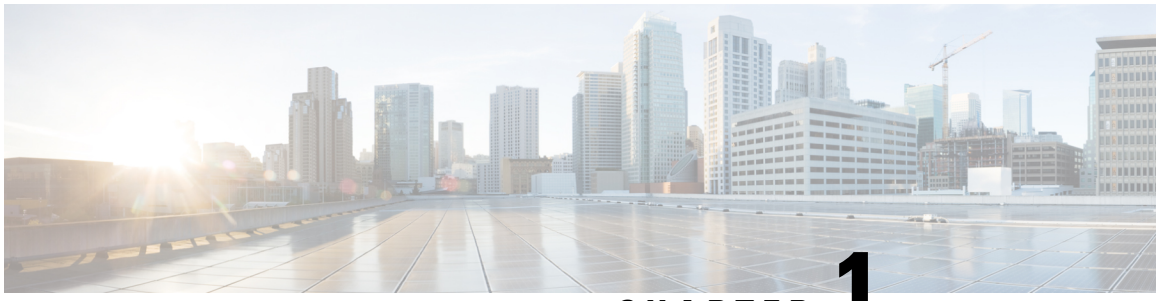
Cisco Catalyst 8500 and 8500L Series Edge Platforms Software Configuration Guide

First Published: 2020-08-20

Last Modified: 2023-04-10

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

CONTENTS



CHAPTER 1

Preface

This preface describes the objectives and organization of this document and explains how to find additional information on related products and services.

Objectives

This document provides an overview of software functionality that is specific to the Cisco Catalyst 8500 Series Edge (includes Cisco Catalyst 8500 platform and Cisco Catalyst 8500L Series platform). It is not intended as a comprehensive guide to all of the software features that can be run using the Cisco Catalyst 8500 Series Edge Platforms, but only the software aspects that are specific to this platform.

For information on general software features that are also available on the Cisco Catalyst 8500 Series Edge Platforms, see the Cisco IOS XE technology guide for that specific software feature.

Document Revision History

The Document Revision History records technical changes to this document. The table shows the Cisco IOS XE software release number and document revision number for the change, the date of the change, and a brief summary of the change.

Release No.	Date	Change Summary
IOS XE 17.4	March 17, 2021	Included information on Cisco Catalyst 8500L Series platform.
IOS XE 17.3.2	October 22, 2020	First release of the book.

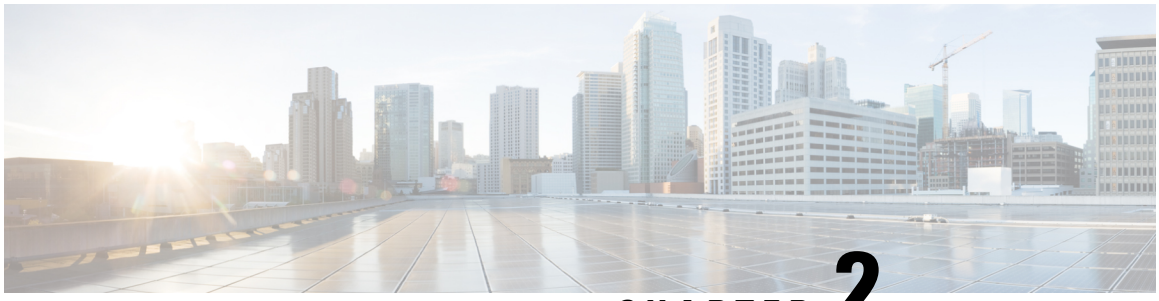
Communications, Services, and Additional Information

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
- To get the business impact you're looking for with the technologies that matter, visit Cisco Services.

- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions and services, visit Cisco Marketplace.
- To obtain general networking, training, and certification titles, visit Cisco Press.
- To find warranty information for a specific product or product family, access Cisco Warranty Finder.

Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.



CHAPTER 2

Read Me First

Feature Information

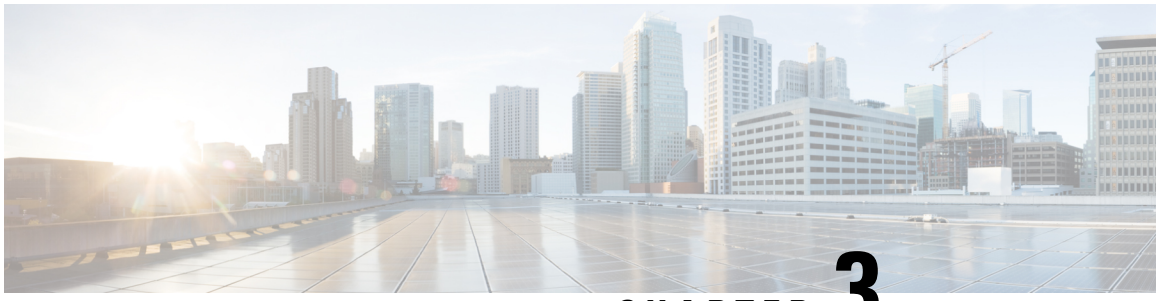
Use Cisco Feature Navigator to find information about feature support, platform support, and Cisco software image support. An account on Cisco.com is not required.

Related References

- Cisco IOS Command References, All Releases

Obtaining Documentation and Submitting a Service Request

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
- To get the business impact you're looking for with the technologies that matter, visit Cisco Services.
- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions and services, visit Cisco Marketplace.
- To obtain general networking, training, and certification titles, visit Cisco Press.
- To find warranty information for a specific product or product family, access Cisco Warranty Finder.



CHAPTER 3

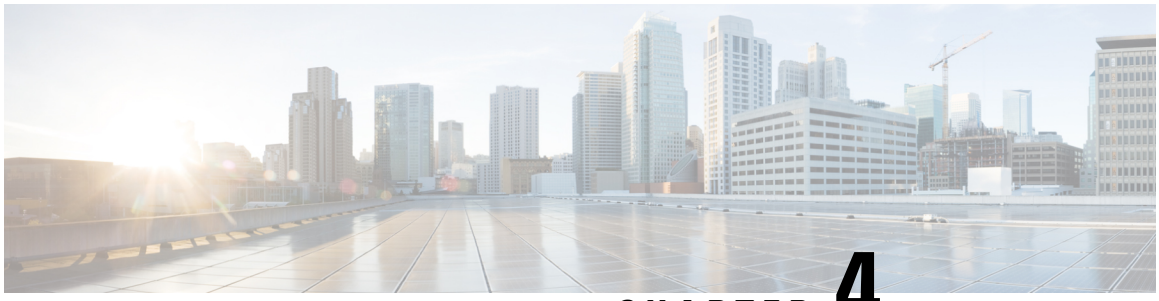
Overview

Cisco 8500 Series Catalyst Edge Platform significantly increases services performance, router throughput, and router scale at lower costs.

This document covers configuration details for the following models:

- Catalyst 8500 Platforms (C8500-12X4QC, C8500-12X and C8500-20X6C)
- Catalyst 8500L Platform (C8500L-8S4X)

Features	C8500-12X4QC	C8500-12X	C8500L-8S4X	C8500-20X6C
Support for In-Service Software Upgrade (ISSU)	Not supported	Not supported	Not supported	Not supported
Data plane processing	QFP 3.0	QFP 3.0	Software-based	QFP 3.0
Support for Unified Threat Defense(UTD)	Not supported	Not supported	Support exists	Not Supported
Support for Fast Reroute(FRR)	Not supported	Not supported	Not supported	Support exists



CHAPTER 4

Software Packaging and Architecture

The Cisco Catalyst 8500 Series Edge Platform (includes Cisco Catalyst 8500 platform and Cisco Catalyst 8500L Series platform) introduces a new software packaging model and architecture.

This chapter discusses this new packaging and architecture and contains the following sections:

Software Packaging on the Cisco Catalyst 8500 Series Edge Platforms

This section covers the following topics:

Cisco Catalyst 8500 Series Edge Platforms Software Overview

The Cisco Catalyst 8500 Series Edge Platforms are high-performance cloud edge platforms designed for accelerated services, multi-layer security, cloud-native agility, and edge intelligence to accelerate your journey to cloud.

Consolidated Packages

A consolidated package is a single image composed of individual software subpackage files. A single consolidated package file is a bootable file, and the Cisco Catalyst 8500 Series Edge Platforms can be run using the consolidated package.

Each consolidated package also contains a provisioning file. A provisioning file is used for booting in cases where the individual subpackages are extracted from the consolidated package, or optional subpackages are used to run the router. For additional information on the advantages and disadvantages of running a complete consolidated package, see the *Running the Cisco Catalyst 8500 Series Edge Platforms: An Overview*.

Important Information About Consolidated Packages

The important information about consolidated packages include:

- For each version of a consolidated package, the RPBase, RPControl, and ESPBase subpackages are identical among consolidated packages.

- For each version of consolidated package, the RPIOS subpackage is always different among consolidated packages.
- A consolidated package file is a bootable file. If the router is configured to run using the complete consolidated package, boot the router using the consolidated package file. If the router is configured to run using individual subpackages, boot the router using the provisioning file. For additional information on the advantages and disadvantages of running a complete consolidated package, see the *Running the Cisco Catalyst 8500 Series Edge Platforms: An Overview* section .
- If you need to install optional subpackages, then you must boot the router using the individual subpackage provisioning file method.

Individual Software SubPackages Within a Consolidated Package

This section provides an overview of the Cisco Catalyst 8500 Series Edge Platforms subpackages and the purpose of each individual subpackage. Every consolidated package will have all of these individual subpackages. To see additional information about each individual subpackages in a particular Cisco IOS XE release, see *Cisco IOS XE Release Notes* for that release.

Table 1: Individual SubPackages

SubPackage	Purpose
RPBase	Provides the operating system software for the Route Processor.
RPControl	Controls the control plane processes that interface between the IOS process and the rest of the platform.
RPAccess	Exports processing of restricted components, such as Secure Socket Layer (SSL), Secure Shell (SSH), and other security features.
RPIOS	Provides the Cisco IOS kernel, which is where IOS features are stored and run. Each consolidated package has a different RPIOS.
ESPBase	Provides the ESP operating system and control processes, and the ESP software.

Important Notes About Individual SubPackages

The important information about individual subpackage include:

- Individual subpackages cannot be downloaded from Cisco.com individually. To get these individual subpackages, users must download a consolidated package and then extract the individual subpackages from the consolidated package using the command-line interface.
- If the router is being run using individual subpackages instead of being run using a complete consolidated package, the router must be booted using a provisioning file. A provisioning file is included in all consolidated packages and is extracted from the image along with the individual subpackages whenever individual subpackages are extracted.

Provisioning Files

Note You must use the provisioning files to manage the boot process if you need to install optional subpackages.

Provisioning files manage the boot process when the Cisco Catalyst 8500 Series Edge Platforms is configured to run using individual subpackages or optional subpackages (such as the package for the Cisco WebEx Node Cisco Catalyst 8500 Series Edge Platforms Series). When individual subpackages are being used to run the Cisco Catalyst 8500 Series Edge Platforms, the router has to be configured to boot the provisioning file. The provisioning file manages the bootup of each individual subpackage and the Cisco Catalyst 8500 Series Edge Platform assumes normal operation.

Provisioning files are extracted automatically when individual subpackage files are extracted from a consolidated package.

Provisioning files are not necessary for running the router using the complete consolidated package; if you want to run the router using the complete consolidated package, simply boot the router using the consolidated package file.

Important Notes About Provisioning Files

The important information about provisioning files include:

- Each consolidated package contains two provisioning files. One of the provisioning files is always named “packages.conf”, while the other provisioning file will have a name based on the consolidated package naming structure. In any consolidated package, both provisioning files perform the exact same function.
- In most cases, the “packages.conf” provisioning file should be used to boot the router. Configuring the router to boot using this file is generally easier because the router can be configured to boot using “packages.conf”, so no changes have to be made to the boot statement when Cisco IOS XE is upgraded (the **boot system** *file-system*:**packages.conf** configuration command can remain unmodified before and after an upgrade).
- The provisioning file and individual subpackage files must be kept in the same directory. The provisioning file does not work properly if the individual subpackage files are in other directories.
- The provisioning filename can be renamed; the individual subpackage filenames cannot be renamed.
- After placing the provisioning file and the individual subpackage files in a directory and booting the router, it is highly advisable not to rename, delete, or alter any of these files. Renaming, deleting, or altering the files can lead to unpredictable router problems and behaviors.

File to Upgrade Field Programmable Hardware Devices

Starting in Cisco IOS XE Release 3.1.0S, a hardware programmable package file used to upgrade field programmable hardware devices is released as needed . A package file is provided for the field programmable device to customers in cases where a field upgrade is required. If the Cisco Catalyst 8500 Series Edge Platforms contains an incompatible version of the hardware programmable firmware, then that firmware may need to be upgraded.

Generally an upgrade is only necessary in cases where a system message indicates one of the field programmable devices on the Cisco Catalyst 8500 Series Edge Platforms needs an upgrade or a Cisco technical support representative suggests an upgrade.

For more information on upgrading field programmable hardware devices, see the *Upgrading Field Programmable Hardware Devices for Cisco Catalyst 8500 Series Edge Platforms* document.

Processes Overview

Cisco IOS XE has numerous components that run entirely as separate processes on the Cisco Catalyst 8500 Series Edge Platforms. This modular architecture increases network resiliency by distributing operating responsibility among separate processes rather than relying on Cisco IOS software for all operations.

IOS as a Process

In almost all previous Cisco router platforms, an overwhelming majority of the internal software processes are run using Cisco IOS memory.

The Cisco Catalyst 8500 Series Edge Platforms introduce a distributed software architecture that moves many operating system responsibilities out of the IOS process. In this architecture, IOS, which previously was responsible for almost all of the internal software processes, now runs as one of many Linux processes while allowing other Linux processes to share responsibility for running the router. This architecture allows for better allocation of memory so the router can run more efficiently.

Dual IOS Processes

The Cisco Catalyst 8500 Series Edge Platforms introduces a dual IOS process model that allows for increased high availability at all times.

Using SSO, a second IOS process can be enabled on a Cisco Catalyst 8500 Series Edge Router. On Cisco Catalyst 8500 Series Edge Platforms configured with dual Route Processors, the second IOS process runs on the standby Route Processor.

The state of these dual IOS processes can be checked by entering the **show platform** command.

The advantages of a second IOS process includes:

- Increased fault tolerance—In the event of an active IOS failure, the second IOS process immediately becomes the active IOS process with little to no service disruption.

File Systems on the Cisco Catalyst 8500 Series Edge Platforms

The following table provides a list of file systems that can be seen on the Cisco Catalyst 8500 Series Edge Platforms.

Table 2: File Systems

File System	Description
bootflash:	The boot flash memory file system on the active RP.
cns:	The Cisco Networking Services file directory.
harddisk:	The hard disk file system on the active RP.
nvram:	Router NVRAM. You can copy the startup configuration to NVRAM or from NVRAM.

File System	Description
obfl:	The file system for Onboard Failure Logging files.
system:	The system memory file system, which includes the running configuration.
tar:	The archive file system.
tmpsys:	The temporary system files file system.
usb[0-1]:	The Universal Serial Bus (USB) flash drive file systems on the active RP.

If you run into a file system not listed in the above table, enter the**?** help option or see the **copy** command reference for additional information on that file system.

Autogenerated File Directories and Files

This section discusses the autogenerated files and directories that might appear on your Cisco Catalyst 8500 Series Edge Platforms, and how the files in these directories can be managed.

The following table provides a list and descriptions of autogenerated files on the Cisco Catalyst 8500 Series Edge Platforms.

Table 3: Autogenerated Files

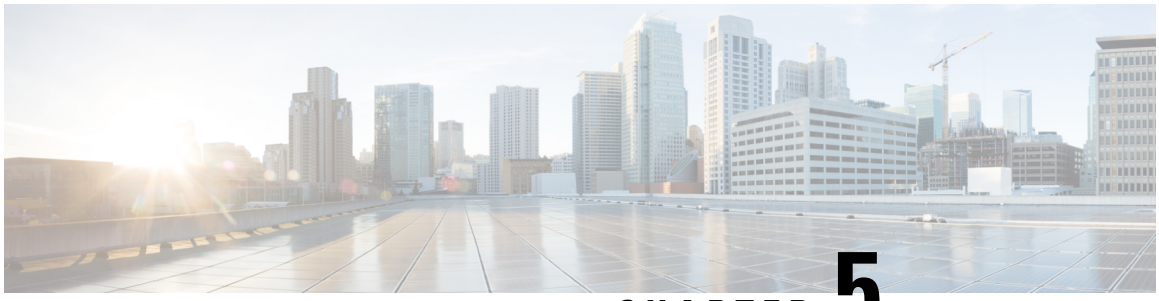
File or Directory	Description
crashinfo files	A crashinfo file may appear in the bootflash: or harddisk: file system. These files provide descriptive information of a crash and may be useful for tuning or troubleshooting purposes, but the files are not part of router operations and can be erased without impacting the functioning of the router.
core directory	The storage area for.core files. If this directory is erased, it will automatically regenerate itself at bootup. The .core files in this directory can be erased without impacting any router functionality, but the directory itself should not be erased.
lost+found directory	This directory is created on bootup if a system check is performed. Its appearance is completely normal and does not indicate any issues with the router.
tracelogs directory	The storage area for trace files. Trace files are useful for troubleshooting. Trace files, however, are not part of router operations and can be erased without impacting the router’s performance.

Important Notes About Autogenerated Directories

The important information about autogenerated directories include:

- Any autogenerated file on the bootflash: directory should not be deleted, renamed, moved, or altered in any way unless directed by customer support. Altering autogenerating files on the bootflash: can have unpredictable consequences for system performance.

- Crashinfo, core, and trace files can be deleted, but the core and tracelog directories that are automatically part of the harddisk: file system should not be deleted.



CHAPTER 5

Managing the SD-Routing Device Using Cisco SD-WAN Manager

This chapter includes information about managing and monitoring the SD-Routing devices using Cisco SD-WAN Manager. It contains the following sections:

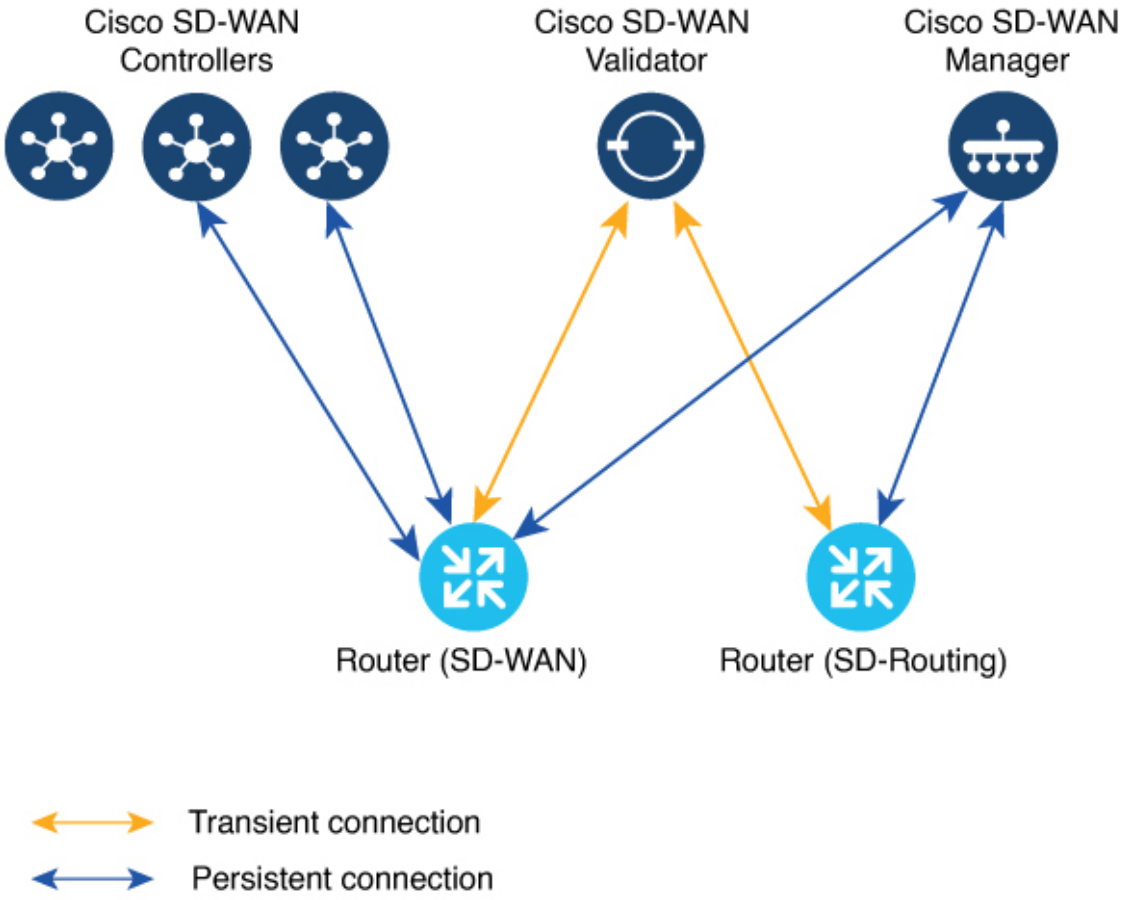
Information About Using Cisco SD-WAN Manager to Monitor the SD-Routing Devices

This feature allows you to perform the basic management capabilities through Cisco SD-WAN Manager on the Cisco IOS XE devices that are operating in non-SD-WAN mode. From Cisco IOS XE 17.12.1a onwards, such devices will be referred as SD-Routing devices. You can use a single Network Management System (NSM) (Cisco SD-WAN Manager) to manage and monitor all the Cisco IOS XE routers and help in simplifying solution deployments.

Note Cisco IOS-XE Software No Payload Encryption (NPE) or No Lawful Intercept and No Payload Encryption (NOLI/NPE) images does not support managing the SD-Routing devices using Cisco SD-WAN Manager feature.

Note The minimum software version required for this feature to work is Cisco IOS XE 17.12.1a and Cisco SD-WAN Release 20.12.1.

Figure 1: Managing the SD-Routing Devices



Benefits of Managing the SD-Routing Devices Using Cisco SD-WAN Manager

1. Use of a single NMS (Cisco SD-WAN Manager) for Cisco Catalyst SD-WAN and SD-Routing deployments in an Enterprise network.
2. Co-existence of Cisco SD-WAN and SD-Routing devices on the same Cisco SD-WAN Manager.

Prerequisites

The following are the prerequisites to onboard the SD-Routing devices:

- Ensure that the device run the Cisco IOS XE 17.12.1a image in install mode. For more information on the modes, see the Modes Using Cisco CLI section.
- A Cisco SD-WAN Manager instance either on-prem or hosted on a cloud.
- Connectivity from the device to the Cisco SD-WAN Manager.
- Enable netconf-yang models for enabling DMI which is required for managing from Cisco SD-WAN Manager.
- Devices operating in autonomous mode must be configured with the following basic configuration manually to establish the secure control connections with controllers (Cisco SD-WAN Validator and Cisco SD-WAN Manager):
  - System properties:
    - System-ip
    - Site-id
    - Organization-name
    - Cisco SD-WAN Validator information (IP address or FQDN Cisco SD-WAN Validator server)
  - Interface configuration:
    - Physical interface with a static or dynamic IP address and subnet mask
    - Dynamic routing or default route to provide reachability to Cisco SD-WAN Validator or Cisco SD-WAN Manager

Limitations

- Cisco SD-routing devices onboarding onto Cisco SD-WAN Manager is only supported with universalk9 images. No Payload Encryption (NPE) images are not supported.
- In Cisco IOS XE 17.12.1a release, basic monitoring is supported and additional features will be supported in the subsequent releases. For more information on supported features list, see the platform specific Release Notes.
- Cisco SD-Routing devices can only have one control connection to Cisco SD-WAN Manager from an interface with reachability to the controllers.
- Cicso SD-routing devices will not have any active connection with Cisco SD-WAN Controller.
- Dedicated management interface is not supported for the connection to the Cisco SD-WAN Manager.

Supported WAN Edge Devices

The table lists the supported WAN Edge platforms and onboarding options.

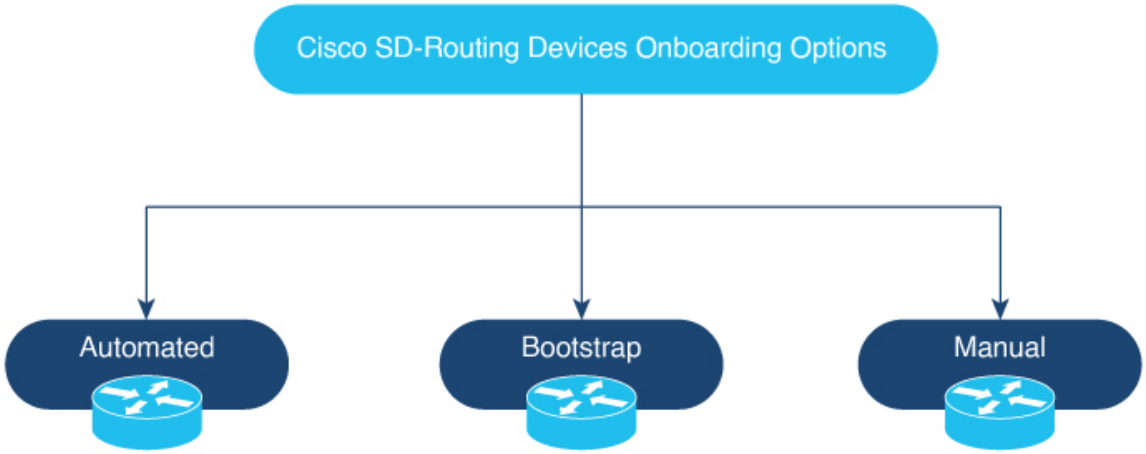
Table 4: Supported WAN Edge Platforms and Onboarding Options

Platforms	Automated	Bootstrap	Manual
Cisco ASR 1000 Series Aggregation Services Routers			
ASR1001-HX	Yes	Yes	Yes
ASR1002-HX	Yes	Yes	Yes
Cisco 4400 Series Integrated Services Routers			
Cisco 4431 ISR	Yes	Yes	Yes
Cisco 4451 ISR	Yes	Yes	Yes
Cisco 4461 ISR	Yes	Yes	Yes
Cisco 4300 Series Integrated Services Routers			
Cisco 4321 ISR	Yes	Yes	Yes
Cisco 4331 ISR	Yes	Yes	Yes
Cisco 4351 ISR	Yes	Yes	Yes
Cisco 4200 Series Integrated Services Routers			
Cisco 4221 ISR	Yes	Yes	Yes
Cisco 100 Series Integrated Services Routers			
Cisco 1000 ISR	Yes	Yes	Yes
Cisco Catalyst 8000V Series Edge Platforms			
Cisco Catalyst 8000V	Not applicable **Note** Automated onboarding is applicable only for the hardware device.	Yes	Yes
Cisco Catalyst 8200 Series Edge Platforms			
C8200-1N-4T	Yes	Yes	Yes
C8200L-1N-4T	Yes	Yes	Yes
Cisco Catalyst 8300 Series Edge Platforms			
C8300-1N1S-4T2X|6T	Yes	Yes	Yes
C8300-2N2S-4T2X|6T	Yes	Yes	Yes

Platforms	Automated	Bootstrap	Manual
Cisco Catalyst 8500 Series Edge Platforms			
C8500-12X4QC	Yes	Yes	Yes
C8500-12X	Yes	Yes	Yes
C8500L-8S4X	Yes	Yes	Yes
C8500-20X6C	Yes	Yes	Yes

Onboarding the SD-Routing Devices

This section explains the workflows to onboard the SD-Routing devices:



- Onboarding the SD-Routing Devices
  - Automated Onboarding: Uses the Dynamic Host Configuration Protocol (DHCP) and Cisco Plug and Play (PNP) to automatically onboard the device to Cisco SD-WAN Manager.
  - Bootstrap Onboarding: Uses the bootstrap file either on the bootflash or on a USB and configures the device with the minimum configuration to reach the Cisco SD-WAN Manager.
  - Manual Onboarding: Configures the device manually using IOS-XE commands to onboard the device to Cisco SD-WAN Manager.

To onboard the SD-Routing devices, the prerequisites are:

- System IP

For manual Onboarding, the prerequisites are:

- Site ID
- Organization-name

- Cisco SD-WAN Validator information (IP address or FODN Cisco SD-WAN Validator server)
- Interface for connection to Cisco SD-WAN Manager (Physical, Sub-interface, and Loopback)

Onboarding the SD-Routing Devices Using Automated Workflow

To onboard the SD-routing devices using the automated workflow, perform these steps:

- Configure the Plug and Play Connect Portal
- Configure the Cisco SD-WAN Manager using quick connect workflow
- Bring up the device in Day0 mode

Configuring the Plug and Play Connect Portal

To configure the PnP Connect portal, perform these steps:

Before you begin

Ensure that you can access to the PnP Connect portal and an active Smart Account and Virtual Account using your Cisco User ID. You have to also use a CCO ID that is associated as the Smart Account or Virtual Account admin of the account, on PnP Connect portal.

Note You can enable the PnP Connect Sync only after you enter the Smart Account credentials in the Cisco SD-WAN Manager Settings page.

Step 1 Go to software.cisco.com > **Network Plug and Play** > **Manage Devices** and ensure that you have access to Smart Account and Virtual Account.

Step 2 Create a Controller Profile and upload the **root-ca** if it is for an Enterprise network.

Note If the overlay network is **Cisco PKI**, you do not have to upload any certificate.

Step 3 Enter the Controller Profile with controller type as VBond and click **Next**.

Step 4 Enter the required parameters in the **Add Controller Profile** and click **Next**.

Step 5 Add the device to PnP Connect. When you add the device, in the Device Mode field, select **AUTONOMOUS** for device in SD-Routing mode from the drop-down list.

Configuring the Cisco SD-WAN Manager Using Quick Connect Workflow

To configure the Cisco SD-WAN Manager using Quick Connect workflow, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, go to **Workflows** > **Quick Connect**.

Step 2 Click **Get Started**.

Step 3 Click **Next**.

Step 4 If you have not uploaded the provisioning file (*.csv* or *.viptela*) from PnP to Cisco SD-WAN Manager, you can use either **.csv upload** or **.viptela upload** or **Sync Smart Account** option to add the device to Cisco SD-WAN Manager. If the device is already added to Cisco SD-WAN Manager, select the **skip for now** option.

Note The *.csv* file is applicable only for hardware devices. The *.viptela* file is applicable for both hardware and software devices.

Step 5 Click **Sync Smart Account** if you have not syncrnized it already. You should now see your device listed in the table of the devices.

Click Sync Smart Account,

Step 6 Click **Next**.

Step 7 In the Add and Review Device Configuration dialog box, enter the Site-ID, System-IP, Hostname, and click **Apply**.

Step 8 Click **Next**.

Step 9 Add any option Tag and click **Next**.

Step 10 To verify the device that is added , choose **Configuration**> **Devices** and click enable **Device Model** in Table Settings.

Step 11 A list of routers in the network is displayed, showing detailed information about each router. To verify that the devices are added, select **Configuration** > **Certificates**.

Bringing Up the SD-Routing Device

To bring up the SD-Routing device, perform these steps:

Step 1 Bring up the device in Day-0 state. If the device is not in Day-0 state, use either **controller-mode reset** or **writer erase** with **reload** option to bring it to Day-0 state.

Step 2 Ensure that the device gets the IP address over DHCP on one of the interfaces other than the Gigabit Etherner0 interface. Also, ensure that the device is reachable to devicehelper.cisco.com and the Cisco SD-WAN Validator.

Note Dedicated management interface is not supported for the connection to the Cisco SD-WAN Manager.

Step 3 The device control connection comes up on Cisco SD-WAN Manager.

Step 4 Verify the control connection status on the Edge device using the**show sd-routing connections summary** command:

Example:

```
Router#show sd-routing connections summary

PEER                                          PEER
PEER     PEER  PEER             SITE        PEER                                  PRIV
PEER                                    PUB
TYPE     PROT  SYSTEM IP        ID          PRIVATE IP                            PORT   PUBLIC
IP                               PORT   STATE   UPTIME
------------------------------------------------------------------------------------------------
Cisco SD-WAN Manager  dtls  172.16.255.22    200         10.0.12.22
12446  10.0.12.22                            12446  up      12:05:29:3
```

Step 5 Verify the control connection status on Cisco SD-WAN Manager.

Onboarding the SD-Routing Devices Using Bootstrap

To onboard the SD-Routing device using the bootstrap, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, go to **Workflows** > **Quick Connect**.

Step 2 Click **Get Started**.

Step 3 Click **Next**.

Step 4 If you have not uploaded the provisioning file (*.csv* or *.viptela*) from PnP to Cisco SD-WAN Manager, you can use either **.csv upload** or **.viptela upload**or **Sync Smart Account** option to add the device to Cisco SD-WAN Manager. If the device is already added to Cisco SD-WAN Manager, select the **skip for now** option.

Note The *.csv* file is applicable only for hardware devices. The *.viptela* file is applicable for both hardware and software devices.

Step 5 Select the device that you want to onboard and click **Next**.

Step 6 In the Add and Review Configuration dialog box, enter the Site-ID, System-IP, Hostname, and click **Apply**.

Step 7 To verify the device that is added, choose **Configuration**> **Devices** and click enable **Device Model** in Table Settings.

Step 8 Ensure that the device is in valid state from **Configuration** > **Certificate** page.

Step 9 From the Cisco SD-WAN Manager menu, choose **Configuration**> **Devices**.

Step 10 For the Cisco SD-Routing software devices (Cisco c8000V), perform these steps to generated the bootstrap and onboard the device:

Note For hardware devices, follow the instructions in Step 11.

a) Click **...** at the right pane of the window and choose **Generate Bootstrap Configuration**.

b) Choose Cloud-init option and enter a name for the WAN Interface Name and click **OK**.

Note Ensure that the DHCP is enabled on the selected interface and is reachable to Cisco SD-WAN Validator and Cisco SD-WAN Manager. Also, for the software device, use only Gigabit Ethernet1interface as the VPN0 interface.

c) Click **Download** to download the image on the device.

Example:

Sample image: ciscosdwan_cloud_init.cfg

Sample image with Certificate : ciscosdwan_cloud_init_with_ent_cert.cfg

d) For cloud-based controllers, the downloaded bootstrap file can be added as a user data field when you deploy the device. It will bring up the controller in SD-Routing mode and establish the connection with Cisco SD-WAN Validator and Cisco SD-WAN Manager.

Step 11 For hardware devices, perform these steps to generate the bootstrap and onboard the device:

a) From the Cisco SD-WAN Manager menu on the device page, click **Export Bootstrap Configuration**.

b) Select the check box for SD-Routing. In the **Export Bootstrap Configuration** dialog box, enter the **WAN Interface name**.

Note The management interface name may vary among Cisco IOS XE device models. Specify the interface name based on the model you wish to onboard and which can reach the Cisco SD-WAN Validator and Cisco SD-WAN Controller.

c) Click **Generate Generic Configuration** to download the generic *.cfg* bootstrap applicable for the hardware devices. Unzip the file and rename it as *ciscosdawn.cfg*.

Note Ensure that the DHCP is enabled on the selected interfaces and is reachable to Cisco SD-WAN Validator and Cisco SD-WAN Manager.

The bootstrap file will contain the organization name, Cisco SD-WAN validator IP, and root-ca certificates. For the enterprise network, it will have the enterprise root-ca- certificates.

d) Copy the bootstrap file to the device bootflash as *ciscosdwan.cfg*.

e) Execute the **sd-routing bootstrap load bootflash:ciscosdwan.cfg** command.

Example:

```
Router# sd-routing bootstrap load bootflash:ciscosdwan.cfg
Located the file. Beginning to extract the data
Extraction summary
-Organization name - "aniltb2"
-Interface - GigabitEthernet0/0/0
-vbond  - 99.99.1.51
Successfully extracted root-cert info

Do you want to proceed and apply extracted
parameters to enable sd-routing feature?? (yes/[no]): yes
Successfully configured bootstrap extracted parameters
Router#
*May 10 08:56:11.159: %SYS-5-CONFIG_P: Configured programmatically by process Exec from console as console
*May 10 09:05:11.751: %DMI-5-AUTH_PASSED: R0/0: dmiauthd: User 'vmanage-admin' authenticated successfully from
201.201.201.1:41902  for netconf over ssh. External groups
```

f) Verify the control connection using these **show sd-routing system status**, **show sd-routing system status**, and **show sd-routing local-properties summary** commands.

Onboarding the Devices Manually

To onboard the SD-Routing devices manually, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, go to **Workflows** > **Quick Connect**.

Step 2 Click **Get Started**.

Step 3 Click **Next**.

Step 4 If you have not uploaded the provisioning file (*.csv* or *.viptela*) from PnP to Cisco SD-WAN Manager, you can use either **.csv upload** or **.viptela upload** or **Sync Smart Account** option to add the device to Cisco SD-WAN Manager. If the device is already added to Cisco SD-WAN Manager, select the **skip for now** option.

Note The *.csv* file is applicable only for hardware devices. The *.viptela* file is applicable for both hardware and software devices.

Step 5 Select the device that you want to onboard and click **Next**.

Step 6 In the Add and Review Configuration dialog box, enter the Site-ID, System-IP, Hostname, and click **Apply**.

Step 7 To verify device that is added , choose **Configuration**> **Devices** and click enable **Device Model** in Table Settings.

Step 8 A list of routers in the network is displayed with detailed information about each router. To verify that the devices are added, select **Configuration** > **Certificates**.

Step 9 Preform one of the following steps based on the device that you want to onboard manually:

a) For the hardware device, enter the initial day-0 configurations using the IOS command after a system boot up.

b) For the Cisco SD-Routing software devices, deploy the Cisco c8000v in Amazon Web Services (AWS) or Azure without the bootstrap.

Step 10 Configure the minimum parameters to enable the control connection on Cisco SD-WAN Manager.

Example:

```
netconf-yang

sd-routing
  no ipv6-strict-control
  organization-name "%Your Org. Name%"
  site-id %id%
  system-ip %system ip%
  vbond name %vbond name or vbond ip%
  vbond port 12346
  wan-interface %uplink interface%

ip route 0.0.0.0 0.0.0.0 %next hop ip%

interface %uplink interface%
   ip address  %dhcp or static%
   no shutdown
```

Step 11 Configure the required parameter to enable the SD-Routing mode:

a) Ensure that the interface is configured with a static IP address or through DHCP. Also, the interface must be in **no shut** state.

b) Configure either Validator IP or Validator Name.

c) Configure the System-IP, Site-ID, Organization-Name and WAN-Interface.

Step 12 Verify that the feature is enabled by checking the status of the vdaemon.

Example:

```
Router# show platform software yang-management process state
Confd Status: Started


Process              Status              State
------------------------------------------------------
nesd                 Running             Active
syncfd               Running             Active
ncsshd               Running             Not Applicable
dmiauthd             Running             Active
nginx                Running             Not Applicable
ndbmand              Running             Active
pubd                 Running             Active
```

```
Router#show platform software process list r0 name vdaemon
Name: vdaemon
  Process id       : 29075
  Parent process id: 29070
  Group id         : 29075
  Status           : S
  Session id       : 8829
  User time        : 263002
  Kernel time      : 347183
  Priority         : 20
```

```
Virtual bytes    : 405110784
Resident pages   : 12195
Resident limit   : 18446744073709551615
Minor page faults: 716496
Major page faults: 9130
```

Step 13 If the overlay network is for an enterprise, install the root certificates using the **request platform software sd-routing root-cert-chain install bootflash:cacert.pem** command. If the Cisco SD-WAN Manager is configured with Enterprise Certificates instead of **Cisco PKI**, you must install the root certificate on the device.

Step 14 Perform one of the following steps based on the device:

a) For Cisco 8000v device, copy the root certificate from the CA to Cisco 8000v.

b) Cisco devices are loaded with PKI and symantec root-certificates by default. If you need to install the enterprise root-certificate, install the certificate using the **request platform software sd-routing root-cert-chain install** <*path-to-root-cert*> command.

Example:

```
Device# request platform software sd-routing root-cert-chain install bootflash:ctrl_mng/cacert.pem
```

Step 15 Install the client enterprise certificates.

Note By default, the certificates will be loaded on the hardware devices. This step is only applicable for manually onboarding the software devices.

Step 16 Generate a Certificate Signed Request (CSR) for the device using the **request platform software sd-routing csr upload** <*bootflash:ctrl_mng/test*> command. You can specify any name for the folder that is created within the *bootflash:ctrl_mng/* directory.

Step 17 Copy the generated CSR file to the directory where you have the Enterprise CA. You can sing the certificate using the root key and root CA certificate and generate the pem certificate file.

Step 18 Copy the generated *certificate.pem* file to the device and use the **request platform software sd-routing certificate install** <*path-to-certificate-file*> command to install the certificate in the device.

Step 19 Verify the installation status of the certificates.

Example:

```
SJC_Primary# show sd-routing local-properties summary
….....
certificate-status               Installed
certificate-validity             Valid
certificate-not-valid-before     Apr 25 00:55:28 2023 GMT
certificate-not-valid-after      Apr 24 00:55:28 2024 GMT
….........
dns-name                         Validator
site-id                          100
tls-port                         0
system-ip                        172.16.255.11
chassis-num/unique-id            C8K-aa079ca1-c141-4ac6-9b76-05864005f94e
serial-num                       12345707
```

Step 20 Onboard the device on Cisco SD-WAN Manager. When you install the client certificate, ensure that you add the following in Cisco SD-WAN Manager .

a) Get the Chassis number and Serial number. To get the Chassis number and Serial number, use the s**how sd-routing local-properties** or **show sd-routing certificate serial** command.

```
Router# show sd-routing local-properties summary
chassis-num/unique-id            C8K-aa079ca1-c141-4ac6-9b76-05864005f94e
serial-num                       12345707
```

b) Upload the chassis-id using the **request vedge add chassis-num** <*Chassis id*> **org-name** <*Org Name*> **serial-num** <*Serial number from c8kv*> command on all the controllers.

Or

c) Create a *.viptela* file using the chassis number and serial number and upload the file to Cisco SD-WAN Manager and send to controllers.

Step 21 Verify the control connection status on Cisco SD-WAN Manager.

Example:

```
Router#show sd-routing connections summary

PEER                                          PEER
PEER     PEER  PEER             SITE        PEER                                  PRIV
PEER                                    PUB
TYPE     PROT  SYSTEM IP        ID          PRIVATE IP                            PORT   PUBLIC
 IP                                PORT   STATE   UPTIME
------------------------------------------------------------------------------------------------
vmanage  dtls  172.16.255.22    200         10.0.12.22                            12446
10.0.12.22                              12446  up      12:05:29:3
```

Onboarding the Device by Activating the Chassis Using the Token

To activate the chassis number, perform these steps:

Note This method is supported only on Cisco SD-WAN software devices (Cisco c8000v).

Step 1 Add the device to Cisco SD-WAN Manager using PnP Smart Sync method.

Step 2 Go to software.cisco.com > **Network Plug and Play** > **Manage Devices** and ensure that you have access to Smart Account and Virtual Account.

Step 3 Create a controller profile and upload the **root-ca** if it is for an Enterprise network.

Step 4 Enter the controller type as vBond and click **Next**.

Step 5 Enter the required parameters in the **Add Controller Profile** and click **Next**.

Step 6 Add the device to PnP Connect. When you add the device, in the Device Mode field, select **AUTONOMOUS** for device in SD-Routing mode from the drop-down list.

Step 7 From the Cisco SD-WAN Manager menu, select **Administration** > **Settings**.

Step 8 Go to **Smart Account Credentials** and click **Edit**.

Step 9 Enter the **Username** and **Password** and click **Save**.

Step 10 You can import the device list from PnP Connect Portal using these methods:

a) Go to **Configuration** > **Devices** and click **Sync Smart account**.

Or

a) Upload the *.viptela* that is downloaded from PnP Connect. Go to **Controller profiles** and click **Download the Provisioning file**.

b) From the Cisco SD-WAN Manager menu, choose **Configuration**> **Devices** > **Upload WAN Edge List**.

Step 11 The device will be in autonomous mode with startup config. The device will not be in Day0 mode.

Step 12 Apply the minimum configuration on the device.

Example:

```
netconf-yang
!
sd-routing
 no ipv6-strict-control
 organization-name "vIptela Inc Regression"
 site-id 500
 system-ip 172.16.255.15
 vbond ip 10.0.12.26
 vbond port 12346
 wan-interface GigabitEthernet2
!
ip route 0.0.0.0 0.0.0.0 10.0.5.13
!
ip interface GigabitEthernet2
 ip address 10.0.5.11 255.255.255.0
 no shutdown
!
```

Step 13 From the Cisco SD-WAN Manager menu, choose **Configuration**> **Certificates** and get the UUID and One Time Password (OTP) of the device you want to onboard.

Step 14 To override the chassis number that is generated by the software device, use the **request platform soft sd-routing activate chassis** <*newly uploaded chassis id*> **token** <*token generated by Cisco SD-WAN Manager*> command.

Step 15 If the overlay network is for an enterprise, install the enterprise-root certificates using the request platform **software sd-routing root-cert-chain install bootflash:cacert.pem** command. If the overlay network is **Cisco PKI**, you do not have to install the root certificate.

Note You do not have to generate a Certificate Signing Request (CSR) and sign it. The CSR will be generated while executing the step 14.

Step 16 Verify the control connection status on the Edge device using these commands:

Example:

```
show sd-routing local-properties summary
show sd-routing local-properties wan ipv4
show sd-routing connections summary
show sd-routing connections history
```

Onboarding the Multi-Tenancy SD-Routing Devices

This section explains the workflows to onboard the Multi-Tenancy SD-Routing devices:

- Automated Onboarding
- Manual Onboarding

Onboarding the Multi-Tenancy SD-Routing Devices Using Automated Workflow

To onboard the a multi-tenancy SD-Routing device, perform these steps:

Step 1 Go to software.cisco.com > **Network Plug and Play** > **Manage Devices** and ensure that you have access to Smart Account and Virtual Account.

a) Create a virtual account.
b) Create a controller profile and upload the root-ca if it is for an Enterprise network.
c) Enter the controller type as vBond and click **Next**.
d) Enter the required parameters in the **Add Controller Profile** and click **Next**.
e) Add the device to PnP Connect. When you add the device, in the Device Mode field, select **AUTONOMOUS** for device in SD-Routing mode from the drop-down list.

Or

Step 2 From the Cisco SD-WAN Manager menu, go to **Workflows** > **Quick Connect**.

Step 3 Click **Get Started**.

Step 4 Click **Next**.

Step 5 If you have not uploaded the *.csv* file to Cisco SD-WAN Manager, you can use one of the upload options to upload the file. Select **skip for now** option if you have uploaded the file.

Step 6 Click **Sync Smart account** or **.csv upload** or **.viptela upload**. You should now see your device listed in the table of devices.

Step 7 For Software device, generate bootstrap file as explained in previous section and add it as c8000v user config file.

Note For Multi-tenant setup, the System-IP must be configured only through quick connect workflow. You should not configure the system-IP using the CLI option.

Step 8 Based on the device type, perform one of these steps:

a) For the software device, deploy the Cisco c8000v in Azure or AWS and enter the bootstrap file either as custom data or user data input.
b) For hardware device, bring up the device in Day-0 state. If the device is not in Day-0 state, use either **controller-mode reset** or **writer erase** with **reload** option to bring it to Day-0 state.

Step 9 The device comes up with the Cisco SD-WAN Manager.

Step 10 To verify the status of the device, use the **show sd-routing connection summary status** and **show sd-routing local-properties summary** commands.

Onboarding the Multi-Tenancy SD-Routing Devices Manually

To onboard the Multi-Tenancy SD-Routing device manually, perform these steps:

Step 1 Deploy the Cisco Catalyst 8000v in Azure or AWS in autonomous mode.

a) Go to software.cisco.com > **Network Plug and Play** > **Manage Devices** and ensure that you have access to Smart Account and Virtual Account.
b) Create a virtual account.
c) Create a controller profile and upload the root-ca if it is for an Enterprise network.
d) Enter the controller type as vBond and click **Next**.
e) Enter the required parameters in the **Add Controller Profile** and click **Next**.

f) Add the device to PnP Connect. When you add the device, in the Device Mode field, select **AUTONOMOUS** for device in SD-Routing mode from the drop-down list.

Step 2 Configure the minimum parameters to enable Netconf-Yang:

Example:

```
config terminal
 netconf-yang
end
```

Step 3 Check the status of the Netconf-Yang using the **show platform software yang-management process state** command.

Step 4 Configure the required parameter to enable the Cisco SD-Routing mode:

a) Ensure that the interface is configured either with static IP address or through DHCP. Also, the interface must be in **no shut** state.

b) Configure either Cisco SD-WAN Validator IP or Cisco SD-WAN Validator name.

c) Configure the Cisco SD-WAN Validator, Site-ID, Organization-Name and WAN-Interface.

Note For Multi-tenant setup, the System-IP must be configured only through quick connect workflow. You must not configure the System-IP using the CLI option. However, you can use the CLI option to configure the SP Organization Name for SD-Routing devices in Multi-tenant deployment. The organization name refers to tenant's organization name for Multi-tenant deployment. It is visible only under the **show sd-routing local-properties summary** command after the device is onboarded.

Step 5 Verify that the feature is enabled by checking the status of the vdaemon.

Example:

```
Router#show platform software process list r0 name vdaemon
Name: vdaemon
  Process id       : 29075
  Parent process id: 29070
  Group id         : 29075
  Status           : S
  Session id       : 8829
  User time        : 263002
  Kernel time      : 347183
  Priority         : 20
  Virtual bytes    : 405110784
  Resident pages   : 12195
  Resident limit   : 18446744073709551615
  Minor page faults: 716496
  Major page faults: 9130
```

Step 6 Verify the SD-Routing configurations in the Edge device. Also, get the chassis number for signing and upload to Cisco SD-WAN Manager WAN Edge List.

Step 7 To verify the status of the device, use this**show sd-routing local-properties summary** command.

Step 8 Copy the root-ca-chain.crt certificate from Cisco SD-WAN Manager into SD-Routing device.

Note This step is required only if you are using Enterprise certificate method. You can skip this step if you are using **Cisco PKI** method.

Step 9 Install the *root-ca-chain.crt* in SD-Routing device.

Step 10 Upload the provision file (*.Viptela*) from PnP to Cisco SD-WAN Manager WAN Edge List and send to controllers.

Step 11 Create a *.viptela* file using the chassis number, serial number and sign it. Upload the file to Cisco SD-WAN Manager and send to controllers.

Step 12 Get the Token from Cisco SD-WAN Manager. To onboard the device by establishing the control connection with Cisco SD-WAN Validator and Cisco SD-WAN Manager, use the **request platform software sd-routing activate chassis-number** <*chassis-num*> **token** <*token*> command.

Step 13 To verify the status of the device, use the **show sd-routing connection summary status** and **show sd-routing local-properties summary** commands.

Onboarding the Device to Cisco SD-WAN Manager Using One Touch Provisioning

To perform the one touch provisioning for a device, follow these steps:

Before you begin

When you configure a device by using the one touch provisioning, ensure that the process meets these requirements:

- Device must be in autonomous mode. You should stop the PnP discovery and device must have either a start up configuration or any configuration. The device should not be in Day-0 state.
- Device must be configured to reach Cisco SD-WAN Validator and Cisco SD-WAN over the WAN interface.

  Device must have the minimum required configuration for SD-Routing feature to communicate with controllers.

Also, onboarding the device to Cisco SD-WAN Manager using One Touch Provisioning method eliminates these steps to add the device:

- Adding WAN Edge device to Cisco SD-WAN Manager by using .**csv** or **.viptela** or **sync smart account**.
- Cisco device must be configured in SD-routing mode. You have to use the Manual or Bootstrap method to configure the device without adding the device to Cisco SD-WAN Manager.

Step 1 From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings** and enable One Touch Provisioning.

Step 2 Check if **One Touch Provisioning** is **Enabled**. If **Enabled**, go to Step 5.

Step 3 If **One Touch Provisioning** is **Disabled**, click **Edit**.

Step 4 For the **Enable Claim WAN Edges** setting, choose **Enabled** and click **Save**.

Step 5 Go to **Configuration** > **Devices** > **Unclaimed Devices**.

a) Choose the device you wish to claim and click **Claim Device(s)**.

b) The device is removed from **Unclaimed Devices List** and listed on **WAN Edge List**.

Step 6 To verify the status of the device, use these **show sd-routing system status** , and **show sd-routing local-properties summary** commands.

Unprovisioning the Feature

To unprovision the feature, perform these steps:

Step 1 Remove the SD-Routing feature configuration from the device.

Example:

Note This option will delete all the certificates. You have to reinstall all the certificates.

Example:

```
Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#no sd-routing
Warning! Disabling this feature will result in deleting client certificates. Please backup the
certificates and use the CLIs to reinstall them on enabling this feature again.
Do you want to continue? (y/n)[n]: y
```

Step 2 Invalidate the device. For instructions, see the step 4 from the Onboarding the Devices Manually, on page 21 section.

Step 3 To delete the device:

a) From the Cisco SD-WAN Manager menu, choose **Configuration**> **Devices**.
b) Click **WAN Edge List** and choose the device that you want to delete.
c) Click **Delete WAN Edge**.
d) Read the message and click **Yes**.

Software Image Management

This section explains the process to upgrade the software image. Cisco SD-WAN Manager supports uploading a prepackaged Cisco virtual machine image, *tar.gz*, or an image in *qcow2* format. It is mandatory to upload a scaffold file if you choose a *qcow2* image file. Similarly, you can now select either an image package file or a *qcow2* image file with a scaffold file when configuring a Virtual Network Function (VNF) during service chain creation. Cisco SD-WAN Manager communicates with NETCONF that uses a simple Remote Procedure Call to retrieve operational data when an autonomous mode device is onboarded in Cisco SD-WAN Manager. (NETCONF) is a standard transport protocol that communicates with network devices. NETCONF provides mechanisms to edit configuration data. Cisco SD-WAN Manager upgrade workflow for the SD-Routing device is similar to the Controller mode Workflows.

Note The minimum software version required for this feature to work is Cisco IOS XE 17.12.1a.

Software Upgrade Using CLI

To upgrade the software, perform these steps:

Before you begin

- Disk Space Check: Checks for available bootflash space for downloading and expanding image.
- Image repository Check: Checks for remote server reachability.
- Auto Boot Enable: Checks if auto boot is enabled on the device.

Step 1 Download the Cisco IOS XE Release 17.12 image from the software page https://software.cisco.com.

Step 2 Upload the image to the device.

Step 3 Install the new software using the **install add file <bootflash:/file name> activate commit** command and activate.

