Series Router 10-Slot		
Cisco ASR 9000 Series 10-Slot System	ASR-9010	Release 3.7.2
Cisco ASR 9000 Series 10-Slot Fan Tray	ASR-9010-FAN	Release 3.7.2
Cisco ASR 9000 Series 10-Slot Door Kit	ASR-9010-DOOR	NA
Cisco ASR 9000 Series 10-Slot AC Chassis	ASR-9010-AC	Release 3.7.2
Cisco ASR 9000 Series 10-Slot DC Chassis	ASR-9010-DC	Release 3.7.2
Cisco ASR 9000 Series 2 Post Mounting Kit	ASR-9010-2P-KIT	Release 3.7.2

Table 3 Cisco ASR 9000 Series Router Supported Hardware and Minimum Software Requirements (continued)

Component	Part Number	Support from Version
Cisco ASR 9000 Series 4 Post Mounting Kit	ASR-9010-4P-KIT	Release 3.7.2
Cisco ASR 9000 Series Router 10-Slot Air		
Cisco ASR 9000 Series 10-Slot Air Filter	ASR-9010-FILTER	Release 3.7.2
Cisco ASR 9000 Series 10-Slot External Exhaust Air Shaper	ASR-9010-AIRSHPR	NA
Cisco ASR 9000 Series 10-Slot Air Inlet Grill	ASR-9010-GRL	NA
Cisco ASR 9000 Series Router Power		
Cisco ASR 9000 Series 1.5kW DC Power Module	A9K-1.5KW-DC	Release 3.7.2
Cisco ASR 9000 Series 2kW DC Power Module	A9K-2KW-DC	Release 3.7.2
Cisco ASR 9000 Series 3kW AC Power Module	A9K-3KW-AC	Release 3.7.2
Cisco ASR 9000 Series Router Line Cards		
Cisco ASR 9000 Series 2-Port Ten Gigabit Ethernet + Cisco ASR 9000 Series 20-Port Gigabit Ethernet, Medium Queue	A9K-2T20GE-B	Release 3.9.0
Cisco ASR 9000 Series 2-Port Ten Gigabit Ethernet + Cisco ASR 9000 Series 20-Port Gigabit Ethernet, High Queue	A9K-2T20GE-E	Release 3.9.0
Cisco ASR 9000 Series 4-Port Ten Gigabit Ethernet, Medium Queue	A9K-4T-B	Release 3.7.2
Cisco ASR 9000 Series 4-Port Ten Gigabit Ethernet Extended Line Card, High Queue	A9K-4T-E	Release 3.7.2
Cisco ASR 9000 Series 4-Port Ten Gigabit Ethernet, Low Queue	A9K-4T-L	Release 3.9.0
Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet, 80G Line Rate Extended Line Card, Medium Queue	A9K-8T-B	Release 4.0.1
Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet, 80G Line Rate Extended Line Card, High Queue	A9K-8T-E	Release 3.9.0
Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet, 80G Line Rate, Low Queue	A9K-8T-L	Release 3.9.0
Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet, Medium Queue	A9K-8T/4-B	Release 3.7.2
Cisco ASR 9000 Series 8-Port TenGE DX Extended Line Card, High Queue	A9K-8T/4-E	Release 3.7.2
Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet, Low Queue	A9K-8T/4-L	Release 3.9.0
Cisco ASR 9000 Series 16-Port Ten Gigabit Ethernet, Medium Queue	A9K-4T-B	Release 4.0.1
Cisco ASR 9000 Series 40-Port Gigabit Ethernet, Medium Queue	A9K-40GE-B	Release 3.7.2
Cisco ASR 9000 Series 40-Port Gigabit Ethernet Extended Line Card, High Queue	A9K-40GE-E	Release 3.7.2
Cisco ASR 9000 Series 40-Port Gigabit Ethernet, Low Queue	A9K-40GE-L	Release 3.9.0
Cisco ASR 9000 Series Line Card Filler	A9K-LC-FILR	Release 3.7.2
ISM (Integrated Service Module) Line Card	A9K-ISM-100	Release 4.1
Cisco ASR 9000 Series Router Processor Cards		

Table 3 Cisco ASR 9000 Series Router Supported Hardware and Minimum Software Requirements (continued)

Component	Part Number	Support from Version
Cisco ASR 9000 Series Route Switch Processor, 4G Memory	A9K-RSP-4G	Release 3.7.2
Cisco ASR 9000 Series Route Switch Processor, 8G Memory	A9K-RSP-8G	Release 4.0.1
Cisco ASR 9000 Series Route Switch Processor Filler	ASR-9000-RSP-FILR	Release 3.7.2
Cisco ASR 9000 Series SIP and SPA Cards		
Cisco ASR 9000 SIP-700 SPA interface processor	A9K-SIP-700	Release 3.9.0
2-Port Channelized OC-12/DS0 SPA	SPA-2XCHOC12/DS0	Release 3.9.0
1-Port Channelized OC48/STM16 DS3 SPA	SPA-1XCHOC48/DS3	Release 4.0.1
2-Port OC-48/STM16 SPA	SPA-2XOC48POS/RPR	Release 4.0.1
8-Port OC12/STM4 SPA	SPA-8XOC12-POS	Release 4.0.1
1-Port OC-192/STM-64 POS/RPR SPA	SPA-OC192POS-XFP	Release 4.0.1
4-Port Clear Channel T3/E3 SPA	SPA-4XT3E3	Release 4.0.1
2-Port Clear Channel T3/E3 SPA	SPA-2XT3E3	Release 4.0.1
1-Port Channelized OC-3/STM-1 SPA	SPA-1XCHSTM1/OC3	Release 4.0.1
4-Port OC-3/STM-1 POS SPA	SPA-4XOC3	Release 4.0.1
8-Port OC-3/STM-1 POS SPA	SPA-8XOC3	Release 4.0.1
4-Port Channelized T3 to DS0 SPA	SPA-4XCT3/DS0	Release 4.1
8-Port Channelized T1/E1 SPA	SPA-8XCHT1/E1	Release 4.1
Cisco ASR 9000 Series SFP Modules		
GE SFP, LC Connector, EX Transceiver	GLC-EX-SMD	Release 4.1.1
1000BASE-LX/LH SFP Transceiver Module	GLC-LH-SMD	Release 4.1.1
1000BASE-SX SFP Transceiver Module	GLC-SX-MMD	Release 4.1.1
1000BASE-ZX SFP Transceiver Module	GLC-ZX-SMD	Release 4.1.1

Software Compatibility

Cisco IOS XR Software Release 4.1 is compatible with the following Cisco ASR 9000 Series Router systems:

- Cisco ASR 9000 Series Router 6-Slot Line Card Chassis
- Cisco ASR 9000 Series Router 10-Slot Line Card Chassis

Table 4 lists the supported software licenses on the Cisco ASR 9000 Series Router and the appropriate part numbers.

Table 4 Cisco ASR 9000 Series Router Supported Software Licenses

Software License	Part Number
Cisco ASR 9000 Series iVRF License	A9K-IVRF-LIC
Cisco ASR 9000 Series Per Chassis Advanced Video License	A9K-ADV-VIDEO-LIC

Table 4 Cisco ASR 9000 Series Router Supported Software Licenses (continued)

Software License	Part Number
Cisco ASR 9000 Series Per Line Card Advanced Optical License	A9K-ADV-OPTIC-LIC
Cisco ASR 9000 Series L3VPN License, Medium Queue and Low Queue Line Cards	A9K-AIP-LIC-B
Cisco ASR 9000 Series L3VPN License, High Queue Line Cards	A9K-AIP-LIC-E

Note that error messages may display if features run without the appropriate licenses installed. For example, when creating or configuring VRF, if the A9K-IVRF-LIC license is not installed before creating a VRF, the following message displays:

```
RP/0/RSP0/CPU0:PE1-AS1#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.
```

For Cisco license support, please contact your Cisco Sales Representative or Customer Service at 800-553-NETS (6387) or 408-526-4000. For questions on the program other than ordering, please send e-mail to: cwm-license@cisco.com.

Cisco ASR 9000 Series Right-To-Use (RTU) Licensing

The locations of the Cisco ASR 9000 Series Aggregation Services Router Right-To-Use (RTU) licensing documents are as follows:

http://www.cisco.com/en/US/docs/routers/asr9000/hardware/Prodlicense/A9k-AIP-LIC-B.html

http://www.cisco.com/en/US/docs/routers/asr9000/hardware/Prodlicense/A9k-AIP-LIC-E.html

Note Layer 3 VPNs are only to be used after you have purchased a license. Cisco enforces the RTU of L3VPNs in subsequent releases. You should contact Cisco, or check the release notes for the subsequent release before upgrading for directions on how to install the license as part of the upgrade, else the L3VPN feature may be affected.

The activation of VRF capability still requires the use of the appropriate per line card license (A9K-IVRF-LIC / A9K-AIP-LIC-B / A9K-AIP-LIC-E). Please contact your sales representative for more details.

Other Firmware Support

The Cisco ASR 9000 Series Router supports the following firmware code:

- The minimum ROMMON version required for this release is 1.05 for the following line cards:
  - A9K-40GE-B
  - A9K-40GE-E
  - A9K-40GE-L
  - A9K-8T/4-B
  - A9K-8T/4-E
  - A9K-8T/4-L
  - A9K-4T-B
  - A9K-4T-E
  - A9K-4T-L
  - A9K-2T20GE-B
  - A9K-2T20GE-E
  - A9K-2T20GE-L
- The minimum ROMMON version required for this release is 1.03 for the following line cards:
  - A9K-8T-B
  - A9K-8T-E
  - A9K-8T-L
  - A9K-16T/8-B
- The minimum ROMMON version required for this release is 1.05 for RSPs.
- The minimum CPUCNTRL version required for this release is line card-specific. Use the **show fpd package** command to check the firmware needed.

Note For more information about CPU controller bits, see the *Managing the Router Hardware* section in the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide.*

Note In upgrading from Release 3.7.3 or earlier releases, you may be expected to do a one-time FPD upgrade for any firmware images that may have changed since the last release. Refer to the documents at http://www.cisco.com/web/Cisco_IOS_XR_Software/index.html for upgrade instructions.

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

```
RP/0/RSP0/CPU0:router(admin)#show fpd package
Mon Nov 21 09:40:16.880 PST

================================ ==============================================
                                        Field Programmable Device Package
                                 ==============================================
                                                      SW      Min Req   Min Req
```

Card Type	FPD Description	Type	Subtype	Version	SW Ver	HW Vers
A9K-40GE-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONA LC2	lc	rommonA	1.05	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-4T-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.0	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	PHY LC2	lc	fpga3	14.44	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-8T/4-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.0	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	PHY LC2	lc	fpga3	14.44	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-2T20GE-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.11	0.0	0.1
	LCClkCtrl LC2	lc	cpld3	0.09	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.16	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-40GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONA LC2	lc	rommonA	1.05	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-4T-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.0	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	PHY LC2	lc	fpga3	14.44	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-8T/4-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.0	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.0	0.1
	PHY LC2	lc	fpga3	14.44	0.0	0.1
	Bridge LC2	lc	fpga1	0.43	0.0	0.1
	ROMMONB LC2	lc	rommon	1.05	0.0	0.1
A9K-2T20GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.0	0.1

```
                    PHYCtrl LC2              lc   cpld2      0.11        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3      0.09        0.0        0.1
                    PortCtrl LC2             lc   fpga2      0.16        0.0        0.1
                    Bridge LC2               lc   fpga1      0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon     1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-B            Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.08        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.03        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.11        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-B         Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.01        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-B         Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.01        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-E            Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.08        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.03        0.0        0.1
                    CPUCtrl LC3              lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.11        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-E         Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.01        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-E         Can Bus Ctrl (CBC) LC3   lc   cbc        6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1      1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2      0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3      0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4      1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2      0.01        0.0        0.1
                    Raven LC3                lc   fpga1      1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon     1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-40GE-L          Can Bus Ctrl (CBC) LC2   lc   cbc        2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1      1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2      0.06        0.0        0.1
                    PortCtrl LC2             lc   fpga2      0.10        0.0        0.1
```

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                    Bridge LC2                lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2               lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-4T-L            Can Bus Ctrl (CBC) LC2    lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2               lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2               lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2             lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2              lc   fpga2       0.10        0.0        0.1
                    Serdes Upgrade LC2        lc   fpga3      14.44        0.0        0.1
                    Bridge LC2                lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2               lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T/4-L          Can Bus Ctrl (CBC) LC2    lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2               lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2               lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2             lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2              lc   fpga2       0.10        0.0        0.1
                    Serdes Upgrade LC2        lc   fpga3      14.44        0.0        0.1
                    Bridge LC2                lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2               lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-2T20GE-L        Can Bus Ctrl (CBC) LC2    lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2               lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2               lc   cpld2       0.11        0.0        0.1
                    LCClkCtrl LC2             lc   cpld3       0.09        0.0        0.1
                    Tomcat LC2                lc   fpga2       0.16        0.0        0.1
                    Bridge LC2                lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2               lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-L            Can Bus Ctrl (CBC) LC3    lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3               lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3               lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC3             lc   cpld3       0.03        0.0        0.1
                    CPUCtrl LC3               lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3              lc   fpga2       0.11        0.0        0.1
                    Raven LC3                 lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3               lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-L         Can Bus Ctrl (CBC) LC3    lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3               lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3               lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3             lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3            lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3              lc   fpga2       0.01        0.0        0.1
                    Raven LC3                 lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3               lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-SIP-700         Can Bus Ctrl (CBC) LC5    lc   cbc         3.05        0.0        0.1
                    CPUCtrl LC5               lc   cpld1       0.15        0.0        0.1
                    QFPCPUBridge LC5          lc   fpga2       5.14        0.0        0.1
                    NPUXBarBridge LC5         lc   fpga1       0.22        0.0        0.1
                    ROMMONA LC5               lc   rommonA     1.03        0.0        0.1
                    ROMMONB LC5               lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-SIP-500         Can Bus Ctrl (CBC) LC5    lc   cbc         3.05        0.0        0.1
                    CPUCtrl LC5               lc   cpld1       0.15        0.0        0.1
                    QFPCPUBridge LC5          lc   fpga2       5.14        0.0        0.1
                    NPUXBarBridge LC5         lc   fpga1       0.22        0.0        0.1
                    ROMMONA LC5               lc   rommonA     1.03        0.0        0.1
                    ROMMONB LC5               lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-RSP-2G          Can Bus Ctrl (CBC) RSP2   lc   cbc         1.02        0.0        0.1
                    CPUCtrl RSP2              lc   cpld2       1.17        0.0        0.1
                    IntCtrl RSP2              lc   fpga2       1.15        0.0        0.1
```

	ClkCtrl RSP2	lc	fpga3	1.23	0.0	0.1
	UTI RSP2	lc	fpga4	3.08	0.0	0.1
	PUNT RSP2	lc	fpga1	1.05	0.0	0.1
	HSBI RSP2	lc	hsbi	4.00	0.0	0.1
	ROMMONA RSP2	lc	rommonA	1.05	0.0	0.1
	ROMMONB RSP2	lc	rommon	1.05	0.0	0.1
A9K-RSP-4G	Can Bus Ctrl (CBC) RSP2	lc	cbc	1.02	0.0	0.1
	CPUCtrl RSP2	lc	cpld2	1.17	0.0	0.1
	IntCtrl RSP2	lc	fpga2	1.15	0.0	0.1
	ClkCtrl RSP2	lc	fpga3	1.23	0.0	0.1
	UTI RSP2	lc	fpga4	3.08	0.0	0.1
	PUNT RSP2	lc	fpga1	1.05	0.0	0.1
	HSBI RSP2	lc	hsbi	4.00	0.0	0.1
	ROMMONA RSP2	lc	rommonA	1.05	0.0	0.1
	ROMMONB RSP2	lc	rommon	1.05	0.0	0.1
A9K-RSP-8G	Can Bus Ctrl (CBC) RSP2	lc	cbc	1.02	0.0	0.1
	CPUCtrl RSP2	lc	cpld2	1.17	0.0	0.1
	IntCtrl RSP2	lc	fpga2	1.15	0.0	0.1
	ClkCtrl RSP2	lc	fpga3	1.23	0.0	0.1
	UTI RSP2	lc	fpga4	3.08	0.0	0.1
	PUNT RSP2	lc	fpga1	1.05	0.0	0.1
	HSBI RSP2	lc	hsbi	4.00	0.0	0.1
	ROMMONA RSP2	lc	rommonA	1.05	0.0	0.1
	ROMMONB RSP2	lc	rommon	1.05	0.0	0.1
ASR-9010-FAN	Can Bus Ctrl (CBC) FAN	lc	cbc	4.00	0.0	0.1
ASR-9006-FAN	Can Bus Ctrl (CBC) FAN	lc	cbc	5.00	0.0	0.1
A9K-BPID2-10-SLOT	Can Bus Ctrl (CBC) BP2	lc	cbc	7.103	0.0	0.1
A9K-BPID2-6-SLOT	Can Bus Ctrl (CBC) BP2	lc	cbc	7.103	0.0	0.1
A9K-ISM-100	Can Bus Ctrl (CBC) LC6	lc	cbc	18.05	0.0	0.1
	CPUCtrl LC6	lc	cpld1	0.01	0.0	0.1
	Maintenance LC6	lc	fpga2	1.11	0.0	0.1
	Amistad LC6	lc	fpga1	0.29	0.0	0.20
	ROMMONA LC6	lc	rommonA	1.02	0.0	0.1
	ROMMONB LC6	lc	rommon	1.02	0.0	0.1
A9K-8T-B	CPUCtrl LC3	lc	cpld1	1.02	0.0	0.1
	PHYCtrl LC3	lc	cpld2	0.08	0.0	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.02	0.0	0.1
A9K-8T-E	CPUCtrl LC3	lc	cpld1	1.02	0.0	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.02	0.0	0.1
SPA-4XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.0	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.0	0.0
	SPA I/O FPGA	spa	fpga1	1.01	0.0	0.0
	SPA ROMMON	spa	rommon	2.12	0.0	0.0
SPA-2XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.0	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.0	0.0
	SPA I/O FPGA	spa	fpga1	1.01	0.0	0.0
	SPA ROMMON	spa	rommon	2.12	0.0	0.0
SPA-4XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	0.11	0.0	0.100

