Release Notes for Cisco ASR 9000 Series Aggregation Services Routers for Cisco IOS XR Software Release 4.3.0

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 4.3.0, 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 4.3.0 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 4.3.0, see the Caveats, on page 77 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 4.3.0.

To determine the software versions or levels of your current system, see the Determining Your Software Version, on page 32 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 4.3.0

Table 1: Cisco IOS XR Software Release 4.3.0 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 4.3.0 supported on the Cisco ASR 9000 Series Aggregation Services Router.

Table 1: Cisco IOS XR Software Release 4.3.0 PX PIE Files

Feature Set	Filename	Description

Composite Package		
Cisco IOS XR IP Unicast Routing Core Bundle	asr9k-mini-px.pie-4.3.0	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-4.3.0	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-4.3.0	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-4.3.0	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-4.3.0	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-4.3.0	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-4.3.0	Firmware for the advanced video feature for Cisco ASR 9000 Series Router chassis.
Cisco IOS XR Optics Package	asr9k-optic-px.pie-4.3.0	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-4.3.0	Firmware pie for all LC and RSP FPGA's and ASIC's.
Cisco IOS XR Documentation Package	asr9k-doc-px.pie-4.3.0	.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-4.3.0	Includes binaries to support CGv6 on ISM.
Cisco IOS XR Satellite Package	asr9000v-nV-px.pie-4.3.0	Includes Satellite software images.
Cisco IOS XR BNG Package	asr9k-bng-px.pie-4.3.0	Includes binaries to support BNG features.
Cisco IOS XR Cisco ASR 903 Series Router Package	asr9k-asr903-nV-px.pie-4.3.0	Includes binaries to support Cisco ASR 903 Series Router software.
Cisco IOS XR Cisco ASR 901 Series Router Package	asr9k-asr901-nV-px.pie-4.3.0	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 4.3.0TAR Files, on page 6 lists the Cisco ASR 9000 Series Aggregation Services Router TAR files.

Table 2: Cisco IOS XR Software Release 4.3.0TAR Files

Feature Set	Filename	Description
Cisco IOS XR IP/MPLS Core Software [for RSP440 systems]	ASR9K-iosxr-px-4.3.0.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-k9-4.3.0.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 4.3.0 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	Release 4.2.3
ASR 9922 Route Processor 12GB for Service Edge	ASR-9922-RP-SE	Release 4.2.3
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 4.3.0 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 4.3.0 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 4.3.0 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 4.3.0 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 4.3.0 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 4.3.0 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 4.3.0 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	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot 20 Line Card Slot DC Chassis w/ PEM V2	ASR-9922-DC	Release 4.2.3
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	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Air Filter with Media, Center	ASR-9922-FLTR-CEN	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Air Filter with Media, Left & Right	ASR-9922-FLTR-LR	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor Filler	ASR-9922-RP-FILR	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor 12GB for Service Edge	ASR-9922-RP-SE	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Route Processor 6GB for Packet Transport	ASR-9922-RP-TR	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 22-Slot Switch Fabric Card Slot Filler	ASR-9922-SFC-FILR	Release 4.2.3

Cisco ASR 9000 Series Aggregation Services Router 22-Slot Switch Fabric Card/110G	ASR-9922-SFC110	Release 4.2.3
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	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 1-port 100GE, Packet Transport Optimized	A9K-1X100GE-TR	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 36-port 10GE, Service Edge Optimized	A9K-36X10GE-SE	Release 4.2.3
Cisco ASR 9000 Series Aggregation Services Router 36-port 10GE, Packet Transport Optimized LC	A9K-36X10GE-TR	Release 4.2.3
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 4.3.0 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 Aggregation 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-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
	HSBI RSP2	lc	hsbi	4.00	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
	HSBI RSP2	lc	hsbi	4.00	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
	HSBI RSP2	lc	hsbi	4.00	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

A9K-RP-SC-3G	Can Bus Ctrl (CBC) SSRP	lc	cbc	30.01	0.00	0.1
	ROMMONB SSRP	lc	rommon	6.09	0.00	0.1
ASR-9912-RP-TR	Can Bus Ctrl (CBC) SSRP	lc	cbc	30.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga12	1.01	0.00	0.1
	IntrCtrl	lc	fpga2	0.05	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	UTI	lc	fpga4	4.09	0.00	0.1
	Timex	lc	fpga5	0.02	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga6	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga9	1.01	0.00	0.1
	CPUCtrl	lc	fpga1	0.06	0.00	0.1
	ROMMONB SSRP	lc	rommon	6.09	0.00	0.1
ASR-9912-RP-SE	Can Bus Ctrl (CBC) SSRP	lc	cbc	30.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga10	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga11	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga12	1.01	0.00	0.1
	IntrCtrl	lc	fpga2	0.05	0.00	0.1
	ClkCtrl	lc	fpga3	1.03	0.00	0.1
	UTI	lc	fpga4	4.09	0.00	0.1
	Timex	lc	fpga5	0.02	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga6	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga7	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga8	1.01	0.00	0.1
	Fabric Ctrl3 SSFC	lc	fpga9	1.01	0.00	0.1
	CPUCtrl	lc	fpga1	0.06	0.00	0.1
	ROMMONB SSRP	lc	rommon	6.09	0.00	0.1
A9K-RP-SC-24G	Can Bus Ctrl (CBC) SSRP	lc	cbc	30.01	0.00	0.1
	ROMMONB SSRP	lc	rommon	6.09	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	1.35	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        29.09        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9912-FAN        Can Bus Ctrl (CBC) SFAN   lc   cbc        31.02        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9010-FAN-V2     Can Bus Ctrl (CBC) FAN    lc   cbc        29.09        0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9001-FAN        Can Bus Ctrl (CBC) FAN    lc   cbc        24.114       0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9912-BPID2      Can Bus Ctrl (CBC) BP2    lc   cbc         7.103       0.00       0.1
--------------------------------------------------------------------------------------------
ASR-9922-BPID2      Can Bus Ctrl (CBC) BP2    lc   cbc         7.103       0.00       0.1
--------------------------------------------------------------------------------------------
A9K-BPID2-10-SLOT   Can Bus Ctrl (CBC) BP2    lc   cbc         7.103       0.00       0.1
--------------------------------------------------------------------------------------------
A9K-BPID2-6-SLOT    Can Bus 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       1.16        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      1.35        0.00       0.1
--------------------------------------------------------------------------------------------
A9K-ISM-100         Can Bus Ctrl (CBC) LC6    lc   cbc        18.06        0.00       0.1
                    CPUCtrl LC6               lc   cpld1       0.01        0.00       0.1
                    Maintenance LC6           lc   fpga2       2.13        0.00       0.1
                    Amistad LC6               lc   fpga1       0.30        0.00       0.20
                    ROMMONB LC6               lc   rommon      1.02        0.00       0.1
--------------------------------------------------------------------------------------------
```

A9K-RSP-3G	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-RSP-24G	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
SPA-4XT3/E3	SPA E3 Subrate FPGA	spa	fpga2	1.04	0.00	0.0
	SPA T3 Subrate FPGA	spa	fpga3	1.04	0.00	0.0
	SPA I/O FPGA	spa	fpga1	1.01	0.00	0.0
	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-4XCT3/DS0	SPA T3 Subrate FPGA	spa	fpga2	0.11	0.00	0.100
	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.00	0.200
	SPA I/O FPGA	spa	fpga1	2.08	0.00	0.100
	SPA ROMMON	spa	rommon	2.12	0.00	0.100
SPA-1XCHSTM1/OC3	SPA T3 Subrate FPGA	spa	fpga2	1.04	0.00	0.0
	SPA I/O FPGA	spa	fpga1	1.08	0.00	0.0
	SPA ROMMON	spa	rommon	2.12	0.00	0.0
SPA-24CHT1-CE-ATM	SPA T3 Subrate FPGA	spa	fpga2	1.10	0.00	1.0
	SPA I/O FPGA	spa	fpga1	2.32	0.00	1.0
	SPA ROMMON	spa	rommon	1.03	0.00	1.0
SPA-2CHT3-CE-ATM	SPA T3 Subrate FPGA	spa	fpga2	1.11	0.00	1.0
	SPA I/O FPGA	spa	fpga1	2.23	0.00	1.0
	SPA ROMMON	spa	rommon	1.04	0.00	1.0
SPA-1CHOC3-CE-ATM	SPA OC3 Subrate FPGA	spa	fpga2	2.23	0.00	0.0
	SPA I/O FPGA	spa	fpga1	2.23	0.00	2.0
	SPA ROMMON	spa	rommon	1.04	0.00	0.0
SPA-1XCHOC48/DS3	SPA I/O FPGA	spa	fpga2	1.00	0.00	0.49
	SPA I/O FPGA	spa	fpga3	1.00	0.00	0.52
	SPA I/O FPGA	spa	fpga1	1.36	0.00	0.49
	SPA ROMMON	spa	rommon	2.02	0.00	0.49
SPA-2XCHOC12/DS0	SPA FPGA2 swv1.00	spa	fpga2	1.00	0.00	0.0

```
                    SPA FPGA swv1.36          spa  fpga1       1.36        0.00       0.49
                    SPA ROMMON swv2.2         spa  rommon      2.02        0.00       0.49
--------------------------------------------------------------------------------------------
A9K-MPA-20X1GE      EP I/O FPGA               spa  fpga3       0.08        0.00       0.0
--------------------------------------------------------------------------------------------
A9K-MPA-2X10GE      EP I/O FPGA               spa  fpga6       1.06        0.00       0.0
--------------------------------------------------------------------------------------------
A9K-MPA-4X10GE      EP I/O FPGA               spa  fpga6       1.06        0.00       0.0
--------------------------------------------------------------------------------------------
A9K-MPA-2X40GE      EP Sage                   spa  fpga7       1.03        0.00       0.0
--------------------------------------------------------------------------------------------
A9K-MPA-1X40GE      EP Sage                   spa  fpga7       1.03        0.00       0.0
--------------------------------------------------------------------------------------------
SPA-8XOC12-POS      SPA FPGA swv1.0           spa  fpga1       1.00        0.00       0.5
--------------------------------------------------------------------------------------------
SPA-8XCHT1/E1       SPA I/O FPGA              spa  fpga1       2.08        0.00       0.0
                    SPA ROMMON                spa  rommon      2.12        0.00       0.140
--------------------------------------------------------------------------------------------
SPA-OC192POS-XFP    SPA FPGA swv1.2 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
--------------------------------------------------------------------------------------------
SPA-1XOC12-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 4.3.0[Default]
Copyright (c) 2012 by Cisco Systems, Inc.