Example:

```
Device# install add file <bootflash:/c8000v-universalk9.17.12.01.0.166070.SSA.bin activate commit
```

The device reloads when the activation is complete.

Note This is an interactive command and it prompts to review and accept it. This command fails if there is any unsaved configuration in the device. You will have to execute the **write memory** command and reinstall the software.

Step 4 Verify the upgrade using the **install commit** command.

Add Software Images to the Repository

Before you can upgrade the software on an SD-Routing device or Cisco SD-WAN Manager to a new software version, you need to add the software image to the Cisco SD-WAN Manager software repository. For more information on uploading the Cisco Catalyst 8000v Edge software to Cisco SD-WAN Controller using Cisco SD-WAN Manger and Remote server, see the Manage Software Repository section of the *Cisco SD-WAN Monitor and Maintain Configuration Guide.*

Software Upgrade Using Cisco SD-WAN Manager

To upgrade the software image on a device, perform these steps:

Before you begin

- This procedure does not enable downgrading to an older software version. If you need to downgrade, see Downgrade a Cisco vEdge Device to an Older Software Image in the Cisco SD-WAN Getting Started Guide.
- If you want to perform a Cisco SD-WAN Manager cluster upgrade see, Upgrade Cisco vManage Cluster
- Auto Boot Enable: Checks if auto boot is enabled on device.

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Upgrade**.

Step 2 Click **WAN Edge**, **Control Components**, or **Manager** based on the type of device for which you wish to upgrade the software.

Step 3 In the table of devices, select the devices to upgrade by selecting the check box on the far left.

Note While upgrading Cisco SD-WAN Manager clusters, select all the nodes of the cluster in the table.

Step 4 Click **Upgrade**.

Step 5 In the **Software Upgrade** slide-in pane, do as follows:

a) Choose the server from which the device should download the image: **Manager**, **Remote Server**, or **Remote Server – Manager**.

Note
- If you chose **Remote Server**, ensure that the device can reach the remote server.
- When downloading an image from a remote server manually, ensure that only the following valid characters are used:
  - User ID: a-z, 0-9, ., _, -
  - Password: a-z, A-Z, 0-9, _, *, ., +, =, %, -
  - URL Name or Path: a-z, A-Z, 0-9, _, *, ., +, =, %, -, :, /, @, ?, ~

b) For **SD-WAN Manager**, choose the image version from the **Version** drop-down list.

c) For **Remote Server – SD-WAN Manager**, choose the **vManage OOB VPN** from the drop-down list and choose the image version from the **Version** drop-down list.

d) Check the **Activate and Reboot** check box.

If you do not check this check box, the software image is downloaded and installed on the device, but, the image is not activated, and the device is not rebooted. You must activate the image after the upgrade task is completed.

Note The **Activate and Reboot** option is not available while upgrading Cisco SD-WAN Manager software. You must activate the image after the upgrade task is completed and reboot Cisco SD-WAN Manager.

e) Click **Upgrade**

The device restarts, using the new software version, preserving the current device configuration. The **Task View** page opens, showing the progress of the upgrade on the devices.

Step 6 Wait for the upgrade process, which takes several minutes, to complete. When the **Status** column indicates Success, the upgrade is complete.

Step 7 From the Cisco SD-WAN Manger menu, choose **Maintenance** > **Software Upgrade** and view the devices.

Step 8 Click **WAN Edge**, **Control Components**, or **Manager** based on the type of device for which you wish to upgrade the software.

Step 9 In the table of devices, confirm that the **Current Version** column for the upgraded devices shows the new version. Confirm that the **Reachability** column says reachable.

Note

- If the control connection to Cisco SD-WAN Manager does not come up within the configured time limit, Cisco SD-WAN Manager automatically reverts the device to the previously running software image.
- If you upgrade the Cisco VEdge software to a version higher than that running on a controller device, a warning message is displayed that software incompatibilities might occur. It is recommended that you upgrade the controller software first before upgrading the Cisco VEdge software.

Delete a Software Image

To delete a software image from a SD-Routing device:

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Upgrade**.
2. Click **WAN Edge**, **Controller**, or **Cisco SD-WAN Manager**.
3. Choose one or more devices from which you want to delete a software image.
4. Click the **Delete Available Software**.

   The **Delete Available Software** dialog box opens.
5. Choose the software version to delete.
6. Click **Delete**.

View Log of Software Upgrade Activities

1. From the Cisco SD-WAN Manager toolbar, click the **Tasks** icon.

   Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.
2. Click the **Arrow** icon to see details of a task. Cisco SD-WAN Manager opens a status window displaying the status of the task and details of the device on which the task was performed.

Monitoring the Device Using Cisco SD-WAN Manager

The **Monitor** window provides a single-page, real-time user interface that facilitates a consolidated view of all the monitoring components and services of a Cisco SD-Routing devices. You can establish the connection and monitor the device using the following options:

- SSH Terminal
- Ping
- Traceroute

Also, you can collect the system status information in a compressed *.tar* file. Cisco SD-WAN Manager can retrieve and download a *.tar* file from the device. After retrieving the file, you can delete the copy of the file on the device to free up the disk space.

When you enable the SD-Routing mode, this feature is enabled on the device and Cisco SD-WAN Manager by default.

Monitoring the Device Using SSH

To establish the connection and monitor the device using the SSH option, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 Choose a device from the list of devices that is displayed.

Step 3 For a single device, click **. . .** for the desired device and choose **SSH Terminal**.

(Or)

Step 4 From the Cisco SD-WAN Manager menu, choose **tools** > **SSH Terminal**.

Step 5 Enter the password twice (same as SD-Routing) in the terminal to establish the connection with the device.

Step 6 From the terminal, execute the **show commands** to monitor the device.

Pinging the Device

To ping the device, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 Choose a device from the list of devices that is displayed.

Step 3 For a single device, click **. . .** for the desired device and choose **Ping**.

Step 4 From the **Monitor** page, enter the destination IP address.

Step 5 Click **Ping**.

The results of the ping will be printed in the window below.

Tracing the Route

To establish the connection and monitor the device using the trace routing option, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 Choose a device from the list of devices that is displayed.

Step 3 For a single device, click **. . .** for the desired device and choose **Trace Route**.

Step 4 From the **Trace Route** page, enter the destination IP address.

Step 5 Click the **Start** button to trace the route.

Alarms and Events

When an even occurs on an individual device in the overlay network, the device reports it by sending a notification to Cisco SD-WAN Manager. Cisco SD-WAN Manager then filters the event notifications and correlates related events, and it consolidates major and critical events into alarms.

Use the Alarms screen to display detailed information about alarms generated by SD-Routing devices in the overlay network.

Monitoring the Alarms and Events

You can view alarms from the Cisco SD-WAN Manager dashboard by clicking the **Bell** icon at the top-left corner. The alarms are grouped into Active or Cleared. By default, alarms are displayed for the last 24 hours. Alternatively, follow these steps to view alarms from the **Alarms** screen in Cisco SD-WAN Manager.

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices** > **Logs**.

Step 2 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Alarms**.

The alarms are displayed in graphical and tabular formats.

Step 3 To view more details for a specific alarm, click **…** for the desired alarm, and then click **Alarm Details**.

The **Alarm Details** window opens and displays the probable cause of the alarm, impacted entities, and other details.

Admin-Tech Files

You can view the generated admin-tech files whenever the admin-tech files are available on a device.

You can view the list of generated admin-tech files and then decide which files to copy from your SD-Routing device to Cisco SD-WAN Manager. You can then download the selected admin-tech files to your local device, or delete the downloaded admin-tech files from Cisco SD-WAN Manager, the device, or both.

Requesting the Admin-tech File Using Cisco SD-WAN Manager

An Admin-tech file is a collection of system status information used for troubleshooting a given issue. To request a Admin-tech file, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands**.

Step 2 For a single device, click **. . .** for the desired device and choose **Generate Admin Tech**.

Step 3 In the **Generate admin-tech File** window, limit the contents of the Admin-tech tar file if desired:

a) The **Include Logs** check box is checked by default. Uncheck this check box to omit any log files from the compressed tar file.
b) Check the **Include Cores** check box to include any core files.

Note The core files are stored in the *bootflash:/core* or *harddisk:/core* directory on the local device.

c) Check the **Include Tech** check box to include any files related to device processes (daemons), memory details and operations.

Step 4 Click **Generate**.

Cisco SD-WAN Manager creates the Admin-tech file. The file name format is *hostname-date-time-admin-tech.tar.gz*.

Step 5 To veiw the generated Admin-tech file, from the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands** > **Show Admin Tech List**.

Requesting the Admin-tech File Using CLI

To request a Admin-tech file using CLI, perform these steps:

Use the **request tech-support** command to generate the admin-tech file.

```
Device#request tech-support
21:03:46.447 UTC Thu Aug 10 2023 : Collecting 'show tech-support'...
21:04:51.880 UTC Thu Aug 10 2023 : 'show tech-support' collected successfully!
21:04:55.091 UTC Thu Aug 10 2023 : Collecting binary traces...
21:04:55.216 UTC Thu Aug 10 2023 : Binary traces collected successfully!
21:04:55.219 UTC Thu Aug 10 2023 : Collecting platform-dependent files...
21:05:43.467 UTC Thu Aug 10 2023 : Platform-dependent files collected successfully!
21:05:43.475 UTC Thu Aug 10 2023 : Generating tech-support bundle...
21:05:56.648 UTC Thu Aug 10 2023 : Tech-support bundle file
bootflash:core/1HX-2017-debug_bundle_20230810-210346-UTC.tar.gz [size: 8648 KB]
21:05:56.648 UTC Thu Aug 10 2023 : Tech-support bundle generated successfully!

1HX-2017#
1HX-2017#dir bootflash:core
Directory of bootflash:/core/

1471682  -rw-               1  Aug 11 2023 04:26:51 +00:00  .callhome
45       -rw-           25429  Aug 10 2023 21:05:56 +00:00
1HX-2017_RP_0-debug_bundle_20230810-210346-UTC-info.txt
49       -rw-         8854997  Aug 10 2023 21:05:54 +00:00
1HX-2017-debug_bundle_20230810-210346-UTC.tar.gz
1471685  drwx             4096  Mar 22 2021 20:03:54 +00:00  modules

29633794048 bytes total (16795193344 bytes free)
1HX-2017#
```

Monitoring the Real Time Data

To ping the device, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 Choose a device from the list of devices that is displayed.

Step 3 For a single device, click **...** for the desired device and choose **Real Time**.

Step 4 Select the category of data from the **Device Options** drop-down list.

The results will be diplayed.

Configuration Examples

This section provides the configuration exmaples.

Example: Enabling Control Connection on Cisco SD-WAN Manager

This example shows how to enable control connection on Cisco SD-WAN Manager:

```
(config) sd-routing
(config-sd-routing) system-ip  172.16.255.15
(config-sd-routing) organization-name viptela
(config-sd-routing) vbond ip 10.0.12.26
(config-sd-routing) site-id 500
(config-sd-routing) wan-interface GigabitEthernet2
```

Example: Verifying the Enable Control Connection

Use the **show platform software yang-management process state** command to check the connection status.

```
Device#show platform software yang-management process state
Confd Status: Started


Process              Status              State
------------------------------------------------------
nesd                 Running             Active
syncfd               Running             Active
ncsshd               Running             Not Applicable
dmiauthd             Running             Active
nginx                Running             Not Applicable
ndbmand              Running             Active
pubd                 Running             Active
```

Use the **show platform software yang-management process list r0 name vdaemon** command to check the vdaemon status.

```
Device#show platform software process list r0 name vdaemon
Name: vdaemon
  Process id       : 29075
  Parent process id: 29070
  Group id         : 29075
  Status           : S
  Session id       : 8829
  User time        : 263002
```

```
Kernel time      : 347183
Priority         : 20
Virtual bytes    : 405110784
Resident pages   : 12195
Resident limit   : 18446744073709551615
Minor page faults: 716496
Major page faults: 9130
```

Example: Installing the Root Certificate

This examples shows how to install the root certificate:

```
Device# request platform software sd-routing root-cert-chain install bootflash:root-ca.crt
```

Example: Verifying the Root Certificate Installation

Use the **show sd-routing local-properties summary** command to check the root certificate installation status.

```
Device#show sd-routing local-properties summary
personality                     vedge
sp-organization-name            vIPtela Inc Regression
organization-name               vIPtela Inc Regression
root-ca-chain-status            Installed
root-ca-crl-status              Not-Installed
```

```
Device#show sd-routing local-properties summary
certificate-status              Installed
certificate-validity            Valid
certificate-not-valid-before    Apr 25 00:55:28 2023 GMT
certificate-not-valid-after     Apr 24 00:55:28 2024 GMT
…….....
dns-name                        vbond
site-id                         100
tls-port                        0
system-ip                       172.16.255.11
chassis-num/unique-id           C8K-aa079ca1-c141-4ac6-9b76-05864005f94e
serial-num                      12345707
```

Troubleshooting

This section provides commands that can be used to troubleshoot the common issues while managing and monitoring the SD-Routing devices using Cisco SD-WAN Manager:

- **Show version**

Note The operating mode is included in **show version** command.

```
When sd-routing feature is enabled:
Device#show version | include mode
Router operating mode: Autonomous (SD-Routing)
Device#
```

```
When sd-routing feature is not enabled:
Device#show version | include mode
Router operating mode: Autonomous
Device#
```

- `show platform software yang-management process state`
- `show sd-routing system status`
- `show sd-routing connections summary`
- `show platform software process list r0 name vdaemon`
- `show sd-routing local-properties summary`
- `show sd-routing local-properties wan ipv4`
- `show sd-routing local-properties vbond`
- `show sd-routing connections history`

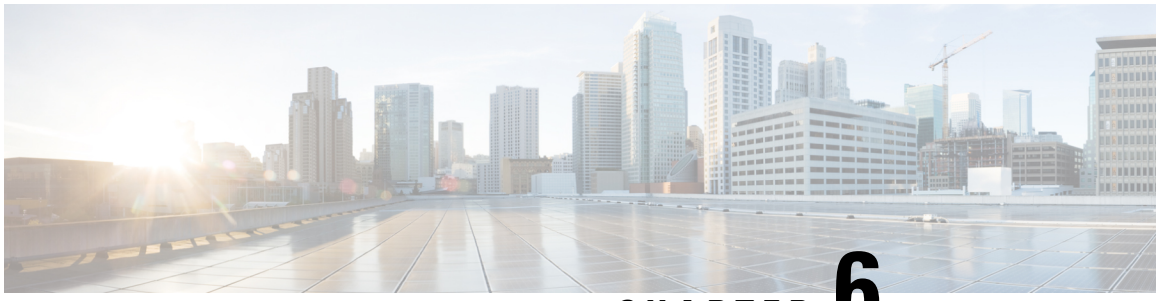
Feature Information for Managing SD-Routing Devices Using Cisco SD-WAN Manager

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 5: Feature Information for SD-Routing Devices Using Cisco SD-WAN Manager

Feature Name	Releases	Feature Information
Managing SD-Routing Devices Using Cisco SD-WAN Manager	Cisco IOS XE Release 17.12.1a	This feature allows you to perform management operations for SD-Routing devices using Cisco SD-WAN Manager. You can use a single network manage system (Cisco SD-WAN Manager) to monitor all the SD-Routing devices and therefore help in simplifying solution deployments.



CHAPTER 6

Software Upgrade on SD-Routing Devices

This chapter includes information on how to upgrade the software on the SD-Routing devices. It contains the following sections:

Information About the Software Upgrade Workflow

Using this workflow, you can download and upgrade software images on the supported Cisco SD-Routing devices with an option to schedule the upgrade process at your convenience. The workflow also shows the status of the software upgrade. This workflow provides you to perform the software **Download and Upgrade**.

Benefits of Software Upgrade Workflow

- The software upgrade workflow helps you prevent various device software upgrade failures by displaying device upgrade status. For example, if the upgrade process fails at any particular stage, the workflow flags it as **failed**.
- With this workflow, you can choose to download, install, and activate the new software image in discrete steps or in a single step. You can schedule the workflow during the specified date and time.

Prerequisites for Using the Software Upgrade Workflow

Ensure that the Cisco SD-Routing devices are running the required software versions for using the software upgrade workflow feature.

Access the Software Upgrade Workflow

Before You Begin

To check if there is an in-progress software upgrade workflow:

From the Cisco SD-WAN Manager toolbar, click the **Task-list** icon. Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.

1. In the Cisco SD-WAN Manager menu, click **Workflows** > **Workflow Library**.

Note In the Cisco SD-WAN Manager, the **Workflow Library** is titled **Launch Workflows**.

2. Start a new software upgrade workflow: **Library** > **Software Upgrade**.
3. Follow the on-screen instructions to start a new software upgrade workflow.

Note Click **Exit** to exit from an in-progress software upgrade workflow. You can resume the in-progress workflow at your convenience.

Note In a multi-node cluster setup, if the control connection switches to a different node during a SD-Routing device upgrade from Cisco SD-WAN Manager, the upgrade may be impacted due to NetConf session timeout. The SD-Routing device then establishes control connection to a different node. You need to re-trigger the upgrade activity.

Verify the Status of the Software Upgrade Workflow

To check the software upgrade workflow status:

1. From the Cisco SD-WAN Manager toolbar, click the **Task-list** icon.

   Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.

2. Click the + icon to view the details of a task.

   Cisco SD-WAN Manager opens a pane displaying the status of the task and details of the SD-Routing device on which the task was performed.

Schedule Software Upgrade Workflow for SD-Routing Devices

The scheduler in the software upgrade workflow enables you to schedule workflows at your convenience and avoid any downtime due to the software upgrade process. A scheduler enables you to schedule the upgrade workflow either **Now** or **Later**. If you choose to schedule an upgrade for a later time, you can enter the **Start Date**, **Start time**, and **Select Timezone**.

Scheduling Software Upgrade Workflow

Use the following steps to schedule a software upgrade workflow:

Before you begin

Step 1 From the Cisco SD-WAN Manager menu, click **Workflows** > **Workflow Library**

OR

Click **Workflows** > **Popular Workflows** > **Software Upgrade.**.

Step 2 Start a new software upgrade workflow: **Workflow Library** > **Software Upgrade**.

OR

Alternatively, resume an in-progress software upgrade workflow: **In-progress** > **Software Upgrade**.

Step 3 In the **Scheduler** section, choose **Later**.

Note Use the **Now** option to perform the software upgrade for the selected devices immediately.

Step 4 Choose the **Start Date**, **Start Time**, and **Select Timezone**.

Note Start date and time should always be greater than the Cisco SD-WAN Manager server date and time.

Step 5 Click **Next**.

The software upgrade workflow is scheduled.

Cancel the Scheduled Software Upgrade Workflow for SD-Routing

To cancel a scheduled software upgrade workflow,

1. From the Cisco SD-WAN Manager menu, click **Maintenance** > **Software Upgrade**.
2. Choose the SD-Routing device that is scheduled for a software upgrade from the list of devices.
3. Click **Cancel Software Upgrade**.

Delete a Downloaded Software Images on the SD-Routing Devices

To delete downloaded software images on the SD-Routing devices:

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Upgrade**.
2. Click **WAN Edge**.
3. Click **Delete Downloaded Images**
4. In the **Delete Downloaded Images** dialogue box, choose the appropriate image or images to delete.
5. Click **Delete**.

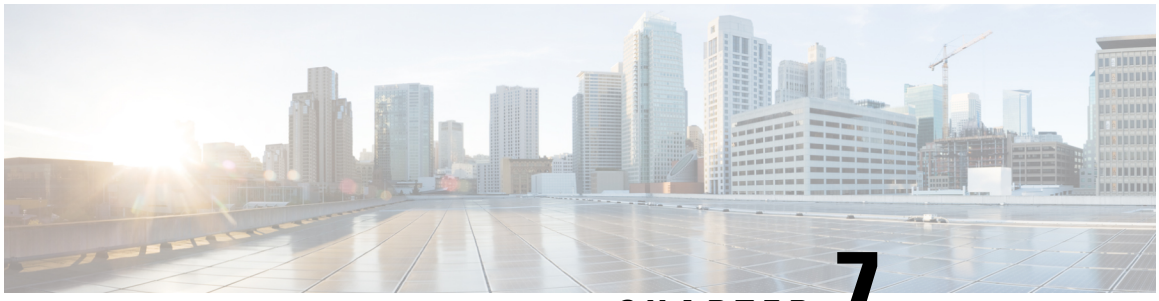
Feature Information for Schedule Software Upgrade on SD-Routing Devices

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 6: Feature Information for Schedule Software Upgrade on SD-Routing Devices

Feature Name	Releases	Feature Information
Schedule Software Upgrade on SD-Routing Devices	Cisco IOS XE Release 17.13.1a	With this feature, you can schedule software image upgrade on Cisco SD-Routing devices. This allows you to avoid any downtime due to the software upgrade process.



CHAPTER 7

Deploy IOS-XE and SDWAN

Overview

You can use the universalk9 image to deploy both Cisco IOS XE SD-WAN and Cisco IOS XE on Cisco IOS XE devices. This helps in seamless upgrades of both the SD-WAN and non SD-WAN features and deployments.

Restrictions

Autonomous or Controller Mode

Access the Cisco IOS XE and Cisco IOS XE SD-WAN functionality through Autonomous and Controller execution modes, respectively. The Autonomous mode is the default mode for the routers and includes the Cisco IOS XE functionality. To access Cisco IOS XE SD-WAN functionality switch to the Controller mode.

For more information, see https://www.cisco.com/c/en/us/td/docs/routers/sdwan/configuration/sdwan-xe-gs-book/install-upgrade-17-2-later.html#Cisco_Concept.dita_42020dbf-1563-484f-8824-a0b3f468e787

Switch Between Controller and Autonomous Modes

The default mode of the device is autonomous mode. Use the **controller-mode** command in Privileged EXEC mode to switch between controller and autonomous modes.

The **controller-mode enable** command switches the device to controller mode

The **controller-mode disable** command switches the device to autonomous mode

For information see Cisco SD-WAN Getting Started Guide

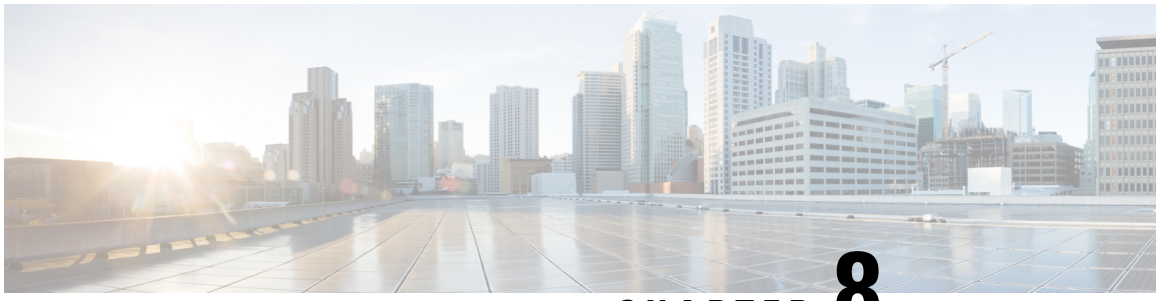
PnP Discovery Process

You can use the existing Plug and Play Workflow to determine the mode of the device.

The PnP-based discovery process determines the mode in which the device operates, based on the controller discovery and initiates a mode change, if required. This discovery is based on the controller profile attached to the device UID in the smart account/virtual account. The mode change results in a reboot of the device. Once reboot is complete, the device performs appropriate discovery process.

Plug and Play (PnP) deployment include the following discovery process scenarios:

Boot up Mode	Discovery Process	Mode Change
Autonomous	Plug and Play Connect Discovery or on-premise plug and play server discovery	No Mode change
Controller	Plug and Play Connect Discovery or on-premise plug and play server discovery	Mode change to autonomous mode



CHAPTER 8

Cisco SD-Routing Cloud OnRamp for Multicloud

This chapter includes information on how to configure Cloud OnRamp for Multicloud on the SD-Routing devices. It contains the following sections:

Overview

Cisco Catalyst SD-Routing Cloud OnRamp for Multicloud extends enterprise WAN to public clouds. This multicloud solution helps to integrate public cloud infrastructure into the Cisco Catalyst SD-Routing devices. Using the AWS Transit Gateway (TGW), we support SD-Routing branch sites. With these capabilities, the branch devices can access the applications interfacing with cloud networks. This feature is supported from the Cisco IOS XE 17.13.1 release onwards.

Note From Cisco IOS XE 17.12.1a, the following components have been rebranded: **Cisco vManage** to **Cisco Catalyst SD-WAN Manager** and **Cisco vBond** to **Cisco Catalyst SD-WAN Validator**.

Information About the AWS Integration

A transit gateway is a network transit hub that you can use to interconnect your VPC and on-premises networks. You can attach a VPC, or a VPN connection to a transit gateway. It acts as a virtual router for traffic flowing between your VPC and VPN connections.

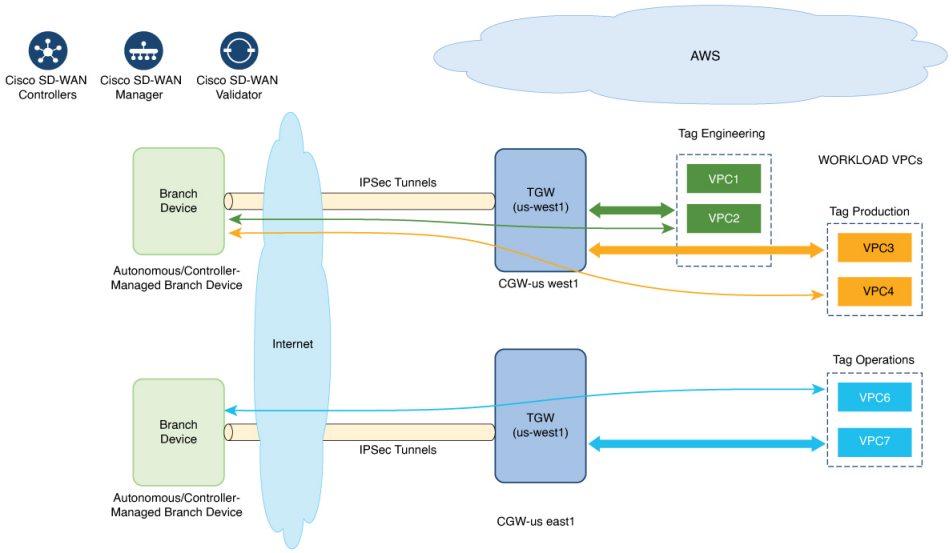
You can configure and manage Cloud OnRamp for Multicloud environments through the Cisco SD-WAN Manager controller. A configuration wizard in Cisco SD-WAN Manager automates the bring-up of the transit gateway to your public cloud account and automates the connections between public-cloud applications and the users of those applications at branches in the overlay network. This feature works with AWS virtual private clouds (VPCs) on Cisco cloud routers.

Cloud OnRamp for Multicloud supports integration with multiple AWS accounts.

AWS Branch Connect with SD-Routing Devices

When you deploy SD-Routing Cloud OnRamp through SD-Routing based branch, it should be deployed though the SD-Routing based Config group. Also, you should set the bootup license level manually through the respective CG device CLI template for the tunnel-based config to work during Cloud OnRamp connecitvity.

The edge/branch devices connect to the host VPCs in the cloud over secure point-to-point tunnels. IPSec tunnels are set up between edge devices and the AWS Transit Gateway (TGW). These tunnels carry the branch VPNs or VRFs traffic and BGP routing traffic. Using BGP, the devices and the transit gateway exchange the routing information and build routing tables.



The SD-Routing branch device can have only the default VRF. You can use this default VRF to mapping through the SD-Routing Cloud OnRamp branch connect. You cannot use any other VPN/VRF for mpping. Along with SD-Routing soluction, you can have multiple VPN mapping for SD-WAN solution. Both the Cisco SD-WAN and Cisco SD-Routing connection can co-exist.

Note A branch site can have more than one branch endpoint connecting to the cloud.

Benefits of Cloud OnRamp for SD-Routing Devices

SD-Routing Cloud OnRamp supports secure cloud connectivity for the cloud workloads deployed in AWS or Azure using SD-Routing devices through Multicloud workflows.

Prerequisites for Cloud onRamp

The following are the prerequisites for Cloud onRamp:

- The branch site should be in reachable state and the status should be In-Sync.
- The branch site should have one of these boot level licenses:
  - network-advantage

- network-essentials
- network-premier

Otherwise, when you attach the site, the IPSec tunnel configurations will not get applied.

- Interface should have a public IP address assigned that is reachable from AWS TGW or Azure vHub, or NAT on the branch device. Otherwise, the tunnel will not be formed between the branch site and AWS TGW or Azure vHub.
- SD-routing branch should be deployed using or ported to Config-Group.
  - Refer to Onboarding the Existing Devices , on page 47 and Onboarding the New SD-Routing Device Using Config Group Automated Workflow, on page 48 sections to On-board or to get SD-Routing device compatible to use the Cloud onRamp feature.

Limitations

- Cloud OnRamp does not support peering between the TGWs in different regions.

Configure AWS Integration on SD-Routing Devices

This section explains the workflows to onboard the SD-Routing devices for features:

- Onboarding the existing devices:
  - Converting the existing Autonomous Device to SD-Routing device and use the Cloud onRamp feature
  - Converting the existing Non-config group based SD-Routing devices to use Cloud onRamp feature
- Onboarding new SD-Routing device using Config Group Automated Workflow

Onboarding the Existing Devices

To onboard the existing devices, perform these steps:

Step 1 To deploy or convert the existing autonomous device to SD-Routing device manually, follow the instrucion provided in the section Onboarding the Devices Manually.

Or

Step 2 To deploy SD-Routing device using the Quick Connect Workflow follow the instrucion provided in the section Onboarding the SD-Routing Devices Using Bootstrap.

Pre-requisities:

Step 3 To port the SD-Routig device to Configuration Group, do the following:

Note The devices from steps 1 and 2 should have following pre-requisities taken care before proceeding further:

- Log into the deivce using the username and password (admin/admin).
- At the command prompt, configure the **license boot level network-advantage addon dna-advantage** command.

- Save the configuration and reboot the device. Ensure that the device is in-sync under Configuration Devices in Cisco SD-WAN Manager.

a) From Cisco IOS XE Catalyst SD-WAN Manager menu, choose **Configuration** > **Configuration Groups** > **Add CLI based Configuration Group**
b) In the **Add CLI Group** pop-up dialog box, enter the configuration group name.
c) Click the **Solution Type** drop-down list and select the solution type as **sd-routing** for the SD-Routing devices.
d) In the **Description** field, enter the description.
e) Click **Create**.

The new configuration group page is displayed with the Feature Profiles and Associated Device tabs.

f) Click **Load Running Config from Reachable Device** from the drop-down list and select the System-IP of the device for which you want to build the configuration. You can edit the configuration based on the requirement in the Preview text box.
g) Copy the configuration that is loaded in the **Configuration Preview** text box and save it in your system as a text file.

Step 4 To add the Configuration Group on the SD-routing device, do the following:

a) From **Cisco SD-WAN Manager** menu, choose **Configuration** > **Configuration Groups** > **Add Configuration Group** > **Create SD-Routing Config** .
b) In the **Name** field, enter a name for the configuration group.
c) In the **Description** field, enter the description.
d) Click **Create SD-Routing Config**.
e) In the **Configuration Group Created** pop-up dialog box, click the **No, I will Do It Later** option.
f) From the **What's Next?** section, click **Go to Configuration Groups**.
g) Click **(…)** adjacent to the configuration group name and choose **Edit**.
h) Click on the Cli profile under Feature Profiles and select **Unconfigured**.
i) Click **Create New**.
j) Enter an unique name. Copy and paste the configuration that is saved as a text file.
k) Click **Save**.

Step 5 Click on **Associate Devices** and selct the Site ID for the SD-routing device and proceed with associtation.

Step 6 Click on the deployment status link and ensure that the deployent is successful.

Step 7 Check the following details in the **Configuration** > **Devices** page.

- Device Status - The status of the device should be In Sync
- Managed By - The respective SD-Routing Config Group created in Step 4a.

Step 8 To verify the status, use the **show sd-routing connections summary** command.

Onboarding the New SD-Routing Device Using Config Group Automated Workflow

To onboard the new SD-Routing device using Config Group automated workflow, perform these steps:

Step 1 From **Cisco SD-WAN Manager** menu, choose **Configuration** > **Configuration Groups** > **Add Configuration Group** > **Create SD-Routing Config** .

Step 2 In the **Name** field, enter a name for the configuration group.

Step 3 In the **Description** field, enter the description.

Step 4 Click **Create SD-Routing Config**.

Step 5 In the **Configuration Group Created** pop-up dialog box, click the **No, I will Do It Later** option.

Step 6 From the **What's Next?** section, click **Go to Configuration Groups**.

Step 7 Click **(…)** adjacent to the configuration group name and choose **Edit**.

Step 8 Click on the Cli profile under Feature Profiles and select **Unconfigured**.

Step 9 Click **Create New**.

Step 10 Configure the basic Cnfiguration Group.

This example shows the minimum CLIs for the Config Group.

```
Configurations:
==============
sd-routing
organization-name CSRQA20231024
site-id 1
system-ip 4.7.8.9
vbond ip 44.226.182.48
vbond port 12346
wan-interface GigabitEthernet1
!
interface GigabitEthernet1
no shutdown
negotiation auto
ip address dhcp
exit
interface GigabitEthernet2
no shutdown
negotiation auto
ip address dhcp
exit

ip domain lookup

license boot level network-advantage addon dna-advantage
no logging console
```

Step 11 Click **Save**.

Step 12 Click on **Associate Devices** > **Associate Devices**.

Step 13 Choose **Unassigned** and select one UUID .

Step 14 Click **Save.**

Step 15 You can provision the device with the respective Sytem IP, Site ID, and Host name.

Step 16 Click **Next** .

Step 17 Click **Deploy**,

Step 18 Click on the deployment status link and ensure that the deployent is successful.

Step 19 Go to **Configuration** > **Devices** > against the uuid three dots click "generate bootstrap " enter the wan interface name (eg: GigabitEthernet1) and genreta the bootstrap

Step 20 Click **(…)** adjacent to the UUID name and click **Generate bootstrap** .

Step 21 In the **WAN Interface** field, enter interface name a GigabitEthernet1 and generatethe bootstrap.

Step 22 Use the bootstrap to deploy the Cisco 8000v instance against the respective AMI in AWS console and assign the public IP to the WAN interface.

Step 23 Click on the deployment status link and ensure that the deployent is successful.

Step 24 Check the following details in the **Configuration** > **Devices** page.

- Device Status - The status of the device should be In Sync
- Managed By - The respective SD-Routing Config Group created in Step 1.

Step 25 To verify the status, use the **show sd-routing connections summary** command.

Create AWS Cloud Account

To create the AWS cloud account, follow these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**. The Cloud OnRamp for Multicloud dashboard displays.

Step 2 Click **Associate Cloud Account** in the Setup pane. Note the external Id from the **Associate Cloud Account** page.

Step 3 In the **Cloud Provider** field, choose Amazon Web Services from the drop-down list..

Step 4 Enter the account name in the **Cloud Account Name** field.

Step 5 (Optional) Enter the description in the **Description** field.

Step 6 In **Use for Cloud Gateway**, choose **Yes** if you want to create cloud gateway in your account, or choose **No**.

Step 7 Choose the authentication model you want to use in the field **Login in to AWS With**.

- **Key**
- **IAM Role**

If you choose the **Key** model, then provide **API Key** and **Secret Key** in the respective fileds.

Or

If you choose the **IAM Role** model, then create an IAM role with Cisco SD-WAN Manager provided **External ID**. Note the displayed external Id from the window and provide the **Role ARN** value that is available when creating an IAM role.

Starting from Cisco IOS XE Catalyst SD-WAN Release 17.4.1a, to create an IAM role, you must enter the External Idprovided by Cisco SD-WAN Manager into a policy by using the AWS Management Console. Do the following:

a. Attach an IAM Role to an existing Cisco SD-WAN Manager EC2 instance.

1. See the Creating an IAM role (console) topic of AWS documentation to create a policy. In the AWS **Create policy** wizard, click **JSON** and enter the following JSON policy document.

```
{

"Version": "2012-10-17",

  "Statement": [{

    "Sid": "VisualEditor0",

"Effect": "Allow",

    "Action": "sts:AssumeRole",

"Resource": "*"

    }
]
```

```
}
```

2. See the Easily Replace or Attach an IAM Role to an Existing EC2 Instance by Using the EC2 Console blog of AWS Security Blog for information about creating an IAM role and attaching it to the Cisco SD-WAN Manager EC2 instance based on the policy created in Step 1.

   Note On the **Attach permissions policy** window, choose the AWS managed policy that you created in Step 1.

   Note The following set of permissions are allowed:

   - AmazonEC2FullAccess
   - IAMReadOnlyAccess
   - AWSNetworkManagerFullAccess
   - AWSResourceAccessManagerFullAccess

   For more information on creating an AWS IAM Role, refer Creating an AWS IAM Role.

b. Create an IAM role on an AWS account that you want to use for the multicloud environment.

1. See the Creating an IAM role (console) topic of AWS Documentation and create an IAM role by checking **Require external ID** and pasting the external Id that you noted in Step 2.
2. See the Modifying a role trust policy (console) topic of AWS Documentation to change who can assume a role.

   In the **IAM Roles** window, scroll down and click the role you created in the previous step.

   In the **Summary** window, note the **Role ARN** that is displayed at the top.

   Note You can enter this role ARN value when you choose the authentication model as IAM role in Step 7.

3. After modifying the trust relationship, click **JSON** and enter the following JSON document. Save the changes.

   Note The account Id in the following JSON document belongs to the Cisco SD-WAN Manager EC2 instance.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::[Account ID from Part 1]:root"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEquals": {
          "sts:ExternalId": "[vManage provided External ID]"
       }
      }
    }
  ]
}
```

Step 8 Click **Add**.To view or update cloud account details, click **...** on the Cloud Account Management page. You can also remove the cloud account if there are no associated host VPC tags or cloud gateways.

Configure Cloud Global Settings

To configure cloud global settings for AWS, peform these stpes:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**. Click **Cloud Global Settings** in the **Setup** pane. The **Cloud Global Settings** window appears.

Step 2 In the **Cloud Provider** field, choose **Amazon Web Services**.

Step 3 Click **Cloud Gateway Solution** drop-down list to choose the Transit Gateway–Branch-connect.

- **Transit Gateway–Branch-connect**—Allows connectivity of different SD-Routing devices to VPCs in the cloud through the transit gateway that is instantiated in the AWS cloud. This option uses the AWS VPN connection (IPSec) approach.

Step 4 In the **Cloud Gateway BGP ASN Offset** field, enter the value.

Step 5 Choose the **Intra Tag Communication**. The options are **Enabled** or **Disabled**

Step 6 Choose the **Program Default Route in VPCs towards TGW/Core**. The options are **Enabled** or **Disabled**.

Step 7 Enable or disable the **Enable Periodic Audit** field by clicking **Enabled** or **Disabled**.

If you the enable periodic audit, Cisco SD-WAN Manager triggers an automatic audit every two hours. This automatic audit takes place in the background, and a discrepancies report is generated.

Step 8 Enable or disable the **Enable Auto Correct** field by clicking **Enabled** or **Disabled**. If you enable the auto correct option, after every periodic audit is triggered, all the recoverable issues that are discovered are auto corrected.

Step 9 Click **Add** or **Update**.

Discover Host Private Networks

You can discover host VPCs in all the accounts across all the respective regions of the account that are available. When the **Host VPC Discovery** is invoked, the discovery of the VPCs is performed without any cache.

To discover the host private networks, peform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**. Click **Host Private Networks** under **Discover**. The **Discover Host Private Networks** window appears with the list of available VPCs.

The host VPC table includes the following columns:

- Cloud Region
- Account Name
- Host VPC Name
- Host VPC Tag
- Account ID

- Host VPC ID

Click a column to sort the VPCs, as required.

Step 2 Click the **Region** drop-down list to select the VPCs based on particular region.

Step 3 Click **Tag Actions** to perform the following actions:

- **Add Tag** - group the selected VPCs and tag them together.
- **Edit Tag** - migrate the selected VPCs from one tag to another.
- **Delete Tag** - remove the tag for the selected VPCs.

A number of host VPCs can be grouped under a tag. All VPCs under the same tag are considered as a singular unit.

Create a Cloud Gateway

Cloud gateway is an instantiation of Transit VPC (TVPC)and transit gateway in the cloud. To create a cloud gateway, perform the following steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**. Click **Create Cloud Gateway** under **Manage**. The **Manage Cloud Gateway - Create** window appears.

Step 2 In the **Cloud Provider** field, choose Amazon Web Services from the drop-down list.

Step 3 In the **Cloud Gateway Name** field, enter the cloud gateway name.

Step 4 (Optional) In the **Description**, enter the description.

Step 5 Choose the account name from the **Account Name** drop-down list.

Step 6 Choose the region from the **Region** drop-down list.

Step 7 Click **Add** to create a new cloud gateway.

Attaching Sites

To attach sites to a cloud gateway, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud** > **Gateway Management** under **Manage**. The **Cloud Gateway** window appears. A table displays the list of cloud gateways with cloud account name, ID, cloud type, transit gateway.

For each of the cloud gateways, you can view, delete, or attach more sites.

Step 2 For the desired cloud gateway, click **(…)** and choose **Cloud Gateway**.

Step 3 Click **Attach SD-Routing**.

Step 4 Click **Attach Sites**.

Step 5 Click **Next**. The **Attach Sites - Select Sites** window appears. The table shows the sites with the selected WAN interface.

Step 6 Choose one or more sites from **Available Sites** and move them to **Selected Sites**.

Step 7 Click **Next**.

Step 8 On the **Attach Sites - Site Configuration** window, enter the **Tunnel Count**. The tunnel count ranges from 1 to 8 and each tunnel gives a bandwidth of 2.5 Gbps.

Step 9 On **Attach Sites - Select Interface** window, enter the details of the Interface . This interface is used to form the tunnel to TGW.

we provide

Step 10 For the **Accelerated VPN** option, choose **Enabled** or **Disabled**. AWS Global Accelerator helps in optimized connectivity to the cloud.

Step 11 For the **Use selected interface as Preferred Path** option, chose **Enabled** or **Disabled**. Multicloud workflow will configure the selected WAN interface as the default path.

Step 12 Click **Next**.

Step 13 Click **Save and Exit**. If the configuration is successful, you see a message that indicates that the branch devices are successfully attached.

Step 14 To verify the status of the device, use the **show running cofig** command.

Step 15 To view the status of the configuration, from the Cisco SD-WAN Manager menu, choose **Configuration**> **Configuration Groups**> **Feature Profile** and click **View Details**.

Detaching Sites

To detach sites to a cloud gateway, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud** >**Cloud Gateways**. A table displays the list of cloud gateways with cloud account name, ID, cloud type, transit gateway.

Step 2 For the desired cloud gateway, click **...** and choose **Cloud Gateway**.

Step 3 Click **Attach SD-Routing**.

Step 4 Choose one or more sites from **Available Sites** and click **Detach Sites**.

The **Are you sure you want to detach sites from cloud gateway?** window appears.

Step 5 Click **OK**.

The sites attached to a cloud gateway are detached.

Step 6 To view the status of the configuration, from the Cisco SD-WAN Manager menu, choose **Configuration**> **Configuration Groups**> **Feature Profile** and click **View Details**.

Editing a Site

To edit a site, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud** >**Cloud Gateways**. A table displays the list of cloud gateways with cloud account name, ID, cloud type, transit gateway.

Step 2 For the desired cloud gateway, click **...** and choose **Cloud Gateway**.

Step 3 Click **Edit Site Details**.

Step 4 In the Edit Sife Details dialog box, enter the tunnel count.

Step 5 Enable or disable the **Accelerated VPN** field. By default, this field is **Enabled**.

Step 6 Enable or disable the **Use Select Interface as Preferred path** field. By default, this field is **Enabled**.

Step 7 Click **Submit**.

Intent Management - Connectivity

Mapping workflow in Cisco SD-WAN Manager enables connectivity between Cisco Catalyst SD-Routing VPNs (segment) and VPCs, and VPCs to VPCs. VPCs are represented based on the tags.

Note The SD-Routing branch device can have only the Default VRF. You can use this default VRF to mapping through the SD-Routing Cloud OnRamp branch connect. You cannot use any other VPN/VRF for mpping. Along with SD-Routing soluction, you can have multiple VPN mapping for SD-WAN solution. Both the Cisco SD-WAN and Cisco SD-Routing connection can co-exist.

When the system records the intent for connectivity, mapping is realized in cloud in regions where cloud gateway is present. Mapping intents can be entered without cloud gateways being present in different regions. The user mapping intent is preserved and realized when a new cloud gateway or mapping change is discovered. As and when cloud gateways get instantiated in different regions, the mapping intents are realized in those regions. Similarly, tagging operations can influence the mapping in different regions as well and mappings as per the tags are realized in the cloud.

In the Cloud OnRamp for Multicloud dashboard, click **Connectivity** under **Management**. The **Intent Management - Connectivity** window appears. The window displays the connectivity status with the following legends:

- Blank - Editable
- Grey color - System Defined
- Blue color - Intent Defined
- Green color - Intent Realized
- Red color - Intent Realized With Errors

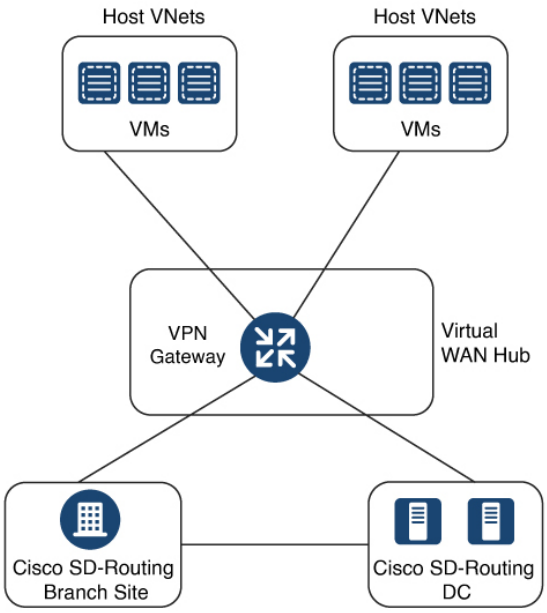
On the **Connectivity** window, you can:

- View the changes in connectivity as required.
- Filter and sort.
- Define the connectivity independent of cloud gateways in different regions.
- Realize the connectivity in regions wherever cloud gateways are present.

Azure Virtual WAN Hub Integration with Cisco SD-Routing

The integration of the Cisco Catalyst SD-Routing solution with Azure virtual WAN enhances Cloud OnRamp for Multicloud deployments and enables configuring Cisco VPN Gateway as a network virtual appliance in Azure Virtual WAN Hubs.

This integration simplifies the consumption model for cloud services because it eliminates the need to create a transit virtual network (VNet) and you can control your host VNet connectivity directly through the Azure Virtual WAN Hub. Azure Virtual WAN is a networking service that provides optimized and automated branch-to-cloud connectivity through Microsoft Azure. It enables you to connect and configure SD-Routing branch devices that can communicate with Azure. Configuring VPN Gateway inside Azure virtual hubs provides higher speeds and bandwidth and overcomes the speed and bandwidth limitation of using transit VNets.



How Virtual WAN Hub Integration Works

The connection between the SD-Routing branches and a public-cloud application is provided by an Azure VPN Gateway that is configured inside the Azure Virtual WAN hub as part of Cloud OnRamp for Multicloud SD-Routing workflow for Azure.

The Cloud OnRamp for Multicloud flow in Cisco SD-WAN Manager discovers your existing VNets in geographical cloud regions and allows you to connect select VNets to the overlay network. In such a scenario, Cloud OnRamp for Multicloud allows simple integration between legacy public-cloud connections and the Cisco Catalyst SD-Routing network.

A configuration wizard in Cisco SD-WAN Manager automates the bring-up of the Azure Virtual WAN Hub to connect with your public cloud account. The wizard also automates the connections between public-cloud applications and the users of those applications at branches in the overlay network. Using tags, Cisco SD-Routing Manager enables you to map the service default-VRF in your branches with specific VNets in your public cloud infrastructure.

VNet to VPN Mapping

The Intent Management workflow in Cisco SD-WAN Manager enables connectivity between Cisco SD-Routing default VRF (branch networks) and VNets, and VNets to VNets. You can enable both SD-Routing and SD-WAN connectivity mapping. When you enable the SD-WAN VPN, the SD-Routing VRF gets enabled by default. VNets are represented by tags created under the Discover workflow for Cloud OnRamp for

Multicloud. When you create VNet tags within an Azure region, mapping is automatically created based on the other VNets and VPNs that share the same tag.

When Cisco SD-WAN Manager records the intent for connectivity, mapping is realized in cloud in regions where the cloud gateway is present. Mapping intents can be entered without cloud gateways being present in different regions. Your mapping intent is preserved and realized when a new cloud gateway or mapping change is discovered. As and when cloud gateways get instantiated or discovered in different regions, the mapping intents are realized in those regions. Similarly, tagging operations can influence the mapping in different regions as well and mappings as per the tags are realized in the cloud.

Components of Azure Virtual WAN Integration Workflow

A cloud gateway to connect your branches and data centers to the public cloud infrastructure is a logical object that hosts Azure Virtual Hub VPN Gateways. It comprises Azure Resource Groups, Azure Virtual WAN, Azure VPN Gateway, and Azure Virtual WAN Hub.

Resource Groups

All Azure networking resources belong to a resource group and resource groups are created under Azure subscriptions. For Azure cloud gateways, Azure virtual WAN, and Azure Virtual WAN Hub are created under a resource group.

The first step to create an Azure cloud gateways is therefore to create a resource group.

After a resource group is created, you can configure Azure Virtual WAN.

Azure Virtual WAN

Azure Virtual WAN is the backbone of the Azure networking service. It's created under an existing Azure resource group. An Azure Virtual WAN can contain multiple Azure virtual hubs within it, as long as each virtual hub belongs to a different Azure region. Only one virtual hub per Azure region is supported.

After a virtual WAN has been defined under a resource group in a region, the next step is to create an Azure Virtual WAN Hub.

Azure Virtual WAN Hubs

The Azure virtual WAN Hub manages the core connectivity between your default VRF sites and VPN Gateways and VNets. Once a virtual hub is created, the VPN Gateway can be integrated into the Azure networking service.

Prerequisites for Azure

- Minimum supported releases: Cisco IOS XE Catalyst SD-Routing Release 17.13.1.
- Azure cloud account details.
- Subscription to Azure Marketplace.
- Cisco SD-WAN Manager must be connected to the internet and must be able to communicate with Microsoft Azure to authenticate your Azure account.

Limitations for Azure SD-Routing Cloud OnRamp

- Only one VPN gateway can be created for each region. However, you can create multiple NVA based cloud gateways in a single region.
- Only one resource group is permitted on the Cisco SD-WAN Manager.
- We cannot have a combination of VPN gateway and NVA based Cloud gateways in the same region.
- Audit cannot be executed when you have only VPN gateways. Audit can be executed only when you have at least one NVA based cloud gateway.

Configure Azure Virtual WAN Hubs for SD-Rourting

Use the Cloud OnRamp for Multicloud workflow in Cisco SD-WAN Manager to create Azure virtual WAN hubs to connect your Cisco Catalyst SD-Routing branche Sites to the applications in your private networks or Host VNets. To configure an Azure virtual WAN hub, perform the following tasks:

Associate your Account with Cisco SD-WAN Manager

To associate your account with Cisco SD-WAN Manager, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.

Step 2 Under **Setup**, click **Associate Cloud Account**.

Step 3 In the **Cloud Provider** field, choose **Microsoft Azure** from the drop-down list.

Step 4 Enter the requested information:

Field	Description
Cloud Account Name	Enter a name for your Azure subscription.
Description (optional)	Enter a description for the account. This field is optional.
Use for Cloud Gateway	Choose **Yes** to create a cloud gateway in your account. The option **No** is chosen by default.
Tenant ID	Enter the ID of your Azure Active Directory (AD). To find the tenant ID, go to your Azure Active Directory and click **Properties**.
Subscription ID	Enter the ID of the Azure subscription you want to use as part of this workflow.
Client ID	Enter your existing Azure application ID. See Azure documentation for more information on how to register an application in Azure AD, get the client ID and secret key, and more.
Secret Key	Enter the password associated with the client ID.

Step 5 Click **Add**.

Add and Manage Global Cloud Settings

To add and manage the global cloud settings, perform these steps:

Step 1 On the **Cloud OnRamp for Multicloud** window, click **Cloud Global Settings** in the Setup area.

Step 2 In the **Cloud Provider** field, choose **Microsoft Azure** from the drop-down list.

Step 3 To edit global settings, click **Edit**.

Step 4 To add global settings, click **Add**.

Step 5 In the **Software Image** field, choose the software image of the WAN edge device to be used in the Azure Virtual Hub.

Step 6 In the **SKU Scale** field, from the drop-down list, choose a scale based on your capacity requirements.

Step 7 In the **IP Subnet Pool** field, specify the IP subnet pool to be used for the Azure virtual WAN hub. A subnet pool needs prefixes between /16 and /24.

Step 8 In the **Autonomous System Number** field, specify the ASN to be used by the cloud gateway for eBGP peering with the virtual hub.

Step 9 For the **Push Monitoring Metrics to Azure** field, choose **Enabled** or **Disabled**. If you choose **Enabled**, the cloud gateway metrics associated with your Azure subscription are sent to the Microsoft Azure Monitoring Service portal periodically. These metrics are sent in a format prescribed by Microsoft Azure for all NVA vendors.

Step 10 Enable or disable the **Advertise Default route to Azure Virtual Hub** field. By default, this field is **Disabled**. If you click **Enabled**, the internet traffic from the virtual network is redirected through Cisco Catalyst SD-WAN branches.

Step 11 Enable or disable the **Enable Periodic Audit** field by clicking **Enabled** or **Disabled**.

If you the enable periodic audit, Cisco SD-WAN Manager triggers an automatic audit every two hours. This automatic audit takes place in the background, and a discrepancies report is generated.

Step 12 Enable or disable the **Enable Auto Correct** field by clicking **Enabled** or **Disabled**. If you enable the auto correct option, after every periodic audit is triggered, all the recoverable issues that are discovered are auto corrected.

Step 13 Click **Add** or **Update**.

Create and Manage Cloud Gateways

Creation of cloud gateways involves the instantiation or discovery of Azure Virtual WAN Hub and two Cisco VPN Gateways within the hub.

To create and manage the cloud gateways, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.

Step 2 Under **Manage**, click **Create Cloud Gateway**

Step 3 In the **Cloud Provider** field, choose **Microsoft Azure** from the drop-down list.

Step 4 In the **Cloud Gateway Name** field, enter the name of your cloud gateway.

Step 5 (Optional) In the **Description** field, enter a description for the cloud gateway.

Step 6 In the **Account Name** field, choose your Azure account name from the drop-down list.

Note . You can have only one Azure account.

Step 7 In the **Region** field, choose an Azure region from the drop-down list.

Note You have only one VPN gateway in a region. When you have a VPN gateway in a region, you cannot have a NVA gateway in the same region.

Step 8 In the **Resource Group** field, either choose a resource group from the drop-down list, or choose **Create New**.

Note If you choose to create a new Resource Group, you have to delete all the existing cloud gateways. Also, you need to create a new Azure Virtual WAN and a Azure Virtual WAN hub in the next two fields.

Step 9 In the **Virtual WAN** field, choose a Azure Virtual WAN from the drop-down list. Alternatively, click **Create New** to create a new Azure Virtual WAN.

Step 10 In the **Virtual HUB** field, choose an Azure Virtual WAN Hub from the drop-down list. Alternatively, click **Create New** to create a new Azure Virtual WAN Hub.

Step 11 In the **Solution Type** field, choose a Cisco vHub With VPN from the drop-down list.

Step 12 In the **SKU Scale Unit Size** field, choose SKU scale unit size from the drop-down list.

Step 13 Click **Add**. to deploy the VPN gateway.

Attaching a Site

To attach sites to a cloud gateway, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud** >**Cloud Gateways**. A table displays the list of cloud gateways with cloud account name, ID, cloud type, transit gateway.

For each of the cloud gateways, you can view, delete, or attach more sites.

Step 2 For the desired cloud gateway, click **...** and choose **Cloud Gateway**.

Step 3 Click **Attach SD-Routing**.

Step 4 Click **Attach Sites**.

Step 5 Click **Next**. The **Attach Sites - Select Sites** window appears. The table shows the sites with the selected WAN interface.

Step 6 Choose one or more sites from **Available Sites** and move them to **Selected Sites**.

Step 7 Click **Next**.

Step 8 On the **Attach Sites - Site Configuration** window, enter the **Tunnel Count**. The tunnel count is 1 and it gives a bandwidth of 2.5 Gbps.

Step 9 For the **Use selected interface as Preferred Path** option, chose **Enabled** or **Disabled**. Multicloud workflow will configure the selected WAN interface as the default path.

Step 10 Click **Next**.

Step 11 Click **Save and Exit**. If the configuration is successful, you see a message that indicates that the branch devices are successfully attached.

Step 12 To verify the status of the device, use the **show running cofig** command.

Step 13 To view the status of the configuration, from the Cisco SD-WAN Manager menu, choose **Configuration**> **Configuration Groups**> **Feature Profile** and click **View Details**.

Detaching Sites

To detach sites to a cloud gateway, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud** >**Cloud Gateways**. A table displays the list of cloud gateways with cloud account name, ID, cloud type, transit gateway.

Step 2 For the desired cloud gateway, click **...** and choose **Cloud Gateway**.

Step 3 Click **Attach SD-Routing**.

Step 4 Choose one or more sites from **Available Sites** and click **Detach Sites**.

The **Are you sure you want to detach sites from cloud gateway?** window appears.

Step 5 Click **OK**.

The sites attached to a cloud gateway are detached.

Step 6 To view the status of the configuration, from the Cisco SD-WAN Manager menu, choose **Configuration**> **Configuration Groups**> **Feature Profile** and click **View Details**.

Discover Host VNets and Create Tags

After you create an Azure virtual hub, you can discover your host VNets in the region of the virtual hub. To discover the host VNets and create tags, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.

Step 2 In the **Discover** workflow, click **Host Private Networks**.

Step 3 In the **Cloud Provider** field, choose **Microsoft Azure**.

Step 4 Click the **Tag Actions** drop-down list to choose any of the following:

ul

- **Add Tag:** Create a tag for a VNet or a group of VNets.
- **Edit Tag:** Change the existing tag of a selected VNet.
- **Delete Tag:** Delete the tag for the selected VNet.

Map VNets Tags and Branch Network VRF

To edit the VNet-VRF mapping for your Cisco Catalyst SD-Routing networks, follow these steps:

Before you begin

To enable VNet to VRF mapping, you select a set of VNets in one or multiple Azure regions and define a tag. You then select the default VRF that you want to map the VNets to using the same tags. Only a single set of VNets can be mapped to a single set of branch offices.

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.

Step 2 Under, **Intent Management** click **Connectivity**.

Step 3 To define the intent, click **Edit**.

Step 4 Choose the cells that correspond to a VRF and the VNet tags associated with it, and click **Save**.

The **Intent Management - Connectivity** window displays the connectivity status between the branch VRF and the VNet tags they are mapped to. A legend is available at the top of the screen to help you understand the various statuses. Click any of the cells in the matrix displayed to get a more detailed status information, such as, Mapped, Unmapped, and Outstanding mapping.

Rebalance VNets

You can choose to redistribute VNets to load balance the existing VNets among all the cloud gateways in a region for a given tag at any time. You can reassign only the VNets with **Auto** option selected across cloud gateways. The VNets assignment is based on a load-balancing algorithm. As the rebalancing involves detachment and re-attachments of VNETs to cloud gateways, traffic disruption may occur. After rebalancing the VNets, you can view the revised mapping of VNETs to cloud gateways on the tagging page.

Step 1 From the Cisco SD-WAN Manager menu, choose **Configuration > Cloud OnRamp for Multicloud**.

Step 2 In **Intent Management** workflow, click **Rebalance VNETS (Azure)**.

Step 3 In the **Cloud Provider** field, choose **Microsoft Azure**.

Step 4 In the **Region** field, choose an Azure region from the drop-down list.

Note For the Cisco 17.13.1 release, you can have only one VPN gateway for a region.

Step 5 In the **Tag Name** field, choose a tag from the drop-down list.

Step 6 Click **Rebalance**.

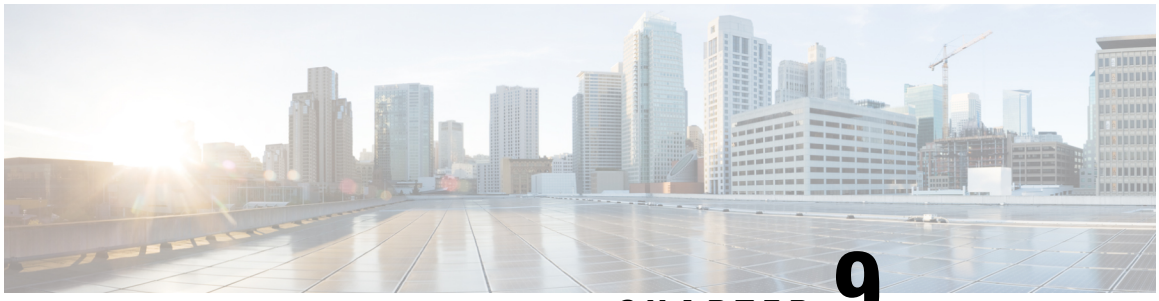
Feature Information for Cisco SD-Routing Cloud OnRamp for Multicloud

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 7: Feature Information for Cisco SD-Routing Cloud OnRamp for Multicloud

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	Cisco IOS XE Release 17.13.1a	Cisco SD-Routing Cloud OnRamp for Multicloud extends enterprise WAN to public clouds. This multicloud solution helps to integrate public cloud infrastructure into the Cisco Catalyst SD-Routing devices. With these capabilities, the devices can access the applications hosted in the cloud.



CHAPTER 9

Application Performance Monitoring on SD-Routing Devices

This chapter includes information on how to monitor application performance on SD-Routing devices. It contains the following sections:

Information about Application Performance Monitor

The Application Performance Monitor feature is a simplified framework that enables you to configure intent-based performance monitors. With this feature, you can view real-time, end-to-end application performance filtered by client segments, network segments, and server segments. This information helps you optimize application performance.

An application performance monitor is a predefined configuration that is used to collect performance metrics for specific traffic.

Key Concepts in Application Performance Monitoring

- **Monitoring Profile:** A profile is a predefined set of traffic monitors that can be enabled or disabled for a context. As part of this feature, the SD-Routing performance profile include Application Response Time (ART) aggregation monitor to monitor traffic passing through Cisco Catalyst SD-Routing interfaces. The SD-Routing performance profile has a dedicated policy to filter traffic based on your intent.
- **Context:** A context represents a performance monitor policy map that is attached to an interface for ingress and egress traffic. A context contains information about a traffic monitor that has to be enabled. When a context is attached to an interface, two policy-maps are created, one each for ingress and egress traffic. Depending on the direction specified in the traffic monitor, the policy maps are attached in that direction and the traffic is monitored.

Application Performance Monitor Workflow

You can enable performance monitor only on Direct Internet Access (DIA) interfaces. Performance is monitored for traffic going out of, and coming into the DIA interfaces. You can then view details of the application that you are monitoring using various show commands.

Prerequisites for Application Performance Monitoring

- Minimum software version for Cisco IOS XE Catalyst SD-Routing devices: Cisco IOS XE Catalyst SD-WAN Release 17.13.1a

Limitations

The limitations for Application Performance Monitor are:

- The Application Performance Monitor support only ART on the SD-Routing device.
- Only Direct Internet Access (DIA) scenario is supported in this release
- Performance monitoring is only supported on IPv4 traffic. IPv6 traffic is not supported.
- Application Performance Monitor does not support multi application-aggregation monitors on the device.
- The class-map used in APM only supports maximum two layer class-map and does not support three or more layer class-map.
- Only CLI based config group is supported on Cisco SD-WAN Manager to config APM for SD-Routing device.

Configuring Application Performance Monitor

You can enable application performance monitor on DIA interfaces and monitor the traffic metrics for ART.

Enabling Performance on DIA Interface

The following example shows how to configure a performance monitor context using the SD-Routing application-aggregation profile. This configuration enables monitoring of traffic metrics for ART and applies it to a specific interface.