```
                    SPA T3 Subrate FPGA        spa  fpga2       1.04        0.0     0.200
                    SPA I/O FPGA               spa  fpga1       2.08        0.0     0.100
                    SPA ROMMON                 spa  rommon      2.12        0.0     0.100
------------------------------------------------------------------------------------------
SPA-2XCT3/DS0       SPA T3 Subrate FPGA        spa  fpga2       0.11        0.0     0.100
                    SPA T3 Subrate FPGA        spa  fpga2       1.04        0.0     0.200
                    SPA I/O FPGA               spa  fpga1       2.08        0.0     0.100
                    SPA ROMMON                 spa  rommon      2.12        0.0     0.100
------------------------------------------------------------------------------------------
SPA-1XCHSTM1/OC3    SPA T3 Subrate FPGA        spa  fpga2       1.04        0.0       0.0
                    SPA I/O FPGA               spa  fpga1       1.08        0.0       0.0
                    SPA ROMMON                 spa  rommon      2.12        0.0       0.0
------------------------------------------------------------------------------------------
SPA-1XCHOC48/DS3    SPA I/O FPGA               spa  fpga2       1.00        0.0      0.49
                    SPA I/O FPGA               spa  fpga3       1.00        0.0      0.52
                    SPA I/O FPGA               spa  fpga1       1.36        0.0      0.49
                    SPA ROMMON                 spa  rommon      2.02        0.0      0.49
------------------------------------------------------------------------------------------
SPA-2XCHOC12/DS0    SPA FPGA2 swv1.00          spa  fpga2       1.00        0.0       0.0
                    SPA FPGA swv1.36           spa  fpga1       1.36        0.0      0.49
                    SPA ROMMON swv2.2          spa  rommon      2.02        0.0      0.49
------------------------------------------------------------------------------------------
SPA-8XOC12-POS      SPA FPGA swv1.0            spa  fpga1       1.00        0.0       0.5
------------------------------------------------------------------------------------------
SPA-8XCHT1/E1       SPA I/O FPGA               spa  fpga1       2.08        0.0       0.0
                     SPA ROMMON                 spa  rommon      2.12        0.0     0.140
------------------------------------------------------------------------------------------
SPA-OC192POS-XFP    SPA FPGA swv1.2 hwv2       spa  fpga1       1.02        0.0       2.0
------------------------------------------------------------------------------------------
SPA-2XOC48POS/RPR   SPA FPGA swv1.0            spa  fpga1       1.00        0.0       0.0
------------------------------------------------------------------------------------------
SPA-8XOC3-POS       SPA FPGA swv1.0            spa  fpga1       1.00        0.0       0.5
------------------------------------------------------------------------------------------
SPA-10X1GE-V2       SPA FPGA swv1.10           spa  fpga1       1.10        0.0       0.0
------------------------------------------------------------------------------------------
SPA-5X1GE-V2        SPA FPGA swv1.10           spa  fpga1       1.10        0.0       0.0
------------------------------------------------------------------------------------------
SPA-1X10GE-L-V2     SPA FPGA swv1.9            spa  fpga1       1.09        0.0       0.0
------------------------------------------------------------------------------------------
SPA-4XOC3-POS-V2    SPA FPGA swv1.0            spa  fpga1       1.00        0.0       0.5
------------------------------------------------------------------------------------------
SPA-1X10GE-WL-V2    SPA FPGA swv1.9            spa  fpga1       1.09        0.0       0.0
------------------------------------------------------------------------------------------
RP/0/RSP0/CPU0:router(admin)#

RP/0/RSP0/CPU0:router(admin)#show fpd package
Mon Nov 21 09:40:46.670 PST

=============================== ================================================
                                        Field Programmable Device Package
                                ================================================
                                                                 SW      Min Req   Min Req
Card Type            FPD Description           Type Subtype   Version   SW Ver    HW Vers
==================== ========================== ==== ======= =========== ======== ========
A9K-40GE-B          Can Bus Ctrl (CBC) LC2     lc   cbc         2.02        0.0       0.1
                    CPUCtrl LC2                lc   cpld1       1.00        0.0       0.1
                    PHYCtrl LC2                lc   cpld2       0.06        0.0       0.1
                    PortCtrl LC2               lc   fpga2       0.10        0.0       0.1
                    Bridge LC2                 lc   fpga1       0.43        0.0       0.1
                    ROMMONA LC2                lc   rommonA     1.05        0.0       0.1
                    ROMMONB LC2                lc   rommon      1.05        0.0       0.1
------------------------------------------------------------------------------------------
A9K-4T-B            Can Bus Ctrl (CBC) LC2     lc   cbc         2.02        0.0       0.1
                    CPUCtrl LC2                lc   cpld1       1.00        0.0       0.1
```

```
                    PHYCtrl LC2              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    PHY LC2                  lc   fpga3      14.44        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T/4-B          Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    PHY LC2                  lc   fpga3      14.44        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-2T20GE-B        Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.11        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.09        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.16        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-40GE-E          Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.06        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONA LC2              lc   rommonA     1.05        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-4T-E            Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    PHY LC2                  lc   fpga3      14.44        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T/4-E          Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    PHY LC2                  lc   fpga3      14.44        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-2T20GE-E        Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.11        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.09        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.16        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-B            Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.03        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.11        0.0        0.1
```

```
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-B         Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.01        0.0        0.1
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-B         Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.01        0.0        0.1
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-E            Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.03        0.0        0.1
                    CPUCtrl LC3              lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.11        0.0        0.1
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-E         Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.01        0.0        0.1
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-E         Can Bus Ctrl (CBC) LC3   lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3              lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3              lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3            lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3           lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3             lc   fpga2       0.01        0.0        0.1
                    Raven LC3                lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3              lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-40GE-L          Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.06        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-4T-L            Can Bus Ctrl (CBC) LC2   lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2              lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2              lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2            lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2             lc   fpga2       0.10        0.0        0.1
                    Serdes Upgrade LC2       lc   fpga3      14.44        0.0        0.1
                    Bridge LC2               lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2              lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
```

```
A9K-8T/4-L          Can Bus Ctrl (CBC) LC2     lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2                lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2                lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC2              lc   cpld3       0.03        0.0        0.1
                    PortCtrl LC2               lc   fpga2       0.10        0.0        0.1
                    Serdes Upgrade LC2         lc   fpga3      14.44        0.0        0.1
                    Bridge LC2                 lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2                lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-2T20GE-L        Can Bus Ctrl (CBC) LC2     lc   cbc         2.02        0.0        0.1
                    CPUCtrl LC2                lc   cpld1       1.00        0.0        0.1
                    PHYCtrl LC2                lc   cpld2       0.11        0.0        0.1
                    LCClkCtrl LC2              lc   cpld3       0.09        0.0        0.1
                    Tomcat LC2                 lc   fpga2       0.16        0.0        0.1
                    Bridge LC2                 lc   fpga1       0.43        0.0        0.1
                    ROMMONB LC2                lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-8T-L            Can Bus Ctrl (CBC) LC3     lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3                lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3                lc   cpld2       0.08        0.0        0.1
                    LCClkCtrl LC3              lc   cpld3       0.03        0.0        0.1
                    CPUCtrl LC3                lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3               lc   fpga2       0.11        0.0        0.1
                    Raven LC3                  lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3                lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-16T/8-L         Can Bus Ctrl (CBC) LC3     lc   cbc         6.02        0.0        0.1
                    CPUCtrl LC3                lc   cpld1       1.02        0.0        0.1
                    PHYCtrl LC3                lc   cpld2       0.04        0.0        0.1
                    LCClkCtrl LC3              lc   cpld3       0.01        0.0        0.1
                    DB CPUCtrl LC3             lc   cpld4       1.03        0.0        0.1
                    PortCtrl LC3               lc   fpga2       0.01        0.0        0.1
                    Raven LC3                  lc   fpga1       1.02        0.0        0.1
                    ROMMONB LC3                lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-SIP-700         Can Bus Ctrl (CBC) LC5     lc   cbc         3.05        0.0        0.1
                    CPUCtrl LC5                lc   cpld1       0.15        0.0        0.1
                    QFPCPUBridge LC5           lc   fpga2       5.14        0.0        0.1
                    NPUXBarBridge LC5          lc   fpga1       0.22        0.0        0.1
                    ROMMONA LC5                lc   rommonA     1.03        0.0        0.1
                    ROMMONB LC5                lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-SIP-500         Can Bus Ctrl (CBC) LC5     lc   cbc         3.05        0.0        0.1
                    CPUCtrl LC5                lc   cpld1       0.15        0.0        0.1
                    QFPCPUBridge LC5           lc   fpga2       5.14        0.0        0.1
                    NPUXBarBridge LC5          lc   fpga1       0.22        0.0        0.1
                    ROMMONA LC5                lc   rommonA     1.03        0.0        0.1
                    ROMMONB LC5                lc   rommon      1.03        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-RSP-2G          Can Bus Ctrl (CBC) RSP2    lc   cbc         1.02        0.0        0.1
                    CPUCtrl RSP2               lc   cpld2       1.17        0.0        0.1
                    IntCtrl RSP2               lc   fpga2       1.15        0.0        0.1
                    ClkCtrl RSP2               lc   fpga3       1.23        0.0        0.1
                    UTI RSP2                   lc   fpga4       3.08        0.0        0.1
                    PUNT RSP2                  lc   fpga1       1.05        0.0        0.1
                    HSBI RSP2                  lc   hsbi        4.00        0.0        0.1
                    ROMMONA RSP2               lc   rommonA     1.05        0.0        0.1
                    ROMMONB RSP2               lc   rommon      1.05        0.0        0.1
--------------------------------------------------------------------------------------------
A9K-RSP-4G          Can Bus Ctrl (CBC) RSP2    lc   cbc         1.02        0.0        0.1
                    CPUCtrl RSP2               lc   cpld2       1.17        0.0        0.1
                    IntCtrl RSP2               lc   fpga2       1.15        0.0        0.1
                    ClkCtrl RSP2               lc   fpga3       1.23        0.0        0.1
                    UTI RSP2                   lc   fpga4       3.08        0.0        0.1
```

	PUNT RSP2	lc	fpga1	1.05	0.0	0.1
	HSBI RSP2	lc	hsbi	4.00	0.0	0.1
	ROMMONA RSP2	lc	rommonA	1.05	0.0	0.1
	ROMMONB RSP2	lc	rommon	1.05	0.0	0.1
A9K-RSP-8G	Can Bus Ctrl (CBC) RSP2	lc	cbc	1.02	0.0	0.1
	CPUCtrl RSP2	lc	cpld2	1.17	0.0	0.1
	IntCtrl RSP2	lc	fpga2	1.15	0.0	0.1
	ClkCtrl RSP2	lc	fpga3	1.23	0.0	0.1
	UTI RSP2	lc	fpga4	3.08	0.0	0.1
	PUNT RSP2	lc	fpga1	1.05	0.0	0.1
	HSBI RSP2	lc	hsbi	4.00	0.0	0.1
	ROMMONA RSP2	lc	rommonA	1.05	0.0	0.1
	ROMMONB RSP2	lc	rommon	1.05	0.0	0.1
ASR-9010-FAN	Can Bus Ctrl (CBC) FAN	lc	cbc	4.00	0.0	0.1
ASR-9006-FAN	Can Bus Ctrl (CBC) FAN	lc	cbc	5.00	0.0	0.1
A9K-BPID2-10-SLOT	Can Bus Ctrl (CBC) BP2	lc	cbc	7.103	0.0	0.1
A9K-BPID2-6-SLOT	Can Bus Ctrl (CBC) BP2	lc	cbc	7.103	0.0	0.1
A9K-ISM-100	Can Bus Ctrl (CBC) LC6	lc	cbc	18.05	0.0	0.1
	CPUCtrl LC6	lc	cpld1	0.01	0.0	0.1
	Maintenance LC6	lc	fpga2	1.11	0.0	0.1
	Amistad LC6	lc	fpga1	0.29	0.0	0.20
	ROMMONA LC6	lc	rommonA	1.02	0.0	0.1
	ROMMONB LC6	lc	rommon	1.02	0.0	0.1
A9K-8T-B	CPUCtrl LC3	lc	cpld1	1.02	0.0	0.1
	PHYCtrl LC3	lc	cpld2	0.08	0.0	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.02	0.0	0.1
A9K-8T-E	CPUCtrl LC3	lc	cpld1	1.02	0.0	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.02	0.0	0.1
SPA-4XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.0	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.0	0.0
	SPA I/O FPGA	spa	fpga1	1.01	0.0	0.0
	SPA ROMMON	spa	rommon	2.12	0.0	0.0
SPA-2XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.0	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.0	0.0
	SPA I/O FPGA	spa	fpga1	1.01	0.0	0.0
	SPA ROMMON	spa	rommon	2.12	0.0	0.0
SPA-4XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	0.11	0.0	0.100
	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.0	0.200
	SPA I/O FPGA	spa	fpga1	2.08	0.0	0.100
	SPA ROMMON	spa	rommon	2.12	0.0	0.100
SPA-2XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	0.11	0.0	0.100
	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.0	0.200
	SPA I/O FPGA	spa	fpga1	2.08	0.0	0.100
	SPA ROMMON	spa	rommon	2.12	0.0	0.100
SPA-1XCHSTM1/OC3	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.0	0.0
	SPA I/O FPGA	spa	fpga1	1.08	0.0	0.0
	SPA ROMMON	spa	rommon	2.12	0.0	0.0

```
-------------------------------------------------------------------------------------
SPA-1XCHOC48/DS3     SPA I/O FPGA              spa  fpga2       1.00        0.0       0.49
                     SPA I/O FPGA              spa  fpga3       1.00        0.0       0.52
                     SPA I/O FPGA              spa  fpga1       1.36        0.0       0.49
                     SPA ROMMON                spa  rommon      2.02        0.0       0.49
-------------------------------------------------------------------------------------
SPA-2XCHOC12/DS0     SPA FPGA2 swv1.00         spa  fpga2      1.00        0.0       0.0
                     SPA FPGA swv1.36          spa  fpga1       1.36        0.0       0.49
                     SPA ROMMON swv2.2         spa  rommon      2.02        0.0       0.49
-------------------------------------------------------------------------------------
SPA-8XOC12-POS       SPA FPGA swv1.0           spa  fpga1      1.00        0.0       0.5
-------------------------------------------------------------------------------------
SPA-8XCHT1/E1        SPA I/O FPGA              spa  fpga1      2.08        0.0       0.0
                      SPA ROMMON                spa  rommon      2.12        0.0     0.140
-------------------------------------------------------------------------------------
SPA-OC192POS-XFP     SPA FPGA swv1.2 hwv2      spa  fpga1      1.02        0.0       2.0
-------------------------------------------------------------------------------------
SPA-2XOC48POS/RPR    SPA FPGA swv1.0           spa  fpga1      1.00        0.0       0.0
-------------------------------------------------------------------------------------
SPA-8XOC3-POS        SPA FPGA swv1.0           spa  fpga1      1.00        0.0       0.5
-------------------------------------------------------------------------------------
SPA-10X1GE-V2        SPA FPGA swv1.10          spa  fpga1      1.10        0.0       0.0
-------------------------------------------------------------------------------------
SPA-5X1GE-V2         SPA FPGA swv1.10          spa  fpga1      1.10        0.0       0.0
-------------------------------------------------------------------------------------
SPA-1X10GE-L-V2      SPA FPGA swv1.9           spa  fpga1      1.09        0.0       0.0
-------------------------------------------------------------------------------------
SPA-4XOC3-POS-V2     SPA FPGA swv1.0           spa  fpga1      1.00        0.0       0.5
-------------------------------------------------------------------------------------
SPA-1X10GE-WL-V2     SPA FPGA swv1.9           spa  fpga1      1.09        0.0       0.0
-------------------------------------------------------------------------------------
RP/0/RSP0/CPU0:router(admin)#
```

Determining Your Software Version

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

Step 1 Establish a Telnet session with the router.

Step 2 Enter the show version command:

```
RP/0/RSP0/CPU0:router#sh vers
Mon Nov 21 09:38:44.142 PST

Cisco IOS XR Software, Version 4.1.2[Default]
Copyright (c) 2011 by Cisco Systems, Inc.

ROM: System Bootstrap, Version 1.05(20101118:025914) [ASR9K ROMMON],

router uptime is 12 hours, 11 minutes
System image file is "bootflash:disk0/asr9k-os-mbi-4.1.2/mbiasr9k-rp.vm"

cisco ASR9K Series (MPC8641D) processor with 4194304K bytes of memory.
MPC8641D processor at 1333MHz, Revision 2.2
ASR-9010-AC Chassis

4 Management Ethernet
2 WANPHY controller(s)
10 TenGigE
```

```
10 DWDM controller(s)
60 GigabitEthernet
10 SONET/SDH
8 Packet over SONET/SDH
1 MgmtMultilink
3 T3
2 Serial network interface(s)
28 T1
1 Serial network interface(s)
219k bytes of non-volatile configuration memory.
977M bytes of compact flash card.
67988M bytes of hard disk.
1605616k bytes of disk0: (Sector size 512 bytes).
1605616k bytes of disk1: (Sector size 512 bytes).

Configuration register on node 0/RSP0/CPU0 is 0x102
Boot device on node 0/RSP0/CPU0 is disk0:
Package active on node 0/RSP0/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9K-doc-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9K-doc-supp-4.1.2
    Built on Sat Nov 19 15:31:01 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-security, V 4.1.2[00], Cisco Systems, at disk0:iosxr-security-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mgbl, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mgbl-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
```

```
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fpd, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fpd-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-k9sec-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-k9sec-supp-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mgbl-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mgbl-supp-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Configuration register on node 0/RSP1/CPU0 is 0x102
Boot device on node 0/RSP1/CPU0 is disk0:
```

```
Package active on node 0/RSP1/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9K-doc-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9K-doc-supp-4.1.2
    Built on Sat Nov 19 15:31:01 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-security, V 4.1.2[00], Cisco Systems, at disk0:iosxr-security-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mgbl, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mgbl-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fpd, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fpd-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-k9sec-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-k9sec-supp-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mgbl-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mgbl-supp-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/0/CPU0 is mem:
Package active on node 0/0/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
```

```
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
```

```
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/2/CPU0 is mem:
Package active on node 0/2/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/4/CPU0 is mem:
Package active on node 0/4/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
```

```
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/5/CPU0 is mem:
Package active on node 0/5/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/7/CPU0 is mem:
Package active on node 0/7/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
```

```
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

RP/0/RSP0/CPU0:router#sh vers
Mon Nov 21 09:38:51.818 PST

Cisco IOS XR Software, Version 4.1.2[Default]
Copyright (c) 2011 by Cisco Systems, Inc.

ROM: System Bootstrap, Version 1.05(20101118:025914) [ASR9K ROMMON],

router uptime is 12 hours, 9 minutes
System image file is "bootflash:disk0/asr9k-os-mbi-4.1.2/mbiasr9k-rp.vm"

cisco ASR9K Series (MPC8641D) processor with 4194304K bytes of memory.
MPC8641D processor at 1333MHz, Revision 2.2
ASR-9010-AC Chassis

4 Management Ethernet
8 DWDM controller(s)
8 TenGigE
40 GigabitEthernet
219k bytes of non-volatile configuration memory.
33994M bytes of hard disk.
1605616k bytes of disk0: (Sector size 512 bytes).
1605616k bytes of disk1: (Sector size 512 bytes).