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


BNG1 uptime is 18 hours, 12 minutes
System image file is "disk0:asr9k-os-mbi-4.3.0/0x100305/mbiasr9k-rsp3.vm"

cisco ASR9K Series (Intel 686 F6M14S4) processor with 12582912K bytes of memory.
Intel 686 F6M14S4 processor at 2127MHz, Revision 2.174
ASR-9006 AC Chassis

4 Management Ethernet
8 TenGigE
100 GigabitEthernet
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 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr903-supp-4.3.0
    Built on Wed Dec 19 05:46:31 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-asr903-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr903-nV-px-4.3.0
    Built on Wed Dec 19 05:47:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-asr901-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr901-supp-4.3.0
    Built on Wed Dec 19 05:46:20 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-asr901-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr901-nV-px-4.3.0
    Built on Wed Dec 19 05:46:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-9000v-nV-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-9000v-nV-supp-4.3.0
    Built on Wed Dec 19 05:46:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-9000v-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-9000v-nV-px-4.3.0
    Built on Wed Dec 19 05:46:19 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-adv-video, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
    Built on Wed Dec 19 05:46:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-service, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-service-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-service-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
    Built on Wed Dec 19 05:46:06 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
    Built on Wed Dec 19 05:44:13 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mgbl, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.0
    Built on Wed Dec 19 05:44:41 PST 2012
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mgbl-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mgbl-supp-4.3.0
    Built on Wed Dec 19 05:44:41 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mgbl-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mgbl-px-4.3.0
    Built on Wed Dec 19 05:44:52 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mcast, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.0
    Built on Wed Dec 19 05:44:38 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-security, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-security-4.3.0
    Built on Wed Dec 19 05:44:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-k9sec-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-k9sec-supp-4.3.0
    Built on Wed Dec 19 05:44:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-k9sec-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-k9sec-px-4.3.0
    Built on Wed Dec 19 05:45:03 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fpd, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fpd-4.3.0
    Built on Wed Dec 19 05:45:30 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fpd-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fpd-px-4.3.0
    Built on Wed Dec 19 05:45:55 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9K-doc-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9K-doc-supp-4.3.0
    Built on Wed Dec 19 05:45:20 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-doc-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-doc-px-4.3.0
    Built on Wed Dec 19 05:45:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-bng, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-4.3.0
```

```
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
    Built on Wed Dec 19 05:45:18 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
    Built on Wed Dec 19 05:39:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-diags-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
    Built on Wed Dec 19 05:37:01 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
    Built on Wed Dec 19 05:43:40 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/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 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr903-supp-4.3.0
    Built on Wed Dec 19 05:46:31 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-asr903-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr903-nV-px-4.3.0
    Built on Wed Dec 19 05:47:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-asr901-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr901-supp-4.3.0
    Built on Wed Dec 19 05:46:20 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-asr901-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-asr901-nV-px-4.3.0
    Built on Wed Dec 19 05:46:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-9000v-nV-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-9000v-nV-supp-4.3.0
    Built on Wed Dec 19 05:46:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-9000v-nV-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-9000v-nV-px-4.3.0
    Built on Wed Dec 19 05:46:19 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-adv-video, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
    Built on Wed Dec 19 05:46:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-service, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-service-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-service-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
    Built on Wed Dec 19 05:46:06 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
    Built on Wed Dec 19 05:44:13 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mgbl, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mgbl-4.3.0
    Built on Wed Dec 19 05:44:41 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mgbl-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mgbl-supp-4.3.0
    Built on Wed Dec 19 05:44:41 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mgbl-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mgbl-px-4.3.0
    Built on Wed Dec 19 05:44:52 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mcast, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.0
    Built on Wed Dec 19 05:44:38 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-security, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-security-4.3.0
    Built on Wed Dec 19 05:44:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-k9sec-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-k9sec-supp-4.3.0
    Built on Wed Dec 19 05:44:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-k9sec-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-k9sec-px-4.3.0
    Built on Wed Dec 19 05:45:03 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fpd, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fpd-4.3.0
    Built on Wed Dec 19 05:45:30 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-fpd-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fpd-px-4.3.0
    Built on Wed Dec 19 05:45:55 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9K-doc-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9K-doc-supp-4.3.0
    Built on Wed Dec 19 05:45:20 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-doc-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-doc-px-4.3.0
    Built on Wed Dec 19 05:45:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-bng, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
    Built on Wed Dec 19 05:45:18 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
    Built on Wed Dec 19 05:39:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-diags-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
    Built on Wed Dec 19 05:37:01 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
    Built on Wed Dec 19 05:43:40 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

Boot device on node 0/0/CPU0 is mem:
Package active on node 0/0/CPU0:
iosxr-adv-video, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
    Built on Wed Dec 19 05:46:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-service, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-service-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-service-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
    Built on Wed Dec 19 05:46:06 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
    Built on Wed Dec 19 05:44:13 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mcast, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.0
    Built on Wed Dec 19 05:44:38 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-bng, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
    Built on Wed Dec 19 05:45:18 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
    Built on Wed Dec 19 05:39:29 PST 2012
```

```
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-diags-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
    Built on Wed Dec 19 05:37:01 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
    Built on Wed Dec 19 05:43:40 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

Boot device on node 0/1/CPU0 is mem:
Package active on node 0/1/CPU0:
iosxr-adv-video, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
    Built on Wed Dec 19 05:46:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-service, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-service-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-service-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
    Built on Wed Dec 19 05:46:06 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
    Built on Wed Dec 19 05:44:13 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mcast, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.0
    Built on Wed Dec 19 05:44:38 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-bng, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-4.3.0
    Built on Wed Dec 19 05:45:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
    Built on Wed Dec 19 05:45:18 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
```

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    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
    Built on Wed Dec 19 05:39:29 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
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asr9k-diags-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
    Built on Wed Dec 19 05:37:01 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
    Built on Wed Dec 19 05:43:40 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

Boot device on node 0/2/CPU0 is mem:
Package active on node 0/2/CPU0:
iosxr-adv-video, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-adv-video-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
    Built on Wed Dec 19 05:45:59 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
    Built on Wed Dec 19 05:46:04 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-service, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-service-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

```
asr9k-service-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-service-supp-4.3.0
    Built on Wed Dec 19 05:46:07 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
    Built on Wed Dec 19 05:46:06 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
    Built on Wed Dec 19 05:44:13 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-mcast, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mcast-4.3.0
    Built on Wed Dec 19 05:44:15 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
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asr9k-mcast-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-px-4.3.0
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    Built on Wed Dec 19 05:45:04 PST 2012
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asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
    Built on Wed Dec 19 05:45:18 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
```

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    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
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asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
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asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
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asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
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asr9k-diags-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-diags-supp-4.3.0
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asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
    Built on Wed Dec 19 05:37:01 PST 2012
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asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
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asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
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asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
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asr9k-adv-video-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-adv-video-supp-4.3.0
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```
asr9k-video-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-video-px-4.3.0
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asr9k-services-p-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-services-p-px-4.3.0
    Built on Wed Dec 19 05:46:14 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optics-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optics-supp-4.3.0
    Built on Wed Dec 19 05:46:05 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-optic-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-optic-px-4.3.0
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iosxr-mpls, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-mpls-4.3.0
    Built on Wed Dec 19 05:43:54 PST 2012
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asr9k-mpls-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mpls-px-4.3.0
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asr9k-mcast-supp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mcast-supp-4.3.0
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iosxr-bng, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-bng-4.3.0
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asr9k-bng, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-4.3.0
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asr9k-bng-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-bng-px-4.3.0
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    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-infra, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-infra-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-fwding, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-fwding-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-routing, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-routing-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-diags, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-diags-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

iosxr-ce, V 4.3.0[Default], Cisco Systems, at disk0:iosxr-ce-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-os-mbi, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-os-mbi-4.3.0
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    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-base, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-base-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-fwding, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-fwding-4.3.0
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asr9k-scfclient, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-scfclient-4.3.0
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    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-cpp, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-cpp-4.3.0
    Built on Wed Dec 19 05:36:57 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-ce, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-ce-4.3.0
    Built on Wed Dec 19 05:37:00 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie

asr9k-mini-px, V 4.3.0[Default], Cisco Systems, at disk0:asr9k-mini-px-4.3.0
    Built on Wed Dec 19 05:43:40 PST 2012
    By iox-bld2 in /auto/srcarchive7/production/4.3.0/all/workspace for pie
```

Software Features Introduced in Cisco IOS XR Software Release 4.3.0 for Cisco ASR 9000 Series Aggregation Service Router

Bidirectional Forwarding Detection IPv6 Multihop

Bidirectional Forwarding Detection (BFD) IPv6 Multihop feature enables IPv6 Multihop BFD sessions where BFD neighbors can be multiple hops away, either physically or logically. More than one path is available to reach the BFD neighbor. BFD packets are received on a line card that may or may not host the respective BFD session. The BFD Agent in one line card may need to transmit BFD packets out of an egress interface on a different line card.

