Release Notes for Cisco ASR 9000 Series Aggregation Services Routers for Cisco IOS XR Software Release 4.3.14.3.2

NCS 6000 Series Router Key Features [Infographic]

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

Note For information on Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.14.3.2, see the Features Supported on the Cisco ASR 9000 Series Aggregation Services Router section.

These release notes describe the features provided on the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.14.3.2 and are updated as needed.

For a list of software caveats that apply to the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.14.3.2, see the Caveats, on page 67 section. The caveats are updated for every release and are described at http://www.cisco.com.

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 (VRRP) features.
- **Ethernet Services—**The following Ethernet features are supported:
  - 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—**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) [including TE-FRR and TW 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 Aggregation Services 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 Aggregation Services 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—**This provides industry-standard management interfaces including modular command-line interface (CLI), Simple Network Management Protocol (SNMP), and native Extensible Markup Language (XML) interfaces. Includes a comprehensive set of Syslog messages.
- **Security—**This provides comprehensive network security features including 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 management plane security, and Simple Network Management Protocol version3 (SNMPv3). Control plane protections integrated into line card Application-Specific Integrated Circuits (ASICs) include Generalized TTL Security Mechanism (GTSM), RFC 3682, and Dynamic Control Plane Protection (DCPP).

- **Availability—**This supports rich availability features such as fault containment, fault tolerance, fast switchover, link aggregation, nonstop routing for ISIS, LDP 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)
  - IP fast convergence with Fast Reroute (FRR) support for Open Shortest Path First (OSPF)
  - Path Computation Element (PCE) capability for traffic engineering

System Requirements

This section describes the system requirements for Cisco ASR 9000 Series Aggregation Services Router Software Release .

To determine the software versions or levels of your current system, see the Determining Your Software Version, on page 30 section.

Feature Set Table

The Cisco ASR 9000 Series Aggregation Services Router Software is packaged in *feature sets* (also called *software images*). Each feature set contains a specific set of Cisco ASR 9000 Series Aggregation Services Router Software Release 4.3.14.3.2

Table 1: Cisco IOS XR Software Release 4.3.14.3.2 PX PIE Files, on page 3 lists the Cisco ASR 9000 Series Aggregation Services Router Software feature set matrix (PX PIE files) and associated filenames available for the Release 4.3.14.3.2 supported on the Cisco ASR 9000 Series Aggregation Services Router.

Table 1: Cisco IOS XR Software Release 4.3.14.3.2 PX PIE Files

Feature Set	Filename	Description

Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	asr9k-mini-px.pie-4.3.1	Contains the required core packages, including OS, Admin, Base, Forwarding, Modular Services Card, Routing, SNMP Agent, and Alarm Correlation.
Cisco IOS XR IP Unicast Routing Core Bundle	asr9k-mini-px.vm-4.3.1	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 (Packages are installed individually)		
Cisco IOS XR Manageability Package	asr9k-mgbl-px.pie-4.3.1	CORBA2 agent, XML3 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-px.pie-4.3.1	MPLS Traffic Engineering (MPLS-TE), Label Distribution Protocol (LDP), MPLS Forwarding, MPLS Operations, Administration, and Maintenance (OAM), Link Manager Protocol (LMP), Optical User Network Interface (OUNI), Resource Reservation Protocol (RSVP), and Layer-3 VPN.
Cisco IOS XR Multicast Package	asr9k-mcast-px.pie-4.3.1	Multicast Routing Protocols (PIM, Multicast Source Discovery Protocol [MSDP], Internet Group Management Protocol [IGMP], Auto-RP), Tools (SAP, MTrace), and Infrastructure [(Multicast Routing Information Base [MRIB], Multicast-Unicast RIB [MURIB], Multicast forwarding [MFWD]), and Bidirectional Protocol Independent Multicast (BIDIR-PIM).

Cisco IOS XR Security Package	asr9k-k9sec-px.pie-4.3.1	Support for Encryption, Decryption, IP Security (IPSec), Secure Shell (SSH), Secure Socket Layer (SSL), and Public-key infrastructure (PKI) (Software based IPSec support—maximum of 500 tunnels)
Cisco IOS XR Advanced Video Package	asr9k-video-px.pie-4.3.1	Firmware for the advanced video feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Optics Package	asr9k-optic-px.pie-4.3.1	Firmware for the optics feature for Cisco ASR 9000 Series Aggregation Services Router Chassis. It enables Transport / OTN feature under interfaces.
Cisco IOS XR FPD Package	asr9k-fpd-px.pie-4.3.1	Firmware pie for all LC and RSP FPGA's and ASIC's.
Cisco IOS XR Documentation Package	asr9k-doc-px.pie-4.3.1	.man pages for Cisco IOS XR Software on the Cisco ASR 9000 Series Aggregation Services Router Chassis.
Cisco IOS XR Services Package	asr9k-services-px.pie-4.3.1	Includes binaries to support CGv6 on ISM.
Cisco IOS XR Satellite Package	asr9000v-nV-px.pie-4.3.1	Includes Satellite software images.
Cisco IOS XR BNG Package	asr9k-bng-px.pie-4.3.1	Includes binaries to support BNG features.
Cisco IOS XR Cisco ASR 903 Series Router Package	asr9k-asr903-nV-px.pie-4.3.1	Includes binaries to support Cisco ASR 903 Series Router software.
Cisco IOS XR Cisco ASR 901 Series Router Package	asr9k-asr901-nV-px.pie-4.3.1	Includes binaries to support Cisco ASR 901 Series Router software.

Caution PX PIE image files are the only option on all ASR9000 platforms including RSP-2 and ASR9001 starting from Cisco IOS XR Software Release 4.3.0.

Starting Cisco IOS XR Software Release 4.3.0 of the Cisco ASR 9000 Aggregation Services Router platform, P images are no longer supported. The P images are now converged with PX. Through the normal upgrade process the migration will happen to PX.

Table 2: Cisco IOS XR Software Release 4.3.14.3.2TAR Files, on page 6 lists the Cisco ASR 9000 Series Aggregation Services Router TAR files.

Table 2: Cisco IOS XR Software Release 4.3.14.3.2TAR Files

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software [for RSP440 systems]	ASR9K-iosxr-px-4.3.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR 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

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software 3DES [for RSP440 systems]	ASR9K-iosxr-px-k9-4.3.1.tar	• Cisco IOS XR IP Unicast Routing Core Bundle • Cisco IOS XR Manageability Package • Cisco IOS XR MPLS Package • Cisco IOS XR Multicast Package • Cisco IOS XR Security Package • 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 Aggregation Services Router running Cisco IOS XR Software Release 4.3.14.3.2 consist of the following:

- minimum 6-GB memory on the RSP-440 and ASR9922 RP [A9K-RSP-4G and A9K-RSP-8G is 4-GB]
- maximum 12-GB memory on the RSP-440 and ASR9922 RP [A9K-RSP-4G and A9K-RSP-8G is 4-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.

The supported ASR9K low memory and high memory RSP card PIDs are :

Description	PID	Release
ASR 9922 Route Processor 6GB for Packet Transport	ASR-9922-RP-TR	
ASR 9922 Route Processor 12GB for Service Edge	ASR-9922-RP-SE	
ASR9001 Route Switch Processor 8GB	—	Release 4.2.1
ASR9K Route Switch Processor with 440G/slot Fabric and 6GB	A9K-RSP440-TR	Release 4.2.0
ASR9K Route Switch Processor with 440G/slot Fabric and 12GB	A9K-RSP440-SE	Release 4.2.0
ASR9K Fabric, Controller 4G memory	A9K-RSP-4G	Release 3.7.2
Route Switch Processor 8G Memory	A9K-RSP-8G	Release 3.7.2
ASR 9900 Route Processor 12GB for Service Edge	ASR-9900-RP-SE	Release 4.3.2
ASR 9900 Route Processor 6GB for Packet Transport	ASR-9900-RP-TR	Release 4.3.2

RSP Memory Upgrade

This section describes the process to upgrade the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a small memory model ASR-9922-RP-TR RSP card to a large memory model ASR-9922-RP-SE RSP card.

The upgrade sequence is as follows:

Procedure

Step 1 Remove the standby small memory (ASR-9922-RP-TR) RSP card.

Step 2 Insert the large memory (ASR-9922-RP-SE) RSP card.

Step 3 Boot up the large memory (ASR-9922-RP-SE) RSP card so that it comes up as standby.

Step 4 Failover from the active small memory (ASR-9922-RP-TR) RSP card to the standby large memory (ASR-9922-RP-SE) RSP card.

Step 5 Remove the standby small memory (ASR-9922-RP-TR) RSP card.

Step 6 Insert the second large memory (ASR-9922-RP-SE) RSP card. Boot up this second large memory (ASR-9922-RP-SE) RSP card so that it comes up as standby.

Upgrading from A9K-RSP440-TR to A9K-RSP440-SE RSP

The process to upgrade the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a small memory model A9K-RSP440-TR RSP card to a large memory model A9K-RSP440-SE RSP card is as follows:

Procedure

Step 1 Remove the standby small memory A9K-RSP440-TR RSP card.

Step 2 Insert the large memory A9K-RSP440-SE RSP card.

Step 3 Boot up the large memory A9K-RSP440-SE RSP card so that it comes up as standby.

Step 4 Failover from the active small memory A9K-RSP440-TR RSP card to the standby large memory A9K-RSP440-SE RSP card.

Step 5 Remove the standby small memory A9K-RSP440-TR RSP card.

Step 6 Insert the second large memory A9K-RSP440-SE RSP card. Boot up this second large memory A9K-RSP440-SE RSP card so that it comes up as standby.

Upgrading from A9K-RSP-4G RSP to A9K-RSP-8G RSP

The process to upgrade the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a small memory model A9K-RSP-4G RSP card to a large memory model A9K-RSP-8G RSP card is as follows:

Procedure

Step 1 Remove the standby small memory A9K-RSP-4G RSP card.

Step 2 Insert the large memory A9K-RSP-8G RSP card.

Step 3 Boot up the large memory A9K-RSP-8G RSP card so that it comes up as standby.

Step 4 Failover from the active small memoryA9K-RSP-4G RSP card to the standby large memory A9K-RSP-8G RSP card.

Step 5 Remove the standby small memoryA9K-RSP-4G RSP card.

Step 6 Insert the second large memory A9K-RSP-8G RSP card. Boot up this second large memory A9K-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 Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a large memory model ASR-9922-RP-SE RSP card to a small memory model ASR-9922-RP-TR RSP card.

Caution Before attempting an RSP memory downgrade, measure the memory consumption of the current system configuration using the large memory model ASR-9922-RP-SE RSP card. You need to ensure that the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 is still able to run the system configuration using the small memory model ASR-9922-RP-TR RSP card.

The RSP memory downgrade sequence is as follows:

Procedure

Step 1 Verify that the memory consumption on the active large memory model (ASR-9922-RP-SE) RSP card can fit within the memory constraints of the small memory model (ASR-9922-RP-TR) RSP card.

Step 2 Remove the standby large memory model (ASR-9922-RP-SE) RSP card.

Step 3 Insert the small memory model (ASR-9922-RP-TR) RSP card. The system does not boot up the small memory model (ASR-9922-RP-TR) RSP card by default. Send user command to boot up the small memory model (ASR-9922-RP-TR) RSP card as standby.

Step 4 Failover from the active large memory model (ASR-9922-RP-SE) RSP card to the standby small memory model (ASR-9922-RP-TR) RSP card.

Step 5 Remove the standby large memory model (ASR-9922-RP-SE) RSP card.

Step 6 Insert the small memory model (ASR-9922-RP-TR) RSP card. Boot up this second small memory model (ASR-9922-RP-TR) RSP card as standby.

Downgrading from A9K-RSP440-SE to A9K-RSP440-TR

The process to downgrade the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a large memory model A9K-RSP440-SE RSP card to a small memory model A9K-RSP440-TR RSP card is as follows:

Procedure

Step 1 Verify that the memory consumption on the active large memory model A9K-RSP440-SE RSP card can fit within the memory constraints of the small memory model A9K-RSP440-TR RSP card.

Step 2 Remove the standby large memory model A9K-RSP440-SE RSP card.

Step 3 Insert the small memory model A9K-RSP440-TR RSP card. The system does not boot up the small memory model A9K-RSP440-TR RSP card by default. Send user command to boot up the small memory model A9K-RSP440-TR RSP card as standby.

Step 4 Failover from the active large memory model A9K-RSP440-SE RSP card to the standby small memory model A9K-RSP440-TR RSP card.

Step 5 Remove the standby large memory model A9K-RSP440-SE RSP card.

Step 6 Insert the small memory model A9K-RSP440-TR RSP card. Boot up this second small memory model A9K-RSP440-TR RSP card as standby.