```
class-map match-any APP_PERF_MONITOR_APPS_0
 match protocol attribute application-group amazon-group
 match protocol attribute application-group box-group
 match protocol attribute application-group concur-group
 match protocol attribute application-group dropbox-group
 match protocol attribute application-group google-group
 match protocol attribute application-group gotomeeting-group
 match protocol attribute application-group intuit-group
 match protocol attribute application-group ms-cloud-group
 match protocol attribute application-group oracle-group
 match protocol attribute application-group salesforce-group
 match protocol attribute application-group sugar-crm-group
 match protocol attribute application-group webex-group
 match protocol attribute application-group zendesk-group
 match protocol attribute application-group zoho-crm-group
class-map match-any APP_PERF_MONITOR_FILTERS     --- class-map max 2 layer supported, 3 or
 more layer class-map not supported for APM feature
 match class-map APP_PERF_MONITOR_APPS_0
!
```

This configuration example shows how to configure the context of performance monitor.

```
performance monitor context APP_PM_POLICY profile application-aggregation
 exporter destination local-controller source Null0
 traffic-monitor art-aggregated class-and APP_PERF_MONITOR_FILTERS interval-timeout 300
sampling-interval 100
```

This configuration example shows how to enable the performance monitor context on an interface.

```
interface GigabitEthernet1                                                    --- DIA
interface(s)
 performance monitor context APP_PM_POLICY
```

Configuring Application Performance Monitoring on SD-Routing Device

To create a configuration group, perform these steps:

Step 1 From Cisco IOS XE Catalyst SD-WAN Manager menu, choose **Configuration** > **Configuration Groups** > **Add CLI based Configuration Group** .

Step 2 In the **Add CLI based Configuration Group** pop-up dialog box, enter the configuration group name.

Step 3 Click the **Solution Type** drop-down list and select the solution type as **sd-routing** for the SD-Routing devices.

Step 4 In the **Description** field, enter a description for the feature

Step 5 Click **Next**.

Step 6 Click the **Load Running Config from Reachable Device** drop-down list and select the running configuration or add the configuration CLI in text box.

Step 7 Click **Save**

Step 8 Click **…** adjacent to the configuration group name and choose **Edit**

Step 9 Click **Associated Devices**.

Step 10 Choose one or more devices, and then click **Deploy**

Note Application Performance Monitoring does not support performance monitor context profile and flow monitor change when the performance monitor context profile and flow monitor are attached to an interface.

Step 11 Click **Configuration** > **Configuration Groups** > **Deploy**

Step 12 Click **…** adjacent to the configuration group name and choose **Edit** to modify performance monitor context profile and flow monitor and re-attach it to the interface.

Step 13 Click **Deploy**.

Step 14 Click **Save**.

Verifying Application Performance Monitor

To verify the Application Performance Monitor configuration on the SD-Routing device , use the **show performance monitor cache monitor** command.

```
Device#show performance monitor cache monitor APP_PM_POLICY-art_agg detail format record
Monitor: APP_PM_POLICY-art_agg
Data Collection Monitor:
  CAT-art-aggregated CTX:0 ID:2947958679|2000002 Epoch:0
  Max number of records:             675000
  Current record count:              7
  High Watermark:                    13
  Record added:                      14
  Record aged:                       7
  Record failed to add:              0
  Synchronized timeout (secs):       300
```

```
FLOW DIRECTION:                          Output
TIMESTAMP MONITOR START:                 14:10:00.000
FLOW OBSPOINT ID:                        4294967298
INTERFACE OVERLAY SESSION ID OUTPUT:     0
IP VPN ID:                               65535
APPLICATION NAME:                        layer7 share-point
connection server resp counter:          1477
connection to server netw delay sum:     10822  < --- SND_ samples
connection to server netw delay min:     100
connection to server netw delay max:     103
connection to client netw delay sum:     3559 < --- CND_ samples
connection to client netw delay min:     20
connection to client netw delay max:     198
connection application delay sum:        936
connection application delay min:        0
connection application delay max:        122
connection responder retrans packets:    2    <---- lost_samples
connection to server netw jitter mean:   0
connection count new:                    108      < ---- SND/CND_counts
connection server packets counter:       2018     <---- total_samples

Latency(SND  ms) = SND_ samples/ SND/CND_counts
Latency(CND  ms) = CND_ samples/ SND/CND_counts
Loss ratio = lost_samples /total_samples
```

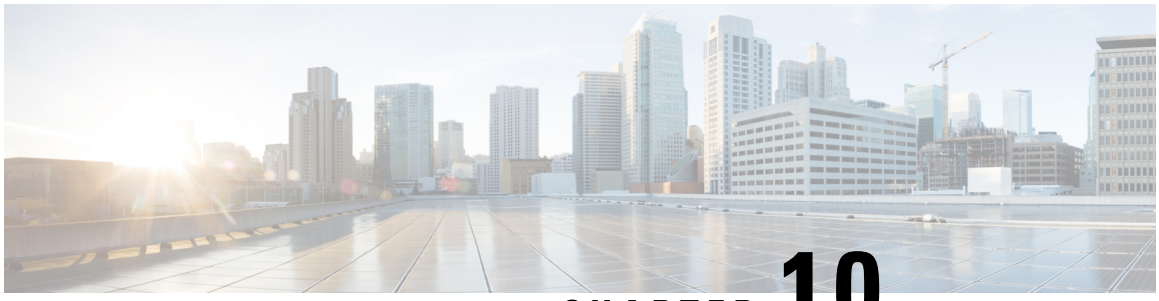
Feature Information for Application Performance Monitor

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 8: Feature Information for Application Performance Monitor

Feature Name	Releases	Feature Information
Cisco SD-Routing Application Performance Monitor	Cisco IOS XE Release 17.13.1a	The Application Performance Monitor feature introduces a simplified framework that enables you to configure intent-based performance monitors. With this framework, you can view real-time, end-to-end application performance filtered by client segments, network segments, and network segments.



CHAPTER 10

Flexible NetFlow Application Visibility on SD-Routing Devices

This chapter includes information on how to configure Flexible NetFlow Application Visibility on SD-Routing devices. It contains the following sections:

Flexible NetFlow Application Visibility on SD-Routing Devices

This chapter includes information on how to configure Flexible NetFlow Application Visibility on SD-Routing devices. It contains the following sections:

Information About Flexible Netflow Application Visibility

The Flexible NetFlow (FNF) provides statistics on packets flowing through the device. The FNF on WAN or LAN interfaces provide visibility for all the traffic (both ingress and egress) hitting the WAN or LAN interfaces on Cisco SD-Routing devices by using the Application Intelligence Engine (SAIE). The Application Intelligence Engine flow provides the ability to look into the packet past the basic header information. The SAIE flow determines the contents of a particular packet, and then either records that information for statistical purposes or performs an action on the packet.

Note You can apply FNF only on WAN or LAN interfaces. You should not apply on both WAN and LAN interfaces.

To enable t he Flexible Netflow Application Visibility on the device, you must enable the flow data aggregation using Cisco SD-WAN Manager in the following ways:

- Performance monitor context profile (recommended method)
- Flow exporter to local controller

Note If you have a existed FNF monitors, to avoid performance impact by adding a new performance monitor, add the flow exporter to local controller as flow exporter of existed FNF monitor. Otherwise, you can use the performance monitor context profile.

Prerequisites for Flexible NetFlow Application Visibility with SAIE Flows

The following are the prerequisites:

- Ensure that the device run the Cisco IOS XE 17.13.1a image.
- Ensure that you enable flow data aggregation in Cisco SD-WAN Manager.

Limitations

The following are the limitations:

- Only Aggregated statistics by Cisco SD-WAN Application Intelligence Engine (SAIE) is suppotted.
- On-demand troubleshooting is not supported.
- If context profile and FNF exporter uses the same name, the **show flow exporter name** command will display only one of them.
- The performance monitor context profile and flow exporter to local controller can only use either the context profile or flow exporter to local controller. Otherwise, it will dobule count the packets.
- Only CLI based configuration group is supported.

Enabling Flexible NetFlow Application Visibility

You can enahle the FNF Application Visibility either using the context profile or flow exporter on the device.

Configuring Context Profile Option-1

It is recommended to use this option. This example shows how to enable flow data aggregation using Context Profile on the device:

```
performance monitor context FNF profile app-visibility
 exporter destination local-controller source Null0
 traffic-monitor app-visibility-stats

interface GigabitEthernet5
 performance monitor context FNF
```

Device will apply this profile to FNF flow monitor when it is attached to an interface.

Configuring Flow Exporter Option-2

This example shows how to enable flow data aggregation using Flow Exporter on the device:

```
flow exporter fnf-1
 destination local controller
 export-protocol ipfix
 template data timeout 300
 option interface-table timeout 300
 option vrf-table timeout 300
 option application-table timeout 300
 option application-attributes timeout 300

flow record fnf-app-visiblility
 match routing vrf input
 match interface input
 match interface output
 match application name
 collect counter bytes long
 collect counter packets long

flow monitor fnf-app-visiblility
 exporter fnf-1
 cache timeout inactive 10
 cache timeout active 60
 cache entries 5000
 record fnf-app-visiblility

interface GigabitEthernet5
 ip flow monitor fnf-app-visiblility input
 ip flow monitor fnf-app-visiblility output
 ipv6 flow monitor fnf-app-visiblility input
 ipv6 flow monitor fnf-app-visiblility output
```

Configuring Flexible NetFlow Application Visibility

To configure FNF Application Visibility, on the SD-Routing device, perform these steps:

Step 1 From Cisco IOS XE Catalyst SD-WAN Manager menu, choose **Configuration** > **Configuration Groups** > **Add CLI based Configuration Group** .

Step 2 In the **Add CLI configuration Group** pop-up dialog box, enter the configuration group name.

Step 3 Click the **Solution Type** drop-down list and select the solution type as **sd-routing** for the SD-Routing devices.

Step 4 In the **Description** field, enter a description for the feature

Step 5 Click **Next**

The new configuration group page is displayed with the Feature Profiles and Associated Device tabs.

Step 6 In the **Feature Profiles** section, add the corresponding configuration.

Step 7 Click **Save** to save the configuration.

Step 8 Click **(…)** adjacent to the configuration group name and choose **Edit**

Step 9 Click **Associated Devices**.

Step 10 Choose one or more devices, and then click **Deploy**

Note Flexible Netflow does not support performance monitor context profile and flow monitor change when the performance monitor context profile and flow monitor are attached to an interface.

Step 11 Click **Configuration** > **Configuration Groups** > **Deploy**

Step 12 Click **(…)** adjacent to the configuration group name and choose **Edit** to modify performance monitor context profile and flow monitor and re-attach it to the interface.

Step 13 Click **Deploy**.

Step 14 Click **Save**.

Verifying Flexible NetFlow Application Visibility Using Cisco SD-WAN Manager

To verify the FNF Application Visibility, perform the following steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices** and select a SD-Routing device from the list.

Step 2 In the left pane, choose **SAIE Applications**> **Fliter**.

Step 3 In the **Filter By** dialog box, select the VPN.

Step 4 For the Traffic Source, check either the **LAN** or **Remote Access** check box.

Step 5 Click **Search** to search the flow records based on the selected filters.

The flow records are displayed.

Step 6 Click **Export** to export the flow records to your local system.

Step 7 Click **Reset All** to reset all the search filters.

Verifying Flexible NetFlow Application Visibility

To check the basic network metrics that are used to calculate the the SD-Routing FNF application visibility, use the **show performance monitor context** [profile name] **configuration**, **show platform sofware td-l database content dta fnf-statistics**, and **show performance monitor context fnf traffic monitoring app-visibility-stats cache** commands.

```
Device #show performance monitor context fnf configuration
!==============================================================================
! Equivalent Configuration of Context fnf !
!==============================================================================
!Exporters
!==========
!
flow exporter fnf-1
description performance monitor context fnf exporter
destination local controller
export-protocol ipfix
template data timeout 300
option interface-table timeout 300 export-spread 0
option vrf-table timeout 300 export-spread 0
option application-table timeout 300 export-spread 0
option application-attributes timeout 300 export-spread 0
!
!Access Lists
!=============
```

```
!Class-maps
!===========
!Samplers
!=========
!Records and Monitors
!=====================
!
flow record fnf-app-visiblility-v4
description ezPM record
match routing vrf input
match interface input
match interface output
match application name
collect counter bytes long
collect counter packets long
!
!
flow monitor fnf-app-visiblility-v4
description ezPM monitor
exporter fnf-1
cache timeout inactive 10
cache timeout active 60
cache entries 5000
record fnf-app-visiblility-v4
!
!
flow record fnf-app-visiblility-v6
description ezPM record
match routing vrf input
match interface input
match interface output
match application name
collect counter bytes long
collect counter packets long
!
!
flow monitor fnf-app-visiblility-v6
description ezPM monitor
exporter fnf-1
cache timeout inactive 10
cache timeout active 60
cache entries 5000
record fnf-app-visiblility-v6
!
!Interface Attachments
!======================
interface GigabitEthernet5
ip flow monitor fnf-app-visiblility-v4 input
ip flow monitor fnf-app-visiblility-v4 output
ipv6 flow monitor fnf-app-visiblility-v6 input
ipv6 flow monitor fnf-app-visiblility-v6 output
```

```
Device# show performance context fnf traffic-monitor app-visibility stats cache
Monitor fnf-app-visibility-v4

Cache  type:                           Normal (platform cache)
Cache  size :                               10000
Current entries:                             2
High Watermark:                              4

Flows added:                                 6
Flows aged:                                  4
 - Inactive timeout           (10sec)        4

IP VRF  ID INPUT  INFE INPUT  INTF OUTPUT  APP Name           bytese long   pkts long
```

```
======  =======   =========   ===========  ================    ===========  ==========
1         (1)       Gi3         Gi5         layer7 share-point  1517476       3277
1         (1)       Gi5         Gi3        layer7 share-point  1306568       3463
```

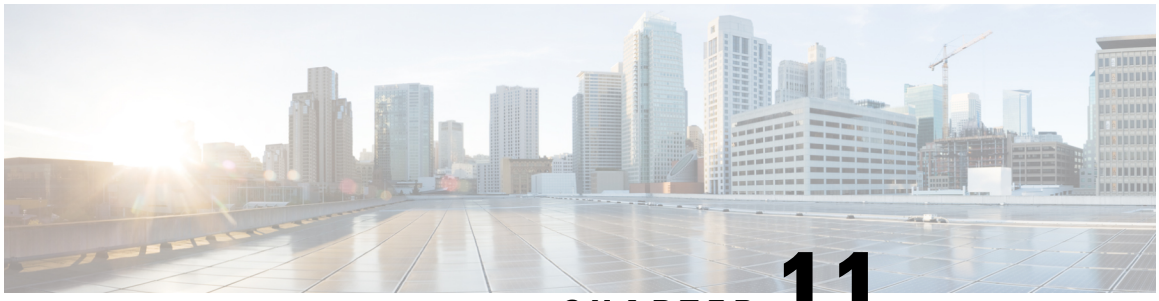
Feature Information for Flexible NetFlow Application Visibility on SD-Routing Devices

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 9: Feature Information for Flexible NetFlow Application Visibility on SD-Routing Devices

Feature Name	Releases	Feature Information
Flexible NetFlow Application Visibility on SD-Routing Devices	Cisco IOS XE Release 17.13.1a	The Flexible NetFlow (FNF) feature provides statistics on packets flowing through the device and helps to identify the tunnel or service VPNs. Also, it provides visibility for all the traffic that passes through the VPN0 on Cisco SD-Routing devices by using the SD-Routing Application Intelligence Engine (SAIE).



CHAPTER 11

SD-Routing Configuration Group

This chapter includes information on how to configure the SD-Routing Configuration Group. It contains the following sections:

Information About Configuration Groups

The Configuration Group feature provides a simple, reusable, and structured approach for configuring the SD-Routing device using Cisco Catalyst SD-WAN manager.

- **Configuration Group:** A configuration group is a logical grouping of features or configurations that can be applied to one or more devices in the network managed by Cisco Catalyst SD-WAN Manager. You can define and customize this grouping based on your business needs.
- **Feature Profile:** A feature profile is a flexible building block of configurations that can be reused across different configuration groups. You can create profiles based on features that are required, recommended, or uniquely used, and then put together the profiles to complete a device configuration.
- **Feature Parcels:** Features are the individual capabilities you want to share across different configuration groups.

Configuration Group Workflow

The Configuration Group feature enables you to do the following:

- Create a configuration group
- Associate the confiiguration group with the device
- Deploy the configuration group on the device

Prerequisites for Configuration Groups

- Minimum software version for Cisco IOS XE Catalyst SD-Routing devices: Cisco IOS XE Release 17.13.1.

Creating a Configuration Group

To create a configuration group, perform these steps:

Step 1 From Cisco IOS XE Catalyst SD-WAN Manager menu, choose **Configuration** > **Configuration Groups** > **Add CLI based Configuration Group** .

Step 2 In the Add CLI Group pop-up dialog box, enter the confiration group name.

Step 3 Click the **Solution Type** drop-down list and select the solution type as **sd-routing** for the SD-Routing devices.

Step 4 In the **Description** field, enter a description for the feature.

Step 5 Click **Create**.

The new configuration group page is displayed with the Feature Profiles and Associated Device tabs.

Step 6 In the Feature Profiles tab, do the following:

a) Click **Load Running Config from Reachable Device** from the drop-down list and select the System-IP of the device for which you want to build the configuration. You can edit the configuration based on the requirement in the Preview text box.

OR

b) Click **Import Config Files** form top-right corner and choose the configuration files that you want to apply on the device.

OR

c) Enter the configuration in the **Config Preview** text box.

Step 7 Click **Save** to save the configuration.

Associating a SD-Routing Device with the Configuration Group

After you create the configuration group, you can associate a device with the configuration group. To associate a device with the configuration group, perform these steps:

Step 1 From Cisco SD-WAN Manager menu, choose **Configuration** > **Configuration Groups**.

Step 2 Click **(…)** adjacent to the configuration group name and choose **Edit**.

Step 3 Click **Associated Devices**, and then choose the device that you want to associate.

Step 4 Click **Save**.

Deploying the SD-Routing Device

After you associate the configuration group with the device, you can deploy the device . To deploy a SD-Routing device with the configuration group, perform these steps:

Step 1 From Cisco SD-WAN Manager menu, choose **Configuration** > **Configuration Groups**.
Step 2 Click **(…)** adjacent to the configuration group name and choose **Edit**.
Step 3 Click **Associated Devices**.
Step 4 Choose one or more devices, and then click **Deploy**.
Step 5 In the Add and Review Configuration page, you can edit the variable.
Step 6 Click **Apply**.
Step 7 In the Summary page, click **Preview CLI** to preview the configuration.
Step 8 Click **Save**.

Removing the SD-Routing Devices from a Configuration Group

To remove a SD-Routing device from a configuration group, perform these steps:

Step 1 From Cisco SD-WAN Manager menu, choose **Configuration** > **Configuration Groups**.
Step 2 Click **(…)** adjacent to the configuration group name and choose **Edit**.
Step 3 Click **Associated Devices**.
Step 4 In the **Devices** table, choose the devices that you want to remove from the configuration group.
Step 5 Click **Remove Devices**.

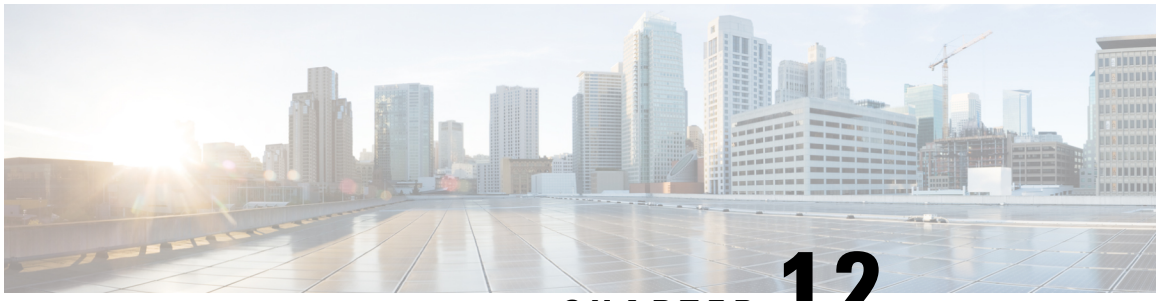
Feature Information for SD-Routing Configuration Group

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 10: Feature Information for SD-Routing Configuration Group

Feature Name	Releases	Feature Information
SD-Routing Configuration Group	Cisco IOS XE Release 17.13.1a	The SD-Routing Configuration Group feature provides a simple, reusable, and structured method to configure the SD-Routing device using Cisco Catalyst SD-WAN Manager.



CHAPTER 12

Packet Capture on SD-Routing Devices

This chapter includes information on how to configure the packet capture on the SD-Routing devices. It contains the following sections:

Information about Packet Capture

The Packet Capture feature allows you to capture and analyze traffic on the SD-Routing devices. You can initiate a packet capture by selecting the target interface under the selected VRF. Also, you can set simple traffic filter by specifying the Source IP address, Destination IP address, Layer 4 protocol number and so on.

Configuring Packet Capture

Prerequisites

- Minimum software version for Cisco IOS XE Catalyst SD-Routing devices: Cisco IOS XE Catalyst SD-WAN Release 17.13.1.
- Ensure that the data stream is enabled from **Administration** > **settings** page.

Limitations

The limitations are:

- xDSL (ATM/Ethernet interface) is not supported.
- The Dynamic virtual-access interfaces are only support with FlexVPN.
- Loopback interface is not supported
- BDI and Layer 2 EFP/Service instance interfaces are not supported.

Configuring Packet Capture

To configure the packet capture, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 To choose a device, click the device name in the **Hostname** column.

Step 3 Click **Troubleshooting** in the left pane and click **Packet Capture**.

Step 4 In the **VPN** field, choose the VPN for filtering the interfaces.

Step 5 In the **Interface corresponding to the VPN**field, choose the target interface to capture the packets.

Step 6 (Optional) Click **Traffic Filters** to configure filters to capture only relevant traffic, which helps to reduces the load on the network and makes it easier to analyze specific packets.

a) In the **Source IP** field, enter the source IP address of the device to capture packet.

b) In the **Destination IP** field, enter the destination IP address of the device to capture packet.

c) In the **Source Port** field, enter the number of the source port.

d) In the **Destination Port** field, enter the number of the destination port.

Note The Source and Destination ports are applicable only when the protocol is 6 (TCP) or 17 (UDP).

e) Use the **toggle** button to enable the **Bidirectional** filter and filter both the Source IP and Destination IP traffic.

Step 7 Click **Start**.

The Cisco SD-WAN Manager starts to capture the packets with the filters specified.

Step 8 You can stop the packet capture using the **Force Stop** or using time out option. Also, when you have captured 5MB of packets, the packet capture stops automatically.

Step 9 Click the **Download** icon to download the Packet Capture file to your system.

Note Do not refresh or navigate away from the Packet Capture page during the packet capturing process is running.

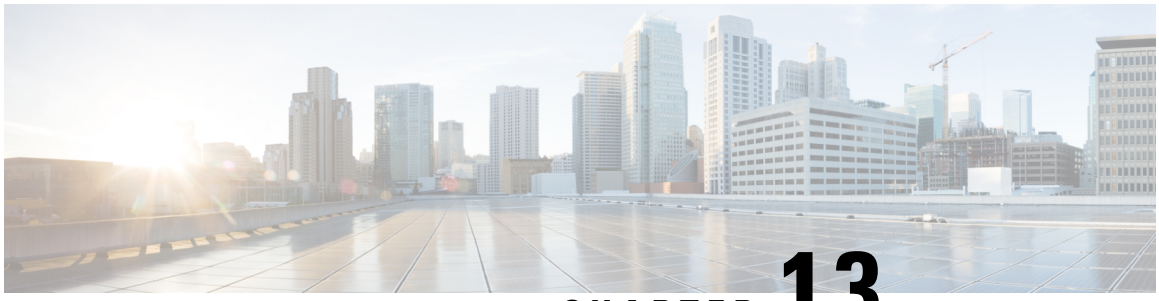
Feature Information for Packet Capture for SD-Routing

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 11: Feature Information for Packet Capture for SD-Routing

Feature Name	Releases	Feature Information
Packet Capture for SD-Routing	Cisco IOS XE Release 17.13.1a	This feature allows you to configure options to capture the bidirectional IPv6 traffic data to troubleshoot connectivity on the SD-Routing devices.



CHAPTER 13

Packet Capture on SD-Routing Devices

This chapter includes information on how to configure the packet capture on the SD-Routing devices. It contains the following sections:

Information about Packet Capture

The Packet Capture feature allows you to capture and analyze traffic on the SD-Routing devices. You can initiate a packet capture by selecting the target interface under the selected VRF. Also, you can set simple traffic filter by specifying the Source IP address, Destination IP address, Layer 4 protocol number and so on.

Configuring Packet Capture

Prerequisites

- Minimum software version for Cisco IOS XE Catalyst SD-Routing devices: Cisco IOS XE Catalyst SD-WAN Release 17.13.1.
- Ensure that the data stream is enabled from **Administration** > **settings** page.

Limitations

The limitations are:

- xDSL (ATM/Ethernet interface) is not supported.
- The Dynamic virtual-access interfaces are only support with FlexVPN.
- Loopback interface is not supported
- BDI and Layer 2 EFP/Service instance interfaces are not supported.

Configuring Packet Capture

To configure the packet capture, perform these steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Step 2 To choose a device, click the device name in the **Hostname** column.

Step 3 Click **Troubleshooting** in the left pane and click **Packet Capture**.

Step 4 In the **VPN** field, choose the VPN for filtering the interfaces.

Step 5 In the **Interface corresponding to the VPN**field, choose the target interface to capture the packets.

Step 6 (Optional) Click **Traffic Filters** to configure filters to capture only relevant traffic, which helps to reduces the load on the network and makes it easier to analyze specific packets.

a) In the **Source IP** field, enter the source IP address of the device to capture packet.

b) In the **Destination IP** field, enter the destination IP address of the device to capture packet.

c) In the **Source Port** field, enter the number of the source port.

d) In the **Destination Port** field, enter the number of the destination port.

Note The Source and Destination ports are applicable only when the protocol is 6 (TCP) or 17 (UDP).

e) Use the **toggle** button to enable the **Bidirectional** filter and filter both the Source IP and Destination IP traffic.

Step 7 Click **Start**.

The Cisco SD-WAN Manager starts to capture the packets with the filters specified.

Step 8 You can stop the packet capture using the **Force Stop** or using time out option. Also, when you have captured 5MB of packets, the packet capture stops automatically.

Step 9 Click the **Download** icon to download the Packet Capture file to your system.

Note Do not refresh or navigate away from the Packet Capture page during the packet capturing process is running.

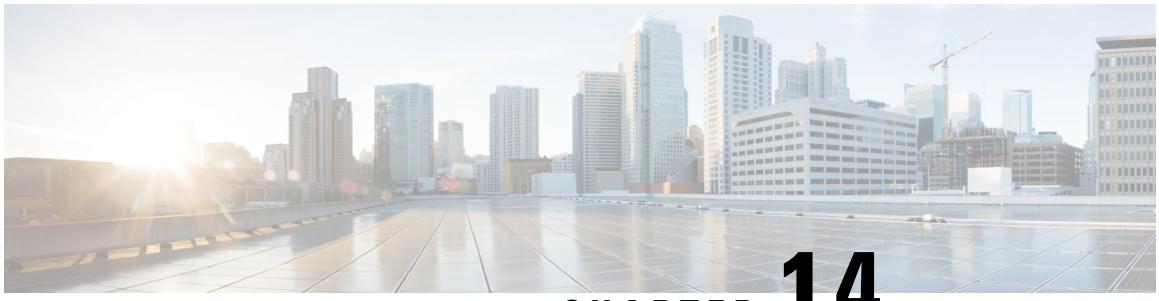
Feature Information for Packet Capture for SD-Routing

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 12: Feature Information for Packet Capture for SD-Routing

Feature Name	Releases	Feature Information
Packet Capture for SD-Routing	Cisco IOS XE Release 17.13.1a	This feature allows you to configure options to capture the bidirectional IPv6 traffic data to troubleshoot connectivity on the SD-Routing devices.



CHAPTER 14

Speed Test on SD-Routing Devices

This chapter includes information on how to configure the speed test on the SD-Routing devices. It contains the following sections:

Speed Test on SD-Routing Devices

This chapter includes information on how to configure the speed test on the SD-Routing devices. It contains the following sections:

Information About Speed Test

Internet speed test: Cisco SD-WAN Manager tests the network speed. Cisco SD-WAN Manager designates the device as the client site and the iperf3 server as the remote site. You can specify the IP address (or domain name) and port number for an iperf3 server.

The speed tests measure upload speed from the source device to the selected or specified iperf3 server, and measure download speed from the iperf3 server to the source device.

Prerequisites for Speed Test

Speed testing requires the device host name of the target device. Also, you must enable Data Stream. To enable data stream go to **Settings** page and choosing **Settings** > **Data Stream**.

Run Internet Speed Test

To run a speed test, perform the following:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

2. To choose a device, click the device name in the **Hostname** column.
3. Click **Troubleshooting** in the left pane.
4. In the **Connectivity** area, click **Speed Test**.
5. Specify the following:
   - **Source Interface**: From the drop-down list, choose the source interface on the local device.
   - **Destination Device**: From the drop-down list, choose **Internet**.
   - **iPerf3 Server**: (Optional) Enter the domain name or iPerf3 server's IP address in IPv4 format.
   - **Server Port Range**: (Optional) Enter the server port or a port range. For example, 5201, 5210, or 5201-5205.
6. Click **Start Test**.

   The speed test result is displayed.

Verify Speed Test

After you successfully execute the speed test, the following details are displayed on the **Speed Test** page:

- The middle part of the right pane reports the results of the speed test.
- The clock reports the recently obtained circuit speed results.
- When measuring the uploading speed, packets are sent from the source device to the iPerf3 server, and the source device receives acknowledgments from the destination.

  When measuring the downloading speed, packets are sent from the iPerf3 server to the source device, and the destination device receives acknowledgments from the source.

Troubleshooting Speed Test Issues

The following table provides troubleshooting information for speed testing:

Table 13: Troubleshooting Scenarios

Error Information	Possible Root Cause
Failed to resolve iperf server address	DNS server is not configured at edge device or is unable to resolve the iperf server from the configured DNS server at edge device.
Speed test servers not reachable	The speed test server ping failed. The edge device cannot reach the server IP.
iPerf client: unable to connect stream: Resource temporarily unavailable	Unable to connect to the speed test server. Access may be blocked by access-control list (ACL) permissions.
iPerf client: unable to connect to server	The iPerf3 server is not providing the test service at the user-specified port or default port 5201.

Error Information	Possible Root Cause
Device Error: Speed test in progress	The selected source or destination device is performing a speed test and cannot start a new one.
Device error: Failed to read server configuration	The data stream configuration is missing. Workaround: Running a CLI command at the SD-Routing device and clearing the SD-Rounting control connections can fix the issue.
Speed test session has timed out	The speed test has not successfully completed in 180 seconds. This might be because the SD-Rouring device has lost the control connection to Cisco SD-WAN Manager during the speed testing.

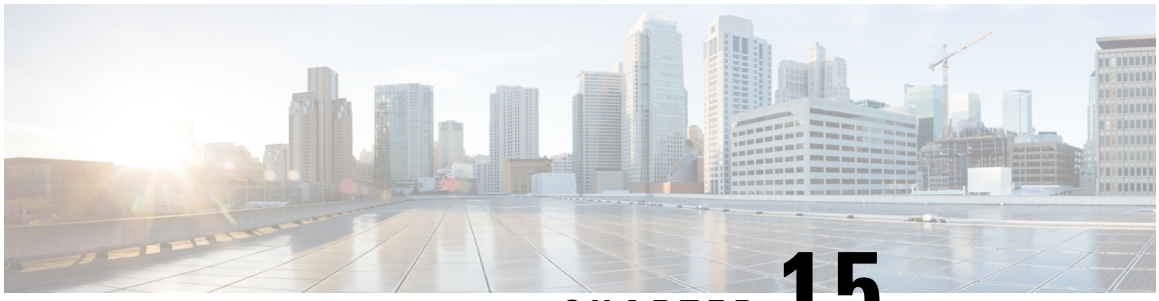
Feature Information for Speed Test on SD-Routing Devices Using Cisco SD-WAN Manager

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 14: Feature Information for Speed Test on SD-Routing Devices Using Cisco SD-WAN Manager

Feature Name	Release Information	Description
Speed Test	Cisco IOS XE 17.13.1	Cisco SD-WAN Manager allows you to measure the network speed and available bandwidth between a device and an iPerf3 server. The speed tests measure upload and download speed from the source device to the destination device.



CHAPTER 15

Using Cisco IOS XE Software

This chapter provides information to prepare you to configure the Cisco Catalyst 8500 Series Edge Platforms:

Accessing the CLI Using a Router Console

The following sections describe how to access the command-line interface (CLI) using a directly-connected console or by using Telnet or a modem to obtain a remote console:

Accessing the CLI Using a Directly-Connected Console

This section describes how to connect to the console port on the router and use the console interface to access the CLI.

The console port on a Cisco Catalyst 8500 Series Edge Platforms is an EIA/TIA-232 asynchronous, serial connection with no flow control and an RJ-45 connector. The console port is located on the front panel of each Route Processor (RP).

Connecting to the Console Port

To connect to the console port, complete the following steps:

SUMMARY STEPS

1. Configure your terminal emulation software with the following settings:
2. Connect to the port using the RJ-45-to-RJ-45 cable and RJ-45-to-DB-25 DTE adapter or using the RJ-45-to-DB-9 DTE adapter (labeled “Terminal”).

DETAILED STEPS

Step 1 Configure your terminal emulation software with the following settings:

- 9600 bits per second (bps)
- 8 data bits
- No parity
- 1 stop bit
- No flow control

Step 2 Connect to the port using the RJ-45-to-RJ-45 cable and RJ-45-to-DB-25 DTE adapter or using the RJ-45-to-DB-9 DTE adapter (labeled “Terminal”).

Using the Console Interface

Every RP on a Cisco Catalyst 8500 Series Edge Platforms has a console interface. Notably, a standby RP can be accessed using the console port in addition to the active RP in a dual RP configuration.

To access the CLI using the console interface, complete the following steps:

SUMMARY STEPS

1. After you attach the terminal hardware to the console port on the router and you configure your terminal emulation software with the proper settings, the following prompt appears:
2. Press **Return** to enter user EXEC mode. The following prompt appears:
3. From user EXEC mode, enter the **enable** command as shown in the following example:
4. At the password prompt, enter your system password. If an enable password has not been set on your system, this step may be skipped.The following example shows entry of the password enablepass:
5. When your enable password is accepted, the privileged EXEC mode prompt appears:
6. You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.
7. To exit the console session, enter the **quit** command as shown in the following example:

DETAILED STEPS

Step 1 After you attach the terminal hardware to the console port on the router and you configure your terminal emulation software with the proper settings, the following prompt appears:

Example:

```
Press RETURN to get started.
```

Step 2 Press **Return** to enter user EXEC mode. The following prompt appears:

Example:

```
Router>
```

Step 3 From user EXEC mode, enter the **enable** command as shown in the following example:

Example:

```
Router> enable
```

Step 4 At the password prompt, enter your system password. If an enable password has not been set on your system, this step may be skipped.The following example shows entry of the password enablepass:

Example:

```
Password: enablepass
```

Step 5 When your enable password is accepted, the privileged EXEC mode prompt appears:

Example:

```
Router#
```

Step 6 You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 7 To exit the console session, enter the **quit** command as shown in the following example:

Example:

```
Router# quit
```

Accessing the CLI from a Remote Console Using Telnet

This section describes how to connect to the console interface on a router using Telnet to access the CLI.

Preparing to Connect to the Router Console Using Telnet

Before you can access the router remotely using Telnet from a TCP/IP network, you need to configure the router to support virtual terminal lines (vtys) using the **line vty** global configuration command. You also should configure the vtys to require login and specify a password.

Note To prevent disabling login on the line, be careful that you specify a password with the **password** command when you configure the **login** line configuration command. If you are using authentication, authorization, and accounting (AAA), you should configure the **login authentication** line configuration command. To prevent disabling login on the line for AAA authentication when you configure a list with the **login authentication** command, you must also configure that list using the **aaa authentication login** global configuration command. For more information about AAA services, see the *Cisco IOS XE Security Configuration Guide,* and the *Cisco IOS Security Command Reference Guide* .

In addition, before you can make a Telnet connection to the router, you must have a valid host name for the router or have an IP address configured on the router. For more information about requirements for connecting to the router using Telnet, information about customizing your Telnet services, and using Telnet key sequences, see the *Cisco IOS Configuration Fundamentals Configuration Guide.*

Using Telnet to Access a Console Interface

To access a console interface using Telnet, complete the following steps:

SUMMARY STEPS

1. From your terminal or PC, enter one of the following commands:
2. At the password prompt, enter your login password. The following example shows entry of the password mypass:
3. From user EXEC mode, enter the **enable** command as shown in the following example:
4. At the password prompt, enter your system password. The following example shows entry of the password enablepass:
5. When the enable password is accepted, the privileged EXEC mode prompt appears:
6. You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.
7. To exit the Telnet session, use the **exit** or **logout** command as shown in the following example:

DETAILED STEPS

Step 1 From your terminal or PC, enter one of the following commands:

- **connect** *host* [*port*] [*keyword*]
- **telnet** *host* [*port*] [*keyword*]

In this syntax, *host* is the router hostname or an IP address, *port* is a decimal port number (23 is the default), and *keyword* is a supported keyword. For more information, see the *Cisco IOS Configuration Fundamentals Command Reference Guide* .

Note If you are using an access server, then you will need to specify a valid port number such as **telnet 172.20.52.40 2004**, in addition to the hostname or IP address.

The following example shows the **telnet** command to connect to the router named router:

Example:

```
unix_host% telnet router
Trying 172.20.52.40...
Connected to 172.20.52.40.
Escape character is '^]'.
unix_host% connect
```

Step 2 At the password prompt, enter your login password. The following example shows entry of the password mypass:

Example:

```
User Access Verification
Password: mypass
```

Note If no password has been configured, press **Return**.

Step 3 From user EXEC mode, enter the **enable** command as shown in the following example:

Example:

```
Router> enable
```

Step 4 At the password prompt, enter your system password. The following example shows entry of the password enablepass:

Example:

```
Password: enablepass
```

Step 5 When the enable password is accepted, the privileged EXEC mode prompt appears:

Example:

```
Router#
```

Step 6 You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 7 To exit the Telnet session, use the **exit** or **logout** command as shown in the following example:

Example:

```
Router# logout
```

Using Keyboard Shortcuts

Commands are not case sensitive. You can abbreviate commands and parameters if the abbreviations contain enough letters to be different from any other currently available commands or parameters.

The following table lists the keyboard shortcuts for entering and editing commands.

Table 15: Keyboard Shortcuts

Keystrokes	Purpose
Ctrl-B or the **Left Arrow** key[1]	Move the cursor back one character
Ctrl-F orthe **Right Arrow** key1	Move the cursor forward one character
Ctrl-A	Move the cursor to the beginning of the command line
Ctrl-E	Move the cursor to the end of the command line
Esc B	Move the cursor back one word
Esc F	Move the cursor forward one word

[1] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Using the History Buffer to Recall Commands

The history buffer stores the last 20 commands you entered. History substitution allows you to access these commands without retyping them, by using special abbreviated commands.

The following table lists the history substitution commands.

Table 16: History Substitution Commands

Command	Purpose
Ctrl-P or the **Up Arrow** key[2]	Recall commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Ctrl-N or the **Down Arrow** key1	Return to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the **Up Arrow** key.
Router# **show history**	While in EXEC mode, list the last several commands you have just entered.

[2] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Understanding the Command Mode

The command modes available in the traditional Cisco IOS CLI are exactly the same as the command modes available in Cisco IOS XE.

You use the CLI to access Cisco IOS XE software. Because the CLI is divided into many different modes, the commands available to you at any given time depend on the mode that you are currently in. Entering a question mark (**?**) at the CLI prompt allows you to obtain a list of commands available for each command mode.

When you log in to the CLI, you are in user EXEC mode. User EXEC mode contains only a limited subset of commands. To have access to all commands, you must enter privileged EXEC mode, normally by using a password. From privileged EXEC mode, you can issue any EXEC command—user or privileged mode—or you can enter global configuration mode. Most EXEC commands are one-time commands. For example, **show** commands show important status information, and **clear** commands clear counters or interfaces. The EXEC commands are not saved when the software reboots.

Configuration modes allow you to make changes to the running configuration. If you later save the running configuration to the startup configuration, these changed commands are stored when the software is rebooted. To enter specific configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and a variety of other modes, such as protocol-specific modes.

ROM monitor mode is a separate mode used when the Cisco IOS XE software cannot load properly. If a valid software image is not found when the software boots or if the configuration file is corrupted at startup, the software might enter ROM monitor mode.

The following table describes how to access and exit various common command modes of the Cisco IOS XE software. It also shows examples of the prompts displayed for each mode.

Table 17: Accessing and Exiting Command Modes

Command Mode	Access Method	Prompt	Exit Method
User EXEC	Log in.	`Router>`	Use the **logout** command.
Privileged EXEC	From user EXEC mode, use the **enable** EXEC command.	`Router#`	To return to user EXEC mode, use the **disable** command.
Global configuration	From privileged EXEC mode, use the **configure terminal** privileged EXEC command.	`Router(config)#`	To return to privileged EXEC mode from global configuration mode, use the **exit** or **end** command.
Interface configuration	From global configuration mode, specify an interface using an **interface** command.	`Router(config-if)#`	To return to global configuration mode, use the **exit** command. To return to privileged EXEC mode, use the **end** command.
Diagnostic	The router boots up or accesses diagnostic mode in the following scenarios: In some cases, diagnostic mode will be reached when the IOS process or processes fail. In most scenarios, however, the router will. A user-configured access policy was configured using the **transport-map** command that directed the user into diagnostic mode. See the Chapter 4, "Console Port, Telnet, and SSH Handling" of this book for information on configuring access policies. The router was accessed using a Route Processor auxiliary port. A break signal (**Ctrl-C**, **Ctrl-Shift-6**, or the **send break** command) was entered and the router was configured to go into diagnostic mode when the break signal was received.	`Router(diag)#`	If the IOS process failing is the reason for entering diagnostic mode, the IOS problem must be resolved and the router rebooted to get out of diagnostic mode. If the router is in diagnostic mode because of a transport-map configuration, access the router through another port or using a method that is configured to connect to the Cisco IOS CLI. If the router is accessed through the Route Processor auxiliary port, access the router through another port. Accessing the router through the auxiliary port is not useful for customer purposes anyway.
ROM monitor	From privileged EXEC mode, use the **reload** EXEC command. Press the **Break** key during the first 60 seconds while the system is booting.	`>`	To exit ROM monitor mode, use the **continue** command.

Getting Help

Entering a question mark (**?**) at the CLI prompt displays a list of commands available for each command mode. You can also get a list of keywords and arguments associated with any command by using the context-sensitive help feature.

To get help specific to a command mode, a command, a keyword, or an argument, use one of the commands listed in the following table:

Table 18: Help Commands and Purpose

Command	Purpose
help	Provides a brief description of the help system in any command mode.
abbreviated-command-entry?	Provides a list of commands that begin with a particular character string. (No space between command and question mark.)
abbreviated-command-entry<Tab>	Completes a partial command name.
?	Lists all commands available for a particular command mode.
command ?	Lists the keywords or arguments that you must enter next on the command line. (Space between command and question mark.)

Finding Command Options

This section provides an example of how to display syntax for a command. The syntax can consist of optional or required keywords and arguments. To display keywords and arguments for a command, enter a question mark (**?**) at the configuration prompt or after entering part of a command followed by a space. The Cisco IOS XE software displays a list and brief description of available keywords and arguments. For example, if you were in global configuration mode and wanted to see all the keywords or arguments for the **arap** command, you would type **arap ?**.

The <cr> symbol in command help output stands for "carriage return." On older keyboards, the carriage return key is the Return key. On most modern keyboards, the carriage return key is the Enter key. The <cr> symbol at the end of command help output indicates that you have the option to press **Enter** to complete the command and that the arguments and keywords in the list preceding the <cr> symbol are optional. The <cr> symbol by itself indicates that no more arguments or keywords are available and that you must press **Enter** to complete the command.

The following table shows examples of how you can use the question mark (**?**) to assist you in entering commands.

Table 19: Finding Command Options

Command	Comment

`Router> enable`
`Password: <password>`
`Router#`
	Enter the **enable** command and password to access privileged EXEC commands. You are in privileged EXEC mode when the prompt changes to a "# " from the "> "; for example, Router> to Router# .

`Router#`
`configure terminal`
`Enter configuration commands, one per line. End with CNTL/Z.`
`Router(config)#`
	Enter the **configure terminal** privileged EXEC command to enter global configuration mode. You are in global configuration mode when the prompt changes to Router(config)# .

Command	Comment

`Router(config)# interface serial ?`
`  <0-6>  Serial interface number`
`Router(config)# interface serial 4 ?`
`  /`
`Router(config)# interface serial 4/ ?`
`  <0-3>  Serial interface number`
`Router(config)# interface serial 4/0 ?`
`<cr>`
`Router(config)# interface serial 4/0`
`Router(config-if)#`
	Enter interface configuration mode by specifying the serial interface that you want to configure using the **interface serial** global configuration command.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter the serial interface slot number and port number, separated by a forward slash.
	When the <cr> symbol is displayed, you can press Enter to complete the command.
	You are in interface configuration mode when the prompt changes to Router(config-if)# .

`Router(config-if)# ?`
`Interface configuration commands:`
`  .`
`  .`
`  .`
`  ip  Interface Internet Protocol config`
` commands`
`  keepalive  Enable keepalive`
`  lan-name  LAN Name command`
`  llc2  LLC2 Interface Subcommands`
`  load-interval  Specify interval for load`
`calculation for an`
`  interface`
`  locaddr-priority  Assign a priority group`
`  logging  Configure logging for interface`
`  loopback  Configure internal loopback on`
`an interface`
`  mac-address  Manually set interface MAC address`
`  mls  mls router sub/interface commands`
`  mpoa  MPOA interface configuration`
`commands`
`  mtu  Set the interface Maximum`
`Transmission Unit (MTU)`
`  netbios  Use a defined NETBIOS access list`
` or enable`
`  name-caching`
`  no  Negate a command or set its`
`defaults`
`  nrzi-encoding  Enable use of NRZI encoding`
`  ntp  Configure NTP`
`  .`
`  .`
`  .`
`Router(config-if)#`
	Enter **?** to display a list of all the interface configuration commands available for the serial interface. This example shows only some of the available interface configuration commands.

Command	Comment

`Router(config-if)# ip ?`
`Interface IP configuration subcommands:`
`  access-group  Specify access control for packets`
`  accounting  Enable IP accounting on this interface`
`  address  Set the IP address of an interface`
`  authentication  authentication subcommands`
`  bandwidth-percent  Set EIGRP bandwidth limit`
`  broadcast-address  Set the broadcast address of an interface`
`  cgmp  Enable/disable CGMP`
`  directed-broadcast  Enable forwarding of directed broadcasts`
`  dvmrp  DVMRP interface commands`
`  hello-interval  Configures IP-EIGRP hello interval`
`  helper-address  Specify a destination address for UDP broadcasts`
`  hold-time  Configures IP-EIGRP hold time`
`  .`
`  .`
`  .`
`Router(config-if)# ip`
	Enter the command that you want to configure for the interface. This example uses the **ip** command.
	Enter **?** to display what you must enter next on the command line. This example shows only some of the available interface IP configuration commands.

`Router(config-if)# ip address ?`
`  A.B.C.D  IP address`
`  negotiated  IP Address negotiated over PPP`
`Router(config-if)# ip address`
	Enter the command that you want to configure for the interface. This example uses the **ip address** command.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP address or the **negotiated** keyword.
	A carriage return (<cr>) is not displayed; therefore, you must enter additional keywords or arguments to complete the command.

`Router(config-if)# ip address 172.16.0.1 ?`
`  A.B.C.D  IP subnet mask`
`Router(config-if)# ip address 172.16.0.1`
	Enter the keyword or argument that you want to use. This example uses the 172.16.0.1 IP address.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP subnet mask.
	A <cr> is not displayed; therefore, you must enter additional keywords or arguments to complete the command.

`Router(config-if)# ip address 172.16.0.1 255.255.255.0 ?`
`  secondary  Make this IP address a secondary address`
`  <cr>`
`Router(config-if)# ip address 172.16.0.1 255.255.255.0`
	Enter the IP subnet mask. This example uses the 255.255.255.0 IP subnet mask.
	Enter **?** to display what you must enter next on the command line. In this example, you can enter the **secondary** keyword, or you can press **Enter**.
	A <cr> is displayed; you can press **Enter** to complete the command, or you can enter another keyword.

`Router(config-if)# ip address 172.16.0.1 255.255.255.0` `Router(config-if)#`	In this example, **Enter** is pressed to complete the command.

Using the no and default Forms of Commands

Almost every configuration command has a **no** form. In general, use the **no** form to disable a function. Use the command without the **no** keyword to re-enable a disabled function or to enable a function that is disabled by default. For example, IP routing is enabled by default. To disable IP routing, use the **no ip routing** command; to re-enable IP routing, use the **ip routing** command. The Cisco IOS software command reference publications provide the complete syntax for the configuration commands and describe what the **no** form of a command does.

Many CLI commands also have a **default** form. By issuing the command **default** *command-name* , you can configure the command to its default setting. The Cisco IOS software command reference publications describe the function of the **default** form of the command when the **default** form performs a different function than the plain and **no** forms of the command. To see what default commands are available on your system, enter **default ?** in the appropriate command mode.

Saving Configuration Changes

Use the **copy running-config startup-config** command to save your configuration changes to the startup configuration so that the changes will not be lost if the software reloads or a power outage occurs. For example:

```
Router# copy running-config startup-config
Building configuration...
```

It might take a minute or two to save the configuration. After the configuration has been saved, the following output appears:

```
[OK]
Router#
```

This task saves the configuration to NVRAM.

Managing Configuration Files

On the Cisco Catalyst 8500 Series Edge Platforms, the startup configuration file is stored in the nvram: file system and the running-configuration files are stored in the system: file system. This configuration file storage setup is not unique to the Cisco Catalyst 8500 Series Edge Platforms and is used on several Cisco router platforms.

As a matter of routine maintenance on any Cisco router, users should backup the startup configuration file by copying the startup configuration file from NVRAM onto one of the router's other file systems and, additionally, onto a network server. Backing up the startup configuration file provides an easy method of recovering the startup configuration file in the event the startup configuration file in NVRAM becomes unusable for any reason.

The **copy** command can be used to backup startup configuration files. The following examples show the startup configuration file in NVRAM being backed up:

Example 1: Copying a Startup Configuration File to Bootflash

```
Router# dir bootflash:
Directory of bootflash:/
  11 drwx 16384 Sep 18 2020 15:16:35 +00:00 lost+found
1648321 drwx 4096 Oct 22 2020 12:08:47 +00:00 .installer
97921 drwx 4096 Sep 18 2020 15:18:00 +00:00 .rollback_timer
12 -rw- 1910 Oct 22 2020 12:09:09 +00:00 mode_event_log
1566721 drwx 4096 Sep 18 2020 15:33:23 +00:00 core
1215841 drwx 4096 Oct 22 2020 12:09:48 +00:00 .prst_sync
1289281 drwx 4096 Sep 18 2020 15:18:18 +00:00 bootlog_history
13 -rw- 133219 Oct 22 2020 12:09:34 +00:00 memleak.tcl
14 -rw- 20109 Sep 18 2020 15:18:39 +00:00 ios_core.p7b
15 -rwx 1314 Sep 18 2020 15:18:39 +00:00 trustidrootx3_ca.ca
391681 drwx 4096 Oct 6 2020 15:08:54 +00:00 .dbpersist
522241 drwx 4096 Sep 18 2020 15:32:59 +00:00 .inv
783361 drwx 49152 Oct 27 2020 08:36:44 +00:00 tracelogs
832321 drwx 4096 Sep 18 2020 15:19:17 +00:00 pnp-info
1207681 drwx 4096 Sep 18 2020 15:19:20 +00:00 onep
750721 drwx 4096 Oct 22 2020 12:09:57 +00:00 license_evlog
946561 drwx 4096 Sep 18 2020 15:19:24 +00:00 guest-share
383521 drwx 4096 Sep 18 2020 15:34:13 +00:00 pnp-tech
1583041 drwx 4096 Oct 22 2020 11:27:38 +00:00 EFI
16 -rw- 34 Oct 6 2020 13:56:03 +00:00 pnp-tech-time
17 -rw- 82790 Oct 6 2020 13:56:14 +00:00 pnp-tech-discovery-summary
18 -rw- 8425 Oct 6 2020 15:09:18 +00:00 1g_snake
19 -rw- 6858 Oct 7 2020 10:53:21 +00:00 100g_snake
20 -rw- 4705 Oct 22 2020 13:01:54 +00:00 startup-config

26975526912 bytes total (25538875392 bytes free)
Router# copy nvram:startup-config bootflash:
Destination filename [startup-config]?
3517 bytes copied in 0.647 secs (5436 bytes/sec)
```

Example 2: Copying a Startup Configuration File to USB Flash Disk

```
Router# dir usb0:
Directory of usb0:/
43261 -rwx 208904396 Oct 27 2020 14:10:20 -07:00
c8000aep-universalk9.17.02.01.SPA.bin
255497216 bytes total (40190464 bytes free)
Router# copy nvram:startup-config usb0:
Destination filename [startup-config]?
3172 bytes copied in 0.214 secs (14822 bytes/sec)
Router# dir usb0:
Directory of usb0:/
43261 -rwx 208904396 Oct 27 2020 14:10:20 -07:00
c8000aep-universalk9.17.02.01.SPA.bin
15:40:45 -07:00 startup-config255497216 bytes total (40186880 bytes free)
```

Example 3: Copying a Startup Configuration File to a TFTP Server

```
Router# copy bootflash:startup-config tftp:
Address or name of remote host []? 172.17.16.81
Destination filename [pe24_asr-1002-confg]? /auto/tftp-users/user/startup-config
!!
3517 bytes copied in 0.122 secs (28828 bytes/sec)
```

For more detailed information on managing configuration files, see the *Managing Configuration Files* section in the *Cisco IOS XE Configuration Fundamentals Configuration Guide*

Dynamic Allocation of Cores

Dynamic core allocations on the Cisco Catalyst 8500L Series platform provide flexibility for users to leverage the CPU cores for different services and/or CEF/IPSec performances. The Cisco Catalyst 8500L Series platform are equipped with 12 CPU cores and have the flexibility to allocate cores into the service plane from the data plane. The core allocation is based on the customer configuration of the different services available on these platforms.

From Cisco IOS XE Release 17.4 onwards, you can use the **platform resource { service-plane-heavy | data-plane-heavy }** command to adjust the cores across service plane and data plane. However, you have to reboot the device for the configured profile to take effect.

```
Router(config)# platform resource { service-plane-heavy | data-plane-heavy }
```

Note By default, when a device boots up, the mode is service-plane-heavy.

The following show command output shows the CPU cores allocation for the data plane:

```
Router# show platform software cpu allocation
CPU alloc information:

  Control plane cpu alloc: 0-1,12-13

  Data plane cpu alloc: 2-11

  Service plane cpu alloc: 0

  Template used: CLI-data_plane_heavy
```

Note In the above example, the maximum data plane core allocation is 12.

The following show command output shows the CPU cores allocation for the service plane:

```
Router# show platform software cpu allocation

CPU alloc information:
  Control plane cpu alloc: 0-1,12-13

  Data plane cpu alloc: 6-11

  Service plane cpu alloc: 2-5,14-17

  Template used: CLI-service_plane_heavy
```

Filtering the Output of the show and more Commands

You can search and filter the output of **show** and **more** commands. This functionality is useful if you need to sort through large amounts of output or if you want to exclude output that you need not see.

To use this functionality, enter a **show** or **more** command followed by the "pipe" character (|); one of the keywords **begin**, **include**, or **exclude**; and a regular expression on which you want to search or filter (the expression is case sensitive):

show *command* | {**append** | **begin** | **exclude** | **include** | **redirect** | **section** | **tee**} *regular-expression*

The output matches certain lines of information in the configuration file. The following example illustrates how to use output modifiers with the **show interface** command when you want the output to include only lines in which the expression "protocol" appears:

```
Router# show interface | include protocol
FastEthernet0/0 is up, line protocol is up
Serial4/0 is up, line protocol is up
Serial4/1 is up, line protocol is up
Serial4/2 is administratively down, line protocol is down
Serial4/3 is administratively down, line protocol is down
```

Disabling Front-Panel USB Ports

SUMMARY STEPS

1. enable
2. configure terminal
3. platform usb disable
4. end
5. write memory

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	configure terminal **Example:** `Device# configure terminal`	Enters global configurationmode.
Step 3	platform usb disable **Example:** `Device # platform usb disable`	Disables USB ports. **Note** For re-enabling of front-panel usb ports, use the no form of command (**no platform usb disable**).
Step 4	end **Example:** `Device(config-router-af)# end`	Exits address family configuration mode and returns to privileged EXEC mode.
Step 5	write memory	Save to configuration.

Configuration Examples for Disabling of Front-Panel USB Ports

Example: Disabling Front-Panel USB Ports On Autonomous, Controller and vManage Mode

The following example shows the configuration of disabling front-panel USB ports on autonomous, controller and vManage mode:

```
13RU#sh run | inc usb
platform usb disable
13RU#
```

Verifying Disabling of Front Panel USB Ports

To verify the disabling of USB ports on your device, use the following show command:

show platform usb status

```
Router#show platform usb status
USB enabled
Router#
```

Powering Off a Router

Before you turn off a power supply, make certain the chassis is grounded and you perform a soft shutdown on the power supply. Not performing a soft shutdown will often not harm the router, but may cause problems in certain scenarios.

To perform a soft shutdown before powering off the router, enter the **reload** command to halt the system and then wait for ROM Monitor to execute before proceeding to the next step.

The following screenshot shows an example of this process:

```
Router# reload
Proceed with reload? [confirm]
...(Some messages are omitted here)
Initializing Hardware...
Calculating the ROMMON CRC...CRC is correct.
```

Place the power supply switch in the Off position after seeing this message.

Finding Support Information for Platforms and Cisco Software Images

Cisco software is packaged in feature sets consisting of software images that support specific platforms. The feature sets available for a specific platform depend on which Cisco software images are included in a release. To identify the set of software images available in a specific release or to find out if a feature is available in a given Cisco IOS XE software image, you can use Cisco Feature Navigator or the software release notes.

Using the Cisco Feature Navigator

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS XE software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Using the Software Advisor

To see if a feature is supported by a Cisco IOS XE release, to locate the software document for that feature, or to check the minimum software requirements of Cisco IOS XE software with the hardware installed on your router, Cisco maintains the Software Advisor tool on Cisco.com at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

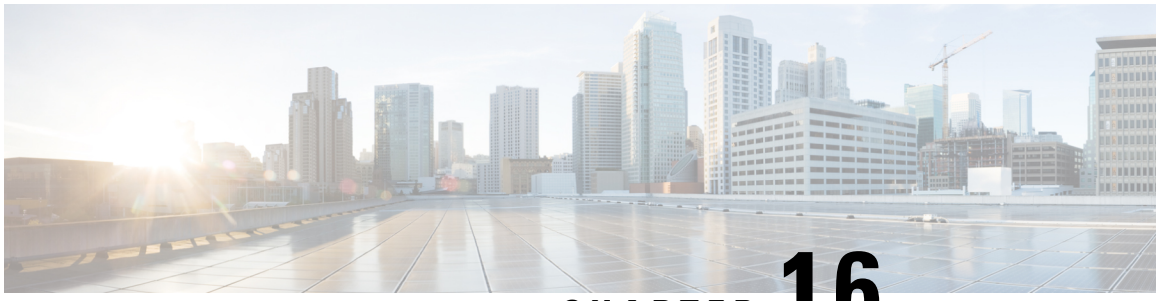
You must be a registered user on Cisco.com to access this tool.

Using the Software Release Notes

Cisco IOS XE software releases include release notes that provide the following information:

- Platform support information
- Memory recommendations
- New feature information
- Open and resolved severity 1 and 2 caveats for all platforms

Release notes are intended to be release-specific for the most current release, and the information provided in these documents may not be cumulative in providing information about features that first appeared in previous releases. Refer to Cisco Feature Navigator for cumulative feature information.



CHAPTER 16

Bay Configuration

Bay Configuration C8500-12X4QC

On C8500-12X4QC there are three built-in EPAs that are configurable.

The following table describes the port details:

Bay Number	EPA	Port Configuration	Interface numbers
Bay 0 8xSFP+	1/10G EPA	Eight 1/10G interfaces - TE0 - TE7 Disabled when 100G port in used in Bay 1	0/0/0 0/0/1 0/0/2 0/0/3 0/0/4 0/0/5 0/0/6 0/0/7 0/0/8

Bay Number	EPA	Port Configuration	Interface numbers
Bay 1 4xSFP+/1xQSFP	1/10/40/100G EPA	Four 1/10G interfaces active - TE0 - TE3 (interfaces 0/1/0 … 0/1/3) The bay can be used in the following modes: • Four 1/10G interfaces • One 40G interface active • One 100G interface. This utilizes the eight 1/10G ports of Bay 0	0/1/0 0/1/1 0/1/2 0/1/3
Bay 2 3xQSFP	40/100G EPA	Three 40G interfaces (0/1/0 to 0/1/2) One 100G interface (0/0/0) (0/0/0)	0/0/0 0/1/0 0/1/1 0/1/2

Note The speed of a 10G interface can be 1G or 10G based on the SFP transceiver plugged into to the port. Even when the speed changes the interface name is still indicated as TenGigabitEthernet.

By default , C8500-12X4QC operates Bay 1 in 10G mode and Bay 2 in 40G mode. The Bay 1 mode can be changed from 10G to 40G to 100G and vice versa. But if Bay 1 is set to 100G, all ports of Bay 0 move to *admin down* state and the ports are no longer functional.

The Bay 2 mode can be changed from 40G to 100G and vice versa. The mode change on Bay 2 does not impact traffic on Bay 1.

Use the **show platform** and **show ip interface** commands to view the bay and interface details:

```
Router#show platform
Chassis type: C8500-12X4QC

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C8500-12X4QC        ok                    1w3d
 0/0      BUILTIN-8x1/10G     ok                    1w3d
 0/1      BUILTIN-100/40/4x10Gok                    00:04:53
 0/2      BUILTIN-100G/3X40G  ok                    00:08:16
R0        C8500-12X4QC        ok                    1w3d
 R0/0                         ok, active            1w3d
 R0/1                         ok, standby           1w3d
F0        C8500-12X4QC        ok, active            1w3d
P0        AIR-AC-750W-R       ok                    1w3d
P1        AIR-AC-750W-R       ps, fail              1w3d
```

```
P2        C8500-FAN-1R        ok                  1w3d

Slot      CPLD Version        Firmware Version
--------- ------------------- ------------------------------------
0         19020715            12.2(20181120:104547) [user-gd_secur...
R0        19020715            12.2(20181120:104547) [user-gd_secur...
F0        19020715            12.2(20181120:104547) [user-gd_secur...
```

```
Router#show ip interface
Te0/0/0                unassigned      YES NVRAM  down                    down
Te0/0/1                unassigned      YES NVRAM  down                    down
Te0/0/2                unassigned      YES NVRAM  down                    down
Te0/0/3                unassigned      YES NVRAM  down                    down
Te0/0/4                unassigned      YES NVRAM  down                    down
Te0/0/5                unassigned      YES NVRAM  down                    down
Te0/0/6                unassigned      YES NVRAM  down                    down
Te0/0/7                unassigned      YES NVRAM  down                    down
Te0/1/0                unassigned      YES NVRAM  down                    down
Te0/1/1                unassigned      YES NVRAM  down                    down
Te0/1/2                unassigned      YES NVRAM  down                    down
Te0/1/3                unassigned      YES NVRAM  down                    down
Fo0/2/0                unassigned      YES unset  down                    down
Fo0/2/4                unassigned      YES unset  down                    down
Fo0/2/8                unassigned      YES unset  down                    down
GigabitEthernet0       10.104.33.213   YES NVRAM  up                      up
Router#
```

Bay Configuration Examples

The following examples show how mode can be changed on C8500-12X4QC to achieve different traffic speeds:

Examples

The following example shows how to change to 40G mode on Bay 1 of C8500-12X4QC:

```
Router(config)# hw-module subslot 0/1 mode 40G
Present configuration of this subslot will be erased and will not be restored.
CLI will not be available until mode change is complete and EPA returns to OK state.
Do you want to proceed? [confirm]

The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
*Oct 29 17:58:10.020 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 17:58:10.028 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.028 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.028 IST: BUILTIN-100/40/4x10G[0/1] : TenGigabitEthernet0/1/0 moved to
default config
*Oct 29 17:58:10.028 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 1 would be lost
*Oct 29 17:58:10.035 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.036 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.036 IST: BUILTIN-100/40/4x10G[0/1] : TenGigabitEthernet0/1/1 moved to
default config
*Oct 29 17:58:10.036 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 2 would be lost
```

```
*Oct 29 17:58:10.043 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.043 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.043 IST: BUILTIN-100/40/4x10G[0/1] : TenGigabitEthernet0/1/2 moved to
default config
*Oct 29 17:58:10.043 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 3 would be lost
*Oct 29 17:58:10.050 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.050 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 17:58:10.050 IST: BUILTIN-100/40/4x10G[0/1] : TenGigabitEthernet0/1/3 moved to
default config
*Oct 29 17:58:11.050 IST: BUILTIN-100/40/4x10G[0/1] : Received mode change request from 10G
 to 40G! system_configured TRUE
*Oct 29 17:58:11.057 IST: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(BUILTIN-100/40/4x10G) reloaded
on subslot 0/1
*Oct 29 17:58:11.057 IST: BUILTIN-100/40/4x10G[0/1] : EPA moving from 10G mode to 40G mode
*Oct 29 17:58:11.057 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 17:58:11.058 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 1 would be lost
*Oct 29 17:58:11.059 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 2 would be lost
*Oct 29 17:58:11.059 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 3 would be lost
*Oct 29 17:58:11.060 IST: BUILTIN-100/40/4x10G[0/1] : Old mode cleanup done!
*Oct 29 17:58:11.061 IST: %SPA_OIR-6-OFFLINECARD: SPA (BUILTIN-100/40/4x10G) offline in
subslot 0/1
*Oct 29 17:58:16.297 IST: BUILTIN-100/40/4x10G[0/1] : Number of ports 1
*Oct 29 17:58:16.298 IST: BUILTIN-100/40/4x10G[0/1] : XCVR namestring create: Maximum number
 of XCVR = 1
```

The following example shows how to change to 40G mode to 100G on Bay 1 of C8500-12X4QC:

```
Router(config)# hw-module subslot 0/1 mode 100G
Changing mode of subslot 0/1 to 100G will cause EPA in subslot 0/0 to go offline
Present configuration of this subslot will be erased and will not be restored.
CLI will not be available until mode change is complete and EPA returns to OK state.
Do you want to proceed? [confirm]

*Oct 29 18:09:01.360 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 18:09:01.368 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:01.368 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
The "[no] negotiation auto" command will have no effect with this interface
*Oct 29 18:09:01.368 IST: BUILTIN-100/40/4x10G[0/1] : FortyGigabitEthernet0/1/0 moved to
default config
*Oct 29 18:09:02.368 IST: BUILTIN-8x1/10G[0/0] : config for spa port 0 would be lost
*Oct 29 18:09:02.375 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.376 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.376 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/0 moved to default
config
*Oct 29 18:09:02.376 IST: BUILTIN-8x1/10G[0/0] : config for spa port 1 would be lost
*Oct 29 18:09:02.382 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.382 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
```

```
*Oct 29 18:09:02.382 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/1 moved to default
config
*Oct 29 18:09:02.382 IST: BUILTIN-8x1/10G[0/0] : config for spa port 2 would be lost
*Oct 29 18:09:02.389 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.389 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.389 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/2 moved to default
config
*Oct 29 18:09:02.389 IST: BUILTIN-8x1/10G[0/0] : config for spa port 3 would be lost
*Oct 29 18:09:02.395 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.395 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.395 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/3 moved to default
config
*Oct 29 18:09:02.395 IST: BUILTIN-8x1/10G[0/0] : config for spa port 4 would be lost
*Oct 29 18:09:02.402 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.402 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.402 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/4 moved to default
config
*Oct 29 18:09:02.402 IST: BUILTIN-8x1/10G[0/0] : config for spa port 5 would be lost
*Oct 29 18:09:02.409 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.409 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.409 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/5 moved to default
config
*Oct 29 18:09:02.409 IST: BUILTIN-8x1/10G[0/0] : config for spa port 6 would be lost
*Oct 29 18:09:02.415 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.415 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.415 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/6 moved to default
config
*Oct 29 18:09:02.415 IST: BUILTIN-8x1/10G[0/0] : config for spa port 7 would be lost
*Oct 29 18:09:02.422 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.422 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:09:02.422 IST: BUILTIN-8x1/10G[0/0] : TenGigabitEthernet0/0/7 moved to default
config
*Oct 29 18:09:03.423 IST: BUILTIN-100/40/4x10G[0/1] : Received mode change request from 40G
 to 100G! system_configured TRUE
*Oct 29 18:09:03.433 IST: BUILTIN-8x1/10G[0/0] : config for spa port 0 would be lost
*Oct 29 18:09:03.434 IST: BUILTIN-8x1/10G[0/0] : config for spa port 1 would be lost
*Oct 29 18:09:03.435 IST: BUILTIN-8x1/10G[0/0] : config for spa port 2 would be lost
*Oct 29 18:09:03.435 IST: BUILTIN-8x1/10G[0/0] : config for spa port 3 would be lost
*Oct 29 18:09:03.436 IST: BUILTIN-8x1/10G[0/0] : config for spa port 4 would be lost
*Oct 29 18:09:03.437 IST: BUILTIN-8x1/10G[0/0] : config for spa port 5 would be lost
*Oct 29 18:09:03.437 IST: BUILTIN-8x1/10G[0/0] : config for spa port 6 would be lost
*Oct 29 18:09:03.438 IST: BUILTIN-8x1/10G[0/0] : config for spa port 7 would be lost
*Oct 29 18:09:03.439 IST: BUILTIN-8x1/10G[0/0] : Old mode cleanup done!
*Oct 29 18:09:03.440 IST: %SPA_OIR-6-OFFLINECARD: SPA (BUILTIN-8x1/10G) offline in subslot
 0/0
*Oct 29 18:09:03.445 IST: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(BUILTIN-100/40/4x10G) reloaded
on subslot 0/1
*Oct 29 18:09:03.445 IST: BUILTIN-100/40/4x10G[0/1] : EPA moving from 40G mode to 100G mode
*Oct 29 18:09:03.445 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 18:09:03.446 IST: BUILTIN-100/40/4x10G[0/1] : Old mode cleanup done!
*Oct 29 18:09:03.446 IST: %SPA_OIR-6-OFFLINECARD: SPA (BUILTIN-100/40/4x10G) offline in
subslot 0/1
```

```
*Oct 29 18:09:08.790 IST: BUILTIN-100/40/4x10G[0/1] : Number of ports 1
*Oct 29 18:09:08.792 IST: BUILTIN-100/40/4x10G[0/1] : XCVR namestring create: Maximum number
 of XCVR = 1
Router(config)#
*Oct 29 18:09:15.552 IST: %SPA_OIR-6-ONLINECARD: SPA (BUILTIN-100/40/4x10G) online in subslot
 0/1
```

The following example shows how to change to 10G mode from 100G on Bay 1 of C8500-12X4QC:

```
Router(config)# hw-module subslot 0/1 mode 10G
Present configuration of this subslot will be erased and will not be restored.
CLI will not be available until mode change is complete and EPA returns to OK state.
Do you want to proceed? [confirm]
*Oct 29 18:14:36.484 IST: %PLATFORM_SCC-1-AUTHENTICATION_FAIL: Chassis authentication failed

*Oct 29 18:14:38.219 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 18:14:38.227 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:14:38.227 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:14:38.227 IST: BUILTIN-100/40/4x10G[0/1] : HundredGigE0/1/0 moved to default
config
*Oct 29 18:14:39.228 IST: BUILTIN-100/40/4x10G[0/1] : Received mode change request from
100G to 10G! system_configured TRUE
*Oct 29 18:14:39.230 IST: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(BUILTIN-100/40/4x10G) reloaded
on subslot 0/1
*Oct 29 18:14:39.230 IST: BUILTIN-100/40/4x10G[0/1] : EPA moving from 100G mode to 10G mode
*Oct 29 18:14:39.230 IST: BUILTIN-100/40/4x10G[0/1] : config for spa port 0 would be lost
*Oct 29 18:14:39.231 IST: BUILTIN-100/40/4x10G[0/1] : Old mode cleanup done!
*Oct 29 18:14:39.232 IST: %SPA_OIR-6-OFFLINECARD: SPA (BUILTIN-100/40/4x10G) offline in
subslot 0/1
*Oct 29 18:14:44.472 IST: BUILTIN-100/40/4x10G[0/1] : Number of ports 4
*Oct 29 18:14:44.475 IST: BUILTIN-100/40/4x10G[0/1] : XCVR namestring create: Maximum number
 of XCVR = 4
*Oct 29 18:15:03.336 IST: %SPA_OIR-6-ONLINECARD: SPA (BUILTIN-100/40/4x10G) online in subslot
 0/1
```

The following example shows how to change to 100G mode from 100G on Bay 2 of C8500-12X4QC:

```
Router(config)# hw-module subslot 0/2 mode 100G
Present configuration of this subslot will be erased and will not be restored.
CLI will not be available until mode change is complete and EPA returns to OK state.
Do you want to proceed? [confirm]

*Oct 29 18:17:03.394 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 0 would be lost
*Oct 29 18:17:03.401 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:17:03.401 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:17:03.401 IST: BUILTIN-100G/3X40G[0/2] : FortyGigabitEthernet0/2/0 moved to
default config
*Oct 29 18:17:03.401 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 1 would be lost
*Oct 29 18:17:03.406 IST: BUILTIN-100G/3X40G[0/2] : Breakout XCVR type QSFP 4X10G AC7M (546)
 is not allowed as XCVR port Fortyrnet0/2/0 is not configured in breakout
*Oct 29 18:17:03.406 IST: %IOSXE_EPA-3-XCVR_PROHIBIT: Transceiver is prohibited to come
online for interface FortyGigabitEther
*Oct 29 18:17:03.407 IST: BUILTIN-100G/3X40G[0/2] : XCVR prohibited on port
FortyGigabitEthernet0/2/0, epa_name=BUILTIN-100G/3=FortyGigabitEthernet0/2/0,
xcvr_speed=40000000, admin_state=UNSHUT xcvr_type=546

*Oct 29 18:17:03.409 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:17:03.409 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
```

```
 console as console
*Oct 29 18:17:03.409 IST: BUILTIN-100G/3X40G[0/2] : FortyGigabitEthernet0/2/4 moved to
default config
*Oct 29 18:17:03.409 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 2 would be lost
*Oct 29 18:17:03.417 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:17:03.417 IST: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
 console as console
*Oct 29 18:17:03.417 IST: BUILTIN-100G/3X40G[0/2] : FortyGigabitEthernet0/2/8 moved to
default config
*Oct 29 18:17:03.423 IST: BUILTIN-100G/3X40G[0/2] : Breakout XCVR type QSFP 4SFP10G CU4M
(541) is not allowed as XCVR port Forhernet0/2/4 is not configured in breakout
*Oct 29 18:17:03.423 IST: %IOSXE_EPA-3-XCVR_PROHIBIT: Transceiver is prohibited to come
online for interface FortyGigabitEther
*Oct 29 18:17:03.423 IST: BUILTIN-100G/3X40G[0/2] : XCVR prohibited on port
FortyGigabitEthernet0/2/4, epa_name=BUILTIN-100G/3=FortyGigabitEthernet0/2/4,
xcvr_speed=40000000, admin_state=UNSHUT xcvr_type=541

*Oct 29 18:17:04.418 IST: BUILTIN-100G/3X40G[0/2] : Received mode change request from 40G
to 100G! system_configured TRUE
*Oct 29 18:17:04.423 IST: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(BUILTIN-100G/3X40G) reloaded on
 subslot 0/2
*Oct 29 18:17:04.423 IST: BUILTIN-100G/3X40G[0/2] : EPA moving from 40G mode to 100G mode
*Oct 29 18:17:04.423 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 0 would be lost
*Oct 29 18:17:04.424 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 1 would be lost
*Oct 29 18:17:04.425 IST: BUILTIN-100G/3X40G[0/2] : config for spa port 2 would be lost
*Oct 29 18:17:04.425 IST: BUILTIN-100G/3X40G[0/2] : Old mode cleanup done!
*Oct 29 18:17:04.426 IST: %SPA_OIR-6-OFFLINECARD: SPA (BUILTIN-100G/3X40G) offline in subslot
 0/2
*Oct 29 18:17:09.685 IST: BUILTIN-100G/3X40G[0/2] : Number of ports 1
*Oct 29 18:17:09.686 IST: BUILTIN-100G/3X40G[0/2] : XCVR namestring create: Maximum number
 of XCVR = 1
Router(config)#
Router(config)#
*Oct 29 18:17:16.017 IST: %SPA_OIR-6-ONLINECARD: SPA (BUILTIN-100G/3X40G) online in subslot
 0/2
```

Breakout Support

Understand Breakout Support

Breakout support for a port helps to split a higher density port to multiple independent and logical ports. Starting from Cisco IOS XE 17.4, breakout support is introduced in Bay 2 of C8500-12X4QC that supports breakout capable 40G native ports. The breakout support is of 4X10G and uses a 3-tuple approach.

Note Breakout support is only supported on C8500-12X4QC (not C8500-20X6C).

The following table explains the interface names when breakout is configured:

Table 20: Interface Names when Breakout is Configured

Sr. No	Interface names	Description
	Te0/2/0, Te0/2/1, Te0/2/2, Te0/2/3, Te0/2/4, Te0/2/5, Te0/2/6, Te0/2/7, Te0/2/8, Te0/2/9, Te0/2/10, Te0/2/11	All three 40 G native ports working in 10G breakout mode
	Fo0/2/0,Fo0/2/4, Te0/2/8, Te0/2/9, Te0/2/10, Te0/2/11	1st native port in 40G mode 2nd native port in 40G mode 3rd native port in 10G breakout mode
	Fo0/2/0, Te0/2/4, Te0/2/5, Te0/2/6, Te0/2/7 Fo0/2/8	1st native port in 40G mode 2nd native port 10G breakout mode 3rd native port in 40G mode
	Te0/2/0, Te0/2/1, Te0/2/2, Te0/2/3, Fo0/2/4, Fo0/2/8	1st native port in 10G breakout mode 2nd native port in 40G mode 3rd native port in 40G mode
	1st native port in 10G breakout mode 2nd native port in 40G mode 3rd native port in 40G mode	1st native port in 40G mode 2nd native port in 10G breakout mode 3rd native port in 10G breakout mode
	Te0/2/0, Te0/2/1, Te0/2/2, Te0/2/3, Te0/2/4, Te0/2/5, Te0/2/6, Te0/2/7, Fo0/2/8	1st native port in 10G breakout mode 2nd native port in 10G breakout mode 3rd native port in 40G mode
	Te0/2/0, Te0/2/1, Te0/2/2, Te0/2/3, Fo0/2/4, Te0/2/8, Te0/2/9, Te0/2/10, Te0/2/11	1st native port in 10G breakout mode 2nd native port in 40G mode 3rd native port in 10G breakout mode

Breakout Support

Note Before using the breakout capability, ensure that Bay 2 is configured in 40G mode

```
Router(config)#hw-module subslot 0/2 breakout 10G port ?

all                configure all native ports in breakout mode
native_port_0      configure native port 0 in breakout mode
native_port_4      configure native port 4 in breakout mode
native_port_8      configure native port 8 in breakout mode
```

Sample Commands to Configure Breakout Support

When native_port 0 and 8 are in 10G breakout and native_port 4 is running in 40G mode

```
hw-module subslot 0/2 breakout 10g port native_port_0
hw-module subslot 0/2 breakout 10g port native_port_8
```

When all three native 40G ports have same breakout config

```
hw-module subslot 0/2 breakout 10g port all
hw-module subslot 0/2 breakout none port all
```

When you want to remove breakout configuration from all ports

```
hw-module subslot 0/2 breakout none port all
```

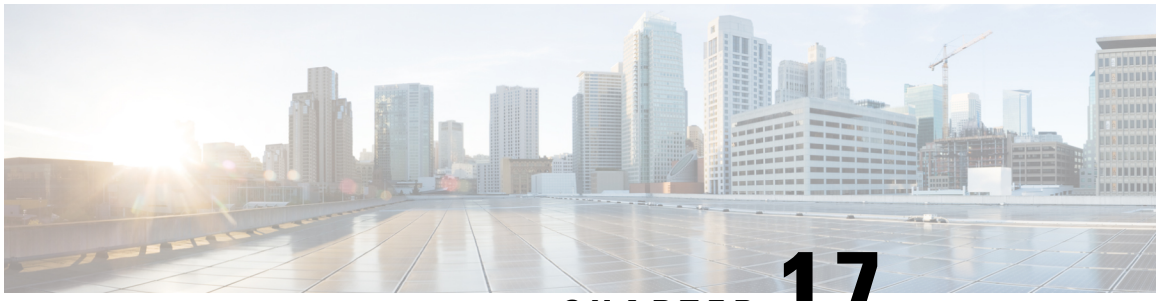
Bay Configuration C8500-12X

On C8500-12X4 there is one built-in EPA that supports ports TE0 - TE11 for SFP/SFP+ transceivers.

Bay Configuration C8500-20X6C

On C8500-20X6C there are two built-in EPAs that are configurable.

Bay Number	EPA	Port Configuration	Interface numbers
Bay 0 20xSFP+	1/10G EPA	Twenty 1G interfaces Twenty 10G interfaces Twenty 1/10G interfaces	0/0/0 0/0/1 0/0/2 0/0/3 0/0/4 0/0/5 0/0/6 0/0/7 0/0/8 0/0/9 0/0/10 0/0/11 0/0/12 0/0/13 0/0/14 0/0/15 0/0/16 0/0/17 0/0/18 0/0/19
Bay 1 6xQSFP+	40/100G EPA	Six 40/100G interfaces active The bay can be used in the following modes: • Six 40G interfaces Six 100G interfaces • Six 40/100G interfaces	0/1/0 0/1/1 0/1/2 0/1/3 0/1/4 0/1/5



CHAPTER 17

Licenses and Licensing Models

This chapter provides information about the licenses that are available on Cisco Catalyst 8000 Edge Platforms Family, supported throughput options, and how to configure the available licenses and throughput. It also outlines the licensing models available on Cisco Catalyst 8000 Edge Platforms Family.

Note The information in this chapter applies predominantly to a device operating in the autonomous mode. References to the controller mode are included in certain sections for the sake of comparison and completeness. Where the information applies to controller mode, this has been called-out categorically.

For a more detailed overview on Cisco Licensing, go to https://cisco.com/go/licensingguide.

This chapter includes the following major sections:

Feature Information for Available Licenses and Licensing Models

The following table provides a summary of license related changes applicable to the Cisco Catalyst 8000 Edge Platforms Family. The table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 21: Feature Information for Available Licenses and Licensing Models

Feature Name	Release	Feature Information
500 Mbps Aggregate for Tier 1 and 250 Mbps Throughput Configuration in Autonomous Mode	Cisco IOS XE 17.14.1a	On virtual platforms - when you configure a throughput of 250 Mbps or T1, if an HSECK9 license is available on the device, then throughput is capped at 500 Mbps transmitted (Tx) data only. In earlier releases, throughput was capped at 200 Mbps Tx. On physical platforms - when you configure a throughput of 250 Mbps or T1, if an HSECK9 license is available on the device, then aggregate throughput throttling is effective. Throughput is capped at 500 Mbps and any distribution of traffic in the upstream and downstream direction is allowed. In earlier releases, bidirectional throughput throttling was applicable to T1 and 250 Mbps - throughput was capped at 250 Mbps in each direction. See Release-Wise Changes in Throttling Behavior, on page 123.
Aggregate Throughput Throttling - Virtual Platforms	Cisco IOS XE Cupertino 17.9.1a	On virtual platforms of the Cisco Catalyst 8000 Edge Platforms Family, *for all throughput levels*, when you configure a bidirectional throughput value on the device, aggregate throughput throttling is effective. This enhancement does not change the throttling behaviour that has always been applicable to virtual platforms: any throttling applies only to data that is transmitted (Tx). Data that is received (Rx) is unthrottled. See Throughput , on page 121 and Numeric and Tier-Based Throughput, on page 121.
Aggregate Throughput Throttling - Physical Platforms	Cisco IOS XE Cupertino 17.8.1a	On the *physical* platforms of Cisco Catalyst 8000 Edge Platforms Family, for throughput levels greater than 250 Mbps and Tier 2 and higher tiers, when you configure the bidirectional throughput value on the device, aggregate throughput throttling is effective. This means that traffic is throttled in an aggregate manner irrespective of the distribution of the traffic in the upstream and downstream direction. The bidirectional throughput is represented in the license PID (For example, DNA-C-**500M**-E-3Y and DNA-C-**T2**-E-3Y). The aggregate throughput is double the bidirectional throughput. See Release-Wise Changes in Throttling Behavior, on page 123.

Feature Name	Release	Feature Information
Tier-Based Licenses	Cisco IOS XE Cupertino 17.7.1a	Support for tier-based throughput configuration was introduced in addition to existing bandwidth-based (numeric) throughput configuration. Starting with the lowest throughput level, the available tiers are Tier 0 (T0), Tier 1 (T1), Tier 2 (T2), and Tier3 (T3). Each tier represents a throughput level. If the license PID for a product is tier-based, the license is displayed with the tier value in the CSSM Web UI. For a product with a tier-based license, you can *configure* a tier-based throughput value, and you can also *convert* to a tier-based throughput value. See Throughput , on page 121 and Numeric and Tier-Based Throughput, on page 121.
Cisco Digital Network Architecture (DNA) licenses	Cisco IOS XE Amsterdam 17.3.2	Support for Cisco DNA licenses was introduced on Cisco Catalyst 8000 Edge Platforms Family. Cisco DNA Licenses are categorised into network-stack licenses and a DNA-stack add-on licenses. See Cisco DNA License, on page 116.
High Security License (HSECK9)	Cisco IOS XE Amsterdam 17.3.2	Support for the HSECK9 license was introduced on Cisco Catalyst 8000 Edge Platforms Family. See High Security License , on page 118.
Cisco Unified Border Element license (Cisco UBE license) Cisco Unified Communications Manager Express license (Cisco Unified CME license) Cisco Unified Survivable Remote Site Telephony license (Cisco Unified SRST license)	Cisco IOS XE Amsterdam 17.3.2	Support for Cisco UBE, Cisco Unified CME, Cisco Unified SRST licenses was introduced on Cisco Catalyst 8000 Edge Platforms Family See Cisco CUBE License, on page 120, Cisco Unified CME License, on page 120, and Cisco Unified SRST License, on page 120.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Available Licenses

This section lists all the licenses that are available on Cisco Catalyst 8000 Edge Platforms Family, usage guidelines, and ordering considerations.

Cisco DNA License

A Cisco Digital Network Architecture (DNA) software license combines several feature-specific licenses.

Note A Cisco DNA license includes all feature licenses except the following: High Security (HSECK9), Cisco Unified Border Element (Cisco UBE), Cisco Unified Communications Manager Express (Cisco Unified CME), and Cisco Unified Survivable Remote Site Telephony (Cisco Unified SRST). See Ordering Considerations for a Cisco DNA License, on page 117.

Cisco DNA licenses are categorized into network-stack licenses and DNA-stack add-on licenses.

Cisco DNA Licenses Available on Catalyst 8000V Edge Software, Catalyst 8200, and 8300 Series Edge Platforms:

Network-stack licenses:

- Network Essentials
- Network Advantage: includes features available with Network Essentials, and more.
- Network Premier: includes features available Network Essentials, Network Advantage, and more.

DNA-stack add-on licenses:

- Cisco DNA Essentials: add-on license available only with Network Essentials.
- Cisco DNA Advantage: add-on license available only with Network Advantage. Includes features available with DNA Essentials and more.
- Cisco DNA Premier: add-on license available only with Network Premier. Includes features available with DNA Essentials, DNA Advantage and more.

Cisco DNA Licenses Available on Catalyst 8500 Series Edge Platforms:

Network-stack licenses:

- Network Advantage
- Network Premier: includes features available Network Advantage, and more.

DNA-stack add-on licenses:

- Cisco DNA Advantage
- Cisco DNA Premier: add-on license available only with Network Premier. Includes features available with DNA Advantage and more.

Guidelines for Using a Cisco DNA License

- Guidelines that apply to all platforms in the Cisco Catalyst 8000 Edge Platforms Family:
  - A network-stack license is a perpetual or permanent license and has no expiration date.
  - A DNA-stack add-on license is a subscription or term license and is valid only until a certain date. A 3-year and 5-year option is available for all DNA-stack add-on licenses. A 7-year subscription option is available for certain DNA-stack add-on licenses.
  - Tier 3 (T3) or higher tiers are not supported with the Network Essentials and DNA Essentials licenses.

    This also means that if you have configured T3 or higher tiers as the throughput, you cannot change the boot level license to Network Essentials and DNA Essentials.

    For information about the various tiers available with Cisco DNA Licenses, see Tier and Numeric Throughput Mapping, on page 124.

- Guidelines that apply only to Catalyst 8000V Edge Software:

  On Catalyst 8000V Edge Software, when you configure a network-stack license, you must also configure the corresponding DNA-stack add-on license.

- Guidelines that apply only to Catalyst 8200, 8300, 8500 Series Edge Platforms:
  - The DNA-stack add-on license that is available with each network-stack license is optional. You can configure a network-stack license without a DNA-stack add-on license, but you cannot configure DNA-stack add-on license without the corresponding network-stack license.
  - If you use a DNA-stack add-on license, renew the license before term expiry to continue using it, or deactivate the DNA-stack add-on license and then reload the device to continue operating with the network-stack license capabilities.

Ordering Considerations for a Cisco DNA License

A Cisco DNA license subsumes all performance, boost, and technology package licenses (securityk9, uck9, and appxk9). This means that when you order a Cisco DNA network-stack license, or a Cisco DNA-stack add-on license, if a performance, boost, and technology package license is required or applicable, it is automatically added to the order.

The license Product ID (PID) you purchase can only be a DNA-stack add-on license PID.

Even if you order a Cisco DNA license along with new hardware, the license is not preconfigured on the device. You must configure the boot level license and then the throughput, on the device.

When ordering a Cisco DNA license, you are also specifiying a throughput value. If the throughput you order is greater than 250 Mbps, an HSECK9 license is *required* on all variants of Cisco Catalyst 8000 Edge Platforms Family - except for Catalyst 8500 and 8500L Series Edge Platforms. For more information, see High Security License , on page 118.

When you order a license PID with a tier-based throughput value of *T1*, an HSECK9 license is automatically added to the order.

High Security License

The High Security license (HSECK9 license) is an export-controlled license and is restricted by U.S. export control laws. This license is required for the use of full cryptographic functionality, that is, throughput greater than 250 Mbps, and tunnel count over and above a certain number (refer to table below). This requirement applies to all devices of Cisco Catalyst 8000 Edge Platforms Family except for Catalyst 8500 and 8500L Series Edge Platforms.

Only on Catalyst 8500 and 8500L Series Edge Platforms, throughput and tunnel scale are not impacted by the non-availability of the HSECK9 license. On these platforms, the HSECK9 license is required only for compliance purposes. On all remaining models of Cisco Catalyst 8000 Edge Platforms Family, supported tunnel count and throughput are restricted in the absence of an HSECK9 license. The table below specifies supported tunnel count and supported throughput without the HSECK9 license:

PID	No. Of Tunnels *Without* HSECK9 License	Supported Throughput *Without* HSECK9 License
C8000V	150	T0, T1
C8200-1N-4T	1000	T0, T1
C8200L-1N-4T	1000	T0, T1
C8300-1N1S-4T2X	1000	T0, T1
C8300-1N1S-6T	1000	T0, T1
C8300-2N2S-4T2X	1000	T0, T1
C8300-2N2S-6T	1000	T0, T1
C8500-12X4QC	N/A	N/A
C8500-12X	N/A	N/A
C8500-20X6C	N/A	N/A
C8500L-8S4X	N/A	N/A

Note The term "throughput" refers to encrypted throughput on physical platforms. On virtual platforms, it refers to encrypted *and* unencrypted throughput - combined.

By using an HSECK9 license, the tunnel count restriction is lifted and you can also configure throughput greater than 250 Mbps. For detailed information about the available throughput options, see Tier and Numeric Throughput Mapping, on page 124.

To know if an HSECK9 license is being used on a device, enter the **show license summary** command in privileged EXEC mode. On all devices in the Cisco Catalyst 8000 Edge Platforms Family, the HSECK9 license as displayed as: `Router US Export Lic. for DNA (DNA_HSEC)`. For example:

```
Device# show license summary

Account Information:
  Smart Account: Eg-SA As of Dec 03 15:26:02 2021 UTC
  Virtual Account: Eg-VA

License Usage:
  License                 Entitlement Tag               Count Status
  -----------------------------------------------------------------------------
  network-advantage_T2    (NWSTACK_T2_A)                    1 IN USE
  dna-advantage_T2        (DSTACK_T2_A)                     1 IN USE
  Router US Export Lic... (DNA_HSEC)                        1 IN USE
```

Guidelines for Using an HSECK9 License

The HSECK9 license is tied to the chassis. Therefore, one HSECK9 license is required for each chassis UDI where you want to use cryptographic functionality.

An HSECK9 license requires authorization before use. This authorisation is provided by a Smart Licensing Authorization Code (SLAC). You must install a SLAC for each HSECK9 license you use. A SLAC is generated in and obtained from CSSM. How you obtain SLAC from CSSM depends on the topology you have implemented. For more information, see Installing SLAC for an HSECK9 License, on page 136.

To know if SLAC is installed, enter the **show license authorization** command in privileged exec mode, to confirm. If SLAC is installed, the status field displays: `SMART AUTHORIZATION INSTALLED on <timestamp>`. For example:

```
Device# show license authorization
Overall status:
  Active: PID:C8300-1N1S-4T2X,SN:FDO2250A0J5
      Status: SMART AUTHORIZATION INSTALLED on Dec 03 08:24:35 2021 UTC
      Last Confirmation code: 418b11b3

Authorizations:
  Router US Export Lic. for DNA (DNA_HSEC):
    Description: U.S. Export Restriction Compliance license for DNA based Routers
    Total available count: 1
    Enforcement type: EXPORT RESTRICTED
    Term information:
      Active: PID:C8300-1N1S-4T2X,SN:FDO2250A0J5
        Authorization type: SMART AUTHORIZATION INSTALLED
        License type: PERPETUAL
          Term Count: 1