BFD support for IPv6 Multihop is on a par with the BFD IPv4 Multihop. The BFD IPv6 Multihop is supported on the ASR 9000 Ethernet Line Card and the ASR 9000 Enhanced Ethernet Line Card.

BFD IPv6 Multihop feature is not supported on Cisco ASR 9000 Series SPA Interface Processor-700.

For more information on configuring BFD IPv6 Multihop, 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*.

Bidirectional Forwarding Detection over Generic Routing Encapsulation

Bidirectional Forwarding Detection (BFD) over Generic Routing Encapsulation (GRE) allows link failures to be detected more rapidly than existing GRE keepalives. BFD switching over GRE links works when the BFD packets are transmitted from one end point node to another remote end point node. BFD punting over GRE links works when BFD packets are received at any of the end points.

BFD over GRE feature is not supported on Cisco ASR 9000 Series SPA Interface Processor-700.

For more information on configuring BFD over GRE, 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*.

Bidirectional Forwarding Detection over Logical Bundle

The Bidirectional Forwarding Detection (BFD) over Logical Bundle feature implements and deploys BFD over bundle interfaces based on RFC 5880. The BFD over Logical Bundle (BLB) feature replaces the BVLAN feature and resolves certain interoperability issues with other platforms that run BFD over bundle interface in pure RFC5880 fashion. These platforms include products of other vendors, as well as other Cisco products running Cisco IOS or Cisco Nexus OS software.

BLB is a multipath (MP) single-hop session. BLB requires limited knowledge of the bundle interfaces on which the sessions run; this is because BFD treats the bundle as one big pipe. To function, BLB requires only

information about IP addresses, interface types, and caps on bundle interfaces. Information such as list of bundle members, member states, and configured minimum or maximum bundle links are not required.

BLB is supported on IPv4 address, IPv6 global address, and IPv6 link-local address.

BFD over Logical Bundle feature is not supported on Cisco ASR 9000 Series SPA Interface Processor-700.

For more information on BFD over Logical Bundle, refer the *Configuring Bidirectional Forwarding Detection* chapter in *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-RIB Feedback Mechanism for Update Generation

The Border Gateway Protocol-Routing Information Base (BGP-RIB) feedback mechanism for update generation feature avoids premature route advertisements and subsequent packet loss in a network. This mechanism ensures that routes are installed locally, before they are advertised to a neighbor.

BGP waits for feedback from RIB indicating that the routes that BGP installed in RIB are installed in forwarding information base (FIB) before BGP sends out updates to the neighbors. RIB uses the the BCDL feedback mechanism to determine which version of the routes have been consumed by FIB, and updates the BGP with that version. BGP will send out updates of only those routes that have versions up to the version that FIB has installed. This selective update ensures that BGP does not send out premature updates resulting in attracting traffic even before the data plane is programmed after router reload, LC OIR, or flap of a link where an alternate path is made available.

To configure BGP to wait for feedback from RIB indicating that the routes that BGP installed in RIB are installed in FIB, before BGP sends out updates to neighbors, use the **update wait-install** command in router address-family IPv4 or router address-family VPNv4 configuration mode. The **show bgp**, **show bgp neighbors**, and **show bgp process performance-statistics** commands display the information from update wait-install configuration.

For more information on the **update wait-install** and **show bgp** commands, see the *BGP Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

EIGRP Wide Metric Computation

The Cisco IOS XR Enhanced Interior Gateway Routing Protocol (EIGRP) implementation is enhanced to perform wide metric computation. This enhancement is to support high bandwidth interfaces.

A new EIGRP command is added and existing EIGRP commands are enhanced to support wide metric computation feature.

- **metric rib-scale—**This command was introduced.
- **metric—**The **picoseconds** keyword was added.
- **metric weights—**Support was added for the *k6* constant.
- **show eigrp interfaces—**The command output was modified to display relevant wide metric information.
- **show eigrp neighbors —**The command output was modified to display relevant wide metric information.
- **show eigrp topology—**The command output was modified to display relevant wide metric information.
- **show protocols—**The command output was modified to display relevant wide metric information.

For more complete command reference information of these commands, see the EIGRP Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Locator/ID Separation Protocol on Cisco IOS XR

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

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

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

LISP creates a Level of indirection with two namespaces: EID and RLOC. The EID (Endpoint Identifier) is the IP address of a host. The RLOC (Routing Locator) is the IP address of the LISP router for the host. EID-to-RLOC mapping is the distributed architecture that maps EIDs to RLOCs. The LISP Map Lookup is analogous to a DNS lookup. DNS resolves IP addresses for URLs. LISP resolves locators for queried identifiers or EID prefix.

LISP in Cisco IOS XR supports:

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

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

For information on LISP Commands, see the *LISP Commands on Cisco IOS XR* module in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*

Route Convergence Monitoring and Diagnostics OSPF Type 3/5/7 Link-state Advertisements Monitoring

The Route Convergence Monitoring and Diagnostics (RCMD) OSPF type 3/5/7 link-state advertisements (LSA) monitoring feature flags and differentiates the LSAs during the monitoring of LSAs. A change in route for type 3/5/7 LSAs has to be monitored. During the route calculation, if the route source appears to be type 3/5/7 LSAs and the route change is an add or delete action, then those prefixes have to be monitored. RCMD monitors all deletion of available paths (a purge operation) and addition of the first path (a restoration operation)

for all type 3/5/7 LSAs. The OSPF type 3/5/7 LSAs are monitored and reported on a individual prefix basis. However, a modify operation that involves a change in paths not affecting reachability as a whole, is not monitored. Although all prefixes are logged for reporting, the convergence tracking is rate-limited for the first 10 prefixes that are affected in an SPF run.

The RCMD OSPF type 3/5/7 LSA monitoring is enabled by configuring the **track-external-routes** and **track-summary-routes** under Router OSPF monitor-convergence configuration mode.

For more information on configuring RCMD OSPF Type 3/5/ LSA Monitoring, see the *Implementing RCMD* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the RCMD OSPF Type 3/5/7 LSA Monitoring commands, see the *RCMD Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Route Convergence Monitoring and Diagnostics Prefix Monitoring

The Route Convergence Monitoring and Diagnostics (RCMD) prefix monitoring feature enables convergence monitoring for specific individual prefixes in Open Shortest Path First (OSPF) and Intermediate System-to-Intermediate System (IS-IS) Interior Gateway Protocols (IGP). In IGP, when the route information is created, the prefix is verified against the configured prefix-list. If the prefix is found to be monitored, it is marked for monitoring and information about each prefix change event is captured. The RCMD prefix monitoring individually monitors specific prefixes on each RCMD enabled router in the network. A maximum of 10 prefixes can be monitored. Individual prefix monitoring compliments the probes enabled at customer network edges to monitor connectivity and availability of specific service end-points.

The RCMD prefix monitoring for IS-IS prefixes is enabled by configuring the **prefix-list** command under Router IS-IS monitor-convergence configuration mode. The RCMD prefix monitoring for OSPF prefixes is enabled by configuring the **prefix-list** command under Router OSPF monitor-convergence configuration mode.

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

OSPFv3 Timers Link-state Advertisements and Shortest Path First Throttle Default Values Update

The Open Shortest Path First version 3 (OSPFv3) timers link-state advertisements (LSAs) and shortest path first (SPF) throttle default values are updated to:

- **timers throttle lsa all—***start-interval*: 50 milliseconds and *hold-interval*: 200 milliseconds
- **timers throttle spf —***spf-start*: 50 milliseconds, *spf-hold*: 200 milliseconds, *spf-max-wait*: 5000 milliseconds

For complete command reference of the timers throttle lsa all and timers throttle spf commands, see the OSPFv3 Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

Route Convergence Monitoring and Diagnostics Prefix Monitoring

The Route Convergence Monitoring and Diagnostics (RCMD) prefix monitoring feature enables convergence monitoring for specific individual prefixes in Open Shortest Path First (OSPF) and Intermediate System-to-Intermediate System (IS-IS) Interior Gateway Protocols (IGP). In IGP, when the route information is created, the prefix is verified against the configured prefix-list. If the prefix is found to be monitored, it is marked for monitoring and information about each prefix change event is captured. The RCMD prefix monitoring individually monitors specific prefixes on each RCMD enabled router in the network. A maximum of 10 prefixes can be monitored. Individual prefix monitoring compliments the probes enabled at customer network edges to monitor connectivity and availability of specific service end-points.

The RCMD prefix monitoring for IS-IS prefixes is enabled by configuring the **prefix-list** command under Router IS-IS monitor-convergence configuration mode. The RCMD prefix monitoring for OSPF prefixes is enabled by configuring the **prefix-list** command under Router OSPF monitor-convergence configuration mode.

