Cisco Catalyst 8300 and Catalyst 8200 Series Edge Platforms Software Configuration Guide

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Preface

This section briefly describes the objectives of this document and provides links to additional information on related products and services:

Objectives

This guide provides an overview of the Cisco Catalyst 8300 and 8200 Series Edge Platforms and explains how to configure the various features on these routers.

Important Information on Features and Commands

For more information about Cisco IOS XE software, including features available on the router (described in configuration guides), see the Cisco IOS XE 17 Software Documentation set.

To verify support for specific features, use Cisco Feature Navigator. For more information about this, see Using Cisco Feature Navigator, on page 109.

To find reference information for a specific Cisco IOS XE command, see the Cisco IOS Master Command List, All Releases.

Related Documentation

- Hardware Installation Guide for the Cisco C8000 Series Router
- Release Notes for the Cisco C8000 Series Routers

Commands

Cisco IOS XE commands are identical in look, feel, and usage to Cisco IOS commands on most platforms. To find reference information for a specific Cisco IOS XE command, see the Cisco IOS Master Command List, All Releases document.

Features

The router runs Cisco IOS XE software which is used on multiple platforms. To verify support for specific features, use the Cisco Feature Navigator tool. For more information, see Using Cisco Feature Navigator, on page 109.

Document Conventions

This documentation uses the following conventions:

Convention	Description
^ or **Ctrl**	The ^ and **Ctrl** symbols represent the Control key. For example, the key combination **^D** or **Ctrl-D** means hold down the **Control** key while you press the **D** key. Keys are indicated in capital letters but are not case sensitive.
string	A string is a nonquoted set of characters shown in italics. For example, when setting an SNMP community string to public, do not use quotation marks around the string or the string will include the quotation marks.

Command syntax descriptions use the following conventions:

Convention	Description
bold	Bold text indicates commands and keywords that you enter exactly as shown.
italics	Italic text indicates arguments for which you supply values.
[x]	Square brackets enclose an optional element (keyword or argument).
|	A vertical line indicates a choice within an optional or required set of keywords or arguments.
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical line indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a vertical line indicate a required choice.

Nested sets of square brackets or braces indicate optional or required choices within optional or required elements. For example:

Convention	Description
[x {y | z}]	Braces and a vertical line within square brackets indicate a required choice within an optional element.

Examples use the following conventions:

Convention	Description
`screen`	Examples of information displayed on the screen are set in Courier font.
`bold screen`	Examples of text that you must enter are set in Courier bold font.
< >	Angle brackets enclose text that is not printed to the screen, such as passwords.
!	An exclamation point at the beginning of a line indicates a comment line. (Exclamation points are also displayed by the Cisco IOS XE software for certain processes.)
[ ]	Square brackets enclose default responses to system prompts.

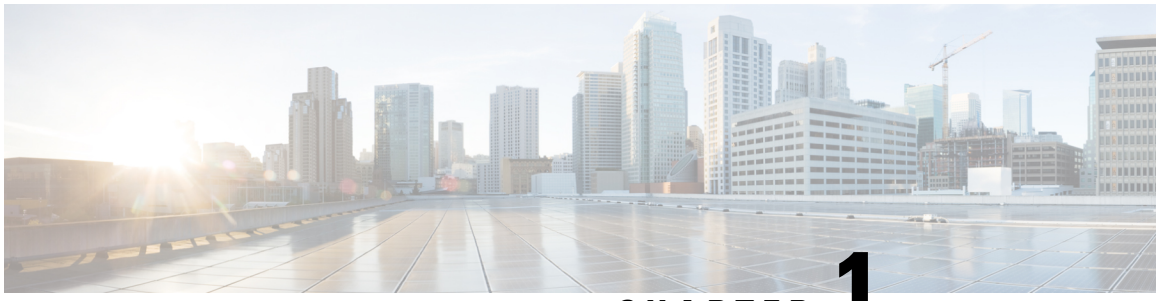
Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Note Means *reader take note*. Notes contain helpful suggestions or references to materials that may not be contained in this manual.

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 1

Overview

This chapter includes information about Cisco Catalyst 8300 and 8200 Series Edge Platforms and describes the autonomous mode and controller mode. It contains the following sections:

Introduction

The Cisco Catalyst 8300 and 8200 Series Edge Platforms are best-of-breed, 5G-ready, cloud edge platforms designed for accelerated services, multi-layer security, cloud-native agility, and edge intelligence to accelerate your journey to cloud.

Cisco Catalyst 8300 and 8200 Series Edge Platforms with Cisco IOS XE SD-WAN Software deliver Cisco's secure, cloud-scale SD-WAN solution for the branch. The Cisco Catalyst 8300 and 8200 Series Edge Platforms is built for high performance and integrated SD-WAN Services along with flexibility to deliver security and networking services together from the cloud or on premises. It provides higher WAN port density and a redundant power supply capability. The Cisco Catalyst 8300 and 8200 Series Edge Platforms have a wide variety of interface options to choose from—ranging from lower and higher module density with backward compatibility to a variety of existing WAN, LAN, LTE, voice, and compute modules. Powered by Cisco IOS XE, fully programmable software architecture, and API support, these platforms can facilitate automation at scale to achieve zero-touch IT capability while migrating workloads to the cloud. The Cisco Catalyst 8300 and 8200 Series Edge Platforms also come with Trustworthy Solutions 2.0 infrastructure that secures the platforms against threats and vulnerabilities with integrity verification and remediation of threats.

The Cisco Catalyst 8300 and 8200 Series Edge Platforms are well suited for medium-sized and large enterprise branch offices for high WAN IPsec performance with integrated SD-WAN services.

Cisco Catalyst 8300 and 8200 Series Edge Platforms target these use-cases:

- Enterprise Branch office, Managed Service Provide CPE, Internet Gateway for DIA, SASE cloud platform with SD-WAN
- Next-generation of Software Defined (SD) Branch routing platforms

This document is a summary of software functionality that is specific to the Cisco Catalyst 8300 and 8200 Series Edge Platforms. You can 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 device and includes the Cisco IOS XE functionality. To access Cisco IOS XE SD-WAN functionality

switch to the Controller mode. You can use the existing Plug and Play workflow to determine the mode of the device.

You can use the universalk9 image to deploy both Cisco IOS XE SD-WAN and Cisco IOS XE on Cisco IOS XE platforms. The Cisco IOS XE Amsterdam 17.3 helps in seamless upgrades of both the SD-WAN and non-SDWAN features and deployments.

Switch Between Controller and Autonomous Modes Using Cisco CLI

Use the **controller-mode** command in Privileged EXEC mode to switch between controller and autonomous modes.

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

```
Device# controller-mode disable
```

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

```
Device# controller-mode enable
```

Note When the device mode is switched from autonomous to controller, the startup configuration and the information in NVRAM (certificates), are erased. This action is same as the **write erase**.

When the device mode is switched from controller to autonomous, all Yang-based configuration is preserved and can be reused if you switch back to controller mode. If you want to switch the mode from controller to autonomous, ensue that the configuration on the device is set to auto-boot.

Switch Between Controller and Autonomous Modes using Bootstrap Configuration Files

On a device that already runs a Cisco IOS XE non SD-WAN image, after installing Cisco IOS XE Release 17.3.2 or later image, the device boots up in autonomous mode.

On a device that already runs a Cisco IOS XE SD-WAN image, after installing Cisco IOS XE Release17.3.1r or later image, the device boots up in controller mode.

To switch modes, use the **controller-mode enable** command to switch from autonomous to controller mode and **controller-mode disable** command to switch from controller mode to autonomous mode. After the device boots up, the configuration present in the configuration file is applied.

After the device boots up in controller mode, the configuration present in the configuration file is applied.

For more information on how to use a single universalk9 image to deploy Cisco IOS XE SD-WAN and Cisco IOS XE functionality on all the supported devices, see the Install and Deploy Cisco IOS XE and Cisco IOS XE SD-WAN Functionality on Edge Platforms guide.

The following are the Cisco Catalyst 8300 and 8200 Series Edge Platforms models:

- C8300-2N2S-4T2X
- C8300-2N2S-6T
- C8300-1N1S-4T2X

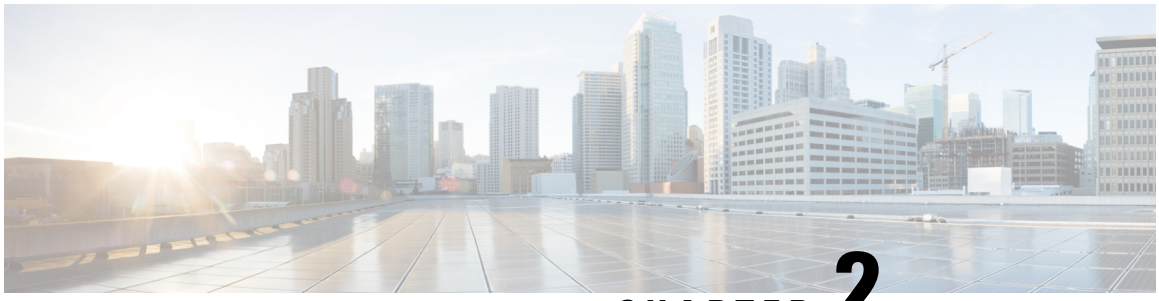
- C8300-1N1S-6T
- C8200-1N-4T
- C8200L-1N-4T

Supported Modules and Features-on Cisco 8300 and 8200 Series Edge Platforms

The following table provides the supported modules and features on Cisco Catalyst 8300 and 8200 Series Edge Platforms.

Table 1: Supported Modules and Features on Cisco 8300 and 8200 Series Edge Platforms

Features	Cisco 8300	Cisco 8200	Cisco 8200L
Service Plane Applications (UTD, AppQoE, and TcpOpt)	Yes	No	No
CPU Core	8 Core C8300-2N2S-4T2X supports 12 Core	8 Core	4 Core
CPU Memory	8 G	8 G	4 G
Backplane Support	10 G	10 G	1 G



CHAPTER 2

Basic Platform Configuration

This section includes information about some basic platform configuration in Autonomous mode, and contains the following sections:

Default Configuration

When you boot up the device in autonomous mode, the device looks for a default file name-the PID of the device. For example, the Cisco Catalyst 8000 Series Edge Platforms look for a file named c8000.cfg. The device looks for this file before finding the standard files-router-confg or the ciscortr.cfg.

The device looks for the c8000.cfg file in the bootflash. If the file is not found in the bootflash, the device then looks for the standard files-router-confg and ciscortr.cfg. If none of the files are found, the device then checks for any inserted USB that may have stored these files in the same particular order.

Note If there is a configuration file with the PID as its name in an inserted USB, but one of the standard files are in bootflash, the system finds the standard file for use.

Use the **show running-config** command to view the initial configuration, as shown in the following example:

```
Router# show running-config
Building configuration...

Current configuration : 6504 bytes
!
! Last configuration change at 05:04:58 UTC Mon Jul 6 2020
!
```

```
version 17.3
service config
service timestamps debug datetime msec
service timestamps log datetime msec
service call-home
platform qfp utilization monitor load 80
platform punt-keepalive disable-kernel-core
platform hardware throughput crypto 1G
!
hostname Router
!
boot-start-marker
boot system bootflash:c8000be-universalk9.17.03.01prd8.SPA.bin
boot-end-marker
!
!
!
no aaa new-model

!
!
!
login on-success log

!
!
subscriber templating

!
!
multilink bundle-name authenticated
no device-tracking logging theft

!
!
!
crypto pki trustpoint TP-self-signed-2347094934
 enrollment selfsigned
 subject-name cn=IOS-Self-Signed-Certificate-2347094934
 revocation-check none
 rsakeypair TP-self-signed-2347094934
!
crypto pki trustpoint SLA-TrustPoint
 enrollment pkcs12
 revocation-check crl
!
!
crypto pki certificate chain TP-self-signed-2347094934
 certificate self-signed 01
  30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
  31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
  69666963 6174652D 32333437 30393439 3334301E 170D3230 30353238 32333331
  30325A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649
  4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 33343730
  39343933 34308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

  8B2FA1A7 29F5E8BD 57EB2459 CBBA7D64 4471BD34 0EC80AF2 0B693D0C 8DC3F771
  5D377065 57F16FD6 1B7AE4D3 3C5824B5 46FCDA97 4A5CA003 8B0BF2C9 E04A84E5
  E34E5EC6 AF94ACF3 DE5F9295 AA1C474F 30902D92 77F67A29 E4934212 DB9B253F
  1EC8F61F FD32D662 2F062666 13B8DC71 031F2119 551A487F 77E3BD46 3E5E7BBD
  9669BD8E FC4AEE6E EAD00DA5 DD56E370 716EC5CC 67DA7F35 6F4B3428 AD6EF6BD
  92868FAD 84871242 08C4FBED D5DB5249 336EB488 0D9A0B02 8BEE4BF9 5D03C416
  266E0F49 81030203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF
  301F0603 551D2304 18301680 14AE8751 EF7BF338 F7AB9FD8 E3EB151C F9E68DFA
```

```
  8A301D06 03551D0E 04160414 AE8751EF 7BF338F7 AB9FD8E3 EB151CF9 E68DFA8A
  300D0609 2A864886 F70D0101 05050003 82010100 925E6454 796E21F8 6401B0D1
  F2E09800 0B41752A B72F240E 21466633 1A2DAF8B 6F1C81B5 CE069EE0 F88888E4
  F6BAB34D 8328C2C7 781C4A6C FBB3DBCE 6F5C7100 388A6ADD 97D0E0CB 9407A5A3
  FF51FBD7 816E3D74 41769DAD C861B83B 68C58783 0A369849 32C27426 04513E09
  E3393274 201F3C44 D3EA63B2 EAB62240 B57200FE 3E3018C6 8013136A D9A51431
  DAB97350 17CEBF1F 2CFC553A 2C95A041 8426DABC AEFC27F7 B4A9F3F3 8C58C682
  2BDD7B4C 77F419A7 3F0B775B 8110B16F A67FEFE1 41EF7FE1 C9F0268B 943A9C62
  E367846A D2208BEF FE2562B3 FE96D8A9 2D2D4FB0 74C40850 914A0BDD 2B7C2C6E
  23F9BEB8 52A23129 4265A869 C2FA2BA5 039F4933
        quit
        quit
crypto pki certificate chain SLA-TrustPoint
 certificate ca 01
  30820321 30820209 A0030201 02020101 300D0609 2A864886 F70D0101 0B050030
  32310E30 0C060355 040A1305 43697363 6F312030 1E060355 04031317 43697363
  6F204C69 63656E73 696E6720 526F6F74 20434130 1E170D31 33303533 30313934
  3834375A 170D3338 30353330 31393438 34375A30 32310E30 0C060355 040A1305
  43697363 6F312030 1E060355 04031317 43697363 6F204C69 63656E73 696E6720
  526F6F74 20434130 82012230 0D06092A 864886F7 0D010101 05000382 010F0030
  82010A02 82010100 A6BCBD96 131E05F7 145EA72C 2CD686E6 17222EA1 F1EFF64D
  CBB4C798 212AA147 C655D8D7 9471380D 8711441E 1AAF071A 9CAE6388 8A38E520
  1C394D78 462EF239 C659F715 B98C0A59 5BBB5CBD 0CFEBEA3 700A8BF7 D8F256EE
  4AA4E80D DB6FD1C9 60B1FD18 FFC69C96 6FA68957 A2617DE7 104FDC5F EA2956AC
  7390A3EB 2B5436AD C847A2C5 DAB553EB 69A9A535 58E9F3E3 C0BD23CF 58BD7188
  68E69491 20F320E7 948E71D7 AE3BCC84 F10684C7 4BC8E00F 539BA42B 42C68BB7
  C7479096 B4CB2D62 EA2F505D C7B062A4 6811D95B E8250FC4 5D5D5FB8 8F27D191
  C55F0D76 61F9A4CD 3D992327 A8BB03BD 4E6D7069 7CBADF8B DF5F4368 95135E44
  DFC7C6CF 04DD7FD1 02030100 01A34230 40300E06 03551D0F 0101FF04 04030201
  06300F06 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1449DC85
  4B3D31E5 1B3E6A17 606AF333 3D3B4C73 E8300D06 092A8648 86F70D01 010B0500
  03820101 00507F24 D3932A66 86025D9F E838AE5C 6D4DF6B0 49631C78 240DA905
  604EDCDE FF4FED2B 77FC460E CD636FDB DD44681E 3A5673AB 9093D3B1 6C9E3D8B
  D98987BF E40CBD9E 1AECA0C2 2189BB5C 8FA85686 CD98B646 5575B146 8DFC66A8
  467A3DF4 4D565700 6ADF0F0D CF835015 3C04FF7C 21E878AC 11BA9CD2 55A9232C
  7CA7B7E6 C1AF74F6 152E99B7 B1FCF9BB E973DE7F 5BDDEB86 C71E3B49 1765308B
  5FB0DA06 B92AFE7F 494E8A9E 07B85737 F3A58BE1 1A48A229 C37C1E69 39F08678
  80DDCD16 D6BACECA EEBC7CF9 8428787B 35202CDC 60E4616A B623CDBD 230E3AFB
  418616A9 4093E049 4D10AB75 27E86F73 932E35B5 8862FDAE 0275156F 719BB2F0
  D697DF7F 28
        quit

!
!
license feature hseck9
license udi pid C8300-1N1S-6T sn FDO2320A0CF

diagnostic bootup level minimal
!
spanning-tree extend system-id
!
!
redundancy
 mode none
!
!
!

!
!
!
interface GigabitEthernet0/0/0
 ip dhcp client client-id ascii FDO2320A0CF
 ip address dhcp
```

```
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/2
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/3
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/4
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/5
 no ip address
 negotiation auto
!
ip http server
ip http authentication local
ip http secure-server
ip http client source-interface GigabitEthernet0/0/0
ip forward-protocol nd

!
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default

!
!
dspfarm profile 7 conference security
 shutdown

!
line con 0
 exec-timeout 0 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 login
 transport input ssh
!
call-home
 ! If contact email address in call-home is configured as sch-smart-licensing@cisco.com
 ! the email address configured in Cisco Smart License Portal will be used as contact email
 address to send SCH notifications.
 contact-email-addr sch-smart-licensing@cisco.com
 profile "CiscoTAC-1"
  active
  destination transport-method http
```

```
!
!
end
```

Configuring Global Parameters

To configure the global parameters for your device, follow these steps.