Purchased Licenses:
  No Purchase Information Available
```

Ordering Considerations for an HSECK9 License

If you order your DNA licenses in the same order as Catalyst 8000 hardware platforms, the option to order an HSECK9 license is available or is selected, if applicable. For example, in case of Catalyst 8500 Series Edge Platforms, when you order hardware, an HSECK9 license is automatically added to the order, because throughput support *starts* at greater than 250 Mbps on these platforms. Further, the requisite SLAC for the HSECK9 license is also factory-installed on the device.

If you order your DNA licenses in an order that is separate from your Catalyst 8000 hardware platforms, you must separately order the HSECK9 license in the order for the Catalyst 8000 hardware platforms, if required.

If you plan to use an HSECK9 license with new hardware that you are ordering, provide your Smart Account and Virtual Account information *with* the hardware order. This enables Cisco to factory-install SLAC for the

HSECK9 license on the hardware. You must still configure throughput on the device before you start using it.

Note If the HSECK9 license is ordered separately (not with the hardware order), SLAC cannot be factory-installed.

Cisco CUBE License

A Cisco Unified Border Element License (Cisco UBE license) does not require any boot level configuration before you enable it. After purchase, you can refer to the configuration guide to configure the available Cisco UBE features.

For information about the features available with a Cisco UBE license, see the *Cisco Unified Border Element Configuration Guide* for the required release at: https://www.cisco.com/c/en/us/support/unified-communications/unified-border-element/products-installation-and-configuration-guides-list.html.

For information about supported platforms and about purchasing a Cisco UBE license, see the datasheet at: https://www.cisco.com/c/en/us/products/collateral/unified-communications/unified-border-element/data-sheet-c78-729692.html. You must order a Cisco UBE license separately if required. It is not automatically included with any other license.

For information about how to report usage of a Cisco UBE license, see Smart Licensing Using Policy for Cisco Enterprise Routing Platforms. In the context of this licensing model, a Cisco UBE license is an *unenforced* license.

Cisco Unified CME License

A Cisco Unified Communications Manager Express License (Cisco Unified CME license) does not require any boot level configuration before you enable it. After purchase, you can refer to the configuration guide to configure the available features.

For information about the features available with a Cisco Unified CME license, see the Cisco Unified Communications Manager Express System Administrator Guide.

For information about supported platforms and about purchasing a Cisco Unified CME license, see the datasheet at: https://www.cisco.com/c/en/us/products/collateral/unified-communications/unified-communications-manager-express/datasheet-c78-744069.html. You must order a Cisco Unified CME license separately if required. It is not automatically included with any other license.

For information about how to report usage of a Cisco Unified CME license, see Smart Licensing Using Policy for Cisco Enterprise Routing Platforms. In the context of this licensing model, a Cisco Unified CME license is an *unenforced* license.

Cisco Unified SRST License

A Cisco Unified Survivable Remote Site Telephony License (Cisco Unified SRST license) does not require any boot level configuration before you enable it. After purchase, you can refer to the configuration guide to configure the available Unified SRST features.

For information about the features available with a Cisco Unified SRST license, see the Cisco Unified SCCP and SIP SRST System Administrator Guide (All Versions).

For information about supported platforms and about purchasing a Cisco Unified SRST license, see the datasheet at: https://www.cisco.com/c/en/us/products/collateral/unified-communications/unified-communications-manager-express/datasheet-c78-744069.html. You must order a Cisco Unified SRST license separately if required. It is not automatically included with any other license.

For information about how to report usage of a Unified SRST license, see Smart Licensing Using Policy for Cisco Enterprise Routing Platforms. In the context of this licensing model, a Unified SRST license is an *unenforced* license.

Throughput

The *throughput* tells you how much data is allowed to be transferred through the device. You configure this value in the autonomous mode. Data is then transmitted (Tx) and received (Rx) at the configured rate.

If you don't explicitly configure a throughput, default throughput is effective.

To know the configured throughput of a device, enter the applicable command:

- For physical platforms enter the **show platform hardware throughput crypto** command, in privileged EXEC mode.
- For virtual platforms enter the **show platform hardware throughput level** command, in privileged EXEC mode.

The following sections provide information about how a throughput value is represented, whether the throughput on a device refers to encrypted or unencrypted throughput and what this means, and if and how a limit may be enforced on device throughput.

Numeric and Tier-Based Throughput

The throughput you are entitled to, is specified in the device's Cisco DNA license product ID (PID). It is a value that can be represented by a number or by a tier. It is this same value that is also configured on the device.

Numeric Throughput Value

When throughput is represented by a number, it is called a numeric throughput value. For example, DNA-C-**10M**-E-3Y is a license PID with a numeric throughput value of 10M, that is, 10 Mbps.

Depending on the device, some of the other available numeric throughput values are: 15M, 25M, 50M, 100M, 250M, 500M, 1G, 2.5G, 5G, 10G, and so on. Throughput *greater* than 250 Mbps requires an HSECK9 license.

Tier-Based Throughput Value

When throughput is represented by a tier, it is called a tier-based throughput value. A tier represents a throughput level and is mapped to a numeric throughput value. For example, DNA-C-**T0**-E-3Y is a license PID with a tier-based throughput value of T0. The numeric equivalent it is mapped to is a throughput of up to 25 Mbps.

Note Tier-based throughput configuration is supported starting with Cisco IOS XE Cupertino 17.7.1a. From this release onwards, tier-based throughput configuration is also the recommended way of configuring throughput on the device.

Starting with the lowest throughput level, the available tiers are Tier 0 (T0), Tier 1 (T1), Tier 2 (T2), Tier 3 (T3), Tier 4 (T4), and Tier 5 (T5). T2 and higher tiers require an HSECK9 license.

Note the following about tiers:

- Not all tiers are available with all Cisco DNA licenses.

  For example, T3 and higher tiers are not available with the Network Essentials and DNA-Essentials licenses. This also means that if you have T3 as the configured throughput, you cannot change the boot level license to Network Essentials and DNA Essentials.

- Each tier maps to or means a different numeric value for different platforms.

  The different platforms in the Cisco Catalyst 8000 Edge Platforms Family support different maximum throughput levels. For example, T2 means 1G throughput for C8300-2N2S-4T2X, 500M for C8200-1N-4T, and 250M for C8200L-1N-4T.

To know which tiers are available with a particular DNA License and to know the numeric equivalent of each tier for a particular platform and see the Tier and Numeric Throughput Mapping, on page 124 section in this chapter.

To know when to configure a numeric throughput value and when to configure tier-based throughput on your device, see the Numeric vs. Tier-Based Throughput Configuration, on page 131 section in this chapter.

Encrypted and Unencrypted Throughput

Encrypted throughput, also known as crypto throughput, is throughput that is protected by a cryptographic algorithm.

Unencrypted throughput on the other hand, is in plain text. Unencrypted throughput is also referred to as Cisco Express Forwarding (CEF) traffic.

Important In case of physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms), all references to “throughput” in this document refer to cryptographic throughput.

In case of virtual platforms (Catalyst 8000V Edge Software), all references to “throughput” in this document refer to encrypted *and* unencrypted throughput, combined.

Throttled and Unthrottled Throughput

Throttled throughput, is throughput on which a limit has been enforced. (When you configure a throughput value, you are throttling device throughput to the configured extent.)

Unthrottled throughput means that no limit is enforced, and the device throughput is at the maximum capability of the device.

Note On virtual platforms, if throughput is throttled, throttling applies only to Tx data. Rx is always unthrottled. On physical platforms, if throughput is throttled, throttling applies to Tx and Rx data.

On physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms), unencrypted throughput (Tx and Rx), is unthrottled by default.

Types of Throttling Behavior: Aggregate and Bidirectional

The system can impose throttling in a bidirectional manner or an aggregate manner.

Bidirectional throughput throttling

Here the system throttles data in each direction. When bidirectional throttling is effective, Tx data is capped at the bidirectional throughput value and the Rx data is capped at the bidirectional throughput value - separately. (Note the exception that always applies to virtual platforms: Rx is unthrottled.)

For example, if the bidirectional throughput value is 25 Mbps or T0 and bidirectional throughput throttling is effective:

- On virtual platforms, Tx data is capped at 25 Mbps. Rx is unthrottled.
- On physical platforms, Tx data is capped at 25 Mbps and Rx data is capped at 25 Mbps.

Note The value that you see in a license PID (whether numeric or tier-based) represents a bidirectional throughput value.

Aggregate throughput throttling

Here the system doubles the configured value and throttles throughput at this aggregate limit. When aggregate throughput throttling is effective, traffic is not throttled separately in each direction.

For example, if the bidirectional throughput value that is configured is 500 Mbps and aggregate throughput throttling is effective:

- On virtual platforms, Tx data is capped at 1 Gbps. Rx is unthrottled.
- On physical platforms, traffic in the upstream and downstream direction can be any ratio within the 1 Gbps aggregate limit. For instance, 800 Mbps Tx and 200 Mbps Rx, or, 300 Mbps Tx and 700 Mbps Rx)

Release-Wise Changes in Throttling Behavior

To know if the throughput on your device will be throttled in a bidirectional manner or in an aggregate manner, check the software version running on the device, and refer to the release-wise changes in throttling behavior described below.

- **Until Cisco IOS XE Cupertino 17.7.x**: Only bidirectional throughput throttling is effective. This applies to physical and virtual platforms.
- **Starting with Cisco IOS XE Cupertino 17.8.1a**:

- Only on physical platforms, when you configure a *throughput value greater than 250 Mbps* or T2 and higher tiers, aggregate throughput throttling is effective.

  On C8200L-1N-4T, if you configure a numeric value of 250 Mbps, bidirectional throughput throttling is effective and a maximum of 250 Mbps is available in each direction. But if you configure tier T2, aggregate throttling is effective and 500 Mbps is available for use in any Tx and Rx ratio.

- On virtual platforms, Tx throttling continues to apply, and Rx continues to remain unthrottled.

- **Starting with Cisco IOS XE Cupertino 17.9.1a**: On virtual platforms, for all throughput levels and all tiers, aggregate throughput throttling is effective.

Note If the aggregate for the throughput level you configure on a virtual platform amounts to *greater than 250 Mbps*, aggregate throughput throttling is not effective unless an HSECK9 license is available on the device (that is, SLAC is installed).

- **Starting with Cisco IOS XE 17.14.1a**: On physical and virtual platforms, when you configure a throughput of 250 Mbps or T1, aggregate throughput throttling is effective - as long as an HSECK9 license is available on the device. On virtual platforms, this means that Tx throughput is capped at 500 Mbps. On physical platforms, this means an aggregate limit of 500 Mbps is available for use in any Tx and Rx ratio.

  If an HSECK9 license is not available on the device and you configure a throughput value of 250 Mbps, or T1, then bidirectional throughput throttling is effective. On virtual platforms this means Tx throughput is throttled at 250 Mbps. On physical platforms throughput is throttled at 250 Mbps in each direction.

Tier and Numeric Throughput Mapping

The following tables provide information about about the numeric equivalent of each tier, and the DNA licenses that each tier is available with.

Tip The mapping tables clarify only the numeric equivalent of a tier. This mapping does not reflect the final throughput that you are entitled to. The entitled throughput depends on the device's capability, the software version running on the device, and throttling behavior for that version.

Note When you purchase a license PID with a tier-based throughput value of *T1*, an HSECK9 license is automatically provided.

Y: Network Premium and DNA Premium

Y: Network Advantage and DNA Advantage

Y: Network Essentials and DNA Essentials

* = HSECK9 license required. On C8500 and C8500L, the HSECK9 license is required for compliance purposes only.

Table 22: Tier and Numeric Throughput Mapping for Virtual Platforms (C8000v)

Tiers from 17.9.1a:	**T0**		**T1**		**T2***			**T3***			**T4***
Tiers in 17.7.x, 17.8.x:	**T0**	**T1**			**T2***			**T3***			**T4***
Numeric Mapping:	**15M**	**25M**	**50M**	**100M**	**250M**	**500M**	**1G**	**2.5G**	**5G**	**10G**	**Unthrottled**
Available DNA Licenses:	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y	Y Y	Y Y	Y Y

Table 23: Tier and Numeric Throughput Mapping for Physical Platforms (C8200, C8300, C8500)

Tiers from 17.8.1a:	T0		T1			T2*			T3*			T4*	T5*
Tiers in 17.7.x:	T0		T1			T2*			T3*			n.a.	n.a.
Configured Numeric Value:	**10M**	**15M**	**25M**	**50M**	**100M**	**250M**	**500M**	**1G**	**2.5G**	**5G**	**10G**	**50G**	**Unthrottled**
C8200-1N-4T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y						
C8200L-1N-4T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y							
C8300-1N1S-4T2X	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y				
C8300-1N1S-6T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y					
C8300-2N2S-4T2X	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y				
C8300-2N2S-6T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y					
C8500-12X									Y Y	Y Y	Y Y		
C8500-12X4QC									Y Y	Y Y	Y Y		
C8500-20X6C												Y Y	Y Y
C8500L-8S4X								Y Y	Y Y	Y Y	Y Y		

Entitled Throughput and Throttling Specifications in the Autonomous Mode

These tables tell you about the throughput you are entitled to. This is based on the device, the throughput value, which can be aggregate or numeric, and the release, which determines if throttling is imposed in an aggregate or bidirectional manner.

Table 24: C8000v

Throughput = Encrypted and Unencrypted Throughput Rx is Unthrottled * HSECK9 license is required.				
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= 17.4.1a**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >=17.9.1a**	**Entitled Throughput & Throttling in >=17.14.1a**
10M	10M Tx Only	10M Tx Only	20M Tx Only	20M Tx Only
15M	15M Tx Only	15M Tx Only	30M Tx Only	30M Tx Only
25M	25M Tx Only	25M Tx Only	50M Tx Only	50M Tx Only
50M	50M Tx Only	50M Tx Only	100M Tx Only	100M Tx Only
100M	100M Tx Only	100M Tx Only	200M Tx Only	200M Tx Only
250M	250M Tx Only	250M Tx Only	250M Tx Only	With HSECK9: 500M Tx Without HSECK9: 250M Tx
500M*	500M Tx Only	500M Tx Only	1G Tx Only	1G Tx Only
1G*	1G Tx Only	1G Tx Only	2G Tx Only	2G Tx Only
2.5G*	2.5G Tx Only	2.5G Tx Only	5G Tx Only	5G Tx Only
5G*	5G Tx Only	5G Tx Only	10G Tx Only	10G Tx Only
10G*	10G Tx Only	10G Tx Only	20G Tx Only	20G Tx Only
T0	-	15M Tx Only	50M Tx Only	50M Tx Only
T1	-	100M Tx Only	200M Tx Only	With HSECK9: 500M Tx Without HSECK9: 250M Tx
T2*	-	1G Tx Only	2G Tx Only	2G Tx Only
T3*	-	10 Tx Only	20G Tx Only	20G Tx Only
T4*	-	Unthrottled	Unthrottled	Unthrottled

Table 25: C8200-1N-4T

Throughput = Encrypted Throughput * HSECK9 license is required.

Supported Throughput Values (default 10M)	Entitled Throughput & Throttling in >= 17.4.1a	Entitled Throughput & Throttling in >= 17.7.1a	Entitled Throughput & Throttling in >= 17.8.1a	Entitled Throughput & Throttling in >= 17.14.1a
10M	10M Bidirectional	10M Bidirectional	10M Bidirectional	10M Bidirectional
15M	15M Bidirectional	15M Bidirectional	15M Bidirectional	15M Bidirectional
25M	25M Bidirectional	25M Bidirectional	25M Bidirectional	25M Bidirectional
50M	50M Bidirectional	50M Bidirectional	50M Bidirectional	50M Bidirectional
100M	100M Bidirectional	100M Bidirectional	100M Bidirectional	100M Bidirectional
250M	250M Bidirectional	250M Bidirectional	250M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
500M*	500M Bidirectional	500M Bidirectional	1G Aggregate	1G Aggregate
T0	-	15M Bidirectional	25M Bidirectional	25M Bidirectional
T1	-	100M Bidirectional	100M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
T2	-	500M Bidirectional	1G Aggregate	1G Aggregate

Table 26: C8200L-1N-4T

				Throughput = Encrypted Throughput * HSECK9 license is required.
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= >= 17.5.1a**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >= 17.8.1a**	**Entitled Throughput & Throttling in >= 17.14.1a**
10M	10M Bidirectional	10M Bidirectional	10M Bidirectional	10M Bidirectional
15M	15M Bidirectional	15M Bidirectional	15M Bidirectional	15M Bidirectional
25M	25M Bidirectional	25M Bidirectional	25M Bidirectional	25M Bidirectional
50M	50M Bidirectional	50M Bidirectional	50M Bidirectional	50M Bidirectional
100M	100M Bidirectional	100M Bidirectional	100M Bidirectional	100M Bidirectional
250M	250M Bidirectional	250M Bidirectional	250M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional

T0	-	15M Bidirectional	25M Bidirectional	25M Bidirectional
T1	-	100M Bidirectional	100M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
T2*	-	250M Bidirectional	500M Aggregate	500M Aggregate
-			**Note** From 17.8.1a, On C8200-1N-4T-L, if you configure a numeric value of 250 Mbps, a maximum of 250 Mbps is available in each direction. But if you configure tier-based value T2 (which requires an HSECK9 license), 500 Mbps is available for use in any Tx and Rx ratio.	

Table 27: C8300-1N1S-4T2X, C8300-2N2S-4T2X

Throughput = Encrypted Throughput * HSECK9 license is required.				
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= 17.3.2**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >= 17.8.1a**	**Entitled Throughput & Throttling in >= 17.14.1a**
10M	10M Bidirectional	10M Bidirectional	10M Bidirectional	10M Bidirectional
15M	15M Bidirectional	15M Bidirectional	15M Bidirectional	15M Bidirectional
25M	25M Bidirectional	25M Bidirectional	25M Bidirectional	25M Bidirectional
50M	50M Bidirectional	50M Bidirectional	50M Bidirectional	50M Bidirectional
100M	100M Bidirectional	100M Bidirectional	100M Bidirectional	100M Bidirectional
250M	250M Bidirectional	250M Bidirectional	250M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
500M*	500M Bidirectional	500M Bidirectional	1G Aggregate	1G Aggregate
1G*	1G Bidirectional	1G Bidirectional	2G Aggregate	2G Aggregate
2.5G*	2.5G Bidirectional	2.5G Bidirectional	5G Aggregate	5G Aggregate
T0	-	15M Bidirectional	25M Bidirectional	25M Bidirectional
T1	-	100M Bidirectional	100M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional

T2*	-	1G Bidirectional	2G Aggregate	2G Aggregate
T3*	-	10G Bidirectional	20G Aggregate	20G Aggregate

Table 28: C8300-1N1S-6T, C8300-2N2S-6T

Throughput = Encrypted Throughput * HSECK9 license is required.				
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= 17.3.2**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >= 17.8.1a**	**Entitled Throughput & Throttling in >= 17.14.1a**
10M	10M Bidirectional	10M Bidirectional	10M Bidirectional	10M Bidirectional
15M	15M Bidirectional	15M Bidirectional	15M Bidirectional	15M Bidirectional
25M	25M Bidirectional	25M Bidirectional	25M Bidirectional	25M Bidirectional
50M	50M Bidirectional	50M Bidirectional	50M Bidirectional	50M Bidirectional
100M	100M Bidirectional	100M Bidirectional	100M Bidirectional	100M Bidirectional
250M	250M Bidirectional	250M Bidirectional	250M Bidirectional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
500M*	500M Bidirectional	500M Bidirectional	1G Aggregate	1G Aggregate
1G*	1G Bidirectional	1G Bidirectional	2G Aggregate	2G Aggregate
T0	-	15M Bidirectional	25M Bi-directional	25M Bi-directional
T1	-	100M Bidirectional	100M Bi-directional	With HSECK9: 500M Aggregate Without HSECK9: 250M Bidirectional
T2*	-	1G Bidirectional	2G Aggregate	2G Aggregate

Table 29: C8500-12X, C8500-12X4QC

Throughput = Encrypted Throughput *HSECK9 license required for compliance purposes only.			
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= 17.3.2**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >= 17.8.1a**
2.5G*	2.5G Bidirectional	2.5G Bidirectional	5G Aggregate
5G*	5G Bidirectional	5G Bidirectional	10G Aggregate

10G*	10G Bidirectional	10G Bidirectional	20G Aggregate
T3*	-	10G Bidirectional	20G Aggregate

Table 30: C8500L-8S4X

Throughput = Encrypted Throughput *HSECK9 license required for compliance purposes only.			
Supported Throughput Values (default 10M)	**Entitled Throughput & Throttling in >= 17.4.1a**	**Entitled Throughput & Throttling in >= 17.7.1a**	**Entitled Throughput & Throttling in >= 17.8.1a**
1G*	1G Bidirectional	1G Bidirectional	2G Aggregate
2.5G*	2G Bidirectional	2G Bidirectional	5G Aggregate
5G*	5G Bidirectional	5G Bidirectional	10G Aggregate
10G*	10G Bidirectional	10G Bidirectional	20G Aggregate
T2*	-	1G Bidirectional	2G Aggregate
T3*	-	10G Bidirectional	20G Aggregate

Table 31: C8500-20X6C

Throughput = Encrypted Throughput *HSECK9 license required for compliance purposes only.	
Supported Throughput Values (default T4)	**Entitled Throughput and Throttling in >= 17.10.1a**
T4*	50G Aggregate
T5*	Unthrottled

Entitled Throughput and Throttling Specifications in the SD-WAN Controller Mode

PID	Introductory Release for PID	Throughput Without HSECK9 - Bi-directional	Throughput With HSECK9 (>=17.3.2 and <17.8.1a, Bi-directional)	Throughput With HSECK9 (>17.8.1a, Aggregate)
C8300-1N1S-4T2X (default 250M)	17.3.2	250M	unthrottled	unthrottled

PID	Introductory Release for PID	Throughput Without HSECK9 - Bi-directional	Throughput With HSECK9 (>=17.3.2 and <17.8.1a, Bi-directional)	Throughput With HSECK9 (>17.8.1a, Aggregate)
C8300-2N2S-6T (default 250M)	17.3.2	250M	1G	2G
C8300-1N1S-6T (default 250M)	17.3.2	250M	1G	2G
C8300-2N2S-4T2X (default 250M)	17.3.2	250M	unthrottled	unthrottled
C8200-1N-4T (default 250M)	17.4.1a	250M	500M	1G
C8200L-1N-4T (default 250M)	17.5.1a	250M	250M	500M
C8500-12X4QC (default unthrottled)	17.3.2	unthrottled	unthrottled	unthrottled
C8500-12X (default unthrottled)	17.3.2	unthrottled	unthrottled	unthrottled
C8500L-8S4X (default unthrottled)	17.4.1a	unthrott led	unthrottled	unthrottled
C8500-20X6C (default T4)	17.10.1a	unthrottled	-	unthrottled
C8000v (default 250M)	17.4.1a	250M	unthrottled	unthrottled

Numeric vs. Tier-Based Throughput Configuration

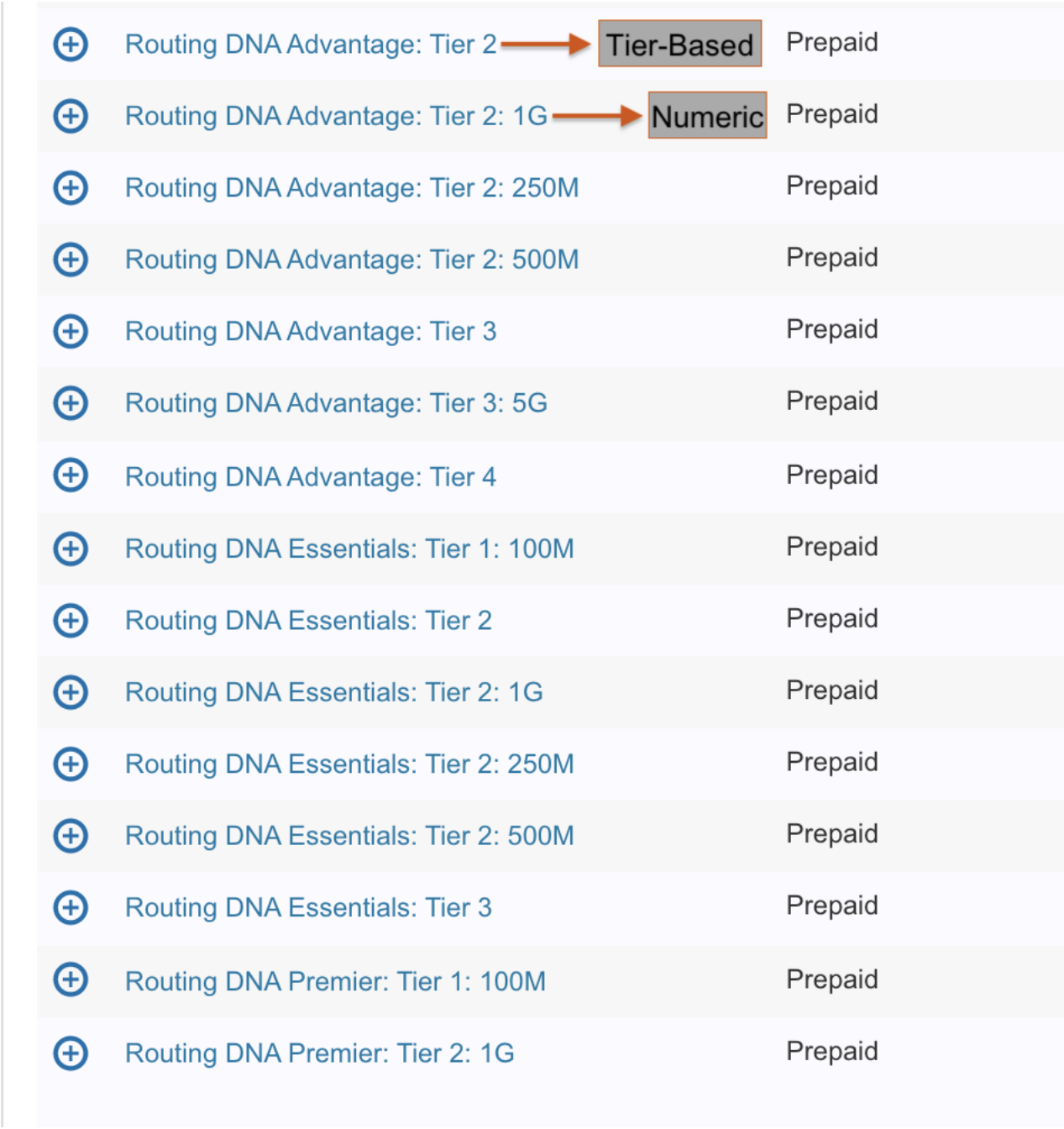
With the introduction of tier-based throughput configuration in Cisco IOS XE Cupertino 17.7.1a, when you configure throughput on the device, both numeric and tier-based options are available. This section provides information about when to configure a numeric throughput value and when to configure tier-based throughput.

Identifying whether you have tier-based or numeric licenses

Cisco Smart Software Manager (CSSM) is a portal that enables you to manage all your Cisco software licenses. All the license PIDs you purchase are listed in the CSSM Web UI at: https://software.cisco.com → **Manage licenses**. One way of identifying whether you have a tier-based or numeric licenses is to see how the license is displayed in CSSM.

To do this, log in to the portal and in the corresponding Smart Account and Virtual Account, navigate to **Inventory** > **Licences**, to display the licenses in the account. The screenshot below shows you how both are displayed:

Figure 2: Numeric and Tier Values Displayed in the CSSM Web UI



Recommendations for whether to configure a numeric or tier-based throughput value

- If you purchase a numeric license PID, the license is displayed with the numeric throughput value *and* tier-based value in the CSSM Web UI. For such a license, we recommend that you configure only a numeric throughput value.

  See Configuring a Numeric Throughput, on page 137.

- If you purchase a tier-based license PID, the license is displayed with only the tier value in the CSSM Web UI. For such a license, you can either configure a tier-based throughput value to match the display in the CSSM Web UI, or you can configure a numeric throughput value.

  See Configuring a Tier-Based Throughput, on page 140 or Configuring a Numeric Throughput, on page 137.

Note There is no functional impact if you have tier-based license PID in CSSM and you configure a numeric throughput value on the device.

When to *convert* the configured value to a numeric or tier-based one

The following scenarios further clarify when you can *convert* from numeric to tier-based throughput configuration, or from tier-based throughput configuration to numeric, when conversion is required, and when it is optional:

- You have configured a numeric throughput value on the device and the license PID is a numeric license: *You must not* convert to tier-based throughput value.
- You have configured a numeric throughput value on the device and the license PID is a tier-based license: You can convert the throughput configuration to tier-based value - but this is optional. There is no functional impact if you do not convert to a tier-based throughput value.

  If you want to convert to a tier-based value, see Converting From a Numeric Throughput Value to a Tier, on page 144
- You are upgrading to a release where tier-based throughput values are supported and the license PID is tier-based: You can convert the throughput to tier-based value after upgrade - but this is optional. There is no functional impact if you do not convert to a tier-based throughput value.

  See Upgrading from a Release Supporting Numeric Throughput to a Release Supporting Tiers, on page 146.
- You are upgrading to a release where tier-based throughput values are supported, and your license PID is numeric: *You must not* convert to a tier-based throughput value.
- You are downgrading to a release where only numeric throughput values are supported and your license PID and throughput configuration are tier-based: *You must* change configuration to a numeric throughput value, *before you downgrade.*

  See Downgrading from a Release Supporting Tiers to a Release Supporting Only Numeric Throughput, on page 147.

How to Configure Available Licenses and Throughput

This section provides information about the sequence in which you must complete tasks, for the various licenses available on the Cisco Catalyst 8000 Edge Platforms Family - before you can start using them.

For a Cisco DNA license: **Configure a Boot Level License → Configure Numeric or Tier-Based Throughput → Implement a Smart Licensing Using Policy Topology → Report License Usage (If Applicable)**.

For an HSECK9 license: **Configure a Boot Level License → Implement a Smart Licensing Using Policy Topology → Install SLAC**[3] **→ Enable HSECK9 on applicable platforms**[4] **→ Configure Numeric or Tier-Based Throughput → Report License Usage (If Applicable)**.

For a Cisco UBE, or Cisco Unified CME, or Cisco Unified SRST license: **Implement a Smart Licensing Using Policy Topology → Report License Usage (If Applicable)**.

Configuring a Boot Level License

If you have purchased a Cisco DNA license for a new device, or if you have an existing device and you want to change (upgrade or downgrade, add or remove) the currently configured license on your device, complete the following task.

This sets a boot level license and requires a reload before the configured changes are effective.

Step 1 **show version**

Displays the currently set boot level license.

In the accompanying example, Network Advantage and DNA Advantage licences are configured on the device.

Example:

```
Device# show version
<output truncated>
Technology Package License Information:

------------------------------------------------------------------
Technology     Type         Technology-package Technology-package
                            Current           Next Reboot
------------------------------------------------------------------
Smart License  Perpetual    network-advantage  network-advantage
Smart License  Subscription dna-advantage      dna-advantage

<output truncated>
```

Step 2 **configure terminal**

Enters global configuration mode.

Example:

```
Device# configure terminal
```

[3] If a SLAC has been factory-installed by Cisco (in case of new hardware), skip this step

[4] Enter the **license feature hseck9** command in global configuration mode for Catalyst 8200, and 8300 Series Edge Platforms only.

Step 3 Depending on whether the device is a physical or virtual one, configure the applicable command:

- For physical platforms: [**no**] **license boot level** {**network-advantage** [**addon dna-advantage**] | **network-essentials** [**addon dna-essentials**] | **network-premier** [**addon dna-premier**] }
- For virtual platforms: [**no**] **license boot level** {**network-advantage** {**addon dna-advantage**} | **network-essentials** {**addon dna-essentials**} | **network-premier** {**addon dna-premier**} }

Sets a boot level license.

On all platforms, first configure a network-stack license. Only after this can you configure the corresponding add-on license.

In the command syntax note how the configuration of a DNA-stack add-on license is optional on physical platforms, but mandatory on virtual platforms.

The accompanying example, shows configuration on a C8300-1N1S-4T2X router, which is a physical platform. The network-stack license, Network Premier and the corresponding add-on license, DNA-Premier are configured.

Example:

```
Device(config)# license boot level network-premier addon dna-premier
% use 'write' command to make license boot config take effect on next boot
```

Step 4 **exit**

Exits global configuration mode and returns to privileged EXEC mode.

Example:

```
Device# exit
```

Step 5 **copy running-config startup-config**

Saves your entries in the configuration file.

Example:

```
Device# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
<output truncated>
```

Step 6 **reload**

Reloads the device. License levels configured in Step 3 are effective and displayed only after this reload.

Example:

```
Device# reload
Proceed with reload? [confirm]

*Dec  8 01:04:12.287: %SYS-5-RELOAD: Reload requested by console.
Reload Reason: Reload Command.
<output truncated>
```

Step 7 **show version**

Displays the currently set boot level license.

In the accompanying example, the output confirms that Network Premier and DNA-Premier licenses are configured.

Example:

```
Device# show version
<output truncated>
```

```
Technology Package License Information:

------------------------------------------------------------------
Technology     Type         Technology-package Technology-package
                            Current            Next Reboot
------------------------------------------------------------------
Smart License  Perpetual    network-premier    network-premier
Smart License  Subscription dna-premier        dna-premier
<output truncated>
```

Step 8 **show license summary**

Displays a summary of license usage, which includes information about licenses being used, the count, and status.

Example:

```
Device# show license summary

Account Information:
  Smart Account: Eg-SA As of Dec 08 08:10:33 2021 UTC
  Virtual Account: Eg-VA

License Usage:
  License                 Entitlement Tag               Count Status
  -----------------------------------------------------------------------------
  network-premier_T2      (NWSTACK_T2_P)                    1 IN USE
  dna-premier_T2          (DSTACK_T2_P)                     1 IN USE
```

Step 9 Complete usage reporting - if required

After you configure a license level, you may have to send a RUM report (Resource Utilization Measurement Report) to CSSM to report license usage information. To know if reporting is required, you can wait for a system message or refer to the policy using show commands.

- The system message, which indicates that reporting is required: %SMART_LIC-6-REPORTING_REQUIRED: A Usage report acknowledgement will be required in [dec] days. [dec] is the amount of time (in days) left to meet reporting requirements.
- If using **show** commands, refer to the output of the **show license status** privileged EXEC command and check the `Next ACK deadline` field. This means a RUM report must be sent and the acknolwedgement (ACK) from CSSM must be installed by this date.

How you send the RUM report, depends on the topology you have implemented in the Smart Licensing Using Policy environment. For more information, see How to Configure Smart Licensing Using Policy: Workflows by Topology.

Installing SLAC for an HSECK9 License

A Smart Licensing Authorization Code (SLAC) is generated in and obtained from Cisco Smart Software Manager (CSSM) portal.

There are multiple ways in which a product may be connected to the CSSM, in order to obtain a SLAC. Each way of connecting to CSSM is called a topology. You must implement one of the supported topologies so you can then install SLAC in the corresponding method.

For information about all the methods, see the Supported Topologies section of the Smart Licensing Using Policy for Cisco Enterprise Routing Platforms document.

Note Ensure that a boot level license is already configured on the device. See Configuring a Boot Level License, on page 134. In the output of the show version privileged EXEC command ensure that a license is mentioned in the `License Level` field.

Required Tasks After Installing SLAC

Complete the following required tasks after installing SLAC - only if applicable to the platform:

Platform	Required Tasks After Installing SLAC
For Catalyst 8200 and 8300 Series Edge Platforms	Enter the **license feature hseck9** command in global configuration mode. This *enables* the HSECK9 license on these platforms.
For the *C8500L* models of the Catalyst 8500 Series Edge Platforms	Reload the device after installing SLAC.

Configuring a Numeric Throughput

This task shows you how to change the numeric throughput level on physical and virtual platforms. If you do not configure a throughput level, the platform's default throughput level is effective.

Configuration of a throughput level requires a reload on physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms). A reload is not required for virtual platforms (Catalyst 8000V Edge Software).

Before you begin

- Read sections Numeric and Tier-Based Throughput, on page 121 and Numeric vs. Tier-Based Throughput Configuration, on page 131.
- Ensure that a boot level license is already configured on the device. Otherwise you will not be able to configure a throughput value. See Configuring a Boot Level License, on page 134. In the output of the **show version** privileged EXEC command ensure that a license is mentioned in the `License Level` field.
- If you are configuring throughput greater than 250 Mbps, you must install a Smart Licensing Authorization Code (SLAC) before you start with this task. See Installing SLAC for an HSECK9 License, on page 136.
- You can configure the `250M` value with or without an HSECK9 license. The system allows both. The difference is that aggregate throttling is effective if HSECK9 is available on the device. See: Release-Wise Changes in Throttling Behavior, on page 123.
- Note the throughput you are entitled to. This is indicated in the Cisco DNA license PID you purchase.

Step 1 Depending on whether the device is a physical or virtual one, enter the applicable command:

- For physical platforms: **show platform hardware throughput crypto**
- For virtual platforms: **show platform hardware throughput level**

Displays the current throughput level on the device.

In the accompanying example:

- The **show platform hardware throughput crypto** sample output is of a physical platform (a C8300-2N2S-4T2X). Here the throughput level is throttled at 250M.
- The **show platform hardware throughput level** sample output is of a virtual platform (a C8000V).

Example:

```
Device# show platform hardware throughput crypto
Current configured crypto throughput level: 250M
     Level is saved, reboot is not required
Current enforced crypto throughput level: 250M
Crypto Throughput is throttled at 250M
Default Crypto throughput level: 10M
Current boot level is network-advantage

OR

Device# show platform hardware throughput level
The current throughput level is 1000000 kb/s
```

Step 2 **configure terminal**

Enters global configuration mode.

Example:

```
Device# configure terminal
```

Step 3 Depending on whether the device is a physical or virtual one, configure the applicable command:

- For physical platforms: **platform hardware throughput crypto** {**100M** | **10M** | **15M** | **1G** | **2.5G** | **250M** | **25M** | **500M** | **50M**}
- For virtual platforms: **platform hardware throughput level MB** {**100** | **1000** | **10000** | **15** | **25** | **250** | **2500** | **50** | **500** | **5000**}

Configures the throughput level. The displayed throughput options depend on the device.

Note On physical and virtual platforms, ensure that a boot level license is configured. Otherwise the command is not recognized as a valid one on the command line interface.

In the accompanying example:

- 1 Gbps is configured on the physical platform. The software version running on the device is Cisco IOS XE Cupertino 17.8.1a and this means aggregate throughput throttling applies. After reload, the sum of upstream and downstream throughput will not exceed the 2 Gbps limit.
- 5000 Mbps is configured on the virtual platform. The software version running on the device is Cisco IOS XE Cupertino 17.8.1a and this means Tx data is throttled at 5000 Mbps. Rx is unthrottled.

Example:

```
Device(config)# platform hardware throughput crypto ?
  100M  100 mbps bidirectional thput
  10M   10 mbps bidirectional thput
  15M   15 mbps bidirectional thput
  1G    2 gbps aggregate thput
  2.5G  5 gbps aggregate thput
  250M  250 mbps bidirectional thput
  25M   25 mbps bidirectional thput
  500M  1gbps aggregate thput
```

```
  50M   50 mbps bidirectional thput
Device(config)# platform hardware throughput crypto 1G
% These values don't take effect until the next reboot.
Please save the configuration.

OR

Device(config)# platform hardware throughput level MB 5000
%Throughput has been set to 5000 Mbps.
```

Step 4 **exit**

Exits global configuration mode and returns to privileged EXEC mode.

Example:

```
Device# exit
```

Step 5 **copy running-config startup-config**

Saves your entries in the configuration file.

Example:

```
Device# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Step 6 **reload**

Reloads the device.

Note Perform this step only if the device you are configuring throughput on a physical platform.

Skip this step if you are configuring throughput on a virtual platform.

Example:

```
Device# reload
```

Step 7 Depending on whether the device is a physical or virtual one, enter the applicable command:

- **For physical platforms: show platform hardware throughput crypto**
- **For virtual platforms: show platform hardware throughput level**

Displays the current throughput level on the device.

Tip On physical platforms, you can also enter the **show platform hardware qfp active feature ipsec state** privileged EXEC command to display the configured throughput level.

Example:

```
Device# show platform hardware throughput crypto
Current configured crypto throughput level: 1G
     Level is saved, reboot is not required
Current enforced crypto throughput level: 1G
Crypto Throughput is throttled at 2G(Aggregate)
Default Crypto throughput level: 10M

OR
```

```
Device# show platform hardware throughput level
The current throughput level is 5000000 kb/s
```

Configuring a Tier-Based Throughput

This task shows you how to configure a tier-based throughput level on physical and virtual platforms. If you do not configure a throughput level, the platform's default throughput level is effective.

Tier-based throughput levels are supported starting with Cisco IOS XE Cupertino 17.7.1a only.

Configuration of a throughput level requires a reload on physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms). A reload is not required for virtual platforms (Catalyst 8000V Edge Software).

Before you begin

- Read sections Numeric and Tier-Based Throughput, on page 121 and Numeric vs. Tier-Based Throughput Configuration, on page 131.
- Ensure that a boot level license is already configured on the device. Otherwise you will not be able to configure a throughput value. See Configuring a Boot Level License, on page 134. In the output of the **show version** privileged EXEC command ensure that a license is mentioned in the `License Level` field.
- If you are configuring Tier 2 (T2) or a higher tier, you must install a Smart Licensing Authorization Code (SLAC) before you start with this task. See Installing SLAC for an HSECK9 License, on page 136.
  - On physical platforms, T2 or higher tiers are not displayed if SLAC is not installed.
  - On virtual platforms, all tier options are displayed even if SLAC is not installed. But SLAC is required if you want to configure T2 or a higher tier.
- If you want to configure Tier 3 (T3) ensure that the boot level license is Network Advantage/ DNA Advantage, or Network Premier/DNA Premier. T3 and higher tiers are not supported with Network Essentials and DNA Essentials.
- You can configure the `T1` value with or without an HSECK9 license. The system allows both. The difference is that aggregate throttling is effective if HSECK9 is available on the device. See: Release-Wise Changes in Throttling Behavior, on page 123.
- Note the throughput you are entitled to. This is indicated in the Cisco DNA license PID you purchase.

Step 1 Depending on whether the device is a physical or virtual one, enter the applicable command:

- For physical platforms: **show platform hardware throughput crypto**
- For virtual platforms: **show platform hardware throughput level**

Displays the current throughput level on the device.

In the accompanying example:

- The **show platform hardware throughput crypto** sample output is of a physical platform (a C8300-2N2S-4T2X). Here throughput is currently throttled at 250 Mbps.

- The **show platform hardware throughput level** sample output is of a virtual platform (a C8000V). Here the current throughput level is 10 Mbps.

Example:

```
Device# show platform hardware throughput crypto
show platform hardware throughput crypto
Current configured crypto throughput level: 250M
     Level is saved, reboot is not required
Current enforced crypto throughput level: 250M
Crypto Throughput is throttled at 250M
Default Crypto throughput level: 10M
Current boot level is network-premier

OR

Device# show platform hardware throughput level
The current throughput level is 10000 kb/s
```

Step 2 **show license authorization**

(Optional) Displays SLAC information on the product instance.

In the accompanying example:

- SLAC is installed on the physical platform. This is so we can configure T2.
- SLAC is not available on the virtual platform. Note how this affects throughput configuration in the subsequent steps.

Example:

```
Device# show license authorization
Overall status:
  Active: PID:C8300-2N2S-4T2X,SN:FDO2250A0J5
      Status: SMART AUTHORIZATION INSTALLED on Mar 02 05:05:19 2022 UTC
      Last Confirmation code: 418b11b3

Authorizations:
  Router US Export Lic. for DNA (DNA_HSEC):
    Description: U.S. Export Restriction Compliance license for
    DNA based Routers
    Total available count: 1
    Enforcement type: EXPORT RESTRICTED
    Term information:
      Active: PID:C8300-1N1S-4T2X,SN:FDO2250A0J5
        Authorization type: SMART AUTHORIZATION INSTALLED
        License type: PERPETUAL
          Term Count: 1

Purchased Licenses:
  No Purchase Information Available

OR

Device# show license authorization
Overall status:
  Active: PID:C8000V,SN:9I8GRCH8CMN
      Status: NOT INSTALLED
```

Step 3 **configure terminal**

Enters global configuration mode.

Example:

```
Device# configure terminal
```

Step 4 Depending on whether the device is a physical or virtual one, configure the applicable command:

- For physical platforms: **platform hardware throughput crypto** {**T0** | **T1** | **T2** | **T3** | **T4** | **T5**}
- For virtual platforms: **platform hardware throughput level MB** {**T0** | **T1** | **T2** | **T3** | **T4** }

Configures a tier-based throughput. The throughput options that are displayed, depend on the device.

Note Only tiers are mentioned in command, for the sake of clarity. When you enter the command on the CLI, numeric and tier values are displayed - as shown in the accompanying example.

The following apply to both physical and virtual platforms:

- Ensure that you have configured a boot level license already. Otherwise the command for throughput configuration is not recognized as a valid one on the command line interface.
- If you are configuring T2 or a higher tier, you have installed SLAC.

  On a physical platform, you will not be able to configure T2 or a higher tier if SLAC is not installed.

  On a virtual platform, if you configure T2 or a higher tier without SLAC, the product instance automatically tries to reach CSSM to request and install SLAC. If it is successful, throughput is set to the configured tier. If it is not successful, the system sets the throughput *to* 250 Mbps. If and when SLAC is installed, the throughput is automatically set to the last configured value.

In the accompanying example:

- 1 Gbps is configured on the physical platform. The software version running on the device is Cisco IOS XE Cupertino 17.8.1a and this means aggregate throughput throttling applies. After reload, the sum of upstream and downstream throughput will not exceed the 2 Gbps limit.
- 5000 Mbps is configured on the virtual platform. The software version running on the device is Cisco IOS XE Cupertino 17.8.1a and this means Tx data is throttled at 5000 Mbps. Rx is unthrottled.
- On the physical platform (**platform hardware throughput crypto**), T2 and higher tiers are displayed, because SLAC is installed. If SLAC were not available, T1 would have been the highest tier displayed.

  The software version running on the device is Cisco IOS XE Cupertino 17.8.1a and this means aggregate throughput throttling applies. After reload, the sum of upstream and downstream throughput will not exceed the 2 Gbps limit.
- On the virtual platform (**platform hardware throughput level MB**), all tiers are displayed. After T2 is configured, the system message alerts you to the fact that the configuration is not set, because SLAC is not installed.

Example:

```
Device(config)# platform hardware throughput crypto ?
  100M  100 mbps bidirectional thput
  10M   10 mbps bidirectional thput
  15M   15 mbps bidirectional thput
  1G    2 gbps aggregate thput
  2.5G  5 gbps aggregate thput
  250M  250 mbps bidirectional thput
  25M   25 mbps bidirectional thput
  500M  1gbps aggregate thput
  50M   50 mbps bidirectional thput
  T0    T0(up to 15 mbps) bidirectional thput
  T1    T1(up to 100 mbps) bidirectional thput
  T2    T2(up to 2 gbps) aggregate thput
```

```
  T3    T3(up to 5 gbps) aggregate thput

Device(config)# platform hardware throughput crypto T2
% These values don't take effect until the next reboot.
Please save the configuration.
*Mar 02 05:06:19.042: %CRYPTO_SL_TP_LEVELS-6-SAVE_CONFIG_AND_RELOAD:
New throughput level not applied until reload; please save config

OR
Device(config)# platform hardware throughput level MB ?
  100    Mbps
  1000   Mbps
  10000  Mbps
  15     Mbps
  25     Mbps
  250    Mbps
  2500   Mbps
  50     Mbps
  500    Mbps
  5000   Mbps
  T0     Tier0(up to 15M throughput)
  T1     Tier1(up to 100M throughput)
  T2     Tier2(up to 1G throughput)
  T3     Tier3(up to 10G throughput)
  T4     Tier4(unthrottled)

Device(config)# platform hardware throughput level MB T2
%Requested throughput will be set once HSEC authorization
code is installed
```

Step 5 **exit**

Exits global configuration mode and returns to privileged EXEC mode.

Example:

```
Device# exit
```

Step 6 **copy running-config startup-config**

Saves your entries in the configuration file.

Example:

```
Device# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Step 7 **reload**

Reloads the device.

Note Perform this step only if the device you are configuring throughput on a physical platform.

Skip this step if you are configuring throughput on a virtual platform.

Example:

```
Device# reload
```

Step 8 Depending on whether the device is a physical or virtual one, enter the applicable command:

- **For physical platforms: show platform hardware throughput crypto**
- **For virtual platforms: show platform hardware throughput level**

Displays the current throughput level on the device.

In the accompanying example:

- On the physical platform, the tier value is set to T2.

  Tip On a physical platform, you can also enter the **show platform hardware qfp active feature ipsec state** privileged EXEC command to display the configured throughput level.

- On the virtual platform, throughput is set to 250 Mbps. If and when SLAC is installed, the throughput will be automatically set to the last configured value, which is T2.

Example:

```
Device# show platform hardware throughput crypto
Current configured crypto throughput level: T2
     Level is saved, reboot is not required
Current enforced crypto throughput level: 1G
Crypto Throughput is throttled at 2G(Aggregate)
Default Crypto throughput level: 10M
Current boot level is network-premier

OR

Device# show platform hardware throughput level
The current throughput level is 250000 kb/s
```

Converting From a Numeric Throughput Value to a Tier

This task shows you how to convert a numeric throughput value to a tier-based throughput value. To know how numeric throughput values are mapped to tier values refer to the table here:Tier and Numeric Throughput Mapping, on page 124 .

Converting the throughput level requires a reload on physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms). A reload is not required for virtual platforms (Catalyst 8000V Edge Software).

Before you begin

- Read section Numeric vs. Tier-Based Throughput Configuration, on page 131.
- If you are converting numeric throughput that is equal or greater than 250 Mbps, ensure that a SLAC is installed on the device. See Installing SLAC for an HSECK9 License, on page 136.
- The software version running on the device is Cisco IOS XE Cupertino 17.7.1a or a later release.

Step 1 Depending on whether the device is a physical or virtual one, enter the applicable command:

- For physical platforms: **show platform hardware throughput crypto**
- For virtual platforms: **show platform hardware throughput level**

Displays the currently running throughput on the device.

Example:

```
Device# show platform hardware throughput crypto
Current configured crypto throughput level: 500M
     Level is saved, reboot is not required
Current enforced crypto throughput level: 500M
Crypto Throughput is throttled at 500M
Default Crypto throughput level: 10M
Current boot level is network-premier

OR

Device# show platform hardware throughput level
The current throughput level is 100000 kb/s
```

Step 2 Depending on whether the device is a physical or virtual one, enter the applicable command:

- For physical platforms: **license throughput crypto auto-convert**
- For virtual platforms: **license throughput level auto-convert**

Converts the numeric throughput to a tier-based throughput value. The converted tier value is displayed on the CLI.

Example:

```
Device# license throughput crypto auto-convert
Crypto throughput auto-convert from level 500M to T2

% These values don't take effect until the next reboot.
Please save the configuration.
*Dec  8 03:21:01.401: %CRYPTO_SL_TP_LEVELS-6-SAVE_CONFIG_AND_RELOAD:
New throughput level
not applied until reload; please save config

OR

Device# license throughput level auto-convert
%Throughput tier set to T1 (100 Mbps)
% Tier conversion is successful.
Please write memory to save the tier config
```

Step 3 **copy running-config startup-config**

Saves your entries in the configuration file.

Note Even though the command you use to convert from numeric to tier-based throughput is a privileged EXEC command, it changes running configuration from a numeric value to a tier-based value. You must therefore save configuration for the next reload to be displayed with a tier value.

Example:

```
Device# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Step 4 **reload**

Reloads the device.

Note A reload is required only on physical platforms.

Example:

```
Device# reload
Proceed with reload? [confirm]
*Dec  8 03:24:09.534: %SYS-5-RELOAD: Reload requested by console.
```

```
Reload Reason:
Reload Command
```

Step 5 Depending on whether the device is a physical or virtual one, enter the applicable command:

- For physical platforms: **show platform hardware throughput crypto**
- For virtual platforms: **show platform hardware throughput level**

Displays the currently running throughput on the device.

Example:

```
Device# show platform hardware throughput crypto
Current configured crypto throughput level: T2
     Level is saved, reboot is not required
Current enforced crypto throughput level: 1G
Crypto Throughput is throttled at 1G
Default Crypto throughput level: 10M
Current boot level is network-premier


OR

Device# show platform hardware throughput level
The current throughput level is 100000 kb/s
```

Step 6 Verify that conversion is complete.

- For physical platforms: **license throughput crypto auto-convert**
- For virtual platforms: **license throughput level auto-convert**

Tip To cross-check that conversion is complete, you can also enter the conversion command again. If the numeric throughput value has already been converted, the system displays a message confirming this.

Example:

```
Device# license throughput crypto auto-convert
Crypto throughput is already tier based, no need to convert.

OR

Device# license throughput level auto-convert
% Tier conversion not possible since the device is already
in tier licensing
```

Upgrading from a Release Supporting Numeric Throughput to a Release Supporting Tiers

If you are upgrading to Cisco IOS XE Cupertino 17.7.1 or later release ***and*** the license PID is a tier-based one, you can convert throughput configuration to a tier-based value, or you can retain the numeric throughput configuration.

Note There is no functional impact if you have tier-based license PID in CSSM and a numeric throughput value is configured on the device.

If you want to convert to a tier-based value note the required action depending on the throughput level that is configured:

Throughput Configuration Before Upgrade	Action Before Upgrade	Action After Upgrade to 17.7.1 or Later
Lesser than 250 Mbps	No action required.	Converting From a Numeric Throughput Value to a Tier, on page 144
Equal to 250 Mbps	Obtain an HSECK9 license and install SLAC if you want to convert to T2.	Converting From a Numeric Throughput Value to a Tier, on page 144
Greater than 250 Mbps	No action required.	Converting From a Numeric Throughput Value to a Tier, on page 144

Downgrading from a Release Supporting Tiers to a Release Supporting Only Numeric Throughput

If you are downgrading to a release where only numeric throughput configuration is supported, you *must* convert tier-based throughput configuration to a numeric throughput value before downgrade. This is applicable even if the license PID is a tier-based license PID.

Caution If a tier-based throughput value was configured before downgrade and you downgrade without changing to a numeric value, tier configuration is not recognized by a pre-17.7.1 image and configuration fails. Further, throughput may not be restored to the pre-downgrade level and you have to configure a numeric throughput level after downgrade.

Throughput Configuration Before Downgrade	Action Before Downgrade	Action After Downgrade to a pre-17.7.1 Version
Numeric	No action required.	No action required.
Tier	Configuring a Numeric Throughput, on page 137	No action required.

Available Licensing Models

The licensing model defines *how* you account for or report the licenses that you use, to Cisco. The following licensing models are available on the Cisco Catalyst 8000 Edge Platforms Family:

Smart Licensing Using Policy

With this licensing model, you purchase the licenses you want to use, configure them on the device, and then report license usage – as required. You do not have to complete any licensing-specific operations, such as registering or generating keys before you start using the software and the licenses that are tied to it - unless you are using export-controlled and enforced licenses.

This licensing model is supported on all products in the Cisco Catalyst 8000 Edge Platforms Family.

For more information, see Smart Licensing Using Policy for Cisco Enterprise Routing Platforms.

Pay As You Go (PAYG) Licensing

Note This licensing model is available only on Catalyst 8000V Edge Software.

Cisco Catalyst 8000V supports the PAYG licensing model with Amazon Web Services (AWS) and Microsoft Azure Marketplace - in both the autonomous mode and the controller mode. The Cisco Catalyst 8000V hourly-billed Amazon Machine Image (AMI) or the Pay As You Go licensing model allows you to consume an instance for a defined period of time.

- In the autonomous mode, you can directly launch an instance from the AWS or Azure Marketplace and start using it. The licenses are embedded in the image and the selected license package and configured throughput level are effective when you launch the instance
- In the controller mode, which is supported from Cisco IOS-XE Bengaluru 17.5.1, you must first onboard the device into Cisco SD-WAN as per Onboard Cisco Catalyst 8000V Edge Software Hosted by a Cloud Service, Using PAYG Licensing. After this, when you launch the instance from AWS, the device comes-up with the license already installed for unlimited throughput.

Managed Service Licensing Agreement

A Managed Service License Agreement (MSLA) is a buying program agreement, designed for Service Providers.

- **MSLA in Cisco SD-WAN Controller Mode**

  In the Cisco SD-WAN controller mode, an MSLA is supported on all products in the Cisco Catalyst 8000 Edge Platforms Family. For more information, see:

  Managed Service Licensing Agreement (MSLA) for Cisco SD-WAN At-a-Glance

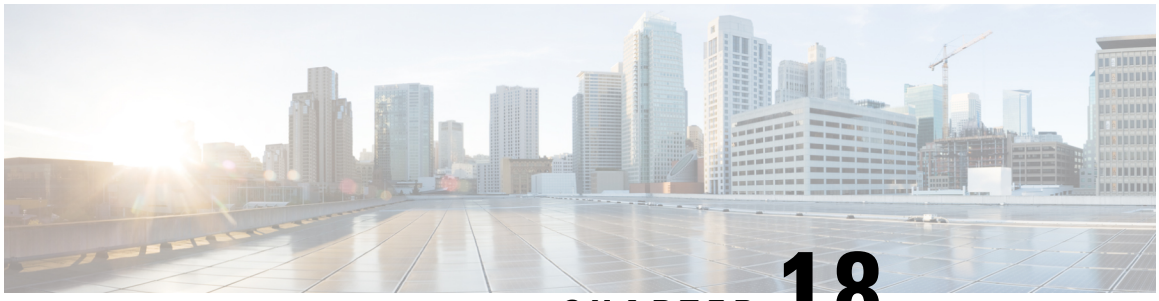
  Cisco SD-WAN Getting Started Guide → *Manage Licenses for Smart Licensing Using Policy*.

  Cisco vManage How-Tos for Cisco IOS XE SD-WAN Devices → *Manage Licenses for Smart Licensing Using Policy*.

- **MSLA in Autonomous Mode**

  In the autonomous mode, an MSLA is available only with Catalyst 8000V Edge Software, starting from Cisco IOS XE Cupertino 17.9.1a.

  For more information, see: MSLA.



CHAPTER 18

Consolidated Package Management

This chapter discusses how consolidated packages are managed and are used to run the Cisco Catalyst 8500 Series Edge Platforms.

Note This process is not applicable for C8500L-8S4X.