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

VRF-lite Support for OSPFv2

VRF-lite capability is enabled for OSPF version 2 (OSPFv2). VRF-lite is the virtual routing and forwarding (VRF) deployment without the BGP/MPLS based backbone. In VRF-lite, individual provider edge (PE) routers are directly connected using VRF interfaces. To enable VRF-lite in OSPFv2, configure the **capability vrf-lite** command in VRF configuration mode. When VRF-lite is configured, the DN bit processing and the automatic Area Border Router (ABR) status setting are disabled.

For complete command reference information of the **capability-vrf** command, see the *OSPFv2 Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*

Circuit Emulation over Packet Service on the Cisco ASR 9000 Series Router

Circuit Emulation over Packet (CEoP) is a way to carry TDM circuits over packet switched network. Circuit Emulation over Packet is an imitation of a physical connection. The goal of CEoP is to replace leased lines and legacy TDM networks. This feature allows network administrators to use their existing IP or MPLS network to provide leased-line emulation services or to carry data streams or protocols that do not meet the format requirements of other multiservice platform interfaces. CEoP puts TDM bits into packets, encapsulates them into an appropriate header and then sends that through PSN. The receiver side of CEoP restores the TDM bit stream from packets.

In Cisco IOS XR Software Release 4.3.0, Circuit Emulation Service over Packet Switched Network was added in these SPAs:

- Cisco 24-Port Channelized T1/E1 Circuit Emulation and Channelized ATM SPA (SPA-24CHT1-CE-ATM)
- Cisco 2-Port Channelized T3/E3 Circuit Emulation and Channelized ATM SPA (SPA-2CHT3-CE-ATM)

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

Satellite nV Switching System

The Cisco ASR 9000 Series Router Satellite Network Virtualization (nV) service or the Satellite Switching System enables you to configure a topology in which one or more satellite switches complement one or more Cisco ASR 9000 Series routers, to collectively realize a single virtual switching system. In this system, the satellite switches act under the management control of the routers. The complete configuration and management of the satellite chassis and features is performed through the control plane and management plane of the Cisco ASR 9000 Series Router, which is referred as the host.

In Cisco IOS XR Software Release 4.3.0, the Satellite nV Service includes support for Cisco ASR 9001 and Cisco ASR 9922 Series Routers as hosts, and Cisco ASR 901, and Cisco ASR 903 as satellite devices. For more information on Satellite nV Service and Configuration, see *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*. For more information on Satellite nV commands, see *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component 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.

Y.1731 Synthetic Loss Measurement

The Y.1731 Synthetic Loss Measurement (SLM) is a mechanism that injects synthetic measurement probes, and measures the loss of these probes in order to measure the loss of real data traffic. Each probe packet carries a sequence number; the sender increments the sequence number by one for each packet that is sent, and the receiver can thereby detects lost packets by spotting missing sequence numbers.

For more information on Y.1731 SLM, see *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Guide*. For more information on Y.1731 SLM commands, see the Ethernet OAM Commands on the Cisco ASR 9000 Series Router chapter in the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference*.

IPv6 Support for Broadband Network Gateway

IPv6 addressing is supported for the following Broadband Network Gateway features:

- Dynamic Host Configuration Protocol
- Neighbor Discovery
- Distributed Address Pool Service
- HTTP Redirect Support
- Subscriber Session Support
- Packet Handling on Subscriber Interfaces
- Access Control Lists

For more information on IPv6 Support for Broadband Network Gateway, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference on IPv6 Support for Broadband Network Gateway, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Broadband Network Gateway Dual Stack Scale Support

In Cisco IOS XR Release 4.3.0, 32000 dual stack (both IPv4 and IPv6 enabled) PPPoE and IPoE sessions are supported while 64000 dual stack sessions are supported for Early Field Trials or lab testing only.

Ciso IOS XR Release 4.3.0 also supports 128000 IPv4 dual stack PPPoE and IPoE sessions.

Broadband Network Gateway on Satellite Enhancements

Broadband Network Gateway supports nV Satellite feature. The two different topologies that nV Satellite supports in BNG are:

- Bundled Ethernet ports on the CPE side of the Satellite node connected to the Cisco ASR 9000 Series Router via single Ethernet port connections.
- Non-bundle from the satellite out to the access network and bundle between the Satellite node and user node.

For more information on Satellite Enhancements in Broadband Network Gateway, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*.

Broadband Network Gateway Packaging

A BNG package is a collection of components that provide the BNG feature set. The BNG feature set is provided by several components that include the platform independent (PI) and platform dependent (PD) components. BNG is used by only the subset of Cisco ASR 9000 Series Router deployments. Hence, BNG packaging feature ensures that minimum system resources are used on systems that do not use the BNG features.

A BNG pie supporting the BNG feature set, could be compiled, installed, uninstalled, activated, and deactivated on the Cisco ASR 9000 Series Router. The requirements of a BNG pie are as follows:

- BNG feature set should not be available on Cisco ASR 9000 Series Router until BNG pie is installed.
- When the BNG pie is installed, ensure that the Cisco ASR 9000 Series Router CPU is not restarted.
- When the BNG pie is deactivated or removed, the relevant BNG configurations are removed from the running configuration.

BNG feature is deployed on x86 based platforms only and the pie available is **asr9k-bng-px.pie**.

For more information on Broadband Network Gateway Packaging, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*.

Excessive Punt Flow Trap in Broadband Network Gateway

The Excessive Punt Flow Trap feature attempts to identify and mitigate control packet traffic from remote devices that send more than their fair share of control packet traffic. A remote device can be a subscriber device, a device on a VLAN interface, or a device identified by its source MAC address.

When remote devices send control packet traffic to the router, the control packets are punted and policed by a local packet transport service (LPTS) queue to protect the router CPU. If one device sends an excessive rate of control packet traffic, the policer queue fills up, causing many packets to be dropped. If the rate from one "bad actor" device greatly exceeds that of other devices, most of the other devices do not get any of their control packets through to the router. The Excessive Punt Flow Trap feature attempts to address these kinds of scenarios.

The Excessive Punt Flow Trap feature is supported on both subscriber interfaces, and non-subscriber interfaces such as L2 and L3 VLAN sub-interfaces and bundle virtual interfaces (BVIs). If the source that floods the punt queue with packets is a device with an interface handle, then all punts from that bad actor interface are penalty policed. The penalty rate, per protocol, is a default value of 10 protocols per second (pps). Otherwise, if the source is a device that does not have an interface handle, then all packets from this bad actor are dropped.

Note In the 4.2.x releases, the Excessive Punt Flow Trap feature was called "Subscriber Control Plane Policing (CoPP)", which operated only on subscriber interfaces.

For more information on Excessive Punt Flow Trap in Broadband Network Gateway, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference on Excessive Punt Flow Trap, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Radius-based Lawful Intercept

Radius-based Lawful Intercept feature intercepts the BNG subscriber traffic through RADIUS attributes. This is a preferred method over SNMP user-connection MIB, as SNMP-based method prevents a session to be tapped until an IP address has been assigned to the session. In the Radius-based LI mechanism, tapping is possible as soon as a session is established.

A RADIUS-based Lawful Intercept solution enables intercept requests to be sent (through Access-Accept packets or Change of Authorization (CoA)-Request packets) to the network access server (NAS) or to the

Layer 2 Tunnel Protocol access concentrator (LAC) from the RADIUS server. All traffic data going to or from a PPP or L2TP session is passed to a mediation device. Another advantage of RADIUS-based Lawful Intercept solution is to set the tap with Access-Accept packets that allows all target traffic to be intercepted simultaneously.

The RADIUS-based Lawful Intercept feature provides tap initiation support for the following modes:

- Access-Accept based Lawful Intercept for the new session
- CoA based Lawful Intercept for existing session

Note The Radius-based Lawful Intercept functionality is not enabled by default.

For more information on Radius-based Lawful Intercept, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*.

Support for Shared Policy Instance

Shared Policy Instance (SPI) allows allocation of a single set of QoS resources among groups of BNG sub-interfaces and bundle sub-interfaces, and shares them across a group of sub-interfaces, multiple Ethernet flow points (EFPs), or bundle interfaces.

Using SPI, a single instance of qos policy can be shared across multiple sub-interfaces, allowing for aggregate shaping of the sub-interfaces to one rate. All of the sub-interfaces that share the instance of a QoS policy must belong to the same physical interface. The number of sub-interfaces sharing the QoS policy instance can range from 2 to the maximum number of sub-interfaces on the port.

BNG configures a complete hierarchical policy-map that includes parent and child policies. Optionally, the SPI name can be defined and attached to the appropriate dynamic template or downloaded from RADIUS, as follows:

- Policy configured through a CLI and applied through a dynamic-template
- Policy configured through a CLI and applied through RADIUS

For more information on support for shared policy instance, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference on shared policy instance, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

TCP MSS Adjustment for BNG Subscribers

The TCP MSS Adjustment for BNG Subscribers feature allows for the configuration of the maximum segment size (MSS) on transient packets that traverse a Cisco ASR 9000 Series Router.

When dealing with PPPoE or L2TP cases, an additional header is added to the packet that the client initiating a TCP session may not be aware of. This can result in lost packets, broken transmissions or fragmentation when packet sizes exceed the MTU's due to the added headers.

Here is an example scenario of how the TCP MSS Adjustment for BNG Subscribers feature works:

Figure 1: Sample TCP MSS Adjustment for BNG Subscribers

TCP encapsulated in both IPv4 and IPv6 are supported.