SUMMARY STEPS

1. **configure terminal**
2. **hostname** *name*
3. **enable secret** *password*
4. **no ip domain-lookup**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`Router> enable`
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode when using the console port.
		Use the following to connect to the device with a remote terminal:
		`telnet router-name or address`
		`Login: login-id`
		`Password: *********`
		`Router> enable`

Step 2	**hostname** *name* **Example:** `Router(config)# hostname Router`	Specifies the name for the device.
Step 3	**enable secret** *password* **Example:** `Router(config)# enable secret cr1ny5ho`	Specifies an encrypted password to prevent unauthorized access to the device.
Step 4	**no ip domain-lookup** **Example:** `Router(config)# no ip domain-lookup`	Disables the device from translating unfamiliar words (typos) into IP addresses. For complete information on global parameter commands, see the Cisco IOS Release Configuration Guide documentation set.

Configuring Gigabit Ethernet Interfaces

To manually define onboard Gigabit Ethernet interfaces, follow these steps, beginning from global configuration mode.

SUMMARY STEPS

1. **interface gigabitethernet** *slot/bay/port*
2. **ip address** *ip-address mask*
3. **ipv6 address** *ipv6-address/prefix*
4. **no shutdown**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface gigabitethernet** *slot/bay/port* **Example:** `Router(config)# interface gigabitethernet 0/0/1`	Enters the configuration mode for a Gigabit Ethernet interface on the device.
Step 2	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.0.2.2 255.255.255.0`	Sets the IP address and subnet mask for the specified Gigabit Ethernet interface. Use this Step if you are configuring an IPv4 address.
Step 3	**ipv6 address** *ipv6-address/prefix* **Example:** `Router(config-if)# ipv6 address 2001.db8::ffff:1/128`	Sets the IPv6 address and prefix for the specified Gigabit Ethernet interface. Use this step instead of Step 2, if you are configuring an IPv6 address.
Step 4	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables the Gigabit Ethernet interface and changes its state from administratively down to administratively up.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits configuration mode for the Gigabit Ethernet interface and returns to privileged EXEC mode.

Configuring a Loopback Interface

Before you begin

The loopback interface acts as a placeholder for the static IP address and provides default routing information.

To configure a loopback interface, follow these steps.

SUMMARY STEPS

1. **interface** *type number*
2. (Option 1) **ip address** *ip-address mask*
3. (Option 2) **ipv6 address** *ipv6-address/prefix*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface** *type number* **Example:** `Router(config)# interface Loopback 0`	Enters configuration mode on the loopback interface.
Step 2	(Option 1) **ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.108.1.1 255.255.255.0`	Sets the IP address and subnet mask on the loopback interface. (If you are configuring an IPv6 address, use the **ipv6 address** *ipv6-address/prefix* command described below.
Step 3	(Option 2) **ipv6 address** *ipv6-address/prefix* **Example:** `Router(config-if)# 2001:db8::ffff:1/128`	Sets the IPv6 address and prefix on the loopback interface.
Step 4	**exit** **Example:** `Router(config-if)# exit`	Exits configuration mode for the loopback interface and returns to global configuration mode.

Example

Verifying Loopback Interface Configuration

This configuration example shows the loopback interface configured on the Gigabit Ethernet interface with an IP address of 203.0.113.1/32, which acts as a static IP address. The loopback interface points back to virtual-template1, which has a negotiated IP address.

```
!
interface loopback 0
ip address 203.0.113.1 255.255.255.255 (static IP address)
ip nat outside
!
interface Virtual-Template1
ip unnumbered loopback0
no ip directed-broadcast
ip nat outside
```

Enter the **show interface loopback** command. You should see an output similar to the following example:

```
Router# show interface loopback 0
Loopback0 is up, line protocol is up
  Hardware is Loopback
  Internet address is 203.0.113.1/32
  MTU 1514 bytes, BW 8000000 Kbit/sec, DLY 5000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation LOOPBACK, loopback not set
  Keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/0 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     Output 0 broadcasts (0 IP multicasts)
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Alternatively, use the **ping** command to verify the loopback interface, as shown in the following example:

```
Router# ping  203.0.113.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Configuring Module Interfaces

For detailed information about configuring service modules, see "Service Modules" in the "Service Module Management" section of the Cisco Service Module Configuration Guide.

Dynamic Allocation of Cores

Dynamic core allocations on the Catalyst 8000 Series Edge platforms provide flexibility for users to leverage the CPU cores for different services and/or CEF/IPSec performances. The Catalyst 8000 Series Edge platforms are equipped with a minimum of 8 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 }
```

From Cisco IOS XE Release 17.5.1 onwards, Catalyst 8000 Series Edge Platforms supports changing the core allocation dynamically. You do not have to reboot the devices to have the new allocation to take effect.

Following are the list of Catalyst 8000 Series Edge platforms that support changing the core allocations dynamically:

- C8300-2N1S-6T
- C8300-2N1S-4T2X
- C8300-2N2S-6T
- C8300-2N2S-4T2X
- C8200-1N-4T

Note By default, when a device boots up, the mode is service-plane-heavy.

The following show command output shows the CPU cores allocaiton for the data plane :

```
Router# show platform software cpu alloc

CPU alloc information:
 Control plane cpu alloc: 0
 Data plane cpu alloc: 1-7
 Service plane cpu alloc: 0
 Template used: CLI-data_plane_heavy
```

Note In the above example, the maximum data plane core allocation is 7.

The following show command output shows the CPU cores allocaiton for the service plane:

```
Router# show platform software cpu alloc

CPU alloc information:
  Control plane cpu alloc: 0
   Data plane cpu alloc: 4-7
  Service plane cpu alloc: 1-3
  Template used: CLI-service_plane_heavy
```

The following show command output shows the PPE status:

```
Router# show platform hardware qfp active datapath infrastructure sw-cio

Credits Usage:

  ID      Port  Wght  Global WRKR0  WRKR1  Total
   1      rcl0     1:    474     0     38    512
```

```
  1       rcl0   128:     480      0      32     512
  2        ipc     1:     508      0       3     511
  3 vxe_punti     1:     474      0      38     512
  4       fpe0     1:     976      0      48    1024
  5       fpe1     1:     976      0      48    1024
  6       fpe2     1:     976      0      48    1024
  7       fpe3     1:     976      0      48    1024

Core Utilization over preceding 5475356.7738 seconds
-----------------------------------------------------
      ID:       0       1
    % PP:    0.63    0.00
    % RX:    0.00    1.54
    % TM:    0.00    1.63
  % COFF:    0.00    0.69
  % IDLE:   99.37   96.15
```

Enabling Cisco Discovery Protocol

Cisco Discovery Protocol (CDP) is enabled by default on the router.

For more information on using CDP, see Cisco Discovery Protocol Configuration Guide.

Configuring Command-Line Access

To configure parameters to control access to the device, follow these steps.

SUMMARY STEPS

1. **line** [| **console** | **tty** | **vty**] *line-number*
2. **password** *password*
3. **login**
4. **exec-timeout** *minutes* [*seconds*]
5. **exit**
6. **line** [| **console** | **tty** | **vty**] *line-number*
7. **password** *password*
8. **login**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**line** [| **console**	**tty**	**vty**] *line-number* **Example:** `Router(config)# line console 0`	Enters line configuration mode, and specifies the type of line. The example provided here specifies a console terminal for access.
Step 2	**password** *password* **Example:**	Specifies a unique password for the console terminal line.

	Command or Action	Purpose
	`Router(config-line)# password 5dr4Hepw3`	
Step 3	**login** **Example:** `Router(config-line)# login`	Enables password checking at terminal session login.

Step 4	**exec-timeout** *minutes* [*seconds*]
	Example:
	`Router(config-line)# exec-timeout 5 30`
	`Router(config-line)#`
		Sets the interval during which the EXEC command interpreter waits until user input is detected. The default is 10 minutes. Optionally, adds seconds to the interval value.
		The example provided here shows a timeout of 5 minutes and 30 seconds. Entering a timeout of **0 0** specifies never to time out.

Step 5	**exit** **Example:** `Router(config-line)# exit`	Exits line configuration mode to re-enter global configuration mode.

Step 6	**line** [| **console**	**tty**	**vty**] *line-number*
			Example:
			`Router(config)# line vty 0 4`
			`Router(config-line)#`
				Specifies a virtual terminal for remote console access.

Step 7	**password** *password* **Example:** `Router(config-line)# password aldf2ad1`	Specifies a unique password for the virtual terminal line.
Step 8	**login** **Example:** `Router(config-line)# login`	Enables password checking at the virtual terminal session login.
Step 9	**end** **Example:** `Router(config-line)# end`	Exits line configuration mode, and returns to privileged EXEC mode.

Example

The following configuration shows the command-line access commands.

You do not have to input the commands marked **default**. These commands appear automatically in the configuration file that is generated when you use the **show running-config** command.

```
!
line console 0
 exec-timeout 10 0
 password 4youreyesonly
 login
transport input none (default)
stopbits 1 (default)
line vty 0 4
 password secret
 login
!
```

Configuring Static Routes

Static routes provide fixed routing paths through the network. They are manually configured on the device. If the network topology changes, the static route must be updated with a new route. Static routes are private routes unless they are redistributed by a routing protocol.

To configure static routes, follow these steps.

SUMMARY STEPS

1. (Option 1) **ip route** *prefix mask* {*ip-address* | *interface-type interface-number* [*ip-address*]}
2. (Option 2) **ipv6 route** *prefix/mask* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]}
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	(Option 1) **ip route** *prefix mask* {*ip-address* | *interface-type interface-number* [*ip-address*]} **Example:** `Router(config)# ip route 192.0.2.8 255.255.0.0 10.10.10.2`	Specifies a static route for the IP packets. (If you are configuring an IPv6 address, use the **ipv6 route** command described below.)
Step 2	(Option 2) **ipv6 route** *prefix/mask* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]} **Example:** `Router(config)# ipv6 route 2001:db8:2::/64 2001:DB8:3000:1`	Specifies a static route for the IP packets.

	Command or Action	Purpose
Step 3	**end** **Example:** `Router(config)# end`	Exits global configuration mode and enters privileged EXEC mode.

Verifying Configuration

In the following configuration example, the static route sends out all IP packets with a destination IP address of 192.0.2.8 and a subnet mask of 255.255.255.0 on the Gigabit Ethernet interface to another device with an IP address of 10.10.10.2. Specifically, the packets are sent to the configured interface.

You do not have to enter the command marked **default**. This command appears automatically in the configuration file generated when you use the **running-config** command.

```
!
ip classless (default)
ip route 192.0.2.8 255.255.255.0 10.10.10.2
```

To verify that you have configured static routing correctly, enter the **show ip route** command (or **show ipv6 route** command) and look for static routes marked with the letter S.

When you use an IPv4 address, you should see verification output similar to the following:

```
Router# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR
       & - replicated local route overrides by connected

Gateway of last resort is 10.0.10.1 to network 192.0.2.6

S*    192.0.2.6/0 [254/0] via 10.0.10.1
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.0.10.0/24 is directly connected, GigabitEthernet0/0/0
L        10.0.10.13/32 is directly connected, GigabitEthernet0/0/0
C        10.108.1.0/24 is directly connected, Loopback0
L        10.108.1.1/32 is directly connected, Loopback0
```

When you use an IPv6 address, you should see verification output similar to the following:

```
Router# show ipv6 route
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE -
Destination
```

```
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       ls - LISP site, ld - LISP dyn-EID, a - Application

C   2001:DB8:3::/64 [0/0]
       via GigabitEthernet0/0/2, directly connected
S   2001:DB8:2::/64 [1/0]
       via 2001:DB8:3::1
```

Configuring Dynamic Routes

In dynamic routing, the network protocol adjusts the path automatically, based on network traffic or topology. Changes in dynamic routes are shared with other devices in the network.

A device can use IP routing protocols, such as Routing Information Protocol (RIP) or Enhanced Interior Gateway Routing Protocol (EIGRP), to learn about routes dynamically.

- Configuring Routing Information Protocol, on page 18
- Configuring Enhanced Interior Gateway Routing Protocol, on page 22

Configuring Routing Information Protocol

To configure the RIP on a router, follow these steps.

SUMMARY STEPS

1. **router rip**
2. **version** {**1** | **2**}
3. **network** *ip-address*
4. **no auto-summary**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**router rip** **Example:** `Router(config)# router rip`	Enters router configuration mode, and enables RIP on the router.
Step 2	**version** {**1**	**2**} **Example:** `Router(config-router)# version 2`	Specifies use of RIP version 1 or 2.

	Command or Action	Purpose

Step 3	**network** *ip-address*
	Example:
	`Router(config-router)# network 192.0.2.8`
	`Router(config-router)# network 10.10.7.1`
		Specifies a list of networks on which RIP is to be applied, using the address of the network of each directly connected network.

Step 4	**no auto-summary** **Example:** `Router(config-router)# no auto-summary`	Disables automatic summarization of subnet routes into network-level routes. This allows subprefix routing information to pass across classful network boundaries.
Step 5	**end** **Example:** `Router(config-router)# end`	Exits router configuration mode, and enters privileged EXEC mode.

Example

Verifying Configuration

To see this configuration, use the **show running-config** command from privileged EXEC mode.

```
!
Router# show running-config
Building configuration...

Current configuration : 6504 bytes
!
! Last configuration change at 05:04:58 UTC Mon Jul 6 2020
!
version 17.3
service config
service timestamps debug datetime msec
service timestamps log datetime msec
service call-home
platform qfp utilization monitor load 80
platform punt-keepalive disable-kernel-core
platform hardware throughput crypto 1G
!
hostname Router
!
boot-start-marker
boot system bootflash:c8000be-universalk9.17.03.01prd8.SPA.bin
boot-end-marker
!
!
!
no aaa new-model
!
login on-success log

!
subscriber templating
!
```

```
!
multilink bundle-name authenticated
no device-tracking logging theft


!
crypto pki trustpoint TP-self-signed-2347094934
 enrollment selfsigned
 subject-name cn=IOS-Self-Signed-Certificate-2347094934
 revocation-check none
 rsakeypair TP-self-signed-2347094934
!
crypto pki trustpoint SLA-TrustPoint
 enrollment pkcs12
 revocation-check crl
!
!

crypto pki certificate chain SLA-TrustPoint
 certificate ca 01
  30820321 30820209 A0030201 02020101 300D0609 2A864886 F70D0101 0B050030
  32310E30 0C060355 040A1305 43697363 6F312030 1E060355 04031317 43697363
  6F204C69 63656E73 696E6720 526F6F74 20434130 1E170D31 33303533 30313934
  3834375A 170D3338 30353330 31393438 34375A30 32310E30 0C060355 040A1305
  43697363 6F312030 1E060355 04031317 43697363 6F204C69 63656E73 696E6720
  526F6F74 20434130 82012230 0D06092A 864886F7 0D010101 05000382 010F0030
  82010A02 82010100 A6BCBD96 131E05F7 145EA72C 2CD686E6 17222EA1 F1EFF64D
  CBB4C798 212AA147 C655D8D7 9471380D 8711441E 1AAF071A 9CAE6388 8A38E520
  1C394D78 462EF239 C659F715 B98C0A59 5BBB5CBD 0CFEBEA3 700A8BF7 D8F256EE
  4AA4E80D DB6FD1C9 60B1FD18 FFC69C96 6FA68957 A2617DE7 104FDC5F EA2956AC
  7390A3EB 2B5436AD C847A2C5 DAB553EB 69A9A535 58E9F3E3 C0BD23CF 58BD7188
  68E69491 20F320E7 948E71D7 AE3BCC84 F10684C7 4BC8E00F 539BA42B 42C68BB7
  C7479096 B4CB2D62 EA2F505D C7B062A4 6811D95B E8250FC4 5D5D5FB8 8F27D191
  C55F0D76 61F9A4CD 3D992327 A8BB03BD 4E6D7069 7CBADF8B DF5F4368 95135E44
  DFC7C6CF 04DD7FD1 02030100 01A34230 40300E06 03551D0F 0101FF04 04030201
  06300F06 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1449DC85
  4B3D31E5 1B3E6A17 606AF333 3D3B4C73 E8300D06 092A8648 86F70D01 010B0500
  03820101 00507F24 D3932A66 86025D9F E838AE5C 6D4DF6B0 49631C78 240DA905
  604EDCDE FF4FED2B 77FC460E CD636FDB DD44681E 3A5673AB 9093D3B1 6C9E3D8B
  D98987BF E40CBD9E 1AECA0C2 2189BB5C 8FA85686 CD98B646 5575B146 8DFC66A8
  467A3DF4 4D565700 6ADF0F0D CF835015 3C04FF7C 21E878AC 11BA9CD2 55A9232C
  7CA7B7E6 C1AF74F6 152E99B7 B1FCF9BB E973DE7F 5BDDEB86 C71E3B49 1765308B
  5FB0DA06 B92AFE7F 494E8A9E 07B85737 F3A58BE1 1A48A229 C37C1E69 39F08678
  80DDCD16 D6BACECA EEBC7CF9 8428787B 35202CDC 60E4616A B623CDBD 230E3AFB
  418616A9 4093E049 4D10AB75 27E86F73 932E35B5 8862FDAE 0275156F 719BB2F0
  D697DF7F 28
        quit

!
!
license feature hseck9
license udi pid C8300-1N1S-6T sn FDO2320A0CF

diagnostic bootup level minimal
!
spanning-tree extend system-id
!
!
redundancy
 mode none

!
interface GigabitEthernet0/0/0
 ip dhcp client client-id ascii FDO2320A0CF
```

```
 ip address dhcp
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 negotiation auto
!
!
ip http server
ip http authentication local
ip http secure-server
ip http client source-interface GigabitEthernet0/0/0
ip forward-protocol nd

!
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default

!
!
dspfarm profile 7 conference security
 shutdown

!
line con 0
 exec-timeout 0 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 login
 transport input ssh
!
call-home
 ! If contact email address in call-home is configured as sch-smart-licensing@cisco.com
 ! the email address configured in Cisco Smart License Portal will be used as contact email
 address to send SCH notifications.
 contact-email-addr sch-smart-licensing@cisco.com
 profile "CiscoTAC-1"
  active
  destination transport-method http

!
!
end
```

To verify that you have configured RIP correctly, enter the **show ip route** command and look for RIP routes marked with the letter R. You should see an output similar to the one shown in the following example:

```
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.108.1.0 is directly connected, Loopback0
R    192.0.2.3/8 [120/1] via 192.0.2.2, 00:00:02, Ethernet0/0/0
```

Configuring Enhanced Interior Gateway Routing Protocol

To configure Enhanced Interior Gateway Routing Protocol (EIGRP), follow these steps.

SUMMARY STEPS

1. **router eigrp** *as-number*
2. **network** *ip-address*
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**router eigrp** *as-number* **Example:** `Router(config)# router eigrp 109`	Enters router configuration mode, and enables EIGRP on the router. The autonomous-system number identifies the route to other EIGRP routers and is used to tag the EIGRP information.

Step 2	**network** *ip-address*
	Example:
	`Router(config)# network 192.0.2.8`
	`Router(config)# network 10.10.12.15`
		Specifies a list of networks on which EIGRP is to be applied, using the IP address of the network of directly connected networks.

Step 3	**end** **Example:** `Router(config-router)# end`	Exits router configuration mode, and enters privileged EXEC mode.

Verifying the Configuration

The following configuration example shows the EIGRP routing protocol enabled in IP networks 192.0.2.8 and 10.10.12.15. The EIGRP autonomous system number is 109. To see this configuration, use the **show running-config** command.