Configuration register on node 0/RSP0/CPU0 is 0x102
Boot device on node 0/RSP0/CPU0 is disk0:
Package active on node 0/RSP0/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
```

```
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9K-doc-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9K-doc-supp-4.1.2
    Built on Sat Nov 19 15:31:01 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-security, V 4.1.2[00], Cisco Systems, at disk0:iosxr-security-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mgbl, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mgbl-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
```

```
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fpd, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fpd-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-k9sec-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-k9sec-supp-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mgbl-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mgbl-supp-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Configuration register on node 0/RSP1/CPU0 is 0x102
Boot device on node 0/RSP1/CPU0 is disk0:
Package active on node 0/RSP1/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9K-doc-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9K-doc-supp-4.1.2
    Built on Sat Nov 19 15:31:01 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-security, V 4.1.2[00], Cisco Systems, at disk0:iosxr-security-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mgbl, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mgbl-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fpd, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fpd-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-k9sec-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-k9sec-supp-4.1.2
    Built on Sat Nov 19 15:30:57 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
asr9k-mgbl-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mgbl-supp-4.1.2
    Built on Sat Nov 19 15:30:45 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/5/CPU0 is mem:
Package active on node 0/5/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
```

```
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

Boot device on node 0/7/CPU0 is mem:
Package active on node 0/7/CPU0:
iosxr_os_test, V 4.1.2[00], Cisco Systems, at disk0:iosxr_os_test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-ce, V 4.1.2[00], Cisco Systems, at disk0:iosxr-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-optics-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-optics-supp-4.1.2
    Built on Sat Nov 19 15:31:08 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-fwding, V 4.1.2[00], Cisco Systems, at disk0:asr9k-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-cpp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-cpp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-ce, V 4.1.2[00], Cisco Systems, at disk0:asr9k-ce-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

```
asr9k-scfclient, V 4.1.2[00], Cisco Systems, at disk0:asr9k-scfclient-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-video-adv, V 4.1.2[00], Cisco Systems, at disk0:iosxr-video-adv-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mpls, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mpls-4.1.2
    Built on Sat Nov 19 15:30:50 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-mcast, V 4.1.2[00], Cisco Systems, at disk0:iosxr-mcast-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-routing, V 4.1.2[00], Cisco Systems, at disk0:iosxr-routing-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-testfiles, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-testfiles-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra-test, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-test-4.1.2
    Built on Sat Nov 19 16:15:41 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-infra, V 4.1.2[00], Cisco Systems, at disk0:iosxr-infra-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-fwding, V 4.1.2[00], Cisco Systems, at disk0:iosxr-fwding-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

iosxr-diags, V 4.1.2[00], Cisco Systems, at disk0:iosxr-diags-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-adv-video-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-adv-video-supp-4.1.2
    Built on Sat Nov 19 15:31:17 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-diags-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-diags-supp-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-mcast-supp, V 4.1.2[00], Cisco Systems, at disk0:asr9k-mcast-supp-4.1.2
    Built on Sat Nov 19 15:30:37 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-base, V 4.1.2[00], Cisco Systems, at disk0:asr9k-base-4.1.2
    Built on Sat Nov 19 15:27:56 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie

asr9k-os-mbi, V 4.1.2[00], Cisco Systems, at disk0:asr9k-os-mbi-4.1.2
    Built on Sat Nov 19 15:29:00 PST 2011
    By sjc-lds-511 in /auto/srcarchive5/production/4.1.2/all/workspace for pie
```

Features Supported on the Cisco ASR 9000 Series Router

The following sections describe the features supported on the Cisco ASR 9000 Series Router platform:

- Features Introduced in Cisco IOS XR Software Release 4.1.2
- Features Introduced in Cisco IOS XR Software Release 4.1.1
- Features Introduced in Cisco IOS XR Software Release 4.1.0
- Features Introduced in Cisco IOS XR Software Release 4.0.1
- Features Introduced in Cisco IOS XR Software Release 4.0.0
- Features Introduced in Cisco IOS XR Software Release 3.9.2
- Features Introduced in Cisco IOS XR Software Release 3.9.1
- Features Introduced in Cisco IOS XR Software Release 3.9.0
- Features Introduced in Cisco IOS XR Software Release 3.7.3
- Features Introduced in Cisco IOS XR Software Release 3.7.2

Note The Cisco ASR 9000 Series Router platform is not supported on Cisco IOS XR Software Release 3.8.0.

Features Introduced in Cisco IOS XR Software Release 4.1.2

The following sections contain information on new features and enhancements is Cisco IOS XR Software Release 4.1.2:

- Software Features Introduced in Cisco IOS XR Software Release 4.1.2 for the Cisco ASR 9000 Series Router, page 40
- Hardware Features Introduced in Cisco IOS XR Software Release 4.1.2 for the Cisco ASR 9000 Series Router, page 46

Software Features Introduced in Cisco IOS XR Software Release 4.1.2 for the Cisco ASR 9000 Series Router

The following software features are introduced in Release 4.1.2:

- CDS-IS Support
- Integrated Routing and Bridging
- Bulk Ping

CDS-IS Support

Cisco IOS XR Software Release 4.1.2 introduces ISM support for Release 2.5.11 CDS-IS. The Cisco Internet Streamer Content Delivery System (CDS-IS) is a distributed network of Content Delivery Engines (CDEs) running Content Delivery Applications (CDAs) that collaborate with each other to deliver multi-format content to a variety of client devices such as personal computers and Wi-Fi enabled mobile devices.

CDS uses a variety of mechanisms to offer end-to-end solution for service providers to ingest and stream entertainment-grade content to subscribers.

The components that are comprised in CDS functionality are as follows:

- Ingest and Distribution

  Ingest device is the service engine designated as the content acquirer for a delivery service. The distribution of content within the CDS is determined by the method of ingest used. The following four methods of content ingest are supported in CDS-IS:

  - Prefetch ingest
  - Dynamic ingest
  - Hybrid ingest
  - Live stream ingest and split

- Delivery

  For handling client requests for content, the service router determines the best service engine to deliver the content based on proximity, load, and health states. After the best service engine is determined, the following mechanisms are used to deliver the content to the client device:

  - Static Content Download using HTTP—Content is downloaded by the client device before it is rendered to the user.
  - Progressive Content Download using HTTP—Before the content is fully downloaded, it is rendered in segments to the user.
  - Content Streaming using HTTP, RTMP, RTSP, or RTP—This is a very common method of streaming video content to client devices. Here, the service engines collect feedback and can fine-tune the streaming content to the client device. This also performs advanced error recovery.

- Management

  The administrator can manage and monitor the entire CDS network using the Internet Streaming CDSM, which is a secure Web browser-based user interface and a centralized system management device. For this, all devices, service engines and service routers in the CDS must be registered to the Internet Streaming CDSM. The Internet Streaming CDSM also provides an automated workflow to apply a software image upgrade to a device group.

Each CDE in the CDS contributes to one or more of these functions as determined by the CDAs running on it.

The CDS-IS command-line interface (CLI) uses the following modes to issue commands:

- Using CDS Device Modes—The device mode determines whether the CDS device is functioning as a service engine, CDS Manager, or service router. The **device mode** global configuration command is used to change the current device mode to another configuration and the **show device-mode** command is used to display the current device configuration.

- Using Command-Line Processing—As the Cisco Internet Streamer CDS software commands are not case sensitive, the commands and parameters can be abbreviated as long as the letters contained in them are different from any other currently available commands or parameters. The following are some of the Command-Line processing keystroke combinations:
  - Ctrl-A—Jumps to the first character of the command line.
  - Ctrl-B or the Left Arrow key—Moves the cursor back one character.
  - Ctrl-C—Escapes and terminates prompts and tasks.
  - Ctrl-D—Deletes the character at the cursor.

  For a complete list of Command-Line Processing commands, see the Cisco Internet Streamer CDS 2.5 Command Reference Guide.
- Using Command Modes—The CLI for CDS-IS is similar to the CLI for the Cisco IOS Software. The following command modes are provided by Cisco Internet Streamer CDS software CLI:
  - EXEC Mode—This mode is used for setting, viewing, and testing system operations. For this, the EXEC mode is divided into two access levels: user and privileged. The commands used in this mode are:
    - **enable** and **disable**—Used to switch between the user and privileged levels.
    - **Delete** and **Backspace**—Used to edit commands when you enter commands at the EXEC prompt.
    - **Show** or **Sho**—Used to show the output.
    - **exit**—Used to leave EXEC mode.
  - Global Configuration Mode—This mode is used for setting, viewing, and testing the configuration of Internet Streamer CDS software features for the entire device. To enter this mode, enter the **configure** command from privileged EXEC mode. You must be in global configuration mode to enter global configuration commands. To exit the global configuration mode, use the **end** global configuration command or press **Ctrl-Z** at the prompt.
  - Interface Configuration Mode—This mode is used for setting, viewing, and testing the configuration of Internet Streamer CDS software features on a specific interface. To enter this mode, enter the **interface** command from the Global configuration mode. The following example shows how to enter interface configuration mode:

    ```
    ServiceEngine# configure
    ServiceEngine(config)# interface ?
    GigabitEthernet Select a gigabit ethernet interface to configure
    PortChannel Ethernet Channel of interfaces
    Standby Standby groups
    ```

    To exit interface configuration mode, use the **exit** command to return to Global configuration mode.
  - Other Configuration Modes—To make it easier to configure specific features, the CLI provides several other configuration modes. This includes the following configuration modes too:
    - Standard access control list (ACL) configuration mode—Use the **ip access-list standard** command from Global configuration mode.
    - Extended ACL configuration mode—Use the **ip access-list extended** command from Global configuration mode.

System and Alarm Messages

This section lists and describes the error messages for the Cisco Internet Streamer CDS Release 2.5. The system software send these error messages to the console, local disk, and logging server on another system. The following types of error messages are expected to occur in the system:

- System Error Messages

  A system error message has the following structure:

  FACILITY-SEVERITY-MNEMONIC: Message test

  A typical system error message will look this:

  ```
  SE-ACQ-2-100010 Failed to acquire start-url
  ```

  where:

  - SE is the facility code.
  - ACQ is the source code.
  - 2 is the severity level.
  - 100010 is the mnemonic code.
  - *Failed to acquire start-url* is the message text.

- Alarm Messages

  Cisco CDS alarms have the following structure:

  SOURCE-MNEMONIC CODE: Alarm text

  Here, MNEMONIC CODE is a unique code for identifying the alarm and the **Alarm text** is a brief description of the alarm.

  A typical alarm message example is shown as follows:

  Alarm 330001 (svcdisabled) -service name- service has been disabled.

Integrated Routing and Bridging

Cisco IOS XR Software Release 4.1.2 introduces Integrated Routing and Bridging (IRB) support on ISM CDS-TV. The Cisco TV Content Delivery System (CDS-TV) introduced in Release 4.1.1, is a distributed network of Content Delivery Engines (CDEs) running Content Delivery Applications (CDAs) that collaborate with each other to deliver personalized entertainment and interactive media to subscribers. The CDS-TV interoperates with electronic program guides (EPGs), set-top boxes (STBs) and backoffice applications, offering an end-to-end solution for video delivery systems.

Prior to Cisco IOS XR Software Release 4.0.1, where IRB was not supported, a physical cabling solution was needed to connect the egress Layer 2 bridge domain interface to a Layer 3 routing domain interface on the Cisco ASR 9000 Series Router. With IRB in Cisco IOS XR Release 4.0.1, Layer 2 bridge domain interface is connected to a Layer 3 routing domain interface using a BVI and its supporting interface and bridge group configuration.

IRB provides the ability to exchange traffic between bridging services on the Cisco ASR 9000 Series Router and a routed interface using a Bridge-Group Virtual Interface (BVI). The BVI is a virtual interface within the router that acts like a normal routed interface. BVI only acts as a gateway for the corresponding bridge-domain to a routed interface within the router. In addition to supporting a configurable MAC address, BVI supports only Layer 3 attributes.

The following are the characteristics of BVI:

- Uses a MAC address taken from the local chassis MAC address pool, unless it is overridden at the BVI interface.
- Uses **interface bvi** command to be configured as an interface type.
- Uses an IPv4 address that is in the same subnet as the hosts on the segments of the bridged domain. It also supports secondary addresses.
- User independent BVI identifier and the bridge-domain identifier that do not need to correlate.
- Uses **routed interface bvi** command to get associated to a bridge group.

Few commands that are supported on BVI are:

- arp purge-delay
- arp timeout
- bandwidth
- ipv4
- ipv6 (not supported in IRP environment with the Cisco ASR 9000 Series Router SIP-700)
- mac-address
- mtu
- shutdown

When IRB is configured on a router, the following processes occur:

- ARP requests are resolved between the hosts and BVI that are part of the bridge domain.
- All packets from a host on a bridged interface go to the BVI, if the destination MAC address matches the BVI MAC address. Otherwise, the packets are bridged.
- For packets destined for a host on a routed network, the BVI forwards the packets to the routing engine before sending the packets out from a routed interface.
- All packets either from or destined to a host on a bridged interface go to the BVI first (unless the packet is destined for a host on the bridge domain).
- For packets destined for a host on a segment in the bridge domain that come in to the router on a routed interface, the BVI forwards the packet to the bridging engine. The bridging engine forwards it through the appropriate bridged interface.

When configuring the BVI, the following guidelines must be considered:

- The BVI must be assigned an IPv4 or IPv6 address, that is in the same subnet as the hosts in the bridged segments.
- If the bridged network has multiple IP networks, then the BVI must be assigned secondary IP addresses for each network.

To configure IRB on the Cisco ASR 9000 Series Router, the following commands are used:

- **interface bvi**—This is used in global configuration mode to create a bridge-group virtual interface (BVI). To delete the BVI, **no** form of this command should be used.
- **routed interface bvi**—This is used to associate the specified BVI as the routed interface for the interfaces assigned to the bridge domain, this command is used in L2VPN bridge group bridge domain configuration mode.
- **show interfaces bvi**—This is used in EXEC mode to display interface status, line protocol state, and packet counters for the specified BVI.

Bulk Ping

In prior Cisco IOS XR Software releases, multiple ping commands are issued through CLI or XML, to check reachability to multiple destinations. This resulted in buying huge CPU time at the QNX/XR microkernel OS, which in turn resulted in more time consumption, thus blocking other processes during this interval.

To overcome this issue, the platform independent Bulk Ping feature is introduced in Release 4.1.2. When a bulk ping mode is chosen, users can input multiple destinations in one ping process itself. The ping process checks the reachability to all the multiple destinations that have been provided and prints the result on the console or back in XML agent. The advantage over this is that there will be no more spawn or exit overhead of QNX. The destination addresses can either be specified in a file or directly entered at the CLI prompt.

The following shows the format of the bulk ping command:

```
    ping bulk ipvr\ipv6 input cli\file [filesystem://<path to input file>]

[vrf <vrf1>] addr1 <other ping options currently supported>
       [vrf <vrf2>] addr2 <other ping option currently supported >
       ….
       [vrf <vrfm>] addrn <other ping options currently supported >
```

The following factors are considered while implementing the Bulk Ping feature:

- In the bulk ping mode, back-to-back pings to multiple destinations greater than 50 should not take high CPU time of QNX process for handling the spawn or exit.
- Unlike single ping command, bulk ping process must get completed very quickly by taking only 10% of the actual time on an idle system.
- Bulk ping mode must be made available for IPv4 destinations also.
- With CLI being the preferred input method, destination address is entered one by one in inline mode and as a batch (complete set of destination addresses) in batch mode.
- Except for the vrf option, no other options should be used with the destination address.
- Only about 8000 destinations are allowed in a single bulk ping process to avoid memory conflicts within the DOS.

The bulk ping commands are issued at the CLI interface both in inline mode and bulk mode as follows:

Example for Input through CLI using inline mode

```
RP/0/RP0/CPU0:router#ping bulk ipv4 input cli inline
Fri Sep 16 15:57:23.640 EDT Please enter the first destination (or) Ctrl-D/(exit) to
exit:
vrf NMVPN 10.2.1.16

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.1.16, vrf is NMVPN, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 6/7/8 ms
Please enter the next destination: (or) Ctrl-D/(exit) to exit:
```

Example for Input through CLI using batch mode

```
RP/0/RP0/CPU0:router#ping bulk ipv4 input cli batch
Fri Sep 16 15:57:40.141 EDT
Please enter input via CLI with one destination per line and when done Ctrl-D/(exit)
to initiate pings:
1: vrf NMVPN 10.2.1.16 2: Starting pings...
```

```
Type escape sequence to abort. Sending 5, 100-byte ICMP Echos to 10.2.1.16, vrf is
NMVPN, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 5/7/9 ms
RP/0/RP0/CPU0:router#
```

Hardware Features Introduced in Cisco IOS XR Software Release 4.1.2 for the Cisco ASR 9000 Series Router

There are no hardware features supported in IOS XR Software Release 4.1.2 for the Cisco ASR 9000 Series Router.

Features Introduced in Cisco IOS XR Software Release 4.1.1

The following sections contain information on new features and enhancements in Cisco IOS XR Software Release 4.1.1

- Software Features Introduced in Cisco IOS XR Software Release 4.1.1 for the Cisco ASR 9000 Series Router, page 46
- Hardware Features Introduced in Cisco IOS XR Software Release 4.1.1 for the Cisco ASR 9000 Series Router, page 59

Software Features Introduced in Cisco IOS XR Software Release 4.1.1 for the Cisco ASR 9000 Series Router

The following new software features were introduced in Cisco IOS XR Software Release 4.1.1 on the Cisco ASR 9000 Series Router platform:

- **25k MPLS-TE Midpoints**—This feature allows for up to 25k combined static and dynamic MPLS-TE midpoints on the Cisco ASR 9000 Series Router.
- **64K EFP System Scale for EFP on the Port Channel**—This feature allows for improving the Scalability of EFP Bundles. The scalability of the EFP bundles are improved in these ways:
  - The number of bundle EFPs per chassis is increased to 64000 from 32000.
  - The number of bundle EFPs per line card, on a single node point, is increased to the same scale as physical interface EFPs.
- **128K IPv6 Neighbor Discovery Entry Support**—This feature scales IPv6 neighbor discovery to 128K adjacencies in 1D scaled profiles on the Cisco ASR 9000 Series Router on IRB interfaces. The scale limit is 128K IPv6 ND per LC for physical interfaces and 128K IPv6 ND per system for virtual interfaces, for example BVI and bundles.
- **BGP Accept Own**—This feature allows movement from a PE-Based service provisioning model to a centralized router reflector (RR)-based service provisioning model. With this feature, you can define route TO service-VRF mapping within a centralized route reflector and then propagate this information down to all the PE clients of that RR. Without this feature, you would define the route TO service VRF mapping in all PE devices, thereby incurring a high configuration overhead, which could result in more errors.

This feature enables a route reflector to modify the Route Target (RT) list of a VPN route that is distributed by the route reflector, enabling the route reflector to control how a route originated within one VRF is imported into other VRFs

- **Deterministic Large VRF Support**—Cisco ASR 9000 Series Router VRF scale is enhanced to support a number of prefixes per VRF up to global forwarding information base [FIB] size ("big" VRF) for up to 16 user-configured VRF ID's.

  To enable big mode, use the **vrf mode** command in the global configuration mode. To terminate big mode, use the **no** form of this command.

  vrf *vrf-name* **mode big**

  no vrf *vrf-name* **mode big**

Syntax Description

vrf-name	VRF instance that identifies a VPN.
mode big	Maximum prefix scale is set to more than 64 K.

Command Default

VRF big mode is not set by default.

Command Modes

Global configuration

Command History

Release	Modification
Release 4.1.1	This command was introduced on the Cisco ASR 9000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

A router maintains about 4096 VRF-IDs in a queue of which 16 VRF IDs are reserved for big mode. After changing the mode as big, the corresponding VRF must be re-configured.

Task ID

Task ID	Operations
ip-services	read, write

Examples

The following example shows how to enable the big mode:

```
RP/0/RSP0/CPU0:router# config
RP/0/RSP0/CPU0:router(config)# vrf v1 mode big
RP/0/RSP0/CPU0:router(config)#
```

- **DHCPv6 Relay with Prefix Delegation**—This feature allows the router working as a DHCPv6 relay agent to find prefix delegation options by reviewing the contents of a DHCPv6 RELAY-REPLY packet that is being relayed by the relay agent to the client.

When a prefix delegation option is found by the relay agent, the relay agent extracts the information about the prefix being delegated and inserts an IPv6 subscriber route matching the prefix delegation information onto the relay agent. Future packets destined to that prefix via relay are forwarded based on the information contained in the prefix delegation. The IPv6 subscriber route is then left in the routing table until the prefix delegation lease time expires or the relay agent receives a release packet from the client releasing the prefix delegation.

Subscriber route management is done automatically by the relay agent. The IPv6 routes are added when the relay agent relays a RELAY-REPLY packet, and the IPv6 routes are deleted when the prefix delegation lease time expires or the relay agent receives a release message. An IPv6 subscriber route in the routing table of the relay agent can be updated when the prefix delegation lease time is extended.

This feature leaves an IPv6 route on the routing table of the relay agent. This registered IPv6 address allows unicast reverse packet forwarding (uRPF) to work by allowing the router doing the reverse lookup to confirm that the IPv6 address on the relay agent is not malformed or spoofed. The route left in the routing table of the relay agent can be redistributed to other routing protocols to advertise the subnets to other nodes. The routes will be removed when an DHCP_DECLINE message is sent by the client.

The following commands are introduced on the Cisco IOS XR Software Release 4.1.1:

clear dhcp ipv6 proxy binding

To clear Dynamic Host Configuration Protocol (DHCP) relay bindings for prefix delegation, use the **clear dhcp ipv6 proxy binding** command in EXEC mode.

clear dhcp ipv6 proxy binding [*ipv6-prefix*]

Syntax Description

ipv6-prefix	The IPv6 network assigned to the interface. This argument must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.