It contains the following sections:

Running the Cisco Catalyst 8500 Series Edge Platforms: An Overview

The Cisco Catalyst 8500 Series Edge Platforms can be run using a complete consolidated package.

This section covers the following topics:

Running the Cisco Catalyst 8500 Series Edge Platforms Using a Consolidated Package: An Overview

The Cisco Catalyst 8500 Series Edge Platforms can be configured to run using a consolidated package.

When the router is configured to run using a consolidated package, the entire consolidated package file is copied onto the router or accessed by the router via TFTP or another network transport method. The router runs using the consolidated package file.

When a Cisco Catalyst 8500 Series Edge Platforms is configured to run using the consolidated package file, more memory is required to process router requests because the router has to search one larger file for every request. The peak amount of memory available for passing network traffic is therefore lower when the router is configured to run using a consolidated package.

A Cisco Catalyst 8500 Series Edge Platforms configured to run using a consolidated package is booted by booting the consolidated package file.

A consolidated package can be booted and utilized using TFTP or another network transport method.Running the router using a consolidated package may be the right method of running the router in certain networking environments.

The consolidated package should be stored on bootflash:, usb[0-1]:, or a remote file system when this method is used to run the router.

Running the Cisco Catalyst 8500 Series Edge Platforms: A Summary

This section summarizes the advantages and disadvantages of each method of running your Cisco Catalyst 8500 Series Edge Platforms.

The advantages of running your router using a consolidated package include:

- Simplified installation—Only one software file needs to be managed instead of several separate images.
- Storage—A consolidated package can be used to run the router while being stored in bootflash:, on a USB Flash disk, or on a network server. A consolidated package can be booted and utilized using TFTP or another network transport method.

Software File Management Using Command Sets

Software files can be managed on the Cisco Catalyst 8500 Series Edge Platforms using three distinct command sets. This section provides overviews of the following command sets:

The request platform Command Set

The **request platform software package** command is part of the larger **request platform** command set being introduced on the Cisco Catalyst 8500 Series Edge Platforms. For additional information on each **request platform** command and the options available with each command, see the *Cisco IOS Configuration Fundamentals Command Reference* .

The **request platform software package** command, which can be used to upgrade individual subpackages and a complete consolidated package, is used to upgrade software on the Cisco Catalyst 8500 Series Edge Platforms. Notably, the **request platform software package** command is the recommended way of performing an individual subpackage upgrade, and also provides the only method of no-downtime upgrades of individual subpackages on the router when the router is running individual subpackages.

The **request platform software package** command requires that the destination device or process be specified in the command line, so the commands can be used to upgrade software on both an active or a standby processor. The **request platform software package** command allows for no downtime software upgrades in many scenarios.

The basic syntax of the command is **request platform software package install rp** *rp-slot-number* **file** *file-URL*, where *rp-slot-number* is the number of the RP slot and *file-URL* is the path to the file being used to upgrade the Cisco Catalyst 8500 Series Edge Platforms. The command has other options; see the **request platform software package** command references for information on all of the options available with this command set.

The copy Command

To upgrade a consolidated package on the Cisco Catalyst 8500 Series Edge Platforms, copy the consolidated package onto a file system, usually bootflash: or usb[0-1]: on the router, using the **copy** command as you would on most other Cisco routers. After making this copy, configure the router to boot using the consolidated package file.

See the **copy** command reference for a list of the options that are available with the **copy** command.

Managing and Configuring the Router to Run Using Consolidated Packages

This section discusses the following topics:

Quick Start Software Upgrade

The following instructions provide a quick start version of upgrading the software running the Cisco Catalyst 8500 Series Edge Platforms. These instructions assume you have access to the consolidated package and that the files will be stored in a bootflash: file system and has enough room for the file or files.

For more detailed installation examples, see the other sections of this chapter.

To upgrade the software using a quick start version, perform the following steps:

SUMMARY STEPS

1. Copy the consolidated package into bootflash: using the **copy** *URL-to-image* **bootflash:** command.
2. Enter the **dir bootflash:** command to verify your consolidated package in the directory.
3. Set up the boot parameters for your boot. Set the configuration register to 0x2 by entering the **config-register 0x2102** global configuration command, and enter the **boot system flash bootflash:***image-name*
4. Enter **copy running-config startup-config** to save your configuration.
5. Enter the **reload** command to reload the router and finish the boot. The upgraded software should be running when the reload completes.

DETAILED STEPS

Step 1 Copy the consolidated package into bootflash: using the **copy** *URL-to-image* **bootflash:** command.

Step 2 Enter the **dir bootflash:** command to verify your consolidated package in the directory.

Step 3 Set up the boot parameters for your boot. Set the configuration register to 0x2 by entering the **config-register 0x2102** global configuration command, and enter the **boot system flash bootflash:***image-name*

Step 4 Enter **copy running-config startup-config** to save your configuration.

Step 5 Enter the **reload** command to reload the router and finish the boot. The upgraded software should be running when the reload completes.

Managing and Configuring a Router to Run Using a Consolidated Package

This section documents the following procedures:

Managing and Configuring a Consolidated Package Using the copy Command

To upgrade a consolidated package on the Cisco Catalyst 8500 Series Edge Platforms using the **copy** command, copy the consolidated package into the bootflash: directory on the router using the **copy** command as you would on most other Cisco routers. After making this copy, configure the router to boot using the consolidated package file.

In the following example, the consolidated package file is copied onto the bootflash: file system from TFTP. The config-register is then set to boot using **boot system** commands, and the **boot system** commands instruct the router to boot using the consolidated package stored in the bootflash: file system. The new configuration is then saved using the **copy running-config startup-config** command, and the system is then reloaded to complete the process.

```
Router# dir bootflash:
Directory of bootflash:/
   11  drwx       16384   Dec 4 2007 04:32:46 -08:00  lost+found
86401  drwx        4096   Dec 4 2007 06:06:24 -08:00  .ssh
14401  drwx        4096   Dec 4 2007 06:06:36 -08:00  .rollback_timer
28801  drwx        4096  Mar 18 2008 17:31:17 -07:00  .prst_sync
43201  drwx        4096   Dec 4 2007 04:34:45 -08:00  .installer
   13  -rw-       45977   Apr 9 2008 16:48:46 -07:00  target_support_output.tgz.tgz
928862208 bytes total (712273920 bytes free)
Router# copy tftp bootflash:



Router# dir bootflash:


Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.

Router# reload
```

Managing and Configuring a Consolidated Package Using the request platform software package install Command

In the following example, the **request platform software package install** command is used to upgrade a consolidated package running on RP 0. The **force** option, which forces the upgrade past any prompt (such as already having the same consolidated package installed), is used in this example.

```
Router# request platform software package install rp 0 file bootflash: force

--- Starting installation state synchronization ---
Finished installation state synchronization
--- Starting file path checking ---
Finished file path checking
--- Starting image file verification ---
Checking image file names
Verifying image file locations
Locating image files and validating name syntax
Inspecting image file types
Processing image file constraints
```

```
Extracting super package content
Verifying parameters
Validating package type
Copying package files
Checking and verifying packages contained in super package
Creating candidate provisioning file

  WARNING:
  WARNING: Candidate software will be installed upon reboot
  WARNING:

Finished image file verification
--- Starting candidate package set construction ---
Verifying existing software set
Processing candidate provisioning file
Constructing working set for candidate package set
Constructing working set for running package set
Checking command output
Constructing merge of running and candidate packages
Finished candidate package set construction
--- Starting compatibility testing ---
Determining whether candidate package set is compatible
WARNING:
WARNING: Candidate software combination not found in compatibility database
WARNING:
Determining whether installation is valid
Determining whether installation is valid ... skipped
Checking IPC compatibility with running software
Checking IPC compatibility with running software ... skipped
Checking candidate package set infrastructure compatibility
Checking infrastructure compatibility with running software
Checking infrastructure compatibility with running software ... skipped
Finished compatibility testing
--- Starting commit of software changes ---
Updating provisioning rollback files
Creating pending provisioning file
Committing provisioning file
Finished commit of software changes
SUCCESS: Software provisioned.  New software will load on reboot.
```

Router# **reload**

Note A reload must be performed to finish this procedure.The Managing and Configuring a Consolidated Package Using the copy Command, on page 152 includes an example of how to configure the router to boot using the consolidated package, and then an example of what happens after the reload is performed to finish the installation.

Installing the Software Using install Commands

From Cisco IOS XE Cupertino 17.7.1a, Cisco Catalyst 8000 Edge platforms are shipped in install mode by default. Users can boot the platform, and upgrade or downgrade to Cisco IOS XE software versions using a set of **install** commands.

Restrictions for Installing the Software Using install Commands

- ISSU is not covered in this feature.
- Install mode requires a reboot of the system.

Information About Installing the Software Using install Commands

From Cisco IOS XE Cupertino 17.7.1a release, for routers shipped in install mode, a set of **install** commands can be used for starting, upgrading and downgrading of platforms in install mode. This update is applicable to the Cisco Catalyst 8000 Edge platforms.

The following table describes the differences between Bundle mode and Install mode:

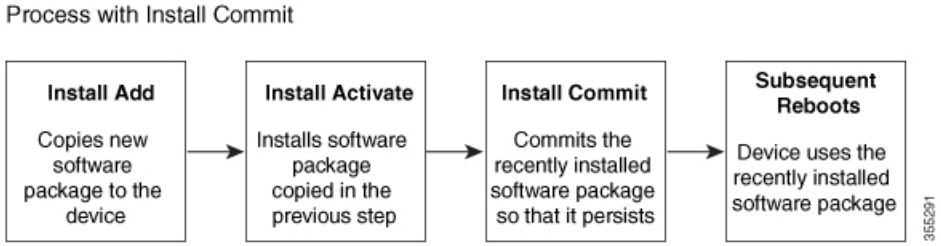
Table 32: Bundle Mode vs Install Mode

Bundle Mode	Install Mode
This mode provides a consolidated boot process, using local (hard disk, flash) or remote (TFTP) .bin image.	This mode uses the local (bootflash) packages.conf file for the boot process.
This mode uses a single .bin file.	.bin file is replaced with expanded .pkg files in this mode.
CLI: `#boot system file <filename>`	CLI: `#install add file bootflash: [activate commit]`
To upgrade in this mode, point the boot system to the new image.	To upgrade in this mode, use the **install** commands.
Image Auto-Upgrade: When a new Field-Replaceable Unit (FRU) is inserted in a modular chassis, manual intervention is required to get the new FRU running with the same version as the active FRUs.	Image Auto-Upgrade: When a new FRU is inserted in a modular chassis, the joining FRU is auto-upgraded to the image version in sync with the active FRUs.
Rollback: Rollback to the previous image with multiple Software Maintenance Updates (SMUs) may require multiple reloads.	Rollback: Enables rollback to an earlier version of Cisco IOS XE software, including multiple patches in single reload.

Install Mode Process Flow

The install mode process flow comprises three commands to perform installation and upgrade of software on platforms–**install add**, **install activate**, and **install commit**.

The following flow chart explains the install process with **install** commands:



The **install add** command copies the software package from a local or remote location to the platform. The location can be FTP, HTTP, HTTPs, or TFTP. The command extracts individual components of the .package file into subpackages and packages.conf files. It also validates the file to ensure that the image file is specific to the platform on which it is being installed.

The **install activate** command performs the required validations and provisions the packages previously added using the **install add** command. It also triggers a system reload.

The **install commit** command confirms the packages previously activated using the **install activate** command, and makes the updates persistent over reloads.

Note Installing an update replaces any previously installed software image. At any time, only one image can be installed in a device.

The following set of install commands is available:

Table 33: List of install Commands

Command	Syntax	Purpose
install add	**install add file** *location:filename.bin*	Copies the contents of the image, package, and SMUs to the software repository. File location may be local or remote. This command does the following: • Validates the file–checksum, platform compatibility checks, and so on. • Extracts individual components of the package into subpackages and packages.conf • Copies the image into the local inventory and makes it available for the next steps.

Command	Syntax	Purpose
install activate	**install activate**	Activates the package added using the **install add** command. • Use the **show install summary** command to see which image is inactive. This image will get activated. • System reloads on executing this command. Confirm if you want to proceed with the activation. Use this command with the **prompt-level none** keyword to automatically ignore any confirmation prompts.
(install activate) auto abort-timer	**install activate auto-abort timer** *<30-1200>*	The **auto-abort timer** starts automatically, with a default value of 120 minutes. If the **install commit** command is not executed within the time provided, the activation process is terminated, and the system returns to the last-committed state. • You can change the time value while executing the **install activate** command. • The **install commit** command stops the timer, and continues the installation process. • The **install activate auto-abort timer stop** command stops the timer without committing the package. • Use this command with the **prompt-level none** keyword to automatically ignore any confirmation prompts. • This command is valid only in the three-step install variant.

Command	Syntax	Purpose
install commit	**install commit**	Commits the package activated using the **install activate** command, and makes it persistent over reloads. • Use the **show install summary** command to see which image is uncommitted. This image will get committed.
install abort	**install abort**	Terminates the installation and returns the system to the last-committed state. • This command is applicable only when the package is in activated status (uncommitted state). • If you have already committed the image using the **install commit** command, use the **install rollback to** command to return to the preferred version.
install remove	**install remove {file** <*filename*> **| inactive}**	Deletes inactive packages from the platform repository. Use this command to free up space. • **file**: Removes specified files. • **inactive**: Removes all the inactive files.

Command	Syntax	Purpose
install rollback to	**install rollback to {base | label | committed | id}**	Rolls back the software set to a saved installation point or to the last-committed installation point. The following are the characteristics of this command: • Requires reload. • Is applicable only when the package is in committed state. • Use this command with the **prompt-level none** keyword to automatically ignore any confirmation prompts. **Note** If you are performing install rollback to a previous image, the previous image must be installed in install mode. Only SMU rollback is possible in bundle mode.
install deactivate	**install deactivate file** <*filename*>	Removes a package from the platform repository. This command is supported only for SMUs. • Use this command with the **prompt-level none** keyword to automatically ignore any confirmation prompts.

The following show commands are also available:

Table 34: List of show Commands

Command	Syntax	Purpose
show install log	**show install log**	Provides the history and details of all install operations that have been performed since the platform was booted.
show install package	**show install package** <*filename*>	Provides details about the .pkg/.bin file that is specified.

Command	Syntax	Purpose
show install summary	**show install summary**	Provides an overview of the image versions and their corresponding install states for all the FRUs. • The table that is displayed will state for which FRUs this information is applicable. • If all the FRUs are in sync in terms of the images present and their state, only one table is displayed. • If, however, there is a difference in the image or state information among the FRUs, each FRU that differs from the rest of the stack is listed in a separate table.
show install active	**show install active**	Provides information about the active packages for all the FRUs. If there is a difference in the information among the FRUs, each FRU that differs from the rest of the stack is listed in a separate table.
show install inactive	**show install inactive**	Provides information about the inactive packages, if any, for all the FRUs. If there is a difference in the information among the FRUs, each FRU that differs from the rest of the stack is listed in a separate table.
show install committed	**show install committed**	Provides information about the committed packages for all the FRUs. If there is a difference in the information among the FRUs, each FRU that differs from the rest of the stack is listed in a separate table.

Command	Syntax	Purpose
show install uncommitted	**show install uncommitted**	Provides information about uncommitted packages, if any, for all the FRUs. If there is a difference in the information among the FRUs, each FRU that differs from the rest of the stack is listed in a separate table.
show install rollback	**show install rollback {point-id | label}**	Displays the package associated with a saved installation point.
show version	**show version [rp-slot] [installed [user-interface] | provisioned | running]**	Displays information about the current package, along with hardware and platform information.

Booting the Platform in Install Mode

You can install, activate, and commit a software package using a single command (one-step install) or multiple separate commands (three-step install).

If the platform is working in bundle mode, the one-step install procedure must be used to initially convert the platform from bundle mode to install mode. Subsequent installs and upgrades on the platform can be done with either one-step or three-step variants.

One-Step Installation or Converting from Bundle Mode to Install Mode

Note

- All the CLI actions (for example, add, activate, and so on) are executed on all the available FRUs.
- The configuration save prompt will appear if an unsaved configuration is detected.
- The reload prompt will appear after the second step in this workflow. Use the **prompt-level none** keyword to automatically ignore the confirmation prompts.
- If the prompt-level is set to None, and there is an unsaved configuration, the install fails. You must save the configuration before reissuing the command.

Use the one-step install procedure described below to convert a platform running in bundle boot mode to install mode. After the command is executed, the platform reboots in install boot mode.

Later, the one-step install procedure can also be used to upgrade the platform.

This procedure uses the **install add file activate commit** command in privileged EXEC mode to install a software package, and to upgrade the platform to a new version.

SUMMARY STEPS

1. **enable**
2. **install add file location:** *filename* [**activate commit**]
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**install add file location:** *filename* [**activate commit**] **Example:** `Device#install add file bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bin activate commit`	Copies the software install package from a local or remote location (through FTP, HTTP, HTTPs, or TFTP) to the platform and extracts the individual components of the .package file into subpackages and packages.conf files. It also performs a validation and compatibility check for the platform and image versions, activates the package, and commits the package to make it persistent across reloads. The platform reloads after this command is run.
Step 3	**exit** **Example:** `Device#exit`	Exits privileged EXEC mode and returns to user EXEC mode.

Three-Step Installation

Note

- All the CLI actions (for example, add, activate, and so on) are executed on all the available FRUs.
- The configuration save prompt will appear if an unsaved configuration is detected.
- The reload prompt will appear after the install activate step in this workflow. Use the **prompt-level none** keyword to automatically ignore the confirmation prompts.

The three-step installation procedure can be used only after the platform is in install mode. This option provides more flexibility and control to the customer during installation.

This procedure uses individual **install add**, **install activate**, and **install commit** commands for installing a software package, and to upgrade the platform to a new version.

SUMMARY STEPS

1. **enable**
2. **install add file location:** *filename*
3. **show install summary**
4. **install activate** [**auto-abort-timer** <*time*>]

5. **install abort**
6. **install commit**
7. **install rollback to committed**
8. **install remove** {**file** *filesystem: filename* | **inactive**}
9. **show install summary**
10. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**install add file location:** *filename* **Example:** `Device#install add file bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bin`	Copies the software install package from a remote location (through FTP, HTTP, HTTPs, or TFTP) to the platform, and extracts the individual components of the .package file into subpackages and packages.conf files.
Step 3	**show install summary** **Example:** `Device#show install summary`	(Optional) Provides an overview of the image versions and their corresponding install state for all the FRUs.
Step 4	**install activate** [**auto-abort-timer** <*time*>] **Example:** `Device# install activate auto-abort-timer 120`	Activates the previously added package and reloads the platform. • When doing a full software install, do not provide a package filename. • In the three-step variant, **auto-abort-timer** starts automatically with the **install activate** command; the default for the timer is 120 minutes. If the **install commit** command is not run before the timer expires, the install process is automatically terminated. The platform reloads and boots up with the last committed version.
Step 5	**install abort** **Example:** `Device#install abort`	(Optional) Terminates the software install activation and returns the platform to the last committed version. • Use this command only when the image is in activated state, and not when the image is in committed state.
Step 6	**install commit** **Example:** `Device#install commit`	Commits the new package installation and makes the changes persistent over reloads.

	Command or Action	Purpose
Step 7	**install rollback to committed** **Example:** `Device#install rollback to committed`	(Optional) Rolls back the platform to the last committed state.
Step 8	**install remove** {**file** *filesystem: filename* | **inactive**} **Example:** `Device#install remove inactive`	(Optional) Deletes software installation files. • **file**: Deletes a specific file • **inactive**: Deletes all the unused and inactive installation files.
Step 9	**show install summary** **Example:** `Device#show install summary`	(Optional) Displays information about the current state of the system. The output of this command varies according to the **install** commands run prior to this command.
Step 10	**exit** **Example:** `Device#exit`	Exits privileged EXEC mode and returns to user EXEC mode.

Upgrading in Install Mode

Use either the one-step installation or the three-step installation to upgrade the platform in install mode.

Downgrading in Install Mode

Use the **install rollback** command to downgrade the platform to a previous version by pointing it to the appropriate image, provided the image you are downgrading to was installed in install mode.

The **install rollback** command reloads the platform and boots it with the previous image.

Note The **install rollback** command succeeds only if you have not removed the previous file using the **install remove inactive** command.

Alternatively, you can downgrade by installing the older image using the **install** commands.

Terminating a Software Installation

You can terminate the activation of a software package in the following ways:

- When the platform reloads after activating a new image, the auto-abort-timer is triggered (in the three-step install variant). If the timer expires before issuing the **install commit** command, the installation process is terminated, and the platform reloads and boots with the last committed version of the software image.

  Alternatively, use the **install auto-abort-timer stop** command to stop this timer, without using the **install commit** command. The new image remains uncommitted in this process.

- Using the **install abort** command returns the platform to the version that was running before installing the new software. Use this command before issuing the **install commit** command.

Configuration Examples for Installing the Software Using install Commands

The following is an example of the one-step installation or converting from bundle mode to install mode:

```
Router# install add file
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bin
 activate commit
install_add_activate_commit: START Thu Oct 28 21:57:21 UTC 2021

System configuration has been modified.
Press Yes(y) to save the configuration and proceed.
Press No(n) for proceeding without saving the configuration.
Press Quit(q) to exit, you may save configuration and re-enter the command. [y/n/q]y
Building configuration...

[OK]Modified configuration has been saved

*Oct 28 21:57:39.818: %SYS-6-PRIVCFG_ENCRYPT_SUCCESS: Successfully encrypted private config
 file
*Oct 28 21:57:39.925: %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started install
 one-shot
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bininstall_add_activate_commit:
 Adding PACKAGE
install_add_activate_commit: Checking whether new add is allowed ....

--- Starting Add ---
Performing Add on Active/Standby
  [1] Add package(s) on R0
  [1] Finished Add on R0
Checking status of Add on [R0]
Add: Passed on [R0]
Finished Add

Image added. Version: 17.07.01.0.1515
install_add_activate_commit: Activating PACKAGE
Following packages shall be activated:
/bootflash/c8000be-rpboot.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-mono-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_sm_nim_adpt.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_sm_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_sm_async.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_sm_1t3e3.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_sm_10g.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_xdsl.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_ssd.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_shdsl.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_cwan.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_bri_st_fw.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_nim_async.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_ngwic_t1e1.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_dsp_tilegx.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_dsp_analogbri.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
/bootflash/c8000be-firmware_dreamliner.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
```

```
This operation may require a reload of the system. Do you want to proceed? [y/n]y
--- Starting Activate ---
Performing Activate on Active/Standby

*Oct 28 22:05:49.484: %INSTALL-5-INSTALL_AUTO_ABORT_TIMER_PROGRESS: R0/0: rollback_timer:
Install auto abort timer will expire in 7200 seconds  [1] Activate package(s) on R0
  [1] Finished Activate on R0
Checking status of Activate on [R0]
Activate: Passed on [R0]
Finished Activate

--- Starting Commit ---
Performing Commit on Active/Standby
  [1] Commit package(s) on R0

Building configuration...
  [1] Finished Commit on R0
Checking status of Commit on [R0]
Commit: Passed on [R0]
Finished Commit

[OK]
*Oct 28 22:06:55.375: %SYS-6-PRIVCFG_ENCRYPT_SUCCESS: Successfully encrypted private config
 fileSend model notification for install_add_activate_commit before reload
Install will reload the system now!
SUCCESS: install_add_activate_commit  Thu Oct 28 22:07:22 UTC 2021

Router#
*Oct 28 22:07:22.661: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
install one-shot PACKAGE
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.binOct
 28 22:07:26.864: %PMAN-5-EXITACTION: R0/0: pvp: Process manager is exiting: reload action
 requested

□

Press RETURN to get started!
```

The following is an example of the three-step installation:

```
Router# install add file
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bin

install_add: START Thu Oct 28 22:36:43 UTC 2021

*Oct 28 22:36:44.526: %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started install
 add
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bininstall_add:
 Adding PACKAGE
install_add: Checking whether new add is allowed ....

--- Starting Add ---
Performing Add on Active/Standby
  [1] Add package(s) on R0
  [1] Finished Add on R0
Checking status of Add on [R0]
Add: Passed on [R0]
Finished Add

Image added. Version: 17.07.01.0.1601
SUCCESS: install_add  Thu Oct 28 22:40:25 UTC 2021

Router#
```

```
*Oct 28 22:40:25.971: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
install add PACKAGE
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bin

Router# show install log
[0|install_op_boot]: START Thu Oct 28 22:09:29 Universal 2021
[0|install_op_boot(INFO, )]: Mount IMG INI state base image
[0|install_op_boot]: END SUCCESS  Thu Oct 28 22:09:30 Universal 2021
[0|install_op_boot(INFO, )]: cleanup_trap  remote_invocation 0 operation install_op_boot
.. 0 .. 0
[1|display_install_log]: START Thu Oct 28 22:12:11 UTC 2021
[2|install_add]: START Thu Oct 28 22:36:43 UTC 2021
[2|install_add(INFO, )]: Set INSTALL_TYPE to PACKAGE
[2|install_add(CONSOLE, )]: Adding PACKAGE
[2|install_add(CONSOLE, )]: Checking whether new add is allowed ....
[2|install_add(INFO, )]: check_add_op_allowed: Install type PACKAGE
[remote|install_add]: START Thu Oct 28 22:37:12 UTC 2021
[remote|install_add]: END SUCCESS  Thu Oct 28 22:40:10 UTC 2021
[remote|install_add(INFO, )]: cleanup_trap  remote_invocation 1 operation install_add .. 0
 .. 0
[2|install_add(INFO, )]: Remote output from R0
[2|install_add(INFO, )]: install_add: START Thu Oct 28 22:37:12 UTC 2021
Expanding image file:
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bin
Verifying parameters
Expanding superpackage
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.bin
... parameters verified
Validating package type
... package type validated
Copying package files
    c8000be-firmware_dreamliner.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg


c8000be-firmware_dsp_analogbri.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

    c8000be-firmware_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

    c8000be-firmware_dsp_tilegx.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

    c8000be-firmware_ngwic_t1e1.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

    c8000be-firmware_nim_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg


c8000be-firmware_nim_bri_st_fw.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

     c8000be-firmware_nim_cwan.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
    c8000be-firmware_nim_shdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

     c8000be-firmware_nim_ssd.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_nim_xdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_sm_10g.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_sm_1t3e3.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-firmware_sm_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

c8000be-firmware_sm_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

    c8000be-firmware_sm_nim_adpt.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

     c8000be-mono-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
     c8000be-rpboot.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
```

```
  WARNING: A different version of provisioning file packages.conf already exists in bootflash:

  WARNING: The provisioning file from the expanded bundle will be saved as
  WARNING: bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211027_0.conf
... package files copied
SUCCESS: Finished expanding all-in-one software package.
Image file expanded
SUCCESS: install_add  Thu Oct 28 22:40:10 UTC 2021
[2|install_add]: END SUCCESS  Thu Oct 28 22:40:25 UTC 2021
[2|install_add(INFO, )]: cleanup_trap  remote_invocation 0 operation install_add .. 0 .. 0
[3|COMP_CHECK]: START Thu Oct 28 22:40:26 UTC 2021
[3|COMP_CHECK]: END FAILED exit(1)  Thu Oct 28 22:40:27 UTC 2021
[3|COMP_CHECK(INFO, )]: cleanup_trap  remote_invocation 0 operation COMP_CHECK .. 1 .. 1
[4|install_activate]: START Thu Oct 28 22:42:53 UTC 2021
[4|install_activate(INFO, require user prompt)]: install_cli
[4|install_activate(CONSOLE, )]: Activating PACKAGE
[4|install_activate(INFO, )]: Acquiring transaction lock...
[4|install_activate(INFO, )]: global_trans_lock:
/bootflash/.installer/install_global_trans_lock
[4|install_activate(INFO, )]: tmp_global_trans_lock: /tmp/tmp_install_global_trans_lock
[4|install_activate(INFO, )]: tmp lock does not exist: /tmp/tmp_install_global_trans_lock
[4|install_activate(INFO, )]: global_trans_lock:
/bootflash/.installer/install_global_trans_lock
[4|install_activate(INFO, )]: tmp_global_trans_lock: /tmp/tmp_install_global_trans_lock
[4|install_activate(INFO, )]: local_trans_lock: /bootflash/.installer/install_local_trans_lock
[4|install_activate(INFO, )]: global_trans_lock:
/bootflash/.installer/install_global_trans_lock
[4|install_activate(INFO, )]: validate_lock: lock_duration is 7200
[4|install_activate(INFO, )]: install type stored in lock PACKAGE, install type PACKAGE,
install operation install_activate
[4|install_activate(INFO, )]: lock duration: 7200
[4|install_activate(INFO, )]: extend trans lock done.
/bootflash/.installer/install_global_trans_lock
[4|install_activate(INFO, require user prompt)]: install_cli
[4|install_activate( FATAL)]: Cannot proceed activate because of user input
[4|install_activate(INFO, )]: cleanup_trap  remote_invocation 0 operation install_activate
 .. 6 .. 0
[5|install_add]: START Thu Oct 28 22:45:48 UTC 2021
[5|install_add(INFO, )]: Set INSTALL_TYPE to PACKAGE
[5|install_add(CONSOLE, )]: Adding PACKAGE
[5|install_add(CONSOLE, )]: Checking whether new add is allowed ....
[5|install_add(INFO, )]: check_add_op_allowed: Install type PACKAGE
[5|install_add( FATAL)]: Super package already added. Add operation not allowed. install
remove inactive can be used to discard added packages

Router# install activate
install_activate: START Thu Oct 28 23:57:57 UTC 2021
install_activate: Activating PACKAGE

*Oct 28 23:57:57.823: %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started install
 activateFollowing packages shall be activated:
/bootflash/c8000be-rpboot.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-mono-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_sm_nim_adpt.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_sm_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_sm_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_sm_1t3e3.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_sm_10g.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_xdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_ssd.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_shdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_cwan.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
```

```
/bootflash/c8000be-firmware_nim_bri_st_fw.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_nim_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_ngwic_t1e1.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_dsp_tilegx.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_dsp_analogbri.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
/bootflash/c8000be-firmware_dreamliner.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

This operation may require a reload of the system. Do you want to proceed? [y/n]y
--- Starting Activate ---
Performing Activate on Active/Standby

*Oct 29 00:04:19.400: %INSTALL-5-INSTALL_AUTO_ABORT_TIMER_PROGRESS: R0/0: rollback_timer:
Install auto abort timer will expire in 7200 seconds  [1] Activate package(s) on R0
    --- Starting list of software package changes ---
    Old files list:
      Modified
c8000be-firmware_dreamliner.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_dsp_analogbri.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg

      Modified
c8000be-firmware_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_dsp_tilegx.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_ngwic_t1e1.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_async.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_bri_st_fw.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg

      Modified
c8000be-firmware_nim_cwan.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_shdsl.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_ssd.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_nim_xdsl.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_sm_10g.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_sm_1t3e3.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_sm_async.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-firmware_sm_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg

      Modified
c8000be-firmware_sm_nim_adpt.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified
c8000be-mono-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
      Modified c8000be-rpboot.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
    New files list:
      Added
c8000be-firmware_dreamliner.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_dsp_analogbri.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
```

```
      Added
c8000be-firmware_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_dsp_tilegx.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_ngwic_t1e1.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_bri_st_fw.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

      Added
c8000be-firmware_nim_cwan.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_shdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_ssd.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_nim_xdsl.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_sm_10g.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_sm_1t3e3.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_sm_async.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-firmware_sm_dsp_sp2700.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg

      Added
c8000be-firmware_sm_nim_adpt.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added
c8000be-mono-universalk9.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
      Added c8000be-rpboot.BLD_V177_THROTTLE_LATEST_20211027_030841_V17_7_0_120.SSA.pkg
    Finished list of software package changes
  [1] Finished Activate on R0
Checking status of Activate on [R0]
Activate: Passed on [R0]
Finished Activate

Send model notification for install_activate before reload
Install will reload the system now!
SUCCESS: install_activate  Fri Oct 29 00:05:09 UTC 2021

Router#
*Oct 29 00:05:09.504: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
install activate PACKAGEOct 29 00:05:14.494: %PMAN-5-EXITACTION: R0/0: pvp: Process manager
 is exiting: reload action requested

Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610

System Bootstrap, Version 17.3(4.1r), RELEASE SOFTWARE
Copyright (c) 1994-2021 by cisco Systems, Inc.

Current image running   : Boot ROM1
Last reset cause        : LocalSoft
C8300-2N2S-6T platform with 8388608 Kbytes of main memory
```

```
Press RETURN to get started!

Router# install commit
install_commit: START Fri Oct 29 00:13:58 UTC 2021
install_commit: Committing PACKAGE

--- Starting Commit ---
Performing Commit on Active/Standby

*Oct 29 00:13:59.552: %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started install
 commit  [1] Commit package(s) on R0
  [1] Finished Commit on R0
Checking status of Commit on [R0]
Commit: Passed on [R0]
Finished Commit

SUCCESS: install_commit  Fri Oct 29 00:14:03 UTC 2021

Router#
*Oct 29 00:14:03.712: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
install commit PACKAGE
```

The following is an example of downgrading in install mode:

```
ROUTER# install activate file bootflash:c8000be-universalk9.17.06.01a.SPA.bin activate
commit

install_add_activate_commit: START Fri Dec 10 18:07:17 GMT 2021

*Dec 10 18:07:18.405 GMT: %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started
install one-shot bootflash:c8000be-universalk9.17.06.01a.SPA.bininstall_add_activate_commit:
 Adding PACKAGE
install_add_activate_commit: Checking whether new add is allowed ....

--- Starting Add ---
Performing Add on Active/Standby
  [1] Add package(s) on R0
  [1] Finished Add on R0
Checking status of Add on [R0]
Add: Passed on [R0]
Finished Add

Image added. Version: 17.06.01a.0.298
install_add_activate_commit: Activating PACKAGE
Following packages shall be activated:
/bootflash/c8000be-rpboot.17.06.01a.SPA.pkg
/bootflash/c8000be-mono-universalk9.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_sm_nim_adpt.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_sm_dsp_sp2700.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_sm_async.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_sm_1t3e3.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_sm_10g.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_prince.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_xdsl.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_ssd.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_shdsl.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_ge.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_cwan.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_nim_bri_st_fw.17.06.01a.SPA.pkg
```

```
/bootflash/c8000be-firmware_nim_async.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_ngwic_t1e1.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_dsp_tilegx.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_dsp_sp2700.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_dsp_analogbri.17.06.01a.SPA.pkg
/bootflash/c8000be-firmware_dreamliner.17.06.01a.SPA.pkg

This operation may require a reload of the system. Do you want to proceed? [y/n]y
--- Starting Activate ---
Performing Activate on Active/Standby
  [1] Activate package(s) on R0
  [1] Finished Activate on R0
Checking status of Activate on [R0]
Activate: Passed on [R0]
Finished Activate

--- Starting Commit ---
Performing Commit on Active/Standby
  [1] Commit package(s) on R0
Building configuration...

  [1] Finished Commit on R0
Checking status of Commit on [R0]
Commit: Passed on [R0]
Finished Commit

[OK]
*Dec 10 18:14:57.782 GMT: %SYS-6-PRIVCFG_ENCRYPT_SUCCESS: Successfully encrypted private
config fileSend model notification for install_add_activate_commit before reload
/usr/binos/conf/install_util.sh: line 164: /bootflash/.prst_sync/reload_info: No such file
 or directory
/usr/binos/conf/install_util.sh: line 168: /bootflash/.prst_sync/reload_info: No such file
 or directory
cat: /bootflash/.prst_sync/reload_info: No such file or directory
Install will reload the system now!
SUCCESS: install_add_activate_commit  Fri Dec 10 18:15:23 GMT 2021

ROUTER#
*Dec 10 18:15:23.955 GMT: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
 install one-shot PACKAGE bootflash:c8000be-universalk9.17.06.01a.SPA.binDec 10 18:15:27.708:
 %PMAN-5-EXITACTION: R0/0: pvp: Process manager is exiting: reload action requested

Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly

System Bootstrap, Version 17.3(5r), RELEASE SOFTWARE
Copyright (c) 1994-2021 by cisco Systems, Inc.

Current image running: Boot ROM0

Last reset cause: LocalSoft
ROUTER platform with 8388608 Kbytes of main memory

□

Press RETURN to get started!

□

ROUTER#
ROUTER# show version
```

```
Cisco IOS XE Software, Version 17.06.01a
Cisco IOS Software [Bengaluru], c8000be Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
 17.6.1a, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2021 by Cisco Systems, Inc.
Compiled Sat 21-Aug-21 03:27 by mcpre

Cisco IOS-XE software, Copyright (c) 2005-2021 by cisco Systems, Inc.
All rights reserved.  Certain components of Cisco IOS-XE software are
licensed under the GNU General Public License ("GPL") Version 2.0.  The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.  You can redistribute and/or modify such
GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.

ROM: 17.3(5r)

ROUTER uptime is 0 minutes
Uptime for this control processor is 2 minutes
System returned to ROM by LocalSoft
System image file is "bootflash:packages.conf"
Last reload reason: LocalSoft

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Technology Package License Information:

------------------------------------------------------------------
Technology     Type         Technology-package Technology-package
                            Current            Next Reboot
------------------------------------------------------------------
Smart License  Perpetual    None               None
Smart License  Subscription None               None

The current crypto throughput level is 250000 kbps

Smart Licensing Status: Registration Not Applicable/Not Applicable

cisco ROUTER (1RU) processor with 3747220K/6147K bytes of memory.
Processor board ID FDO2521M27S
Router operating mode: Autonomous
5 Gigabit Ethernet interfaces
2 2.5 Gigabit Ethernet interfaces
2 Cellular interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
7573503K bytes of flash memory at bootflash:.
1875361792K bytes of NVMe SSD at harddisk:.
16789568K bytes of USB flash at usb0:.
```

```
Configuration register is 0x2102
```

The following is an example of terminating a software installation:

```
Router# install abort
install_abort: START Fri Oct 29 02:42:51 UTC 2021

This install abort would require a reload. Do you want to proceed? [y/n]
                                                                    *Oct 29 02:42:52.789:
 %INSTALL-5-INSTALL_START_INFO: R0/0: install_engine: Started install aborty
--- Starting Abort ---
Performing Abort on Active/Standby

  [1] Abort package(s) on R0
  [1] Finished Abort on R0
Checking status of Abort on [R0]
Abort: Passed on [R0]
Finished Abort

Send model notification for install_abort before reload
Install will reload the system now!
SUCCESS: install_abort  Fri Oct 29 02:44:47 UTC 2021

Router#
*Oct 29 02:44:47.866: %INSTALL-5-INSTALL_COMPLETED_INFO: R0/0: install_engine: Completed
install abort PACKAGEOct 29 02:44:51.577: %PMAN-5-EXITACTION: R0/0: pvp: Process manager
is exiting: reload action requested

Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610

System Bootstrap, Version 17.3(4.1r), RELEASE SOFTWARE
Copyright (c) 1994-2021 by cisco Systems, Inc.

Current image running   : Boot ROM1
Last reset cause        : LocalSoft
C8300-2N2S-6T platform with 8388608 Kbytes of main memory

□

Press RETURN to get started!

□
```

The following are sample outputs for show commands:

show install log

```
Device# show install log
[0|install_op_boot]: START Thu Oct 28 22:09:29 Universal 2021
[0|install_op_boot(INFO, )]: Mount IMG INI state base image
[0|install_op_boot]: END SUCCESS  Thu Oct 28 22:09:30 Universal 2021
```

show install summary

```
Device# show install summary
[ R0 ] Installed Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
```

```
            C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------------
Type  St   Filename/Version
--------------------------------------------------------------------------
IMG   C    17.07.01.0.1515

--------------------------------------------------------------------------
Auto abort timer: inactive
--------------------------------------------------------------------------
```

show install package *filesystem: filename*

```
Device# show install package
bootflash:c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bin
Package: c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bin
  Size: 831447859
  Timestamp: 2021-10-23 17:08:14 UTC
  Canonical path:
/bootflash/c8000be-universalk9.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.bin


  Raw disk-file SHA1sum:
    5c4e7617a6c71ffbcc73dcd034ab58bf76605e3f
  Header size:     1192 bytes
  Package type:    30000
  Package flags:   0
  Header version:  3

  Internal package information:
    Name: rp_super
    BuildTime: 2021-10-21_13.00
    ReleaseDate: 2021-10-21_03.11
    BootArchitecture: i686
    RouteProcessor: radium
    Platform: C8000BE
    User: mcpre
    PackageName: universalk9
    Build: BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117
    CardTypes:

  Package is bootable from media and tftp.
  Package contents:

  Package:
c8000be-firmware_nim_ge.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
    Size: 2966620
    Timestamp: 2021-10-21 20:10:44 UTC

    Raw disk-file SHA1sum:
      501d59d5f152ca00084a0da8217bf6f6b95dddb1
    Header size:     1116 bytes
    Package type:    40000
    Package flags:   0
    Header version:  3

    Internal package information:
      Name: firmware_nim_ge
      BuildTime: 2021-10-21_13.00
      ReleaseDate: 2021-10-21_03.11
      BootArchitecture: none
      RouteProcessor: radium
      Platform: C8000BE
      User: mcpre
      PackageName: firmware_nim_ge
      Build: BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117
```

```
      CardTypes:

    Package is not bootable.
  Package:
c8000be-firmware_prince.BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117.SSA.pkg
    Size: 10204252
    Timestamp: 2021-10-21 20:10:43 UTC

    Raw disk-file SHA1sum:
      a57bed4ddecfd08af3b456f69d11aaeb962865ea
    Header size:     1116 bytes
    Package type:    40000
    Package flags:   0
    Header version:  3

    Internal package information:
      Name: firmware_prince
      BuildTime: 2021-10-21_13.00
      ReleaseDate: 2021-10-21_03.11
      BootArchitecture: none
      RouteProcessor: radium
      Platform: C8000BE
      User: mcpre
      PackageName: firmware_prince
      Build: BLD_V177_THROTTLE_LATEST_20211021_031123_V17_7_0_117
      CardTypes:

    Package is not bootable.
```

show install active

```
Device# show install active
[ R0 ] Active Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
            C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------------
Type  St   Filename/Version
--------------------------------------------------------------------------
IMG   C    17.07.01.0.1515

--------------------------------------------------------------------------
Auto abort timer: inactive
--------------------------------------------------------------------------
```

show install inactive

```
Device# show install inactive
[ R0 ] Inactive Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
            C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------------
Type  St   Filename/Version
--------------------------------------------------------------------------
No Inactive Packages
```

show install committed

```
Device# show install committed
[ R0 ] Committed Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
            C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------------
Type  St   Filename/Version
--------------------------------------------------------------------------
IMG   C    17.07.01.0.1515
```

```
---------------------------------------------------------------------
Auto abort timer: inactive
---------------------------------------------------------------------
```

show install uncommitted

```
Device# show install uncommitted
[ R0 ] Uncommitted Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
            C - Activated & Committed, D - Deactivated & Uncommitted
---------------------------------------------------------------------
Type  St   Filename/Version
---------------------------------------------------------------------
No Uncommitted Packages
```

Troubleshooting Software Installation Using install Commands

Problem Troubleshooting the software installation

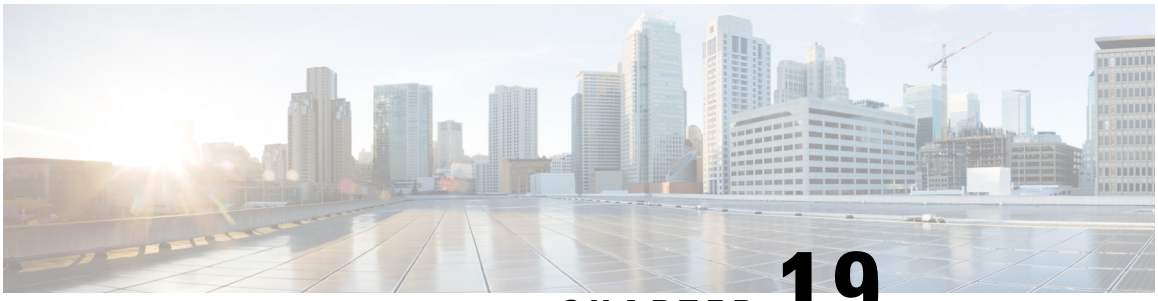
Solution Use the following show commands to view installation summary, logs, and software versions.

- **show install summary**
- **show install log**
- **show version**
- **show version running**

Problem Other installation issues

Solution Use the following commands to resolve installation issue:

- **dir** <*install directory*>
- **more location:***packages.conf*
- **show tech-support install**: this command automatically runs the **show** commands that display information specific to installation.
- **request platform software trace archive target bootflash** <*location*>: this command archives all the trace logs relevant to all the processes running on the system since the last reload, and saves this information in the specified location.

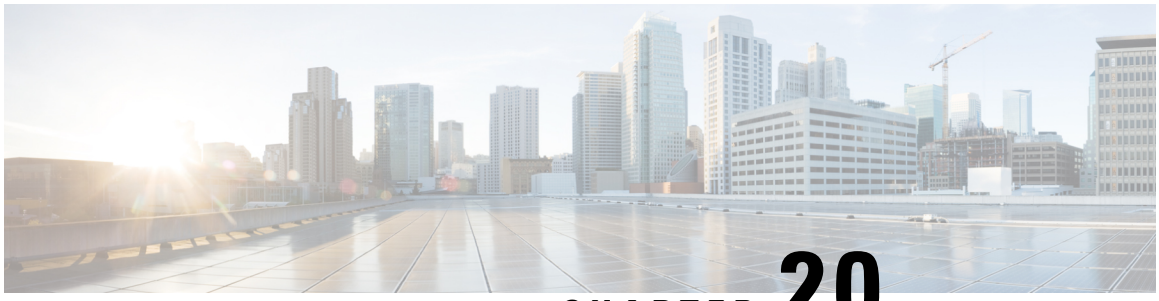


CHAPTER 19

Software Upgrade Processes

If you want to upgrade the ROMMON and IOS at the same time, perform the steps given below:

- Copy the XE image to the router and configure the boot system to point to the new image.
- Copy the ROMMON package to the router and perform the ROMMON upgrade.
- Reload the router and verify that it boots to the IOS prompt on the new XE image.
- Verify that the new ROMMON image was successfully installed using a show platform.



CHAPTER 20

Factory Reset

This chapter describes Factory Reset feature and how it can be used to protect or restore a router to an earlier, fully functional state.

Feature Information for Factory Reset

Table 35: Feature Information for Factory Reset

Feature Name	Releases	Feature Information
Option to retain RUM reports, SLR, and HSEC key using the **factory-reset keep-licensing-info**command	Cisco IOS XE Bengaluru 17.5.1	This feature was introduced.
Secure Factory Reset	Cisco IOS XE Bengaluru 17.6.1	Added the **factory-reset all secure** command.

Information About Factory Reset

Factory Reset is a process of clearing the current running and start-up configuration information on a device, and resetting the device to an earlier, fully-functional state.

The factory reset process uses the **factory-reset all** command to take backup of existing configuration, and then reset the router to an earlier, fully functional state. The duration of the factory reset process is dependent on the storage size of the router. It can vary between 30 minutes on a C8500 consolidated platform, and up to 3 hours on a high availability setup.

From Cisco IOS XE Bengaluru 17.6 release and later, you can use the **factory-reset all secure** command to reset the router and securely clear the files stored in the bootflash memory.

Table 36: Data Erased or Retained during Factory Reset

Command Name	Data Erased	Data Retained
factory-reset all secure	Non-volatile random-access memory (NVRAM) data	Data from remote field-replaceable units (FRUs).
	OBFL (Onboard Failure Logging) logs	Value of configuration register
	Licenses	Contents of USB
	User data, startup, and running configuration	Credentials (Secure Unique Device Identifier [SUDI] certificates, public key infrastructure (PKI) keys, and FIPS-related keys)
	ROMMON variables	
	All writeable file systems and personal data. **Note** If the current boot image is a remote image or stored on a USB, NIM-SSD, or such, ensure that you take a backup of the image before performing factory reset.	

Command Name	Data Erased	Data Retained
factory-reset keep-licensing-info	• License Boot level configuration • Throughput level configuration • Smart license transport type • Smart license URL data	• Real User Monitoring (RUM) Reports (open/unacknowledged license usage report) • Usage reporting details (last ACK received, next ACK scheduled, last/next report push) • Unique Device Identification (UDI) trust codes • Customer policy received from CSSM • SLAC, SLR authorization codes return codes • Factory installed purchase information

After the factory reset process is complete, the router reboots to ROMMON mode. If you have the zero-touch provisioning (ZTP) capability setup, after the router completes the factory reset procedure, the router reboots with ZTP configuration.

Software and Hardware Support for Factory Reset

- This feature is supported on all Cisco Catalyst 8500 and 8500L Series Edge Platforms.
- Factory Reset process is supported on standalone routers as well as on routers configured for high availability.

Prerequisites for Performing Factory Reset

- Ensure that all the software images, configurations and personal data is backed up before performing factory reset.
- Ensure that there is uninterrupted power supply when factory reset is in progress.
- The factory reset process takes a backup of the boot image if the system is booted from an image stored locally (bootflash or hard disk). If the current boot image is a remote image or stored on an USB, NIM-SSD or such, ensure that you take a backup of the image before performing factory reset.
- The **factory-reset all secure** command erases all files, including the boot image, even if the image is stored locally. If the current boot image is a remote image or stored on a USB, NIM-SSD, or such, ensure that you take a backup of the image before performing secure factory reset.

- Ensure that ISSU/ISSD (In- Service Software Upgrade or Downgrade) is not in progress before performing factory reset.

Restrictions for Performing a Factory Reset

- Any software patches that are installed on the router are not restored after the factory reset operation.
- If the factory reset command is issued through a Virtual Teletype (VTY) session, the session is not restored after the completion of the factory reset process.

When to Perform Factory Reset

- Return Material Authorization (RMA): If a router is returned back to Cisco for RMA, it is important that all sensitive information is removed.
- Router is compromised: If the router data is compromised due to a malicious attack, the router must be reset to factory configuration and then reconfigured once again for further use.
- Repurposing: The router needs to be moved to a new topology or market from the existing site to a different site.

How to Perform a Factory Reset

Before you begin

Refer Table 2 to determine which information is going to be deleted and retained. Based on the information you require, execute the appropriate command mentioned below.

Step 1 Log in to a Cisco Catalyst 8500 or 8500L device.

Important If the current boot image is a remote image or is stored in a USB or a NIM-SSD, ensure that you take a backup of the image before starting the factory reset process.

Step 2 This step is divided into two parts (a and b). If you need to retain the licensing information while performing the **factory-reset** command, follow step 2. a. If you do not need to retain the licensing information and want all the data to be erased, perform step 2. b.

a) Execute **factory-reset keep-licensing-info** command to retain the licensing data.

The system displays the following message when you use the **factory-reset keep-licensing-info** command:

```
Router# factory-reset keep-licensing-info

The factory reset operation is irreversible for Keeping license usage. Are you sure? [confirm]
This operation may take 20 minutes or more. Please do not power cycle.

Dec 1 20:58:38.205: %PMAN-5-EXITACTION: R0/0: pvp: Process manager is exiting: process exit with
reload chassis code
/bootflash failed to mount
```

```
Dec 01 20:59:44.264: Factory reset operation completed.
Initializing Hardware ...

Current image running: Boot ROM1

Last reset cause: LocalSoft

ISR4331/K9 platform with 4194304 Kbytes of main memory
rommon 1
```

b) Execute the **factory-reset all secure 3-pass** command to securely erase all data.

The system displays the following message when you use the **factory-reset all secure 3-pass** command:

```
Router# factory-reset all secure 3-pass

The factory reset operation is irreversible for securely reset all. Are you sure? [confirm]
This operation may take hours. Please do not power cycle.

*Jun 19 00:53:33.385: %SYS-5-RELOAD: Reload requested by Exec. Reload Reason: Factory Reset.Jun
19 00:53:42.856: %PMAN-5-EXITACTION:

Enabling factory reset for this reload cycle
  Jun 19 00:54:06.914: Factory reset secure operation. Write 0s. Please do not power cycle.
  Jun 19 01:18:36.040: Factory reset secure operation. Write 1s. Please do not power cycle.
  Jun 19 01:43:49.263: Factory reset secure operation. Write random. Please do not power cycle.
  Jun 19 02:40:29.770: Factory reset secure operation completed.
Initializing Hardware ....
```

Step 3 Enter **confirm** to proceed with the factory reset.

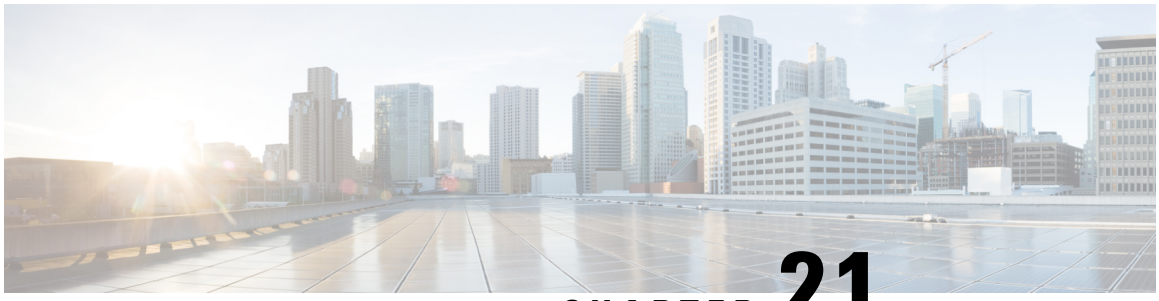
Note The duration of the factory reset process depends on the storage size of the router. It can extend between 30 minutes and up to 3 hours on a high availability setup. If you want to quit the factory reset process, press the **Escape** key.

What Happens after a Factory Reset

After the factory reset is successfully completed, the router boots up. However, before the factory reset process started, if the configuration register was set to manually boot from ROMMON, the router stops at ROMMON.

After you configure Smart Licensing, execute the **#show license status** command, to check whether Smart Licensing is enabled for your instance.

Note If you had Specific License Reservation enabled before you performed the factory reset, use the same license and enter the same license key that you received from the smart agent.



CHAPTER 21

Support for Security-Enhanced Linux

This chapter describes the SELinux feature, and includes the following sections:

Overview

Security-Enhanced Linux (SELinux) is a solution composed of Linux kernel security module and system utilities to incorporate a strong, flexible Mandatory Access Control (MAC) architecture into Cisco IOS-XE platforms.

SELinux provides an enhanced mechanism to enforce the separation of information, based on confidentiality and integrity requirements, which addresses threats of tampering and bypassing of application security mechanisms and enables the confinement of damage that malicious or flawed applications can cause.

Prerequisites for SELinux

There are no specific prerequisites for this feature.