```
Router# show running-config
.
.
.
!
```

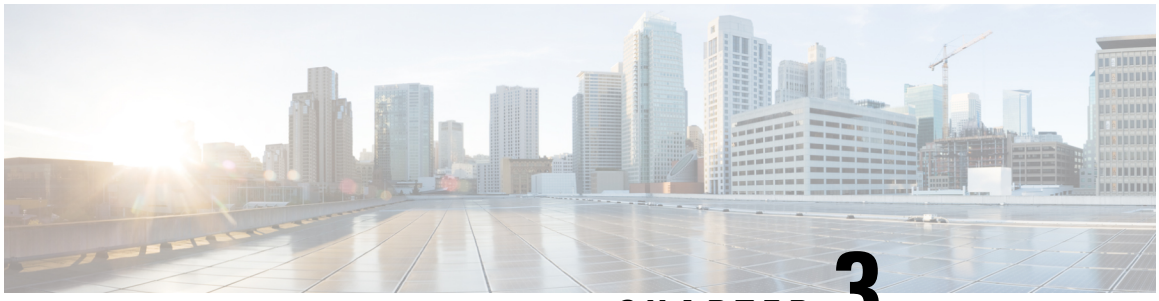
```
router eigrp 109
 network 192.0.2.8
  network 10.10.12.15
!
.
.
.
```

To verify that you have configured IP EIGRP correctly, enter the **show ip route** command, and look for EIGRP routes marked by the letter D. You should see verification output similar to the following:

```
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.108.1.0 is directly connected, Loopback0
D     192.0.2.3/8 [90/409600] via 192.0.2.2, 00:00:02, Ethernet0/0
```



CHAPTER 3

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:

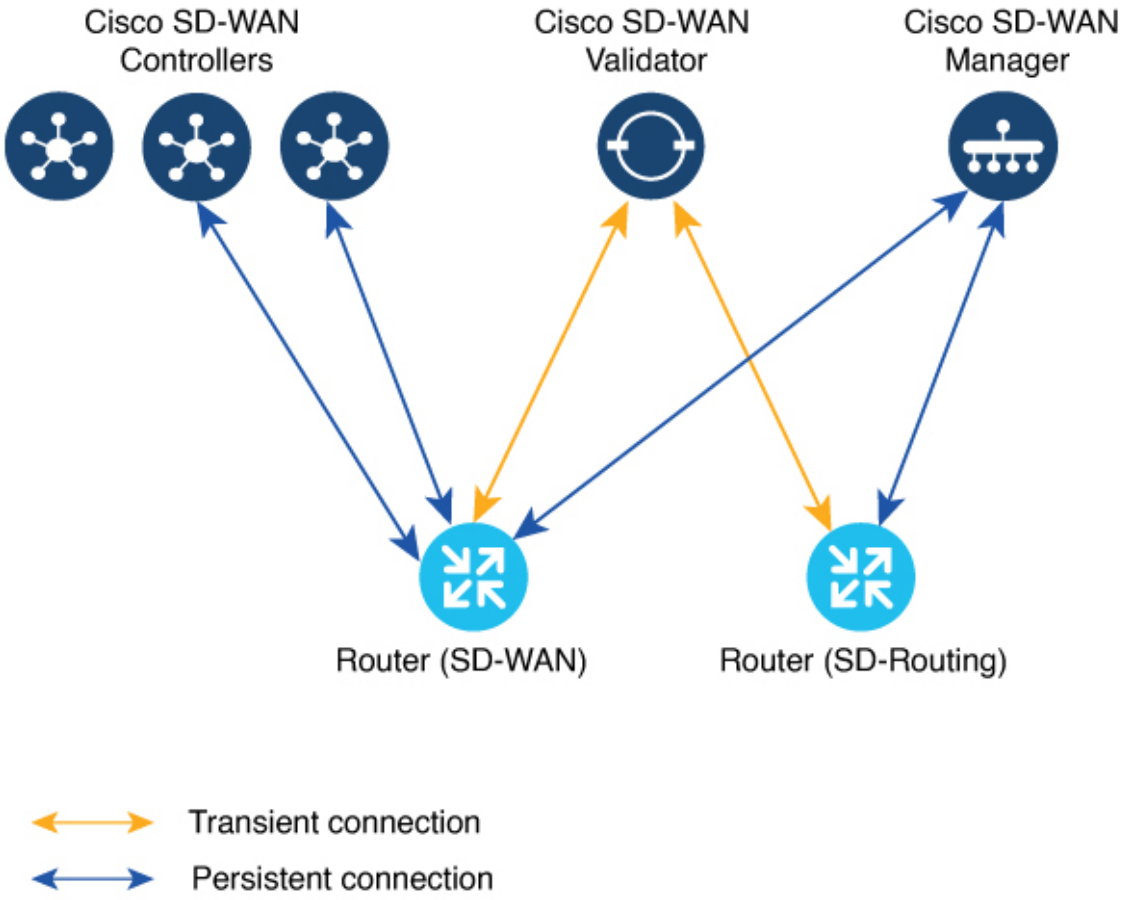
Information About Using Cisco SD-WAN Manager to Monitor the SD-Routing Devices

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.

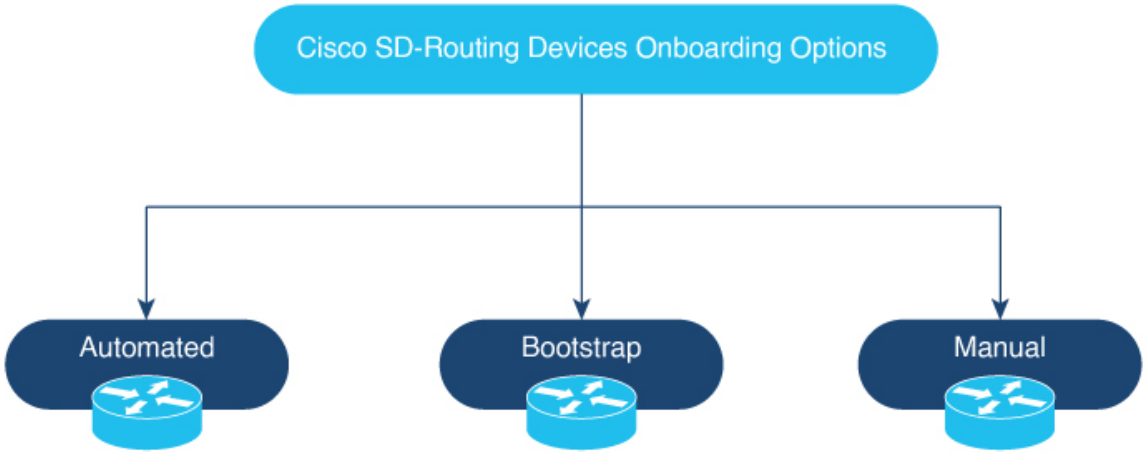
Table 2: Supported WAN Edge Platforms and Onboarding Options

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 (DHCPP and Ciosco 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 33 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 Connetion 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: Verificating 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`

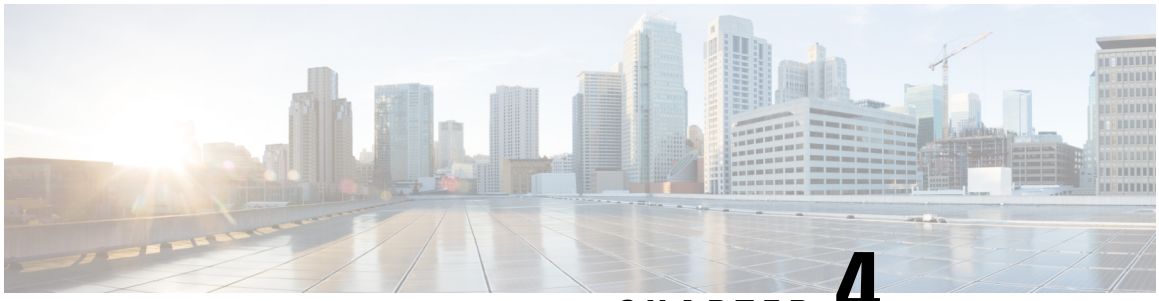
Feature Information for Managing SD-Routing Devcies Using Cisco SD-WAN Manager

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 3: Feature Information for SD-Routing Devcies 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 4

Software Upgrade on SD-Routing Devices

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

Inforamtion 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**.

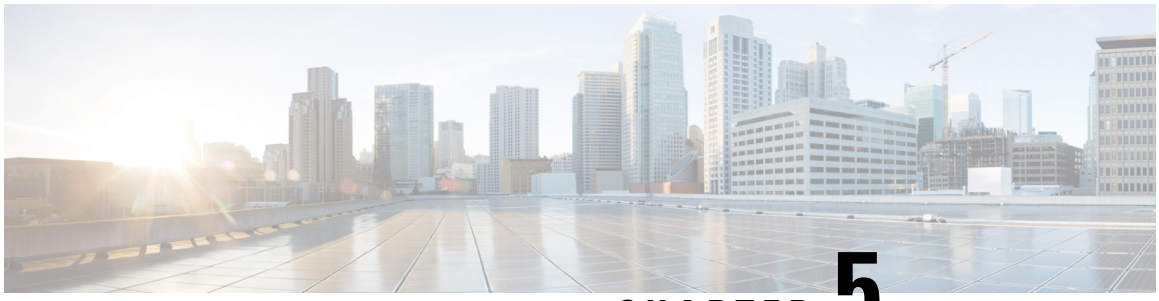
Feature Information for Schedule Software Upgrade on SD-Routing Devices

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

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	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 5

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**.

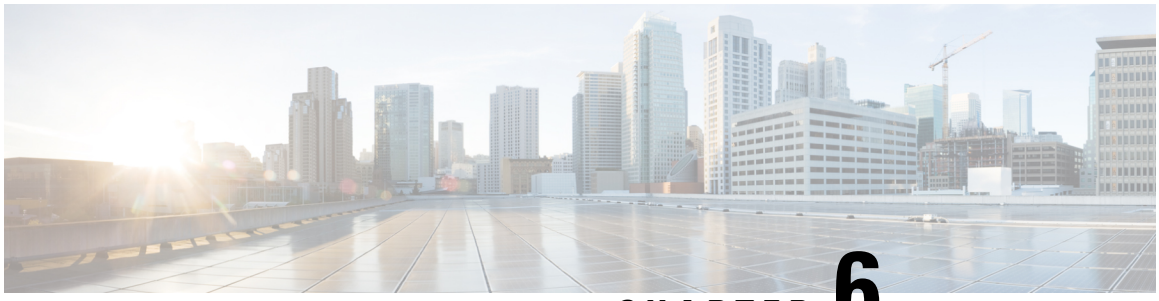
Feature Information for SD-Routing Configuration Group

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 5: Feature Information for SD-Routing Configuration Group

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	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 6

Cisco SD-Routing Cloud OnRamp for Multicloud

This chapter includes information on how to configure Cloud OnRamp for Multicloud on the SD-Routing devcies. 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.

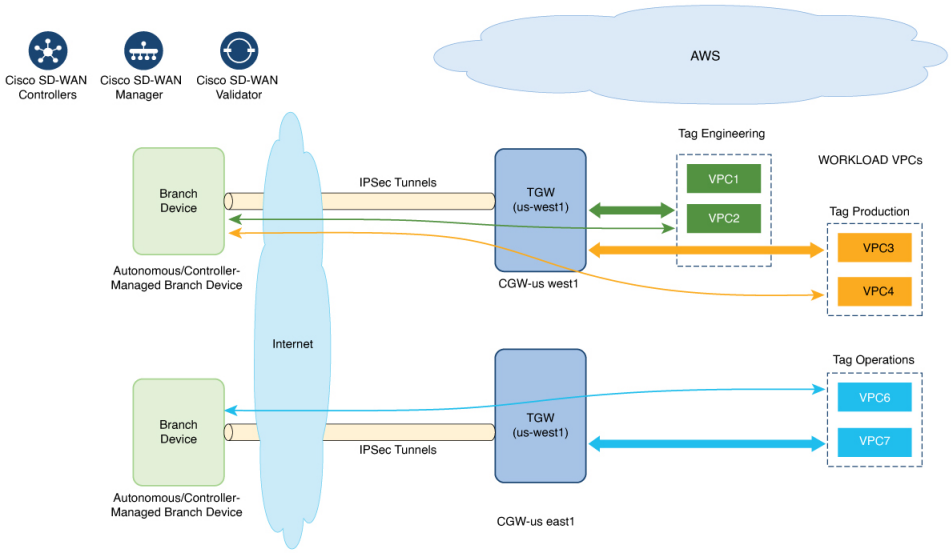
You can configure and manage Cloud OnRamp for Multicloud environments through the Cisco SD-WAN Manager controller. A configuration wizard in Cisco SD-WAN Manager automates the bring-up of the transit gateway to your public cloud account and automates the connections between public-cloud applications 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 61 and Onboarding the New SD-Routing Device Using Config Group Automated Workflow, on page 62 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

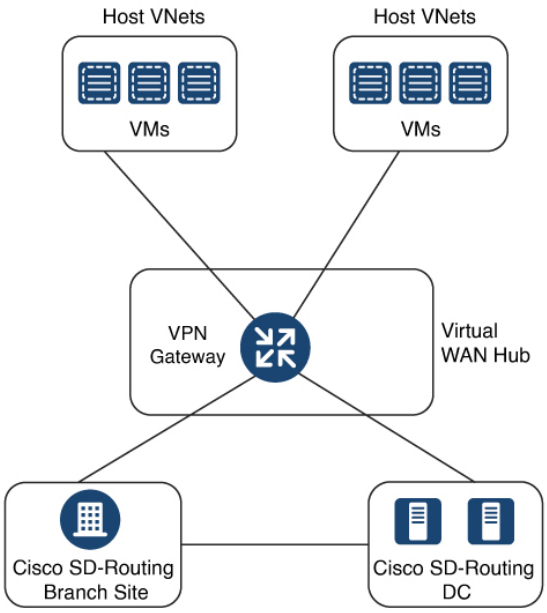
On the **Connectivity** window, you can:

- 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**.

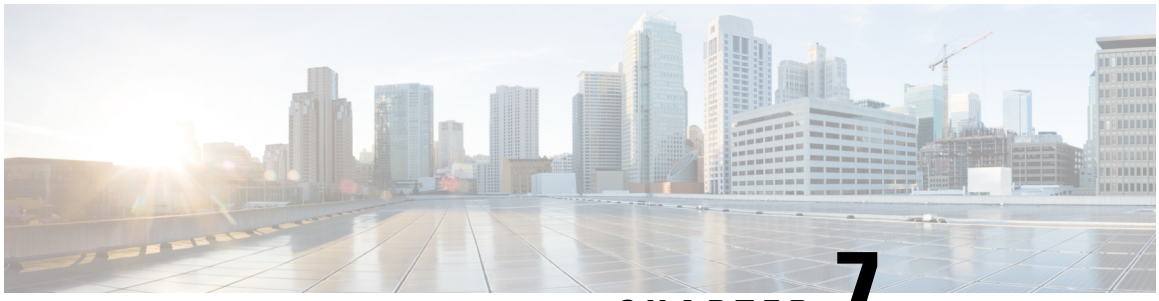
Feature Information for Cisco SD-Routing Cloud OnRamp for Multicloud

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 6: 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 7

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 17.13.1.

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
```

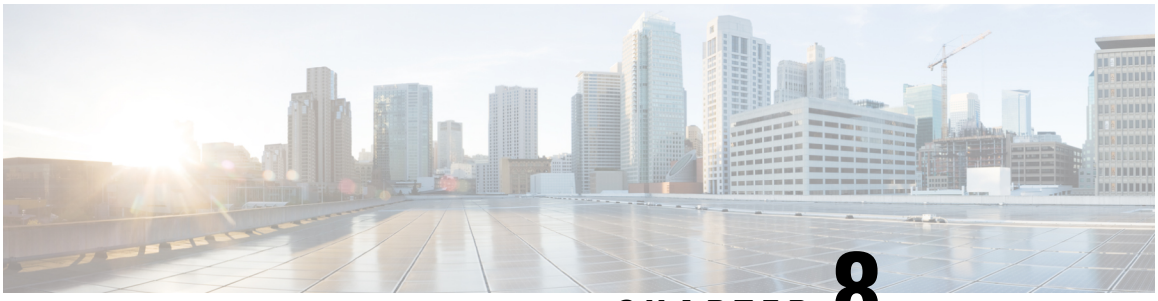
Feature Information for Application Performance Monitor

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 7: Feature Information for Application Performance Monitor

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	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 8