Command Default

No default behavior or values.

Command Modes

EXEC

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
ipservices	execute

Example

The following is sample output from the **clear dhcp ipv6 proxy binding** command:

```
RP/0/RSP0/CPU0:router# clear dhcp ipv6 proxy binding
```

helper-address

To configure the Dynamic Host Configuration Protocol (DHCP) IPv6 relay agent for prefix delegation to relay DHCP packets to a specific DHCP server, use the **helper-address** command in the DHCP IPv6 profile configuration submode. Use the no form of this command to clear the address.

helper-address *ipv6-address* [**interface** *type interface-path-id*]

no helper-address *ipv6-address* [**interface type** *interface-path-id*]

Syntax Description

ipv6-address	The IPv6 address assigned to the interface. This argument must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.
interface	Interface type. For more information, use the question mark (?) online help function.
interface-path-id	(Optional) Either a physical interface instance or a virtual interface instance as follows: *interface-path-id* • Physical interface instance. Naming notation is *rack/slot/module/port* and a slash between value s is required as part of the notation. • *rack*: Chassis number of the rack. • *slot*: Physical slot number of the modular services card or line card. • *module*: Module number. A physical layer interface module (PLIM) is always 0. • *port:* Physical port number of the interface. **Note** In references to a Management Ethernet interface located on a route processor card, the physical slot number is alphanumeric (RSP0) and the module is CPU0. Example: interface MgmtEth0/RSP0/CPU0/0. • Virtual interface instance. Number range varies depending on the interface type. For more information about the syntax for the router, use the question mark (?) online help function.

Command Default No default behavior or values.

Command Modes DHCP IPv6 profile configuration

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
ipservices	read, write

Example

The following is sample output from the **helper-address** command:

```
RP/0/RSP0/CPU0:router# config
RP/0/RSP0/CPU0:router(config)# dhcp ipv6
RP/0/RSP0/CPU0:router(config-dhcpv6)# profile p1 proxy
RP/0/RSP0/CPU0:router(config-dhcpv6-profile)# helper-address 2001:db8::3 GigabitEthernet
0/2/0/0
```

show dhcp ipv6 proxy binding

To display Dynamic Host Configuration Protocol (DHCP) relay bindings for prefix delegation, use the show **dhcp ipv6 proxy binding** command in EXEC mode.

show dhcp ipv6 proxy binding

Syntax Description This command has no arguments or keywords.

Command Default No default behavior or values.

Command Modes EXEC

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
ipservices	read

Example

The following is sample output from the **show dhcp ipv6 proxy binding** command:

```
RP/0/RSP0/CPU0:router# show dhcp ipv6 proxy binding
Summary:
Total number of Proxy bindings = 1
Prefix: 2001::/60 (Gi0/0/0/1)
DUID: 00030001ca004a2d0000
IAID: 00020001
lifetime: 2592000
expiration: Nov 25 2010 16:47
```

trust relay-reply

To configure a DHCP IPv6 profile to enable processing relay-replies, use the **trust relay-reply** command in DCHP IPv6 profile configuration mode. To restore the interface to the default behavior, use the no form of the command.

trust relay-reply

no trust relay-reply

Syntax Description This command has no arguments or keywords.

Command Default By default the interfaces are trusted.

Command Modes DHCP IPv6 profile configuration

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
ipservices	read. write

Example

The following is sample output from the **show dhcp ipv6 proxy binding** command:

```
RP/0/RSP0/CPU0:router(config)# dhcp ipv6
RP/0/RSP0/CPU0:router(config-dhcpv6)# profile downstream proxy
RP/0/RSP0/CPU0:router(config-dhcpv6-profile)# helper-address ff05::1:3
RP/0/RSP0/CPU0:router(config-dhcpv6-profile)# exit
RP/0/RSP0/CPU0:router(config-dhcpv6)# profile upstream proxy
RP/0/RSP0/CPU0:router(config-dhcpv6-profile)# trust relay-reply
```

- **Event Dampening Restart Penalty**—The restart-penalty option was added to the **dampening** command to avoid unnecessary re-convergence.

  In a MPLS-TE environment, sometimes after boot up, the head-end router fails to select the first explicit-path option, and the second path-option is used. The goal of the behavior after bootup is to establish the TE tunnels immediately. But, unnecessary re-optimization is required to use the first path.

  If the dampening restart-option is configured on the backup interface, the IGP adjacencies on the primary interface come up first. And, the first path-option is always picked after reboot.

  dampening [<*half-life*> [<*reuse*> <*suppress*> <*max suppress*> [<*restart penalty*>]]]

Syntax Description

restart-penalty	Penalty to applied to the interface when it comes up for the first time after the router reloads. The configurable range is from 1 to 20000 penalties. The default is 2000 penalties. This argument is not required for any other configurations.

For more information about the other optional arguments of the **dampening** command, refer to the Global Interface Commands on the Cisco IOS XR Software section of the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference*.

For more information on the **ip dampening restart-penalty** command, refer to the *Global Interface Commands on the Cisco ASR 9000 Series Router Aggregation Services Router Interface and Hardware Component Command Reference.*

- **IP FRR (IP Fast Reroute) support on ASR9K-SIP-700**— The LDP Fast Re-Route (FRR) feature minimizes the IP/MPLS traffic loss that might occur during convergence after a failure-triggered topology change. IP FRR is achieved through use of pre-calculated/pre-programmed (per-link or per-prefix) backup next-hops that are loop-free and safe to use until the network convergence completes.
- **IPv6 uRPF Support on Cisco ASR 9000 Series Router SIP-700**—The Unicast IPv6 Reverse Path Forwarding (uRPF) mitigates problems caused by the introduction of malformed or spoofed IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. Unicast RPF does this by doing a reverse lookup in the Cisco Express Forwarding (CEF) table. Therefore, uRPF is possible only if CEF is enabled on the router. Use the **ipv6 verify unicast source reachable-via {any | rx} [allow-default] [allow-self-ping]** command in interface configuration mode to enable IPV6 uRPF.

  For more information on IPv6 uRPF, refer Implementing Cisco Express Forwarding module in C*isco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference.*
- **Load Balancing Enhancements**—In Cisco IOS XR Release 4.1.1 on the Cisco ASR 9000 Router the following Load Balancing features are introduced:
  - **ECMP Support for IGP Prefixes**—The dynamic ECMP (equal-cost multi-path) for IGP (Interior Gateway Protocol) prefixes feature supports dynamic configuration of ECMP paths ranging from 1 to 32 IGP paths. ECMP for non-recursive prefixes is dynamic.

    This feature enables load balancing support in hardware among egress links.

    Cisco ASR 9000 Series Router supports 32 IGP dynamic ECMP paths and 32 LDP (Label Distribution Protocol) dynamic ECMP paths.

    Note Eight ECMP paths are available for BGP recursive prefixes.

  - **(BGP DMZ) Link Bandwidth for Unequal Cost Recursive Load Balancing** —This feature provides support for unequal cost load balancing for recursive prefixes on local node using BGP demilitarized zone (DMZ) Link Bandwidth. The unequal load balance is achieved by using the **dmz-link-bandwidth** command in BGP Neighbor configuration mode and the bandwidth command in Interface configuration mode.

    Perform this task to enable unequal cost recursive load balancing for external BGP (eBGP), interior BGP (iBGP), and eiBGP and to enable BGP to carry link bandwidth attribute of the DMZ link. When the PE router includes the link bandwidth extended community in its updates to the remote PE through the Multiprotocol Interior BGP (MP-iBGP) session (either IPv4 or VPNv4), the remote PE automatically does load balancing if the maximum-paths command is enabled.

To originate a DMZ link bandwidth extended community for the link to an eBGP neighbor, use the **dmz-link-bandwidth** command in an Neighbor configuration mode. To stop origination of the DMZ link bandwidth extended community, use the no form of this command.

Here is the syntax of the **dmz-link-bandwidth** command

dmz-link-bandwidth [i*nheritance-disable*]

SUMMARY STEPS:

Step 1 **configure**

Step 2 **router bgp** *as-number*

Step 3 **vrf** *vrf-name*

Step 4 **address-family { ipv4 | ipv6 } unicast**

Step 5 **maximum-paths { ebgp | ibgp | eibgp } maximum [unequal-cost]**

Step 6 **exit**

Step 7 **neighbor** *ip-address*

Step 8 **dmz-link-bandwidth**

Step 9 Do one of the following:

Step 10 **end**

Step 11 **commit**

- **LPTS Scale Enhancement**—TCAM entries for IGMP and L2TP have been optimized to cater to the scale requirements.

  The following command is introduced on the Cisco IOS XR Software Release 4.1.1:

show lpts pifib hardware entry optimized location

To display a set of optimized entries, which is combined as a single entry, inside the Ternary Content Addressable Memory (TCAM), use the **show lpts pifib hardware entry optimized location** in EXEC mode.

show lpts pifib hardware entry optimized *location*

Syntax Description

location	Mandatory. The location of the line card on which the interface is present.

Command Default No default behavior or values.

Command Modes EXEC

Usage Guidelines To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
lpts	read

ExamplesExample

The following is sample output from the **show lpts pifib hardware entry optimized** command:

```
RP/0/RSP0/CPU0:router# show lpts pifib hardware entry optimized location 0/4/CPU0
Node: 0/4/CPU0:
--------------------------------------
Protocol - Layer4 Protocol; Intf - Interface in optimized list
Protocol laddr.Port, raddr.Port Intf VRF id State
---------- ---------------------- --------------- ------------ --------------------
224.0.0.22.any , any.any Te0/4/0/1 * Uidb Set
Te0/4/0/0 * Uidb Set
224.0.0.2.any , any.any Te0/4/0/1 * Uidb Set
Te0/4/0/0 * Uidb Set
any.any , any.any Te0/4/0/1 * Uidb Set
Te0/4/0/0 * Uidb Set
```

MAC Accounting Support—The MAC address accounting feature provides accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces. This feature calculates the total packet and byte counts for a LAN interface that receives or sends IP packets to or from a unique MAC address. It also records a time stamp for the last packet received or sent. The CISCO-IP-STAT-MIB is the new MIB that has been added for MAC accounting.

The following commands support MAC Accounting for the GE and TenGE interfaces:

mac-accounting

To generate accounting information for IP traffic based on the source and destination Media Access Control (MAC) addresses on LAN interfaces, use the **mac-accounting** command in interface configuration mode. To disable MAC accounting, use the no form of this command.

mac-accounting { **egress** | **ingress** }

Syntax Description

egress	Generates accounting information for IP traffic based on the destination MAC addresses (egress direction).
ingress	Generates accounting information for IP traffic based on the source MAC addresses (ingress direction).

Command Default

MAC accounting is disabled.

Command Modes

Interfaces <GE/TenGE>

Command History

Release	Modification
Release 4.1.1	This command was introduced on the Cisco ASR 9000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

The mac-accounting command calculates the total packet and byte counts for a LAN interface that receives or sends IPv4 packets to or from a unique MAC address.

Task ID

Task ID	Operations
interface	read, write

Examples

The following example shows how to enable MAC accounting for the source MAC address on the ingress direction:

```
RP/0/RSP0/CPU0:router(config-if)# mac-accounting ingress
```

Related Commands

Command	Description
clear mac-accounting	Clears MAC accounting statistics for an interface
show mac-accounting	Displays MAC accounting statistics for an interface.

show mac-accounting

To display MAC accounting statistics for an interface, use the **show mac-accounting** command in EXEC mode.

show mac-accounting {**GigabitEthernet | TenGigE**} *interface-path-id* [**location node-id**]

Syntax Description

{**GigabitEthernet** | **TenGigE** }	Type of Ethernet interface whose MAC accounting statistics you want to display. Enter GigabitEthernet or TenGigE.
interface-path-id	Physical interface or virtual interface.
location node-id	(Optional) Displays detailed MAC accounting information for the specified interface on the specified node. The *node-id* argument is entered in the *rack/slot/module/port* notation.

Command Default

No default behavior or values.

Command Modes

EXEC

Command History

Release	Modification
Release 4.1.1	This command was introduced on the Cisco ASR 9000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

For the *interface-path-id* argument, use the following guidelines:

- If specifying a physical interface, the naming notation is *rack*/*slot*/*module*/*port*. The slash between values is required as part of the notation. An explanation of each component of the naming notation is as follows:
  - *rack*: Chassis number of the rack.
  - s*lot*: Physical slot number of the line card.
  - *module*: Module number. A physical layer interface module (PLIM) is always 0.
  - *port*: Physical port number of the interface.
- If specifying a virtual interface, the number range varies, depending on interface type.

Task ID

Task ID	Operations
interface	read

Examples

The following example shows the output from the **show mac-accounting** command, which displays MAC accounting statistics on the specified interface:

```
RP/0/RSP0/CPU0:router# show mac-accounting TenGE 0/2/0/1
    TenGigE0/2/0/1
      Input (511 free)
        0022.bdcd.7181:  28768187 packets, 10851728047 bytes
                 Total:  28768187 packets, 10851728047 bytes
      Output (511 free)
        0022.bdcd.7181:  32501553 packets, 12544660094 bytes
                 Total:  32501553 packets, 12544660094 bytes
```

Table 5 show mac-accounting Field Descriptions

Field	Description
Interface	The interface from which the statistics are generated.
Input	Heading for the ingress MAC accounting statistics. The number of MAC accounting entries still available is shown in parentheses.
Total	Total statistics for the traffic accounted for by MAC accounting. This excludes any traffic for which there is no MAC address entry, such as non-IP traffic from an unknown MAC source address.

Related Commands

Command	Description
clear mac-accounting	Clears MAC accounting statistics for an interface
mac-accounting	Generates accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces.

clear mac-accounting

To clear Media Access Control (MAC) accounting statistics, use the **clear mac-accounting** command in EXEC mode.

clear mac-accounting { **GigabitEthernet | TenGigE** } *interface-path-id* [**location node-id**]

Syntax Description

{**GigabitEthernet** | **TenGigE** }	Type of Ethernet interface whose MAC accounting statistics you want to clear. Enter GigabitEthernet or TenGigE.
interface-path-id	Physical interface or virtual interface.
location node-id	(Optional) Clears MAC accounting statistics for the designated node. The *node-id* argument is entered in the *rack/slot/module/port* notation.

Command Default

No default behavior or values.

Command Modes

EXEC

Command History

Release	Modification
Release 4.1.1	This command was introduced on the Cisco ASR 9000 Series Router.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes the proper task IDs. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator.

Task ID

Task ID	Operations
interface	read, write
basic-services	read, write

Examples

The following example shows how to clear all MAC accounting statistics for the TenGigE port at 0/2/0/1:

```
RP/0/RSP0/CPU0:router# clear mac-accounting TenGE 0/2/0/1
```

Related Commands

Command	Description
show mac-accounting	Displays MAC accounting statistics for an interface.
mac-accounting	Generates accounting information for IP traffic based on the source and destination MAC addresses on LAN interfaces.

- **MPLS-TE Path Preemption Enhancement**—This feature is similar to Soft Preemption (RFC-5712). The feature is an extension to the RSVP-TE protocol to minimize and eliminate the traffic disruption over the preempted LSP. Since tunnels are not torn down immediately, a path error is sent to headend so it can gracefully reoptimize the tunnel (with no traffic loss).

  The following new commands support this enhancement:

  - soft-preemption
  - timeout
  - show mpls traffic tunnel detail
  - show mpls traffic-eng counter soft-preemption
  - show mpls traffic log preemption
  - show mpls traffic link-management soft-preemption [interface <name>]
  - snmp-server traps mpls traffic-eng cisco-ext preempt

- **Destination-Based NetFlow Accounting**—This feature initiates a usage-based billing application that tracks and records traffic according to its destination and enables service providers to do destination-specific accounting and billing. The destination-based NetFlow accounting record includes the destination peer autonomous system (AS) number and the BGP next-hop IP address.

  In destination-based NetFlow accounting, the following fields are collected and exported:

  - Destination peer AS number
  - BGP next-hop IP address
  - Ingress interface
  - Egress interface
  - Forwarding status
  - EXP bits of the top label that is pushed in
  - Direction of the flow (always ingress in this case)

  Destination-based NetFlow accounting supports these features:

  - IPv4 addresses
  - Configuration on physical interfaces, bundle interfaces, and logical subinterfaces
  - IPv4 unicast and multicast traffic
  - Ingress traffic
  - Full mode NetFlow
  - NetFlow export format Version 9 over User Datagram Protocols (UDPs)

  Destination-based NetFlow accounting does not support these features:

  - IPv6 addresses
  - MPLS IPv6
  - Configuration for individual Modular QoS Command-Line Interface (MQC) classes
  - Simultaneous configuration of destination-based NetFlow accounting with IPv4 sampled NetFlow on the same interface, in the same direction.
  - Layer 2 switched MPLS traffic
  - Egress traffic

- **TE Auto-tunnel Mesh**—This feature introduces dynamically generated tunnel interfaces to reduce config scale. Rather than configuring each tunnel interface under LDP, you can configure only mesh groups in LDP. LDP dynamically learns the tunnel interfaces belonging to each auto-tunnel mesh group. It minimizes both the initial configuration and tunnels' addition that results from network growth.

  Each of these dynamically learned tunnel interfaces are treated exactly the same as if it was configured under LDP.

Hardware Features Introduced in Cisco IOS XR Software Release 4.1.1 for the Cisco ASR 9000 Series Router

The following hardware features introduced in Cisco IOS XR Software Release 4.1.1 are supported on the Cisco ASR 9000 Series Router platform:

- GLC-SX-MMD—1000BASE-SX SFP transceiver, MMF, 850nm, 550m/220m, DOM
- GLC-LH-SMD—1000BASE-LX/LH SFP transceiver, MMF/SMF, 1310nm, 10km, DOM
- GLC-EX-SMD—1000BASE-EX SFP transceiver, SMF, 1310nm, 40km, DOM
- GLC-ZX-SMD—1000BASE-ZX SFP transceiver, SMF, 1550nm, 70km, DOM

Features Introduced in Cisco IOS XR Software Release 4.1.0

The following sections contain information on new features and enhancements in Cisco IOS XR Software Release 4.1:

- Software Features Introduced in Cisco IOS XR Software Release 4.1 for the Cisco ASR 9000 Series Router, page 59
- Hardware Features Introduced in Cisco IOS XR Software Release 4.1 for the Cisco ASR 9000 Series Router, page 62

Software Features Introduced in Cisco IOS XR Software Release 4.1 for the Cisco ASR 9000 Series Router

The following new software features were introduced in Cisco IOS XR Software Release 4.1 on the Cisco ASR 9000 Series Router platform:

- Link Noise Monitoring (LNM) Enhancement on Cisco ASR 9000 Series Router SIP-700—Support for a Link Noise Monitoring enhancement was added on the Cisco 2-Port Channelized OC-12c/DS0 SPA to set thresholds for noise errors on T1/E1 links that are used to signal the Noise Attribute to PPP for removal of an MLPPP bundle link.

  For more information about LNM, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- 5k BGP NSR Support—The number of supported BGP NSR is increased to 5000. For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

- 2R3C Policing Support on Cisco ASR 9000 Series Router SIP-700—The following commands were added:

  - conform-color
  - exceed-color
  - police rate

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Command Reference*.

- Label Switched Multicast (LSM) Point-to-Multipoint Traffic Engineering—LSM is a solution framework providing multicast services over an MPLS/GMPLS backbone network. This feature uses extensions to RSVP-TE to build P2MP trees and data planes and provides support for MPLS replications.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide.*

- VRF aware TACACS+—This feature allows you to setup a management VRF in an MPLS backbone and sends TACACS+ accounting requests or records to this management VRF.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide* and the *Cisco ASR 9000 Series Aggregation Services Router System Security Command Reference*.