Downgrading from A9K-RSP-8G to A9K-RSP-4G

The process to downgrade the Cisco ASR 9000 Series Aggregation Services Router running Cisco IOS XR Software Release 4.3.1 from a large memory model A9K-RSP-8G RSP card to a small memory model A9K-RSP-4G RSP card is as follows:

Procedure

Step 1 Verify that the memory consumption on the active large memory model A9K-RSP-8G RSP card can fit within the memory constraints of the small memory model A9K-RSP-4G RSP card.

Step 2 Remove the standby large memory model A9K-RSP-8G RSP card.

Step 3 Insert the small memory model A9K-RSP-4G RSP card. The system does not boot up the small memory model A9K-RSP-4G RSP card by default. Send user command to boot up the small memory model A9K-RSP-4G RSP card as standby.

Step 4 Failover from the active large memory model A9K-RSP-8G RSP card to the standby small memory model A9K-RSP-4G RSP card.

Step 5 Remove the standby large memory model A9K-RSP-8G RSP card.

Step 6 Insert the small memory model A9K-RSP-4G RSP card. Boot up this second small memory model A9K-RSP-4G RSP card as standby.

Supported Hardware

Cisco IOS XR Software Release supports Cisco ASR 9000 Series Aggregation Services Routers.

All hardware features are supported on Cisco IOS XR Software, subject to the memory requirements specified in the "Memory Requirements, on page 7" section.

The following tables lists the supported hardware components on the Cisco ASR 9000 Series Router and the minimum required software versions. For more information, see the Firmware Support, on page 19 section.

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

Component	Part Number	Support from Version
Cisco ASR 9000 Series Aggregation Services Router 22-Slot		
Cisco ASR 9000 Series Aggregation Services Router 22-Slot 20 Line Card Slot AC Chassis w/ PEM V2	ASR-9922-AC	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot 20 Line Card Slot DC Chassis w/ PEM V2	ASR-9922-DC	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Accessory Kit with grounding locks, guide rails etc	ASR-9922-ACC-KIT	NA
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Accessory - Cover for Power Shelves and Modules	ASR-9922-PWR-COV	NA
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Air Reflector	ASR-9922-AIRREF	NA
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Accessory - Door (with lock) and Fan Tray Covers	ASR-9922-DOOR	NA
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Fan Tray	ASR-9922-FAN	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Air Filter with Media, Center	ASR-9922-FLTR-CEN	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Air Filter with Media, Left & Right	ASR-9922-FLTR-LR	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor Filler	ASR-9922-RP-FILR	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor 12GB for Service Edge	ASR-9922-RP-SE	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor 6GB for Packet Transport	ASR-9922-RP-TR	
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Switch Fabric Card Slot Filler	ASR-9922-SFC-FILR	

Cisco ASR 9000 Series Aggregation Services Router 22-Slot Switch Fabric Card/110G	ASR-9922-SFC110	
Cisco ASR 9000 Series Aggregation Services Router 2-RU		
Cisco ASR 9000 Series Aggregation Services Router 2-Slot Route Processor	—	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router 2-Slot Fan Tray	ASR-9001-FAN	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router 2-Slot Line Card	ASR-9001-LC	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router	ASR-9001-TRAY	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router 6-Slot		
Cisco ASR 9000 Series Aggregation Services Router 6-Slot System	ASR-9006	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 6-Slot Fan Tray	ASR-9006-FAN	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 6-Slot Door Kit	ASR-9006-DOOR	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 6-Slot AC Chassis	ASR-9006-AC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 6-Slot DC Chassis	ASR-9006-DC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 6-Slot Air		
Cisco ASR 9000 Series Aggregation Services Router 6-Slot Air Filter	ASR-9006-FILTER	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot		
Cisco ASR 9000 Series Aggregation Services Router 10-Slot System	ASR-9010	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot Fan Tray	ASR-9010-FAN	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot Door Kit	ASR-9010-DOOR	Release 3.7.2

Cisco ASR 9000 Series Aggregation Services Router 10-Slot AC Chassis	ASR-9010-AC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot DC Chassis	ASR-9010-DC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 2 Post Mounting Kit	ASR-9010-2P-KIT	Release 3.7.2
Cisco ASR 9000 Series Aggregration Services Router 4 Post Mounting Kit	ASR-9010-2P-KIT	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot Air		
Cisco ASR 9000 Series Aggregation Services Router 10-Slot Air Filter	ASR-9010-FILTER	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 10-Slot External Exhaust Air Shaper	ASR-9010-AIRSHPR	NA
Cisco ASR 9000 Series Aggregation Services Router 10-Slot Air Inlet Grill	ASR-9010-GRL	NA
Cisco ASR 9000 Series Aggregation Services Router Power		
Cisco ASR 9000 Series Aggregation Services Router 2KW DC Power Module, version 2	A9K-2KW-DC-V2	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 3KW AC Power Module, version 2	A9K-3KW-AC-V2	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router AC Power Entry Module Version 2	A9K-AC-PEM-V2	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router DC Power Entry Module Version 2	A9K-DC-PEM-V2	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router Power Entry Module Version 2 Filler	A9K-PEM-V2-FILR	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 1.5kW DC Power Module	A9K-1.5KW-DC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 2kW DC Power Module	A9K-2KW-DC	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 3kW AC Power Module	A9K-3KW-AC	Release 3.7.2

Cisco ASR 9000 Series Aggregation Services Router Line Cards		
Cisco ASR 9000 Series Aggregation Services Router 1-port 100GE, Service Edge Optimized	A9K-1X100GE-SE	
Cisco ASR 9000 Series Aggregation Services Router 1-port 100GE, Packet Transport Optimized	A9K-1X100GE-TR	
Cisco ASR 9000 Series Aggregation Services Router 36-port 10GE, Service Edge Optimized	A9K-36X10GE-SE	
Cisco ASR 9000 Series Aggregation Services Router 36-port 10GE, Packet Transport Optimized LC	A9K-36X10GE-TR	
Cisco ASR 9000 Series Aggregation Services Router 2-Port Ten Gigabit Ethernet + Cisco ASR 9000 Series Aggregation Services Router 20-Port Gigabit Ethernet, Medium Queue	A9K-2T20GE-B	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 2-Port Ten Gigabit Ethernet + Cisco ASR 9000 Series Aggregation Services Router 20-Port Gigabit Ethernet, High Queue	A9K-2T20GE-E	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 4-Port Ten Gigabit Ethernet, Medium Queue	A9K-4T-B	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 4-Port Ten Gigabit Ethernet Extended Line Card, High Queue	A9K-4T-E	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 4-Port Ten Gigabit Ethernet, Low Queue	A9K-4T-L	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten Gigabit Ethernet, 80G Line Rate Extended Line Card, Medium Queue	A9K-8T-B	Release 4.0.1
Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten Gigabit Ethernet, 80G Line Rate Extended Line Card, High Queue	A9K-8T-E	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten Gigabit Ethernet, 80G Line Rate Extended Line Card, Low Queue	A9K-8T-L	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten Gigabit Ethernet, Medium Queue	A9K-8T/4-B	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten GE DX Extended Line Card, High Queue	A9K-8T/4-E	Release 3.7.2

Cisco ASR 9000 Series Aggregation Services Router 8-Port Ten Gigabit Ethernet, Low Queue	A9K-8T/4-L	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router 16-Port Ten Gigabit Ethernet, Medium Queue	A9K-4T-B	Release 4.0.1
Cisco ASR 9000 Series Aggregation Services Router 40-Port Ten Gigabit Ethernet, Medium Queue	A9K-40GE-B	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 40-Port Ten Gigabit Ethernet, High Queue	A9K-40GE-E	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router 40-Port Ten Gigabit Ethernet, Low Queue	A9K-40GE-L	Release 3.9.0
Cisco ASR 9000 Series Aggregation Services Router Line Card Filler	A9K-LC-FILR	Release 3.7.2
ISM (Integrated Service Module) Line Card	A9K-ISM-100	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 2-Port Hundred Gigabit Ethernet, Service Edge Optimized	A9K-2X100GE-SE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 2-Port Hundred Gigabit Ethernet, Packet Transport Optimized	A9K-2X100GE-TR	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 24-Port Ten Gigabit Ethernet, Service Edge Optimized	A9K-24X10GE-SE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 24-Port Ten Gigabit Ethernet, Packet Transport Optimized	A9K-24X10GE-TR	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router Modular Line Cards		
Cisco ASR 9000 Series Aggregation Services Router 80 Gig Modular Line Card, Service Edge Optimized	A9K-MOD80-SE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 80 Gig Modular Line Card, Packet Transport Optimized	A9K-MOD80-TR	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 160 Gig Modular Line Card, Service Edge Optimized	A9K-MOD160-SE	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router 160 Gig Modular Line Card, Packet Transport Optimized	A9K-MOD160-TR	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router Modular Port Adapters (MPAs)		
Cisco ASR 9000 Series Aggregation Services Router 1-port 40GE Modular Port Adapter	A9K-MPA-1X40GE	Release 4.2.3

Cisco ASR 9000 Series Aggregation Services Router 4-port 10GE Modular Port Adapter	A9K-MPA-4X10GE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 20-port 1GE Modular Port Adapter	A9K-MPA-20X1GE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 2-port 10GE Modular Port Adapter	A9K-MPA-2X10GE	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router 2-port 40GE Modular Port Adapter	A9K-MPA-2X40GE	Release 4.2.1
Cisco ASR 9000 Series Aggregation Services Router Route Switch Processor Cards		
Cisco ASR 9000 Series Aggregation Services Router Route Switch Processor, 4G Memory	A9K-RSP-4G	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router Route Switch Processor, 8G Memory	A9K-RSP-8G	Release 4.0.1
Cisco ASR 9000 Series Aggregation Services Router Route Switch Processor Filler	ASR-9000-RSP-FILR	Release 3.7.2
Cisco ASR 9000 Series Aggregation Services Router Next Generation Route Switch Processor, Service Edge Optimized	A9K-RSP-440-SE	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router Next Generation Route Switch Processor, Packet Transport Optimized	A9K-RSP-440-TR	Release 4.2.0
Cisco ASR 9000 Series Aggregation Services Router 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 4.1.0
8-Port Channelized T1/E1 SPA	SPA-8XCHT1/E1	Release 4.1.0
1-Port and 3-Port Clear Channel OC-3 ATM SPA	SPA-1/3XOC3ATM	Release 4.2.0
1-Port Clear Channel OC-12 ATM SPA	SPA-1XOC12ATM	Release 4.2.0
1-Port Channelized OC-3 ATM CEoP SPA	SPA-1XOC3-CE-ATM	Release 4.2.0

Software Compatibility

Cisco IOS XR Software Release 4.3.1 is compatible with the following Cisco ASR 9000 Series Aggregation Services Router systems.

- Cisco ASR 9000 Series Aggregation Services Router 6-Slot Line Card Chassis
- Cisco ASR 9000 Series Aggregation Services Router 10-Slot Line Card Chassis
- Cisco ASR 9000 Series Aggregation Services Router 22-Slot Line Card Chassis
- Cisco ASR 9000 Series Aggregation Services Router ASR-9001 Chassis

Table 4: Cisco ASR 9000 Series Aggregation Services Router Supported Software Licenses

Software License	Part Number
Cisco ASR 9000 Series Aggregation Services Router iVRF License	A9K-IVRF-LIC
Cisco ASR 9000 Series Aggregation Services Router Per Chassis Advanced Video License	A9K-ADV-VIDEO-LIC
Cisco ASR 9000 Series Aggregation Services Router Per Line Card Advanced Optical License	A9K-ADV-OPTIC-LIC
Cisco ASR 9000 Series Aggregation Services Router L3VPN License, Medium Queue and Low Queue Line Cards	A9K-AIP-LIC-B
Cisco ASR 9000 Series Aggregation Services Router 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:router#LC/0/0/CPU0:Dec 15 17:57:53.653 : rsi_agent[247]:
%LICENSE-ASR9K_LICENSE-2-INFRA_VRF_NEEDED : 5 VRF(s) are configured without license
A9K-iVRF-LIC in violation of the Software Right To Use Agreement. This feature may be
disabled by the system without the appropriate license. Contact Cisco to purchase the
license immediately to avoid potential service interruption.
```

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 Aggregration Services Router Right-To-Use (RTU) Licensing

Here are on-line locations of the Cisco ASR 9000 Series Aggregation Services Router 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 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.

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.

Firmware Support

To check the firmware code running on the Cisco ASR 9000 Series Router, run the **show fpd package** command in admin mode.

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.