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 17.13.1 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
```

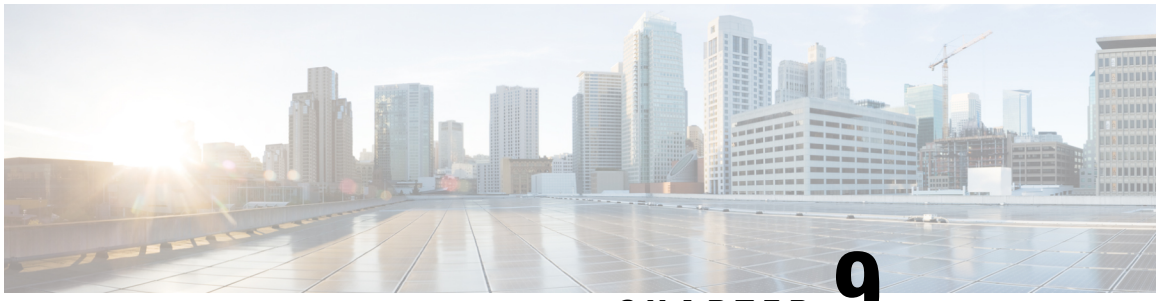
Feature Information for Flexible NetFlow Application Visibility on SD-Routing Devices

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

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	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 9

Packet Capture on SD-Routing Devices

This chapter includes information on how to configure the packet capture on the SD-Routind devcies. 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.

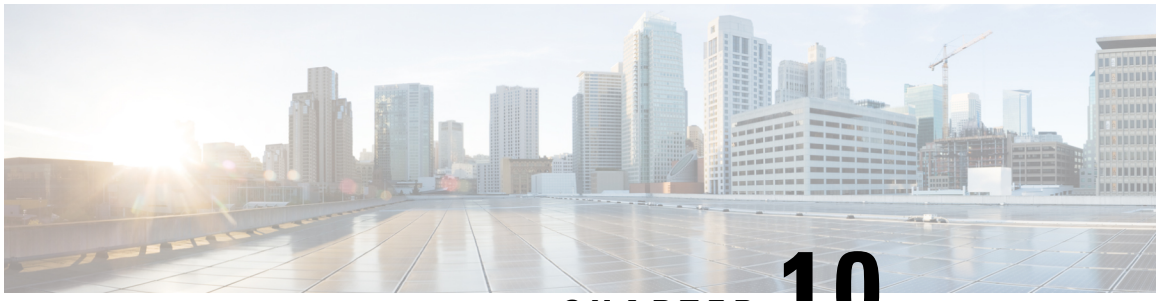
Feature Informationfor Packet Capture for SD-Routing

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 9: Feature Information for Packet Capture for SD-Routing

Feature Name	Releases	Feature Information
Cisco SD-Routing Cloud OnRamp for Multicloud	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 10

Speed Test on SD-Routing Devices

This chapter includes information on how to configure the speed test on the SD-Routind devcies. 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 10: 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.
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.

Error Information	Possible Root Cause
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.

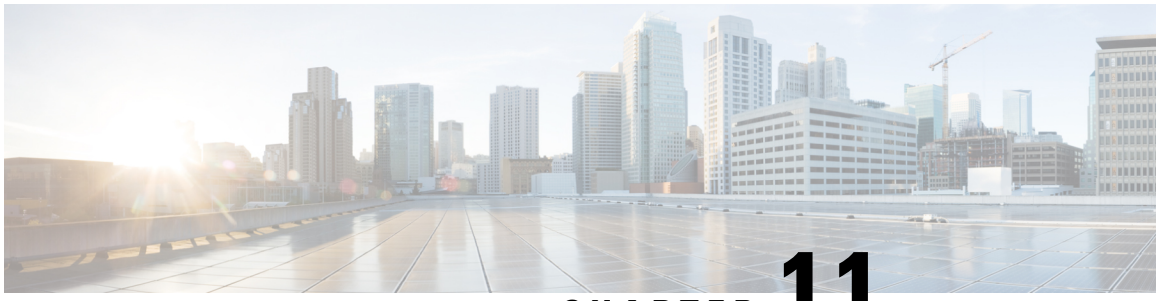
Feature Information for Speed Test on SD-Routing Devices Using Cisco SD-WAN Manager

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 11: 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 adevice and an iPerf3 server. The speed tests measure upload and download speed from the source device to the destination device..



CHAPTER 11

Using Cisco IOS XE Software

This chapter describes the basics of using the Cisco IOS XE software in autonomous mode and includes the following section:

Using Cisco IOS XE Software

Before you begin

Use the console (CON) port to access the command-line interface (CLI) directly or when using Telnet.

The following sections describe the main methods of accessing the device:

Procedure

	Command or Action	Purpose
Step 1	Accessing the CLI Using a Directly-Connected Console, on page 97	
Step 2	Using SSH to Access Console, on page 98	
Step 3	Accessing the CLI from a Remote Console Using Telnet, on page 99	
Step 4	Accessing the CLI from a USB Serial Console Port, on page 101	

Accessing the CLI Using a Directly-Connected Console

The CON port is an EIA/TIA-232 asynchronous, serial connection with no-flow control and an RJ-45 connector. The CON port is located on the front panel of the chassis.

The following sections describe the procedure to access the control interface:

Connecting to the Console Port

Step 1 Configure your terminal emulation software with the following settings:

- 9600 bits per second (bps)
- 8 data bits
- No parity
- No flow control

Step 2 Connect to the CON port using the RJ-45-to-RJ-45 cable and the RJ-45-to-DB-25 DTE adapter or the RJ-45-to-DB-9 DTE adapter (labeled Terminal).

Using the Console Interface

Step 1 Enter the following command:

```
Router> enable
```

Step 2 (Go to Step 3 if the enable password has not been configured.) At the password prompt, enter your system password:

```
Password: enablepass
```

When your password is accepted, the privileged EXEC mode prompt is displayed.

```
Router#
```

You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 3 If you enter the **setup** command, see "Using Cisco Setup Command Facility" in the "Initial Configuration" section of the Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platform.

Step 4 To exit the console session, enter the **quit** command:

```
Router# quit
```

Using SSH to Access Console

Secure Shell (SSH) is a protocol which provides a secure remote access connection to network devices. To enable SSH support on the device:

Step 1 Configure the hostname:

```
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
```

Here, *host name* is the device hostname or IP address.

Step 2 Configure the DNS domain of the device:

```
Router(config)# ip domain name cisco.com
```

Step 3 Generate an SSH key to be used with SSH:

```
Router(config)#  crypto key generate rsa
The name for the keys will be: Router.xxx.cisco.com Choose the size of the key modulus in the range

of 360 to 4096 for your General Purpose Keys. Choosing a key modulus greater than 512 may take a few
minutes.
How many bits in the modulus [512]: 1024 % Generating 1024 bit RSA keys, keys will be non-exportable...
[OK] (elapsed time was 0 seconds)
Router(config)#
```

Step 4 By default, the vtys? transport is Telnet. In this case, Telnet is disabled and only SSH is supported:

```
Router(config)#line vty 0 4
xxx_lab(config-line)#transport input ssh
```

Step 5 Create a username for SSH authentication and enable login authentication:

```
Router(config)# username jsmith privilege 15 secret 0 p@ss3456
Router(config)#line vty 0 4
Router(config-line)# login local
```

Step 6 Verify remote connection to the device using SSH.

Accessing the CLI from a Remote Console Using Telnet

The following topics describe the procedure to access the CLI from a remote console using Telnet:

- Preparing to Connect to the Device Console Using Telnet, on page 99
- Using Telnet to Access a Console Interface, on page 100

Preparing to Connect to the Device Console Using Telnet

To access the device remotely using Telnet from a TCP/IP network, configure the device to support virtual terminal lines using the **line vty** global configuration command. Configure the virtual terminal lines to require users to log in and specify a password.

See the Cisco IOS Terminal Services Command Reference document for more information about the line **vty global** configuration command.

To add a line password to the vty, specify a password with the **password** command when you configure the **login** command.

If you are using authentication, authorization, and accounting (AAA), configure the **login authentication** command. To prevent disabling login on a 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: Secure Connectivity and the Cisco IOS Security Command Reference documents. For more information about the **login line-configuration** command, see the Cisco IOS Terminal Services Command Reference document.

In addition, before you make a Telnet connection to the device, you must have a valid hostname for the device or have an IP address configured on the device. For more information about the requirements for connecting to the device 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

Step 1 From your terminal or PC, enter one of the following commands:

- **connect host** [*port*] [*keyword*]
- **telnet host** [*port*] [*keyword*]

Here, *host* is the device hostname or IP address, *port* is a decimal port number (23 is the default), and *keyword* is a supported keyword. For more information about these commands, see the Cisco IOS Terminal Services Command Reference document.

Note If you are using an access server, specify a valid port number, such as **telnet 198.51.100.2 2004**, in addition to the hostname or IP address.

The following example shows how to use the **telnet** command to connect to a device named **router**:

```
unix_host% telnet router
Trying 198.51.100.2...
Connected to 198.51.100.2.
Escape character is '^]'.
unix_host% connect
```

Step 2 Enter your login password:

```
User Access Verification
Password: mypassword
```

Note If no password has been configured, press **Return**.

Step 3 From user EXEC mode, enter the **enable** command:

```
Router> enable
```

Step 4 At the password prompt, enter your system password:

```
Password: enablepass
```

Step 5 When the **enable** password is accepted, the privileged EXEC mode prompt is displayed:

```
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.

```
Router# logout
```

Accessing the CLI from a USB Serial Console Port

The router provides an additional mechanism for configuring the system: a type B miniport USB serial console that supports remote administration of the router using a type B USB-compliant cable. See the "Connecting to a Console Terminal or Modem" section in the following documents:

- Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platform
- Hardware Installation Guide for Cisco Catalyst 8200 Series Edge Platforms

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 12: Keyboard Shortcuts

Key Name	Purpose
Ctrl-B or the **Left Arrow** key[1]	Move the cursor back one character.
Ctrl-F or the **Right Arrow** key[1]	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.

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 13: History Substitution Commands

Command	Purpose
Ctrl-P or the **Up Arrow** key[1]	Recalls 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** key[1]	Returns to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the **Up Arrow** key.

Command	Purpose
Router# show history	While in EXEC mode, lists the last few commands you entered.

[1] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Understanding Command Modes

The command modes available in Cisco IOS XE are the same as those available in traditional Cisco IOS. This is supported only on the autonomous mode. 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 14: 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** command.	`Router#`	To return to user EXEC mode, use the **disable** command.
Global configuration	From privileged EXEC mode, use the **configure terminal** command.	`Router(config)#`	To return to privileged EXEC mode from global configuration mode, use the **exit** or **end** command.

Command Mode	Access Method	Prompt	Exit Method
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 device boots up or accesses diagnostic mode in the following scenarios: • In some cases, diagnostic mode will be reached when the Cisco IOS process or processes fail. In most scenarios, however, the device will reload. • A user-configured access policy is configured using the **transport-map** command that directs a user into diagnostic mode. • A break signal (**Ctrl-C**, **Ctrl-Shift-6**, or the **send break** command) is entered and the device is configured to go to diagnostic mode when the break signal is received.	`Router(diag)#`	If failure of the Cisco IOS process is the reason for entering diagnostic mode, the Cisco IOS problem must be resolved and the device rebooted to get out of diagnostic mode. If the device is in diagnostic mode because of a transport-map configuration, access the device through another port or by using a method that is configured to connect to the Cisco IOS CLI.
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.	`rommon#>`	To exit ROM monitor mode, manually boot a valid image or perform a reset with autoboot set so that a valid image is loaded.

Understanding Diagnostic Mode

The device boots up or accesses diagnostic mode in the following scenarios:

- The IOS process or processes fail, in some scenarios. In other scenarios, the system resets when the IOS process or processes fail.
- A user-configured access policy was configured using the **transport-map** command that directs the user into the diagnostic mode.
- A send break signal (**Ctrl-C** or **Ctrl-Shift-6**) was entered while accessing the device, and the device was configured to enter diagnostic mode when a break signal was sent.

In the diagnostic mode, a subset of the commands that are available in user EXEC mode are made available to the users. Among other things, these commands can be used to:

- Inspect various states on the device, including the IOS state.
- Replace or roll back the configuration.
- Provide methods of restarting the IOS or other processes.
- Reboot hardware, such as the entire device, a module, or possibly other hardware components.
- Transfer files into or off of the device using remote access methods such as FTP, TFTP, and SCP.

The diagnostic mode provides a more comprehensive user interface for troubleshooting than previous devices, which relied on limited access methods during failures, such as ROMMON, to diagnose and troubleshoot Cisco IOS problems. The diagnostic mode commands can work when the Cisco IOS process is not working properly. These commands are also available in privileged EXEC mode on the device when the device is working normally.

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 that is specific to a command mode, a command, a keyword, or an argument, use one of the following commands.

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. **Note** There is no space between the command and the question mark.
`abbreviated-command-entry<Tab>`	Completes a partial command name.
`?`	Lists all the commands that are available for a particular command mode.

Command	Purpose
`command ?`	Lists the keywords or arguments that you must enter next on the command line. **Note** There is a space between the command and the question mark.

Finding Command Options: Example

This section provides information about how to display the 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 a part of a command followed by a space. The Cisco IOS XE software displays a list and brief descriptions of the available keywords and arguments. For example, if you are in global configuration mode and want to see all the keywords and arguments for the **arap** command, you should 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 using the question mark (**?**) to assist you in entering commands.

Table 15: 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)#`

`Router(config)# interface GigabitEthernet ?`
`<0-1> GigabitEthernet interface number`
 	
`Router(config)# interface GigabitEthernet 0/?`
`<0-5> Port Adapter number`
 	
`Router (config)# interface GigabitEthernet 0/0/?`
 	
`<0-63> GigabitEthernet interface number`
 	
`Router (config)# interface GigabitEthernet0/0/1?`
`. <0-5>`
`Router(config-if)#`
	Enter interface configuration mode by specifying the interface that you want to configure, using the **interface GigabitEthernet** global configuration command.
	Enter **?** to display what you must enter next on the command line.
	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)#`

Command	Comment

`Router(config-if)# ?`
`Interface configuration commands:`
`  .`
`  .`
`  .`
`  ip  Interface Internet Protocol config commands`
`  keepalive  Enable keepalive`
`  lan-name  LAN Name command`
`  llc2  LLC2 Interface Subcommands`
`  logging  Configure logging for interface`
`  mls  mls router sub/interface commands`
`  mpoa  MPOA interface configuration commands`
`  mtu  Set the interface MTU`
`  no  Negate a command or set its defaults`
`  ntp  Configure NTP`
`  .`
`  .`
`  .`
`Router(config-if)#`
	Enter **?** to display a list of all the interface configuration commands available for the interface. This example shows only some of the available interface configuration commands.

`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`
`  cgmp  Enable/disable CGMP`
`  dvmrp  DVMRP interface commands`
`  hello-interval  Configures IP-EIGRP hello interval`
`  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.

Command	Comment
Router(config-if)# ip address 198.51.100.5 ? A.B.C.D IP subnet mask Router(config-if)# **ip address 198.51.100.5**	Enter the keyword or argument that you want to use. This example uses the 198.51.100.5 IP address. Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP subnet mask. <cr> is not displayed. Therefore, you must enter additional keywords or arguments to complete the command.
Router(config-if)# **ip address 198.51.100.5 255.255.255.0 ?** secondary Make this IP address a secondary address <cr> Router(config-if)# **ip address 198.51.100.5 255.255.255.0**	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**. <cr> is displayed. Press **Enter** to complete the command, or enter another keyword.
Router(config-if)# **ip address 198.51.100.5 255.255.255.0** Router(config-if)#	Press **Enter** 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 from a **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 may take a few minutes to save the configuration. After the configuration has been saved, the following output is displayed:

```
[OK]
Router#
```

This task saves the configuration to the NVRAM.

Managing Configuration Files

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 also used on several other Cisco router platforms.

As a matter of routine maintenance on any Cisco router, users should back up the startup configuration file by copying the startup configuration file from NVRAM to one of the router's other file systems and, additionally, to a network server. Backing up the startup configuration file provides an easy method of recovering the startup configuration file if the startup configuration file in NVRAM becomes unusable for any reason.

The **copy** command can be used to back up startup configuration files.

For more detailed information on managing configuration files, see the "Managing Configuration Files" section in the Cisco IOS XE Configuration Fundamentals Configuration Guide.

Filtering Output from 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.

Example

In this example, a modifier of the **show interface** command (**include protocol**) is used to provide only the output lines in which the expression **protocol** is displayed:

```
Router# show interface | include protocol
GigabitEthernet0/0/0 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/1 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/2 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/3 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0 is up, line protocol is up
     0 unknown protocol drops
Loopback0 is up, line protocol is up
     0 unknown protocol drops
```

Powering Off a Device

The device can be safely turned off at any time by moving the device's power supply switch to the Off position. However, any changes to the running config since the last WRITE of the config to the NVRAM is lost.

Ensure that any configuration needed after startup is saved before powering off the device. The copy running-config startup-config command saves the configuration in NVRAM and after the device is powered up, the device initializes with the saved configuration.

Finding Support Information for Platforms and Cisco Software Images

The Cisco IOS XE software is packaged in feature sets consisting of software images that support specific platforms. The group of feature sets that are available for a specific platform depends 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 see the Release Notes for Cisco IOS XE.

Using Cisco Feature Navigator

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator is a tool that enables you to determine which Cisco IOS XE software images support a specific software release, feature set, or platform. To use the navigator tool, an account on Cisco.com is not required.

Using Software Advisor

Cisco maintains the Software Advisor tool. See Tools and Resources. Use the Software Advisor tool to see if a feature is supported in 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 device. You must be a registered user on Cisco.com to access this tool.

Using Software Release Notes

See the Release Notes document for Cisco Catalyst 8000 Series Edge Platforms for information about the following:

- Memory recommendations
- Open and resolved severity 1 and 2 caveats

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. For cumulative feature information, refer to the Cisco Feature Navigator at: http://www.cisco.com/go/cfn/.

CLI Session Management

An inactivity timeout is configurable and can be enforced. Session locking provides protection from two users overwriting changes that the other has made. To prevent an internal process from using all the available capacity, some spare capacity is reserved for CLI session access. For example, this allows a user to remotely access a router.

- Changing the CLI Session Timeout, on page 110
- Locking a CLI Session, on page 110

Information About CLI Session Management

An inactivity timeout is configurable and can be enforced. Session locking provides protection from two users overwriting changes that each other has made. To prevent an internal process from using all the available capacity, some spare capacity is reserved for CLI session access. For example, this allows a user to remotely access the router.

Changing the CLI Session Timeout

Step 1 `configure terminal`

Enters global configuration mode

Step 2 `line console 0`

Step 3 `session-timeout` *`minutes`*

The value of *`minutes`* sets the amount of time that the CLI waits before timing out. Setting the CLI session timeout increases the security of a CLI session. Specify a value of 0 for *`minutes`* to disable session timeout.

Step 4 `show line console 0`

Verifies the value to which the session timeout has been set, which is shown as the value for `" Idle Session "`.

Locking a CLI Session

Before you begin

To configure a temporary password on a CLI session, use the **lock** command in EXEC mode. Before you can use the **lock** command, you need to configure the line using the **lockable** command. In this example the line is configured as **lockable**, and then the **lock** command is used and a temporary password is assigned.

Step 1 `Router# configure terminal`

Enters global configuration mode.

Step 2 Enter the line upon which you want to be able to use the **lock** command.

```
Router(config)# line console 0
```

Step 3 `Router(config)# lockable`

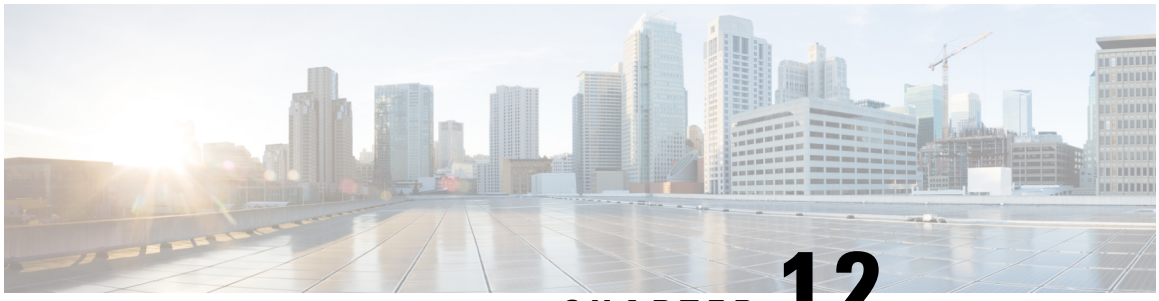
Enables the line to be locked.