- IRB Interoperability Support on Cisco ASR 9000 Series Router SIP-700—This feature provides IRB interoperability support between SIP-700 and Ethernet line cards.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- MPLS VPN OSPFv3 PE-CE—This feature provides support for OSPFv3 Routing Protocol between provider edge-to-customer edge (PE-CE) router over IPv6 L3VPN.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router L3VPN and Ethernet Services Configuration Guide.*

- IPv6 Access Services: DHCPv6 Relay Agent—RFC 3315 defines a DHCP relay agent, which resides on the client's link and relays messages between the client and server. This agent allows a DHCP client to send a message to a DHCP server that is not connected to the same link.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide.*

- Virtual Router Redundancy Protocol (VRRP) over IPv6—This feature provides support to virtual IPv6 addresses. VRRP Version 3 is implemented for both IPv4 and IPv6. The feature also includes VRRP support for IPv6 VRFs and BFD.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

- Virtual Private LAN Services (VPLS) Support on Cisco ASR 9000 Series Router SIP-700—VPLS is a mechanism for transporting Ethernet traffic across multiple sites that belong to the same L2 broadcast domain. This feature builds a point-to-point connection to interconnect two peering customer sites.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*.

- One-way Delay Measurement—Beginning in Cisco IOS XR Release 4.1, the Delay Measurement Message (DMM) and Delay Measurement Response (DMR) packets carry timestamps derived from the DTI timing input on the clock interface port on the RSP.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- MGSCP—The MGSCP solution uses EtherChannel (EC) and the Link Aggregation Control Protocol (LACP) 802.3ad to enable scaling the SCE platform by sending the traffic to an EC. The EtherChannel load balancing is used to distribute the traffic over several SCE platforms.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- Link Bundling—The link bundle interface is enabled to be used as an edge-facing interface by providing new features, for example ACL, Mac Accounting, IPv6, PIMv6, uRPF, MVPNv4 with edge-facing link bundles, L2VPN, BFD, and Unequal BW.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- Integrated Service Module (ISM)—This feature is used for video integration and other services such as content streaming on the ASR9000-SIM-100 platform.

  For more information about installing ISM line cards, refer to the *Cisco ASR 9000 Series Aggregation Services Router ISM Line Card Installation Guide.*

- Call Home—Call Home provides an email-based notification for critical system policies. A range of message formats are available for compatibility with pager services or XML-based automated parsing applications. You can use this feature to page a network support engineer, email a Network Operations Center, or use Cisco Smart Call Home services to generate a case with the Technical Assistance Center. The Call Home feature can deliver alert messages containing information about diagnostics and environmental faults and events.

  For more information about the Call Home feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide* and the *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference*.

- Ethernet Local Management Interface (E-LMI) —E-LMI is an asymmetric protocol that runs on the PE to CE link or User-Network Interface (UNI). The user-facing Provider Edge (uPE) device uses E-LMI to communicate connectivity status (EVC status) and configuration parameters of ethernet services available on the UNI to the CE device.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- Lawful Intercept IPv4—Lawful intercept is the process by which law enforcement agencies conduct electronic surveillance of circuit and packet-mode communications, authorized by a judicial or administrative order. Service providers worldwide are legally required to assist law enforcement agencies in conducting electronic surveillance in both circuit-switched and packet-mode networks.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide*.

- BGP Private AS Filter - Provide the ability for customers to remove/replace Private AS Numbers in the as-path from outgoing BGP updates.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide* and the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference.*

- IGMP Snooping on Cisco ASR 9000 Series Router SIP-700—Cisco IOS XR Release 4.1 supports IGMP snooping on the Cisco ASR 9000 Series Router SIP-700.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide*.

- ITU-T G.8032 Ethernet Ring Protection Switching—This feature implements the Automatic Protection Switching (APS) protocol and protection switching mechanisms for Ethernet layer ring topologies.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration.*

- IEEE 802.1ab Link Layer Discovery Protocol (LLDP)—This feature enables discovering the network topology in a standardized way using standard management tools such as SNMP. LLDP is initially deployed in Ethernet-based enterprise switching networks, which can also be used over other media types such as Token Ring and FDDI.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

- IPv6 Unicast IRB—Support for IPv6 unicast addressing in IRB and 6PE/6VPE support with BVI interfaces was added in Cisco IOS XR Release 4.1 for the following Gigabit Ethernet line cards on the Cisco ASR 9000 Series Router:
  - 2-Port 10-Gigabit Ethernet, 20-Port Gigabit Ethernet Combination Line Cards (A9K-2T20GE-B and A9K-2T20GE-L)
  - 4-Port 10-Gigabit Ethernet Line Cards (A9K-4T-B, -E, -L)
  - 8-Port 10-Gigabit Ethernet DX Line Cards (A9K-8T/4-B, -E, -L)
  - 8-Port 10-Gigabit Ethernet Line Cards (A9K-8T-B, -E, -L)
  - 16-Port 10-Gigabit Ethernet Line Cards (A9K-16T/8-B, -E, -L)
  - 40-Port Gigabit Ethernet Line Cards (A9K-40GE-B, -E, -L)

  Note IPv6 addressing is not supported for IRB on any SPAs on the Cisco Cisco ASR 9000 Series Router SIP-700.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

- MSTAG Edge Mode—In this feature, you can configure MSTAG, so the gateway devices appear to have the best path to the best possible Multiple Spanning Tree Protocol (MSTP) root node.

  For more information, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*.

- Some Cisco ASR 9000 Series Router SIP-700 QFP processes are now restartable. Non reloadable SMUs can be created for these processes.

Hardware Features Introduced in Cisco IOS XR Software Release 4.1 for the Cisco ASR 9000 Series Router

The following hardware features introduced in Cisco IOS XR Software Release 4.1.0 are supported on the Cisco ASR 9000 Series Router platform:

- SPA-4XCT3/DS0—4-Port Channelized T3 to DS0 SPA
- SPA-8XCHT1/E1Å—8-Port Channelized T1/E1 SPA
- ISM (Integrated Service Module) Line Card—A9K-ISM-100

Features Introduced in Cisco IOS XR Software Release 4.0.1

The following sections contain information on new features and enhancements in Cisco IOS XR Software Release 4.0.1:

Software Features Introduced in Cisco IOS XR Software Release 4.0.1 for the Cisco ASR 9000 Series Router

The following new software features were introduced in Cisco IOS XR Software Release 4.0.1 on the Cisco ASR 9000 Series Router platform:

- IP Fast Reroute (IPFRR)—The following commands are introduced on the Cisco IOS XR Software Release 4.0.1:
  - ipfrr lfa
  - ipfrr lfa exclude interface

  The following commands are modified to support this feature:
  - fast-reroute per-link
  - fast-reroute per-link exclude interface

  For more information about these commands, refer to the *Cisco IOS XR Routing Command Reference* documentation.
- CFM on MC-LAG—This feature adds Cisco ASR 9000 Series Router support for Operations, Administration, and Maintenance operations defined by IEEE 802.1ag Connectivity Fault Management (CFM) on Multi-Chassis Link Aggregation Group (MC-LAG) for deployments where the link bundle (LAG) terminates on separate chassis.
- Downstream on Demand for BGP Labels—This feature adds support for the downstream-on-demand mode where the label is not advertised to a peer unless the peer explicitly requests it. At the same time, because the peer does not automatically advertise labels, a label request must be sent whenever the next-hop points to a peer to which no remote label has been assigned.

  For more information about this feature, refer to the Downstream on Demand section of the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*.
- Any Transport over MPLS (AToM): HDLC over MPLS (HDLCoMPLS)—The attachment circuit (AC) is a main interface configured with HDLC encapsulation. Packets to or from the AC are transported using an AToM pseudowire (PW) of VC type 0x6 to or from the other provider edge (PE) router over te MPLS core network.

  With HDLC over MPLS, the entire HDLC packet is transported. The ingress PE router removes only the HDLC flags and FCS bits.
- Any Transport over MPLS (AToM): PPP over MPLS (PPPoMPLS)—The AC is a main interface configured with PPP encapsulation. Packets to or from the AC are transported through an AToM PW of VC type 0x7 to or from the other PE routers over the MPLS core network.

With PPP over MPLS, the ingress PE router removes the flags, address, control field, and the FCS bits.

- Load Balancing on Link Bundles—The Cisco ASR 9000 Series Router supports load balancing for all links in a bundle using Layer 2, Layer 3, and Layer 4 routing information. For more information about load balancing on link bundles, see the Configuring Link Bundling on the Cisco ASR 9000 Series Router section of the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.
  - Dynamic Load Balancing for LAG—Beginning in Cisco IOS XR Release 4.0.1, the Cisco ASR 9000 Series Router supports a method of dynamic load balancing among link aggregation (LAG) members. With dynamic load balancing, the hash algorithms for link selection include up to a maximum of 64 links, and are based on the current number of active members in the bundle.
  - Layer 3 Load Balancing on Link Bundles—Layer 3 load balancing for link bundles is done when outgoing interfaces are either bundles or bundle subinterfaces. 5-tuple hashing is used for load balancing among bundle member links, using the following parameters:

    IP source address

    IP destination address

    Router ID

    Layer 4 source port

    Layer 4 destination port

Note In Cisco IOS XR Release 4.0.1, the **hw-module load-balance bundle l2-service l3-params** command is replaced by the **load-balancing flow** command in L2VPN configuration mode.

- BFD Per Member Link—Beginning in Cisco IOS XR Release 4.0.1, the BFD feature supports BFD sessions on individual physical bundle member links to monitor Layer 3 connectivity on those links, rather than just at a single bundle member as in prior releases on the Cisco ASR 9000 Series Router.

  When you run BFD on link bundles, you can run an independent BFD session on each underlying physical interface that is part of that bundle.

  When BFD is running on a link bundle member, the following layers of connectivity are effectively tested as part of the interface state monitoring for BFD:
  - Layer 1 physical state
  - Layer 2 Link Access Control Protocol (LACP) state
  - Layer 3 BFD state

  The BFD agent on each bundle member link monitors state changes on the link. BFD agents for sessions running on bundle member links communicate with a bundle manager. The bundle manager determines the state of member links and the overall availability of the bundle. The state of the member links contributes to the overall state of the bundle based on the threshold of minimum active links or minimum active bandwidth that is configured for that bundle.

  BFD Echo Latency Detection—Beginning in Cisco IOS XR 4.0.1, you can configure BFD sessions on non-bundle interfaces to bring down a BFD session when it exceeds the configured echo latency tolerance.

  BFD Echo Startup Validation—Beginning in Cisco IOS XR Release 4.0.1, you can verify that the echo packet path is working and within configured latency thresholds before starting a BFD session on non-bundle interfaces.

For more information about BFD Per Member Link, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

- PVST+ Gateway—Per-Vlan STP (PVST) is a mechanism for creating multiple spanning trees. Using PVST, a separate spanning tree is created for each VLAN.

  For more information about this feature, refer to the Implementing Multiple Spanning Tree Protocol section of the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide.*

- Integrated Routing and Bridging (IRB)—IRB provides the ability to exchange traffic between bridging services on the Cisco ASR 9000 Series Router and a routed interface using a Bridge-Group Virtual Interface (BVI). This feature is supported on the following line cards:
  - 2-Port 10-Gigabit Ethernet, 20-Port Gigabit Ethernet Combination Line Cards (A9K-2T20GE-B and A9K-2T20GE-L)
  - 4-Port 10-Gigabit Ethernet Line Cards (A9K-4T-B, -E, -L)
  - 8-Port 10-Gigabit Ethernet DX Line Cards (A9K-8T/4-B, -E, -L)
  - 8-Port 10-Gigabit Ethernet Line Cards (A9K-8T-B, -E, -L)
  - 40-Port Gigabit Ethernet Line Cards (A9K-40GE-B, -E, -L)

  Multicast IRB provides the ability to route multicast packets between a bridge group and a routed interface using a bridge-group virtual interface (BVI).

  For more information about IRB, refer to the Configuring Integrated Routing and Bridging on the Cisco ASR 9000 Series Router section of the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

- Traffic Mirroring—The following traffic mirroring features are added:
  - Traffic mirroring over a pseudowire
  - Flow or ACL-based traffic mirroring
  - Layer 3 interface support
  - Partial packet mirroring

  For more information about the traffic mirroring features, refer to the Configuring Traffic Mirroring on the Cisco ASR 9000 Series Router section of the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide.*

- Dynamic ARP Inspection (DAI)—This feature is method of providing protection against address resolution protocol (ARP) spoofing attacks. It intercepts, logs, and discards ARP packets with invalid IP-to-MAC address bindings.

  For more information about DAI, refer to the Dynamic ARP Inspection section of the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide.*

- PW Over Recursive Path—The following commands are modified in Cisco ASR 9000 Series in Cisco IOS XR software Release 4.0.1:
  - **permit** (IPv4) —The *capture* keyword is added.
  - **permit** (IPv6) —The *capture* keyword is added.

  For more information about these commands, refer to the *Cisco ASR 9000 Series Aggregation Services Router IP Addressing Command Reference.*

- IP Source Guard—This feature provides source IP address filtering on a Layer 2 port to prevent a malicious host from manipulating a legitimate host by assuming the legitimate host's IP address.

For more information about this feature, refer to the IP Source Guard section of the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide.*

- Dynamic 32x IGP ECMP

  MAC Address Security for EVC Bridge-Domain—For information about how to configure MAC Address Security, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide.*

- Enhanced Performance Monitoring for Layer 2—Beginning in Cisco IOS XR Release 4.0.1, the Cisco ASR 9000 Series Router adds support for basic counters for performance monitoring on Layer 2 interfaces.

  The **interface basic-counters** keyword has been added to support a new entity for performance statistics collection and display on Layer 2 interfaces in the following commands:

  - **performance-mgmt statistics interface basic-counters**
  - **performance-mgmt threshold interface basic-counters**
  - **performance-mgmt apply statistics interface basic-counters**
  - **performance-mgmt apply threshold interface basic-counters**
  - **performance-mgmt apply monitor interface basic-counters**
  - **show performance-mgmt monitor interface basic-counters**
  - **show performance-mgmt statistics interface basic-counters**

  The **performance-mgmt threshold interface basic-counters** command supports the following attribute values for Layer 2 statistics, which also appear in the **show performance-mgmt statistics interface basic-counters** and **show performance-mgmt monitor interface basic-counters** command:

Attribute	Description
InOctets	Bytes received (64-bit)
InPackets	Packets received (64-bit)
InputQueueDrops	Input queue drops (64-bit)
InputTotalDrops	Inbound correct packets discarded (64-bit)
InputTotalErrors	Inbound incorrect packets discarded (64-bit)
OutOctets	Bytes sent (64-bit)
OutPackets	Packets sent (64-bit)
OutputQueueDrops	Output queue drops (64-bit)
OutputTotalDrops	Outband correct packets discarded (64-bit)
OutputTotalErrors	Outband incorrect packets discarded (64-bit)

  For information about how to configure Performance Monitoring, see the Implementing Performance Management section of the *Cisco ASR 9000 Series Aggregation Services Router System Monitoring Configuration Guide*.

- Video Monitoring Trap and Clone—The following commands are introduced on the Cisco ASR 9000 Series Router in Cisco IOS XR software Release 4.0.1:

  - **clear performance traffic clone profile**
  - **show performance traffic clone profile**

For more information about these commands, refer to the Video Monitoring Commands on Cisco ASR 9000 Series Router section of the *Cisco ASR 9000 Series Aggregation Services Router Multicast Command Reference.*

- IPv6 Multicast Routing is supported on the Cisco ASR 9000 Series Cisco IOS XR software Release 4.0.1.

  For more information about this feature, refer to the Implementing Layer-3 Multicast Routing on Cisco ASR 9000 Series Routers section of the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide.*

- PW Load Balancing—Traffic load balancing over multiple links is typically required to maximize networks while maintaining redundancy. This feature applies to pseudowires under L2VPN and includes both VPWS and VPLS.

  For more information, refer to the Pseudowire Load Balancing section of the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide.*

- DHCP over PW—The Cisco ASR 9000 Series Routers provide the ability to perform DHCP snooping where the DHCP server is reachable on a pseudowire. The dhcp ipv4 snoop profile {dhcp-snooping-profile1} command is provided under the bridge domain to:
  - enable DHCP snooping on a bridge
  - attach a DHCP snooping profile to the bridge

- QoS Port Shaping Policies—Support for simultaneous configuration of port-shape policies in main interfaces and individual subinterface service policies was added.

  For more information, refer to the Configuring Modular QoS Service Packet Classification and Marking on Cisco ASR 9000 Series Routers section of the *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide*.

- Scale Profiles—The scale profile is a user-configurable setting that tunes the router to perform more efficiently to the selected application. You should specify the scale profile before deploying the router to production use.

  For information about how to configure scale profiles, refer to the Information About Scale Profiles section of the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*.

Note Video Monitoring is not supported in the L3XL scale profile.

- ACL Based Forwarding (ABF) OT—This feature enables you to choose services from multiple providers for broadcast TV over IP, IP telephony, data, and so on.

  For information about how to configure ABF, refer to the ABF section of the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

- MPLS TE Hop Limit—You can limit the number of hops traversed by MPLS-TE Tunnels. Cisco IOS XR Release 4.0.1 introduces the following new command:

```
router#(config-if) path-selection hop-limit <1-255>
```

- IGMP Snooping—Cisco IOS XR software Release 4.0.1 adds support for the CISCO-MLD-SNOOPING-MIB. This MIB provides remote network management systems the ability to manage the IGMP Snooping feature when IGMP Snooping is enabled at the Bridge-Domain level.

  To obtain SNMP data from the CISCO-MLD-SNOOPING-MIB for a bridge domain, create an snmp community mapped to the bridge domain using the following commands:

```
router(config)#snmp-server community community-name rw systemowner
router(config)#snmp-server community-map community-name context
vpls_bridge-domain-name
```

For more information about IGMP Snooping, refer to the Implementing Layer-2 Multicast with IGMP Snooping on *Cisco ASR 9000 Series Routers section of the Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide*.

- Other Performance Management Enhancements—The following additional performance management enhancements are included in Cisco IOS XR Release 4.0.1:

  You can retain performance management history statistics across a process restart or route processor (RP) failover using the new history-persistent keyword option for the performance-mgmt statistics interface command.

  You can save performance management statistics to a local file using the performance-mgmt resources dump local command.

  You can filter performance management instances by defining a regular expression group (performance-mgmt regular-expression command), which includes multiple regular expression indices that specify strings to match. You apply a defined regular expression group to one or more statistics or threshold templates in the performance-mgmt statistics interface or performance-mgmt thresholds interface commands.

Hardware Features Introduced in Cisco IOS XR Software Release 4.0.1 for the Cisco ASR 9000 Series Router

The following hardware features introduced in Cisco IOS XR Software Release 4.0.1 are supported on the Cisco ASR 9000 Series Router platform:

- 4-Port Clear Channel T3/E3 SPA (SPA-4XT3E3)
- 2-Port Clear Channel T3/E3 SPA (SPA-2XT3E3)
- 1-Port Channelized OC-3/STM-1 SPA (SPA-1XCHSTM1/OC3)
- 4-Port OC-3/STM-1 POS SPA (SPA-4XOC3)
- 8-Port OC-3/STM-1 POS SPA (SPA-8XOC3)

Features Introduced in Cisco IOS XR Software Release 4.0.0

The following sections contain information on new features and enhancements in Cisco IOS XR Software Release 4.0.0:

- New Software Features Supported on all Platforms, page 69
- Cisco ASR 9000 Series-Specific Software Features, page 70
- Cisco ASR 9000 Series Hardware Features Introduced in Cisco IOS XR Software Release 4.0.0, page 72

Note Cisco Session Border Controller (SBC) is not supported on any platform in Cisco IOS XR Software Release 4.0.0. Cisco IOS XR Software Release 3.7 is the last release that supports SBC.

