Release Notes for Cisco ASR 9000 Series Aggregation Services Routers for Cisco IOS XR Software Release 3.9.1

April 15, 2013

Cisco ASR 9000 Series Router Software Release 3.9.1

Text Part Number OL-22786-01

Note For information on Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 3.9.1, see the "Features Introduced in Cisco IOS XR Software Release 3.9.1" section on page 16.

These release notes describe the features provided on the Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 3.9.1 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 3.9.1, see the "Caveats" section on page 32. 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**—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 3.9.1 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 stitching
- **BGP Prefix Independent Convergence**—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 with out MPLS. This fast convergence innovation is unique to Cisco IOS XR software.
- **Multiprotocol Label Switching (MPLS)**—Supports MPLS protocols, including Traffic Engineering (TE) [including 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—**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 Automatic route processing (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)—**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. 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—**Provides industry-standard management interfaces including modular command-line interface (CLI), Simple Network Management Protocol (SNMP), and native Extensible Markup Language (XML) interfaces. Includes a comprehensive set of Syslog messaging.
- **Security—**Provides comprehensive network security features including Layer 2 and Layer 3access 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—**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)
  - Traffic engineering support for unequal load balancing
  - 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 3.9.1, see the "Features Introduced in Cisco IOS XR Software Release 3.9.1" section on page 16 in this document.

System Requirements

This section describes the system requirements for Cisco ASR 9000 Series Router Software Release 3.9.1. 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 3.9.1 features.

Table 1 lists the Cisco ASR 9000 Series Router software feature set matrix (PIE files) and associated filenames available for the Release 3.9.1 supported on the Cisco ASR 9000 Series Router.

Table 1 Cisco ASR 9000 Series Router Supported Feature Sets (Cisco IOS XR Software Release 3.9.1 PIE Files)

Feature Set	Filename	Description
Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	comp-asr9k-mini.pie-3.9.1	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	comp-asr9k-mini.vm-3.9.1	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.pie-3.9.1	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.pie-3.9.1	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.pie-3.9.1	Multicast Routing Protocols (PIM, MSDP,[10] IGMP,[11] Auto-RP), Tools (SAP, MTrace), and Infrastructure (MRIB,[12] MURIB[13], MFWD[14]), and BIDIR-PIM.[15]
Cisco IOS XR Security Package	asr9k-k9sec.pie-3.9.1	Support for Encryption, Decryption, SSH,[16] and SSL[17]
Cisco IOS XR Advanced Video Package	asr9k-adv-video-p.pie-3.9.1	Firmware for the advanced video feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Documentation Package	asr9k-doc.pie-3.9.1	.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 3.9.1 TAR Files)

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software	asr9k-iosxr-3.9.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR FPD Package • Cisco IOS XR Diagnostic Package
Cisco IOS XR IP/MPLS Core Software 3DES	asr9k-iosxr-k9-3.9.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR Security Package • Cisco IOS XR FPD Package • Cisco IOS XR Diagnostic 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 3.9.1 consist of the following:

- 4-GB memory on the route switch processors (RSPs)
- 2-GB compact flash on route switch processors (RSPs)

These minimum memory requirements are met with the base board design. There are no optional memory or storage upgrades available or required.

Hardware Supported

Cisco IOS XR Software Release 3.9.1 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 5.

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 9.

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	Release 3.7.2
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	Release 3.7.2
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
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	Release 3.7.2
Cisco ASR 9000 Series 10-Slot Air Inlet Grill	ASR-9010-GRL	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 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 3.9.1
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 3.9.1
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
Cisco ASR 9000 Series Router Processor Cards		
Cisco ASR 9000 Series Route Switch Processor, 4G Memory	A9K-RSP-4G	Release 3.7.2
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

Software Compatibility

Cisco IOS XR Software Release 3.9.1 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
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

Here are on-line locations of the Cisco ASR 9000 Series Right-To-Use (RTU) licensing docs:

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

Other Firmware Support

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

- The minimum ROMMON version required for this release is 1.03 for line cards, 1.04 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:PE44_ASR-9010(admin)#show fpd package
Fri Apr 23 11:35:00.540 DST