```
RP/0/RSP0/CPU0:router(admin)#show fpd package

=============================== ================================================
                                        Field Programmable Device Package
                                ================================================
                                                                SW      Min Req   Min Req
Card Type            FPD Description            Type Subtype  Version   SW Ver    HW Vers
==================== ========================== ==== ======= =========== ======== =========
A9K-40GE-B           Can Bus Ctrl (CBC) LC2     lc   cbc         2.03       0.00      0.1

                     CPUCtrl LC2                lc   cpld1       1.00       0.00      0.1

                     PHYCtrl LC2                lc   cpld2       0.06       0.00      0.1

                     PortCtrl LC2               lc   fpga2       0.10       0.00      0.1
```

	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-4T-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	PHY LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-8T/4-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	PHY LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-2T20GE-B	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.11	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.10	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.16	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-40GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-4T-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1

	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	PHY LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-8T/4-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	PHY LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-2T20GE-E	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.11	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.10	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.16	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-8T-B	Can Bus Ctrl (CBC) LC3	lc	cbc	6.07	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.03	0.00	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.00	0.1
	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-16T/8-B	Can Bus Ctrl (CBC) LC3	lc	cbc	6.08	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.04	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.01	0.00	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.01	0.00	0.1

	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-8T-E	Can Bus Ctrl (CBC) LC3	lc	cbc	6.07	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.03	0.00	0.1
	CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.00	0.1
	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-16T/8-E	Can Bus Ctrl (CBC) LC3	lc	cbc	6.08	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.04	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.01	0.00	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.01	0.00	0.1
	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-40GE-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.06	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-4T-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	Serdes Upgrade LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-8T/4-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1

	PHYCtrl LC2	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.03	0.00	0.1
	PortCtrl LC2	lc	fpga2	0.10	0.00	0.1
	Serdes Upgrade LC2	lc	fpga3	14.44	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-2T20GE-L	Can Bus Ctrl (CBC) LC2	lc	cbc	2.03	0.00	0.1
	CPUCtrl LC2	lc	cpld1	1.00	0.00	0.1
	PHYCtrl LC2	lc	cpld2	0.11	0.00	0.1
	LCClkCtrl LC2	lc	cpld3	0.10	0.00	0.1
	Tomcat LC2	lc	fpga2	0.16	0.00	0.1
	Bridge LC2	lc	fpga1	0.44	0.00	0.1
	ROMMONB LC2	lc	rommon	1.05	0.00	0.1
A9K-8T-L	Can Bus Ctrl (CBC) LC3	lc	cbc	6.07	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.08	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.03	0.00	0.1
	CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.11	0.00	0.1
	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-16T/8-L	Can Bus Ctrl (CBC) LC3	lc	cbc	6.08	0.00	0.1
	CPUCtrl LC3	lc	cpld1	1.02	0.00	0.1
	PHYCtrl LC3	lc	cpld2	0.04	0.00	0.1
	LCClkCtrl LC3	lc	cpld3	0.01	0.00	0.1
	DB CPUCtrl LC3	lc	cpld4	1.03	0.00	0.1
	PortCtrl LC3	lc	fpga2	0.01	0.00	0.1
	Raven LC3	lc	fpga1	1.03	0.00	0.1
	ROMMONB LC3	lc	rommon	1.03	0.00	0.1
A9K-SIP-700	Can Bus Ctrl (CBC) LC5	lc	cbc	3.06	0.00	0.1
	CPUCtrl LC5	lc	cpld1	0.15	0.00	0.1
	QFPCPUBridge LC5	lc	fpga2	5.14	0.00	0.1
	NPUXBarBridge LC5	lc	fpga1	0.23	0.00	0.1
	ROMMONB LC5	lc	rommon	1.04	0.00	0.1

```
A9K-SIP-500          Can Bus Ctrl (CBC) LC5     lc   cbc         3.06        0.00       0.1
                     CPUCtrl LC5                lc   cpld1       0.15        0.00       0.1
                     QFPCPUBridge LC5           lc   fpga2       5.14        0.00       0.1
                     NPUXBarBridge LC5          lc   fpga1       0.23        0.00       0.1
                     ROMMONB LC5                lc   rommon      1.04        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-SIP-700-8G       Can Bus Ctrl (CBC) LC5     lc   cbc         3.06        0.00       0.1
                     CPUCtrl LC5                lc   cpld1       0.15        0.00       0.1
                     QFPCPUBridge LC5           lc   fpga2       5.14        0.00       0.1
                     NPUXBarBridge LC5          lc   fpga1       0.23        0.00       0.1
                     ROMMONB LC5                lc   rommon      1.35        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-RSP-2G           Can Bus Ctrl (CBC) RSP2    lc   cbc         1.03        0.00       0.1
                     CPUCtrl RSP2               lc   cpld2       1.18        0.00       0.1
                     IntCtrl RSP2               lc   fpga2       1.15        0.00       0.1
                     ClkCtrl RSP2               lc   fpga3       1.23        0.00       0.1
                     UTI RSP2                   lc   fpga4       3.08        0.00       0.1
                     PUNT RSP2                  lc   fpga1       1.05        0.00       0.1
                     ROMMONB RSP2               lc   rommon      1.06        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-RSP-4G           Can Bus Ctrl (CBC) RSP2    lc   cbc         1.03        0.00       0.1
                     CPUCtrl RSP2               lc   cpld2       1.18        0.00       0.1
                     IntCtrl RSP2               lc   fpga2       1.15        0.00       0.1
                     ClkCtrl RSP2               lc   fpga3       1.23        0.00       0.1
                     UTI RSP2                   lc   fpga4       3.08        0.00       0.1
                     PUNT RSP2                  lc   fpga1       1.05        0.00       0.1
                     ROMMONB RSP2               lc   rommon      1.06        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-RSP-8G           Can Bus Ctrl (CBC) RSP2    lc   cbc         1.03        0.00       0.1
                     CPUCtrl RSP2               lc   cpld2       1.18        0.00       0.1
                     IntCtrl RSP2               lc   fpga2       1.15        0.00       0.1
                     ClkCtrl RSP2               lc   fpga3       1.23        0.00       0.1
                     UTI RSP2                   lc   fpga4       3.08        0.00       0.1
                     PUNT RSP2                  lc   fpga1       1.05        0.00       0.1
                     ROMMONB RSP2               lc   rommon      1.06        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-RSP440-TR        Can Bus Ctrl (CBC) RSP3    lc   cbc        16.115       0.00       0.1
                     ClockCtrl0 RSP3            lc   fpga2       1.06        0.00       0.1
                     UTI RSP3                   lc   fpga3       4.09        0.00       0.1
```

	CPUCtrl RSP3	lc	fpga1	0.09	0.00	0.1
	ROMMONB RSP3	lc	rommon	0.70	0.00	0.1
A9K-RSP440-SE	Can Bus Ctrl (CBC) RSP3	lc	cbc	16.115	0.00	0.1
	ClockCtrl0 RSP3	lc	fpga2	1.06	0.00	0.1
	UTI RSP3	lc	fpga3	4.09	0.00	0.1
	CPUCtrl RSP3	lc	fpga1	0.09	0.00	0.1
	ROMMONB RSP3	lc	rommon	0.70	0.00	0.1
ASR-9922-RP-TR	Can Bus Ctrl (CBC) MTRP	lc	cbc	25.02	0.00	0.1
	Fabric Ctrl3 MTFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl4 MTFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl5 MTFC	lc	fpga12	1.01	0.00	0.1
	Fabric Ctrl6 MTFC	lc	fpga13	1.01	0.00	0.1
	CPUCtrl1	lc	fpga2	1.03	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	IntCtrl	lc	fpga4	1.03	0.00	0.1
	UTI	lc	fpga5	4.09	0.00	0.1
	Timex	lc	fpga6	0.02	0.00	0.1
	Fabric Ctrl0 MTFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl1 MTFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl2 MTFC	lc	fpga9	1.01	0.00	0.1
	CPUCtrl0	lc	fpga1	1.04	0.00	0.1
	ROMMONB MTRP	lc	rommon	5.10	0.00	0.1
ASR-9922-RP-SE	Can Bus Ctrl (CBC) MTRP	lc	cbc	25.02	0.00	0.1
	Fabric Ctrl3 MTFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl4 MTFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl5 MTFC	lc	fpga12	1.01	0.00	0.1
	Fabric Ctrl6 MTFC	lc	fpga13	1.01	0.00	0.1
	CPUCtrl1	lc	fpga2	1.03	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	IntCtrl	lc	fpga4	1.03	0.00	0.1
	UTI	lc	fpga5	4.09	0.00	0.1
	Timex	lc	fpga6	0.02	0.00	0.1
	Fabric Ctrl0 MTFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl1 MTFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl2 MTFC	lc	fpga9	1.01	0.00	0.1

	CPUCtrl0	lc	fpga1	1.04	0.00	0.1
	ROMMONB MTRP	lc	rommon	5.10	0.00	0.1
ASR-9900-RP-TR	Can Bus Ctrl (CBC) MTRP	lc	cbc	25.02	0.00	0.1
	Fabric Ctrl3 MTFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl4 MTFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl5 MTFC	lc	fpga12	1.01	0.00	0.1
	Fabric Ctrl6 MTFC	lc	fpga13	1.01	0.00	0.1
	CPUCtrl1	lc	fpga2	1.03	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	IntCtrl	lc	fpga4	1.03	0.00	0.1
	UTI	lc	fpga5	4.09	0.00	0.1
	Timex	lc	fpga6	0.02	0.00	0.1
	Fabric Ctrl0 MTFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl1 MTFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl2 MTFC	lc	fpga9	1.01	0.00	0.1
	CPUCtrl0	lc	fpga1	1.04	0.00	0.1
	ROMMONB MTRP	lc	rommon	5.10	0.00	0.1
ASR-9900-RP-SE	Can Bus Ctrl (CBC) MTRP	lc	cbc	25.02	0.00	0.1
	Fabric Ctrl3 MTFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl4 MTFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl5 MTFC	lc	fpga12	1.01	0.00	0.1
	Fabric Ctrl6 MTFC	lc	fpga13	1.01	0.00	0.1
	CPUCtrl1	lc	fpga2	1.03	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	IntCtrl	lc	fpga4	1.03	0.00	0.1
	UTI	lc	fpga5	4.09	0.00	0.1
	Timex	lc	fpga6	0.02	0.00	0.1
	Fabric Ctrl0 MTFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl1 MTFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl2 MTFC	lc	fpga9	1.01	0.00	0.1
	CPUCtrl0	lc	fpga1	1.04	0.00	0.1
	ROMMONB MTRP	lc	rommon	5.10	0.00	0.1
ASR9001-RP	Can Bus Ctrl (CBC) IMRP	lc	cbc	22.114	0.00	0.1
	MB CPUCtrl	lc	fpga2	1.14	0.00	0.0
	ROMMONB IM RP	lc	rommon	1.36	0.00	0.1

A9K-24x10GE-SE	Can Bus Ctrl (CBC) LC6	lc	cbc	19.109	0.00	0.0
	DBCtrl LC6	lc	fpga2	1.03	0.00	0.0
	LinkCtrl LC6	lc	fpga3	1.01	0.00	0.0
	LCCPUCtrl LC6	lc	fpga4	1.07	0.00	0.0
	ROMMONB LC6	lc	rommon	1.29	0.00	0.0
A9K-2x100GE-SE	Can Bus Ctrl (CBC) LC4	lc	cbc	21.108	0.00	0.1
	DB IO FPGA1	lc	cpld1	1.03	0.00	0.0
	MB CPUCtrl	lc	fpga2	1.08	0.00	0.0
	PortCtrl	lc	fpga3	1.05	0.00	0.0
	Imux	lc	fpga4	1.01	0.00	0.0
	Emux	lc	fpga5	1.03	0.00	0.0
	100GIGMAC	lc	fpga6	38.00	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.0
A9K-MOD80-SE	Can Bus Ctrl (CBC) LC4	lc	cbc	20.115	0.00	0.1
	DB Ctrl	lc	fpga2	1.04	0.00	0.0
	MB CPUCtrl	lc	fpga4	1.05	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.1
A9K-MOD160-SE	Can Bus Ctrl (CBC) LC4	lc	cbc	20.115	0.00	0.1
	DB Ctrl	lc	fpga2	1.04	0.00	0.0
	MB CPUCtrl	lc	fpga4	1.05	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.1
A9K-24x10GE-TR	Can Bus Ctrl (CBC) LC6	lc	cbc	19.109	0.00	0.0
	DBCtrl LC6	lc	fpga2	1.03	0.00	0.0
	LinkCtrl LC6	lc	fpga3	1.01	0.00	0.0
	LCCPUCtrl LC6	lc	fpga4	1.07	0.00	0.0
	ROMMONB LC6	lc	rommon	1.29	0.00	0.0
A9K-2x100GE-TR	Can Bus Ctrl (CBC) LC4	lc	cbc	21.108	0.00	0.1
	DB IO FPGA1	lc	cpld1	1.03	0.00	0.0
	MB CPUCtrl	lc	fpga2	1.08	0.00	0.0
	PortCtrl	lc	fpga3	1.05	0.00	0.0
	Imux	lc	fpga4	1.01	0.00	0.0
	Emux	lc	fpga5	1.03	0.00	0.0
	100GIGMAC	lc	fpga6	38.00	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.0

A9K-MOD80-TR	Can Bus Ctrl (CBC) LC4	lc	cbc	20.115	0.00	0.1
	DB Ctrl	lc	fpga2	1.04	0.00	0.0
	MB CPUCtrl	lc	fpga4	1.05	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.1
A9K-MOD160-TR	Can Bus Ctrl (CBC) LC4	lc	cbc	20.115	0.00	0.1
	DB Ctrl	lc	fpga2	1.04	0.00	0.0
	MB CPUCtrl	lc	fpga4	1.05	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.1
A9K-8T-TEST	Can Bus Ctrl (CBC) LC17	lc	cbc	17.214	0.00	0.0
	LCCPUCtrl LC6	lc	fpga4	0.03	0.00	0.0
	ROMMONB LC6	lc	rommon	1.04	0.00	0.0
A9K-36x10GE-SE	Can Bus Ctrl (CBC) LC6	lc	cbc	15.101	0.00	0.0
	DBCtrl LC6	lc	fpga2	1.01	0.00	0.0
	LinkCtrl LC6	lc	fpga3	1.00	0.00	0.0
	LCCPUCtrl LC6	lc	fpga4	1.03	0.00	0.0
	ROMMONB LC6	lc	rommon	1.29	0.00	0.0
A9K-36x10GE-TR	Can Bus Ctrl (CBC) LC6	lc	cbc	15.101	0.00	0.0
	DBCtrl LC6	lc	fpga2	1.01	0.00	0.0
	LinkCtrl LC6	lc	fpga3	1.00	0.00	0.0
	LCCPUCtrl LC6	lc	fpga4	1.03	0.00	0.0
	ROMMONB LC6	lc	rommon	1.29	0.00	0.0
A9K-1x100GE-SE	Can Bus Ctrl (CBC) LC4	lc	cbc	21.108	0.00	0.1
	DB IO FPGA1	lc	cpld1	1.03	0.00	0.0
	MB CPUCtrl	lc	fpga2	1.08	0.00	0.0
	PortCtrl	lc	fpga3	1.05	0.00	0.0
	Imux	lc	fpga4	1.01	0.00	0.0
	Emux	lc	fpga5	1.03	0.00	0.0
	100GIGMAC	lc	fpga6	38.00	0.00	0.0
	ROMMONB LC4	lc	rommon	1.29	0.00	0.0
A9K-1x100GE-TR	Can Bus Ctrl (CBC) LC4	lc	cbc	21.108	0.00	0.1
	DB IO FPGA1	lc	cpld1	1.03	0.00	0.0
	MB CPUCtrl	lc	fpga2	1.08	0.00	0.0
	PortCtrl	lc	fpga3	1.05	0.00	0.0