Restrictions for SELinux

There are no specific restrictions for this feature.

Information About SELinux

SELinux enforces mandatory access control policies that confine user programs and system services to the minimum privilege required to perform their assigned functionality. This reduces or eliminates the ability of

these programs and daemons to cause harm when compromised (for example, through buffer overflows or misconfigurations). This is a practical implementation of principle of least privilege by enforcing MAC on Cisco IOS-XE platforms. This confinement mechanism works independently of the traditional Linux access control mechanisms. SELinux provides the capability to define policies to control the access from an application process to any resource object, thereby allowing for the clear definition and confinement of process behavior.

SELinux can operate either in **Permissive mode** or **Enforcing mode** when enabled on a system.

- In Permissive mode, SELinux does not enforce the policy, and only generates system logs for any denials caused by violation of the resource access policy. The operation is not denied, but only logged for resource access policy violation.
- In Enforcing mode, the SELinux policy is enabled and enforced. It denies resource access based on the access policy rules, and generates system logs.

From Cisco IOS XE 17.13.1a, SELinux is enabled in Enforcing mode by default on supported Cisco IOS XE platforms. In the Enforcing mode, any system resource access that does not have the necessary allow policy is treated as a violation, and the operation is denied. The violating operation fails when a denial occurs, and system logs are generated. In Enforcing mode, the solution works in access-violation prevention mode.

Supported Platforms

From Cisco IOS XE 17.13.1a, SELinux is enabled on the following platforms:

- Cisco 1000 Series Aggregation Services Routers
- Cisco 1000 Series Integrated Services Routers
- Cisco 4000 Series Integrated Services Routers
- Cisco Catalyst 8000v Edge Software
- Cisco Catalyst 8200 Series Edge Platforms
- Cisco Catalyst 8300 Series Edge Platforms
- Cisco Catalyst 8500 and 8500L Series Edge Platforms
- Cisco VG Series Gateways: VG400, VG410, VG420, and VG450
- Cisco 1100 Terminal Services Gateway

Configuring SELinux

The are no additional requirements or configuration steps needed to enable or use the SELinux feature in Enforcing mode.

The following commands are introduced as part of the SELinux feature:

```
set platform software selinux {default | enforcing | permissive}
platform security selinux {enforcing | permissive}
show platform software selinux
```

Note These new commands are implemented as **service internal** commands.

Configuring SELinux (EXEC Mode)

Use the **set platform software selinux** command to configure SELinux in EXEC mode.

The following example shows SELinux configuration in EXEC mode:

```
Device# set platform software selinux ?

default  Set SELinux mode to default
enforcing  Set SELinux mode to enforcing
permissive  Set SELinux mode to permissive
```

Configuring SELinux (CONFIG Mode)

Use the **platform security selinux** command to configure SELinux in configuration mode.

The following example shows SELinux configuration in CONFIG mode:

```
Device(config)# platform security selinux

enforcing  Set SELinux policy to Enforcing mode
permissive  Set SELinux policy to Permissive mode

Device(config)# platform security selinux permissive

Device(config)#
*Oct 20 21:52:45.155: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!

Device(config)#
```

Examples for SELinux

The following example shows the output for changing the mode from Enforcing to Permissive:

```
"*Oct 20 21:44:03.609: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!"
```

The following example shows the output for changing the mode from Permissive to Enforcing:

```
"*Oct 20 21:44:34.160: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode upgraded to enforcing!"
```

Note If the SELinux mode is changed, this change is considered a system security event, and a system log message is generated.

SysLog Message Reference

Facility-Severity-Mnemonic	%SELINUX-1-VIOLATION
Severity-Meaning	Alert Level Log
Message	N/A
Message Explanation	Resource access was made by the process for which a resource access policy does not exist. The operation was flagged, and resource access was denied. A system log was generated with information that process resource access has been denied.
Component	SELINUX
Recommended Action	Contact Cisco TAC with the following relevant information as attachments: • The exact message as it appears on the console or in the system • Output of the **show tech-support** command (text file) • Archive of Btrace files from the box using the following command: **request platform software trace archive target <URL>** • Output of the **show platform software selinux** command

The following examples demonstrate sample syslog messages:

Example 1:

```
*Nov 14 00:09:04.943: %SELINUX-1-VIOLATION: R0/0: audispd: type=AVC
msg=audit(1699927057.934:129): avc: denied { getattr } for pid=5899 comm="ls"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive=0
```

Example 2:

```
*Nov 14 00:09:04.947: %SELINUX-1-VIOLATION: R0/0: audispd: t type=AVC
msg=audit(1699927198.486:130): avc: denied { write } for pid=6012 comm="echo"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive= 0
```

Verifying SELinux Enablement

Use the **show platform software selinux** command to view the SELinux configuration mode:

```
Device# show platform software selinux
========================================
IOS-XE SELINUX STATUS
========================================
SElinux Status :    Enabled
Current Mode :      Enforcing
Config file Mode :  Enforcing
```

Troubleshooting SELinux

If there is an instance of an SELinux violation on your device or network, please reach out to Cisco TAC with the following details:

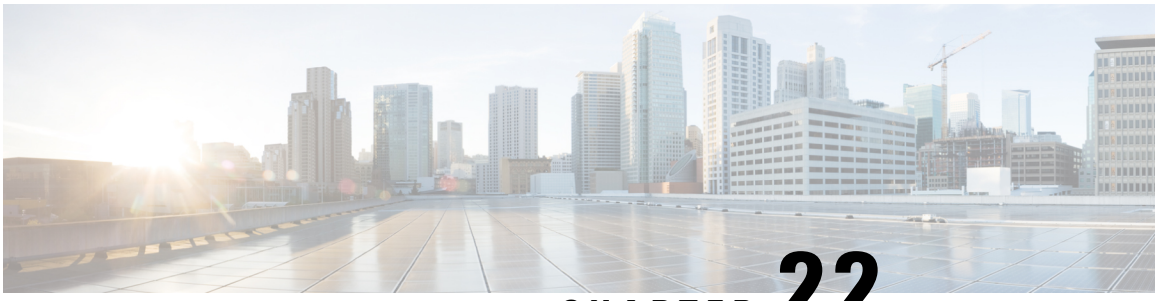
- The message exactly as it appears on the console or in the system log. For example:

  ```
  device#request platform software trace archive target
      flash:selinux_btrace_logs
  ```

- Output of the **show tech-support** command (text file)
- Archive of Btrace files from the box using the following command:

  request platform software trace archive target <URL>

- Output of the **show platform software selinux** command



CHAPTER 22

High Availability Overview

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

The unique hardware and software architecture of the Cisco 8500 Series Catalyst Edge Platform is designed to maximize router uptime during any network event, and thereby provide maximum uptime and resilience within any network scenario.

This guide covers the aspects of High Availability that are unique to the Cisco 8500 Series Catalyst Edge Platform. It is not intended as a comprehensive guide to High Availability, nor is it intended to provide information on High Availability features that are available on other Cisco routers that are configured and implemented identically on the Cisco 8500 Series Catalyst Edge Platform. The Cisco IOS feature documents and guides should be used in conjunction with this chapter to gather information about High Availability-related features that are available on multiple Cisco platforms and work identically on the Cisco 8500 Series Catalyst Edge Platform.

Finding Feature Information in This Module

Your software release might not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Contents

This section discusses various aspects of High Availability on the Cisco 8500 Series Catalyst Edge Platform and contains the following sections:

Software Redundancy on the Cisco 8500 Series Catalyst Edge Platform

This section covers the following topics:

Software Redundancy Overview

On the Cisco 8500 Series Catalyst Edge Platform, IOS runs as one of many processes within the operating system. This is different than on traditional Cisco IOS, where all processes are run within Cisco IOS. See the "IOS as a Process" section on page 2-7 for more information regarding IOS as a process on the Cisco 8500 Series Catalyst Edge Platform.

This architecture allows for software redundancy opportunities that are not available on other platforms that run Cisco IOS software. Specifically, a standby IOS process can be available on the same Route Processor as the active IOS process. This standby IOS process can be switched to in the event of an IOS failure.

On the Cisco 8500 Series Catalyst Edge Platform, the second IOS process can run only on the standby Route Processor.

Configuring two Cisco IOS processes

On the Cisco 8500 Series Catalyst Edge Platform, Cisco IOS runs as one of the many processes. This architecture supports software redundancy opportunities. Specifically, a standby Cisco IOS process is available on the same Route Processor as the active Cisco IOS process. In the event of a Cisco IOS failure, the system switches to the standby Cisco IOS process.

SUMMARY STEPS

1. enable
2. **configure terminal**
3. redundancy
4. mode SSO
5. **exit**
6. reload

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable **Example:**	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
	`Router> enable`	
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	redundancy **Example:** `Router(config)# redundancy`	Enters redundancy configuration mode.
Step 4	mode SSO **Example:** `Router(config)# mode SSO`	Configures SSO. When this command is entered, the redundant supervisor engine is reloaded and begins to work in SSO mode.

Step 5	**exit**
	Example:
	`Router(config)# exit`
	Example:
	`Router #`
		Exits configuration mode and returns to global configuration mode.

Step 6	reload **Example:** `Router # reload`	Reloads IOS.

Example

```
Router# configure terminal
Router(config)# redundancy
Router(config)# mode SSO
Router(config)# exit
Router# reload
```

Stateful Switchover

On the Cisco 8500 Series Catalyst Edge Platform, Stateful Switchover (SSO) can be used to enable a second IOS process.

Stateful Switchover is particularly useful in conjunction with Nonstop Forwarding. SSO allows the dual IOS processes to maintain state at all times, and Nonstop Forwarding lets a switchover happen seamlessly when a switchover occurs

For additional information on NSF/SSO, see the Cisco Nonstop Forwarding document.

SSO-Aware Protocol and Applications

SSO-supported line protocols and applications must be SSO-aware. A feature or protocol is SSO-aware if it maintains, either partially or completely, undisturbed operation through an RP switchover. State information for SSO-aware protocols and applications is synchronized from active to standby to achieve stateful switchover for those protocols and applications.

The dynamically created state of SSO-unaware protocols and applications is lost on switchover and must be reinitialized and restarted on switchover.

To see which protocols are SSO-aware on your router, use the following commands **show redundancy client** or **show redundancy history**.

IPsec Failover

IPSec failover is a feature that increases the total uptime (or availability) of a customer's IPSec network. Traditionally, this is accomplished by employing a redundant (standby) router in addition to the original (active) router. If the active router becomes unavailable for any reason, the standby router takes over the processing of IKE and IPSec. IPSec failover falls into two categories: stateless failover and stateful failover.

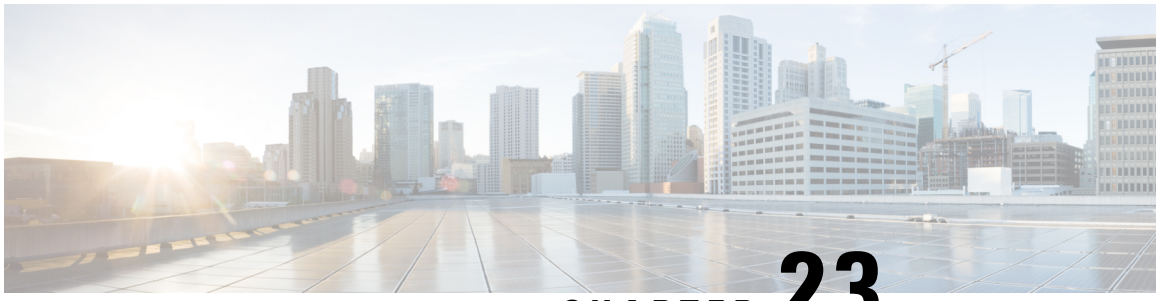
The IPsec on the Cisco 8500 Series Catalyst Edge Platform supports only stateless failover. Stateless failover uses protocols such as the Hot Standby Router Protocol (HSRP) to provide primary to secondary cutover and also allows the active and standby VPN gateways to share a common virtual IP address.

Bidirectional Forwarding Detection

Bidirectional Forwarding Detection (BFD) is a detection protocol designed to provide fast forwarding path failure detection times for all media types, encapsulations, topologies, and routing protocols. In addition to fast forwarding path failure detection, BFD provides a consistent failure detection method for network administrators. Because the network administrator can use BFD to detect forwarding path failures at a uniform rate rather than the variable rates for different routing protocol hello mechanisms, network profiling and planning is easier, and reconvergence time is consistent and predictable.

On the Cisco 8500 Series Catalyst Edge Platform, BFD for IPv4 Static Routes and BFD for BGP are fully supported.

For more information on BFD, see the Bidirectional Forwarding Detection document.



CHAPTER 23

Using the Management Ethernet Interface

The Cisco 8500 Series Catalyst Edge Platform have one Gigabit Ethernet Management Ethernet interface.

Finding Feature Information in This Module

Your software release might not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Contents

This guide covers the following topics:

Gigabit Ethernet Management Interface Overview

The purpose of this interface is to allow users to perform management tasks on the router; it is basically an interface that should not and often cannot forward network traffic but can otherwise access the router, often via Telnet and SSH, and perform most management tasks on the router. The interface is most useful before a router has begun routing, or in troubleshooting scenarios when the SPA interfaces are inactive.

The following aspects of the Management Ethernet interface should be noted:

- IPv4, IPv6, and ARP are the only routed protocols supported for the interface.
- The Ethernet Management Interface cannot be used as a Lawful Intercept MD source interface.

- The Management Ethernet interface is part of its own VRF. This is discussed in more detail in the Gigabit Ethernet Management Interface VRF, on page 196.

Gigabit Ethernet Port Numbering

The Gigabit Ethernet Management port is always GigabitEthernet0.

The port can be accessed in configuration mode like any other port on the Cisco 8500 Series Catalyst Edge Platform:

```
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabitethernet0
Router(config-if)#
```

IP Address Handling in ROMmon and the Management Ethernet Port

On the Cisco 8500 Series Catalyst Edge Platform, IP addresses can be configured in ROMmon (the **IP_ADDRESS=** and **IP_SUBNET_MASK=** commands) and through the use of the IOS command-line interface (the **ip address** command in interface configuration mode).

Assuming the IOS process has not begun running on the Cisco 8500 Series Catalyst Edge Platform, the IP address that was set in ROMmon acts as the IP address of the Management Ethernet interface. In cases where the IOS process is running and has taken control of the Management Ethernet interface, the IP address specified when configuring the Gigabit Ethernet 0 interface in the IOS CLI becomes the IP address of the Management Ethernet interface. The ROMmon-defined IP address is only used as the interface address when the IOS process is inactive.

For this reason, the IP addresses specified in ROMmon and in the IOS CLI can be identical and the Management Ethernet interface will function properly in single RP configurations.

Gigabit Ethernet Management Interface VRF

The Gigabit Ethernet Management interface is automatically part of its own VRF. This VRF, which is named “Mgmt-intf,” is automatically configured on the Cisco 8500 Series Catalyst Edge Platform and is dedicated to the Management Ethernet interface; no other interfaces can join this VRF. Therefore, this VRF does not participate in the MPLS VPN VRF or any other network-wide VRF. The Mgmt-intf VRF supports loopback interface.

Placing the management ethernet interface in its own VRF has the following effects on the Management Ethernet interface:

- Many features must be configured or used inside the VRF, so the CLI may be different for certain Management Ethernet functions on the Cisco 8500 Series Catalyst Edge Platform than on Management Ethernet interfaces on other routers.
- Prevents transit traffic from traversing the router. Because all built-in portd and the Management Ethernet interface are automatically in different VRFs, no transit traffic can enter the Management Ethernet interface and leave a built-in port, or vice versa.

- Improved security of the interface. Because the Mgmt-intf VRF has its own routing table as a result of being in its own VRF, routes can only be added to the routing table of the Management Ethernet interface if explicitly entered by a user.

The Management Ethernet interface VRF supports both IPv4 and IPv6 address families.

Common Ethernet Management Tasks

Because users can perform most tasks on a router through the Management Ethernet interface, many tasks can be done by accessing the router through the Management Ethernet interface.

This section documents tasks that might be common or slightly tricky on the Cisco 8500 Series Catalyst Edge Platform. It is not intended as a comprehensive list of all tasks that can be done using the Management Ethernet interface.

This section covers the following processes:

Viewing the VRF Configuration

The VRF configuration for the Management Ethernet interface is viewable using the **show running-config vrf** command.

This example shows the default VRF configuration:

```
Router# show running-config vrf
Building configuration...
Current configuration : 351 bytes
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
(some output removed for brevity)
```

Viewing Detailed VRF Information for the Management Ethernet VRF

To see detailed information about the Management Ethernet VRF, enter the **show vrf detail Mgmt-intf** command:

```
Router# show vrf detail Mgmt-intf
```

Setting a Default Route in the Management Ethernet Interface VRF

To set a default route in the Management Ethernet Interface VRF, enter the following command

ip route vrf Mgmt-intf 0.0.0.0 0.0.0.0 *next-hop-IP-address*

Setting the Management Ethernet IP Address

The IP address of the Management Ethernet port is set like the IP address on any other interface.

Below are two simple examples of configuring an IPv4 adress and an IPv6 address on the Management Ethernet interface.

IPv4 Example

```
Router(config)# interface GigabitEthernet 0
Router(config-if)# ip address
 A.B.C.D A.B.C.D
```

IPv6 Example

```
Router(config)# interface GigabitEthernet 0
```

Router(config-if)# **ipv6 address** *X:X:X:X::X*

Telnetting over the Management Ethernet Interface

Telnetting can be done through the VRF using the Management Ethernet interface.

In the following example, the router telnets to 172.17.1.1 through the Management Ethernet interface VRF:

```
Router# telnet 172.17.1.1 /vrf Mgmt-intf
```

Pinging over the Management Ethernet Interface

Pinging other interfaces using the Management Ethernet interface is done through the VRF.

In the following example, the router pings the interface with the IP address of 172.17.1.1 through the Management Ethernet interface:

```
Router# ping vrf Mgmt-intf 172.17.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.1.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/1 ms
```

Copy Using TFTP or FTP

To copy a file using TFTP through the Management Ethernet interface, the **ip tftp source-interface GigabitEthernet 0** command must be entered before entering the **copy tftp** command because the **copy tftp** command has no option of specifying a VRF name.

Similarly, to copy a file using FTP through the Management Ethernet interface, the **ip ftp source-interface GigabitEthernet 0** command must be entered before entering the **copy ftp** command because the **copy ftp** command has no option of specifying a VRF name.

TFTP Example

```
Router(config)# ip tftp source-interface gigabitethernet 0
```

FTP Example

```
Router(config)# ip ftp source-interface gigabitethernet 0
```

NTP Server

To allow the software clock to be synchronized by a Network Time Protocol (NTP) time server over the Management Ethernet interface, enter the **ntp server vrf Mgmt-intf** command and specify the IP address of the device providing the update.

The following CLI provides an example of this procedure.

```
Router(config)# ntp server vrf Mgmt-intf 172.17.1.1
```

SYSLOG Server

To specify the Management Ethernet interface as the source IP or IPv6 address for logging purposes, enter the **logging host <ip-address> vrf Mgmt-intf** command.

The following CLI provides an example of this procedure.

```
Router(config)# logging host <ip-address> vrf Mgmt-intf
```

SNMP-Related Services

To specify the Management Ethernet interface as the source of all SNMP trap messages, enter the **snmp-server source-interface traps gigabitEthernet 0** command.

The following CLI provides an example of this procedure:

```
Router(config)# snmp-server source-interface traps gigabitEthernet 0
```

Domain Name Assignment

The IP domain name assignment for the Management Ethernet interface is done through the VRF.

To define the default domain name as the Management Ethernet VRF interface, enter the **ip domain-name vrf Mgmt-intf** *domain* command.

```
Router(config)# ip domain-name vrf Mgmt-intf cisco.com
```

DNS service

To specify the Management Ethernet interface VRF as a name server, enter the **ip name-server vrf Mgmt-intf** *IPv4-or-IPv6-address* command.

```
Router(config)# ip name-server vrf Mgmt-intf
 IPv4-or-IPv6-address
```

RADIUS or TACACS+ Server

To group the Management VRF as part of a AAA server group, enter the **ip vrf forward Mgmt-intf** command when configuring the AAA server group.

The same concept is true for configuring a TACACS+ server group. To group the Management VRF as part of a TACACS+ server group, enter the **ip vrf forwarding Mgmt-intf** command when configuring the TACACS+ server group.

RADIUS Server Group Configuration

```
Router(config)# aaa group server radius hello
Router(config-sg-radius)# ip vrf forwarding Mgmt-intf
```

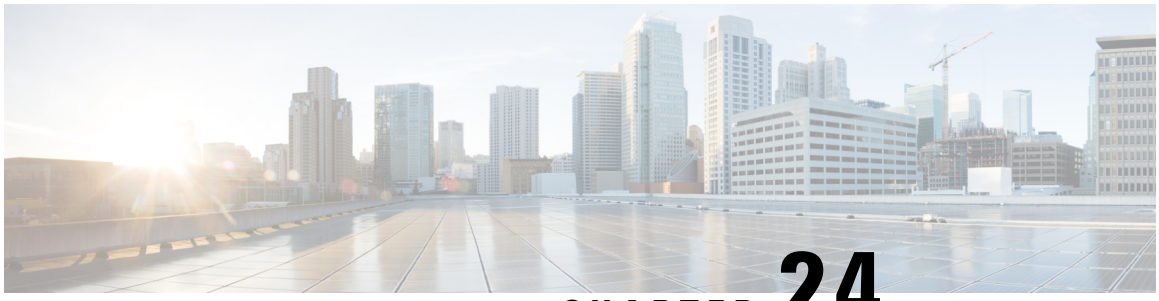
TACACS+ Server Group Example

```
outer(config)# aaa group server tacacs+ hello
Router(config-sg-tacacs+)# ip vrf forwarding Mgmt-intf
```

VTY lines with ACL

To ensure an access control list (ACL) is attached to vty lines that are and are not using VRF, use the **vrf-also** option when attaching the ACL to the vty lines.

```
Router(config)# line vty 0 4
Router(config-line)# access-class 90 in vrf-also
```



CHAPTER 24

Configuring Bridge Domain Interfaces

The Cisco 8500 Series Catalyst Edge Platform support the bridge domain interface (BDI) feature for packaging Layer 2 Ethernet segments into Layer 3 IP.

Restrictions for Bridge Domain Interfaces

The following are the restrictions pertaining to bridge domain interfaces:

- Only 4096 bridge domain interfaces are supported per system.
- For a bridge domain interface, the maximum transmission unit (MTU) size can be configured between 1500 and 9216 bytes.
- Bridge domain interfaces support only the following features:
  - IPv4 Multicast
  - QoS marking and policing. Shaping and queuing are not supported
  - IPv4 VRF
  - IPv6 unicast forwarding
  - Dynamic routing such as BGP, OSPF, EIGRP, RIP, IS-IS, and STATIC
  - Hot Standby Router Protocol (HSRP)
  - Virtual Router Redundancy Protocol (VRRP) from IOS XE 3.8.0 onwards.
- Bridge domain interfaces do not support the following features:
  - PPP over Ethernet (PPPoE)
  - Bidirectional Forwarding Detection (BFD) protocol
  - QoS
  - Network-Based Application Recognition (NBAR) or Advanced Video Coding (AVC)

Information About Bridge Domain Interface

Bridge domain interface is a logical interface that allows bidirectional flow of traffic between a Layer 2 bridged network and a Layer 3 routed network traffic. Bridge domain interfaces are identified by the same index as the bridge domain. Each bridge domain represents a Layer 2 broadcast domain. Only one bridge domain interface can be associated with a bridge domain.

Bridge domain interface supports the following features:

- IP termination
- Layer 3 VPN termination
- Address Resolution Protocol (ARP), G-ARP, and P-ARP handling
- MAC address assignment

Prior to configuring a bridge domain interface, you must understand the following concepts:

- Ethernet Virtual Circuit Overview
- Bridge Domain Interface Encapsulation
- Assigning a MAC Address
- Support for IP Protocols
- Support for IP Forwarding
- Packet Forwarding
- Bridge Domain Interface Statistics

Ethernet Virtual Circuit Overview

An Ethernet Virtual Circuit (EVC) is an end-to-end representation of a single instance of a Layer 2 service that is offered by a provider. It embodies the different parameters on which the service is being offered. In the Cisco EVC Framework, the bridge domains are made up of one or more Layer 2 interfaces known as service instances. A service instance is the instantiation of an EVC on a given port on a given router. Service instance is associated with a bridge domain based on the configuration.

An incoming frame can be classified as service instance based on the following criteria:

- Single 802.1Q VLAN tag, priority-tagged, or 802.1ad VLAN tag
- Both QinQ (inner and outer) VLAN tags, or both 802.1ad S-VLAN and C-VLAN tags
- Outer 802.1p CoS bits, inner 802.1p CoS bits, or both
- Payload Ethernet type (five choices are supported: IPv4, IPv6, PPPoE-all, PPoE-discovery, and PPPoE-session)

Service instance also supports alternative mapping criteria:

- Untagged—Mapping to all the frames lacking a 802.1Q or 802.1ad header
- Default—Mapping to all the frames

Bridge Domain Interface Encapsulation

Security Group classification includes both Source and Destination Group, which is specified by source SGT and DGT. SGT Based PBR feature provides the PBR route-map match clause for SGT/DGT based packet classification. SGT Based PBR feature supports configuration of unlimited number of tags, but it is recommended to configure the tags based on memory available in the platform.

An EVC provides the ability to employ different encapsulations on each Ethernet flow point (EFP) present in a bridge domain. A BDI egress point may not be aware of the encapsulation of an egress packet because the packet may have egressed from one or more EFPs with different encapsulations.

In a bridge domain, if all the EFPs have different encapsulations, the BDI must be untagged (using the no 802.1Q tag). Encapsulate all the traffic in the bridge domain (popped or pushed) at the EFPs. Configure rewrite at each EFP to enable encapsulation of the traffic on the bridge domain.

In a bridge domain, if all the EFPs have the same encapsulation, configure the encapsulations on the BDI using the encapsulation command. Enabling encapsulation at the BDI ensures effective pushing or popping of tags, thereby eliminating the need for configuring the rewrite command at the EFPs. For more information on configuring the encapsulations on the BDI, see the How to Configure a Bridge Domain Interface.

Assigning a MAC Address

All the bridge domain interfaces on the Cisco Catalyst 8500 Series Edge Platforms share a common MAC address. The first bridge domain interface on a bridge domain is allocated a MAC address. Thereafter, the same MAC address is assigned to all the bridge domain interfaces that are created in that bridge domain.

Note You can configure a static MAC address on a bridge domain interface using the **mac-address** command.

Support for IP Protocols

Brigde domain interfaces enable the Cisco 8500 Series Catalyst Edge Platform to act as a Layer 3 endpoint on the Layer 2 bridge domain for the following IP-related protocols:

- ARP
- DHCP
- HTTP
- ICMP
- NTP
- RARP
- SNMP
- TCP
- Telnet
- TFTP
- UDP

Support for IP Forwarding

Bridge domain interface supports the following IP forwarding features:

- IPv4 input and output access control lists (ACL)
- IPv4 input and output QoS policies. The operations supported for the input and output service policies on a bridge domain interface are:
    - Classification
    - Marking

- Policing
- IPv4 L3 VRFs

Packet Forwarding

A bridge domain interface provides bridging and forwarding services between the Layer 2 and Layer 3 network infrastructure.

Layer 2 to Layer 3

During a packet flow from a Layer 2 network to a Layer 3 network, if the destination MAC address of the incoming packet matches the bridge domain interface MAC address, or if the destination MAC address is a multicast address, the packet or a copy of the packet is forwarded to the bridge domain interface.

Note MAC address learning cannot not be performed on the bridge domain interface.

Layer 3 to Layer 2

When a packet arrives at a Layer 3 physical interface of a router, a route lookup action is performed. If route lookup points to a bridge domain interface, then the bridge domain interface adds the layer 2 encapsulation and forwards the frame to the corresponding bridge domain. The byte counters are updated.

During a Layer 2 lookup on a bridge domain to which the bridge domain interface belongs, the bridge domain forwards the packets to the correct service instance based on the destination MAC address.

Link States of a Bridge Domain and a Bridge Domain Interface

Bridge domain interface acts as a routable IOS interface on Layer 3 and as a port on a bridge domain. Both bridge domain interfaces and bridge domains operate with individual administrative states.

Shutting down a bridge domain interface stops the Layer 3 data service, but does not override or impact the state of the associated bridge domain.

Shutting down a bridge domain stops Layer 2 forwarding across all the associated members including service instances and bridge domain interfaces. The associated service instances influence operational state of a bridge domain. Bridge domain interface cannot be operational unless one of the associated service instances is up.

Note Because a bridge domain interface is an internal interface, the operational state of bridge domain interface does not affect the bridge domain operational state.

BDI Initial State

The initial administrative state of a BDI depends on how the BDI is created. When you create a BDI at boot time in the startup configuration, the default administrative state for the BDI is up. It will remain in this state unless the startup configuration includes the shutdown command. This behavior is consistent with all the other interfaces. When you create a BDI dynamically at command prompt, the default administrative state is down.

BDI Link State

A BDI maintains a link state that comprises of three states: administratively down, operationally down, and up. The link state of a BDI is derived from two independent inputs: the BDI administrative state set by the corresponding users and the fault indication state from the lower levels of the interface states. It defines a BDI link state based on the state of the two inputs.

Fault Indication State	BDI Admin{start straddle 2 columns}{end straddle 2 columns}	
{start emdash} {end emdash}	**Shutdown**	**No Shutdown**
No faults asserted	Admin-down	Up
At least one fault asserted	Admin-down	Operationally-Down

Bridge Domain Interface Statistics

For virtual interfaces, such as the bridge domain interface, protocol counters are periodically queried from the QFP.

When packets flow from a Layer 2 bridge domain network to a Layer 3 routing network through the bridge domain interface, the packets are treated as bridge domain interface input packets and bytes. When packets arrive at a Layer 3 interface and are forwarded through the bridge domain interface to a Layer 2 bridge domain, the packets are treated as output packets and bytes, and the counters are updated accordingly.

A BDI maintains a standard set of Layer 3 packet counters as the case with all Cisco IOS interfaces. Use the show interface command to view the Layer 3 packet counters.

The convention of the counters is relative to the Layer 3 cloud. For example, input refers to the traffic entry to the Layer 3 cloud from the Layer 2 BD, while output refers to the traffic exit from the Layer 3 cloud to the Layer 2 BD.

Use the **show interfaces accounting** command to display the statistics for the BDI status. Use the **show interface** <*if-name*> command to display the overall count of the packets and bytes that are transmitted and received.

Creating or Deleting a Bridge Domain Interface

When you define an interface or subinterface for a Cisco IOS router, you name it and specify how it is assigned an IP address.You can create a bridge domain interface before adding a bridge domain to the system. This new bridge domain interface will be activated after the associated bridge domain is configured.

Note When a bridge domain interface is created, a bridge domain is automatically created.

When you create the bridge domain interface and the bridge domain, the system maintains the required associations for mapping the bridge domain-bridge domain interface pair.

The mapping of bridge domain and bridge domain interface is maintained in the system. The bridge domain interface uses the index of the associated bridge domain to show the association.

Bridge Domain Interface Scalability

The following table lists the bridge domain interface scalability numbers, based on the type of Cisco 8500 Series Catalyst Edge Platform Forwarding Processors.

Table 37: Bridge Domain Interface Scalability Numbers Based on the Type of Cisco 8500 Series Catalyst Edge Platform Forwarding Processor

Description
Maximum bridge domain interfaces per router

Bridge-Domain Virtual IP Interface

The Virtual IP Interface (VIF) feature helps to associate multiple BDI interfaces with a BD instance. The BD-VIF interface inherits all the existing L3 features of IOS logical IP interface.

Note You must configure every BD-VIF interface with a unique MAC address and it should belong to a different VRF.

The Virtual IP Interface (VIF) feature has the following limitations:

- BD-VIF interface does not support IP multicast.
- Number of BD-VIF interfaces with automatically generated MAC address varies on the basis of platforms.
- BD-VIF Interface does not support MPLS.
- The maximum number of BD-VIF interfaces per bridge-domain and the total number of BD-VIF interface for per system vary based on the type of platforms.

The maximum number of BD-VIF supported on Cisco Catalyst 8500 Series Edge Platforms are:

- C8500-12X4QC supports maximum 100 BD-VIF for a Bridge Domain
- C8500-12X (support maximum 16 BD-VIF for a Bridge Domain

From Cisco IOS XE 17.7 release, BD-VIF supports Flexible Netflow (FNF).

How to Configure a Bridge Domain Interface

To configure a bridge domain interface, perform the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface BDI** *{interface number}*
4. **encapsulation** *encapsulation dot1q <first-tag> [second-dot1q <second-tag>]*
5. Do one of the following:

6. **match security-group destination tag** *sgt-number*
7. **mac address** *{mac-address}*
8. **no shut**
9. **shut**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface BDI** *{interface number}* **Example:** `Router(config-if)# interface BDI3`	Specifies a bridge domain interface on a Cisco 8500 Series Catalyst Edge Platform.
Step 4	**encapsulation** *encapsulation dot1q <first-tag> [second-dot1q <second-tag>]* **Example:** `Router(config-if)# encapsulation dot1Q 1 second-dot1q 2`	Defines the encapsulation type. The example shows how to define dot1q as the encapsulation type.
Step 5	Do one of the following: **Example:** **ip address** *ip-address mask* **Example:** **Example:** **ipv6 address** *{X:X:X:X::X* **link-local**| *X:X:X:X::X/prefix [***anycast** | **eui-64***]* | **autoconfig** *[***default***]}* **Example:** `Router(config-if)# ip address 2.2.2.1 255.255.255.0` **Example:** **Example:**	Specifies either the IPv4 or IPv6 address for the bridge domain interface.

	Command or Action	Purpose
	`Router(config-if)# ipv6 address AB01:CD1:123:C::/64 eui-64`	
Step 6	**match security-group destination tag** *sgt-number* **Example:** `Router(config-route-map)# match security-group destination tag 150`	Configures the value for security-group destination security tag.
Step 7	**mac address** *{mac-address}* **Example:** `Router(config-if)# mac-address 1.1.3`	Specifies the MAC address for the bridge domain interface.
Step 8	**no shut** **Example:** `Router(config-if)# no shut`	Enables the bridge domain interface on the Cisco 8500 Series Catalyst Edge Platform.
Step 9	**shut** **Example:** `Router(config-if)# shut`	Disables the bridge domain interface on the Cisco 8500 Series Catalyst Edge Platform.

Example

The following example shows the configuration of a bridge domain interface at IP address 2.2.2.1 255.255.255.0:

```
Router# configure terminal
Router(config)# interface BDI3
Router(config-if)# encapsulation dot1Q 1 second-dot1q 2
Router(config-if)# ip address 2.2.2.1 255.255.255.0
Router(config-if)# mac-address 1.1.3
Router(config-if)# no shut
Router(config-if)# exit
```

Displaying and Verifying Bridge Domain Interface Configuration

SUMMARY STEPS

1. **enable**
2. **show interfaces bdi**
3. **show platform software interface fp active name**
4. **show platform hardware qfp active interface if-name**
5. **debug platform hardware qfp feature**
6. **platform trace runtime process forwarding-manager module**

7. platform trace boottime process forwarding-manager module interfaces

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**show interfaces bdi** **Example:** `Router# show interfaces BDI3`	Displays the configuration summary of the corresponding BDI.
Step 3	**show platform software interface fp active name** **Example:** `Router# show platform software interface fp active name BDI4`	Displays the bridge domain interface configuration in a Forwarding Processor.
Step 4	**show platform hardware qfp active interface if-name** **Example:** `Router# show platform hardware qfp active interface if-name BDI4`	Displays the bridge domain interface configuration in a data path.
Step 5	**debug platform hardware qfp feature** **Example:** `Router# debug platform hardware qfp active feature l2bd client all`	The selected CPP L2BD Client debugging is on.
Step 6	**platform trace runtime process forwarding-manager module** **Example:** `Router(config)# platform trace runtime slot F0 bay 0 process forwarding-manager module interfaces level info`	Enables the Forwarding Manager Route Processor and Embedded Service Processor trace messages for the Forwarding Manager process.
Step 7	**platform trace boottime process forwarding-manager module interfaces** **Example:** `Router(config)# platform trace boottime slot`	Enables the Forwarding Manager Route Processor and Embedded Service Processor trace messages for the Route Processor Forwarding Manager process during bootup.

	Command or Action	Purpose
	`R0 bay 1 process forwarding-manager forwarding-manager level max`	

What to do next

For additional information on the commands and the options available with each command, see the Cisco IOS Configuration Fundamentals Command Reference Guide located at:

{start hypertext}http://www.cisco.com/en/US/docs/ios/fundamentals/command/reference/cf_book.html{end hypertext}

Configuring Bridge-Domain Virtual IP Interface

```
enable
configure terminal
[no] interface BD-VIF interface-number
  [[no] vrf forwarding vrf-name]
  [[no] mac address mac-address]
  [[no] ip address ip-address mask]
  [[no] ipv6 address {X:X:X:X::X link-local| X:X:X:X::X/prefix [anycast | eui-64] | autoconfig
 [default]}]

exit
```

To delete BD-VIF interface, use the 'no' form of the command.

Associating VIF Interface with a Bridge Domain

```
enable
configure terminal
bridge-domain bridge-domain number
[no] member BD-VIF interface-number
exit
```

Verifying Bridge-Domain Virtual IP Interface

All existing show commands for interface and IP interface can be used for the BD-VIF interface.

show interface bd-vif *bd-vif-id*

show ip interface bd-vif *bd-vif-id*

show bd-vif interfaces in fman-fp

show pla sof inter fp ac brief | i BD_VIF

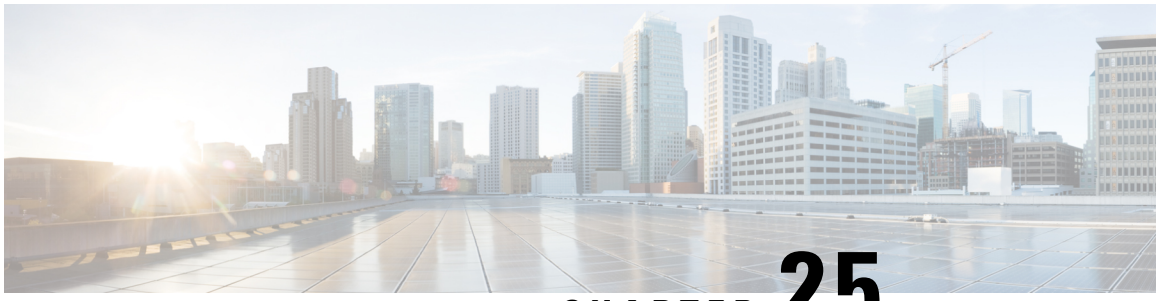
Example Configuration Bridge-Domain Virtual IP Interface

```
Detail sample:

interface Port-channel1
mtu 9000
no ip address
```

```
 !Ethernet service endpoint one per neutron network
service instance 1756 ethernet
  description 4e8e5957-649f-477b-9e5b-f1f75b21c03c
  encapsulation dot1q 1756
  rewrite ingress tag pop 1 symmetric
  bridge-domain 1756
!
interface BD-VIF5001
no shutdown
vrf forwarding vrf5001
ip address 10.0.0.1 255.255.255.0
interface BD-VIF5002
no shutdown
vrf forwarding vrf5002
ip address 10.0.0.2 255.255.255.0

bridge-domain 1756
member Port-channel1 service-instance 1756
member bd-vif5001
member bd-vif5002
```



CHAPTER 25

Packet Trace

First Published: August 03, 2016

The Packet-Trace feature provides a detailed understanding of how data packets are processed by the Cisco IOS XE platform, and thus helps customers to diagnose issues and troubleshoot them more efficiently. This module provides information about how to use the Packet-Trace feature.

Information About Packet Trace

The Packet-Trace feature provides three levels of inspection for packets: accounting, summary, and path data. Each level provides a detailed view of packet processing at the cost of some packet processing capability. However, Packet Trace limits inspection to packets that match the debug platform condition statements, and is a viable option even under heavy-traffic situations in customer environments.

The following table explains the three levels of inspection provided by packet trace.

Table 38: Packet-Trace Level

Packet-Trace Level	Description
Accounting	Packet-Trace accounting provides a count of packets that enter and leave the network processor. Packet-Trace accounting is a lightweight performance activity, and runs continuously until it is disabled.

Packet-Trace Level	Description
Summary	At the summary level of packet trace, data is collected for a finite number of packets. Packet-Trace summary tracks the input and output interfaces, the final packet state, and punt, drop, or inject packets, if any. Collecting summary data adds to additional performance compared to normal packet processing, and can help to isolate a troublesome interface.
Path data	The packet-trace path data level provides the greatest level of detail in packet trace. Data is collected for a finite number of packets. Packet-Trace path data captures data, including a conditional debugging ID that is useful to correlate with feature debugs, a timestamp, and also feature-specific path-trace data. Path data also has two optional capabilities: packet copy and Feature Invocation Array (FIA) trace. The packet-copy option enables you to copy input and output packets at various layers of the packet (layer 2, layer 3 or layer 4). The FIA- trace option tracks every feature entry invoked during packet processing and helps you to know what is happening during packet processing. **Note** Collecting path data consumes more packet-processing resources, and the optional capabilities incrementally affect packet performance. Therefore, path-data level should be used in limited capacity or in situations where packet performance change is acceptable.

Usage Guidelines for Configuring Packet Trace

Consider the following best practices while configuring the Packet-Trace feature:

- Use of ingress conditions when using the Packet-Trace feature is recommended for a more comprehensive view of packets.
- Packet-trace configuration requires data-plane memory. On systems where data-plane memory is constrained, carefully consider how you will select the packet-trace values. A close approximation of the amount of memory consumed by packet trace is provided by the following equation:

memory required = (statistics overhead) + number of packets * (summary size + data size + packet copy size).

When the Packet-Trace feature is enabled, a small, fixed amount of memory is allocated for statistics. Similarly, when per-packet data is captured, a small, fixed amount of memory is required for each packet for summary data. However, as shown by the equation, you can significantly influence the amount of memory consumed by the number of packets you select to trace, and whether you collect path data and copies of packets.

Configuring Packet Trace

Perform the following steps to configure the Packet-Trace feature.

Note The amount of memory consumed by the Packet-Trace feature is affected by the packet-trace configuration. You should carefully select the size of per-packet path data and copy buffers and the number of packets to be traced in order to avoid interrupting normal services. You can check the current data-plane DRAM memory consumption by using the **show platform hardware qfp active infrastructure exmem statistics** command.

SUMMARY STEPS

1. **enable**
2. **debug platform packet-trace packet** *pkt-num* **[fia-trace | summary-only] [circular] [data-size** *data-size***]**
3. **debug platform packet-trace {punt |inject|copy|drop|packet|statistics}**
4. **debug platform condition [ipv4 | ipv6] [interface** *interface***][access-list** *access-list -name* **|** *ipv4-address* **/** *subnet-mask* **|** *ipv6-address* **/** *subnet-mask***] [ingress | egress |both]**
5. **debug platform condition start**
6. **debug platform condition stop**
7. **show platform packet-trace {configuration | statistics | summary | packet {all |** *pkt-num***}}**
8. **clear platform condition all**
9. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables the privileged EXEC mode. Enter your password if prompted.
Step 2	**debug platform packet-trace packet** *pkt-num* **[fia-trace | summary-only] [circular] [data-size** *data-size***]** **Example:** `Router# debug platform packet-trace packets 2048 summary-only`	Collects summary data for a specified number of packets. Captures feature path data by default, and optionally performs FIA trace. *pkt-num*—Specifies the maximum number of packets maintained at a given time. **fia-trace**—Provides detailed level of data capture, including summary data, feature-specific data. Also displays each feature entry visited during packet processing. **summary-only**—Enables the capture of summary data with minimal details. **circular**—Saves the data of the most recently traced packets. *data-size*—Specifies the size of data buffers for storing feature and FIA trace data for each packet in bytes. When very heavy packet processing is performed on packets, users can increase the size of the data buffers if necessary. The default value is 2048.

	Command or Action	Purpose
Step 3	**debug platform packet-trace {punt |inject|copy|drop|packet|statistics}** **Example:** `Router# debug platform packet-trace punt`	Enables tracing of punted packets from data to control plane.
Step 4	**debug platform condition [ipv4 | ipv6] [interface** *interface*]**[access-list** *access-list -name* | *ipv4-address* / *subnet-mask* | *ipv6-address* / *subnet-mask*] **[ingress | egress |both]** **Example:** `Router# debug platform condition interface g0/0/0 ingress`	Specifies the matching criteria for tracing packets. Provides the ability to filter by protocol, IP address and subnet mask, access control list (ACL), interface, and direction.
Step 5	**debug platform condition start** **Example:** `Router# debug platform condition start`	Enables the specified matching criteria and starts packet tracing.
Step 6	**debug platform condition stop** **Example:** `Router# debug platform condition start`	Deactivates the condition and stops packet tracing.
Step 7	**show platform packet-trace {configuration | statistics | summary | packet {all |** *pkt-num*}} **Example:** `Router# show platform packet-trace 14`	Displays packet-trace data according to the specified option. See {start cross reference} Table 21-1 {end cross reference} for detailed information about the **show** command options.
Step 8	**clear platform condition all** **Example:** `Router(config)# clear platform condition all`	Removes the configurations provided by the **debug platform condition** and **debug platform packet-trace** commands.
Step 9	**exit** **Example:** `Router# exit`	Exits the privileged EXEC mode.

Configuring Packet Tracer with UDF Offset

Perform the following steps to configure the Packet-Trace UDF with offset:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **udf** *udf name* **header** {**inner | outer**} {**13|14**} **offset** *offset-in-bytes* **length** *length-in-bytes*
4. **udf** *udf name* {**header | packet-start**} *offset-base offset length*
5. **ip access-list extended** {*acl-name* |*acl-num*}
6. **ip access-list extended { deny | permit } udf udf-name value mask**
7. **debug platform condition [ipv4 | ipv6] [interface** *interface*] **[access-list** *access-list -name* | *ipv4-address / subnet-mask* | *ipv6-address / subnet-mask*] **[ingress | egress |both]**
8. **debug platform condition start**
9. **debug platform packet-trace packet** *pkt-num* **[fia-trace | summary-only] [circular] [data-size** *data-size*]
10. **debug platform packet-trace {punt | inject|copy | drop |packet | statistics}**
11. **debug platform condition stop**
12. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**udf** *udf name* **header** {**inner	outer**} {**13|14**} **offset** *offset-in-bytes* **length** *length-in-bytes*
		Example:
		`Router(config)# udf TEST_UDF_NAME_1 header inner l3 64 1`
		`Router(config)# udf TEST_UDF_NAME_2 header inner l4 77 2`
		`Router(config)# udf TEST_UDF_NAME_3 header outer l3 65 1`
		`Router(config)# udf TEST_UDF_NAME_4 header outer l4 67 1`
			Configures individual UDF definitions. You can specify the name of the UDF, the networking header from which offset, and the length of data to be extracted.
			The **inner** or **outer** keywords indicate the start of the offset from the unencapsulated Layer 3 or Layer 4 headers, or if there is an encapsulated packet, they indicate the start of offset from the inner L3/L4.
			The **length** keyword specifies, in bytes, the length from the offset. The range is from 1 to 2.
			.

Step 4	**udf** *udf name* {**header	packet-start**} *offset-base offset length* **Example:**	• header—Specifies the offset base configuration. • packet-start—Specifies the offset base from packet-start. packet-start" can vary depending on if

	Command or Action	Purpose
	`Router(config)# udf TEST_UDF_NAME_5 packet-start 120 1`	packet-trace is for an inbound packet or outbound packet. If the packet-trace is for an inbound packet then the packet-start will be layer2. For outbound, he packet-start will be layer3. • offset—Specifies the number of bytes offset from the offset base. To match the first byte from the offset base (Layer 3/Layer 4 header), configure the offset as 0. • length—Specifies the number of bytes from the offset. Only 1 or 2 bytes are supported. To match additional bytes, you must define multiple UDFs.
Step 5	**ip access-list extended** {*acl-name* |*acl-num*} **Example:** `Router(config)# ip access-list extended acl2`	Enables extended ACL configuration mode. The CLI enters the extended ACL configuration mode in which all subsequent commands apply to the current extended access list. Extended ACLs control traffic by the comparison of the source and destination addresses of the IP packets to the addresses configured in the ACL.
Step 6	**ip access-list extended { deny | permit } udf udf-name value mask** **Example:** `Router(config-acl)# permit ip any any udf TEST_UDF_NAME_5 0xD3 0xFF`	Configures the ACL to match on UDFs along with the current access control entries (ACEs) . The bytes defined in ACL is 0xD3. Masks are used with IP addresses in IP ACLs to specify what should be permitted and denied.
Step 7	**debug platform condition [ipv4 | ipv6] [interface** *interface***] [access-list** *access-list -name* **|** *ipv4-address* **/** *subnet-mask* **|** *ipv6-address* **/** *subnet-mask***] [ingress | egress |both]** **Example:** `Router# debug platform condition interface gi0/0/0 ipv4 access-list acl2 both`	Specifies the matching criteria for tracing packets. Provides the ability to filter by protocol, IP address and subnet mask, access control list (ACL), interface, and direction.
Step 8	**debug platform condition start** **Example:** `Router# debug platform condition start`	Enables the specified matching criteria and starts packet tracing.
Step 9	**debug platform packet-trace packet** *pkt-num* **[fia-trace | summary-only] [circular] [data-size** *data-size***]** **Example:** `Router# debug platform packet-trace packet 1024 fia-trace data-size 2048`	Collects summary data for a specified number of packets. Captures feature path data by default, and optionally performs FIA trace. *pkt-num*—Specifies the maximum number of packets maintained at a given time. **fia-trace**—Provides detailed level of data capture, including summary data, feature-specific data. Also

	Command or Action	Purpose
		displays each feature entry visited during packet processing. **summary-only**—Enables the capture of summary data with minimal details. **circular**—Saves the data of the most recently traced packets. *data-size*—Specifies the size of data buffers for storing feature and FIA trace data for each packet in bytes. When very heavy packet processing is performed on packets, users can increase the size of the data buffers if necessary. The default value is 2048.
Step 10	**debug platform packet-trace {punt | inject|copy | drop |packet | statistics}** **Example:** `Router# debug platform packet-trace punt`	Enables tracing of punted packets from data to control plane.
Step 11	**debug platform condition stop** **Example:** `Router# debug platform condition start`	Deactivates the condition and stops packet tracing.
Step 12	**exit** **Example:** `Router# exit`	Exits the privileged EXEC mode.

Displaying Packet-Trace Information

Use these **show** commands to display packet-trace information.

Table 39: show Commands

Command	Description
show platform packet-trace configuration	Displays packet trace configuration, including any defaults.
show platform packet-trace statistics	Displays accounting data for all the traced packets.
show platform packet-trace summary	Displays summary data for the number of packets specified.
show platform packet-trace {all | *pkt-num***} [decode]**	Displays the path data for all the packets or the packet specified. The **decode** option attempts to decode the binary packet into a more human- readable form.

Removing Packet-Trace Data

Use these commands to clear packet-trace data.

Table 40: clear Commands

Command	Description
clear platform packet-trace statistics	Clears the collected packet-trace data and statistics.
clear platform packet-trace configuration	Clears the packet-trace configuration and the statistics.

Configuration Examples for Packet Trace

This section provides the following configuration examples:

Example: Configuring Packet Trace

This example describes how to configure packet trace and display the results. In this example, incoming packets to Gigabit Ethernet interface 0/0/1 are traced, and FIA-trace data is captured for the first 128 packets. Also, the input packets are copied. The **show platform packet-trace packet 0** command displays the summary data and each feature entry visited during packet processing for packet 0.

```
Router>
enable
Router# debug platform packet-trace packet 128 fia-trace
Router# debug platform packet-trace punt
Router# debug platform condition interface g0/0/1 ingress
Router# debug platform condition start
Router#! ping to UUT
Router# debug platform condition stop
Router# show platform packet-trace packet 0
Packet: 0           CBUG ID: 9
Summary
  Input     : GigabitEthernet0/0/1
  Output    : GigabitEthernet0/0/0
  State     : FWD
  Timestamp
    Start   : 1819281992118 ns (05/17/2014 06:42:01.207240 UTC)
    Stop    : 1819282095121 ns (05/17/2014 06:42:01.207343 UTC)
Path Trace
  Feature: IPV4
    Source      : 198.51.100.2
    Destination : 198.51.100.2
    Protocol    : 1 (ICMP)
  Feature: FIA_TRACE
    Entry     : 0x8059dbe8 - DEBUG_COND_INPUT_PKT
    Timestamp : 3685243309297
  Feature: FIA_TRACE
    Entry     : 0x82011a00 - IPV4_INPUT_DST_LOOKUP_CONSUME
    Timestamp : 3685243311450
  Feature: FIA_TRACE
    Entry     : 0x82000170 - IPV4_INPUT_FOR_US_MARTIAN
```

```
    Timestamp : 3685243312427
  Feature: FIA_TRACE
    Entry     : 0x82004b68 - IPV4_OUTPUT_LOOKUP_PROCESS
    Timestamp : 3685243313230
  Feature: FIA_TRACE
    Entry     : 0x8034f210 - IPV4_INPUT_IPOPTIONS_PROCESS
    Timestamp : 3685243315033
  Feature: FIA_TRACE
    Entry     : 0x82013200 - IPV4_OUTPUT_GOTO_OUTPUT_FEATURE
    Timestamp : 3685243315787
  Feature: FIA_TRACE
    Entry     : 0x80321450 - IPV4_VFR_REFRAG
    Timestamp : 3685243316980
  Feature: FIA_TRACE
    Entry     : 0x82014700 - IPV6_INPUT_L2_REWRITE
    Timestamp : 3685243317713
  Feature: FIA_TRACE
    Entry     : 0x82000080 - IPV4_OUTPUT_FRAG
    Timestamp : 3685243319223
  Feature: FIA_TRACE
    Entry     : 0x8200e500 - IPV4_OUTPUT_DROP_POLICY
    Timestamp : 3685243319950
  Feature: FIA_TRACE
    Entry     : 0x8059aff4 - PACTRAC_OUTPUT_STATS
    Timestamp : 3685243323603
  Feature: FIA_TRACE
    Entry     : 0x82016100 - MARMOT_SPA_D_TRANSMIT_PKT
    Timestamp : 3685243326183

Router# clear platform condition all
Router# exit
```

Linux Forwarding Transport Service (LFTS) is a transport mechanism to forward packets punted from the CPP into applications other than IOSd. This example displays the LFTS-based intercepted packet destined for binos application.

```
Router# show platform packet-trace packet 10
Packet: 10     CBUG ID: 52
Summary
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  State  : PUNT 55 (For-us control)
  Timestamp
    Start : 597718358383 ns (06/06/2016 09:00:13.643341 UTC)
    Stop : 597718409650 ns (06/06/2016 09:00:13.643392 UTC)
Path Trace
  Feature: IPV4
    Input  : GigabitEthernet0/0/0
    Output : <unknown>
    Source : 10.64.68.2
    Destination : 224.0.0.102
    Protocol : 17 (UDP)
      SrcPort : 1985
      DstPort : 1985
  Feature: FIA_TRACE
    Input  : GigabitEthernet0/0/0
    Output : <unknown>
    Entry  : 0x8a0177bc - DEBUG_COND_INPUT_PKT
    Lapsed time : 426 ns
  Feature: FIA_TRACE
    Input  : GigabitEthernet0/0/0
    Output : <unknown>
    Entry  : 0x8a017788 - IPV4_INPUT_DST_LOOKUP_CONSUME
    Lapsed time : 386 ns
```

```
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : <unknown>
  Entry  : 0x8a01778c - IPV4_INPUT_FOR_US_MARTIAN
  Lapsed time : 13653 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017730 - IPV4_INPUT_LOOKUP_PROCESS_EXT
  Lapsed time : 2360 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017be0 - IPV4_INPUT_IPOPTIONS_PROCESS_EXT
  Lapsed time : 66 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017bfc - IPV4_INPUT_GOTO_OUTPUT_FEATURE_EXT
  Lapsed time : 680 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017d60 - IPV4_INTERNAL_ARL_SANITY_EXT
  Lapsed time : 320 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017a40 - IPV4_VFR_REFRAG_EXT
  Lapsed time : 106 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017d2c - IPV4_OUTPUT_DROP_POLICY_EXT
  Lapsed time : 1173 ns
Feature: FIA_TRACE
  Input  : GigabitEthernet0/0/0
  Output : internal0/0/rp:1
  Entry  : 0x8a017940 - INTERNAL_TRANSMIT_PKT_EXT
  Lapsed time : 20173 ns
LFTS Path Flow: Packet: 10    CBUG ID: 52
  Feature: LFTS
  Pkt Direction: IN
  Punt Cause  : 55
       subCause : 0
```

Example: Using Packet Trace

This example provides a scenario in which packet trace is used to troubleshoot packet drops for a NAT configuration on a Cisco ASR 1006 Router. This example shows how you can effectively utilize the level of detail provided by the Packet-Trace feature to gather information about an issue, isolate the issue, and then find a solution.