================================ ================================================
                                        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       0.19       0.0       0.1
                     PHYCtrl LC2                lc   cpld2       0.06       0.0       0.1
                     PortCtrl LC2               lc   fpga2       0.09       0.0       0.1
                     Bridge LC2                 lc   fpga1       0.42       0.0       0.1
                     ROMMONB LC2                lc   rommon      1.03       0.0       0.1
-------------------------------------------------------------------------------------------
A9K-4T-B             Can Bus Ctrl (CBC) LC2     lc   cbc         2.02       0.0       0.1
                     CPUCtrl LC2                lc   cpld1       0.19       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      14.42       0.0       0.1
                     Bridge LC2                 lc   fpga1       0.42       0.0       0.1
                     ROMMONB LC2                lc   rommon      1.03       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       0.19       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      14.42       0.0       0.1
                     Bridge LC2                 lc   fpga1       0.42       0.0       0.1
                     ROMMONB LC2                lc   rommon      1.03       0.0       0.1
-------------------------------------------------------------------------------------------
A9K-2T20GE-B         Can Bus Ctrl (CBC) LC2     lc   cbc         2.02       0.0       0.1
                     CPUCtrl LC2                lc   cpld1       0.19       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	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-40GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	0.19	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.09	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-4T-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	0.19	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	14.42	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	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	0.19	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	14.42	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-2T20GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	0.19	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	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-8T-B	Can Bus Ctrl (CBC) LC3	lc	cbc	6.02	0.0	0.1
	CPUCtrl LC3	lc	cpld1	1.00	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	1.00	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.00	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	1.00	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	1.00	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.01	0.0	0.1
	Raven LC3	lc	fpga1	1.00	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	1.00	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	1.00	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.00	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	0.19	0.0	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.0	0.1
	PortCtrl LC2	lc	fpga2	0.09	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-4T-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	0.19	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	14.42	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	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	0.19	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	14.42	0.0	0.1
	Bridge LC2	lc	fpga1	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-2T20GE-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.02	0.0	0.1
	CPUCtrl LC2	lc	cpld1	0.19	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	0.42	0.0	0.1
	ROMMONB LC2	lc	rommon	1.03	0.0	0.1
A9K-8T-L	Can Bus Ctrl (CBC) LC3	lc	cbc	6.02	0.0	0.1
	CPUCtrl LC3	lc	cpld1	1.00	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	1.00	0.0	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.0	0.1
	Raven LC3	lc	fpga1	1.00	0.0	0.1
	ROMMONB LC3	lc	rommon	1.03	0.0	0.1
A9K-SIP-700	Can Bus Ctrl (CBC) LC5	lc	cbc	3.03	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
	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	1.18	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
	ROMMONB RSP2	lc	rommon	1.04	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	1.18	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
                    ROMMONB RSP2             lc   rommon      1.04        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       1.18        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
                    ROMMONB RSP2             lc   rommon      1.04        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         7.00        0.0       0.1
-------------------------------------------------------------------------------------------
A9K-BPID2-6-SLOT    Can Bus Ctrl (CBC) BP2   lc   cbc         7.00        0.0       0.1
-------------------------------------------------------------------------------------------
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-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-1X10GE-WL-V2    SPA FPGA swv1.9          spa  fpga1       1.09        0.0       0.0
-------------------------------------------------------------------------------------------
RP/0/RSP0/CPU0:PE44_ASR-9010(admin)#
```

Determining Your Software Version

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

Step 1 Establish a Telnet session with the router.

Step 2 Enter the **show version** command:

```
RP/0/RSP0/CPU0:PE44_ASR-9010#show version
Sun May  2 11:43:19.478 DST

Cisco IOS XR Software, Version 3.9.1[00]
Copyright (c) 2010 by Cisco Systems, Inc.

ROM: System Bootstrap, Version 1.4(20100216:021454) [ASR9K ROMMON],

PE44_ASR-9010 uptime is 3 weeks, 3 days, 19 hours, 53 minutes
System image file is "bootflash:disk0/asr9k-os-mbi-3.9.1/mbiasr9k-rp.vm"