For more information on TCP MSS Adjustment in Broadband Network Gateway, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*. For complete command reference on TCP MSS Adjustment, see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Command Reference*.

Generic Routing Encapsulation

Generic Routing Encapsulation (GRE) is a tunneling protocol developed by Cisco Systems that encapsulates a wide variety of network layer protocols inside virtual point-to-point links over an Internet Protocol internetwork.

For more information on configuring GRE, see the Implementing Generic Routing Encapsulation module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to configure GRE, see the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Pseudowire Headend

Pseudowire Headend (PWHE) is a technology that allows termination of access pseudowires (PWs) into a Layer 3 (VRF or global) domain, or into a Layer 2 domain. PWs provide an easy and scalable mechanism for tunneling customer traffic into a common IP/MPLS network infrastructure. PWHE allows customers to provision features such as QOS access lists (ACL) and L3VPN for each PWHE interface, on a service Provider Edge (PE) router.

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*.

Provider Backbone Bridge VPLS

The Cisco ASR 9000 Series Aggregation Services Routers supports a scenario when the provider backbone bridge is a VPLS network. You can configure pseudowires in the provider backbone bridge (PBB) edge bridge domain and core bridge domain. In either type of bridge domain, the pseudowire functionality remains the same as in native bridge domain.

For more information on configuring PBB VPLS, see the Implementing IEEE 802.1ah Provider Backbone Bridge module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services*

Configuration Guide. For more information on commands to configure PBB VPLS, see the Provider Backbone Bridge Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Multiple I-SID Registration Protocol Lite

The 802.1Qbe—Multiple I-SID Registration Protocol (MIRP) standard provides the ability to flush learned MAC address registration entries held in the filtering database of an I-component on a per I-SID basis. The backbone service instance identifier (I-SID) is a field in the backbone service instance tag which identifies the backbone service instance of a frame. MIRP defines mechanisms for I-SID flushing, and has the required capabilities to handle topology changes that occur in networks attached to a provider backbone bridged network. A backbone edge bridge (BEB) signals to other potentially affected BEBs, the need to alter certain learned associations between customer MAC addresses and backbone MAC addresses. In the absence of MIRP, customer connections across a provider backbone network can take several minutes to restore connectivity after a topology change in an access network.

For more information on configuring MIRP, see the Implementing IEEE 802.1ah Provider Backbone Bridge module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to configure MIRP, see the Provider Backbone Bridge Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Per-VLAN Spanning Tree Access Gateway on Bundle Interfaces

Per-VLAN Spanning Tree Access Gateway (PVSTAG) support on bundle interfaces has been extended along with physical interfaces, to cater to an increasing number of customers that support PVST access networks.

For more information on PVSTAG, see the Implementing Multiple Spanning Tree Protocol module in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*. For more information on commands to configure PVSTAG, see the Multiple Spanning Tree Protocol chapter in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Scale Enhancements on ASR 9000 Enhanced Ethernet Line Card

ASR 9000 Enhanced Ethernet Line Card supports:

- 128000 pseudowires within VPWS and VPLS
- 128000 pseudowires across VPLS and VPWS instances
- Upto 512 pseudowires in a bridge
- 128000 bundle attachment circuits
- 128000 VLANs

Any Transport over MPLS iMSG

The Any Transport over MPLS iMSG (AToM iMSG) feature enables an interworking layer in access networks to terminate all non-Ethernet functionality and translate these connections to a Ethernet centric service, which

can be terminated on the Layer 3 edge routers. Currently, these TDM-based services terminate directly on the Layer 3 edge routers; a simplified and more cost optimized model for the L3 networks is enabled by moving the TDM complexity into the access layer.

For more information on interworking, 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 interworking, see the Point to Point Layer 2 Services Commands chapter in the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

Pseudowire Grouping

When pseudowires (PW) are established, each PW is assigned a group ID that is common for all PWs that are created from the same physical port. Therefore, when the physical port becomes non-functional or is deleted, L2VPN sends a single message to advertise the status change of all PWs belonging to the group. A single L2VPN signal thus avoids a lot of processing and the resulting loss in response.

For more information on configuring pseudowire groups, 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 pseudowire groups, see the *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Command Reference*.

L2VPN Nonstop Routing

The L2VPN Nonstop Routing (NSR) feature avoids label distribution path (LDP) sessions from flapping on events such as process failures (crash) and route processor failover (RPFO). If you have enabled NSR using NSR process failure switchover, NSR on process failure (crash) is supported by performing RPFO.

NSR enables the router (where failure has occurred) to maintain the control plane states without a graceful restart (GR). NSR, by definition, does not require any protocol extension and typically uses Stateful Switch Over (SSO) to maintain its control plane states.

For more information on configuring L2VPN NSR, 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*.

IPv6 Routing over IPv4 MPLS TE Tunnels

IPv6 routing over IPv4 Multiprotocol Label Switching with Traffic Engineering (MPLS TE) tunnels in the core is achieved by configuring the TE tunnels into the IPv6 Interior Gateway Protocol (IGP) topology as IPv6 forwarding adjacencies.

For more information about IPv6 routing over IPv4 MPLS TE tunnels feature, see the *Implementing Cisco Express Forwarding* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

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

Figure 2: IPv6 Routing over IPv4 MPLS TE

IPv6 Support for IP SLA ICMP Echo Operation

IP Service Level Agreements (SLAs) Internet Control Message Protocol (ICMP) Echo operation is used to monitor the end-to-end response time between a Cisco router and devices using IP. ICMP Echo is useful for troubleshooting network connectivity issues.

For more information about IPv6 Support for IP SLA ICMP Echo operation feature, see the *Implementing Host Services and Applications* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

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

Multiple Group Optimization for Virtual Router Redundancy Protocol

Multiple Group Optimization for Virtual Router Redundancy Protocol (VRRP) provides a solution for reducing control traffic in a deployment consisting of many subinterfaces. By running the VRRP control traffic for just one session, the control traffic is reduced for the subinterfaces with identical redundancy requirements. All other sessions are slaves of this primary session, and inherit their states from it.

For more information about Multiple Group Optimization for VRRP feature, see the *Implementing VRRP* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

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

Video Monitoring Metrics

Video monitoring supports RTP, MDI and MPLS metrics in this release.

- The variations of RTP supported are RTP-MMR, RTP-Voice, RTP-J2k, and RTP-Custom
- The variations of MDI supported are MDI-MPEG, and MDI-MPEG over RTP
- The variations of MPLS supported are RSVP-TE, P2MP-TE, LDP, and MLDP

For more information about Video Monitoring Metrics feature, see the *Implementing Video Monitoring* module in the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide*.

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

GMPLS UNI

The Generalized Multiprotocol Label Switching (GMPLS) User Network Interface (UNI) creates a circuit connection between two clients (UNI-C) of an optical network. This connection is achieved by signaling exchanges between UNI Client (UNI-C) and UNI Network (UNI-N) nodes, where UNI-C nodes are router nodes and UNI-N nodes are optical nodes.

For more information about implementing GMPLS UNI feature, see the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide* and *Cisco ASR 9000 Series Aggregation Services Router MPLS Command Reference*.

Explicit Congestion Notification

In mobile networks, a Base Station Controller (BSC) does not have the knowledge if a particular cell site is being overwhelmed by traffic on a particular link, as it sits behind the ASR9000 series router and it will continue to send traffic even if there is acute congestion on the link. So, once the cell site marks the traffic with the (Explicit Congestion Notification) ECN bits and sends it to the BSC, the BSC will mark the affected session from the congested site with the ECN bit flagged towards the ASR9000 series router.

ECN is an extension to WRED (Weighted Random Early Detection). ECN will mark packets instead of dropping them when the average queue length exceeds a specific threshold value. When configured, ECN helps routers and end hosts to understand that the network is congested and slow down sending packets. However If the number of packets in the queue is above the maximum threshold, packets are dropped based on the drop probability. This is the identical treatment a packet receives when WRED is enabled without ECN configured on the router.

Limitations

- ECN is supported only on ASR 9000 SIP-700 linecards.

For more information on the ECN feature, please refer the *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide*

QoS for Bridge-Group Virtual Interfaces

Integrated Routing and Bridging (IRB) provides the ability to route between a bridge group and a routed domain with the help of Bridge-Group Virtual Interface (BVI).

The BVI is a virtual interface within the router that acts like a normal routed interface that does not support bridging, but represents the comparable bridge group to routed interfaces within the router. The interface number of the BVI is the number of the bridge group that the virtual interface represents. The number is the link between the BVI and the bridge group.

For more information on IRB/ BVI, please refer the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*

Non-ECMP MoFRR

TI (Topology-Independent) MoFRR is a multicast feature that performs fast convergence (Fast ReRoute) for specified routes/flows when failure is detected on one of the paths between the router and the source.

Flow based non-ECMP approach uses a mechanism where two copies of the same multicast stream flow through disjoint paths in the network. At the point in the network (usually the tail PE that is closer to the receivers) where the two streams merge, one of the streams is accepted and forwarded on the downstream links, while the other stream is discarded. When a failure is detected in the primary stream due to a link or node failure in the network, MoFRR instructs the forwarding plane to start accepting packets from the backup stream (which now becomes the primary stream).

For more information about topology independent MoFRR, refer the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide*.

MLD Snooping

Multicast Listener Discovery (MLD) snooping provides a way to constrain multicast traffic at Layer 2. By snooping the MLD membership reports sent by hosts in the bridge domain, the MLD snooping application can set up Layer 2 multicast forwarding tables to deliver traffic only to ports with at least one interested member, significantly reducing the volume of multicast traffic.