Note When upgrading the Cisco IOS XR Software Release 3.9.2 to Cisco IOS XR Software Release 4.0.0, IOS XR directories are also created on the boot disk (disk0) along with the ASR 9000 directories.

New Software Features Supported on all Platforms

The following new software features in Cisco IOS XR Software Release 4.0.0 are supported on all platforms:

- BGP-AD with LDP Signalling
- SSH Remote Command Execution
- Non-default SSM Range
- MPLS features
  - Automatic Backup Tunnels
  - SRLG

    MPLS-TE SRLG CLI Migration Steps from pre Release 4.0 to Release 4.0

    In Cisco IOS XR Software Release 4.0.0 the MPLS TE SRLG command has been moved from MPLS TE config to Global level config. Other protocols can now use the SRLG configuration.

    SRLG command syntax in releases prior to Release 4.0:

```
mpls  traffic-eng
    interface GigabitEthernet0/3/0/0
        srlg  400
        srlg  401
        srlg  402
```

    SRLG command syntax in releases prior to Release 4.0:

```
srlg
   interface GigabitEthernet0/3/0/0
       value 400
       value 401
       value 402
```

    Migration Steps

Step 1 Load the new 4.0 image

Step 2 Execute the **show run mpls traffic-eng** command

Step 3 Delete all the SRLG values under the interface in MPLS Traffic-eng configuration using the **no srlg** command

```
config t
mpls traffic-eng
int GigabitEthernet0/3/0/0
   no srlg  400
   no srlg 401
   no srlg 402
commit
```

Step 4 Add the SRLG values in the new configuration using the srlg and value commands

```
config t <enter>
```

```
    srlg <enter>
    interface GigabitEthernet0/3/0/0 <enter>
       value 400 <enter>
       value 401 <enter>
       value 402 <enter>
commit
```

- MPLS OAM

For more information on these new MPLS features, refer to the *Implementing MPLS Traffic Engineering* module and the *Implementing MPLS OAM* module of the *Cisco IOS XR MPLS Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0*.

Cisco ASR 9000 Series-Specific Software Features

The following new software features were introduced in Cisco IOS XR Software Release 4.0.0 on the Cisco ASR 9000 Series Router platform:

- Multi-Chassis Link Aggregation.
  - Multi-chassis support for LACP
- IPoDWDM Proactive Protection For ISIS and IP FRR
- Layer 3 load-balancing on Layer 2 LAG
- Cisco ASR 9000 SIP 700 linecard software features
  - IPHC (IP Header Compression for PPP/MLPPP/MLPPP-LFI) support only on A9K-SIP-700/SPA-2xCHOC12/DS0

    Note Slot level IPHC configuration is supported on the XR12000, but not on the ASR-9000.

  - MPLS/TE-FRR support

    Only the 8-port OC-12 SPA, the 2-port OC-48 SPA and the 1-port OC-192 SPA support the MPLS/TE Fast Reroute feature. The MPLS/TE Fast Reroute feature is supported on the main interface, not on sub-interfaces. There is no support for the MPLS/TE FRR feature on the 2-port channelized OC-12 SPA or on the 1-port channelized OC 48 SPA.
  - Layer 3 VPN (vpn4,mvpn4) support only on the A9K-SIP-700/SPA-8xOC12-POS, A9K-SIP-700/SPA-2xCHOC12-POS, A9K-SIP-700/SPA-2xOC48-POS and the A9K-SIP-700/SPA-1xCHOC48
  - Inter-AS,CSC,6VPE support only on the A9K-SIP-700/SPA-8xOC12-POS, A9K-SIP-700/SPA-2xCHOC12-POS, A9K-SIP-700/SPA-2xOC48-POS and the A9K-SIP-700/SPA-1xCHOC48
  - Frame Relay (FR), MLFR/LFI & FRF.12 support on the Cisco ASR 9000 Series Router SIP 700 linecard
  - Link Noise Monitoring support on the Cisco ASR 9000 Series Router SIP 700 linecard
  - IPv4 BGP-Policy Accounting and BFD (on the Cisco ASR 9000 Series Router SIP 700 linecard only)
  - IPv6 uRPF (on the Cisco ASR 9000 Series Router SIP 700 linecard only)

- Software support for the following SPAs on the Cisco ASR 9000 Series Router SIP 700 linecard:
  - SPA-OC192POS-XFP
  - SPA-2XOC48POS/RPR
  - SPA-8XOC12-POS
  - SPA-1XCHOC48/DS3
- 6PE features for IPv6 L3VPN on the Cisco ASR 9000 Series Router SIP 700 linecard.
  - BGP per VRF/CE label allocation for 6PE feature
- 6VPE features for IPv6 L3VPN on Cisco ASR 9000 Series Router SIP 700 linecard
- IPv6 ACL support on the Cisco ASR 9000 Series Router SIP 700 linecard

For detailed software configuration information on the shared port adapters (SPAs) and SPA interface processors (SIPs), see the following document:

- *Cisco ASR 9000 Series Aggregation Services Router SIP and SPA Hardware Installation Guide*
- *Cisco Interface and Hardware Component Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0.0*
- IPv4 multicast support on serial interfaces

  For more information on this feature, refer to the *Implementing Multicast Routing on Cisco IOS XR Software* module of the *Cisco IOS XR Multicast Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0.*
- Multicast features:
  - MVPN Extranet
  - MVPN Auto-RP Lite
  - MVPN Hub and Spoke Topology

  For more information on these features, refer to the *Implementing Multicast Routing on Cisco IOS XR Software* module of the *Cisco IOS XR Multicast Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0.*
- BGP features:
  - BGP Additional Path Support

    With this feature, BGP advertises additional paths.
  - Accumulated Interior Gateway Protocol (AIGP) Metric Attribute

    Use this attribute for BGP to report the sum of the metric of each link along the path.
  - Unipath PIC for Non-VPN Address-families (6PE/IPv4 Unicast)

  For more information on these features, refer to the *Cisco IOS XR Routing Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0*.
- Multiprotocol Label Switching (MPLS) Ping and Trace features
- Any Transport over MPLS (AToM) features on Point to Point Layer 2 services

  For more information on these new MPLS features, refer to the *Implementing MPLS Traffic Engineering* module and the *Implementing MPLS OAM* module of the *Cisco IOS XR MPLS Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0.*

Cisco ASR 9000 Series Hardware Features Introduced in Cisco IOS XR Software Release 4.0.0

The following hardware features introduced in Cisco IOS XR Software Release 4.0.0 are supported on the Cisco ASR 9000 Series Router platform:

- 1-Port Channelized OC48/STM16 DS3 SPA (SPA-1XCHOC48/DS3)
- 2-Port OC-48/STM16 SPA (SPA-2XOC48POS/RPR)
- 8-Port OC12/STM4 SPA (SPA-8XOC12-POS)
- 1-Port OC192/STM64 POS SPA (SPA-OC192POS-XFP)

For detailed hardware information on the shared port adapters (SPAs) and SPA interface processors (SIPs), see the following document:

- *Cisco ASR 9000 Series Router SIP and SPA Hardware Installation Guide*
- *Cisco Interface and Hardware Component Configuration Guide for the Cisco ASR 9000 Series Router, Release 4.0.0*

Features Introduced in Cisco IOS XR Software Release 3.9.2

The following features introduced in Cisco IOS XR Software Release 3.9.2 are supported on the Cisco ASR 9000 Series Router platform:

- IPv6 Over Bundle

  Cisco IOS XR Software Release 3.9.2 adds IPv6 as a protocol that can be passed over link bundles on the Cisco ASR 9000 Series Router platform.

  This feature covers IPv6 support over Ethernet and POS bundles, including Bundle-VLANs. The features in this release that are supported on IPv6 over bundle interfaces are:

  - IPv6 Unicast
  - IPv6 Multicast
  - 32 members per bundle (bundle-pos or bundle-ether).
  - Bundle interfaces of different bandwidth.
  - IPv6 QOS
  - IPv6 ACL
  - L2 load balance of v6 traffic over bundle interfaces.
  - Ipv6 BGP Policy Accounting

  The following features are not supported in IPv6 over Bundle:

  - RSVP signaling on top of IPv6 bundle interfaces
  - TE and FRR on top of IPv6 bundle interfaces
  - GRE, L2TPv3 tunnels on top of IPv6 bundle interfaces
  - IPSEC tunnels over IPv6 bundle interfaces

  Limitations:

  - User shall be able to configurable thresholds for the number of component links that need to be up and active for a link bundle to be up and active

- Support up to 4000 (4k) Bundle VLANs in total.
- L2VPN service over IPv6 bundled interfaces
- MVPN Service over IPv6 bundled interfaces
- On the Cisco ASR 9000 Series Router platform, this feature is available for all line cards
- Ipv6 on bundles is not supported on the SIP-700 on the Cisco ASR 9000 Series Router platform
- IPv6 ACLs on bundles is supported from release 3.9.2 onwards
- IPv6 multicast is not supported on bundle interfaces/normal interfaces in 3.9.2
- IPv6 BGP Policy Accounting is currently not supported over physical or sub-interfaces.

More information about link bundling configuration and monitoring can be found in the following Command Reference Guides, *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference* and *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*, online.

- ACL Based Forwarding (ABF)

  Cisco IOS XR Software Release 3.9.2 introduces support on the Cisco ASR 9000 Series Router platform for packet forwarding and routing according to customer defined policies.

  An access control list (ACL) consists of one or more access control entries (ACE) that collectively define the network traffic profile. This profile can then be referenced by Cisco IOS XR Software features such as traffic filtering, route filtering, QoS classification, and access control. Each ACL includes an action element (permit or deny) and a filter element based on criteria such as source address, destination address, protocol, and protocol-specific parameters.

  Prefix lists are used in route maps and route filtering operations and can be used as an alternative to access lists in many Border Gateway Protocol (BGP) route filtering commands. A prefix is a portion of an IP address, starting from the far left bit of the far left octet. By specifying exactly how many bits of an address belong to a prefix, you can then use prefixes to aggregate addresses and perform a function on them, such as redistribution (filter routing updates).

  Hardware Limitations:

  - Support for ABF is only for IPv4 and Ethernet line cards. IPv6 and other interfaces are not supported
  - ABF is an ingress line card feature and the egress line card must be ABF aware.
  - SIP-700 is not ABF aware and hence drops ABF packets.

  Restrictions:

  - The following *nexthop* configurations are not supported:

    Attaching ACL having a *nexthop* option in the **egress** direction.

    Modifying an ACL attached in the **egress** direction having *nexthop*.

    deny ACE with *nexthop*.
  - The following interfaces are not supported: loopback, interflex, and L2.
  - The ABF feature configuration on **A9K-SIP-700** is not supported.
  - ABF *nexthop* packets received by **A9K-SIP-700** are dropped.

Note There is one exception to this. In case of IP to TAG, the label is imposed by the ingress LC (based on ABF *nexthop*), and the packet crosses the fabric as a tag packet. These packets are handled by A9K-SIP-700 without any issue.

– Packets punted in the **ingress** direction from the NPU to the LC CPU are not subjected to ABF treatment due to lack of ABF support in the slow path.

Note For example, **IP Options** packets are not subjected to ABF. The packet is forwarded without ABF.

– Packets punted in the **egress** direction from the NPU to the LC CPU other than in order to glean adjacency are not subjected to ABF treatment due to the lack of ABF support in the slow path.

Note IP packet(s) needing **fragmentation** are not subjected to ABF. The packet is forwarded in the traditional way. Fragmented packets received are handled by ABF.

– *nexthop* in **VRF** is not supported. *nexthop* is looked at in the global table only.

- Generic Routing Encapsulation (GRE)

  Cisco IOS XR Software Release 3.9.2 introduces support on the Cisco ASR 9000 Series Router platform for the GRE tunneling protocol. GRE is a simple, generic way to transport packets of one protocol over another protocol by means of encapsulation. The GRE tunneling protocol enables:

  – High Assurance Internet Protocol Encryptor (HAIPE) devices for encryption over the public Internet and non secure connections.

  – Service providers (that do not run MPLS in their core network) to provide VPN services along with the security services.

For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* and the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference* online.

Hardware Limitations:

– Support for GRE is only for the Ethernet line card.

– SIP-700 is not GRE aware and will drop GRE packets.

Restrictions:

The GRE feature has the following restrictions.

– A maximum of 500 GRE tunnels can be configured per system.

– GRE is limited to tunneling of unicast IPv4 data packets.

– Packets received with nested and concatenated GRE headers are dropped.

– Transport header support is limited to IPv4

– Path MTU discovery is not supported over GRE tunnel interfaces. When size of the packet going over GRE tunnel interface exceeds the tunnel MTU, the ucode will punt the packet to the slow path for best effort fragmentation. Since punted packets are policed, this doesn't provide real fragmentation support. If the decap router receives a fragmented GRE packet, the fragments will also be punted to the slow path for best-effort reassembly. The user is responsible for making sure the MTUs configured along the tunnel path are large enough to guarantee the GRE packet will not be fragmented between tunnel source and destination routers.

– No Layer 3 features (like QoS, ACL and netflow) are supported over GRE tunnel interfaces. Features configured on the underlying physical interface will be applied.

– No support for optional checksum as defined in RFC2784.

– No support for key, and sequence number fields as defined in RFC2890.

Features Introduced in Cisco IOS XR Software Release 3.9.1

The following features introduced in Cisco IOS XR Software Release 3.9.1 are supported on the Cisco ASR 9000 Series Router platform:

- AIS for CFM (Y.1732 Performance Monitoring)

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for Alarm Indication Signal (AIS) functionality for Connectivity Fault Management (CFM) in conformance to the ITU-T Y.1731 standard. For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* online.

- CFM over BLM

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for Ethernet Connectivity Fault Management (CFM) over bundled link members (BLM). For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* online.

- CFM over Link Aggregation Groups (LAGs)

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for Ethernet Connectivity Fault Management (CFM) over link aggregation groups (LAGs). For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* online.

- Ethernet Fault Detection for CFM

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for EFD for CFM. Ethernet Fault Detection (EFD) is a feature of Ethernet Connectivity Fault Management (CFM) that provides line protocol fault detection for Ethernet interfaces.

- CFM Configurable Tagging

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for configurable tagging for CFM. For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* online.

- PBB

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the IEEE 802.1ah Standard for Provider Backbone Bridging (PBB). For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide* online.

- MVRP-Lite

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for MVRP-Lite (Multiple VLAN Registration Protocol Lite). For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Multicast Command Reference* and the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide* online.

  Note that MVRP-Lite describes does not implement the MAP or Registrar functions of the MRP specification or enact attribute registrations in the local forwarding table.

- Netflow

Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for Netflow. NetFlow is useful for the following:

- 21Accounting/Billing—NetFlow data provides fine grained metering for highly flexible and detailed resource utilization accounting.
- Network Planning and Analysis—NetFlow data provides key information for strategic network planning.
- Network Monitoring—NetFlow data enables near real-time network monitoring capabilities.

For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Netflow Command Reference* and the *Cisco ASR 9000 Series Aggregation Services Router Netflow Configuration Guide* online.

- 6PE/VPE

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the 6PE (IPv6 over MPLS) feature. 6PE allows IPv6 domains to communicate with each other over an MPLS IPv4 core network. Note that IPv6 over bundles is NOT supported on the Cisco ASR 9000 Series Router platform running Cisco IOS XR Software Release 3.9.1 or earlier.

  Also note that when downgrading from Cisco IOS XR Software Release 4.0.1 or Release 3.9.1 to an earlier release, if a 6PE/VPE configuration is present in the system, the 6PE/VPE configuration needs to be unconfigured before initiating the downgrade.

- 16x10-Gigabit Ethernet (16 x 10 GE) SFP+ Line Card

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the 16x10-Gigabit Ethernet (16 x 10 GE) SFP+ line card.

- BGP-AD with LDP Signalling

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for extending the BGP-AD feature to add support for LDP signalling. BGP-AD with BGP signalling was already supported on the Cisco ASR 9000 Series Router platform. LDP signalling is tied to L2VPN services.

- SSH Remote Command Execution

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the SSH remote command execution feature. This feature allows an operator to execute a command on the Cisco ASR 9000 Series Router without logging into the Cisco ASR 9000 Series Router, using non-interactive SSH mode. The result of the command is sent via the established channel to the operator. The SSH client running on the operator end prints the output.

- Uncompressed Vidmon

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for high bandwidth flow on the Video Monitoring service introduced in Cisco IOS XR Software Release 3.9.0.

- 16K Queues per NPU on 10 Gigabit Ethernet Line Cards

  Cisco IOS XR Software Release 3.9.1 added support on the Cisco ASR 9000 Series Router for 16K Queues per Network Processing Unit (NPU) on the 10 Gigabit Ethernet line cards.

- 2000 VRRP Sessions

  Cisco IOS XR Software Release 3.9.1 added support on the Cisco ASR 9000 Series Router for up to 2000 Virtual Router Redundancy Protocol (VRRP) sessions.

- SONET DS3

Cisco IOS XR Software Release 3.9.1 added support for SONET DS3 on the Cisco ASR 9000 Series Router with SIP-700 and SPA-2XCH0C12. For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide* online.

- BPID-02

  Cisco IOS XR Software Release 3.9.1 added support for the show plugin slot counts command which displays cumulative and running counts of card inserts per slot on the Cisco ASR 9000 Series Router with the BPID-02 card. For more information on the show plugin slot counts command, refer to the *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference* online.

- MPLS-TE Automatic Bandwidth

  Cisco IOS XR Software Release 3.9.1 added support for the MPLS-TE automatic bandwidth feature The MPLS-TE automatic bandwidth feature measures the traffic in a tunnel and periodically adjusts the signaled bandwidth for the tunnel.

- Multicast VPN

  Cisco IOS XR Software Release 3.9.1 added support for the Multicast VPN feature. (For IPv4 address family only - MVPNv6 is not supported on the Cisco ASR 9000 Series Routers in Cisco IOS XR Software Release 4.1.2). For more information on this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Multicast Command Reference* and the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide* online.

- Policy Based Forwarding and Layer 2 Protocol Tunneling

  Cisco IOS XR Software Release 3.9.1 added support for the Policy Based Forwarding and Layer 2 Protocol Tunneling features. Layer 2 Protocol Tunneling (L2PT) is a Cisco proprietary protocol for tunneling Ethernet protocol frames across Layer 2 (L2) switching domains. This includes protocol tunnelling of CDP, PVST+, STP, and VTP protocol frames. For more information on these two features, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide* online.

- Multiple Spanning Tree Protocol (MSTP) over Link Aggregation Groups (LAGs)

  Cisco IOS XR Software Release 3.9.1 added support for the Multiple Spanning Tree Protocol (MSTP) over Link Aggregation Groups (LAGs) feature and the MSTP over MSTAG feature. For more information on these features, refer to the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide* online.

- 8x10-Gigabit Ethernet (8 x 10 GE) Line Card Medium Queue

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the medium queue 8x10-Gigabit Ethernet line card (A9K-8T-B). Support for the high and low queue 8x10-Gigabit Ethernet line cards was introduced in Cisco IOS XR Software Release 3.9.0.

- REP Access Gateway

  Cisco IOS XR Software Release 3.9.1 introduced support on the Cisco ASR 9000 Series Router platform for the REP (Resilient Ethernet Protocol) Access Gateway feature.