Step 4 `Router(config)# exit`

Step 5 `Router# lock`

The system prompts you for a password, which you must enter twice.

```
Password: <password>
Again: <password>
Locked
```



CHAPTER 12

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 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 16: Feature Information for Available Licenses and Licensing Models

Feature Name	Releases	Feature Information
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 118, Throughput as a Numeric Value , on page 120, and Throughput as a Tier, on page 126.
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 Throughput as a Numeric Value , on page 120 and Throughput as a Tier, on page 126.
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.

Feature Name	Releases	Feature Information
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.
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.
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

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 115.

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.
  - If you order a Cisco DNA license when purchasing new hardware, the license is not preconfigured on the device. You must configure the boot level license and then the throughput, on the device.
  - If you configure tier-based throughput, which is supported from Cisco IOS XE Cupertino 17.7.1a, Tier 3 (T3) is not supported with the Network Essentials and DNA Essentials licenses.

    This means, to configure T3 (throughput greater than or equal to 2.5 G), you must configure Network Advantage/ DNA Advantage, or Network Premier/DNA Premier as the boot level license.

    This also means that if you have configured T3 as the throughput, you cannot change the boot level license to Network Essentials and DNA Essentials.

- 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.

The license PID also indicates the throughput you are entitled to. The throughput may be represented by a numeric value or a tier. For example:

- DNA-C-**10M**-E-3Y, is a license PID where the throughput is represented by a numeric value. The **10M** means that you are entitled to 10 Mbps bidirectional throughput.

  For more information about a numeric throughput value and related concepts, see sections Throughput , on page 118 and Throughput as a Numeric Value , on page 120.

- DNA-C-**T0**-E-3Y, is a license PID where the throughput is represented by a tier value. The **T0** means that you are entitled to up to 15 Mbps bidirectional throughput.

  For more information about a tier-based throughput value and related concepts, see sections Throughput , on page 118 and Throughput as a Tier, on page 126.

If the throughput you order is greater than 250 Mbps, or Tier 2 or a higher tier, an HSECK9 license is *required*. See High Security License , on page 115.

Note When you purchase a license PID with a tier-based throughput value of *T1*, an HSECK9 license is automatically provided. However, the maximum throughput on the device is still throttled to 250 Mbps *in each direction.*

High Security License

The High Security license (HSECK9 license) is an export-controlled license. An export-controlled license 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 (Tier 2 and higher tiers), and tunnel count over and above a certain number (the number varies depending on the platform).

Note The term "throughput" refers to encrypted throughput on physical platforms. On virtual platforms, it refers to encrypted *and* unencrypted throughput - combined.

Without an HSECK9 license, the supported tunnel count and the supported throughput for the various models of the Cisco Catalyst 8000 Edge Platforms Family is as follows:

PID	No. Of Tunnels *Without* HSECK9 License	Supported Throughput *Without* HSECK9 License
C8500-12X	N/A	N/A
C8500-12X4QC	N/A	N/A
C8500L-8G4X	N/A	N/A
C8300-2N2S-4T2X	1000	T0, T1
C8300-2N2S-6T	1000	T0, T1
C8300-1N1S-4T2X	1000	T0, T1
C8300-1N1S-6T	1000	T0, T1
C8200-1B-4T	1000	T0, T1
C8200L-1N-4T	1000	T0, T1
C8000V	150	T0, T1

Note By using an HSECK9 license the tunnel count restriction is lifted and you can configure throughput greater than 250 Mbps. For detailed information about the available throughput options, see Throughput and System Hardware Throttling Specifications in the Autonomous Mode, on page 121 and Numeric and Tier Mapping.

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), which you must install on the device. 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 135.

Once 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 configuration 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 a configuration that is separate from your Catalyst 8000 hardware platforms, you must order the HSECK9 license in the configuration 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 Cisco UBE 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 UBE 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 on the device. You can 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.

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 only to cryptographic throughput.

In case of virtual platforms (Catalyst 8000V Edge Software), all references to "throughput" in this document refer to both, encrypted and unencrypted throughput.

Throttled and Unthrottled Throughput

Throttled throughput refers to the enforcement of a restriction on the throughput.

Unthrottled throughput means no limit is enforced, and the device throughput is at the maximum capability of the device.

Whether throughput will be throttled or not, is determined by the throughput value you configure, and if the system's hardware is designed to impose a throttling limit for that configured throughput level. For more information about this, see Throughput and System Hardware Throttling Specifications in the Autonomous Mode, on page 121 in this document.

Depending on whether the device is a physical or a virtual one, throttling is also applied differently. On virtual platforms, if throughput is throttled, throttling applies only to Tx data and not Rx data. On physical platforms, if throughput is throttled, throttling applies to Tx and Rx data.

Note On physical platforms (Catalyst 8200, 8300, and 8500 Series Edge Platforms), unencrypted throughput (Tx and Rx), is unthrottled by default.

Where to Find Throughput Information for a Device

The throughput you are entitled to, is a value that is represented in the License product ID (PID) when you order a Cisco DNA license. It can be a numeric throughput value, such as DNA-C-**10M**-E-3Y, or a tier-based throughput value, such as DNA-C-**T0**-E-3Y.

To display current throughput configuration on the device:

- For physical platforms enter the **show platform hardware throughput crypto** privileged EXEC command.
- For virtual platforms enter the **show platform hardware throughput level** privileged EXEC command.

Depending on whether your license PID has a numeric throughput value, or tier-based throughput value, refer to the corresponding section below for further details.

Throughput as a Numeric Value

This refers to a numeric value (10M, 15M, 250M, 1G, and so on) that is configured as throughput.

The numeric throughput value you are entitled to is in the license PID and it is bi-directional. It is the maximum throughput that is allowed *in each direction* (Tx and Rx). The aggregate throughput is the *sum* of the throughput in both directions and therefore double the bi-directional throughput.

For example, if the license PID is DNA-C-**10M**-E-3Y, 10 Mbps is the bi-directional throughput, and the throughput value you configure on the device. It means that a maximum of 10 Mbps can be transmitted and 10 Mbps can be received. The aggregate throughput available is 20 Mbps.

Starting with Cisco IOS XE Cupertino 17.8.1a, throttling behaviour has changed as follows: *Only on physical platforms*, and *for throughput levels greater than 250 Mbps*, when you configure a 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 Tx and Rx traffic.

Starting with Cisco IOS XE Cupertino 17.9.1a, throttling behaviour has changed as follows: *On virtual platforms*, *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 Tx data. Rx data is always unthrottled.

Note If the aggregate for the throughput level you configure on a virtual platform is greater than 250 Mbps, aggregate throttling is not effective unless an HSECK9 license is available on the device (that is, SLAC is installed).

- **Example: Throttling when throughput is greater than 250 Mbps**

  Let us suppose that you order license PID DNA-C-**500M**-A-3Y. This means that 500 Mbps is the bi-directional throughput and 1Gbps is the aggregate throughput. The release-wise configuration and behaviour is as follows:

  - Until Cisco IOS XE Cupertino 17.7.x, on physical and virtual platforms: If you configure a throughput of 500 Mbps on the device, the maximum Tx throughput available is 500 Mbps and the maximum Rx throughput is 500 Mbps. (Except on virtual platforms, where Rx is not throttled.)
  - From Cisco IOS XE Cupertino 17.8.1a:

    On physical platforms, if you configure a throughput of 500 Mbps on the device, a maximum of 1 Gbps Tx and 0 Mbps Rx, or, 100 Mbps Tx and 900 Mbps Rx or any other ratio within the aggregate 1 Gbps throughput limit, is supported.

    On virtual platforms, if you configure a throughput of 500 Mbps on the device, a maximum of 500 Mbps Tx throughput is supported. Rx is not throttled.
  - From Cisco IOS XE Cupertino 17.9.1a:

    On physical platforms, throughput throttling behaviour described above (starting with 17.8.1a) continues to apply.

    On virtual platforms, if you configure a throughput of 500 Mbps on the device, a maximum of 1 Gbps Tx throughput is supported. Rx continues to remain unthrottled.

- **Example: Throttling when throughput is equal to or lesser than 250 Mbps**

Let us suppose that you order license PID DNA-C-250M-A-3Y. This means that 250 Mbps is the bi-directional throughput, and 500 Mbps is the aggregate throughput. The release-wise configuration and behaviour is as follows:

- Until Cisco IOS XE Cupertino 17.8.x, on physical and virtual platforms: If you configure a throughput of 250 Mbps on the device, the maximum Tx throughput supported is 250 Mbps and the maximum Rx throughput is 250 Mbps - it is not aggregated. (Except on virtual platforms where Rx is not throttled.)

Note 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 a tier-based value (T2), 500 Mbps is available for use in any Tx and Rx ratio.

- From Cisco IOS XE Cupertino 17.9.1a, *only on virtual platforms*, if you configure a throughput of 250 Mbps on the device, the aggregate amounts to 500 Mbps, which requires an HSECK9 license. If you have installed SLAC for the HSECK9 license, then the maximum Tx throughput available is 500 Mbps. Rx throughput continues to remain unthrottled. By contrast, if you configure a throughput of 100 Mbps on a virtual device, then the maximum Tx throughput available is 200 Mbps. Rx throughput remains unthrottled.

The recommended way to arrive at the required throughput for your network is to first calculate the aggregate throughput (Tx and Rx) and divide that by 2 to arrive at the bidirectional throughput value. Finally, select the license PID that is equal to or greater than the bidirectional throughput (tier-based or numeric).

The tables below provide throughput specifications for all devices in the Cisco Catalyst 8000 Edge Platforms Family:

Note Separate tables are provided for throughput specifications in the autonomous mode and SD-WAN controller mode.

Throughput and System Hardware Throttling Specifications in the Autonomous Mode

- Supported throughputs: All the throughput values you can configure on the device. These are the only throughput values you can configure on the specified device. The column heading also mentions the default throughput for a PID.
- Hardware throttled throughput: The throttling limit imposed by the system's hardware, for a supported throughput level. This column in the tables below tell you if hardware is throttled for each supported throughput level and what that hardware throttled level is. Where the value is listed as unthrottled, it means that throughput is not throttled even if you configure a limit.
- Require HSECK9?: Indicates if a supported throughput level requires an HSECK9 license (anything lesser than or equal to 250 Mbps does not require HSECK9).
- Supported Release & Throughput Throttling Behavior: This column provides a few different details. The applicable release for the specified throttling behaviour, if what is finally available is bi-directional or aggregate, and if the throughput being referred to is encrypted or unencrypted. Note that throughput always refers to encrypted throughput for physical platforms; for for virtual platforms it is both, encrypted and unencrypted.

C8300-1N1S-4T2X						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Bi-directional, encrypted
500M	500M	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
1G	1G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
2.5G	unthrottled	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8300-2N2S-6T						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Bi-directional; encrypted
500M	500M	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
1G	1G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8300-1N1S-6T						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Bi-directional; encrypted
500M	500M	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
1G	1G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8300-2N2S-4T2X						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Bi-directional; encrypted
500M	500M	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
1G	1G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
2.5G	unthrottled	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8200-1N-4T						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Bi-directional; encrypted
500M	500M	Yes	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8200L-1N-4T						
Supported Throughputs (default 10M)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M, 15M, 25M, 50M, 100M, 250M	250M	No	>= 17.5.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

Note 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.

C8500-12X4QC						
Supported Throughputs (default 2.5G)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
2.5G	2.5G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8500-12X4QC						
5G	5G	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
10G	unthrottled	Yes	>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8500-12X						
Supported Throughputs (default 2.5G)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
2.5G	2.5G		>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
5G	5G		>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
10G	unthrottled		>= 17.3.2	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8500L-8S4X						
Supported Throughputs (default 1G)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
1G	1G	Yes	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
2.5G	2.5G	Yes	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
5G	5G	Yes	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted
10G	unthrottled	Yes	17.4.1a	Bi-directional; encrypted	>=17.8.1a	Aggregate, encrypted

C8500-20X6C						
Supported Throughputs (default T4)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
T4	50G	Yes	-	-	>=17.10.1a	Aggregate, encrypted
T5	unthrottled	Yes	-	-	>=17.10.1a	Aggregate, encrypted

C8000v						
Supported Throughputs (default)	Hardware Throttled Throughput	Require HSECK9?	Supported Release & Throughput Throttling Behavior		Supported Release & Throughput Throttling Behavior	
10M	10M	No	>= 17.4.1a	Bi-directional; encrypted and unencrypted throughput	>=17.9.1a	Aggregate; encrypted and unencrypted throughput
25M	25M	No				
50M	50M	No				
100M	100M	No				
250M	250M	No				
500M	500M	Yes				
1G	1G	Yes				
2.5G	2.5G	Yes				
5G	5G	Yes				
10G	10G	Yes				
Note This is a virtual platform; Rx is always unthrottled.						

Throughput and System Hardware Throttling Specifications in the SD-WAN Controller Mode

PID	Introductory Release for PID	Throughput Without HSECK9	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
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

PID	Introductory Release for PID	Throughput Without HSECK9	Throughput With HSECK9 (>=17.3.2 and <17.8.1a; Bi-directional)	Throughput With HSECK9 (>17.8.1a; Aggregate)
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	unthrottled	unthrottled	unthrottled
C8500-20X6C (default T4)	17.10.1a	unthrottled	-	unthrottled
C8000v (default 250M)	17.4.1a	250M	unthrottled	unthrottled

Throughput as a Tier

Tier-based throughput configuration is supported starting with Cisco IOS XE Cupertino 17.7.1a.

A tier represents a throughput level. Starting with the lowest throughput level, the available tiers are Tier 0 (T0), Tier 1 (T1), Tier 2 (T2), and Tier 3 (T3). T2 and higher tiers require an HSECK9 license.

The tier-based throughput value you are entitled to is in the license PID and it is bi-directional. It is the maximum throughput that is allowed *in each direction* (Tx and Rx). The aggregate throughput is the *sum* of the throughput in both directions and therefore double the bi-directional throughput.

For example, if the license PID is DNA-C-**T0**-A-3Y, T0 is the bi-directional throughput, and the throughput value you configure on the device. When you configure this value, T0 Tx and T0 Rx, is supported. See table Tier and Numeric Throughput Mapping, on page 128 for information about how numeric throughput values are mapped to tiers and the DNA licenses that are available with each tier.

Note the following:

- All tiers are not available with all Cisco DNA licenses. For example, T3 is 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. The Tier and Numeric Throughput Mapping, on page 128 table clarifies this.
- Different platforms support different maximum throughput levels, therefore each tier means a different value for different platforms. For example, T2 means 1G throughput for C8300-2N2S-4T2, 500M for C8200-1N-4T, and 250M for C8200-1N-4T-L. The Tier and Numeric Throughput Mapping, on page 128 table clarifies this.

Starting with Cisco IOS XE Cupertino 17.8.1a, throttling behaviour has changed as follows: *Only on physical platforms*, and when you configure T2 or highter tiers, aggregate throughput throttling is effective. This means that traffic is throttled in an aggregate manner irrespective of the distribution of Tx and Rx traffic.

Starting with Cisco IOS XE Cupertino 17.9.1a, throttling behaviour has changed as follows: *On virtual platforms*, when you configure *a tier (any tier)*, 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 Tx data. Rx data is always unthrottled.

- **Example: Throttling when throughput is T2 or a higher tier**

  Let us suppose that you order license PID DNA-C-**T2**-A-3Y. With T2, the bi-directional throughput can be upto 1 Gbps and the aggregate throughput can be upto 2 Gbps. The release-wise configuration and behaviour is as follows:

  - Until Cisco IOS XE Cupertino 17.7.x, on physical and virtual platforms: You configure T2 on the device, and depending on the device, a maximum of up to 1 Gbps Tx and up to 1 Gbps Rx throughput is supported. Except on virtual platforms where Rx is not throttled.
  - From Cisco IOS XE Cupertino 17.8.1a:

    On physical platforms if you configure T2, depending on the device, up to 2 Gbps of aggregate throughput is available for use in any Tx and Rx ratio.

Note On C8200-1N-4T-L, if you configure T2, 500 Mbps is available for use in any upstream and downstream ratio. But if you configure a numeric value of 250M, a maximum of 250 Mbps is available in each direction.

    On virtual platforms if you configure T2, a maximum of 1 Gbps Tx is supported. Rx is not throttled.
  - From Cisco IOS XE Cupertino 17.9.1a:

    On physical platforms, the throughput throttling behaviour described above (starting with 17.8.1a) continues to apply.

    On virtual platforms, if you configure T2, up to 2 Gbps of aggregate throughput is supported. Accordingly, Tx is throttled at the aggregate level and Rx continues to remain unthrottled.

- **Example: Throttling when throughput is T0 or T1**

  Let us suppose that you order license PID DNA-C-**T1**-A-3Y. With T1, 100 Mbps is the bi-directional throughput, 200 Mbps is the aggregate throughput. The release-wise configuration and behaviour is as follows:

  - Until Cisco IOS XE Cupertino 17.8.x, on physical and virtual platforms: if you configure a throughput of T1 on the device. A maximum of 100 Mbps Tx and 100 Mbps Rx throughput is available. (Except on virtual platforms where Rx is not throttled).
  - From Cisco IOS XE Cupertino 17.9.1a, only on virtual platforms, if you configure a throughput of T1 on the device, Tx is throttled to a maximum of 200 Mbps. Rx continues to remain unthrottled.

Tier and Numeric Throughput Mapping

The following tables provide information about how numeric throughput values are mapped to tiers and the DNA licenses that are available with each tier.