MLD snooping uses the information in MLD membership report messages to build corresponding information in the forwarding tables to restrict IPv6 multicast traffic at Layer 2. The forwarding table entries are in the form <Route, OIF List>, where:

- Route is a <*, G> route or <S, G> route.
- OIF List comprises all bridge ports that have sent MLD membership reports for the specified route plus all multicast router (mrouter) ports in the bridge domain.

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

QoS on PWHE

QoS on Pseudo-wire Head End (PWHE) enables enhanced L3VPN service on a service-provider-edge router.

For more information on PWHE-QoS, refer the *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide* .

Stateful NAT64

Stateful NAT64 provides a translation mechanism that translates IPv6 packets into IPv4 packets, and vice versa. Packets that are generated in an IPv6 network and are destined for an IPv4 network are routed within the IPv6 network towards the Stateful NAT64 translator. Stateful NAT64 translates the packets and forwards them as IPv4 packets through the IPv4 network.

For more information about the Stateful NAT64 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*.

Mapping of Address and Port-Translation Mode

Mapping of Address and Port-Translation Mode (MAP-T) is a CGN solution that enables IPv4-only clients to communicate with IPv6-only resources using address and packet translation.

For more information about the MAP-T 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*.

High-Availability

High-Availability (HA) enables network-wide protection by providing fast recovery from faults that may occur in any part of the network. With HA, network hardware and software work together and enable rapid recovery from disruptions to ensure fault transparency to users and network applications.

For more information about the HA 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*.

Destination-Based Logging

Destination-Based Logging (DBL) includes the destination IPv4 address and port number in the Netflow to create and delete records for NAT44, Stateful NAT64, and DS-Lite applications. It is also known as Session-Logging.

Session-Logging and Bulk Port Allocation are mutually exclusive.

For more information about the DBL, 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*.

Carrier Grade Network as Default Application on Integrated Service Module

Integrated Service Module (ISM) line card supports Carrier Grade Network (CGN) as the default application.

Configuring CGN as Default Application on ISM

To configure CGN as the default application on the ISM line card, perform these steps:

Procedure

Step 1 Install CGN services.pie.

Step 2 Configure the CGN role using the **hw-module service cgn location 0/2/CPU0** command.

Step 3 Load the CGN Linux image as the default image instead of CDS-IS.

Step 4 Reload ISM.

MVPN GRE

A unicast GRE tunnel could be the accepting or forwarding interface for either a mVPN-GRE VRF route or a core route. When multicast packets arrive on the VRF interface with the intent of crossing the core, they are first encapsulated with a multicast GRE header (S,G) which are applicable to the VRF's MDT. Then, before the packets are actually forwarded , they are encapsulated in a unicast GRE header. The (S,D) in this packet are the origination and termination addresses for the unicast GRE tunnel.

GRE tunnel stitching is when both the accepting and forwarding interfaces are unicast GRE tunnels. Here, the packet has two GRE encaps. The outer encap is the unicast header for the GRE tunnel. The inner encap is the multicast GRE header for the MDT. This is called as double encap. There is a loss in terms of both bandwidth and throughput efficiency. The bandwidth efficiency loss is because 48 bytes of encap headers are being added to the original (VRF) packet. The throughput efficiency loss is the result of the processing time required to apply two encaps.

For the mVPN-GRE, if the VRF interface is a GRE tunnel, the protocol packets received from LPTS will be accompanied with the receiving unicast GRE tunnel interface and the VRF id of the VRF in which the GRE tunnel is configured. Thus VRF specific processing can be done on the packet.

Restrictions

- MVPN GRE is supported only on ASR 9000 Enhanced Ethernet LCs.

Next-Generation Multicast VPN

Next-Generation Multicast VPN (NG-MVPN) offers more scalability for Layer 3 VPN multicast traffic. It allows point-to-multipoint Label Switched Paths (LSP) to be used to transport the multicast traffic between PEs, thus allowing the multicast traffic and the unicast traffic to benefit from the advantages of MPLS transport, such as traffic engineering and fast re-route. This technology is ideal for video transport as well as offering multicast service to customers of the layer 3 VPN service.

Advantages of NG-MVPN:

- VRF Route-Import and Source-AS Extended Communities
- Upstream Multicast Hop (UMH) and Duplicate Avoidance
- Leaf AD (Type-4) and Source-Active (Type-5) BGP AD messages
- Default-MDT with mLDP P2MP trees and with Static P2MP-TE tunnels
- BGP C-multicast Routing

- RIB-based Extranet with BGP AD
- Accepting (*,G) S-PMSI announcements
- Egress-PE functionality for Ingress Replication (IR) core-trees
- Enhancements for PIM C-multicast Routing
- Migration of C-multicast Routing protocol

NTP-PTP Interworking

NTP-PTP interworking provides the ability to use PTP, as well as other valid time of day (TOD) sources such as Data over Cable Service Interface Specification (DOCSIS) Timing Interface (DTI) and global positioning system (GPS), as the time source for the operating system. Prior to the support of NTP-PTP interworking, only backplane time was supported for the operating system time.

NTP-PTP interworking also provides the means to communicate status changes between PTP and NTP processes. It also supports the unambiguous control of the operating system time and backplane time in the event of bootup, switchovers or card and process failures.

For information regarding configuring NTP-PTP interworking, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*. For information regarding commands, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference*.

PTP Hybrid Mode

Your router allows the ability to select separate sources for frequency and time-of-day (ToD). Frequency selection can be between any source of frequency available to the router, such as: BITS, GPS, SyncE or IEEE 1588 PTP. The ToD selection is between the source selected for frequency and PTP, if available. This is known as hybrid mode, where a physical frequency source (BITS or SyncE) is used to provide frequency synchronization, while PTP is used to provide ToD synchronization.

Frequency selection uses the algorithm described in ITU-T recommendation G.871, and is described in the *Configuring Frequency Synchronization* module in this document. The ToD selection is controlled using the time-of-day priority configuration. This configuration is found under the source interface frequency synchronization configuration mode and under the global PTP configuration mode. It controls the order for which sources are selected for ToD. Values in the range of 1 to 254 are allowed, with lower numbers indicating higher priority.

For information regarding configuring PTP hybrid mode, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*. For information regarding commands, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference*.

ITU-T Telecom Profile for PTP

Cisco IOS XR software supports the ITU-T Telecom Profile for PTP as defined in ITU-T recommendation G.8265.1. The Telecom Profile is a profile for the IEEE 1588-2008 standard that fulfills the specific frequency-distribution requirements of telecommunications networks. It differs in several key ways from the default behavior defined in the IEEE 1588-2008 standard:

- *Clock advertisement*: The Telecom Profile specifies changes to values used in Announce messages for advertising PTP clocks. The clock class value is used to advertise the quality level of the clock, while other values are not used.
- *Clock Selection*: The Telecom Profile specifies an alternate Best Master Clock Algorithm (BMCA) for selecting port states, and selecting between clocks. The Telecom Profile also requires Sync messages (and optionally Delay-Response messages, if required by the implementation) to be received in order to qualify a clock for selection.
- *Port State Decision*: As part of the alternate BMCA, the Telecom Profile states that ports are statically configured to be Master or Slave, rather than using an FSM to dynamically set port states.
- *Packet Rates*: The Telecom Profile uses packet rates higher than those specified in the IEEE 1588-2008 standard:
  - Sync/Follow-Up Packets: Rates from 128 packets-per-second to 16 seconds-per-packet.
  - Delay-Request/Delay-Response Packets: Rates from 128 packets-per-second to 16 seconds-per-packet.
  - Announce Packets: Rates from 8 packets-per-second to 16 seconds-per-packet.
- *Transport Mechanism*: The Telecom Profile restricts the PTP transport mechanism to IPv4.
- *Unicast*: The Telecom Profile mandates that all packets should be sent unicast, rather than multicast.
- *Clock Type*: The Telecom Profile restricts the supported clock-types to Ordinary Clock (a clock with only a single PTP port). For a Telecom Profile slave, meaning that all PTP ports on a single device operate independently of each other, functions such as clock selection operate outside of the context of each Ordinary Clock within the system.
- *Domain Numbers:* The Telecom Profile restricts the range of domain numbers to between 4 and 23, with the default being 4.
- *Port Numbers:* The Telecom Profile dictates that all port numbers for PTP ports are 1, as all clocks within a Telecom Profile network are ordinary clocks.

For information regarding configuring the Telecom Profile, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*. For information regarding commands, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Command Reference*.

Updating Software Images Without a Router Reload

In-service software upgrade (ISSU) provides the ability to upgrade the router software with no outage on the control plane and minimal outage (generally within several seconds) on the forwarding plane. ISSU is a user-initiated and user-controlled process that uses Cisco nonstop forwarding (NSF) with stateful switchover (SSO). ISSU upgrades a SSO-NSF-capable image from a lower to a higher version, or installs ISSU software maintenance updates (SMUs) with minimal downtime, degradation of service, or loss of packets.