```
                    Imux                        lc   fpga4       1.01        0.00       0.0
                    Emux                        lc   fpga5       1.03        0.00       0.0
                    100GIGMAC                   lc   fpga6      38.00        0.00       0.0
                    ROMMONB LC4                 lc   rommon      1.29        0.00       0.0
--------------------------------------------------------------------------------------------
ASR-9922-SFC110     Can Bus Ctrl (CBC) MTFC     lc   cbc        28.03        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9912-SFC110     Can Bus Ctrl (CBC) SSFC     lc   cbc        32.02        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9010-FAN        Can Bus Ctrl (CBC) FAN      lc   cbc         4.02        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9006-FAN        Can Bus Ctrl (CBC) FAN      lc   cbc         5.02        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9922-FAN        Can Bus Ctrl (CBC) MFAN     lc   cbc        29.10        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9912-FAN        Can Bus Ctrl (CBC) SFAN     lc   cbc        31.03        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9010-FAN-V2     Can Bus Ctrl (CBC) FAN      lc   cbc        29.09        0.00       0.1
--------------------------------------------------------------------------------------------
                            Ctrl (CBC) BP2      lc   cbc         7.103       0.00       0.1
--------------------------------------------------------------------------------------------
ASR9001-LC          Can Bus Ctrl (CBC) IMLC     lc   cbc        23.114       0.00       0.1
                    DB CPUCtrl                  lc   fpga2       1.17        0.00       0.0
                    EP Gambit                   lc   fpga3       0.08        0.00       0.0
                    MB CPUCtrl                  lc   fpga4       2.07        0.00       0.0
                    EP Rogue                    lc   fpga6       1.06        0.00       0.0
                    EP Sage                     lc   fpga7       1.02        0.00       0.0
                    ROMMONB IM LC               lc   rommon      1.36        0.00       0.1
--------------------------------------------------------------------------------------------
ASR9001-LC-S        Can Bus Ctrl (CBC) IMLC     lc   cbc        23.114       0.00       0.1
                    DB CPUCtrl                  lc   fpga2       1.17        0.00       0.0
                    EP Gambit                   lc   fpga3       0.08        0.00       0.0
                    MB CPUCtrl                  lc   fpga4       2.07        0.00       0.0
                    EP Rogue                    lc   fpga6       1.06        0.00       0.0
-----------------   EP Sage                     lc   fpga7       1.02        0.00       0.0
SPA-8XCHT1/E1       SPA I/O FPGA                spa  fpga1       2.08        0.00       0.0
                   SPA ROMMON                  spa  rommon      2.12        0.00      0.140
--------------------------------------------------------------------------------------------
SPA-OC192POS-XFP    SPA FPGA swv1.2 hwv2        spa  fpga1       1.02        0.00       2.0
--------------------------------------------------------------------------------------------
SPA-2XOC48POS/RPR   SPA FPGA swv1.0            spa  fpga1       1.00        0.00       0.0
--------------------------------------------------------------------------------------------
SPA-4XOC48POS/RPR   SPA FPGA swv1.0            spa  fpga1       1.00        0.00       0.0
```

```
--------------------------------------------------------------------------------
SPA-8XOC3-POS        SPA FPGA swv1.0            spa  fpga1       1.00        0.00      0.5
--------------------------------------------------------------------------------
SPA-2XOC12-POS       SPA FPGA swv1.0            spa  fpga1       1.00        0.00      0.5
--------------------------------------------------------------------------------
SPA-4XOC12-POS       SPA FPGA swv1.0            spa  fpga1       1.00        0.00      0.5
--------------------------------------------------------------------------------
SPA-10X1GE-V2        SPA FPGA swv1.10           spa  fpga1       1.10        0.00      0.0
--------------------------------------------------------------------------------
SPA-5X1GE-V2         SPA FPGA swv1.10           spa  fpga1       1.10        0.00      0.0
--------------------------------------------------------------------------------
SPA-1X10GE-L-V2      SPA FPGA swv1.9            spa  fpga1       1.09        0.00      0.0
--------------------------------------------------------------------------------
SPA-4XOC3-POS-V2     SPA FPGA swv1.0            spa  fpga1       1.00        0.00      0.5
--------------------------------------------------------------------------------
SPA-1X10GE-WL-V2     SPA FPGA swv1.9            spa  fpga1       1.09        0.00      0.0
--------------------------------------------------------------------------------
SPA-1XOC3-ATM-V2     SPA FPGA swv1.2            spa  fpga1       2.02        0.00      0.0
--------------------------------------------------------------------------------
SPA-2XOC3-ATM-V2     SPA FPGA swv1.2            spa  fpga1       2.02        0.00      0.0
--------------------------------------------------------------------------------
SPA-3XOC3-ATM-V2     SPA FPGA swv1.2            spa  fpga1       2.02        0.00      0.0
--------------------------------------------------------------------------------
```

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:

Procedure

Step 1 Establish a Telnet session with the router.

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

```
RP/0/RSP0/CPU0:router#show version

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

ROM: System Bootstrap, Version 0.70(c) 1994-2012 by Cisco Systems,  Inc.

BNG1 uptime is 1 hour, 12 minutes
System image file is "disk0:asr9k-os-mbi-4.3.1/0x100305/mbiasr9k-rsp3.vm"

cisco ASR9K Series (Intel 686 F6M14S4) processor with 12582912K bytes of memory.
Intel 686 F6M14S4 processor at 2131MHz, Revision 2.174
ASR-9006 AC Chassis

4 Management Ethernet
```

```
80 GigabitEthernet
8 TenGigE
8 DWDM controller(s)
8 WANPHY controller(s)
21 GigabitEthernet/IEEE 802.3 interface(s)
503k bytes of non-volatile configuration memory.
5938M bytes of hard disk.
10998768k bytes of disk0: (Sector size 512 bytes).
10998768k bytes of disk1: (Sector size 512 bytes).

Configuration register on node 0/RSP0/CPU0 is 0x1922
Boot device on node 0/RSP0/CPU0 is disk0:
Package active on node 0/RSP0/CPU0:
asr9k-asr903-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr903-supp-4.3.1
    Built on Sat May 11 14:57:03 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr903-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr903-nV-px-4.3.1
    Built on Sat May 11 14:58:08 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr901-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr901-supp-4.3.1
    Built on Sat May 11 14:56:51 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr901-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr901-nV-px-4.3.1
    Built on Sat May 11 14:57:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-9000v-nV-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-9000v-nV-supp-4.3.1
    Built on Sat May 11 14:56:47 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-9000v-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-9000v-nV-px-4.3.1
    Built on Sat May 11 14:56:50 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-adv-video, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-adv-video-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-video-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.1
    Built on Sat May 11 14:56:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-service, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-service-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-service-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
```

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

asr9k-services-p-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.1
    Built on Sat May 11 14:56:46 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optics-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.1
    Built on Sat May 11 14:56:37 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optic-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.1
    Built on Sat May 11 14:56:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sat May 11 14:54:47 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mpls-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.1
    Built on Sat May 11 14:55:00 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mgbl, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.1
    Built on Sat May 11 14:55:21 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mgbl-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mgbl-supp-4.3.1
    Built on Sat May 11 14:55:21 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mgbl-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mgbl-px-4.3.1
    Built on Sat May 11 14:55:29 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mcast-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.1
    Built on Sat May 11 14:55:19 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-security, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-security-4.3.1
    Built on Sat May 11 14:55:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-k9sec-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-k9sec-supp-4.3.1
    Built on Sat May 11 14:55:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-k9sec-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-k9sec-px-4.3.1
```

```
    Built on Sat May 11 14:55:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fpd, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fpd-4.3.1
    Built on Sat May 11 14:56:03 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fpd-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fpd-px-4.3.1
    Built on Sat May 11 14:56:26 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9K-doc-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9K-doc-supp-4.3.1
    Built on Sat May 11 14:55:55 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-doc-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-doc-px-4.3.1
    Built on Sat May 11 14:56:02 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-bng, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.1
    Built on Sat May 11 14:55:54 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.1
    Built on Sat May 11 14:51:31 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
asr9k-base, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-base-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-diags-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.1
    Built on Sat May 11 14:49:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-scfclient, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.1
    Built on Sat May 11 14:49:40 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-cpp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-ce, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-ce-4.3.1
    Built on Sat May 11 14:49:34 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mini-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.1
    Built on Sat May 11 14:54:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Configuration register on node 0/RSP1/CPU0 is 0x1922
Boot device on node 0/RSP1/CPU0 is disk0:
Package active on node 0/RSP1/CPU0:
asr9k-asr903-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr903-supp-4.3.1
    Built on Sat May 11 14:57:03 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr903-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr903-nV-px-4.3.1
    Built on Sat May 11 14:58:08 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr901-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr901-supp-4.3.1
    Built on Sat May 11 14:56:51 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-asr901-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-asr901-nV-px-4.3.1
    Built on Sat May 11 14:57:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-9000v-nV-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-9000v-nV-supp-4.3.1
    Built on Sat May 11 14:56:47 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-9000v-nV-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-9000v-nV-px-4.3.1
    Built on Sat May 11 14:56:50 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
iosxr-adv-video, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-adv-video-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-video-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.1
    Built on Sat May 11 14:56:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-service, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-service-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-service-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-services-p-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.1
    Built on Sat May 11 14:56:46 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optics-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.1
    Built on Sat May 11 14:56:37 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optic-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.1
    Built on Sat May 11 14:56:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sat May 11 14:54:47 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mpls-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.1
    Built on Sat May 11 14:55:00 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mgbl, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.1
    Built on Sat May 11 14:55:21 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mgbl-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mgbl-supp-4.3.1
    Built on Sat May 11 14:55:21 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mgbl-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mgbl-px-4.3.1
    Built on Sat May 11 14:55:29 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
asr9k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mcast-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.1
    Built on Sat May 11 14:55:19 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-security, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-security-4.3.1
    Built on Sat May 11 14:55:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-k9sec-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-k9sec-supp-4.3.1
    Built on Sat May 11 14:55:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-k9sec-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-k9sec-px-4.3.1
    Built on Sat May 11 14:55:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fpd, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fpd-4.3.1
    Built on Sat May 11 14:56:03 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fpd-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fpd-px-4.3.1
    Built on Sat May 11 14:56:26 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9K-doc-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9K-doc-supp-4.3.1
    Built on Sat May 11 14:55:55 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-doc-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-doc-px-4.3.1
    Built on Sat May 11 14:56:02 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-bng, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.1
    Built on Sat May 11 14:55:54 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
```