  The REP (Resilient Ethernet Protocol) Access Gateway provides the same functionality as MST-AG, (Multiple Spanning Tree Access Gateway) but where the access network is running REP rather than MST. All of the old syntax is extended to allow 'repag' where 'mstag' could be specified before:

  Configuration Commands including REPAG

  ```
  spanning-tree { mstag | repag } <protocol instance identifier>
  ```

```
preempt delay { until <hh:mm:ss> |
                for <n> { hours | minutes | seconds } }
interface <Inteface name>
    name <name>
    revision <revision>
    max age <secs>
    provider-bridge
    bridge-id <bridge id> [ startup-value <startup bridge id> ]
    port-id <port id> [ startup-value <startup port id> ]
    external-cost <cost> [ startup-value <startup cost> ]
    hello-time <secs>
    instance <id>
        vlan-id <vlan range>[,<vlan range][,<vlan range>][,<vlan range>]
        priority <pri> [ startup-value <startup pri> ]
        port-priority <pri> [ startup-value <startup pri> ]
        cost <cost> [ startup-value <startup cost> ]
        root-id <bridge id> [ startup-value <startup bridge id> ]
        root-priority <pri> [ startup-value <startup pri> ]
```

Show Commands

```
show spanning-tree { mstag | repag }  <proto-inst> [interface <intf>] [brief]
show spanning-tree { mstag | repag }  <proto-inst> bpdu interface <intf>
```

Debug Command

```
debug spanning-tree { mstag | repag } packet { brief | full } { sent | received }
```

Features Introduced in Cisco IOS XR Software Release 3.9.0

The following features introduced in Cisco IOS XR Software Release 3.9.0 are supported on the Cisco ASR 9000 Series Router platform:

- ANCP over IP Unnumbered Interfaces

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for up to 400 Access Node Control Protocol (ANCP) sessions and an associated 400 IP unnumbered interfaces.

  Note IP unnumbered interfaces on bundled Ethernet is only supported on the Cisco ASR 9000 Series Router platform.

- 100ms LACP

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for LACP running over bundle member interfaces at intervals down to 100 ms.

- Cisco ASR 9000 Series 8-Port Ten Gigabit Ethernet line card, 80G Line Rate

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the A9K-8T line card, which provides an 80G line rate line card.

- 2x10GE + 20xGE on a Single Line Card

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the A9K-2T20GE line card, which provides 2x10GE + 20xGE on a single line card.

- WAN PHY and OTN(G.709) modes

Cisco IOS XR Software Release 3.9.0 added support for WAN PHY and OTN(G.709) modes, which provide IPoDWM on the newly-introduced A9K-8T line card and on the newly-introduced A9K-2T20G line card.

Here is the syntax of the **transport-mode** command, used to choose WAN PHY or OTN(G.709) mode:

```
[no] transport-mode {wan | otn}
```

```
RP/0/RSP0/CPU0:ROSH10(config-if)#transport-mode wan
RP/0/RSP0/CPU0:ROSH10(config-if)#transport-mode otn bit-transparent {opu1e | ouu2e}
```

There are two loopback modes available under IPoDWDM:

```
RP/0/RSP0/CPU0:ROSH10(config)#controller dwdm 0/2/0/0
RP/0/RSP0/CPU0:ROSH10(config-dwdm)#loopback ?
  internal  Select internal loopback mode
  line      Select line loopback mode
```

There are three types of admin states: in-service, maintenance, and out-of-service. Set the admin-state to out-of-service before provisioning any command under controller dwdm mode.

```
RP/0/RSP0/CPU0:ROSH10(config)#controller dwdm 0/2/0/0
RP/0/RSP0/CPU0:ROSH10(config-dwdm)#admin-state ?
  in-service      change the admin-state to In-service (IS)
  maintenance     change the admin-state to Out-of-service-Maintenance (OOS-MT)
  out-of-service  change the admin-state to Out-of-service (OOS)
```

Here are the **show controllers** commands introduced to support the three states (**lan**, **wanphy** and **dwdm**):

```
RP/0/RSP0/CPU0:ROSH10#sh controllers tenGigE 0/2/0/0 ?
  all       Show all the information
  bert      Show BERT status
  control   Show configuration and control information
  internal  Show internal information
  mac       Show mac information
  phy       Show phy information
  regs      Show registers information
  stats     Show stats information
  xgxs      Show xgxs information
```

```
RP/0/RSP0/CPU0:ROSH10#sh controllers wanphy 0/2/0/1 ?
  alarms     Show alarm information
  all        Show all information
  registers  Show register information
```

```
RP/0/RSP0/CPU0:ROSH10#sh controllers dwdm 0/2/0/0 ?
  g709            Show G709  info
  log             Signal logging information
  optics          Show transponder info
  pm              show dwdm performance monitoring
  proactive       Proactive Protection Feature Status
  srlg            Display Network SRLGs configured at this port
  tdc             Show Tunable Dispersion info
  wavelength-map  Wavelength channel number  map table
```

- Low Queue Line Cards

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the following low queue line cards:

  - A9K-40GE-L
  - A9K-8T/4-L
  - A9K-4T-L
  - A9K-8T-L
- SIP-700

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the SIP-700, a 20G SPA Interface Processor.
- SPA-2XCHOC12/DS0

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the SPA-2XCHOC12/DS0, a 2-Port Channelized OC-12/DS0 SPA (Shared Port Adapter).
- SIP-700 and SPA-2XCHOC12/DS0 Software Features

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router with the SIP-700 and SPA-2XCHOC12/DS0 for the following software features:
  - MLPPP/LFI
  - IC-SSO
  - MR-APS
  - SONET, T1
  - Frequency Synchronization
  - IPv4 Netflow
- QoS Features

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router with the SIP-700 and SPA-2XCHOC12/DS0 for the following QoS features:
  - Support for IPv4 payload on Serial (PPP encapsulation), MLPPP, and MCMP interfaces. Support for LFI traffic on MLPPP or MCMP bundles.
  - Support for classification based on DSCP, precedence, protocol, qos-group (egress only), discard-class (egress only), and access-lists.
  - Support for marking, policing, and priority (see Fabric QoS section) in the ingress direction.
  - Support for marking, policing, and all queueing actions (bandwidth, bandwidth-remaining, shaping, queue-limit, priority levels 1 and 2, and random-detect) in the egress direction.
  - On the SIP-700 and SPA-2XCHOC12/DS0 only a 2-parameter scheduler is supported i.e. either bandwidth or bandwidth-remaining can be used in the same policy, but not both.
  - Note that traffic shaping on an input interface is not supported on the SIP-700.
  - Two levels of hierarchy supported, with only class-default permitted in the parent policy-map.
  - Fabric QoS configured using the priority action in the ingress direction.
  - Support for re-programming the QoS policy in response to underlying link bandwidth change on multi-link interfaces. There is no support for in place QoS policy modification on the SIP-700.
  - Support for the “encap-sequence” action to set the traffic class for traffic on multi-class MLPPP interfaces in the egress direction.

  - The “set cos” command on the egress of a Layer 3 interface is valid and supported. The “set cos” command on the ingress of a Layer 3 interface is rejected when performed on a subinterface. The “set cos” command on the ingress of a Layer 3 interface is ignored on a main interface.

- Y.1731 Performance Monitoring - Delay & Delay Variance

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for Y.1731 PM, which initially supports 2-way scheduled delay and delay variance measurements.

- IP FRR

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for IPFRR (IP Fast ReRoute), a set of technologies used in order to rapidly converge traffic flows around link and/or node failures. Only MLPPP encapsulation channels on the OC-12 SONET interface can be protected by IP-FRR in Cisco IOS XR Software Release 4.1.2.

- L2 Multicast Limit

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the Layer 2 Multicast Limit feature, which supports IGMP Snooping based limits for both the maximum number of allowed multicast channels per subscriber and the maximum bandwidth available for multicast per subscriber.

- Traffic Mirroring

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for Local Traffic Mirroring (EFP to EFP) and also the option of appending a VLAN tag on the destination port for transport across an Ethernet network. Traffic Mirroring copies traffic from one or more Layer 2 interfaces or sub-interfaces, including Layer 2 link bundle interfaces/sub-interfaces, and sends the copied traffic to one or more destinations for analysis by a network analyzer or other monitoring device.

  On a switch, unicast traffic from A to B is only forwarded to the B port. Therefore, the network analyzer does not see this traffic. When the Traffic Mirroring feature is enabled, the network analyzer is attached to a port that is configured to receive a copy of every packet that host A sends. This port is called a traffic mirroring port.

  Currently, the Cisco ASR 9000 Series Router only supports Local SPAN and R-SPAN.

  A maximum of 8 monitor sessions, and 800 source ports are supported.

  You can configure 800 source ports on a single monitor session or configure an aggregate total of 800 source ports on up to 8 different monitor sessions.

  The following SPAN types are not supported:

  - ER-SPAN (Encapsulated Remote Switched Port Analyzer)

    Traffic is mirrored to a remote site via a GRE tunnel.

  - Pseudowire SPAN (PW-SPAN).

    Traffic is mirrored to a remote site via an MPLS pseudowire, instead of using a standard destination interface. (Plan to be supported in 4.0.1 release.)

  - VLAN-based SPAN.

    In this case, the source for the mirrored traffic is not simply a set of interfaces, but is a full bridge-domain.

  - Filter-SPAN (F-SPAN)

    In this case, flow and ACL are applied in mirroring the traffic.

Cisco recommends not mirroring more 15% of total transit traffic. On TenGigE or bundle interfaces there is a limit of 1.5G on each ingress and egress traffic port to be mirrored.

SPAN Configurations:

To create a "monitor-session" in global config:

-monitor-session <name>

- destination interface <dst_interface>

To attach a source port in local-plane config:

-interface <src-interface> l2transport

- monitor-session <name> [direction {rx_only | tx_only]

SPAN Configuration Samples:

SPAN with Physical Interfaces (Local SPAN)

The following example shows a basic configuration for SPAN with physical interfaces. When traffic flows over the point to point cross connect between gig0/2/0/19 and gig0/2/0/11, packets received and transmitted on gig0/2/0/19 will also get mirrored to gig0/2/0/15.

```
monitor-session ms1
 destination interface gig0/2/0/15
!
interface gig0/2/0/11
 l2transport
!
interface gig0/2/0/15
 l2transport
!
interface gig0/2/0/19
 l2transport
  monitor-session ms1
!
l2vpn
 xconnect group xg1
  p2p xg1_p1
   interface gig0/2/0/11
   interface gig0/2/0/19
  !
 !
!
```

SPAN with EFPs (R-SPAN)

The following example shows a basic configuration for SPAN with EFP interfaces. When traffic flows over the point to point cross connect between gig0/2/0/19.10 and gig0/2/0/11.10, packets received and transmitted on gig0/2/0/19.10 will also get mirrored to gig0/2/0/15.10.

```
monitor-session ms1
 destination interface gig0/2/0/15.10
!
interface gig0/2/0/11.10 l2transport
 encapsulation dot1q 10
!
interface gig0/2/0/15.10 l2transport
 encapsulation dot1q 10
!
interface gig0/2/0/19.10 l2transport
 encapsulation dot1q 10
```

```
 monitor-session ms1
!
l2vpn
 xconnect group xg1
  p2p xg1_p1
   interface gig0/2/0/11.10
   interface gig0/2/0/19.10
  !
 !
!
```

Display Commands

show monitor-session [session_name] status [detail] [error]

Shows the status of different monitor sessions.

Keywords:

session_name

detail

errors

Example output:

```
RP/0/RSP0/CPU0:router#show monitor-session status
Fri Feb 20 14:56:04.233 UTC
Monitor-session cisco-rtp1
Destination interface GigabitEthernet0/5/0/38
================================================================================
Source Interface      Dir   Status
--------------------- ----  ------------------------------------------------
Gi0/5/0/4             Both  Operational
Gi0/5/0/17            Both  Operational
```

show monitor-session [session_name] counters

Shows the statistics/counters (received/transmitted/dropped) of different source ports.

- Video Monitoring

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for the Video Monitor application, used to monitor video flows, detect quality degradation, report metrics and raise alarms.

- LAG integration with H-QOS

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for extending Hierarchical QoS (H-QoS) support to link aggregation bundles. Shared Policy Instances (SPI) allow for QoS policy shared across multiple sub-interfaces.

- EFP Based Load Balancing.

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for EFP based load balancing, which provides a way to carry all the traffic of a specific EFP over a single physical member link.

- Ethernet Connectivity Fault Management (E-CFM) with Ethernet Wire Service (EWS)

Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for Ethernet Connectivity Fault Management (E-CFM), a subset of EOAM that provides a number of protocols and procedures that allow discovery and verification of the path through 802.1 bridges and LANs. Note that CFM 100 ms CCMs and CFM Exploratory Linktrace were introduced on the Cisco ASR 9000 Series Router with Cisco IOS XR Software Release 3.7.2.

- BGP PIC Edge for IP/MPLS

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for BGP PIC Edge for IP/MPLS, which provides sub-second convergence for IP and MPLS-VPN.

- MPLS TE Path Protection

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for MPLS TE path protection, which provides a backup tunnel between the MPLS/TE head-end and the tail router and added to Cisco's MPLS/TE suite of bandwidth protection features, which also include node protection and link protection.

- Image Refresh using Compact Flash

  Cisco IOS XR Software Release 3.9.0 added support on the Cisco ASR 9000 Series Router for performing an image refresh using compact flash.

Features Introduced in Cisco IOS XR Software Release 3.7.3

The following features introduced in Cisco IOS XR Software Release 3.7.3 are supported on the Cisco ASR 9000 Series Router platform:

- MSTAG Enhancements

  Cisco IOS XR Software Release 3.7.3 added support on the Cisco ASR 9000 Series Router for multiple spanning tree access gateway (MSTAG) topology control.

- MSTP Enhancements

  Cisco IOS XR Software Release 3.7.3 added support on the Cisco ASR 9000 Series Router for the following features added to MSTP:

  - PortFast—allows a port to be marked as an edge port that does not participate in the spanning tree.
  - BPDUGuard—protects PortFast ports from misconfigurations by error-disabling them if they receive a BPDU.
  - UplinkFast—allows a RootPort to transition straight to forwarding, if there are no other active RootPorts on the box.
  - BackboneFast—allows for accelerated recovery from indirect link failures.
  - RootGuard—prevents a port from becoming the RootPort.
  - MSTAG support on physical and bundle Ethernet interfaces.

- EFP Egress Filtering on the Cisco ASR 9000 Series Router

  Cisco IOS XR Software Release 3.7.3 introduced EFP Egress Filtering on the Cisco ASR 9000 Series Router.

  For more information on configuring the EFP Egress Filtering feature including the associated EFP Egress Filtering commands on the Cisco ASR 9000 Series router, refer to the *Egress EFP Filtering on the Cisco ASR 9000 Series Router* feature module.

- Flood Optimization

In prior releases the Cisco ASR 9000 Series Router acting as a bridge flooded broadcast and unknown unicast traffic to all the forwarding engines on all the line cards.

In Cisco IOS XR Software Release 3.7.2 if a pseudo wire is configured in a bridge domain all broadcast and unknown unicast traffic is flooded to all line cards in the system in order to attain fast convergence. With Cisco IOS XR Software Release 3.7.3 the flood optimization feature changes this default behavior. FGID will get programmed based on the primary paths on which the pseudo wire is going out and traffic will get flooded only to the line cards on which the pseudo wire resides. This mode is called Bandwidth Optimization mode.

But if a Fast ReRoute event occurs when fast convergence is set up it will take a longer time to complete the reroute as more hardware programming such as adding bridge ports etc. needs to be done. So for customers who are sensitive to this increased delay a command called **flood mode convergence-optimized** is provided in Cisco IOS XR Software Release 3.7.3. Use this **flood mode convergence-optimized** command to switch back to the convergence optimized mode where traffic gets flooded to all the line cards.

With this **flood mode convergence-optimized** command users are able to turn on/off the bandwidth optimized mode.

For more information on the flooding disable command and other Layer 2 VPLS commands on the Cisco ASR 9000 Series router, refer to the Point to Point Layer 2 Services Commands section in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference* here:

http://www.cisco.com/en/US/partner/docs/routers/asr9000/software/asr9k_r4.0/lxvpn/command/reference/lesr40lp2p.html

- ECMP (Equal Cost Multipath Protocol) Link Bundle hashing for PWs (pseudo wires) on Layer 3 NNI (Network to Network Interface) is now based on Virtual Connection labels

  In Cisco IOS XR software Release 3.7.3 as part of pseudo wire flood optimization, the Layer 3 interface list for a pseudo wire is now based on Virtual Connection labels. By using ECMP Link Bundle hashing, the Layer 3 interface list for a pseudo wire can be condensed to a single Layer 3 interface. This Layer 3 interface (slot and network protocol flood mask) is derived from the ordered array of Layer 3 interface list (masks).

- Early Fast Discard command

  Cisco IOS XR software Release 3.7.3 added support for the Early Fast Discard command. This command was added to process all high priority packets

  Command syntax:

```
(config)# hw-module location <loc> early-fast-discard
    (config-early-fast-discard)# mode [outer-encap-only | include-inner-encap]
    (config-early-fast-discard)# vlan-cos <0-8> vlan-op [lt | ge]
    The defaults are 6 and ge (greater than or equal to)
    (config-early-fast-discard)# ip-prec <0-8> ip-op [lt | ge]
    The defaults are 6 and ge (greater than or equal to)
    (config-early-fast-discard)# mpls-exp <0-8> mpls-op [lt | ge]
    The defaults are 6 and ge (greater than or equal to)
(config)# no hw-module location <loc> early-fast-discard
```

- Power Management multiple override mechanism

  Cisco IOS XR software Release 3.7.3 added support for the user to override the Power Management feature in order to configure extra line cards without full power supply redundancy.

This feature allows a card to be forced to power up, regardless of an unprogrammed EEPROM power draw value. As with the ROMMON variable, this feature is intended for temporary use. After the cookie value has been programmed, remove this configuration by repeating the CLI command with the "no" option.

Command example:

```
RP/0/RSP0/CPU0:ios(admin-config)# hw-mod power override location <loc>
```

- The IGMP Snooping feature no longer removes the state after a port goes down

  Starting with Cisco IOS XR software Release 3.7.3, mrouter and membership states on the Cisco ASR 9000 Series Router no longer need to be relearned after a port goes down. Once a port goes down, the IGMP Snooping feature immediately removes all group membership states from that port. Once an mrouter port goes down, the IGMP Snooping feature removes the port from the list of mrouter ports and removes that port from the flood set of all multicast routes.

  New CLI:

  ```
  tcn_relearning [cisco | rfc4541 | none]
  ```

  For more information on the IGMP Snooping feature on the Cisco ASR 9000 Series router, refer to the Implementing Layer 2 Multicast using IGMP Snooping on Cisco ASR 9000 Series Routers section in the Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide here:

  http://www.cisco.com/en/US/docs/routers/asr9000/software/multicast/configuration/guide/mcasr9kigsn.html

- The VRRP & FRR failover time is no longer greater than 1 sec after a hardware module reload

  Cisco IOS XR software Release 3.7.3 improves the Cisco ASR 9000 Series Router VRRP & FRR failover time after a hardware module reload to less than or equal to one second.

- The VPLS preferred path fallback enable option is now supported on the Cisco ASR 9000 Series Router

  Layer 2 VPNs can provide pseudo wire resiliency through their routing protocols. When the connectivity between end-to-end PE routers fails, an alternative path to the directed LDP session and the user data takes over. With Cisco IOS XR software Release 3.7.3, the user can fall-back to the preferred path once it has been restored.

- 32k EFPs/HQOS/ANCP/ACL/IGMP EFP up time > 30 minutes. This enhancement provides a five minute improvement over Cisco IOS XR software Release 3.7.2.