To achieve ISSU, the IOS XR software uses the ISSU Minimal Disruptive Restart (iMDR) software. iMDR is the warm reload technology that has a primary function of allowing line cards to be upgraded as if they were redundant in hardware. iMDR effectively separates the CPU and CPU memory of the line cards from the forwarding ASICS, memory, and TCAM of the line cards. The CPU and CPU memory can be thought of as the “software” portion of the line cards, while the forwarding ASICS, memory and TCAM can be thought of as the “hardware” portion of the line cards. iMDR allows the software portion of the cards to be upgraded

to a new version (V2) at the same time that the hardware portion is continuing to perform its duties using the old version (V1). After the software portion upgrades itself and stages the information needed to upgrade the hardware portion, it performs a *flush* to replace the V1 image with the V2 image. This flush generally takes no more than several seconds and that is the only time that there is a disruption of service. The exact time required for the flush depends on the hardware configuration of your router.

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

For more information regarding ISSU, refer to *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*.

ISSU Release Information

Note Only Software Maintenance Upgrades (SMUs) that are identified and tagged as ISSU SMUs can be activated using ISSU.

This table provides information regarding supported hardware for the ISSU process in Cisco IOS XR Release 4.3.0:

Table 5: ISSU-Supported Hardware

Type	Component	Part Number
Line Card	16-Port 10 GE DX Medium Queue Line Card	A9K-16T/8-B
Line Card	2-Port 10 GE, 20-Port GE Line Card	A9K-2T20GE-B
Line Card	2-Port 10 GE, 20-Port GE Extended Line Card	A9K-2T20GE-E
Line Card	2-Port 10 GE, 20-Port GE Low Queue Line Card	A9K-2T20GE-L
Line Card	40-Port GE Line Card	A9K-40GE-B
Line Card	40-Port GE Extended Line Card	A9K-40GE-E
Line Card	40-Port GE Low Queue Line Card	A9K-40GE-L
Line Card	4-Port 10 GE Line Card	A9K-4T-B
Line Card	4-Port 10 GE Extended Line Card	A9K-4T-E
Line Card	4-Port 10 GE Low Queue Line Card	A9K-4T-L
Line Card	8-Port 10 GE DX Line Card	A9K-8T/4-B
Line Card	8-Port 10 GE DX Extended Line Card	A9K-8T/4-E
Line Card	8-Port 10 GE DX Low Queue Line Card	A9K-8T/4-L
Line Card	8-Port 10 GE Line Card	A9K-8T-B
Line Card	8-Port 10 GE Extended Line Card	A9K-8T-E
Line Card	8-Port 10 GE Low Queue Line Card	A9K-8T-L

Type	Component	Part Number
SIP	Cisco ASR 9000 Series SPA Interface Processor-700	A9K-SIP-700
SPA	2-Port OC-48/STM-16 POS/RPR Shared Port Adapter	SPA-2XOC48POS/RPR
SPA	4-Port OC-3/STM-1 POS Shared Port Adapter	SPA-4XOC3-POS-V2
SPA	8-Port OC-12/STM-4 POS Shared Port Adapter	SPA-8XOC12-POS
SPA	8-Port OC-3/STM-1 POS Shared Port Adapter	SPA-8XOC3-POS
SPA	1-Port OC-192/STM-64 POS/RPR XFP Shared Port Adapter	SPA-OC192POS-XFP
Line Card	ASR 9000 2-Port 100 GE Service Edge Optimized Line Card	A9K-2X100GE-SE
Line Card	ASR 9000 2-Port 100 GE Packet Transport Optimized Line Card	A9K-2X100GE-TR
Line Card	ASR 9000 24-Port 10 GE Service Edge Optimized Line Card	A9K-24X10GE-SE
Line Card	ASR 9000 24-Port 10 GE Packet Transport Optimized Line Card	A9K-24X10GE-TR
Line Card	ASR 9000 MOD80 Modular Line Card Service Edge Optimized	A9K-MOD80-SE
Line Card	ASR 9000 MOD80 Modular Line Card Packet Transport Optimized	A9K-MOD80-TR
MPA Card	ASR 9000 20-Port 1-Gigabit Ethernet Modular Port Adapter with SFP optics	A9K-MPA-20X1GE
MPA Card	ASR 9000 4-Port 10-Gigabit Ethernet Modular Port Adapter with XFP optics	A9K-MPA-4X10GE
MPA Card	ASR 9000 2-Port 10-Gigabit Ethernet Modular Port Adapter with XFP optics	A9K-MPA-2x10GE
MPA Card	ASR 9000 2-Port 40-Gigabit Ethernet Modular Port Adapter with QSFP optics	A9K-MPA-2x40GE
RSP	ASR 9000 Fabric Controller, 4G memory	A9K-RSP-4G
RSP	ASR 9000 Route Switch Processor 8G memory	A9K-RSP-8G
RSP	ASR 9000 RSP-440 Service Edge Optimized	A9K-RSP440-SE
RSP	ASR 9000 RSP-440 Packet Transport Optimized	A9K-RSP440-TR

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

Available ISSU process syslog events are:

- The event that is logged upon execution of each phase (Load, Run and Complete) of the ISSU process.
- The event that is logged when the ISSU process is completed.

- The event that is logged when the Rollback process is kicked off.
- The event that is logged for all abnormal cases.

Software Maintenance Updates Using ISSU

A software maintenance update (SMU) delivers a software change to the user in the least possible time. Prior to ISSU support, SMU installations resulted in either restart of one or more processes, or reload of one or more nodes. ISSU minimizes the operational impact that a user experiences. Not all Reload SMUs qualify to be ISSU SMUs. Certain changes to the Kernel, ROMMON, memory carving, and other infrastructure areas cannot be achieved using a warm reload, and in such instances the router must undergo a standard reload to load such a SMU.

As ISSU does not support software downgrade, SMU upgrades installed using ISSU can only be uninstalled by means of a parallel reload method.

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

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

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

```
RP/0/RSP0/CPU0:router(admin)# show install package disk0:asr9k-px-4.3.1.04I.CSCuc66088-0.0.4.i
 detail

Mon Nov 19 09:44:24.036 UTC
disk0:asr9k-px-4.3.1.04I.CSCuc66088-0.0.4.i
    asr9k-px-4.3.1.04I.CSCuc66088 V0.0.4.i[SMU]  User specified bundle
        iosxr-infra-asr9k-px1-4.3.1.04I.CSCuc66088.pi.pie.
     [composite package]
     [root package, grouped contents]
    Vendor : Cisco Systems
    Desc   : User specified bundle iosxr-infra-asr9k-px1-4.3.1.04I.CSCuc66088.pi.pie.
    Build  : Built on Fri Nov  9 11:00:11 UTC 2012
   Source : By iox-bld27 in /scratch1/SMU_BLD_WS/ci-431_206626_CSCuc66088_121109102249 for
 pie
    Card(s): RP, CRS-RP-X86, CRS8-RP-x86, CRS16-RP-x86, ASR9001-RP, RP-STARSCREAM,
NP24-4x10GE,
           NP24-40x1GE, NP40-40x1GE, NP40-4x10GE, NP40-8x10GE, NP40-2_20_COMBO, NP80-8x10GE,

             NP80-16x10GE, NP200-24x10GE, NP200-36x10GE, NP200-2x100GE, NP200-1x100GE,
NP200-5x40GE,
              NP200-8x10GE, NP200-MOD-SMEM, NP200-MOD-LMEM, ASR9001-LC, A9K-SIP-700,
A9K-SIP-500, A9K-SIP-AVSM
    Restart information:
      Default:
        parallel impacted processes restart
    Size Compressed/Uncompressed: 1744KB/1830KB (95%)
    Components in package disk0:asr9k-px-4.3.1.04I.CSCuc66088-0.0.4.i, package
asr9k-px-4.3.1.04I.CSCuc66088:
    disk0:iosxr-infra-4.3.1.04I.CSCuc66088-0.0.4.i
        iosxr-infra-4.3.1.04I.CSCuc66088 V0.0.4.i[SMU]  IOS-XR Infra Package Definition
        Vendor : Cisco Systems
        Desc   : IOS-XR Infra Package Definition
        Build  : Built on Fri Nov  9 11:00:10 UTC 2012
       Source : By iox-bld27 in /scratch1/SMU_BLD_WS/ci-431_206626_CSCuc66088_121109102249
 for pie
```

```
        Card(s): RP, CRS-RP-X86, CRS8-RP-x86, CRS16-RP-x86, ASR9001-RP, RP-STARSCREAM,
NP24-4x10GE,
                 NP24-40x1GE, NP40-40x1GE, NP40-4x10GE, NP40-8x10GE, NP40-2_20_COMBO,
NP80-8x10GE,
                 NP80-16x10GE, NP200-24x10GE, NP200-36x10GE, NP200-2x100GE, NP200-1x100GE,

                 NP200-5x40GE, NP200-8x10GE, NP200-MOD-SMEM, NP200-MOD-LMEM, ASR9001-LC,
                 A9K-SIP-700, A9K-SIP-500, A9K-SIP-AVSM
        Restart information:
          Default:
            ISSU (quick) warm reload
            Specific:
             ISSU (quick) warm reload to and from ***-*
        Size Compressed/Uncompressed: 1744KB/1830KB (95%)
        Components in package disk0:iosxr-infra-4.3.1.04I.CSCuc66088-0.0.4.i,
            package  iosxr-infra-4.3.1.04I.CSCuc66088:
            platforms-spa-chopper V[ci-4x-bugfix/8]  This component contains Platform
Independent
            Chopper SPA Code.
            iosxr-infra-4.3.1.04I.CSCuc66088-package V[Default]  Manifest information for
package
            iosxr-infra-4.3.1.04I.CSCuc66088
            iosxr-infra-4.3.1.04I.CSCuc66088-package-compatibility V[Default]
            Package Compatibility information for package iosxr-infra-4.3.1.04I.CSCuc66088
```

Mixed SMU types can only be combined in the same activation if parallel reload is used as the activation type. ISSU cannot be used to activate parallel-process-restart SMUs. However, if you want to install both parallel-process-restart and ISSU SMUs, use one of these two options:

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

You can use these commands outside the maintenance window as there is no traffic impact:

- **install add**

  Example: `install add tftp://223.255.254.254/asr9k-px-4.3.1.CSCzz99999.pie`

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

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

It is recommended that you to use these commands within the maintenance window; there may be minimal traffic disruption.