In this scenario, you can detect that there are issues, but are not sure where to start troubleshooting. You should, therefore, consider accessing the Packet-Trace summary for a number of incoming packets.

```
Router# debug platform condition ingress
Router# debug platform packet-trace packet 2048 summary-only
Router# debug platform condition start
Router# debug platform condition stop
Router# show platform packet-trace summary
```

```
Pkt   Input             Output            State  Reason
0     Gi0/0/0           Gi0/0/0           DROP   402 (NoStatsUpdate)
1     internal0/0/rp:0  internal0/0/rp:0  PUNT   21  (RP<->QFP keepalive)
2     internal0/0/recycle:0  Gi0/0/0      FWD
```

The output shows that packets are dropped due to NAT configuration on Gigabit Ethernet interface 0/0/0, which enables you to understand that an issue is occurring on a specific interface. Using this information, you can limit which packets to trace, reduce the number of packets for data capture, and increase the level of inspection.

```
Router# debug platform packet-trace packet 256
Router# debug platform packet-trace punt
Router# debug platform condition interface Gi0/0/0
Router# debug platform condition start
Router# debug platform condition stop
Router# show platform packet-trace summary
Router# show platform packet-trace 15
Packet: 15          CBUG ID: 238
Summary
  Input     : GigabitEthernet0/0/0
  Output    : internal0/0/rp:1
  State     : PUNT 55  (For-us control)
  Timestamp
    Start   : 1166288346725 ns (06/06/2016 09:09:42.202734 UTC)
    Stop    : 1166288383210 ns (06/06/2016 09:09:42.202770 UTC)
Path Trace
  Feature: IPV4
    Input       : GigabitEthernet0/0/0
    Output      : <unknown>
    Source      : 10.64.68.3
    Destination : 224.0.0.102
    Protocol    : 17 (UDP)
      SrcPort   : 1985
      DstPort   : 1985
IOSd Path Flow: Packet: 15    CBUG ID: 238
  Feature: INFRA
    Pkt Direction: IN
    Packet Rcvd From CPP
  Feature: IP
    Pkt Direction: IN
    Source      : 10.64.68.122
    Destination : 10.64.68.255
  Feature: IP
    Pkt Direction: IN
    Packet Enqueued in IP layer
    Source      : 10.64.68.122
    Destination : 10.64.68.255
    Interface   : GigabitEthernet0/0/0
  Feature: UDP
    Pkt Direction: IN
    src         : 10.64.68.122(1053)
    dst         : 10.64.68.255(1947)
    length      : 48

Router#show platform packet-trace packet 10
Packet: 10          CBUG ID: 10
Summary
  Input     : GigabitEthernet0/0/0
  Output    : internal0/0/rp:0
  State     : PUNT 55  (For-us control)
  Timestamp
    Start   : 274777907351 ns (01/10/2020 10:56:47.918494 UTC)
    Stop    : 274777922664 ns (01/10/2020 10:56:47.918509 UTC)
```

```
Path Trace
  Feature: IPV4(Input)
    Input       : GigabitEthernet0/0/0
    Output      : <unknown>
    Source      : 10.78.106.2
    Destination : 224.0.0.102
    Protocol    : 17 (UDP)
      SrcPort   : 1985
      DstPort   : 1985

IOSd Path Flow: Packet: 10    CBUG ID: 10
  Feature: INFRA
    Pkt Direction: IN
Packet Rcvd From DATAPLANE
 Feature: IP
    Pkt Direction: IN
    Packet Enqueued in IP layer
    Source      : 10.78.106.2
    Destination : 224.0.0.102
    Interface   : GigabitEthernet0/0/0

  Feature: UDP
    Pkt Direction: IN DROP
    Pkt : DROPPED
    UDP: Discarding silently
    src        : 881 10.78.106.2(1985)
    dst         : 224.0.0.102(1985)
    length      : 60

Router#show platform packet-trace packet  12
Packet: 12          CBUG ID: 767
Summary
  Input     : GigabitEthernet3
  Output    : internal0/0/rp:0
  State     : PUNT 11  (For-us data)
  Timestamp
    Start   : 16120990774814 ns (01/20/2020 12:38:02.816435 UTC)
    Stop    : 16120990801840 ns (01/20/2020 12:38:02.816462 UTC)
Path Trace
  Feature: IPV4(Input)
    Input       : GigabitEthernet3
    Output      : <unknown>
    Source      : 12.1.1.1
    Destination : 12.1.1.2
    Protocol    : 6 (TCP)
      SrcPort   : 46593
      DstPort   : 23
IOSd Path Flow: Packet: 12    CBUG ID: 767
  Feature: INFRA
    Pkt Direction: IN
    Packet Rcvd From DATAPLANE

  Feature: IP
    Pkt Direction: IN
    Packet Enqueued in IP layer
    Source      : 12.1.1.1
    Destination : 12.1.1.2
    Interface   : GigabitEthernet3

  Feature: IP
    Pkt Direction: IN
    FORWARDEDTo transport layer
    Source        : 12.1.1.1
    Destination   : 12.1.1.2
```

```
    Interface     : GigabitEthernet3

  Feature: TCP
    Pkt Direction: IN
    tcp0: I NoTCB 12.1.1.1:46593 12.1.1.2:23 seq 1925377975 OPTS 4 SYN  WIN 4128
```

```
Router# show platform packet-trace summary
Pkt   Input                     Output                    State  Reason
0     INJ.2                     Gi1                       FWD
1     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
2     INJ.2                     Gi1                       FWD
3     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
4     INJ.2                     Gi1                       FWD
5     INJ.2                     Gi1                       FWD
6     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
7     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
8     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
9     Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
10    INJ.2                     Gi1                       FWD
11    INJ.2                     Gi1                       FWD
12    INJ.2                     Gi1                       FWD
13    Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
14    Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
15    Gi1                       internal0/0/rp:0          PUNT   11  (For-us data)
16    INJ.2                     Gi1                       FWD
```

The following example displays the packet trace data statistics.

```
Router#show platform packet-trace statistics
Packets Summary
  Matched  3
  Traced   3
Packets Received
  Ingress  0
  Inject   0
Packets Processed
  Forward  0
  Punt     3
    Count       Code  Cause
    3           56    RP injected for-us control
  Drop     0
  Consume  0

          PKT_DIR_IN
             Dropped       Consumed       Forwarded
INFRA            0             0             0
TCP              0             0             0
UDP              0             0             0
IP               0             0             0
IPV6             0             0             0
ARP              0             0             0

         PKT_DIR_OUT
             Dropped       Consumed       Forwarded
INFRA            0             0             0
TCP              0             0             0
UDP              0             0             0
IP               0             0             0
IPV6             0             0             0
ARP              0             0             0
```

The following example displays packets that are injected and punted to the forwarding processor from the control plane.

```
Router#debug platform condition ipv4 10.118.74.53/32 both
 Router#Router#debug platform condition start
Router#debug platform packet-trace packet 200
Packet count rounded up from 200 to 256

Router#show platform packet-tracer packet 0
show plat pack pa 0
Packet: 0           CBUG ID: 674
Summary
  Input     : GigabitEthernet1
  Output    : internal0/0/rp:0
  State     : PUNT 11  (For-us data)
  Timestamp
    Start   : 17756544435656 ns (06/29/2020 18:19:17.326313 UTC)
    Stop    : 17756544469451 ns (06/29/2020 18:19:17.326346 UTC)
Path Trace
  Feature: IPV4(Input)
    Input       : GigabitEthernet1
    Output      : <unknown>
    Source      : 10.118.74.53
    Destination : 198.51.100.38
    Protocol    : 17 (UDP)
      SrcPort   : 2640
      DstPort   : 500

IOSd Path Flow: Packet: 0    CBUG ID: 674
  Feature: INFRA
  Pkt Direction: IN
    Packet Rcvd From DATAPLANE

  Feature: IP
  Pkt Direction: IN
    Packet Enqueued in IP layer
    Source      : 10.118.74.53
    Destination : 198.51.100.38
    Interface   : GigabitEthernet1

  Feature: IP
  Pkt Direction: IN
  FORWARDED To transport layer
    Source        : 10.118.74.53
    Destination   : 198.51.100.38
    Interface     : GigabitEthernet1

  Feature: UDP
  Pkt Direction: IN
  DROPPED
 UDP: Checksum error: dropping
 Source      : 10.118.74.53(2640)
 Destination : 198.51.100.38(500)

Router#show platform packet-tracer packet 2
Packet: 2           CBUG ID: 2

IOSd Path Flow:
  Feature: TCP
  Pkt Direction: OUTtcp0: O SYNRCVD 198.51.100.38:22 198.51.100.55:52774 seq 3052140910
OPTS 4 ACK 2346709419 SYN  WIN 4128

  Feature: TCP
  Pkt Direction: OUT
  FORWARDED
 TCP: Connection is in SYNRCVD state
 ACK         : 2346709419
```

```
 SEQ         : 3052140910
 Source      : 198.51.100.38(22)
 Destination : 198.51.100.55(52774)


  Feature: IP
  Pkt Direction: OUTRoute out the generated packet.srcaddr: 198.51.100.38, dstaddr:
198.51.100.55

  Feature: IP
  Pkt Direction: OUTInject and forward successful srcaddr: 198.51.100.38, dstaddr:
198.51.100.55

  Feature: TCP
  Pkt Direction: OUTtcp0: O SYNRCVD 198.51.100.38:22 198.51.100.55:52774 seq 3052140910
OPTS 4 ACK 2346709419 SYN  WIN 4128
Summary
  Input     : INJ.2
  Output    : GigabitEthernet1
  State     : FWD
  Timestamp
    Start   : 490928006866 ns (06/29/2020 13:31:30.807879 UTC)
    Stop    : 490928038567 ns (06/29/2020 13:31:30.807911 UTC)
Path Trace
  Feature: IPV4(Input)
    Input       : internal0/0/rp:0
    Output      : <unknown>
    Source      : 172.18.124.38
    Destination : 172.18.124.55
    Protocol    : 6 (TCP)
      SrcPort   : 22
      DstPort   : 52774
  Feature: IPSec
    Result    : IPSEC_RESULT_DENY
    Action    : SEND_CLEAR
    SA Handle : 0
    Peer Addr : 55.124.18.172
    Local Addr: 38.124.18.172


Router#
```

Additional References

Standards

Standard	Title
None	—

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at this URL: {start hypertext}http://www.cisco.com/go/mibs{end hypertext}

RFCs

RFC	Title
None	—

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	{start hypertext}http://www.cisco.com/cisco/web/support/index.html{end hypertext}

Feature Information for Packet Trace

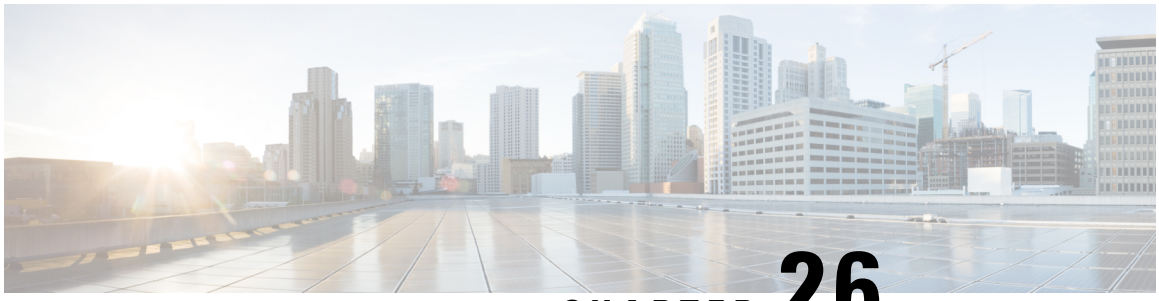
{start cross reference}Table 21-4{end cross reference} lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to{start hypertext} http://www.cisco.com/go/cfn{end hypertext}. An account on Cisco.com is not required.

Note {start cross reference}Table 21-4{end cross reference} lists only the software releases that support a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 41: Feature Information for Packet Trace

Feature Name	Releases	Feature Information
Packet Trace	Cisco IOS XE 3.10S	The Packet Trace feature provides information about how data packets are processed by the Cisco IOS XE software. In Cisco IOS XE Release 3.10S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: • **debug platform packet-trace packet** *pkt-num* [**fia-trace** | **summary-only**] [**data-size** *data-size*] [**circular**] • **debug platform packet-trace copy packet** {**input** | **output** | **both**} [**size** *num-bytes*] [**L2** | **L3** | **L4**] • **show platform packet-trace** {**configuration** | **statistics** | **summary** | **packet** {**all** | *pkt-num*}}
	Cisco IOS XE 3.11S	In Cisco IOS XE Release 3.11S, this feature was enhanced to include the following features: • Matched versus traced statistics. • Trace stop timestamp in addition to trace start timestamp. The following commands were introduced or modified: • **debug platform packet-trace drop** [**code** *drop-num*] • **show platform packet-trace packet** {**all** | *pkt-num*} [*decode*]
	Cisco IOS XE Denali 16.3.1	In Cisco IOS XE Denali 16.3.1, this feature was enhanced to include Layer3 packet tracing along with IOSd. The following commands were introduced or modified: **debug platform packet-trace punt**.
	Cisco IOS XE Amsterdam 17.3.1	The output of the **show platform packet-trace** command now includes additional trace information for packets either originated from IOSd or destined to IOSd or other BinOS processes.



CHAPTER 26

Packet Drops

This document provides information about Packet Drops on the Cisco ASR 1000 Series Aggregation Services Routers.

Information About Packet Drops

High Level Packet Flow

Cisco ASR 1000 Series Router comprises the following functional elements in the system:

- • Cisco ASR 1000 Series Route Processor (RP)
- • Cisco ASR 1000 Series Embedded Services Processor (ESP)
- • Cisco ASR 1000 Series SPA Interface Processor (SIP) or Modular Interface Processor

The Cisco ASR 1000 Series Routers introduce the Cisco Quantum Flow Processor (QFP) as their hardware architecture. In the QFP based architecture, all packets are forwarded through ESP, so, if a problem occurs in ESP, the forwarding stops.

Viewing Packet Drops

From Cisco IOS XE 17.6, you can run the show drops command to troubleshoot the root cause of packet drops.

With the **show drops** command, you can identify the following:

- The root cause of the drop based on the feature or the protocol.
- The history of the QFP Drops.

Viewing Packet Drop Information

Perform the following steps to view and filter the packet drop information for your instance based on the interface, protocol, or feature:

SUMMARY STEPS

1. **enable**
2. **show drops**
3. **show drops** { **bqs** | **crypto**| **firewall**| **interface**| **ip-all**| **nat**| **punt**| **qfp**| **qos**|**history**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables the privileged EXEC mode. Enter your password, if prompted.
Step 2	**show drops** **Example:** `Router# show drops`	Displays the drop statistics.
Step 3	**show drops** { **bqs**	**crypto**| **firewall**| **interface**| **ip-all**| **nat**| **punt**| **qfp**| **qos**|**history**} **Example:** `Router# show drops qfp`	Displays the drop statistics and the summary for the interface or the protocol that you choose. **Note** From Cisco IOS XE 17.13.1a, a new keyword option history is added to the **show drops** command. The **show drops history qfp** command will allow the user to view the history of the QFP drops.

Example

Example for Viewing Packet Drop Information: Sample Output

The following is a sample output of the show drops command. This sample output displays the **packet drops** information related to the Quantum Flow Processor (QFP).

```
Router#show drops
bqs BQS related drops
crypto IPSEC related drops
firewall Firewall related drops
history History of drops
interface Interface drop statistics
ip-all IP related drops
nat NAT related drops
punt Punt path related drops
qfp QFP drop statistics
qos QoS related drops
```

```
| Output modifiers
<cr> <cr>

Router# show drops qfp
------------------ show platform hardware qfp active statistics drop detail
Last clearing of QFP drops statistics : Fri Feb 18 08:02:37 2022
(6d 23h 54m 29s ago)
-------------------------------------------------------------------------------
ID Global Drop Stats Packets
Octets
-------------------------------------------------------------------------------
319 BFDoffload 9
1350
61 Icmp 84
3780
53 IpFragErr 32136
48718168
244 IpLispHashLkupFailed 3
213
56 IpsecInput 18
4654
23 TailDrop 26713208
10952799454
216 UnconfiguredIpv6Fia 241788
26596680
------------------ show platform hardware qfp active interface all
statistics drop_summary
-----------------------------------------------------------------
Drop Stats Summary:
note: 1) these drop stats are only updated when PAL
reads the interface stats.
2) the interface stats include the subinterface
Interface Rx Pkts Tx Pkts
-------------------------------------------------------------------------------
GigabitEthernet1 60547 0
GigabitEthernet2 60782 27769658
GigabitEthernet3 60581 0
GigabitEthernet4 60502 1323990
Tunnel14095001 0 1990214
Tunnel14095002 0 3883238
Tunnel14095003 0 3879243
Tunnel14095004 0 2018866
Tunnel14095005 0 3875972
Tunnel14095006 0 3991497
Tunnel14095007 0 4107743
Tunnel14095008 0 3990601
```

Verifying Packet Information

This section shows examples of command output to verify packet information.

In order to display statistics of drops for all interfaces in Packet Processor Engine (PPE), use the command **show drops qfp**.

Note The wrapper command **show drops qfp** is the shorthand notation for the original **show platform hardware qfp active statistics drop** command.

```
Router#show drops qfp
------------------------------------------------------------
Global Drop Stats Octets
Packets
------------------------------------------------------------
AttnInvalidSpid 0 0
BadDistFifo 0 0
BadIpChecksum 0 0
```

In order to display the history of QFP drops for all interfaces in Packet Processor Engine (PPE), use the command **show drops history qfp**. This command can also track the number of packet drops in the last 1-min, 5-min and 30-min time period.

Note The wrapper command **show drops history qfp** is the shorthand notation for the original **show platform hardware qfp active statistics drop history** command.

Note The wrapper command **show drops history qfp** is not available on Catalyst 8500L Edge Platform.

```
Router# show drops history qfp
Last clearing of QFP drops statistics : Mon Jun 26 07:29:14
2023
(21s ago)
------------------------------------------------------------
Global Drop Stats 1-Min
5-Min 30-Min All
------------------------------------------------------------
Ipv4NoAdj 0
0 0 99818
Ipv4NoRoute 0
0 0 99853
```

Packet Drops Warnings

From Cisco IOS XE 17.14, you can configure the warning thresholds for per drop cause and/or total QFP drop in packets per second. If the configured thresholds are exceeded, then a rate-limited syslog warning is generated. One warning is generated for total threshold exceeded and one warning per drop cause will be generated.

The warning is generated a maximum of once per minute for each drop cause. The drops over the previous minute are checked against the threshold (packets per second) x 60, and if the drops exceed this value, a warning is generated.

The following are the sample warnings for total and per drop cause respectively.

```
%QFP-5-DROP_OVERALL_RATE: Exceeded the overall drop threshold 10000 pps during the last
60-second measurement period, packets dropped in last 1 minute: 641220, last 5 minutes:
1243420, last 30 minutes: 124342200
```

```
%QFP-5-DROP_CAUSE_RATE: Exceeded the drop threshold 1000 pps for QosPolicing (drop code:
20) during the last 60-second measurement period, packets dropped due to QosPolicing in
last 1 minute: 61220, last 5 minutes: 43420, last 30 minutes: 4611200
```

Configuring Packet Drops Warning Thresholds

Perform the following steps to configure the warning thresholds for per drop cause and/or total QFP drop in packets per second.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **platform qfp drops threshold** {**per-cause** *drop_id threshold* | **total** *threshold*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables the privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**platform qfp drops threshold** {**per-cause** *drop_id threshold*	**total** *threshold*} **Example:** `Router# platform qfp drops threshold per-cause 206 10`	Specifies the per drop cause or total threshold value for the drop. **Note** Use the **show platform hardware qfp active statistics drop detail** command to view the drop cause ID.

Example

The following examples show how to configure the warning thresholds for per drop cause and total QFP drops.

Example for configuring warning threshold for per drop cause QFP drops

The following example shows how to configure the warning threshold of 15 pps for drop cause ID 24.

```
Router> enable
Router# configure terminal
Router(config)#platform qfp drops threshold ?
per-cause Set warning threshold for per cause QFP drops
total Set warning threshold for total QFP drops
Router(config)#platform qfp drops threshold per-cause ?
<0-1024> QFP drop cause ID
Router(config)#platform qfp drops threshold per-cause 24 ?
<0-2147483647> Drop threshold in packets per second (pps)
Router(config)#platform qfp drops threshold per-cause 24 15
```

Example for configuring warning threshold for total QFP drops

The following example shows how to configure the warning threshold of 100 pps for total QFP drops.

```
Router> enable
Router# configure terminal
Router(config)#platform qfp drops threshold ?
per-cause Set warning threshold for per cause QFP drops
total Set warning threshold for total QFP drops
Router(config)#platform qfp drops threshold total ?
<0-2147483647> Drop threshold in packets per second (pps)
Router(config)#platform qfp drops threshold total 100
```

Viewing Packet Drops Warning Thresholds

Perform the following steps to view the configured warning thresholds for per drop cause and total QFP drops.

SUMMARY STEPS

1. **enable**
2. **show platform hardware qfp active statistics drop threshold**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables the privileged EXEC mode. Enter your password, if prompted.
Step 2	**show platform hardware qfp active statistics drop threshold** **Example:** `Router# show platform hardware qfp active statistics drop thresholds`	Displays the configured warning thresholds for per drop cause and total QFP drops. **Note** • The wrapper command **show drops thresholds** is the shorthand notation of the **show platform hardware qfp active statistics drop threshold**command. • The wrapper command **show drops thresholds** is currently not available on Catalyst 8500L Edge Platform.

Example

Example for Viewing Packet Drop Warning Thresholds

The following is a sample output of the **show platform hardware qfp active statistics drop threshold** command.

```
Router#show platform hardware qfp active statistics drop thresholds
-----------------------------------------------------
Drop ID         Drop Cause Name             Threshold
-----------------------------------------------------
10             BadIpChecksum                100
```

```
206             PuntPerCausePolicerDrops      10
20              QosPolicing                   200
                 Total                         30
```

The following is a sample output of the **show drops thresholds** wrapper command.

```
Router#show platform hardware qfp active statistics drop thresholds
-----------------------------------------------------
Drop ID          Drop Cause Name             Threshold
-----------------------------------------------------
10              BadIpChecksum                 100
206             PuntPerCausePolicerDrops      10
20              QosPolicing                   200
                 Total                         30
```

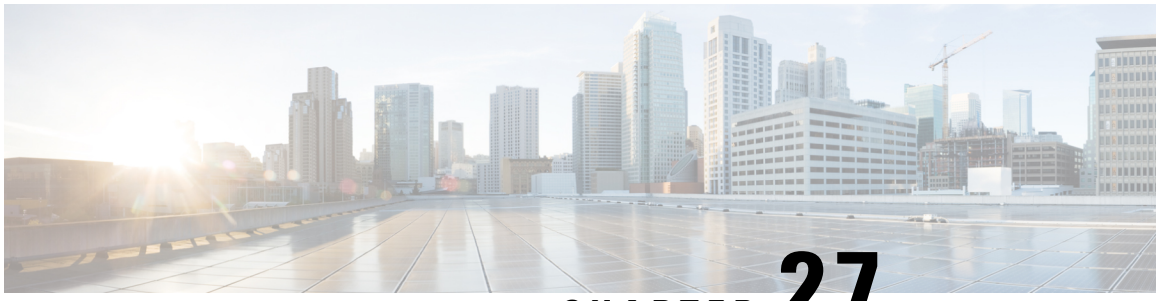
Feature Information for Packet Drops

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 42: Feature Information for Packet Drops

Feature Name	Releases	Feature Information
QFP Drops Threshold and Warning	IOS XE 17.14.1a	From Cisco IOS XE 17.14.1a, this feature enables you to configure the warning threshold for each drop cause, and the total QFP drop in packets per second. If the configured threshold exceeds, then a rate-limited syslog warning is generated. You can configure the threshold using the **platform qfp drops threshold** command on the Cisco ASR 1000 Series and Catalyst 8500 Series Edge Platforms.
Packet Drops History	IOS XE 17.13.1a	From Cisco IOS XE 17.13.1a, you can use the **show drops history qfp** command to view the history of the QFP drops on the Cisco ASR 1000 Series and Catalyst 8500 Series Edge Platforms.



CHAPTER 27

EVPN VPWS over SR-TE Preferred Path

The Ethernet VPN Virtual Private Wire Service (EVPN VPWS) functionality implements the signaling and encapsulation techniques for establishing an EVPN instance between a pair of PEs. This enhancement extends EVPN VPWS to support the specification of an SR-TE policy using the **preferred path** feature.

Feature Information for EVPN VPWS over SR-TE Preferred Path

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use the Cisco Feature Navigator to find information about platform support and Cisco software image support. To access the Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 43: Feature Information for EVPN VPWS over SR-TE Preferred Path

Feature Name	Releases	Feature Information
EVPN VPWS over SR-TE Preferred Path	Cisco IOS XE Cupertino 17.7.1a	This feature was introduced.

Restrictions for EVPN VPWS over SR-TE Preferred Path

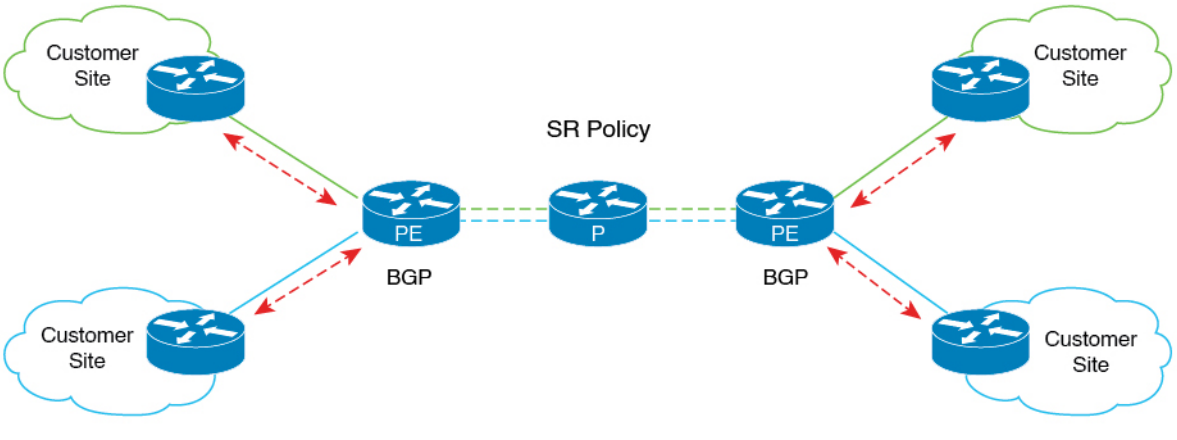
- SR On-Demand Next Hop (ODN) policy is not supported; only SR static policy is supported.
- SR Per-Flow Policy (PFP) is not supported; only SR Per-Destination Policy (PDP) is supported.
- Interior Gateway Protocol (IGP) is Intermediate System-to-Intermediate system (IS-IS).

Information About EVPN VPWS over SR-TE Preferred Path

The EVPN VPWS functionality implements the signaling and encapsulation techniques for establishing an EVPN instance between a pair of PEs. This enhancement enables EVPN VPWS to support the specification of an SR-TE policy using the **preferred path** feature. This feature includes the **fallback disable** option, which disables the default behavior of falling back on an alternate path if the preferred path is down.

The following figure illustrates the architecture:

Figure 3: EVPN VPWS over SR-TE Architecture



How to Configure EVPN VPWS over SR-TE Preferred Path

The following sections provide information about the tasks involved in configuring EVPN VPWS over the SR-TE preferred path.

Configuring EVPN VPWS over SR-TE Preferred Path

The following example shows how to enable EVPN VPWS over the configured SR-TE preferred path:

```
l2vpn evpn instance 100 point-to-point
 rd 100:100
 route-target export 100:100
 route-target import 100:100
 !
 vpws context vc100
  preferred-path segment-routing traffic-eng policy p-100
  service target 100 source 100
interface GigabitEthernet0/0/3
service instance 100 ethernet
encapsulation dot1q 100
```

Configuring EVPN VPWS over SR-TE Preferred Path with Fallback Disable

The **fallback disable** command prevents a device from using the default path if the preferred path SR policy goes down.

```
l2vpn evpn instance 100 point-to-point
rd 100:100
route-target export 100:100
route-target import 100:100
vpws context vc100
service target 100 source 100
member GigabitEthernet0/0/3 service-instance 100
preferred-path segment-routing traffic-eng policy p-100 disable-fallback
```

Removing Fallback Disable from EVPN VPWS over SR-TE Preferred Path

The following example shows how to remove the fallback disable option in EVPN VPWS over SR-TE preferred path:

```
l2vpn evpn instance 100 point-to-point
 vpws context vc100
  preferred-path segment-routing traffic-eng policy p-100
```

Disabling EVPN VPWS over SR-TE Preferred Path Configuration

The following example shows how to disable the EVPN VPWS over SR-TE preferred path configuration:

```
l2vpn evpn instance 100 point-to-point
 vpws context vc100
 no  preferred-path segment-routing traffic-eng policy p-100 disable-fallback
```

Verifying EVPN VPWS over SR-TE Preferred Path

The following sample outputs show how to to verify the EVPN VPWS over SR-TE preferred path and fallback disable configurations.

- The following is a sample output showing the EVPN VPWS configuration over an SR-TE preferred path:

```
device# show l2vpn evpn vpws VC ID 100 detail
EVPN name: vc100, state: up, type: point-to-point
  EVPN ID: 100
  VPWS Service Instance ID: Source 1, Target 2
  Labels: Local 17, Remote 17
  Next Hop Address: 6.6.6.6
  Associated member interface Gi0/0/3 up, Gi0/0/3:3000 status is up
  Output interface: Tu65536, imposed label stack {16016 17}
  Preferred path:   active
  Default path: ready

device# show l2vpn evpn vpws vc preferred-path
Tunnel         EVPN ID  Source    Target    Name      Status
-------------       ------   --------  --------  --------  ----------
Tunnel65536     100       1         2            vc100        up
```

- The following is a sample output showing the EVPN VPWS configuration over an SR-TE preferred path, with fallback disabled:

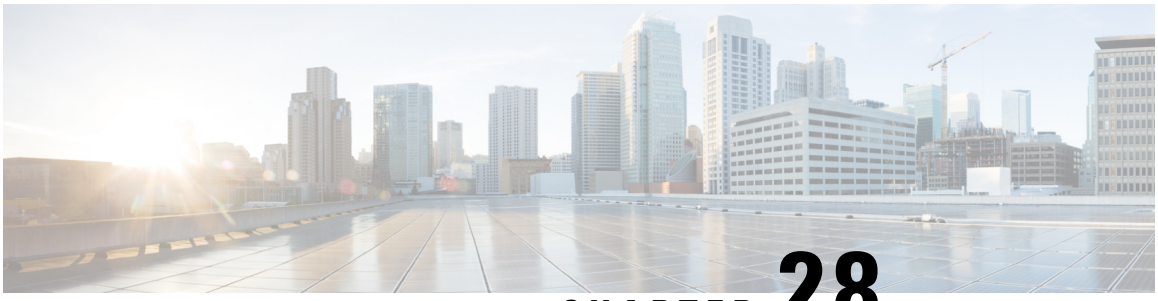
```
device# show l2vpn evpn vpws VC ID 100 detail
EVPN name: vc100, state: up, type: point-to-point
  EVPN ID: 100
  VPWS Service Instance ID: Source 1, Target 2
  Labels: Local 17, Remote 17
  Next Hop Address: 6.6.6.6
  Associated member interface Gi0/0/3 up, Gi0/0/3:3000 status is up
  Output interface: Tu65536, imposed label stack {16016 17}
  Preferred path:   active
  Default path:  disabled
Dataplane:
SSM segment/switch IDs: 25037/12290 (used), PWID: 1
Rx Counters
1241 input transit packets, 463266 bytes
0 drops
Tx Counters
828 output transit packets, 402840 bytes
0 drops
24 VC FSM state transitions, Last 10 shown
DpUp: Act -> Est, Mon Sep 06 23:32:43.809 (2w2d ago)
RemDn: Est -> RemWait, Mon Sep 06 23:32:43.809 (2w2d ago)
RemUp: RemWait -> Act, Mon Sep 06 23:32:43.816 (2w2d ago)
DpUp: Act -> Est, Mon Sep 06 23:32:43.816 (2w2d ago)
DpDn: Est -> Act, Mon Sep 06 23:35:57.944 (2w2d ago)
DpUp: Act -> Est, Mon Sep 06 23:43:50.071 (2w2d ago)
DpDn: Est -> Act, Mon Sep 06 23:46:15.361 (2w2d ago)
DpUp: Act -> Est, Mon Sep 06 23:54:11.508 (2w2d ago)
DpDn: Est -> Act, Tue Sep 07 00:00:11.248 (2w2d ago)
DpUp: Act -> Est, Tue Sep 07 00:06:27.355 (2w2d ago)
```

- The following is a sample output showing the EVPN VPWS configuration over an SR-TE preferred path, with fallback disable option removed:

```
device# show l2vpn evpn vpws VC ID 100 detail
EVPN name: vc100, state: up, type: point-to-point
  EVPN ID: 100
  VPWS Service Instance ID: Source 1, Target 2
  Labels: Local 17, Remote 17
  Next Hop Address: 6.6.6.6
  Associated member interface Gi0/0/3 up, Gi0/0/3:3000 status is up
  Output interface: Tu65536, imposed label stack {16016 17}
  Preferred path:   active
  Default path:  ready
```

- The following is a sample output showing the EVPN VPWS configuration over an SR-TE preferred path disabled:

```
device# show l2vpn evpn vpws VC ID 100 detail
EVPN name: vc100, state: up, type: point-to-point
  EVPN ID: 100
  VPWS Service Instance ID: Source 1, Target 2
  Labels: Local 17, Remote 17
  Next Hop Address: 6.6.6.6
  Associated member interface Gi0/0/3 up, Gi0/0/3:3000  status is up
  Output interface: Gi0/0/0, imposed label stack {16 16}
  Preferred path: not configured
  Default path:  active
```



CHAPTER 28

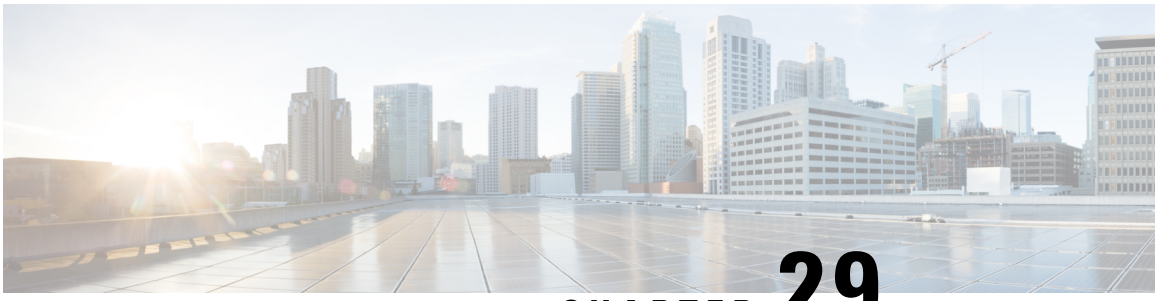
Configuring SFP+

SUMMARY STEPS

1. **enable** *source-interface gigabitethernet slot/port*
2. **configure terminal**
3. **interface tengigabitethernet** *slot/port*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** *source-interface gigabitethernet slot/port* **Example:** `Router# enable`	Enables the privileged EXEC mode. If prompted, enter your password.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 3	**interface tengigabitethernet** *slot/port* **Example:** `Router(config)# interface tengigabitethernet 4/11`	Specifies the 10-Gigabit Ethernet interface to be configured. Here: slot/port—Specifies the location of the interface.



CHAPTER 29

Cisco Thousand Eyes Enterprise Agent Application Hosting

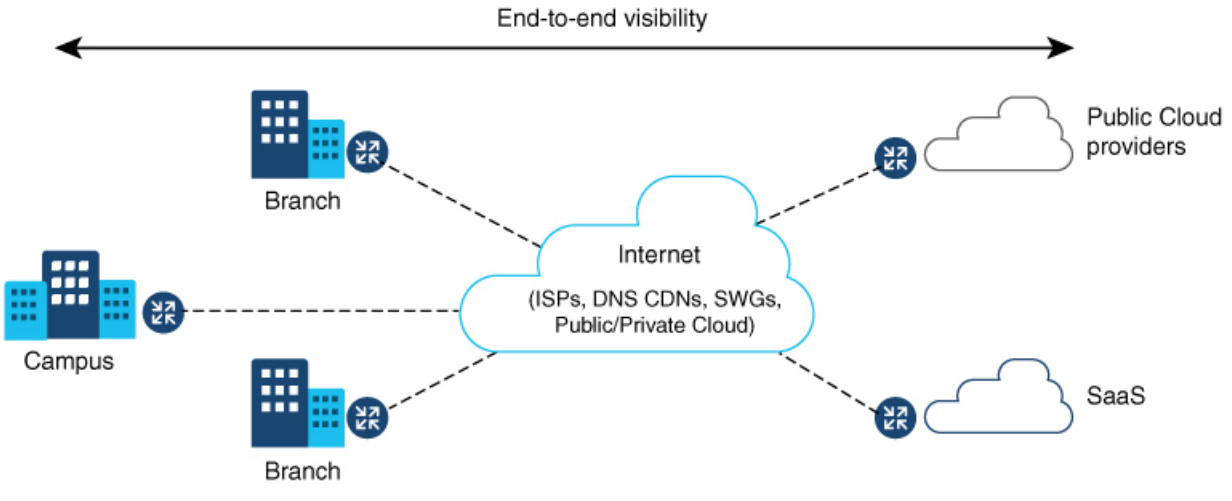
This chapter provides information on Cisco Thousand Eyes Enterprise Agent Application Hosting. The following sections are included in this chapter:

Cisco ThousandEyes Enterprise Agent Application Hosting

Cisco ThousandEyes is a network intelligence platform that allows you to use its agents to run a variety of tests from its agents to monitor the network and application performance. This application enables you to view end-to-end paths across networks and services that impact your business. Cisco ThousandEyes application actively monitors the network traffic paths across internal, external, and internet networks in real time, and helps to analyse the network performance. Also, isco ThousandEyes application provides application availability insights that are enriched with routing and device data for a multidimensional view of digital experience.

From Cisco IOS XE Release 17.8.1, you can use application-hosting capabilities to deploy the Cisco ThousandEyes Enterprise Agent as a container application on Cisco Catalyst 8500 and Catalyst 8500L Series Edge Platforms. This agent application runs as a docker image using Cisco IOx docker-type option. For more information on how to configure Cisco ThousandEyes in controller mode, see Cisco SD-WAN Systems and Interfaces Configuration Guide.

Figure 4: Network View through ThousandEyes Application



Feature Information for Cisco ThousandEyes Enterprise Agent Application Hosting

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 44: Feature Information for ThousandEyes Enterprise Agent Application Hosting

Feature Name	Releases	Feature Information
Cisco ThousandEyes Enterprise Agent Application Hosting	Cisco IOS XE 17.8.1	With the integration of ThousandEyes Agent Application running on routing platforms using the app-hosting capabilities as container, you can have visibility into application experience with deep insights into the Internet, cloud providers, and enterprise networks.

Supported Platforms and System Requirements

The following table lists the supported platforms and system requirements.

Platforms	Bootflash	FRU Storage	DRAM
Cisco Catalyst 8500 Series Edge Platforms			
C8500-12X4QC	32 GB	(Default) 32 GB eUSB (Optional) HDD	16 GB

Platforms	Bootflash	FRU Storage	DRAM
C8500-12X	32 GB	(Default) 32 GB eUSB (Optional) HDD	16 GB
Cisco Catalyst 8500L Series Edge Platforms			
C8500L-8S4X	16 GB	(Default) 32GB M.2 USB	16 GB

Note The minimum DRAM and bootflash storage requirement for running Cisco ThousandEyes Enterprise Agent is 8 GB. If the device does not have enough memory or storage, we recommend that you upgrade DRAM or add an external storage such as SSD/M.2 USB. When the available resources are not sufficient to run other applications, Cisco IOx generates an error message.

Workflow to Install and Run the Cisco ThousandEyes Application

To install and run the Cisco ThousandEyes image on a device, perform these steps:

Step 1 Create a new account on the Cisco ThousandEyes portal.

Step 2 Download the Cisco ThousandEyes application package from the software downloads page and ensure that you use the agent version 4.2.2.

Step 3 Copy the image on the device.

Step 4 Install and launch the image.

Step 5 Connect the agent to the controller.

Note When you order platforms that support Cisco ThousandEyes application with Cisco IOS XE 17.8.1 software, the Cisco ThousandEyes application package is available in the bootflash of the device.

Workflow to Host the Cisco ThousandEyes Application

To install and launch the application, perform these steps:

Before you begin

Create a new account on the Cisco ThousandEyes portal and generate the token. The Cisco ThousandEyes agent application uses this token to authenticate and check into the correct Cisco ThousandEyes account. you see a message stating that your token is invalid and you want to troubleshoot the issue, see Troubleshooting the Cisco ThousandEyes Application, on page 252.

Note If you configure the correct token and Domain Name Server (DNS) information, the device is discovered automatically.

Step 1 Enable Cisco IOX application environment on the device.

- Use the following commands for non-SD-WAN (autonomous mode) images:

```
config terminal
 iox
end
write
```

- Use the following commands for SD-WAN (controller mode) images:

```
config-transaction
iox
commit
```

Step 2 If the IOx command is accepted, wait for a few seconds and check whether the IOx process is up and running by using the **show iox** command. The output must display that the show IOxman process is running.

```
Device #show iox

IOx Infrastructure Summary:
---------------------------
IOx service (CAF) 1.11.0.0     : Running
IOx service (HA)               : Not Supported
IOx service (IOxman)           : Running
IOx service (Sec storage)      : Not Supported
Libvirtd 1.3.4                 : Running
```

Step 3 Ensure that the ThousandEyes application LXC tarball is available in the device *bootflash:*.

Step 4 Create a virtual port group interface to enable the traffic path to the Cisco ThousandEyes application:

```
interface VirtualPortGroup 0
          ip address 192.168.35.1 255.255.255.0
        exit
```

Step 5 Configure the app-hosting application with the generated token:

```
app-hosting appid te
          app-vnic gateway1 virtualportgroup 0 guest-interface 0
          guest-ipaddress 192.168.35.2 netmask 255.255.255.0
          app-default-gateway 192.168.35.1 guest-interface 0
          app-resource docker
                   prepend-pkg-opts □ Required to get the default run-time options from package.yaml

                    run-opts 1 "--hostname thousandeyes"
              run-opts 2 "-e TEAGENT_ACCOUNT_TOKEN=<ThousandEyes token>"
        run-opts 3 "-e TEAGENT_PROXY_TYPE=STATIC -e TEAGENT_PROXY_LOCATION=proxy.something.other:80"

          name-server0 75.75.75.75 □ ISP's DNS server
        end

app-hosting appid te
```

```
app-resource docker
 prepend-pkg-opts
 run-opts 2 "--hostname
```

Note You can use the proxy configuration only if the Cisco ThousandEyes agent does not have an internet access without a proxy. Also, the hostname is optional. If you do not provide the hostname during the installation, the device hostname is used as the Cisco ThousandEyes agent hostname. The device hostname is displayed on the Cisco ThousandEyes portal. The DNS name server information is optional. If the Cisco ThousandEyes agent uses a private IP address, ensure that you establish a connection to the device through NAT.

Step 6 Configure the **start** command to run the application automatically when the application is installed on the device using the **install** command:

```
app-hosting appid te
         start
```

Step 7 On C8500-L platform, convert the device to app-heavy mode and reload the device using the following commands:

```
Device(config)#platform resource app-heavy
Please reboot to activate this template

C8500L(config)#end
C8500L#wr mem
Building configuration...
[OK]
C8500L#

C8500L#reload
Proceed with reload? [confirm]
```

Step 8 Install the ThousandEyes application:

```
app-hosting install appid <appid> package [bootflash: | harddisk: | https:]
```

Select a location to install the ThousandEyes application from these options:

```
Device# app-hosting install appid te package ?
           bootflash:  Package path □ ISR4K case if image is locally available in bootflash:
           harddisk:   Package path □ Cat8K case if image is locally available in M.2 USB
           https:      Package path □ Download over the internet if image is not locally present in
 router. URL to ThousandEyes site hosting agent image to be provided here
```

Step 9 Check if the application is up and running:

```
Device#show app-hosting list
 App id                                   State
---------------------------------------------------------
  te                                       RUNNING
```

Note If any of these steps fail, use the **show logging** command and check the IOx error message. If the error message is about insufficient disk space, clean the storage media (bootflash or hard disk) to free up the space. Use the **show app-hosting resource** command to check the CPU and disk memory.

Downloading and Copying the Image to the Device

To download and copy the image to bootflash, perform these steps:

Step 1 Check if the Cisco ThousandEyes image is precopied to *bootflash:/<directory name>*.

Step 2 If the image is not available in the device directory, perform these steps:

a) If the device has a direct access to internet, use the *https:*. option in the **application install** command. This option downloads the image from the Cisco ThousandEyes software downloads page into *bootflash:/apps* and installs the application.

```
Device# app-hosting install appid <appid string> package [bootflash: | flash | http | https://
| ftp | ] URL to image location hosted on ThousandEyes portal

Device# app-hosting install appid te1000 package
https://downloads.thousandeyes.com/enterprise-agent/thousandeyes-enterprise-agent-4.0.2.cisco.tar

Installing package
'https://downloads.thousandeyes.com/enterprise-agent/thousandeyes-enterprise-agent-4.0.2.cisco.tar'
 for 'te1000'.

Use 'show app-hosting list' for progress.
*Jun 29 23:43:29.244: %IOSXE-6-PLATFORM: R0/0: IOx:  App verification successful
*Jun 29 23:45:00.449: %IM-6-INSTALL_MSG: R0/0: ioxman: app-hosting: Install succeeded: te1000
installed successfully Current state is DEPLOYED
*Jun 29 23:45:01.801: %IOSXE-6-PLATFORM: R0/0: IOx:  App verification successful
*Jun 29 23:45:51.054: %IM-6-START_MSG: R0/0: ioxman: app-hosting: Start succeeded: te1000 started
 successfully Current state is RUNNING

Device#show app-hosting detail appid te1000  ( Details of Application)
App id                 : te1000
Owner                  : iox
State                  : RUNNING
Application
  Type                 : docker
  Name                 : ThousandEyes Enterprise Agent
  Version              : 4.0
  Author               : ThousandEyes <support@thousandeyes.com>
  Path                 : bootflash:thousandeyes-enterprise-agent-4.0-22.cisco.tar
Resource reservation
  Memory               : 500 MB
  Disk                 : 1 MB
  CPU                  : 1500 units
  CPU-percent          : 70 %
```

b) If the device has a proxy server, copy the image manually to *bootflash:/apps*.

c) Download the Cisco ThousandEyes application package from the software downloads page and ensure that you use the agent version 4.0.2.

d) Create an application directory in the *bootflash:* to copy the image:

```
Device# mkdir bootflash:apps
Create directory filename [apps]?
Created dir bootflash:/apps
```

e) Copy the Cisco ThousandEyes image to the *bootflash:apps* directory.

f) Validate the image using the **verify** command:

```
verify /md5 bootflash:apps/<file name>
```

Connecting the Cisco ThousandEyes Agent with the Controller

Before you begin

Ensure that you have an Internet connection before you connect the agent with the controller.

After the Cisco ThousandEyes application is up and running, the agent (ThousandEyes-agent) process connects to the controller that is running on the cloud environment.

Note If you have issues related to connectivity, the application logs the relevant error messages in the application-specific logs (*/var/logs*).

Modifying the Agent Parameters

To modify the agent parameters, perform these actions:

Step 1 Stop the application using the **app-hosting stop appid appid** command.
Step 2 Deactivate the application using the **app-hosting deactivate appid appid** command.
Step 3 Make the required changes to app-hosting configuration.
Step 4 Activate the application using the **app-hosting activate appid appid** command.
Step 5 Start the application using the **app-hosting start appid appid** command.

Uninstalling the Application

To uninstall the application, perform these steps:

Step 1 Stop the application using the **app-hosting stop appid te** command.
Step 2 Check if the application is in active state using the **show app-hosting list** command.
Step 3 Deactivate the application using the **app-hosting deactivate appid te** command.
Step 4 Ensure that the application is not in active state. Use the **show app-hosting list** command to check status of the application.
Step 5 Uninstall the application using the **app-hosting uninstall appid te** command.
Step 6 After the uninstallation process is complete, use the **show app-hosting list** command to check if the application is uninstalled successfully.

Troubleshooting the Cisco ThousandEyes Application

To troubleshoot the Cisco ThousandEyes application, perform these steps:

1. Connect to Cisco ThousandEyes agent application using the **app-hosting connect appid appid session /bin/bash** command.
2. Verify the configuration applied to the application at the following path */etc/te-agent.cfg*.
3. View the logs at the following path */var/log/agent/te-agent.log*. You can use these logs to troubleshoot the configuration.

Checking the ThousandEyes Application Status

When the Cisco ThousandEyes application is in running state, it is registered on the ThousandEyes portal. If the application does not show up in a few minutes after the agent is in running state, check the following using the **app-hosting connect appid thousandeyes_enterprise_agent session** command:

```
Device#app-hosting connect appid thousandeyes_enterprise_agent session
Device# cat /var/log/agent/te-agent.log
2021-02-04 08:59:29.642 DEBUG [e4736a40] [te.agent.AptPackageInterface] {} Initialized APT
 package interface
2021-02-04 08:59:29.642 INFO  [e4736a40] [te.agent.main] {} Agent version 1.103.0 starting.
  Max core size is 0 and max open files is 1024
2021-02-04 08:59:29.642 DEBUG [e4736a40] [te.agent.db] {} Vacuuming database
2021-02-04 08:59:29.643 INFO  [e4736a40] [te.agent.db] {} Found version 0, expected version
 50
2021-02-04 08:59:29.672 INFO  [e4708700] [te.probe.ServerTaskExecutor] {} ProbeTaskExecutor
 started with 2 threads.
2021-02-04 08:59:29.673 INFO  [e2f05700] [te.probe.ProbeTaskExecutor.bandwidth] {}
ProbeTaskExecutor started with 1 threads.
2021-02-04 08:59:29.673 INFO  [e2704700] [te.probe.ProbeTaskExecutor.realtime] {}
ProbeTaskExecutor started with 1 threads.
2021-02-04 08:59:29.673 INFO  [e1f03700] [te.probe.ProbeTaskExecutor.throughput] {}
ProbeTaskExecutor started with 1 threads.
2021-02-04 08:59:29.674 DEBUG [e4736a40] [te.agent.DnssecTaskProceessor] {} Agent is not
running bind
2021-02-04 08:59:29.674 DEBUG [e4736a40] [te.snmp.RequestDispatcher] {} Initialised SNMP++
 session
2021-02-04 08:59:29.674 DEBUG [e4736a40] [te.snmp.RequestDispatcher] {} Initialised SNMP++
 session
2021-02-04 08:59:29.674 DEBUG [e4736a40] [te.snmp.RequestDispatcher] {} Initialised SNMP++
 session
2021-02-04 08:59:29.674 INFO  [e4736a40] [te.agent.main] {} Agent starting up
2021-02-04 08:59:29.675 INFO  [e4736a40] [te.agent.main] {} No agent id found, attempting
to obtain one
2021-02-04 08:59:29.675 INFO  [e4736a40] [te.agent.ClusterMasterAdapter] {} Attempting to
get agent id from sc1.thousandeyes.com
2021-02-04 08:59:29.679 ERROR [e4736a40] [te.agent.main] {} Error calling create_agent:
Curl error - Couldn't resolve host name
2021-02-04 08:59:29.680 INFO  [e4736a40] [te.agent.main] {} Sleeping for 30 seconds
Note :
```

Note Check the DNS server connection. If the Cisco ThousandEyes agent is assigned to a private IP address, check the NAT configuration.