Note When you purchase a license PID with a tier-based throughput value of *T1*, an HSECK9 license is automatically provided. However, the maximum throughput on the device is still throttled to 250 Mbps *in each direction.*

- Table 17: Tier and Numeric Throughput Mapping for Virtual Platforms (C8000v), Cisco IOS XE Cupertino 17.9.1a and Later Releases
- Table 18: Tier and Numeric Throughput Mapping for Physical Platforms, Cisco IOS XE Cupertino 17.8.1a and Later Releases
- Table 19: Tier and Numeric Throughput Mapping for Physical and Virtual Platforms, Cisco IOS XE Cupertino 17.7.x and Earlier Releases

Y: Network Premium and DNA Premium

Y: Network Advantage and DNA Advantage

Y: Network Essentials and DNA Essentials

Table 17: Tier and Numeric Throughput Mapping for Virtual Platforms (C8000v), Cisco IOS XE Cupertino 17.9.1a and Later Releases

Tier (Agg. Value):	T0 (Tx 50M)		T1 (Tx 200M)		T2* (Tx 2 Gbps)			T3* (Tx 20 Gbps)		
					**HSECK9 License Required.*					
Configured Numeric Value:	**15M**	**25M**	**50M**	**100M**	**250M**	**500M**	**1G**	**2.5G**	**5G**	**10G**
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	

Table 18: Tier and Numeric Throughput Mapping for Physical Platforms, Cisco IOS XE Cupertino 17.8.1a and Later Releases

Tier (Agg.):	T0 (50M Agg)			T1 (200M Bi-directional)		T2* (2G Agg.)			T3* (20G Agg. or unthrottled)			T4* (50G Agg.)	T5* (Unthrottled
						**HSECK9 License Required*							
Configured Numeric Value:	**10M**	**15M**	**25M**	**50M**	**100M**	**250M**	**500M**	**1G**	**2.5G**	**5G**	**10G**	-	-

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-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					
C8300-1N1S-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				
C8300-2N2S-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				
C8200-1N-4T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y						
C8200-1N-4T-L	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		
C8500L-8S4X								Y Y	Y Y	Y Y	Y Y		
C8500-20X6C												Y Y	Y Y

Table 19: Tier and Numeric Throughput Mapping for Physical and Virtual Platforms, Cisco IOS XE Cupertino 17.7.x and Earlier Releases

Tier:	T0		T1			T2*			T3*		
						**HSECK9 License Required*					
Configured Numeric Value:	**10M**	**15M**	**25M**	**50M**	**100M**	**250M**	**500M**	**1G**	**2.5G**	**5G**	**10G**
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-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			
C8300-1N1S-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		
C8300-2N2S-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		
C8200-1N-4T	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y				
C8200-1N-4T-L	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
C8500L-8S4X								Y Y	Y Y	Y Y	Y Y
C8000v	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	

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.

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. Log in to the portal and in the corresponding Smart Account and Virtual Account, navigate to **Inventory** > **Licences**, to display the numeric and tier-based licenses in the account. Figure Figure 2: Numeric and Tier Values Displayed in the CSSM Web UI, on page 131 shows you how to distinguish between the two.

- 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.

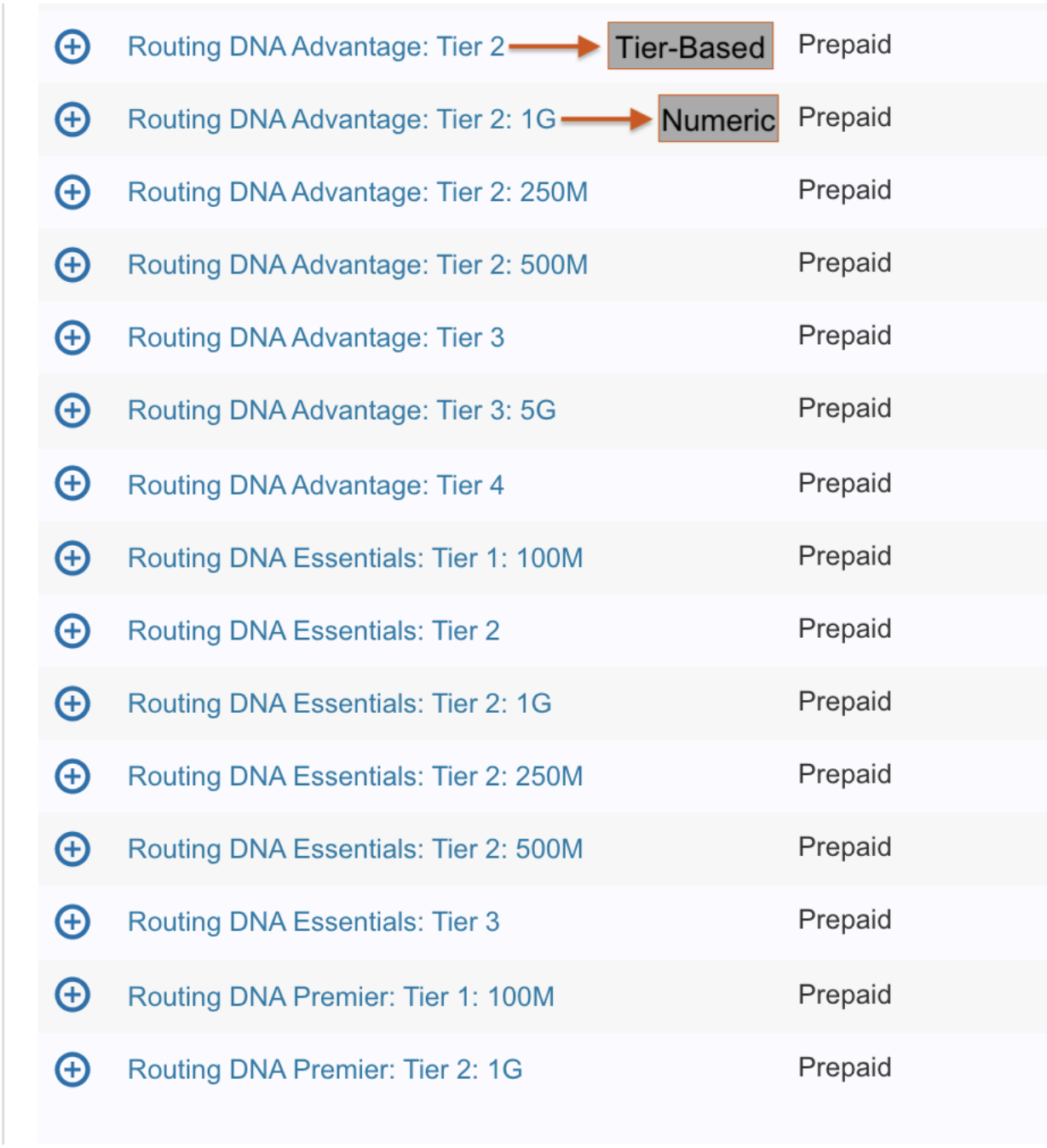
  See Configuring a Numeric Throughput, on page 136.

- 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 139 or Configuring a Numeric Throughput, on page 136.

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.

Figure 2: Numeric and Tier Values Displayed in the CSSM Web UI



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 143

- 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 tasks you must complete, for the 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**[1] **→ Enable HSECK9 on applicable platforms**[2]**→ 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.

[1] If a SLAC has been factory-installed by Cisco manufactory (in case of new hardware), skip this step
[2] Enter the **license feature hseck9** command in global configuration mode for Catalyst 8200, and 8300 Series Edge Platforms only.

SUMMARY STEPS

1. **show version**
2. **configure terminal**
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**} }
4. **exit**
5. **copy running-config startup-config**
6. **reload**
7. **show version**
8. **show license summary**
9. Complete usage reporting - if required

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show version**
	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>`
		Displays the currently set boot level license.
		In the accompanying example, Network Advantage and DNA Advantage licences are configured on the device.

Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
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**}		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.

	Command or Action	Purpose

	network-essentials {**addon dna-essentials**} | **network-premier** {**addon dna-premier**} }
	Example:
	`Device(config)# license boot level network-premier addon dna-premier`
	`% use 'write' command to make license boot config take effect on next boot`
		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.

Step 4	**exit** **Example:** `Device# exit`	Exits global configuration mode and returns to privileged EXEC mode.

Step 5	**copy running-config startup-config**
	Example:
	`Device# copy running-config startup-config`
	`Destination filename [startup-config]?`
	`Building configuration...`
	`[OK]`
	`<output truncated>`
		Saves your entries in the configuration file.

Step 6	**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>`
		Reloads the device. License levels configured in Step 3 are effective and displayed only after this reload.

Step 7	**show version**
	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>`
		Displays the currently set boot level license.
		In the accompanying example, the output confirms that Network Premier and DNA-Premier licenses are configured.

Step 8	**show license summary**
	Example:
	`Device# show license summary`
	`Account Information:`
		Displays a summary of license usage, which includes information about licenses being used, the count, and status.

	Command or Action	Purpose
	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 132. 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 the Throughput as a Numeric Value , on page 120 and Numeric vs. Tier-Based Throughput Configuration, on page 130 sections.
- Ensure that a boot level license is already configured on the device. See Configuring a Boot Level License, on page 132. 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, ensure that you have already installed a Smart Licensing Authorization Code (SLAC) according to the method that applies to your topology in the Smart Licensing Using Policy environment. See Installing SLAC for an HSECK9 License, on page 135.
- Note the throughput you are entitled to. This is indicated in the Cisco DNA license PID you purchase.

SUMMARY STEPS

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**
2. **configure terminal**
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**}

4. **exit**
5. **copy running-config startup-config**
6. **reload**
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**

DETAILED STEPS

	Command or Action	Purpose

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**
	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`
		Displays the currently running throughput on the device.
		In the accompanying examples,
		• 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).

Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
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. The following apply to both physical and virtual platforms: • At a minimum, you must have configured a network-stack license already. Otherwise the command is not recognized as a valid one on the command line interface.

	Command or Action	Purpose

	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.`
		• If you are configuring throughput greater than 250 Mbps, you must have already installed SLAC. Options greater than 250 Mbps are displayed only if SLAC is installed.
		In the accompanying examples,
		• 1 Gbps is configured on the physical platform. Aggregate throughput throttling (Cisco IOS XE Cupertino 17.8.1a and later) is effective. After reboot, irrespective of the distribution of traffic in the upstream and downstream direction, an aggregate throughput limit of 2 Gbps is effective.
		• 5000 Mbps is configured on the virtual platform. A maximum of 5000 Mbps upstream and 5000 Mbps downstream throughput is supported.

Step 4	**exit** **Example:** `Device# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 5	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	Saves your entries in the configuration file.
Step 6	**reload** **Example:** `Device# reload`	Reloads the device. **Note** Perform this step only if the device you are configuring throughput on is a physical platform (Catalyst 8200, 8300, and 8500 Series Edge Platforms). Skip this step if you are configuring throughput on a virtual platform (Catalyst 8000V Edge Software).
Step 7	Depending on whether the device is a physical or virtual one, enter the applicable command:	Displays the currently running throughput on the device.

	Command or Action	Purpose

	• For physical platforms: **show platform hardware throughput crypto**
	• For virtual platforms: **show platform hardware 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`
		Note 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.

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 the Throughput as a Tier, on page 126 and Numeric vs. Tier-Based Throughput Configuration, on page 130 sections.
- Ensure that a boot level license is already configured on the device. See Configuring a Boot Level License, on page 132. In the output of the **show version** privileged EXEC command, ensure that the license is mentioned.
- 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 is not supported with Network Essentials and DNA Essentials.
- If you are configuring Tier 2 (T2) or a higher tier, ensure that you have already installed a Smart Licensing Authorization Code (SLAC) according to the method that applies to your topology in the Smart Licensing Using Policy environment. See Installing SLAC for an HSECK9 License, on page 135.
  - 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.
- Note the throughput you are entitled to. This is indicated in the Cisco DNA license PID you purchase.

SUMMARY STEPS

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**
2. **show license authorization**
3. **configure terminal**
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**}
   - For virtual platforms: **platform hardware throughput level MB** {**T0** | **T1** | **T2** | **T3** }
5. **exit**
6. **copy running-config startup-config**
7. **reload**
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**

DETAILED STEPS

	Command or Action	Purpose

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**
	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`
		Displays the currently running throughput on the device.
		In the accompanying examples:
		• 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.

Step 2	**show license authorization**
	Example:
	`Device# show license authorization`
	`Overall status:`
	`  Active: PID:C8300-2N2S-4T2X,SN:FDO2250A0J5`
	`      Status: SMART AUTHORIZATION INSTALLED on Mar`
		(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 in the subsequent steps.

	Command or Action	Purpose
	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**	• SLAC is not available on the virtual platform. Note how this affects throughput configuration in the subsequent steps.
Step 3	**configure terminal** **Example:** Device# **configure terminal**	Enters global configuration mode.
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**} • For virtual platforms: **platform hardware throughput level MB** {**T0** | **T1** | **T2** | **T3** } **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	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 examples. The following apply to both physical and virtual platforms: • 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.

	Command or Action	Purpose

	<pre> 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</pre>
		Note 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 examples:
		
		• On the physical platform (**platform hardware throughput crypto**), tiers T2 and higher tiers are displayed, because SLAC is installed. If SLAC were not available, T1 would have been the highest tier displayed.
		
		Further, aggregate throughput throttling (Cisco IOS XE Cupertino 17.8.1a and later) is effective. After reboot, irrespective of the distribution of traffic in the upstream and downstream direction, an aggregate throughput limit of 2 Gbps is supported.
		
		• 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.

Step 5	**exit** **Example:** `Device# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 6	**copy running-config startup-config** **Example:**	Saves your entries in the configuration file.

	Command or Action	Purpose

	`Device# copy running-config startup-config`
	`Destination filename [startup-config]?`
	`Building configuration...`
	`[OK]`	

Step 7	**reload**
	Example:
	`Device# reload`
	`Proceed with reload? [confirm]`
	`*Mar 02 05:07:00.979: %SYS-5-RELOAD: Reload requested by console.`
	`Reload Reason: Reload Command.`
		Reloads the device.
		Note A reload is required only for physical platforms.

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**
	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`
		Displays the currently running throughput on the device.
		In the accompanying examples:
		• On the physical platform, the tier value is set to T2.
		Note 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.
		• 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.

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.

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 the Numeric vs. Tier-Based Throughput Configuration, on page 130 section.
- 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 135.
- The software version running on the product instance is Cisco IOS XE Cupertino 17.7.1a or a later release.

SUMMARY STEPS

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**
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**
3. **copy running-config startup-config**
4. **reload**
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**
6. Verify that conversion is complete.
   - For physical platforms: **license throughput crypto auto-convert**
   - For virtual platforms: **license throughput level auto-convert**

DETAILED STEPS

	Command or Action	Purpose

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**
	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`
		Displays the currently running throughput on the device.

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.

	Command or Action	Purpose

	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**
	Example:
	`Device# copy running-config startup-config`
	`Destination filename [startup-config]?`
	`Building configuration...`
	`[OK]`
		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.

Step 4	**reload**
	Example:
	`Device# reload`
	`Proceed with reload? [confirm]`
	`*Dec 8 03:24:09.534: %SYS-5-RELOAD: Reload requested by console.`
	`Reload Reason:`
	`Reload Command`
		Reloads the device.
		Note A reload is required only on physical platforms.

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**
	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`
		Displays the currently running throughput on the device.

	Command or Action	Purpose

	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**
	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`
		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.

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 143
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 143
Greater than 250 Mbps	No action required.	Converting From a Numeric Throughput Value to a Tier, on page 143

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 136	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

Managed Service Licensing Agreement (MSLA) is a consumption-based software licensing model designed for Cisco's Managed Service Provider business.

- **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*.

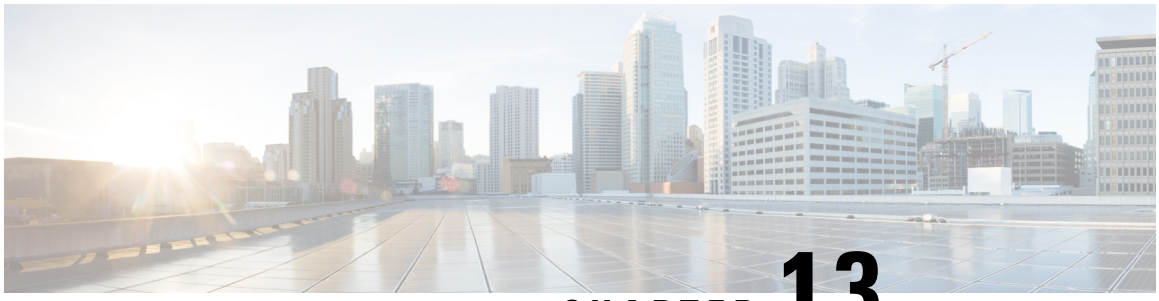
- **MSLA in Autonomous Mode**

  In the autonomous mode, an MSLA is available only with Catalyst 8000V Edge Software, starting from Cisco IOS XE Cupertino 17.9.1a.

  Here, you begin by entering into an MSLA with Cisco, and purchase licenses with subscription IDs.

  Licenses with subscription IDs can be ordered on Cisco commerce workspace (CCW). Ordered licenses are deposited in the specified Smart Account and Virtual Account in CSSM, with the corresponding subscription IDs.

  To complete licensing workflows, you must implement a supported topology. After CSSM receives license usage information, you are billed based on the throughput and the Cisco DNA subscription tier that is activated and in-use. For more information, see: MSLA and Utility Mode.



CHAPTER 13

Change of Authorization

Change of Authorization (CoA) provides a mechanism to change the attributes of an authentication, authorization, and accounting (AAA) session after it is authenticated.

Identity-Based Networking Services supports change of authorization (CoA) commands for session query, reauthentication, and termination, port bounce and port shutdown, and service template activation and deactivation.

Feature Information for Change of Authorization

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 20: Feature Information for Change of Authorization

Feature Name	Releases	Feature Information
Change of Authorization	Cisco IOS XE Amsterdam 17.4.1	The Change of Authorization The following commands were introduced by this feature: **show aaa servers**, **show aaa group radius**, **show device-tracking policies**, **show device-tracking database** **show access-session interface** *interface-name*
Change of Authorization	Cisco IOS XE Amsterdam 17.3.1a	The Change of Authorization The following commands were introduced by this feature: **show ip access-lists**, **show ip access-list interface** , **debug epm plugin acl event**, **debug epm plugin acl errors**

Information About Change of Authorization

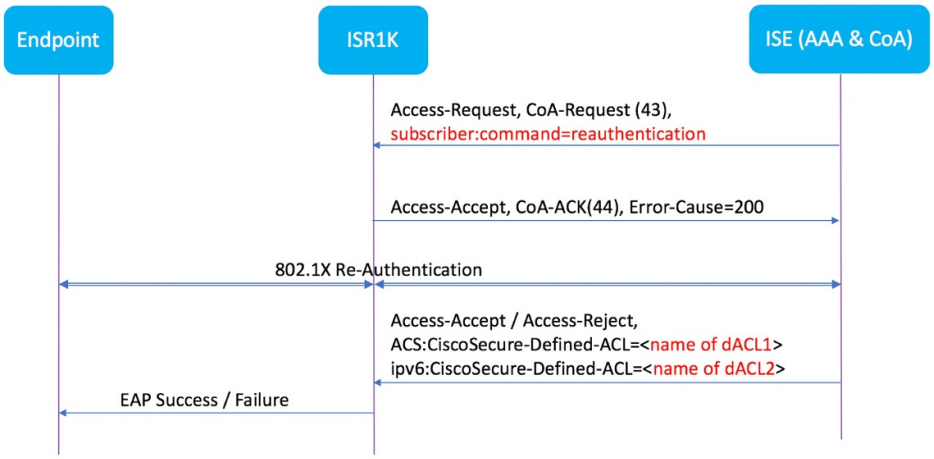
Change of Authorization-Reauthentication Procedure

Change of Authorization (CoA) provides a mechanism to change the attributes of an authentication, authorization, and accounting (AAA) session after it is authenticated. The main steps in this procedure are:

- Authentication
- Posture Assessment
- CoA Re-Authentication
- Network Access Authorization

When a policy changes for a user or user group in AAA, administrators can send RADIUS CoA packets from the AAA server, such as a Cisco Identity Secure Engine (ISE) to reinitialize authentication and apply the new policy. This section provides an overview of the RADIUS interface including available primitives and how they are used during a CoA.