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

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.1
    Built on Sat May 11 14:51:31 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-base, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-base-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-diags-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.1
    Built on Sat May 11 14:49:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-scfclient, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.1
    Built on Sat May 11 14:49:40 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-cpp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-ce, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-ce-4.3.1
    Built on Sat May 11 14:49:34 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mini-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.1
    Built on Sat May 11 14:54:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/0/CPU0 is mem:
Package active on node 0/0/CPU0:
iosxr-adv-video, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-adv-video-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie
```

```
asr9k-video-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.1
    Built on Sat May 11 14:56:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-service, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-service-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-service-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.1
    Built on Sat May 11 14:56:39 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-services-p-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.1
    Built on Sat May 11 14:56:46 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optics-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.1
    Built on Sat May 11 14:56:37 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-optic-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.1
    Built on Sat May 11 14:56:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sat May 11 14:54:47 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mpls-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.1
    Built on Sat May 11 14:55:00 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mcast, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mcast-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.1
    Built on Sat May 11 14:55:01 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mcast-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.1
    Built on Sat May 11 14:55:19 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-bng, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-4.3.1
    Built on Sat May 11 14:55:41 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-bng-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.1
    Built on Sat May 11 14:55:54 PDT 2013
```

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

iosxr-infra, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-infra-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-routing, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-routing-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-diags, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-diags-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-ce, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-ce-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-os-mbi, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.1
    Built on Sat May 11 14:51:31 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-base, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-base-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-fwding, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.1
    Built on Sat May 11 14:49:33 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-diags-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.1
    Built on Sat May 11 14:49:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-scfclient, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.1
    Built on Sat May 11 14:49:40 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-cpp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-ce, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-ce-4.3.1
    Built on Sat May 11 14:49:34 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mini-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.1
    Built on Sat May 11 14:54:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/1/CPU0 is mem:
```

```
Package active on node 0/1/CPU0:
iosxr-adv-video, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-adv-video-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-video-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.1
    Built on Sat May 11 14:56:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-service, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-service-k-diags-supp-4.3.1
    Built on Sat May 11 14:49:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-scfclient, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.1
    Built on Sat May 11 14:49:40 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-cpp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-ce, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-ce-4.3.1
    Built on Sat May 11 14:49:34 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-mini-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.1
    Built on Sat May 11 14:54:36 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

Boot device on node 0/2/CPU0 is mem:
Package active on node 0/2/CPU0:
iosxr-adv-video, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

asr9k-adv-video-supp, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.1
    Built on Sat May 11 14:56:32 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

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iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
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    Built on Sat May 11 14:56:38 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/workspace for pie

iosxr-mpls, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.1
    Built on Sat May 11 14:54:47 PDT 2013
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asr9k-mpls-px, V 4.3.1[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.1
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    Built on Sat May 11 14:55:41 PDT 2013
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    Built on Sat May 11 14:55:54 PDT 2013
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iosxr-fwding, V 4.3.1[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.1
    Built on Sat May 11 14:49:30 PDT 2013
    By iox-bld2 in /auto/srcarchive7/production/4.3.1/all/
```

Software Features Introduced in Cisco IOS XR Software Release 4.3.1 for Cisco ASR 9000 Series Aggregation Service Router

BFD over MPLS Traffic Engineering LSPs

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

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

For more information on configuring BFD over MPLS Traffic Engineering LSPs, see the *Implementing Bidirectional Forwarding Detection* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the BFD over MPLS Traffic Engineering LSPs commands, see the *Bidirectional Forwarding Detection Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

BFD over Pseudowire Headend

The Bidirectional Forwarding Detection over Pseudowire Headend (BFDoPWHE) feature enables BFD support over the customer edge (CE) to pseudowire headend (S-PE) links for fast failure detection along the path between the eBGP neighbors.

BFD over PWHE is supported only on ASR 9000 Enhanced Ethernet Line Card.

BFD over PWHE supports:

- BFD sessions per pseudo-wire for end-to-end fault detection between the CE and PWHE PE
- BFDv4 for IPv4 and BFDv6 for IPv6 (static and BGP)
- BFD asynchronous mode over PWHE
- Pseudowire VC type 4 and type 5

Use the **bfd multipath include location** *node-id* command to include specific line cards to host BFD multiple path sessions and thereby enable BFD over PWHE.

For more information on configuring BFD over Pseudowire Headend, see the *Implementing Bidirectional Forwarding Detection* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*. For complete command reference of the BFD commands, see the Bidirectional Forwarding Detection Commands chapter in the Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference.

BFD over Satellite Interfaces

Bidirectional Forwarding Detection (BFD) over satellite interfaces feature enables BFD support on satellite line cards. Satellite interfaces are known as virtual (bundle) interfaces. BFD uses multipath infrastructure to support BFD on satellite line cards. BFD over satellite is a multipath (MP) single-hop session and is supported on IPv4 address, IPv6 global address, and IPv6 link-local address. The BFD over Satellite is supported only on ASR 9000 Enhanced Ethernet Line Card and is supported in asynchronous mode. BFD over satellite is not supported in echo mode.

Use the **bfd multipath include location** *node-id* command to configure Multipath BFD sessions. With this configuration, all Multipath sessions including BFD over Satellite, are downloaded and hosted on the configured line cards. Configure one or more line cards to allow hosting of Multipath BFD sessions.

For more information on configuring BFD over Satellite Interfaces, see the *Implementing Bidirectional Forwarding Detection* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the BFD commands, see the *Bidirectional Forwarding Detection Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

BGP VRF Dynamic Route Leaking

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

The dynamic route leaking is enabled by:

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

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

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

For more information on configuring VRF Dynamic Route Leaking, see the *Implementing BGP* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the commands used for configuring and displaying Dynamic Route Leaking, see the *BGP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Flexible L3VPN Label Allocation Mode

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

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

For more information on Label-Mode attachpoint, see the Implementing Routing Policy chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the **set label-mode** command, see the *Routing Policy Language Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*. For complete command reference of the **label mode** and **label-allocation-mode** commands, see the *BGP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

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

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

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

For more information on configuring IS-IS IP/LDP Remote Loop Free Alternate Fast Re-route, see the *Implementing IS-IS* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the IS-IS IP/LDP Remote Loop Free Alternate Fast Re-route

commands, see the *IS-IS Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

IS-IS IPv6 Loop Free Alternate Fast Re-route

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

For more information on configuring IS-IS IPv6 Loop Free Alternate Fast Re-route, see the *Implementing IS-IS* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the IS-IS IPv6 Loop Free Alternate Fast Re-route commands, see the *BGP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

IS-IS Link-group

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

For more information on configuring IS-IS link-group, see the *Implementing IS-IS* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of IS-IS link-group commands, see the *IS-IS Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

LISP Virtualization

Locator/ID Separation Protocol (LISP) Virtualization feature enables shared model and parallel mode virtualization.

The shared model vrtualizes the EID namespace, binds an EID namespace that is privately defined using a VRF to an instance-ID, and uses a common shared RLOC (locator) address space, typically default. The mapping system is also part of the locator namespaces and is shared.

The parallel model virtualizes the RLOC (locator) namespace in addition to the EID namespace. One or more EID instances may share a virtualized RLOC namespace. The mapping system is also be of each locator namespace.

LISP xTR Support

Cisco IOS XR Software Locator/ID Separation Protocol (LISP) supports xTR functionality to handle changes to routing locator (RLOC) status bits. The xTR acts as both an Ingress Tunnel Router (ITR) and an Egress Tunnel Router (ETR). Use map resolver to configure xTR.

LISP Common Control Plane

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

OSPF IP/LDP Remote Loop Free Alternate Fast Re-route

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

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

For more information on configuring OSPF IP/LDP Remote Loop Free Alternate Fast Re-route, see the *Implementing OSPF* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the OSPF IP/LDP Remote Loop Free Alternate Fast Re-route commands, see the *OSPF Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

OSPFv2 Autoroute Exclude

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

OSPFv2 Unequal Cost Load Balancing

Unequal Cost Load Balancing feature in Cisco IOS XR OSPFv2 feature enables Unequal Cost Multipath (UCMP) calculation based on configured prefix-list and based on variance factor. UCMP can be calculated for selected prefixes and the calculation can be excluded for paths if the outgoing interface of the UCMP paths is excluded from being used for UCMP. The calculated UCMP paths are then installed in the routing information base (RIB) subject to the max-path limit.

OSPFv3 Loop Free Alternate Fast Re-route

The OSPFv3 Loop Free Alternate fast Re-route (OSPFv3 LFA FRR) feature supports fast re-route (FRR) for OSPFv3 protocol Cisco IOS Software. OSPFv3 FRR helps to minimize traffic loss during convergence for

pure IPv6 unicast prefixes. The OSPFv3 LFA FRR supports both per-prefix LFA and per-link LFA modes. OSPFv3 LFA FRR is enabled by configuring the fast re-route commands under the Router OSPFv3 configuration mode.

For more information on configuring OSPFv3 Loop Free Alternate Fast Re-route, see the *Implementing OSPF* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the OSPFv3 Loop Free Alternate Fast Re-route commands, see the *OSPFv3 Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Match tag Support for OSPF distribute-list in

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

For more information on distribute-list in attachpoint, see the *Implementing Routing Policy* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the **distribute-list in** command, see the *OSPF Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Selective VRF Download Disable

Selective VRF Download (SVD) functionality is disabled, by default. To enable SVD, configure the **svd platform enable** command in administrative configuration mode and reload the chassis using the **reload location all** command. To disable SVD that is already enabled, use the **no svd platform enable** command and reload the chassis using the **reload location all** command.

For more information on enabling and disabling Selective VRF Download, see the *Implementing BGP* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the Selective VRF Download commands, see the BGP Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

VPN Route Limit

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

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

For more information on configuring VPN Route Limit, see the *Implementing BGP* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command

reference of the VPN Route Limit commands, see the *BGP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

VRF Import Policy Enhancement

The VRF RPL based import policy feature provides the ability to perform import operation based solely on import route-policy, by matching on route-targets (RTs) and other criteria specified within the policy. No need to explicitly configure import RTs under global VRF-address family configuration mode.

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

For more information on configuring VRF Import Policy Enhancement, see the *Implementing Routing Policy* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the VRF RPL Based Import Policy, see the *Routing Policy Language Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Auto-IP Configuration for nV Satellite System

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

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

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

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

CFM Scale Enhancements

Connectivity Fault Management(CFM) provides a set of management tools for Ethernet connectivity management. This feature enhances the scale of the CCM frames per second with aggressive timers configuration to allow faster failure detection. These new commands are introduced in Cisco IOS XR Software Release 4.3.1:

- **show ethernet cfm summary**
- **clear ethernet cfm offload**

These modifications were made to the existing commands:

- The **continuity-check interval** command was updated to allow CCM time interval of 10ms

- The **protection-switching** keyword was included in the **efd** command
- The **ccm-learning** keyword is introduced in **mip auto-create** command
- The **show ethernet cfm local meps detail** and **show ethernet cfm local meps verbose** command outputs were modified to include CCM interval information

ICCP Based Service Multihoming

ICCP based Service Multihoming (ICCP-SM) is a MC-LAG configuration in which the CE device uses two independent bundle interfaces to connect to the PoAs. Although bundle interfaces are used, they are not aggregated across the two chasses and mLACP is not involved. The CE device configures the bundle interfaces such that all VLANs are allowed on both bundles. You can manually configure the PoAs to distribute the VLANs across the two bundles such that individual VLANs are active (forwarding) on one bundle/PoA and standby (blocked) on the other. The CE device initially floods a traffic flow on both bundles and learns the MAC address on the interface where it receives the response.

For more information on ICCP based Service Multihoming configuration, see *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

Small Frame Padding

Cisco ASR 9000 Series Router pads the frames smaller than 68 bytes to a 68-byte frame on the egress interface in order to inter-work with other interconnected networks. Cisco ASR 9000 Series Router provides a new configuration CLI called **small-frame-padding** to enable small frame padding on physical interfaces. For more information on the **small-frame-padding** command, see the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference*.

Y.1731 Loss Measurement Mechanism

Y.1731 Loss Measurement is a mechanism which measures the actual data traffic loss between a pair of MEPs in a point-to-point Ethernet service. This is in contrast to the Synthetic Loss Measurement, which measures the frame loss of synthetic frames. By using Y.1731 Loss Measurement, you can measure the one-way loss in each direction for each priority class and also the loss aggregated across all priority classes.

To enable loss measurements to be made, each MEP maintains both source-to-destination and destination-to-source frame counts for its peer MEPs, for each priority class.

There are two Loss Measurement Mechanisms (LMM), namely, single-ended and dual-ended.

Cisco IOS XR Software supports only single-ended LMM.

For more information on Y.1731 LMM configuration, see *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

PPPoE Smart Server Selection

The PPPoE Smart Server Selection (PADO delay) feature in BNG allows the PPPoE client to control the selection of BNG for session establishment, in a multi-BNG setup. The feature provides the option for

configuring a delay in sending PADO messages from BNG, in response to the PADI messages received from the PPPoE clients. This, in turn, helps in establishing a priority order and load balancing across all BNGs.