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

2 Management Ethernet
```

```
40 GigabitEthernet
12 TenGigE
219k bytes of non-volatile configuration memory.
975M bytes of compact flash card.
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:
asr9k-scfclient, V 3.9.1[00], Cisco Systems, at disk0:asr9k-scfclient-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-adv-video, V 3.9.1[00], Cisco Systems, at disk0:asr9k-adv-video-3.9.1
    Built on Sun May  2  18:03:55 DST 2010
    By sjce-gf-078 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fpd, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fpd-3.9.1
    Built on Sun May  2  17:40:10 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-diags, V 3.9.1[00], Cisco Systems, at disk0:asr9k-diags-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-k9sec, V 3.9.1[00], Cisco Systems, at disk0:asr9k-k9sec-3.9.1
    Built on Sun May  2  17:52:31 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mgbl, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mgbl-3.9.1
    Built on Sun May  2  17:51:09 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mcast, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mcast-3.9.1
    Built on Sun May  2  17:49:57 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mpls, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mpls-3.9.1
    Built on Sun May  2  17:46:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-rout, V 3.9.1[00], Cisco Systems, at disk0:asr9k-rout-3.9.1
    Built on Sun May  2  17:40:08 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-lc, V 3.9.1[00], Cisco Systems, at disk0:asr9k-lc-3.9.1
    Built on Sun May  2  17:40:01 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fwdg, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fwdg-3.9.1
    Built on Sun May  2  17:29:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-admin, V 3.9.1[00], Cisco Systems, at disk0:asr9k-admin-3.9.1
    Built on Sun May  2  17:21:42 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-base, V 3.9.1[00], Cisco Systems, at disk0:asr9k-base-3.9.1
    Built on Sun May  2  17:24:43 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-os-mbi, V 3.9.1[00], Cisco Systems, at disk0:asr9k-os-mbi-3.9.1
```

```
    Built on Sun May  2  16:54:46 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

Boot device on node 0/1/CPU0 is mem:
Package active on node 0/1/CPU0:
asr9k-scfclient, V 3.9.1[00], Cisco Systems, at disk0:asr9k-scfclient-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-adv-video, V 3.9.1[00], Cisco Systems, at disk0:asr9k-adv-video-3.9.1
    Built on Sun May  2  18:03:55 DST 2010
    By sjce-gf-078 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fpd, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fpd-3.9.1
    Built on Sun May  2  17:40:10 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-diags, V 3.9.1[00], Cisco Systems, at disk0:asr9k-diags-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mcast, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mcast-3.9.1
    Built on Sun May  2  17:49:57 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mpls, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mpls-3.9.1
    Built on Sun May  2  17:46:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-lc, V 3.9.1[00], Cisco Systems, at disk0:asr9k-lc-3.9.1
    Built on Sun May  2  17:40:01 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fwdg, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fwdg-3.9.1
    Built on Sun May  2  17:29:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-admin, V 3.9.1[00], Cisco Systems, at disk0:asr9k-admin-3.9.1
    Built on Sun May  2  17:21:42 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-base, V 3.9.1[00], Cisco Systems, at disk0:asr9k-base-3.9.1
    Built on Sun May  2  17:24:43 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-os-mbi, V 3.9.1[00], Cisco Systems, at disk0:asr9k-os-mbi-3.9.1
    Built on Sun May  2  16:54:46 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

Boot device on node 0/4/CPU0 is mem:
Package active on node 0/4/CPU0:
asr9k-scfclient, V 3.9.1[00], Cisco Systems, at disk0:asr9k-scfclient-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-adv-video, V 3.9.1[00], Cisco Systems, at disk0:asr9k-adv-video-3.9.1
    Built on Sun May  2  18:03:55 DST 2010
    By sjce-gf-078 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fpd, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fpd-3.9.1
    Built on Sun May  2  17:40:10 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-diags, V 3.9.1[00], Cisco Systems, at disk0:asr9k-diags-3.9.1
```

```
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mcast, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mcast-3.9.1
    Built on Sun May  2  17:49:57 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mpls, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mpls-3.9.1
    Built on Sun May  2  17:46:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-lc, V 3.9.1[00], Cisco Systems, at disk0:asr9k-lc-3.9.1
    Built on Sun May  2  17:40:01 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fwdg, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fwdg-3.9.1
    Built on Sun May  2  17:29:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-admin, V 3.9.1[00], Cisco Systems, at disk0:asr9k-admin-3.9.1
    Built on Sun May  2  17:21:42 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-base, V 3.9.1[00], Cisco Systems, at disk0:asr9k-base-3.9.1
    Built on Sun May  2  17:24:43 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-os-mbi, V 3.9.1[00], Cisco Systems, at disk0:asr9k-os-mbi-3.9.1
    Built on Sun May  2  16:54:46 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