- ISSU Run Phase

  Example: `install operation 70 run`

- ISSU Complete Phase

  Example: `install operation 70 complete`

SMU Installation Combinations

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

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

Asynchronous Syslog Communication

The asynchronous syslog communication feature enables proper ordering of messages testing on each node (LC, RP), non dropping of messages generated from multiple clients on each node (LC, RP) and checking performance, scalability and latency by sending log messages at incremental rates.

This feature enables the following:

- Proper ordering of messages testing on MC min 4+1.
- Non dropping of messages generated from multiple clients on MC min 4+1.
- Syslogd_helper message handling capacity - flood lots of syslog messages using test client (logger), verify if no syslog message is lost (specified rate as per new design).
- 1200/1500 msgs/sec from every node - restart restart/crash syslogd_helper on LCs and RP/correlatord and syslogd on RP.
- Configure the routing protocol ospf. Configure 5k neighbors using sub interfaces. Perform interface flapping to generate log messages and check syslogd_helper performance.
- Enable debug for few heavy processes - sysdb/gsp

Syslog Enhancement

The syslog enhancement feature enables to configure all different combinations of existing options under ***service timestamp log datetime*** and ***service timestamp debug datetime*** and check whether log messages have proper stamping by using keywords **year** in both ***service timestamp log datetime*** and ***service timestamp debug datetime*** to time stamp year in log message and **severity** in the existing cli ***logging <remote-host>***.

This feature enables the following:

- Config and delete **year** option and check whether year is present when configured and deleted.
- Config and delete **year** option and check memory impact.
- Enable the syslog archival feature and look into the impacts.
- Configure multiple remote hosts and check whether they receive log messages with year when the feature is enabled and stop receiving the log messages with year when the feature is disabled.
- Verify year stamping on a MC 4+1.
- Configure remote host to receive log messages of only one **severity** or multiple severities.
- Configure and delete severity for remote hosts and check memory impact.
- Verify remote host severity on a MC 4+1.

Hardware Features Introduced in Cisco IOS XR Software Release 4.3.0 for the Cisco ASR 9000 Series Router

These hardware features introduced in Cisco IOS XR Software Release 4.3.0 are supported on the Cisco ASR 9000 Series Aggregation Services Router platform:

- ASR 9000 4xOC48, 4xOC12, and 2xOC12 SPAs support

  Cisco IOS XR Software Release 4.3.0 introduces support for support for the 4xOC48, 4xOC12, and 2xOC12 SPAs on the Cisco ASR 9000 series platform.

  For more general Cisco ASR 9000 SIP and SPA hardware information, refer to the *Cisco ASR 9000 Hardware Installation Guide* online.

  For Cisco IOS XR software SIP and SPA 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*.

- ASR 9010 Version 2 Fan Tray support

  Cisco IOS XR Software Release 4.3.0 introduces support for the version 2 fan tray in the Cisco ASR 9010 Aggregation Services Router.

  The Cisco ASR 9010 Aggregation Services Router version 2 fan tray provides higher RPM fans which allows support for ZR/DWDM SFP+ optics.

  For more general Cisco ASR 9010 Aggregation Services Router version 2 fan tray hardware information, refer to the *Cisco ASR 9000 Hardware Installation Guide*.

- XFP-10GER-192IR Multirate 10GBASE-ER transceiver modules and OC-192/STM-64 IR-2 XFP, low power (2.5W) transceiver modules

  Cisco IOS XR Software Release 4.3.0 introduces support for XFP-10GER-192IR Multirate 10GBASE-ER transceiver modules and OC-192/STM-64 IR-2 XFP, low power (2.5W) transceiver modules.

  For more general hardware information about the XFP-10GER-192IR Multirate 10GBASE-ER transceiver modules and OC-192/STM-64 IR-2 XFP, low power (2.5W) transceiver modules, refer to 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 903 Router as a satellite shelf

  Cisco IOS XR Software Release 4.3.0 introduces support for connecting the Cisco ASR 903 series Router to the Cisco ASR 9000 to act as a satellite system with the Cisco ASR 9000 family of routers.

  For more general hardware information about the Cisco ASR 903 series router used as a Satellite System, refer to the *Cisco ASR 9000 Hardware 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 901 Series Router as a satellite shelf

  Cisco IOS XR Software Release 4.3.0 introduces support for connecting the Cisco ASR 901 series Router to the Cisco ASR 9000 to act as a satellite system with the Cisco ASR 9000 family of routers.

  For more general hardware information about the Cisco ASR 901 series router used as a Satellite System, refer to the Cisco ASR 9000 Hardware Installation Guide online.

  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*.

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 Release4.3.0 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:

- **CSCts29931**

  Basic Description:

  Modifying the default-MDT in single commit drops traffic.

  Symptom

  If the default MDT for a VRF is changed and committed by using the **mdt default ipv4** *group* command, forwarding over MDT may be impacted.

  Conditions:

  The default MDT has to be changed to a new group in a single commit (i.e., without deleting and re-adding).

  Workaround:

  Perform the following:

  1. Execute the **no mdt default ipv4** *old-group* command and commit.
  2. Configure the new default MDT and commit.

  Recovery:

  Restarting the PIM or PIM6 will recover the issue.

- **CSCud48700**

  Basic Description:

  Reverting to Cisco IOS XR Software R4.3.0.35i from R4.3.0.36i fails.

  Symptom

  Install operation or periodic backup fails.

Conditions:

This behavior is inconsistent.

Workaround:

Run the **cfs check** command to clear this inconsistency and proceed with install operation.

Recovery:

None.

- **CSCuc30287**

  Basic Description:

  Wrong configuration of sat-ether port with deleting satellite and changing MTU.

  Symptom

  When partial configuration is committed for a particular combination of configuration commit, the remaining configuration does not get committed.

  Conditions:

  Delete satellite-fabric-link configuration from an inter chassis link and simultaneously modify satellite interface attributes like MTU in the single configuration commit operation.

  Workaround:

  Split the commits for this operation. Modify sat-ether attributes and commit followed by removal of inter chassis link configuration.

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:

- **CSCud20935**

  Basic Description:

  QoS is not applied when ACL is enabled with logging option.

  Symptom

  QoS features are not applied when QoS and ACL logging is enabled.

  Conditions:

  ACL logging and QoS features are configured on the interface.

  Workaround:

  Remove ACL logging option.

  Recovery:

  QoS features are applied.

- **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

- **CSCuc57165**

  Basic Description:

  When the primary rack goes down in nV Edge system, traffic is lost till the protection switch occurs.

  Symptom

  When the primary rack goes down in nV Edge system, traffic is lost till the protection switch occurs.

  Conditions:

  This occurs when the nV Edge system running Cisco IOS XR software R4.3.0.

  Workaround:

  None.

- **CSCuc57086**

  Basic Description:

  Split Brain happens when all the internal Ethernet out-of-band channel (EOBC) extension and data plane extension connections between the two chassis fails in an nV system. Both the Designated Shelf Controllers (DSCs) comes up as primary DSC.

  Symptom

  Split Brain happens when all the internal EOBC extension and data plane extension connections between the two chassis fails in an nV system. Both the DSCs comes up as primary DSC.

  Conditions:

This happens when EOBC links and Inter Rack Links (IRL) are down.

Workaround:

None.

- **CSCuc57016**

  Basic Description:

  SNMP features does not work on nV Edge system ports.

  Symptom

  SNMP features does not work on nV Edge system ports.

  Conditions:

  This occurs when there is SNMP query or notification on the nV Edge system ports 0 and 1.

  Workaround:

  None.

- **CSCuc57061**

  Basic Description:

  Some of the CLIs are not supported on nV Edge system on Cisco ASR 9001 router.

  Symptom

  The following CLIs are not supported on nV Edge system on Cisco ASR 9001 router:

  - **admin nv edge data allowunsup**
  - **admin nv edge data slowstart**
  - **admin nv edge data stopudld**
  - **admin nv edge data udldpriority**
  - **admin nv edge data udldttltomsg**

  Conditions:

  This happens on the system running Cisco IOS XR Software R4.3.0.

  Workaround:

  None.

- **CSCts82447**

  Basic Description:

  attachCon not working.

  Symptom:

  After running attachCon, the console will not connect to Line card. The below message is seen on console:

  attachCon is not supported in this release in this chassis type

  Conditions:

  This feature is not supported in 4.2.3 as well and will be supported from 4.3.0 onwards.

Workaround:

Convert AUX port as LC console from RP KSH using the command **fill –l 0xd2000198 0x4 0x80000001**. To revert back to AUX port, use **fill –l 0xd2000198 0x4 0x0**.

Recovery:

None.

Upgrading Cisco IOS XR Software

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

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

Refer to Cisco IOS XR Software Release 4.3.0 PX PIE Files table for a list of the Cisco ASR 9000 Series Aggregation Services Router Software feature set matrix (PIE files).

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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