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

NAS-Port-Type on Interface or VLAN Sub-interface

In order to have different production models for subscribers on the same BNG router, but on different physical interfaces of same type, the NAS-Port-Type is made configurable per physical interface or VLAN sub-interface. With a different NAS-Port-Type value being configured on the interface, the NAS-Port and NAS-Port-ID gets formatted as per the formats defined globally for the new NAS-Port-Type configured on the interface, instead of the actual value of NAS-Port-Type which the interface has. This in turn sends different formats of NAS-Port, NAS-Port-ID and NAS-Port-Type to the RADIUS server for the subscribers under different production model.

For more information about the NAS-Port-Type on Interface or VLAN Sub-interface feature, see the *Configuring Authentication, Authorization, and Accounting Functions* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference of the AAA commands, see the *BNG AAA Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

L2TP Reassembly on LAC

The L2TP Reassembly feature on L2TP Access Concentrator (LAC) ensures reassembly of fragmented L2TP data packets in the intervening network, between the LAC and L2TP Network Server (LNS). Data packets are fragmented when they exceed the Maximum Transmission Unit (MTU) of the IPv4 core. Enabling this feature prevents the fragmented packets from getting dropped and ensures the subsequent forwarding of these data packets.

For more information about the L2TP Reassembly feature, see the *Establishing Subscriber Sessions* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference of the PPPoE LAC-Specific commands, see the *PPPoE LAC-Specific Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

IETF Tagged Attributes on LAC

The IETF Tagged Attributes support on L2TP Access Concentrator (LAC) provides a means of grouping tunnel attributes referring to the same tunnel in an Access-Accept packet sent from the RADIUS server to the LAC. The Access-Accept packet can contain multiple instances of same RADIUS attributes, but with different tags. The tagged attributes support ensures that all attributes pertaining to a given tunnel contain the same value in their respective tag fields, and that each set includes an appropriately-valued instance of the Tunnel-Preference attribute. This conforms to the tunnel attributes that are to be used in a multi-vendor network environment, thereby eliminating interoperability issues among Network Access Servers (NASs) manufactured by different vendors.

For more information about the IETF Tagged Attributes on LAC, see the *RADIUS Attributes* appendix chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*

PPPoE Session Limit and Throttle

PPPoE Session Limit

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

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

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

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

PPPoE Session Throttle

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

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

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

- Outer VLAN tag under individual access interface
- Inner and Outer VLAN tag under individual access interface

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

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

VLAN Policy on Access Interface

BNG supports ingress and egress VLAN policies on an access-interface. Unlike as in the case of S-VLAN (subscriber-parent) policy, the access-interface VLAN policy is not inherited by the session policy. The VLAN policy does not provide reference bandwidth to session policies. The VLAN policy statistics does not include session policy statistics. Only the access-interface traffic is subjected to the VLAN policy.

For more information about the QoS features supported on BNG, see the *Deploying the Quality of Service (QoS)* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference of the BNG QoS commands, see the *QoS Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Service Accounting

Accounting records for each service enabled on a subscriber can be sent to the configured RADIUS server. These records can include service-start, service-stop, and service-interim records containing the current state of the service and any associated counters. This feature is the Service Accounting feature. Service accounting records are consolidated accounting records that represent the collection of features that make up a service as part of a subscriber session.

For more information on service accounting for QoS, refer to Configuring Authentication, Authorization, and Accounting Functions chapter of the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For more information on commands to configure service accounting, refer to the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Merging QoS Policy-maps

Multiple QoS policies, applied through multiple dynamic templates, can be merged and implemented on a single subscriber. The order in which the policies are merged is important, and is determined by the value of the sequence number configured in the dynamic template. A policy is deployed using a policy-map. A new optional **merge** keyword is provided with the **service-policy** command under dynamic template submode to allow for the merging of policy-maps applied through multiple dynamic templates.

For more information on merging QoS policy-maps, refer to Deploying the Quality of Service chapter of the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For more information on commands to enable this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

L2TP Access Concentrator Stateful Switchover

The L2TP Access Concentrator Stateful Switchover (LAC SSO) feature establishes one of the RPs as the active processor, designates the other RP as the standby processor, and then synchronizes critical state information between them. In specific Cisco networking devices that support dual RPs, LAC SSO takes advantage of RP redundancy to increase network availability.

For more information on enabling LAC SSO, refer to Establishing Subscriber Sessions chapter of the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For more information on commands to enable LAC SSO, refer to the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Option 82 Relay Information Encapsulation

When two relay agents are relaying messages between the DHCP client and DHCP server, the second relay agent (closer to the server), by default, replaces the first option 82 information with its own option 82. The remote ID and circuit ID information from the first relay agent is lost. In some deployment scenarios, it is necessary to maintain the initial option 82 from the first relay agent, in addition to the option 82 from the second relay agent.

The DHCP option 82 relay information encapsulation feature allows the second relay agent to encapsulate option 82 information in a received message from the first relay agent, if it is also configured to add its own option 82 information. This configuration allows the DHCP server to use option 82 information from both the relay agents.

For more information on option 82 encapsulation support, refer to Establishing Subscriber Sessions chapter of the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For more information on commands to enable this feature, refer to the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

GPRS Tunneling Protocol Load Balancing

GPRS Tunneling Protocol (GTP) is a tunnel control and management protocol among General Packet Radio Service (GPRS) support nodes. Wireless networks use GTP tunnels to deliver mobile data. GTP includes GTP signaling (GTP-C) and data transfer (GTP-U) procedures. GTP-C specifies a tunnel control and management protocol, and is used to create, delete and modify tunnels. GTP-U uses a tunneling mechanism to provide a service for carrying user data packets over the network.

GTP Load balancing enables efficient distribution of traffic in mobile networks, and provides increased reliability and availability for the network.

For more information on GTP Load Balancing, see the Implementing Point to Point Layer 2 Services module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*.

L2TPv3 over IPv6

A L2TPv3 over IPv6 tunnel is a static L2VPN cross-connect that uses Layer 2 Tunneling Protocol version 3 (L2TPv3) over IPv6, with a unique IPv6 source address for each cross-connect. The L2TPv3 over IPv6 tunnels consists of one L2TPv3 tunnel for each subscriber VLAN. The unique IPv6 address completely identifies the

customer, and the service that is delivered. L2TPv3 over IPv6 tunnels are supported on the ASR 9000 Enhanced Ethernet line cards

For more information on configuring L2TPv3 over IPv6 tunnels, see the Implementing Point to Point Layer 2 Services module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to configure L2TPv3 over IPv6 tunnels, see the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

PWHEv6 Support

Pseudowire Headend feature allows Layer 3 service termination on a virtual interface like a pseudowire. This feature introduces IPv6 support on PWHE including routing, Netflow, ACL and more.

For more information on configuring pseudowire headend, see the Implementing Multipoint Layer 2 Services module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to configure pseudowire headend, see the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Virtual Connection Type 4 Support with BGP Auto-discovery

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

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

IPv6 Rapid Deployment

IPv6 Rapid Deployment (6RD) is a mechanism that allows a service provider to provide a unicast IPv6 service to customers over its IPv4 network. This approach utilizes stateless IPv6 in IPv4 encapsulation to transit IPv4-only network infrastructure.

For more information about the 6RD feature, see the Implementing Carrier Grade IPv6 on Cisco IOS XR Software module in the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Configuration Guide*. For more information on CLIs, see the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Command Reference*.

SNMP Phase 1 Enhancements

Support for the CISCO-SUBSCRIBER-SESSION-MIB, CISCO-VPDN-MGMT-MIB, and CISCO-AAA-SERVER-MIB has been added.

For more information about the CISCO-SUBSCRIBER-SESSION-MIB, CISCO-VPDN-MGMT-MIB, and CISCO-AAA-SERVER-MIB, see the *Cisco ASR 9000 Series Routers MIB Specifications* module in the *Cisco ASR 9000 Series Aggregation Services Routers MIB Specifications Guide*.

SyncE and PTP MIB

Support for the CISCO-NETSYNC-MIB, and CISCO-PTP-MIB has been added.

For more information about the CISCO-NETSYNC-MIB, and CISCO-PTP-MIB, see the *Cisco ASR 9000 Series Routers MIB Specifications module* in the *Cisco ASR 9000 Series Aggregation Services Routers MIB Specifications Guide*.

Mapping of Address and Port-Encapsulation Mode

Mapping of Address and Port-Encapsulation Mode (MAP-E) is a CGN solution that enables a service provider to enable IPv4 services to IPv6 (customer) sites to which it provides customer premise equipment (CPE). This approach utilizes stateless IPv4-in-IPv6 encapsulation to transit IPv6-enabled network infrastructure.

For more information about the MAP-E feature, see the Implementing Carrier Grade IPv6 on Cisco IOS XR Software module in the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Configuration Guide*. For more information on CLIs, see the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Command Reference*.

Point-to-Point Tunneling Protocol-Application Level Gateway

Point-to-Point Tunneling Protocol-Application Level Gateway (PPTP-ALG) is a CGN solution that allows traffic from all clients to pass through a single PPTP tunnel.

For more information about the PPTP-ALG feature, see the Implementing Carrier Grade IPv6 on Cisco IOS XR Software module in the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Configuration Guide*. For more information on CLIs, see the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Command Reference*.

Real-Time Streaming Protocol-Application Level Gateway

Real-Time Streaming Protocol-Application Level Gateway (RTSP-ALG) is a CGN solution that provides an extensible framework to enable controlled, on-demand delivery of real-time data, such as audio and video. Sources of data can include both live data feeds and stored clips.

For more information about the RTSP-ALG feature, see the Implementing Carrier Grade IPv6 on Cisco IOS XR Software module in the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Configuration Guide*. For more information on CLIs, see the *Cisco ASR 9000 Series Aggregation Services Router CGv6 Command Reference*.

ACL-Chaining

ACL-Chaining also known as Multi-ACL enables customers to apply two IPv4 or IPv6 (common and interface) ACLs on an interface for packet filtering at the router. One ACL is common across multiple interfaces on the line card. This provides Ternary Content Addressable Memory(TCAM)/HW scalability. This feature is supported on A9K-SIP-700 line card and ASR 9000 Enhanced Ethernet line card only.

For more information about the ACL chaining feature, see the *Implementing Access Lists and Prefix Lists* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*. For complete command reference of the access list commands, see the *Access List Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference*.

ACL Scale Enhancements

The Access Control List (ACL) Scale enhancements feature enables you to define ACL rules as a set of several rules (super-set of ACEs (Access Control Entry)). This is achieved with object-groups of prefixes and ports, which are referred by ACE in the same way as single source address or destination address prefix and ports are referred.

For more information about the ACL Scale enhancements feature, see the *Implementing Access Lists and Prefix Lists* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*. For complete command reference of the access list commands, see the *Access List Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference*.

ATMoMPLS Cell Relay Virtual Path Mode

ATM VP Mode cell relay feature enables you to transmit and receive traffic based on the virtual path (VP) configured on the provider edge (PE) router over an MPLS network. The cell relay feature is supported for virtual path, and on pseudowire of type 0x000A ATM n-to-one VPC cell transport where n equals 1.

Bandwidth Reservation Percentage

The Bandwidth Reservation Percentage allows the RSVP interface bandwidth to be specified as percentages of the link's physical bandwidth.

For more information on configuring RSVP bandwidth, refer to the Implementing MPLS Traffic Engineering chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information on commands for configuring RSVP bandwidth, refer to the RSVP Infrastructure Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

IP-Less MPLS-TP Ping and MPLS-TP Traceroute

According to RFC-6426, IP-Less MPLS-TP ping and MPLS-TP traceroute with the ACH header, if a node receives an MPLS-TP ping or traceroute request packet over ACH, without IP or UDP headers, the node drops the echo request packet and does not send a response when:

- the reply mode is 4
- the node does not have a return MPLS LSP path to the echo request source.

If a node receives an MPLS echo request with a reply mode other than 4 (i.e., reply via application-level control channel), the node responds to using that reply mode. If the node does not support the reply mode requested, or is unable to reply using the requested reply mode in any specific instance, the node drops the echo request packet and does not send a response.

For more information about ping and traceroute, see *Implementing MPLS OAM* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information about ping and traceroute commands, see *MPLS OAM Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

Label Security for BGP Inter-AS Option-B

Option-B is a method to exchange VPNv4/VPNv6 routes between Autonomous Systems (AS), as described in RFC-4364. When the local router that has Option-B peering with other autonomous systems receives a labeled packet from an external peer, the local router ensures the following:

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

For more information on configuring label security, refer to Implementing MPLS Label Distribution Protocol chapter of the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information on commands to configure label security, refer to the MPLS Label Distribution Protocol Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

MPLS OAM Support for BGP 3107

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

For more information about ping and traceroute, see *Implementing MPLS OAM* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information about ping and traceroute commands, see *MPLS OAM Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

MPLS-TP LSP Wrapping

In the MPLS-TP LSP Wrapping protection scheme, a protected MPLS-TP tunnel is associated with a working LSP and protect LSP. This helps to prevent traffic loss as soon as a mid-point LSR detects a failure at physical layer rather than waiting for BFD to time-out. Also, a delay in activating protection switch due to mid-point failure does not further increase the traffic loss.