Boot device on node 0/6/CPU0 is mem:
Package active on node 0/6/CPU0:
asr9k-scfclient, V 3.9.1[00], Cisco Systems, at disk0:asr9k-scfclient-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-adv-video, V 3.9.1[00], Cisco Systems, at disk0:asr9k-adv-video-3.9.1
    Built on Sun May  2  18:03:55 DST 2010
    By sjce-gf-078 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fpd, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fpd-3.9.1
    Built on Sun May  2  17:40:10 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-diags, V 3.9.1[00], Cisco Systems, at disk0:asr9k-diags-3.9.1
    Built on Sun May  2  17:39:52 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mcast, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mcast-3.9.1
    Built on Sun May  2  17:49:57 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-mpls, V 3.9.1[00], Cisco Systems, at disk0:asr9k-mpls-3.9.1
    Built on Sun May  2  17:46:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-lc, V 3.9.1[00], Cisco Systems, at disk0:asr9k-lc-3.9.1
    Built on Sun May  2  17:40:01 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-fwdg, V 3.9.1[00], Cisco Systems, at disk0:asr9k-fwdg-3.9.1
    Built on Sun May  2  17:29:23 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0
```

```
asr9k-admin, V 3.9.1[00], Cisco Systems, at disk0:asr9k-admin-3.9.1
    Built on Sun May  2  17:21:42 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-base, V 3.9.1[00], Cisco Systems, at disk0:asr9k-base-3.9.1
    Built on Sun May  2  17:24:43 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

asr9k-os-mbi, V 3.9.1[00], Cisco Systems, at disk0:asr9k-os-mbi-3.9.1
    Built on Sun May  2  16:54:46 DST 2010
    By iox4 in /auto/ioxbuild8/production/3.9.1/asr9k/workspace for c4.2.1-p0

RP/0/RSP0/CPU0:PE44_ASR-9010#
```

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 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 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 introduces 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 introduces 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 introduces 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 introduces 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 introduces 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 introduces 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 introduces 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 introduces support on the Cisco ASR 9000 Series Router platform for Netflow. NetFlow is useful for the following:

  - Accounting/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 introduces 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 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 introduces 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 introduces 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 introduces 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 introduces 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 3.9.1). 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 adds 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 adds 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 introduces 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 introduces 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 adds 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 3.9.1 adds support on the Cisco ASR 9000 Series Router for LACP running over bundle member interfaces at intervals down to 100ms.

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

  Cisco IOS XR Software Release 3.9.0 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 3.9.1.

- L2 Multicast Limit

  Cisco IOS XR Software Release 3.9.0 adds 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 adds 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:RTP-VIKING-L2-8#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 adds 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 adds 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 adds 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 adds 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 100ms 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 adds 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 adds 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 adds 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 adds 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 adds 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 adds 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 introduces 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 Multipoint Layer 2 Bridging Services (VPLS) Commands on Cisco ASR 9000 Series Routers section in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference* here:

  http://www.cisco.com/en/US/docs/routers/asr9000/software/mpls/command/reference/grasr9kvpls.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 adds 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 adds 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:Green_RO(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 ,3.9.1 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 tunnels.
- For Cisco IOS XR software Release 3.9.0 and above the Cisco ASR 9000 Series Router does not support frame relay.
- **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
```