- The **show environment power-supply** command has been updated:

```
RP/0/RSP0/CPU0:router(admin)#show environment power-supply
Thu Jul 23 17:01:08.829 pst
R/S/I   Modules Sensor          Watts           Status

0/PM0/*
        host    PM              3000            Ok

0/PM1/*
        host    PM              3000            Ok

0/PM4/*
        host    PM              3000            Ok

0/PM5/*
        host    PM              3000            Ok


Power Shelves Type: AC
```

```
Total Power Capacity:                          12000W
Usable Power Capacity:                         9000W
Supply Failure Protected Capacity:             9000W
Feed Failure Protected Capacity:               6000W
Worst Case Power Used:                         3010W

 Slot                                                      Max Watts
 ----                                                      ---------
 0/0/CPU0                                                        375
 0/1/CPU0                                                        395
 0/RSP0/CPU0                                                     250
 0/RSP1/CPU0                                                     250
 0/4/CPU0                                                        375
 0/6/CPU0                                                        375
 0/FT0/SP                                                        495  (default)
 0/FT1/SP                                                        495  (default)


Worst Case Power Available:             5990W
Supply Protected Capacity Available:    5990W
Feed Protected Capacity Available:      2990W
```

Features Introduced in Cisco IOS XR Software Release 3.7.2

The following features in Cisco IOS XR Software Release 3.7.2 are supported on the Cisco ASR 9000 Series Router platform:

- CFM 100ms CCMs
- CFM Exploratory Linktrace
- IPv6 Filtering
- IPv6 Routing
- IPv6 Forwarding
- IPv6 ACL
- ECMP
- ICMP
- HSRP-VRRP L3VPN support
- QoS Shared Policy Instance
- ANCP-triggered interface bandwidth modification
- Tri-rate SFP copper port bandwidth modification
- IPv6 Classification
- Tri-rate copper SFP
- ANCP Termination
- IPv4 VRF on main and sub-interfaces
- CSC, Inter-AS L3VPN
- CE-PE Link and FRR Protection for VPNv4 traffic on MPLS core
- IGMP Snooping v2 and v3

- Multicast Redirect UNI
- PIM to SSM Mapping
- IGMP VRF override
- IPv6 OSPF, RIP, BGP
- Multi-segment dynamic and static VPWS pseudo wires
- Split Horizon Group for ACs
- BGP Auto-discovery and signaling for VPLS and VPWS
- Broadcast Storm Control

Important Notes

For Cisco IOS XR Software Release 4.1 the Cisco ASR 9000 Series Router does not support the following inventory schemas:

  - `vkg_invmgr_adminoper.xsd`
  - `vkg_invmgr_common.xsd`
  - `vkg_invmgr_oper.xsd`
- Only MLPPP encapsulation channels on the OC-12 SONET interface can be protected by IP-FRR in Cisco IOS XR software Release 3.9.0 and above.
- For Cisco IOS XR software Release 3.9.0 and above the SIP 700 with the 2-Port Channelized OC-12/DS0 SPA does not support SDH (including all the mappings under SDH) or DS0 mappings.
- For Cisco IOS XR software Release 3.9.0 and above the SIP 700 with the 2-Port Channelized OC-12/DS0 SPA does not support ATM or POS.
- For Cisco IOS XR software Release 3.9.0 and above the SIP 700 with the 2-Port Channelized OC-12/DS0 SPA does not support MPLS/Traffic Engineering FRR.
- For Cisco IOS XR software Release 4.0.1 and above the SIP 700 with the 1-Port Channelized OC48/STM16 DS3 SPA does not support MPLS/Traffic Engineering FRR.
- For Cisco IOS XR software Release 4.0.1 and above the SIP 700 with the 1-Port Channelized OC48/STM16 DS3 SPA, the 2-Port Channelized OC-12/DS0 SPA , the 8-Port OC12/STM4 SPA , and the 2-Port OC-48/STM16 SPA Layer 2VPN support only includes FR.
- **Country-specific laws, regulations, and licenses—**In certain countries, use of these products may be prohibited and subject to laws, regulations, or licenses, including requirements applicable to the use of the products under telecommunications and other laws and regulations; customers must comply with all such applicable laws in the countries in which they intend to use the products.
- **Card, fan controller, and RSP removal—**For all card removal and replacement (including fabric cards, line cards, fan controller, and RSP) follow the instructions provided by Cisco to avoid impact to traffic. See the *Cisco ASR 9000 Series Router Getting Started Guide* for procedures.

- **Exceeding Cisco testing—**If you intend to test beyond the combined maximum configuration tested and published by Cisco, contact your Cisco Technical Support representative to discuss how to engineer a large-scale configuration maximum for your purpose.
- **Installing a Line Card**—For a fully populated 40-port high density Line Card with cable optics, maintenance time required for card replacement is higher. For more information about Line Card installation and removal, refer to the *Cisco ASR 9000 Aggregation Services Router Ethernet Line Card Installation Guide*.
- **Serial Interfaces Out of Order in "show ip interface brief" Command** —The show ip interface brief command might display interfaces out of order if different types of serialization are used on the SPA cards.

  The serial interfaces are displayed in the show ip interface brief command output in the order shown in the example below:

  The ordering is based on:

  1. Slot
  2. SPA
  3. Type
     a. T3
     b. T3/T1
     c. vt15-T1
     d. multilink

  This may be confusing (the interfaces appear out of order) for the user who is accustomed to IOS.

  Example output:

  With multiple cards:

```
Serial0/2/0/1/1/1:0  (t3/t1)
Serial0/2/0/1/2/1:0
Serial0/2/0/1/3/1:0
Serial0/2/0/1/4/1:0
Serial0/2/0/1/5/1:0
Serial0/2/0/1/6/1:0
Serial0/2/0/1/7/1:0
Serial0/2/0/1/8/1:0
Serial0/2/0/1/9/1:0
Serial0/2/0/1/10/1:0
Serial0/2/0/1/11/1:0
Serial0/2/0/1/12/1:0

Serial0/2/0/0/1/1/1:0  (vt15)
Serial0/2/0/0/2/1/1:0
Serial0/2/0/0/3/1/1:0
Serial0/2/0/0/4/1/1:0
Serial0/2/0/0/5/1/1:0
Serial0/2/0/0/6/1/1:0
Serial0/2/0/0/7/1/1:0
Serial0/2/0/0/8/1/1:0
Serial0/2/0/0/9/1/1:0
Serial0/2/0/0/10/1/1:0
Serial0/2/0/0/11/1/1:0
Serial0/2/0/0/12/1/1:0
```

```
Multilink 0/2/0/0/1

Serial0/2/1/0/1  (t3)

Serial0/2/1/1/1/1:0  (t3/t1)
Serial0/2/1/1/2/1:0
Serial0/2/1/1/3/1:0
Serial0/2/1/1/4/1:0
Serial0/2/1/1/5/1:0
Serial0/2/1/1/6/1:0
Serial0/2/1/1/7/1:0
Serial0/2/1/1/8/1:0
Serial0/2/1/1/9/1:0
Serial0/2/1/1/10/1:0
Serial0/2/1/1/11/1:0
Serial0/2/1/1/12/1:0


Serial0/6/0/1/1/1:0
Serial0/6/0/1/2/1:0
Serial0/6/0/1/3/1:0
Serial0/6/0/1/4/1:0
Serial0/6/0/1/5/1:0
Serial0/6/0/1/6/1:0
Serial0/6/0/1/7/1:0
Serial0/6/0/1/8/1:0
Serial0/6/0/1/9/1:0
Serial0/6/0/1/10/1:0
Serial0/6/0/1/11/1:0
Serial0/6/0/1/12/1:0

Serial0/6/0/0/1/1/1:0
Serial0/6/0/0/2/1/1:0
Serial0/6/0/0/3/1/1:0
Serial0/6/0/0/4/1/1:0
Serial0/6/0/0/5/1/1:0
Serial0/6/0/0/6/1/1:0
Serial0/6/0/0/7/1/1:0
Serial0/6/0/0/8/1/1:0
Serial0/6/0/0/9/1/1:0
Serial0/6/0/0/10/1/1:0
Serial0/6/0/0/11/1/1:0
Serial0/6/0/0/12/1/1:0

Multilink 0/6/0/0/1

Serial0/6/1/0/1

Serial0/6/1/1/1/1:0
Serial0/6/1/1/2/1:0
Serial0/6/1/1/3/1:0
Serial0/6/1/1/4/1:0
Serial0/6/1/1/5/1:0
Serial0/6/1/1/6/1:0
Serial0/6/1/1/7/1:0
Serial0/6/1/1/8/1:0
Serial0/6/1/1/9/1:0
Serial0/6/1/1/10/1:0
Serial0/6/1/1/11/1:0
Serial0/6/1/1/12/1:0
```

- Starting with Cisco IOS XR Software Release 3.9 the **pw-class class name encapsulation mpls** command **control-word** option default is now **disable** -In Cisco IOS XR Software Release 3.9 and above the control word is disabled by default. To configure the control word, enter the control-word keyword shown in the following example:

  ```
  pw-class class1 encapsulation mpls control-word
  ```

- For configured policer rates of less than 1 Mbps, the actual policer rate can be approximately 10 percent less than the configured rate. For example, for a configured policer rate of 500 kbps, the actual policer rate is 448 kbps due to a granularity round down in hardware.
- In Cisco ASR 9000 Series Router Software Release 4.0.0, the minimum configurable logging buffered size has been increased to 307200. Any configuration with a value less than 307200 fails to upgrade to Release 4.0.1.
  - Run the **show configuration failed startup** command on startup to display the failed configuration.
  - Workaround: Prior to upgrading to Release 4.0.1, set the logging buffer size to a value of 307200 or greater (**logging buffered 307200**).
- **dsu mode Command Default—**For E3 interfaces on the 4-Port Clear Channel T3/E3 SPA that interoperate with E3 interfaces on a Cisco 10000 Series router, the default data service unit (DSU) mode is digital-link. To change the DSU mode to cisco, configure scrambling.
- For Cisco IOS XR Software Release 4.0.0 and above the **hw-module location <LOC> reload warm** command has been disabled. This means that the warm reload feature has been disabled.
- In Cisco ASR 9000 Series Router Software Release 4.1.0, you use the **cablelength short** command to set a cable length of 655 feet or shorter for a DS1 link on a 4-Port Channelized T1/E1 SPA. The **cablelength short** command options are listed as follows:

  ```
  RP/0/RSP0/CPU0:router(config-t1)# cablelength short ?
    133ft  0-133ft
    266ft  134-266ft
    399ft  267-399ft
    533ft  400-533ft
    655ft  534-655ft
  ```

  However, when using the **cablelength short** command on a 4-Port Channelized T1/E1 SPA in Cisco ASR 9000 Series Router Software Release 4.1.0, only the 133ft option (for cable lengths from 0 to 133 feet) works. The other values that are greater than 133 feet (266, 399, 533, or 655) all cause the T1 controller to go down. The workaround is to restart the controller after you set the cable length to 266, 399, 533, or 655 feet. The **cablelength long** command works correctly.

Caveats

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

This section lists the caveats for Cisco ASR 9000 Series Router Software Release 4.1.2 and the Cisco ASR 9000 Series platform.

Open Cisco IOS XR Software Release 4.1.2 Caveats

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

- **CSCtt29747**

  Basic Description:

  Error adding 2K RT through XML interface.

  Symptom:

```
<?xml version="1.0"?>
<Response MajorVersion="1" MinorVersion="0"><Set ErrorCode="0x43679000"
ErrorMsg="'XML Service Library' detected the 'warning'
condition 'An error was encountered in the XML beneath this operation
tag'"><Configuration><RoutingPolicy MajorVersion="3"
MinorVersion="1"><Sets><ExtendedCommunityRTSetTable><ExtendedCommunityRTSet
ErrorCode="0x4368a200" ErrorMsg="'XMLMDA' detected the
'warning' condition 'An XML request provided too little or
too much values for a
class'"><Naming><SetName>rt_set_global_service</SetName></Naming><Exten
dedCommunityRTSetAsText ErrorCode="0x42c6aa00" ErrorMsg="'Policy
Repository' detected the 'warning' condition 'The parser
encountered an internal error while parsing the
policy/set.'"/></ExtendedCommunityRTSet></ExtendedCommunityRTSetTable><
/Sets></RoutingPolicy></Configuration></Set><Commit ErrorCode="0x41864e00"
ErrorMsg="'CfgMgr' detected the 'wa!
 rning' condition 'The target configuration buffer is
empty.'"/><ResultSummary ErrorCount="2"/></Response>
```

  Conditions:

  Configuring a number of extended community RTs through the XML interface exceeding 8192 bytes. In other words, string length of the content within the ExtendedCommunityRTSetAsText tag exceeding 8192 bytes.This limitation affects other xxxAsText tags in the RPL configuration schema.

  Workaround:

  None.

  Recovery:

  None.

- **CSCtr78557**

  Basic Description:

  MPP SNMP out-of-band not working.

  Symptom:

  SNMP packets coming on out-of-band interface are dropped. When **snmp-server host trap source-port <port>** configuration gets removed, SNMP inform packets are not received.

  Conditions:

  Inform notification packets coming on MPP out-of-band interface.

  Workaround:

  Restart snmpd process.

  Recovery:

None.

- **CSCti50227**

  Basic Description:

  Not able to modify RPL and delete prefix-set in a single commit.

  Symptom:

  When a policy that is attached directly or indirectly to an attach point needs to be modified, a single commit operation cannot be performed when:

  – Removing a set or policy referred by another policy that is attached to any attach point directly or indirectly.

  – Modifying the policy to remove the reference to the same set or policy that is getting removed.

  Workaround:

  The commit must be performed in two steps:

  1. Modify the policy to remove the reference to the policy or set and then commit.
  2. Remove the policy or set and commit.

Caveats Specific to the Cisco ASR 9000 Series Router

The following caveats are specific to the Cisco ASR 9000 Series Router:

- **CSCts82919**

  Basic Description:

  412 UI:Double tag rewrite default to VC type 5.

  Symptom:

  PW-type does not change to VC TYPE 4 when double tag rewrite option is used under the interface, it defaults to VC type 5.

  Conditions:

  When 2 tags are pushed, ASR9K doesn't allow for a 3rd push, since this is a hardware limitation. Setting a pw-type to "transport-mode vlan" defaults to pw-type as Ethernet and no dummy tag is added and "sh l2vpn xconnect pw-class pw-class-name det" shows pw-type as Ethernet.

  Workaround:

  If pw-type is set to "transport-mode vlan passthrough", then the "sh l2vpn xconnect pw-class pw-class-name det" shows up as pw-type Ethernet vlan and no dummy tag is added in this case as well.

  Recovery:

  None.

- **CSCtt03435**

  Basic Description:

  412 UI: %OS-SYSMGR-7-FUNCTION_PATH : timeout_handler.

  Symptom:

  The following error message is seen:

RP/0/RSP1/CPU0:Sep 28 23:46:35.650 : sysmgr_preload_dll[544]: %OS-SYSMGR-7-FUNCTION_PATH : timeout_handler: MsgSendnc to /net/node0_RSP0_CPU0/dev/dll failed: Bad file descriptor

Conditions:

This error message is seen during **process restart dllmgr**

Workaround:

None. There is no functionality impact due to this error.

Recovery:

None.

- **CSCtr04894**

  Basic Description:

  Egress high priority packets dropped in fabric interface ASIC.

  Symptom:

  When egress NPU port is oversubscribed with 64B line rate unicast high priority (HP) and low priority (LP) traffic, HP unicast packets are being dropped in ingress fabric interface ASIC virtual output queues. Ideal behavior is that HP packets are not to be dropped while dropping some LP packets.

  Conditions:

  If egress NPU is oversubscribed (in terms of ucode processing cycles, not by bps) thus by sending 64B packets of unicast HP and LP traffic, then NPU falls behind the processing. Under such a condition, the fabric unicast arbitor based backpressure causes unicast HP traffic to be queued up in ingress FIA which causes dropes. Also, some LP traffic leaks through the NPU, while HP is dropped.

  Workaround:

  None.

  Recovery:

  None.

- **CSCtr13320**

  Basic Description:

  41126I: IP-IP_EA-3-PLATFORM_UPDATE_BULK Not enough memory messages are flooded.

  Symptom:

  Repeated IP-IP_EA-3-PLATFORM_UPDATE_BULK Not enough memory messages are flooded on the console, with no specific user trigger.

  Conditions:

  This issue occurs only when BGP-PA is configured on bundle-ether interfaces and when all the members of the bundle do not span across all NPs of the LC in certain situations. In case of bundle, PM tries to allocate required BGP-PA stats for all NPs, although there is no member on that NP, which is not correct. Due to this reason, the error messages are displayed.

  Workaround:

  Remove BGP-PA configuration from the bundle or make the bundle members come from all NPs on the LC.

  Recovery:

None.

- **CSCtr08031**

  Basic Description:

  ASR9000 EOBC heartbeat test is not running for A9K-8T line cards.

  Symptom:

  Online diagnostic test number 8, called LcEobcHeartbeat, is not run on the A9K-8T based line cards. This test is operating correctly for all other line cards, including A9K-8T/4 linecards.

Conditions:

The line card type has to be A9K-8T-E or A9K-8T-L or A9K-16T/8-B or A9K-16T/8-E.

Workaround:

There is no workaround. EOBC monitoring for the A9K-8T line cards is working correctly from the standby RSP.

Recovery:

None.

- **CSCto99989**

  Basic Description:

  SNMP bulk config, or load from saved config, or rollback will show error.

  Symptom:

  SNMP bulk configuration, or load from saved configuration, or rollback (which include multiple SNMP commands) can cause following messages to print on console.

  RP/0/RSP0/CPU0:Apr 27 19:26:59.446 : snmpd[1112]: %SNMP-SNMP-4-VIEWOID_NOT_FOUND : The command **snmp view li-view ifMIB included** could not be applied at this time because the oid ifMIB does not belong to a known MIB module.

  RP/0/RSP0/CPU0:Apr 27 19:26:59.481 : snmpd[1112]: %SNMP-SNMP-4-VIEWOID_NOT_FOUND : The command **snmp view li-view ciscoTap2MIB included** could not be applied at this time because the oid ciscoTap2MIB does not belong to a known MIB module.

  RP/0/RSP0/CPU0:Apr 27 19:26:59.495 : snmpd[1112]: %SNMP-SNMP-4-VIEWOID_NOT_FOUND : The command **snmp view li-view ciscoIpTapMIB included** could not be applied at this time because the oid ciscoIpTapMIB does not belong to a known MIB module.

  Conditions:

  This behavior is observed since MIB is not loaded and the OID translation is not in place. After few seconds, this gets resolved and queries to the MIB are successful.

  Workaround:

  None. When this behavior is observed during SNMP configuration for lawful intercept, it still allowed adding taps and lawful intercept functionality is not impacted.

  Recovery:

  None. These messages does not impact any functionality as they are harmless.

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. Refer to Table 1 for a list of the Cisco ASR 9000 Series Router Software feature set matrix (PIE files) and associated filenames available for the Cisco IOS XR Software Release 4.1.2 supported on the Cisco ASR 9000 Series Router.

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 ASR 9000 Series Aggregation Services Routers Getting Started Guide* and the *Cisco ASR 9000 Series Router Troubleshooting Feature Module*.

Resolving Upgrade File Issues

Note In some very rare cases inconsistencies in the content of the internal configuration files can appear. In such situations, to avoid configuration loss during upgrade, the following steps can be optionally done before activating packages:

a. Clear the NVGEN cache:

```
RP/0/RSP0/CPU0:router# run nvgen -F 1
```

b. Create a dummy config commit:

```
RP/0/RSP0/CPU0:router# config
RP/0/RSP0/CPU0:router(config)# hostname <hostname>
RP/0/RSP0/CPU0:router(config)# commit
RP/0/RSP0/CPU0:router(config)# end
```

c. Force a commit update by using the **reload** command. Press **n** when the confirmation prompt appears:

```
RP/0/RSP0/CPU0:router# reload
Updating Commit Database. Please wait...[OK]
Proceed with reload? [confirm]
```

d. Press **n**.

In some cases other activity may preclude a reload. The following message may display:

```
RP/0/RSP0/CPU0:router# reload
Preparing system for backup. This may take a few minutes .....System
configuration backup in progress [Retry later]
```

If you receive this message wait and then retry the command after some time.

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

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