MPLS-TP LSP wrapping has to enabled only on the MID node. MPLS-TP LSP wrapping helps in detecting mid-link failure scenarios; other failures and failures on end node is detected by BFD timeout and TP-OAM message.

For more information on configuring MPLS-TP LSP wrapping, refer to the Implementing MPLS Transport Profile chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information on commands for configuring MPLS-TP LSP wrapping, refer to the MPLS Transport Profile Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

Policy-Based Tunnel Selection

Policy-Based Tunnel Selection (PBTS) provides a mechanism that lets you direct traffic into specific TE tunnels based on different criteria. PBTS will benefit Internet service providers (ISPs) who carry voice and data traffic through their MPLS and MPLS/VPN networks, who want to route this traffic to provide optimized voice service.

PBTS works by selecting tunnels based on the classification criteria of the incoming packets, which are based on the IP precedence, experimental (EXP), differentiated services code point (DSCP), or type of service (ToS) field in the packet. Default-class configured for paths is always zero (0). If there is no TE for a given forward-class, then the default-class (0) will be tried. If there is no default-class, then the packet is dropped.PBTS supports up to seven (exp 1 - 7) EXP values associated with a single TE tunnel.

For more information on configuring PBTS, refer to the Implementing MPLS Traffic Engineering chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information on commands for configuring PBTS, refer to the MPLS Traffic Engineering Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

Weighted-SRLG Auto-backup Path Computation

In shared-risk link groups (SRLG) fate-sharing, links are assigned one or more numbers to represent risks. When two links are assigned a common number then this indicates that these two links are sharing fate. In the weighted-SRLG auto-backup path computation mode, the links that share SRLG numbers with the protected link are not excluded from the topology. The admin-weight of these links is set to reflect the sharing of SRLG with the protected link. Setting the admin weight consists of adding a penalty metric to make using the link less desirable.

For more information about Weighted-SRLG auto-backup path computation, see *Implementing MPLS Traffic Engineering* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*. For more information about Weighted-SRLG auto-backup path computation, see *MPLS Traffic Engineering Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

DHCPv6 Proxy Binding Table Reload Persistency

The Cisco IOS-XR Dynamic Host Configuration Protocol (DHCP) application is responsible for maintaining the DHCP binding state for the DHCP leases allocated to clients by the DHCP application. These binding states are learned by the DHCP application (proxy/relay/snooping). DHCP clients expect to maintain a DHCP lease regardless of the events that occur to the DHCP application.

For more information about the DHCPv6 Proxy Binding Table Reload Persistency feature, see the *Implementing the Dynamic Host Configuration Protocol* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

For complete command reference of the dhcp commands, see the *DHCP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference*.

Service Guarantee Architecture (SGA)

Service-fragment based QoS is available for IPv4 and IPv6 traffic on L2 or L3 interfaces on a physical port.. A service fragment logically represents a group of sub interfaces in the Traffic Manager (TM) and is used for

configuring L2 node(s). It supports complex QoS services in order to enable new high-speed oriented Service Level Agreements (SLA) and can also flexibly emulate legacy service profiles. This is achieved by having three or four hierarchy scheduling layers on both the ingress and egress sides.

VRF-aware MSDP

VRF (VPN Routing and Forwarding) -aware MSDP enables MSDP to function in the VRF context. This in turn, helps the user to locate the PIM (protocol Independent Multicast) RP on the Provider Edge and use MSDP for anycast-RP.

MSDP needs to be VRF-aware when:

- Anycast-RP is deployed in an MVPN (Multicast MVPN) in such a manner that one or more PIM RPs in the anycast-RP set are located on a PE. In such a deployment, MSDP needs to operate in the VRF context on the PE.
- The PIM RP is deployed in an MVPN in such a manner that it is not on a PE and when the customer multicast routing type for the MVPN is BGP and the PEs have suppress-shared-tree-join option configured. In this scenario, there is no PE-shared tree link, so traffic may stop at the RP and it does not flow to other MVPN sites. An MSDP peering between the PIM RP and one or more PEs resolves the issue.

Netflow over BVI

NetFlow monitoring on Bridge-Group Virtual Interface (BVI) enables traffic monitoring, capacity planning, accounting, security threat detection and billing.

For more information about the NetFlow over BVI feature, see the *Configuring NetFlow* module in the *Cisco ASR 9000 Series Aggregation Services Router Netflow Configuration Guide*.For complete command reference of NetFlow, see the *NetFlow Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Netflow Command Reference*.

ISSU Support

Cisco ASR 9000 routers support in-service software upgrade (ISSU) software maintenance upgrades (SMUs) as well as ISSU from Cisco IOS XR Release 4.3.0 to Release 4.3.1.

ISSU test coverage is limited to certain features configuration, scale and hardware. For detailed test results, refer to *ISSU 4.3.0 to 4.3.1 Test Report*.

Note Before you can perform ISSU from Cisco IOS XR Release 4.3.0 to Release 4.3.1, you must have Release 4.3.0 Service Pack 2 software maintenance upgrade (SMU) installed on your Release 4.3.0 image. The ID of this SMU is AA07340 and it provides support for CSCug01445 and CSCue41531..

For more information regarding ISSU, refer to the *Upgrading and Managing Software* module in the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*.

Flexible CLI Configuration Groups

Flexible command line interface (CLI) configuration groups provide the ability to minimize repetitive configurations by defining a series of configuration statements in a configuration group, and then applying this group to multiple hierarchical levels in the router configuration tree.

Flexible CLI configuration groups utilize regular expressions that are checked for a match at multiple submodes of the configuration tree based on where the group is applied within the hierarchy. If a match is found at a configuration submode, the corresponding configuration defined in the group is inherited within the matched submode.

Flexible CLI configuration groups also provide an auto-inheritance feature. Auto-inheritance means that any change done to a CLI configuration group is automatically applied to the configuration in any matched submodes that have an apply-group at that hierarchical level. This allows you to make a configuration change or addition once, and have it applied automatically in multiple locations, depending on where you have applied the flexible CLI configuration group.

For more information on flexible CLI configurations, see the *Configuring Flexible Command Line Interface Configuration Groups* module in the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*. For command information, refer to the *Configuration Management Commands* module in the *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference*.

SSHv2 Client Keyboard-Interactive Authentication

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

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

For more information about the SSHv2 Client Keyboard-Interactive Authentication feature, see the *Implementing Secure Shell* module in the *Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide*.For complete command reference of SSHv2 Client Keyboard-Interactive Authentication commands, see the *Secure Shell Commands*chapter in the *Cisco ASR 9000 Series Aggregation Services Router System Security Command Reference*

Configuring FIPS Mode

The Federal Information Processing Standard (FIPS) 140-2 is an U.S. and Canadian government certification standard that defines requirements that the cryptographic modules must follow. The FIPS specifies best practices for implementing cryptographic algorithms, handling key material and data buffers, and working with the operating system.

In Cisco IOS XR software, these applications are verified for FIPS compliance:

- Secure Shell (SSH)
- Secure Socket Layer (SSL)
- Transport Layer Security (TLS)

- Internet Protocol Security (IPSec) for Open Shortest Path First version 3 (OSPFv3)
- Simple Network Management Protocol version 3 (SNMPv3)

For more information about the Configuring FIPS feature, see the *Configuring FIPS Mode* module in the *Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide*. For complete command reference of FIPS commands, see the *FIPS Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router System Security Command Reference*

Software Feature Enhancements

These software feature enhancements are introduced in Cisco IOS XR Software Release 4.3.1.

- BFD over bundle interfaces require BFD multipath to be enabled. While upgrading from Cisco IOS XR Release 4.2.1 to Cisco IOS XR Release 4.3.1, configure the **bfd multipath include location** *node-id* command for native BFD over bundle interfaces and sub-interfaces to work.
- The Cisco ASR 9000 Series Router allows dissimilar chassis types to participate in a nV Edge System. All combinations of Cisco ASR 9000 Series chassis such as Cisco ASR 9010, Cisco ASR 9006, Cisco ASR 9922, and Cisco ASR 9001 are supported.
- Satellite nV switching bundle enhancements:
  - Support was added to increase the number of bundles.
  - Support of ICL bundle ports terminating on the same NP on Cisco ASR 9000 Series Router.
  - Support of LLDP over ICL bundle.
- The **show ipsubscriber interface** command is enhanced with the support of two new keywords **outer-vlan-id** and **inner-vlan-id**.
- BNG-RADIUS CoA server behavioral updates:
  - The RADIUS CoA server does not differentiate between originators of the disconnect event. Hence, when the BNG receives an account-logoff request from the RADIUS CoA server, for both a user-initiated and an administrator-initiated request, the Acct-Terminate-Cause to be sent to the RADIUS server is always set as Admin-Reset.
  - Duplicate service activate requests can be sent to BNG from the CoA server. BNG does not take any action on services that are already activated. BNG sends a CoA ACK message to the CoA server, when a duplicate request with identical parameters comes from the CoA to apply a parameterized service, or, when a duplicate request with identical parameters comes from the CoA for a service that is already active. BNG sends a CoA NACK message to the CoA server with an error code as an invalid attribute, when a request comes from the CoA to deactivate a parameterized or non-parameterized service that is not applied to the session.
  - The policy-map associated to a dynamic template can be edited to change the service parameters. However, this does not update the accounting records. Therefore, to generate all the accounting records accurately, it is recommended that a new service with all the required service parameters be created and associated to the new service, through a CoA.
  - The active subscriber session is cleared if a session is restarted while processing a CoA request and if the session restoration fails.

For more information, see the *Configuring Authentication, Authorization, and Accounting Functions* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*.

- Support was added to increase the number of L3 sub-interfaces.
- QoS support extended for PWHEv6.
- LAG Bundles Support—PTP is now configurable on Link aggregation group (LAG) Ethernet bundle interfaces. PTP is not supported on LAG Ethernet sub-interfaces.
- ABFv6 is supported on IRB/BVI interfaces for ASR 9000 Enhanced Ethernet line card. It is not supported for ASR 9000 Ethernet line card.
- Support for two new encapsulations for the ambiguous VLAN configuration:
  - **encapsulation ambiguous dot1q any second-dot1q any**
  - **encapsulation ambiguous dot1q any second-dot1q** *vlan-id*
- BNG support is added on Cisco ASR 9922 Series Aggregation Services Routers.
- DHCP IPv4 packet debug capability is enhanced to filter debugs at subscriber level. The filters are available for mac-address, interface, outer-vlan and inner-vlan.
- The **mpls label range** <*min*> <*max*> command enables MPLS-TP and static pseudowire to have larger label space.
- Session Limit Per Circuit-ID - If the lease limit is specified from the AAA server as part of Change of Authorization (CoA) or Access-Accept message, then the DHCP lease limit configured through the proxy profile is overridden. In this case, the most recent session limit received from the AAA server is taken as the current lease limit for the particular Circuit-ID. The lease limit set from the AAA server is cleared when there are no more client bindings associated with the Circuit-ID for which the lease limit is applied.
- If the system is running with a power budget deficiency and the **power budget enforcement disable** command is not configured, a reset of a line card powers down the line card. Beginning with Cisco IOS XR Release 4.3.1, if you configure the **power budget enforcement disable** command, behavior is normal even if the system has a power budget deficiency.

Hardware Features Introduced in Cisco IOS XR Software Release 4.3.1 for the Cisco ASR 9000 Series Router

These hardware features introduced in Cisco IOS XR Software Release 4.3.1 are supported on the Cisco ASR 9000 Series Aggregation Services Router platform:

- Cisco ASR 9000 8-port 10-GE Modular Port Adapter (MPA)

  Cisco IOS XR Software Release 4.3.1 introduces support for the 8-port 10-GE Modular Port Adapter on the Cisco ASR 9000 series platform.

  For more general Cisco ASR 9000 8-port 10-GE Modular Port Adapter hardware information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Overview and Reference Guide* and the *Cisco ASR 9000 Series Aggregation Services Router Ethernet Line Card Installation Guide*.

For Cisco IOS XR software Ethernet port configuration and command information, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference* and the *Cisco ASR 9000 Series Aggregation Services Router Interfaces and Hardware Component Configuration Guide*.

- Cisco ASR 9000 SIP-700 with 8GB memory (A9K-SIP-700-8G)

  Cisco IOS XR Software Release 4.3.1 introduces support for the Cisco ASR 9000 SIP-700 with 8GB memory. Both types of Cisco ASR 9000 SIP-700 are identical in appearance and can be identified by the PID located on the faceplate of the SIP. The A9K-SIP-700 supports 4 GB of memory and A9K-SIP-700-8G supports 8 GB of memory.

  For more general hardware information about the Cisco ASR 9000 SIP-700 with 8GB memory (A9K-SIP-700-8G), refer to the *Cisco ASR 9000 Series Aggregation Services Router SIP and SPA Hardware Installation Guide*.