In the **pw-class class name encapsulation mpls** command the **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
```

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 3.9.1 and the Cisco ASR 9000 Series platform.

Open Cisco IOS XR Software Release 3.9.1 Caveats

The following caveats apply to the Cisco ASR 9000 Series Router running Release 3.9.1 of the Cisco IOS XR software:

- **CSCtf93555**

  Basic Description:

  CLI command not authorized to execute during persist time of EEM policy

  Symptom:

  After persist time start for EEM policy user, CLI command failed to authorize.

  Conditions:

  When the TACACS server is down, persist time starts for the user credentials which registered for EEM policy. If the EEM policy gets triggered and opens a vty connection and try to execute any CLI while the TACACS server is down, it failed to authorize that command.

  Workaround:

  None.

  Recovery:

  Bring the TACACS server up.

- **CSCte01589**

  Basic Description:

  Unable to execute commands through telnet session

Symptom:

First show command after telnet to the router prints incomplete output and then hangs. It does not respond to “ENTER”.

Conditions:

This happens after multiple VTY sessions being opened and closed at the same time.

Workaround:

None.

Recovery:

option 1

Create a new telnet session. FIRST command to execute from this session is “proc restart devc-vty”.

If all the telnet sessions are exhausted, terminate one of the sessions. This frees up a session to use for recovery.

OR

option 2

Connect to the router through a Console or AUX. Recover by executing “proc restart devc-vty” command.

- **CSCtd17516**

  Basic Description:

  CLI over XML Configuration Fails

  Symptom:

  CLI over XML configuration request fails.

  Conditions:

  This happens when

  - CLI command lines in XML request exceeds 200 lines or more

  AND

  - CLI commands are split internally and it happens to be split in middle of sub-mode.

  Workaround:

  - No need to use CLI over XML for config commands that already support XML natively.

  - Split the commands into multiple requests so that command lines of each request are less than 200 lines.

  Recovery:

  None.

- **CSCtf72035**

  Basic Description:

  XML query equivalent to “show version | in uptime” is broken

  Symptom:

  XML request echoes an error in response.

  Conditions:

  Perform XML query equivalent to “show version | in uptime”.

Workaround:

None, use CLI instead.

Recovery:

None.

- **CSCsy98575**

  Basic Description:

  %SECURITY-LOCALD-3-LWA_ADD_FAIL error when Secret is added for a User

  Symptom:

  When a user tries to configure username and secret, the configuration succeeds, but the following console message is generated, which seems to suggest that the configuration did not succeed:

  "% Failed to commit one or more configuration items. Please issue 'show configuration failed' from this session to view the errors"

  Conditions:

  No specific trigger is identified. This is an issue that has been observed a handful of times over several months.

  Workaround:

  None. Although we get the configuration failure message, operation is successful both on disk and as well as in Sysdb. No Operational Impact of this bug to other parts of this system since it is purely a configuration operation failure.

  Recovery:

  Do not need. Console message only, no functional impact.

- **CSCta71930**

  Basic Description:

  lpts_pa tracebacks after clear cef on line card

  Symptom:

  An error log is printed along with the traceback when a message send to BCDL agent fails.

  Conditions:

  The BCDL agent has gone down thus the message send is failing. This is a very rare scenario and would not happen under normal circumstances.

  Workaround:

  Not required, as BCDL will come up eventually.

  Further Problem Description:

  The error message is just to say that BCDL agent might have gone down. This would not cause an error in lpts as BDCL will eventually come up and the messages will be sent again. The only caveat is that it might be some time before the messages are sent again. The solution would aim to put an upper bound on the resend time by having a retrying mechanism for the same.

- **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 caveat is specific to the Cisco ASR 9000 Series platform:

- **CSCtg34390**

  Basic Description:

  crash file created on “reload location all”: Cause: pfm_dev_sm_perform_

  Symptom:

  No active RSP condition detected by the LC resulting in a PFM initiated reboot and kernel dump generation during reload of chassis.

  As a result, an extra reboot history record is written (IOS-XR CLI: show reboot history location LC).

  The first reboot history record will be written by the mbi-hello process which is initiated by the reload CLI. A second reboot history record will be written by the PFM process. The timestamp on the records will be 8-10 seconds apart.

  Conditions:

  Reload of chassis on certain nodes using “reload location all” CLI.

  Workaround:

  None.

- **CSCth19069**

  EoMPLS remote ethernet port shutdown not working.

  Symptom:

  EoMPLS remote ethernet port shutdown is not working.

  Conditions:

  None

  Workaround:

  None

Resolved Cisco IOS XR Software PSIRT-Related Caveats

- **CSCti62211**

  Basic Description:

  BGP flaps due to unknown attribute

Symptom:

Cisco IOS XR Software contains a vulnerability in the Border Gateway Protocol (BGP) feature. The vulnerability manifests itself when a BGP peer announces a prefix with a specific, valid but unrecognized transitive attribute. On receipt of this prefix, the Cisco IOS XR device will corrupt the attribute before sending it to the neighboring devices. Neighboring devices that receive this corrupted update may reset the BGP peering session.

Conditions:

Affected devices running Cisco IOS XR Software corrupt the unrecognized attribute before sending to neighboring devices, but neighboring devices may be running operating systems other than Cisco IOS XR Software and may still reset the BGP peering session after receiving the corrupted update. This is per standards defining the operation of BGP.

Workaround:

No workaround. Cisco developed a fix that addresses this vulnerability and will be releasing free software maintenance upgrades (SMUs) progressively starting 28 August 2010.

A Security Advisory is posted at
http://www.cisco.com/warp/public/707/cisco-sa-20100827-bgp.shtml

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 3.9.1 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:PE44_ASR-9010# run nvgen -F 1
```

b. Create a dummy config commit:

```
RP/0/RSP0/CPU0:PE44_ASR-9010# config
RP/0/RSP0/CPU0:PE44_ASR-9010(config)# hostname <hostname>
RP/0/RSP0/CPU0:PE44_ASR-9010(config)# commit
RP/0/RSP0/CPU0:PE44_ASR-9010(config)# end
```

c. Force a commit update by using the **reload** command. Press "**n**" when the confirmation prompt appears:

```
RP/0/RSP0/CPU0:PE44_ASR-9010# 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:PE44_ASR-9010# 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, 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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