The RADIUS CoA provides a mechanism to change the attributes of an AAA session after it is authenticated. When policy changed on user or user group in RADIUS server, administrators can initiate RADIUS CoA process from RADIUS server to re-authenticate or re-authorize new policy



By default, the RADIUS interface is enabled on the device. However, some basic configuration is required for the following attributes:

- Security and Password
- Accounting

After posture assessment is succeessful, full network access is pushed down to the device for specific client through CoA re-authentication command based on its compliance state derived from last assessment. It is

optional to enforce downloadable ACLs with Permit-ALL or limited access to certain resources to corresponding clients. Per-session CoA requests are supported for session identification, session termination, host reauthentication, port shutdown, and port bounce. This model comprises one request (CoA-Request) and two possible response codes:

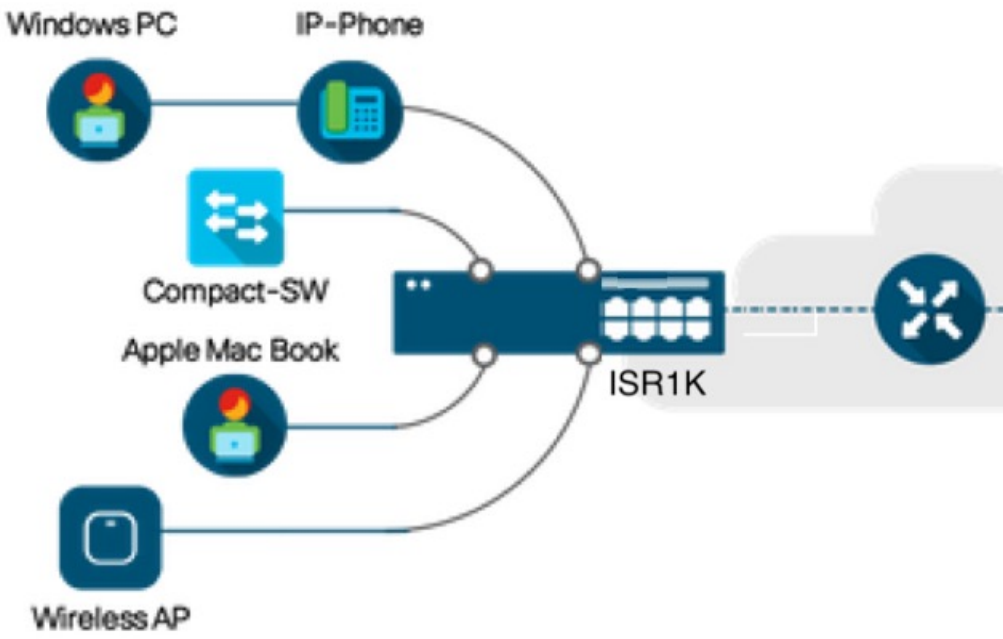
- CoA acknowledgement (ACK) [CoA-ACK]
- CoA nonacknowledgement (NAK) [CoA-NAK]

Change of Authorization

Change of Authorization (CoA) is a critical part of a solution to initiate re-authenticate or re-authorization to an endpoint's network access based on its posture assessment result. This feature is integrated with Cisco AnyConnect, version 4.8 and Cisco ISE, version 2.6.

The network topology below shows a typical Cisco 1000 Series Integrated Services Router as a branch router in a network for secure access with ISE and other network services deployed in Campus or Data Center.

Figure 3: Cisco ISR1000 in a Network for Secure Access with ISE and other Network Services



CoA is critical part of the solution to initiate re-authenticate or re-authorization to endpoint's network access based on its posture assessment result. Downloadable ACL is the Target/Purpose of the entire solution. The per-client basis customized security policies are achieved by it.

Restrictions for Change of Authorization

- Only 8 ports SKUs have TCAM to support DACL and Redirect ACL
- xACL can only match exact value(>,<,>=,<= are not supported)

- Switch ASIC TCAM has only 255 entries (IPv4 ACL entries) in total
- No IPv4 option header support, no IP fragment support in ACL packet inspection
- IPv6 is not supported in this feature
- Port ACL is not supported in this feature
- SISF: Only support none-secure device-tracking (tracking policy with security level ‘glean’)
- Multi-auth vlan is not supported on Cisco 1000 Series Integrated Services Routers
- Tracking is not getting replaced by ‘enable tracking‘
- VLAN change does not happen consistently with multiple iterations on client interfaces

How to Configure Change of Authorization

Essential dot1x | SANet Configuration

```
aaa new-model
aaa authentication dot1x default group coa-ise
aaa authorization network default group coa-ise
dot1x system-auth-control
aaa group server radius coa-ise
 server name coa
radius server coa
 address ipv4 10.10.1.10 auth-port 1812 acct-port 1813
 key cisco123
policy-map type control subscriber simple_coa
 event session-started match-all
  10 class always do-until-failure
   10 authenticate using dot1x
interface gigabitethernet0/0/1
 switchport access vlan 22
 switchport mode access
 access-session closed
 access-session port-control auto
 dot1x pae authenticator
service-policy type control subscriber simple_coa
```

Configure Change of Authorization

```
aaa server radius dynamic-author
 client
 server-key ******
 auth-type any
 ignore server-key
ip access-list extended redirect_acl
 20 deny udp any eq bootps any
 25 deny udp any eq domain any
 30 deny udp any any eq bootpc
 40 deny udp any eq bootpc any
 50 deny ip any host %{ise.ip}
 60 permit tcp any any eq www
```

```
 70 permit tcp any any eq 443
device-tracking tracking
device-tracking policy tracking_test
 security-level glean
 no protocol ndp
 no protocol dhcp6
 tracking enable
interface 0/0/1
 device-tracking attach-policy tracking_test
```

Configuration Examples for Change of Authorization

Example: Check if the RADIUS Server is Active

```
Device# show aaa servers
RADIUS: id 1, priority 1, host 10.75.28.231, auth-port 1812, acct-port 1813, hostname host
     State: current UP, duration 188755s, previous duration 0s
     Dead: total time 0s, count 0
     Platform State from SMD: current UP, duration 188755s, previous duration 0s
```

Example: Device Tracking Policy

```
Device# show aaa group radius coa3 **** port 1813 new-code
User successfully authenticated
USER ATTRIBUTES
username             0   "coa3"
```

To check if the parameters are enabled:

```
Device# show device-tracking policies
Target               Type  Policy               Feature        Target range
Gi0/1/1              PORT  tracking_test        Device-tracking vlan all
Gi0/1/2              PORT  tracking_test        Device-tracking vlan all
Gi0/1/3              PORT  tracking_test        Device-tracking vlan all
Gi0/1/4              PORT  tracking_test        Device-tracking vlan all
```

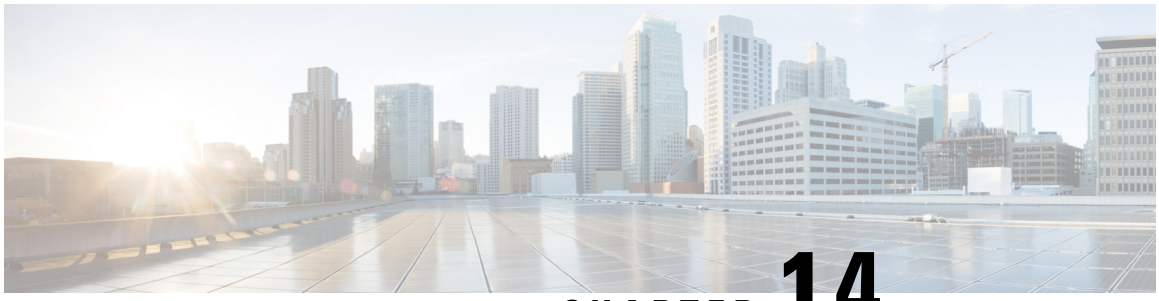
To check the SISF table:

```
Device# show device-tracking database
Binding Table has 1 entries, 1 dynamic (limit 100000)
0001:MAC and LLA match     0002:Orig trunk            0004:Orig access
0008:Orig trusted trunk    0010:Orig trusted access   0020:DHCP assigned
0040:Cga authenticated     0080:Cert authenticated    0100:Statically assigned
Network Address        Link Address       Interface  vlan  prlvl    age    state       Time
 left
ARP 10.11.22.20       0050.5683.3f97      Gi0/1/4     22    0005    11s   REACHABLE
295 s
```

To check if the access-session is authenticated and autorized:

```
Device# show access-session interface gigabitEthernet 0/1/7 detail
            Interface:  GigabitEthernet0/1/7
               IIF-ID:  0x0DB9315A
```

```
       MAC Address:  b496.913d.4f9b
      IPv6 Address:  Unknown
      IPv4 Address:  10.10.22.27
         User-Name:  coa2
         Status:  Authorized
            Domain:  DATA
    Oper host mode:  multi-auth
  Oper control dir:  both
   Session timeout:  N/A
 Common Session ID:  611C4B0A00000053F483D7B0
   Acct Session ID:  Unknown
            Handle:  0x21000049
    Current Policy:  POLICY_COA
Server Policies:  Filter-ID: Filter_ID_COA2
Method status list:  Method           State
                     dot1x           Authc Success
```



CHAPTER 14

Managing the Device Using Web User Interface

The Web User Interface (Web UI) is an embedded GUI-based device-management tool that provides the ability to provision the device, to simplify device deployment and manageability, and to enhance the user experience. It comes with the default image, so there is no need to enable anything or install any license on the device. You can use WebUI to build configurations, and to monitor and troubleshoot the device without having CLI expertise. This chapter includes the these sections:

Setting Up Factory Default Device Using Web UI

Quick Setup Wizard allows you perform the basic router configuration. To configure the router:

Note Before you access the Web UI, you need to have the basic configuration on the device.

Step 1 Connect the RJ-45 end of a serial cable to the RJ-45 console port on the router.

Step 2 After the device initial configuration wizard appears, enter **No** to get into the device prompt when the following system message appears on the router.

Would you like to enter the initial configuration dialog? [yes/no]: no

Step 3 From the configuration mode, enter the following configuration parameters.

```
!
ip dhcp pool WEBUIPool
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1

username admin privilege 15 password 0 default
!
interface gig 0/0/1
ip address 192.168.1.1 255.255.255.0
!
```

Step 4 Connect the PC to the router using an Ethernet cable to the gig 0/0/1 interface.

Step 5 Set up your PC as a DHCP client to obtain the IP address of the router automatically.

Step 6 Launch the browser and enter the device IP address in your browser's address line. For a secure connection, type https://192.168.1.1/#/dayZeroRouting. For a less secure connection, enter http://192.168.1.1/#/dayZeroRouting.

Step 7 Enter the default username (admin) and the password as default.

Using Basic or Advanced Mode Setup Wizard

To configure the router using the basic or advanced mode setup:

Step 1 Choose the **Basic Mode** or **Advanced Mode** and click **Go To Account Creation Page**.

Step 2 Enter the username and password. Reenter the password to confirm.

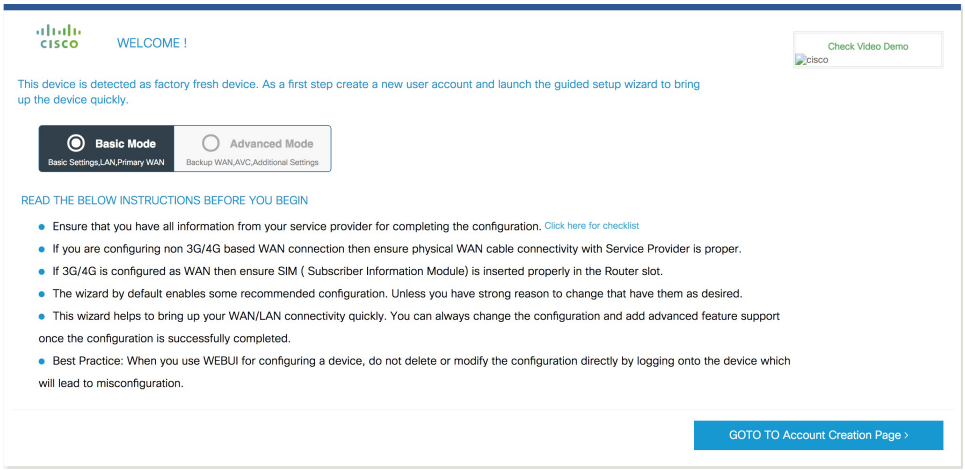
Step 3 Click **Create and Launch Wizard**.

Step 4 Enter the device name and domain name.

Step 5 Select the appropriate time zone from the **Time Zone** drop-down list.

Step 6 Select the appropriate date and time mode from the **Date and Time** drop-down list.

Step 7 Click **LAN Settings**.



Configure LAN Settings

Step 1 Choose the **Web DHCP Pool/DHCP Pool** name or the **Create and Associate Access VLAN** option.

a) If you choose the Web DHCP Pool, specify the following:

Pool Name—Enter the DHCP Pool Name.

Network—Enter network address and the subnet mask.

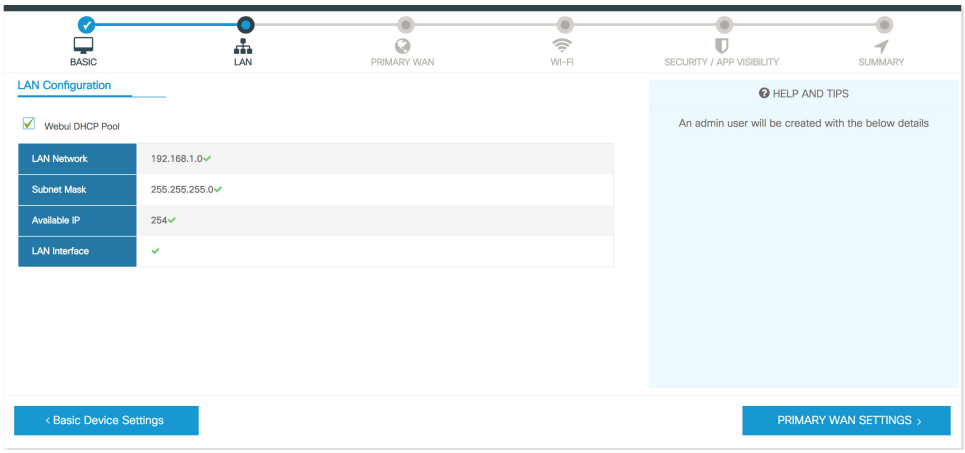
b) If you choose the Create and Associate Access VLAN option, specify the following:

Access VLAN—Enter the Access VLAN identification number. The range is from 1 to 4094.

Network—Enter the IP address of the VLAN.

Management Interfaces—Select the interface and move to the selected list box using the right and left arrows. You can also double click or drag and drop to move the interface to the selected list box.

Step 2 Click **Primary WAN Settings**.



Configure Primary WAN Settings

Step 1 Select the primary WAN type. You con configure Serial, 3G/4G, Ethernet, or Broadband (xDSL) as primary WAN depending on the WAN types supported by the router.

Step 2 Select the interface from the drop-down list.

Step 3 Check the **Get DNS Server info directly from ISP** check box to get the DNS server information directly from the service provider. You can also manually enter the Primary DNS and Secondary DNS.

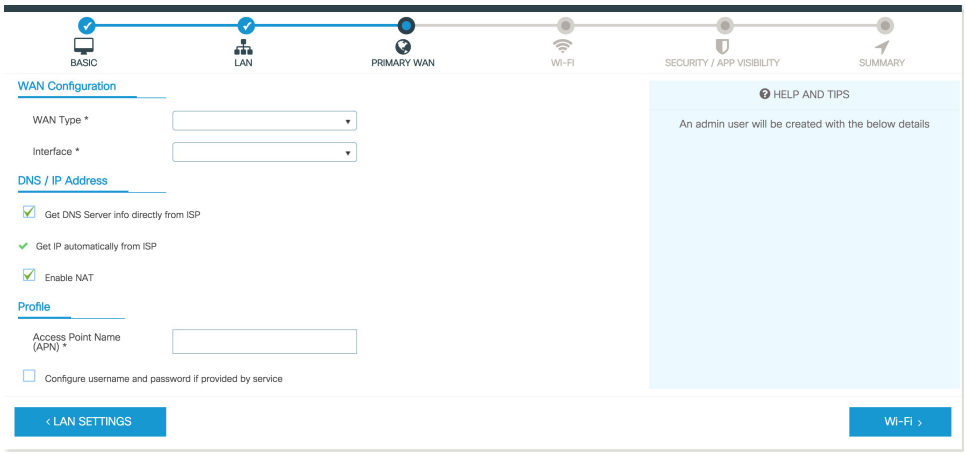
Step 4 Check the **Get IP automatically from ISP** check box to get the IP address information directly from the service provider. You can also manually enter the IP address and subnet mask.

Step 5 Check the **Enable NAT** check box to enable NAT. It is recommended to enable NAT.

Step 6 Check the **Enable PPPOE** check box to enable PPPoE. If you have enabled PPPoE, select the required authentication mode. The options are: **PAP** and **CHAP**.

Step 7 Enter the user name and password provided by the service provider.

Step 8 Click **Security / APP Visibility WAN Settings**.



Configure Secondary WAN Settings

For advanced configuration, you should configure the secondary WAN connection.

Step 1 Select the secondary WAN type. You con configure Serial, 3G/4G, Ethernet, or Broadband (xDSL) as a secondary WAN depending on the WAN types supported by the router.

Step 2 Select the interface from the drop-down list.

Step 3 Check the **Get DNS Server info directly from ISP** check box to get the DNS server information directly from the service provider. You can also manually enter the Primary DNS and Secondary DNS.

Step 4 Check the **Get IP automatically from ISP** check box to get the IP address information directly from the service provider. You can also manually enter the IP address and subnet mask.

Step 5 Check the **Enable NAT** check box to enable NAT. It is recommended to enable NAT.

Step 6 Check the **Enable PPPOE** check box to enable PPPoE. If you have enabled PPPoE, select the required authentication mode. The options are **PAP** and **CHAP** .