- Cisco ASR 9001-S Router

  The Cisco ASR 9001-S Router is a 60 Gbps variant of the Cisco ASR 9001 Router. Similar to other routers in the Cisco ASR 9000 Series, running Cisco IOS XR software images, the Cisco ASR 9001-S Router delivers the features and services found on the ASR 9000 Series platforms, allowing customers to standardize on the same Cisco IOS XR image. The Cisco ASR 9001-S Router comes standard with one modular bay (BAY 0) that supports either a 1 GE, 10 GE, or 40 GE modular port adapters (MPAs). The chassis also comes usable with two fixed SFP+ ports (SFP+0 and SFP+1). The second MPA slot (BAY 1) and other two SFP+ ports (SFP+2 and SFP+3) are disabled and covered with dust caps by default. To enable these ports, in order to achieve the full bandwidth of 120 Gbps, a Cisco license can be obtained.

  For information on configuring the Cisco license for Cisco ASR 9001-S Router, refer to the *Cisco ASR 9001-S 120G Upgrade License Configuration Guide*. For more information on installing the Cisco ASR 9001-S Router, refer to the *Cisco ASR 9001 and ASR 9001-S Routers Hardware Installation Guide*.

Important Notes

For Cisco IOS XR Software Release 4.2, the Cisco ASR 9000 Series Aggregation Services 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 Aggregation Services 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

  4 T3

  5 T3/T1

  6 vt15-T1

  7 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 Aggregation Services 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.
- Starting from Cisco IOS XR Software Release 4.0.0, the **hw-module location <LOC> reload warm** command is disabled. As a result, the warm reload feature also has been disabled.
- In Cisco ASR 9000 Series Aggregation Services 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:vkg_ro1_a(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 Aggregation Services 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 Aggregation Services Router Software Release4.3.1 and the Cisco ASR 9000 Series Aggregation Services Router platform.

Cisco IOS XR Caveats

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

- **CSCud77196**

  Basic Description:

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

  Symptom

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

  Conditions:

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

  Workaround:

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

- **CSCue78677**

  Basic Description:

  Memory leak seen on XML dedicated agent.

  Symptom

  System fails to properly free the memory allocated while processing the "get XML query" query, provided with large number of Broader Gateway Protocol (BGP) configurations. It happens even after the XML session is terminated. Note: The xml_tty_agent process leaks some chunk of memory, for each iteration, for example 328 bytes of memory.

  Conditions:

  Execute the "get XML query" for BGP with large number of BGP configurations.

  Workaround:

  None.

- **CSCuf83074**

Basic Description:

sysmgr reports multiple process restarts post RPFO.

Symptom

Multiple processes restart.

Conditions:

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

Workaround:

None.

- **CSCug47099**

  Basic Description:

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

  Symptom

  Install add operation fails and displays the following messages:

  - Error: ERROR: Process insthelper has been performing an operation for a period of time so that the node failed to respond when completing the installation of packages within the system. Error: AFFECTED NODE(S): 0/RP1/CPU0 1/RP0/CPU0 1/RP1/CPU0.
  - Node failed to respond when completing the disk checks.

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

  Conditions:

  The procedure is not available to reproduce the scenario.

  Workaround:

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

- **CSCug72731**

  Basic Description:

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

  Symptom

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

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

  Conditions:

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

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

Workaround:

Install Software Maintenance Upgrades (SMU).

- **CSCug78374**

  Basic Description:

  mpls_lsd process memory leak on standby RP.

  Symptom

  mpls_lsd process memory leak on standby RP.

  Conditions:

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

  Workaround:

  None.

- **CSCug59485**

  Basic Description:

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

  Symptom

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

  Conditions:

  LPTS policing is configured.

  Workaround:

  None.

Caveats Specific to the Cisco ASR 9000 Series Aggregation Services Router

The following caveats are specific to the Cisco ASR 9000 Series Aggregation Services Router platform:

- **CSCug89872**

  Basic Description:

  OSPFv2 flaps due to SeqNumberMismatch after restoring configuration.

  Symptom

  After executing the **commit replace** and **rollback configuration last** *rollback_value* commands, OSPFv2 over backbone link flaps continuously.

  Conditions:

  This occurs when BFD is configured on the links that are part of OSPFv2.

  Workaround:

  Remove or disable BFD and then reload the router.

- **CSCug26277**

  Basic Description:

Traffic drop with ABFv6 Nexthop as PW-HE.

Symptom

Traffic drop occurs with configuration of ABFv6 Nexthop as PWHE interface.

Conditions:

Traffic drops when ABFv6 Nexthop is PWHE interface for core to access scenario.

Workaround:

This issue is fixed in Cisco IOS XR Software Release 4.3.2.

- **CSCug60473**

  Basic Description:

  Egress PE ASR 9000 Enhanced Ethernet Line Card cannot reply traceroute due to invalid source interface.

  Symptom

  ASR 9000 Enhanced Ethernet Line Card on egress Provider Edge (PE) router does not reply to the **traceroute** command, for (CE-CE).

  Conditions:

  Disable the propagation of IP Time-To-Live (IP TTL) packets for forwarded Multiprotocol Label Switching (MPLS) header on ingress PE by running the following command: "mpls ip-ttl-propagate disable". Configure the per-CE label allocation mode on egress PE by running **label-allocation-mode per-ce** command.

  Workaround:

  Configure the same label to be used for all the routes by executing the **label-allocation-mode per-vrf** command.

- **CSCug60384**

  Basic Description:

  BGP session on standby RSP flaps during LC iMDR

  Symptom

  Nonstop Routing (NSR) remains in DISABLED state for few sessions during LC iMDR (Line card ISSU Minimal Disruptive Restart).

  Conditions:

  Establish 250 Broader Gateway Protocol (BGP) sessions with NSR ENABLED. Restart LC iMDR.

  Workaround:

  None. If the Netflow policy is attached to physical or sub-interfaces, it will monitor both ipv4/ipv6 unicast and multicast traffic.

- **CSCug46522**

  Basic Description:

  Mulicast traffic is not monitored by netflow policy on BVI

  Symptom

  Netflow policy monitors ipv4 packets on Bridge-Group Virtual Interface (BVI). The policy monitors only ipv4/ipv6 unicast traffic and not multicast traffic.

Conditions:

The issue persists with Netflow policy that is attached to BVI as the ingress interface.

Workaround:

None. If the Netflow policy is attached to physical or sub-interfaces, it will monitor both ipv4/ipv6 unicast and multicast traffic.

- **CSCud77196**

  Basic Description:

  BFD bundle interface that was shut, sometimes went goes down after no-shut .

  Symptom

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

  Conditions:

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

  Workaround:

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

- **CSCug88197**

  Basic Description:

  The eem_metric_dir process crashes on RSP fail over on a RSP2 system.

  Symptom

  The eem_metric_dir process crashes during the Route Switch Processor (RSP) switchover on the RSP2 system.

  Conditions:

  The issue occurs when a RSP switchover happens on a RSP2 system.

  Workaround:

  None.

- **CSCud37497**

  Basic Description:

  System configuration fails when downgrading to Cisco IOS XR Software Release 4.2.x from Cisco IOS XR Software Release 4.3.1.

  Symptom

  The system displays the following logs (sample logs) continuously on console and system configuration never completes, while downgrading from Cisco IOS XR Software Release 4.3.1 to Cisco IOS XR Software Release 4.2.x.

```
RP/0/RSP0/CPU0: cfgmgr-rp[161]:
%MGBL-CONFIG-0-INIT_FAILURE : Configuration Manager was unable to initialize
the Configuration Namespace Version History module.
Error: 'Result too large'.
Initialization will be tried again after 60 seconds.
```

Conditions:

The issue recurs and it is observed while downgrading of Cisco IOS XR Software Release 4.3.1 to Cisco IOS XR Software Releaes 4.2.x.

Workaround:

Use the disk boot procedure and set the ROM Monitor (rommon) variable TURBOBOOT explicitly with format option, to downgrade successfully from Cisco IOS XR Software Release 4.3.1 to Cisco IOS XR Software Release 4.2.x.

Ensure to backup the running-configurations if any, so as to apply the configurations later, after downgrade.

- **CSCug17684**

  Basic Description:

  Line protocol flaps on POS/serial Interfaces with HDLC encapsulation.

  Symptom

  Line protocol flaps on few of Packet-over-SONET (POS) or Serial Interfaces with High-Level Data Link Control (HDLC) Encapsulation.

  Conditions:

  This happens when scale configuration is established with 0.6 to 1.5 milion routes; Border Gateway Protocol (BGP) configuration is removed and re-applied; and BGP process is restarted.

  Workaround:

  None.

- **CSCug49753**

  Basic Description:

  The stp_io process blocks during ISSU operation from Cisco IOS XR Software Release 4.3.0 to Release 4.3.1.

  Symptom

  During ISSU operation from Cisco IOS XR Software Release 4.3.0 to Release 4.3.1, the stp_io process process running on the line card enters a blocking state. The router undergoing ISSU does not send BPDUs for several minutes during ISSU. The lack of BPDUs causes an infinite loop in the Layer 2 network.

  Conditions:

  This occurs when ISSU is performed from Cisco IOS XR Software Release 4.3.0 to Release 4.3.1.

  Workaround:

  None. This condition in temporary and the router returns to its original state after ISSU.

- **CSCug68969**

  Basic Description:

  The "ICMP unreachable or fragmentation needed" message is not sent.

  Symptom

  Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.3.0 does not respond with "ICMP destination unreachable or fragmentation needed" message to the source.

Conditions:

Issue exists in Cisco ASR 9000 Series Router running Cisco IOS XR Software Release 4.3.0.

Workaround:

None.

- **CSCud51912**

Basic Description:

Intermittent timeout occurs when polling a single PWHE interface statistics.

Symptom

No response for statistics counters intermittently when PWHE interfaces are polled via SNMP.

Conditions:

When SNMP Walk/get operations are performed on the PWHE interfaces, one of every 10 to 20 polls times out with no response for the SNMP query.

Workaround:

Enable cached statistics based SNMP polling. This can be done by using the **snmp-server ifmib stats cache** command. Alternatively, use 3 to 5 seconds timeout while sending the SNMP queries.

- **CSCuc61943**

Basic Description:

Installing the Cisco IOS XR Software R4.2.3 CGv6 install kit fails.

Symptom:

This happens when the Cisco IOS XR software R4.3.0 image on the ISM card contains FPGA2 version 2.13.

Conditions:

This issue occurs when downgrading the Cisco IOS XR software from R4.3.0 to R4.2.3.

Workaround:

Reboot the ISM card.

Caveats Specific to the ASR 9001 Router

- **CSCue34023**

Basic Description:

IPv6 ping fails on bundle Ethernet interface after switch over/line card reload.

Symptom

IPv6 ping fails from Cisco ASR 9000 Series Router to Cisco ASR 9001 Router ethernet bundle after reloading the line card.

Conditions:

Connect Cisco ASR 9000 Series to Cisco ASR 9001 Router through 2x10G Ethernet bundle.

Workaround:

Delete all the entries in the IPv6 neighbor by executing the **clear ipv6 neighbor** command.

- **CSCug65156**

  Basic Description:

  PPPoE sessions disconnect after rack reload.

  Symptom

  Point-to-Point Protocol over Ethernet (PPPoE) commands for Broadband Network Gateway (BNG) sessions disconnect.

  Conditions:

  Reload the rack that carries the active links of the Access bundle interface, in an ASR-9001 cluster setup.

  Workaround:

  Configuring a lacp switchover suppress-flaps 15000 for the bundle interface gives enough time (15s) for the standby bundle link to transition to active. So the bundle stays UP and hence the PPPoE(BNG) sessions. 15000ms timer is tested with a scale of 8K sessions per bundle interface.

- **CSCug60558**

  Basic Description:

  The front panel ports 2 and 3 on the Cisco ASR 9001 Router flapping.

  Symptom

  The front panel ports 2 and 3 on the Cisco ASR 9001 Router may go down without displaying any warning messages. However, the tengig0/0/2/0 and 0/0/2/1 onboard ports are not affected.

  Conditions:

  This occurs only on fixed ports 2 and 3 of Cisco ASR 9001 Router.

  Workaround:

  Execute the **shut** or **no shut** command on the affected ports. This brings up the port temporarily. No permanent workaround exists.

Upgrading Cisco IOS XR Software

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

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

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

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

Troubleshooting

For information on troubleshooting Cisco IOS XR Software, see the *Cisco 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:

1 Clear the NVGEN cache:

```
RP/0/RSP0/CPU0:router# run nvgen -F 1
```

2 Create a dummy config commit:

```
RP/0/RSP0/CPU0:router# config
RP/0/RSP0/CPU0:router(config)# hostname <hostname>
RP/0/RSP0/CPU0:rotuer(config)# commit
RP/0/RSP0/CPU0:router(config)# end
```

3 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]
```

4 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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