Step 7 Enter the user name and password provided by the service provider.

Step 8 Click **Security / APP Visibility WAN Settings**.

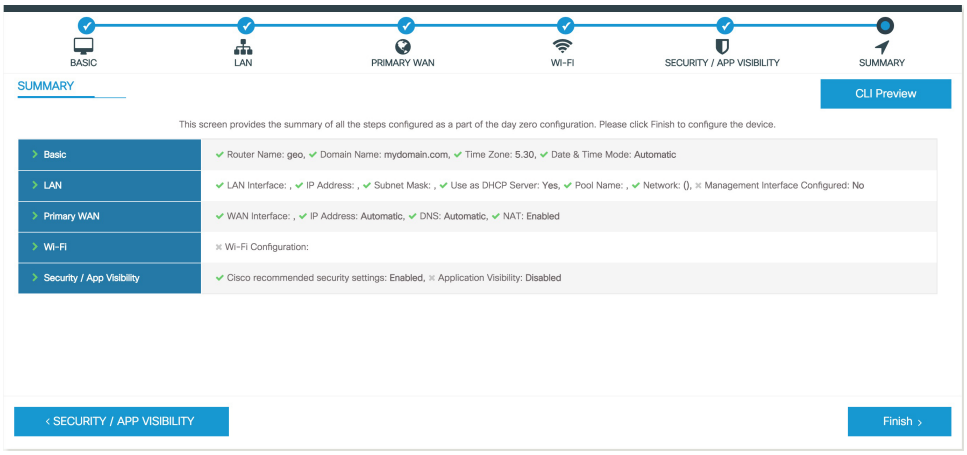
Configure Security Settings

Step 1 Check the **Enable Cisco Recommended Security Settings** check box to ensure that all passwords are not shown in plain text. The passwords are encrypted.

Step 2 Click **Day 0 Config Summary**.

Step 3 To preview the configuration, click **CLI Preview** to preview the configuration.

Step 4 Click **Finish** to complete the Day Zero setup.



Using Web User Interface for Day One Setup

To configure the Web user interface:

Step 1 Configure the HTTP server. By default, the HTTP server configuration should be present on the device. Ensure the configuration by checking if the **ip http server** and **ip http secure-server** commands are present in the running configuration.

```
Device #configure terminal
Device (config)#ip http server
Device (config)#ip http secure-server
```

Step 2 Set up the authentication options to log into Web UI. You can use one of these methods to authenticate:

a) You can authenicate using local database. To use a local database for Web UI authentication, ensure to have the **ip http authentication local** command in the running configuration. This command is preconfigured on the device. If the command is not present, configure the device as shown in this example:

```
Device #configure terminal
Device (config)#ip http authentication local
```

Note You need a user with privilege 15 to access the configuration screens on Web UI. If the privilege is less than 15, you can access only the Dashboard and Monitoring screens on Web UI.

To create a user account, use the **username** <username> **privilege** <privilege> **password 0** <passwordtext>

```
Device #configure terminal
Device (config)# username <username> privilege <privilege> password 0 <passwordtext>
```

b) Authenticate using AAA options. To use AAA authentication for Web UI, ensure to configure ‘ip http authentication aaa’ on the device. Also, ensure that the required AAA server configuration is present on the device.

```
Device #configure terminal
Device (config)#ip http authentication local
```

Step 3 Launch the browser. In the address bar, type the IP address of the device. For a secure connection, type https://ip-address.

Step 4 Enter the default username (cisco) and password provided with the device

Step 5 Click **Log In**.

Monitor and Troubleshoot Device Plug and Play (PnP) Onboarding using WebUI

Table 21: Feature History

Feature Name	Release Information	Description
Monitor and Troubleshoot Device PnP Onboarding using WebUI	Cisco IOS XE Catalyst SD-WAN Release 17.5.1a	You can now monitor and troubleshoot your Day-0 device onboarding using WebUI through PnP onboarding. If the automated PnP onboarding fails, you can manually onboard your device.

A device can be automatically onboarded to Cisco vManage through either Zero Touch Provisioning (ZTP) or the Plug and Play (PnP) process. This section describes the procedure to monitor and troubleshoot device onboarding through the PnP method. This feature on WebUI enables you to monitor and troubleshoot the PnP onboarding process, and also see its real-time status. If this onboarding is stuck or fails, you can terminate the process and onboard your device manually.

Prerequisites

- Your device (a computer that can run a web browser) running the WebUI and the device you are onboarding must be connected through an L2 switch port (NIM) on the device.
- The DHCP client-identifier on your device must be set to string “webui”.
- Your device must support Cisco SD-WAN Day-0 device onboarding on WebUI.

Troubleshoot Device PnP Onboarding

To troubleshoot device onboarding through PnP in controller mode:

1. Enter the controller mode in WebUI:
    - Switching from autonomous mode to controller mode:

      Usually, when you boot your device for the first time it is in autonomous mode. Go to the URL https://192.168.1.1/webui/ and log in using the default credentials— webui/cisco. If your device supports Cisco SD-WAN Day-0 device onboarding on WebUI, you can switch to the controller mode by selecting **Controller Mode.** A dialogue box appears, asking if you want to continue. Click **Yes.** Your device reloads to switch to controller mode.

    - Booting your device in controller mode:

      If your device is already in the controller mode, you do not have to make any changes to the mode. Go to the URL https://192.168.1.1 or https://192.168.1.1/webui. If your device supports Cisco

SD-WAN Day-0 device onboarding on WebUI, the URL is redirected to https://192.168.1.1/ciscosdwan/ and you can log in using the default credentials for Cisco IOS XE SD-WAN devices - admin/admin.

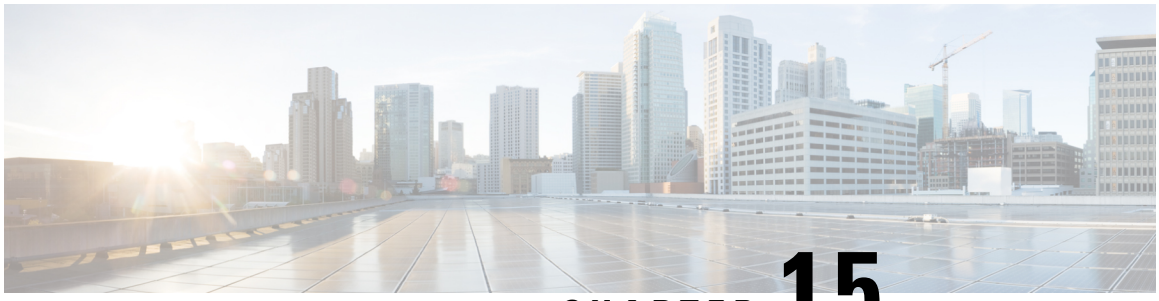
Note If the device does not have start-up configuration at the time of PnP onboarding, the WebUI is enabled by default on supported devices.

2. On the **Welcome to Cisco SDWAN Onboarding Wizard** page, click **Reset Default Password.**

Note The default password of your Day-0 device is weak. Therefore, for a secure log in, you must reset the password when you first log in to the device on WebUI. The WebUI configuration is automatically deleted after the device is onboarded successfully. In rare cases where the template configuration for your device on Cisco vManage has the WebUI configuration, it is not deleted even after a successful device onboarding.

3. You are redirected to the Device hardware and software details page. Enter your password and click **Submit.**
4. The next page displays the onboarding progress and lists statuses of different components of the PnP Connect Portal and Cisco SD-WAN controllers. If the PnP IPv4 component fails, it indicates that the device PnP onboarding has failed.

   To view and download logs for the onboarding process, click the information icon on the right hand side of the SDWAN Onboarding Progress bar.
5. If the automated PnP onboarding fails, click **Terminate Automated Onboarding.** This allows you to onboard your device manually.
6. A dialogue box appears. To continue with the termination, click **Yes**. It might take a few minutes for the termination to complete.
7. On the Bootstrap Configuration page click **Select File** and choose the bootstrap file for your device. This file can be either a generic bootstrap file (common platform-specific file) or a full configuration bootstrap file that you can download from Cisco SD-WAN Manager. This file must contain details such as the vBond number, UUID, WAN interface, root CA and configuration.
8. Click **Upload**.
9. After your file is successfully uploaded, click **Submit.**
10. You can see the SDWAN Onboarding Progress page again with statuses of the Cisco SD-WAN controllers. To open the Controller Connection History table click the information icon on the right hand side of the SDWAN Control Connections bar. In this table you can see the state of your onboarded device. After the onboarding is complete, the state of your device changes to **connect**.



CHAPTER 15

Console Port, Telnet, and SSH Handling

This chapter includes the following sections:

Notes and Restrictions for Console Port, Telnet, and SSH

- Telnet and Secure Shell (SSH) settings configured in the transport map override any other Telnet or SSH settings when the transport map is applied to the Ethernet management interface.
- Only local usernames and passwords can be used to authenticate users entering a Ethernet management interface. AAA authentication is not available for users accessing the device through a Ethernet management interface using persistent Telnet or persistent SSH.
- Applying a transport map to a Ethernet management interface with active Telnet or SSH sessions can disconnect the active sessions. Removing a transport map from an interface, however, does not disconnect any active Telnet or SSH session.
- Configuring the diagnostic and wait banners is optional, but recommended. The banners are especially useful as indicators to users about the status of their Telnet or SSH attempts.

Console Port Overview

The console port on the device is an EIA/TIA-232 asynchronous, serial connection with no flow control and an RJ-45 connector. The console port is used to access the device and is located on the front panel of the Route Processor.

For information on accessing the device using the console port, see Using Cisco IOS XE Software, on page 97.

Console Port Handling Overview

If you are using the console port to access the router, you are automatically directed to the Cisco IOS command-line interface (CLI).

If you are trying to access the router through the console port and send a break signal (by entering **Ctrl-C** or **Ctrl-Shift-6**, or by entering the **send break** command at the Telnet prompt) before connecting to the CLI, you are directed to a diagnostic mode if the non-RPIOS subpackages are accessible. These settings can be changed by configuring a transport map for the console port and applying that transport map to the console interface.

Configuring a Console Port Transport Map

This task describes how to configure a transport map for a console port interface on the device.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **transport-map type console** *transport-map-name*
4. **connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]]
5. (Optional) **banner** [**diagnostic** | **wait**] *banner-message*
6. **exit**
7. **transport type console** *console-line-number* **input** *transport-map-name*

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	**transport-map type console** *transport-map-name* **Example:** `Router(config)# transport-map type console consolehandler`	Creates and names a transport map for handling console connections, and enters transport map configuration mode.
Step 4	**connection wait** [**allow** [**interruptible**]	**none** [**disconnect**]]	Specifies how a console connection will be handled using this transport map.

	Command or Action	Purpose
	Example: `Router(config-tmap)# connection wait none`	• **allow interruptible**—The console connection waits for a Cisco IOS VTY line to become available, and also allows users to enter diagnostic mode by interrupting a console connection that is waiting for a Cisco IOS VTY line to become available. This is the default setting. **Note** Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**. • **none**—The console connection immediately enters diagnostic mode.

Step 5	(Optional) **banner** [**diagnostic** | **wait**] *banner-message*
	Example:
	`Router(config-tmap)# banner diagnostic X`
	`Enter TEXT message. End with the character 'X'.`
	`--Welcome to Diagnostic Mode--`
	`X`
	`Router(config-tmap)#`
		(Optional) Creates a banner message that will be seen by users entering diagnostic mode or waiting for the Cisco IOS VTY line because of the console transport map configuration.
		• **diagnostic**—Creates a banner message seen by users directed to diagnostic mode because of the console transport map configuration.
		Note Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**.
		• **wait**—Creates a banner message seen by users waiting for Cisco IOS VTY to become available.
		• *banner-message*—Banner message, which begins and ends with the same delimiting character.

Step 6	**exit** **Example:** `Router(config-tmap)# exit`	Exits transport map configuration mode to re-enter global configuration mode.
Step 7	**transport type console** *console-line-number* **input** *transport-map-name* **Example:** `Router(config)# transport type console 0 input consolehandler`	Applies the settings defined in the transport map to the console interface. The *transport-map-name* for this command must match the *transport-map-name* defined in the **transport-map type console** command.

Examples

The following example shows how to create a transport map to set console port access policies and attach to console port 0:

```
Router(config)# transport-map type console consolehandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# banner diagnostic X
```

```
Enter TEXT message. End with the character 'X'.
--Welcome to diagnostic mode--
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
Waiting for IOS vty line
X
Router(config-tmap)# exit
Router(config)# transport type console 0 input consolehandler
```

Viewing Console Port and SSH Handling Configurations

Use the following commands to view console port, SSH, and Telnet handling configurations:

- **show transport-map**
- **show platform software configuration access policy**

Use the **show transport-map** command to view transport map configurations.

show transport-map [**all** | **name** *transport-map-name* | **type** [**console** [**ssh**]]

This command can be used either in user EXEC mode or privileged EXEC mode.

Example

The following example shows transport maps that are configured on the device: a console port (`consolehandler`), persistent SSH (`sshhandler`), and persistent Telnet transport (`telnethandler`):

```
Router# show transport-map all
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

bshell banner:

Welcome to Diagnostic Mode


Transport Map:
Name: sshhandler
Type: Persistent SSH Transport

Interface:
GigabitEthernet0/0/0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS prompt

Bshell banner:
Welcome to Diagnostic Mode
```

```
Router# show transport-map type console
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

Bshell banner:

Welcome to Diagnostic Mode


Router# show transport-map type persistent ssh
Transport Map:
Name: sshhandler
Type: Persistent SSH Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS prompt

Bshell banner:

Welcome to Diagnostic Mode


SSH:
Timeout: 120
Authentication retries: 5
RSA keypair: sshkeys



Router# show transport-map name consolehandler
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

Bshell banner:

Welcome to Diagnostic Mode
```

Use the **show platform software configuration access policy** command to view the current configurations for handling the incoming console port, SSH, and Telnet connections. The output of this command provides the current wait policy for each type of connection (Telnet, SSH, and console), as well as information on the currently configured banners.

Unlike the **show transport-map** command, the **show platform software configuration access policy** command is available in diagnostic mode so that it can be entered in scenarios where you need transport map configuration information, but cannot access the Cisco IOS CLI.

Example

```
Router# show platform software configuration access policy
The current access-policies

Method : telnet
Rule : wait
Shell banner:
Wait banner :

Method : ssh
Rule : wait
Shell banner:
Wait banner :

Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :
```

Example

The following example shows the **show platform software configuration access policy** command being issued both before and after a new transport map for SSH are configured. During the configuration, the connection policy and banners are set for a persistent SSH transport map, and the transport map for SSH is enabled.

```
Router# show platform software configuration access policy
The current access-policies

Method : telnet
Rule : wait with interrupt
Shell banner:
Welcome to Diagnostic Mode

Wait banner :
Waiting for IOS Process


Method : ssh
Rule : wait
Shell banner:
Wait banner :

Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :

Router# configure terminal
```

```
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# transport-map type persistent ssh sshhandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# banner diagnostic X
Enter TEXT message. End with the character 'X'.
Welcome to Diag Mode
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
Waiting for IOS
X
Router(config-tmap)# rsa keypair-name sshkeys
Router(config-tmap)# transport interface gigabitethernet 1
Router(config-tmap)# exit
Router(config)# transport type persistent ssh input sshhandler
Router(config)# exit

Router# show platform software configuration access policy
The current access-policies

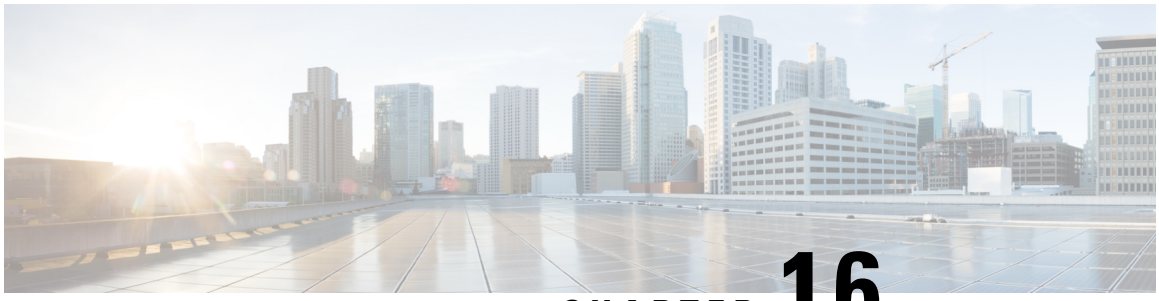
Method : telnet
Rule : wait with interrupt
Shell banner:
Welcome to Diagnostic Mode

Wait banner :
Waiting for IOS process


Method : ssh
Rule : wait with interrupt
Shell banner:
Welcome to Diag Mode

Wait banner :
Waiting for IOS


Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :
```



CHAPTER 16

Installing the Software

This chapter includes the following sections:

Overview

Installing software on the router involves installing a consolidated package (bootable image). This consists of a bundle of subpackages (modular software units), with each subpackage controlling a different set of functions.

These are the two main methods to install the software:

- Managing and Configuring a Device to Run Using a Consolidated Package, on page 175—This method allows for individual upgrade of subpackages and generally has reduced boot times compared to the method below. Use this method if you want to individually upgrade a module's software.
- Managing and Configuring a Device to Run Using Individual Packages, on page 203—This a simple method that is similar to a typical Cisco router image installation and management that is supported across Cisco routers.

It is better to upgrade software in a planned period of maintenance when an interruption in service is acceptable. The router needs to be rebooted for a software upgrade to take effect.

ROMMON Images

A ROMMON image is a software package used by ROM Monitor (ROMMON) software on a router. The software package is separate from the consolidated package normally used to boot the router. For more information on ROMMON, see Hardware Installation Guide for the Cisco Catalyst 8000 Series Edge Platforms..

An independent ROMMON image (software package) may occasionally be released and the router can be upgraded with the new ROMMON software. For detailed instructions, see the documentation that accompanies the ROMMON image.

Note A new version of the ROMMON image is not necessarily released at the same time as a consolidated package for a router.

Provisioning Files

This section provides background information about the files and processes used in Managing and Configuring a Device to Run Using Individual Packages, on page 203.

The consolidated package on a device consists of a collection of subpackages and a provisioning file titled `packages.conf`. To run the software, the usual method used is to boot the consolidated package, which is copied into memory, expanded, mounted, and run within memory. The provisioning file's name can be renamed but subpackage file's names cannot be renamed. The provisioning file and subpackage files must be kept in the same directory. The provisioning file does not work properly if any individual subpackage file is contained within a different directory.

Note An exception to this is that if a new or upgraded module firmware package is subsequently installed, it need not be in the same directory as the provisioning file.

Configuring a device to boot, using the provisioning file packages.conf, is beneficial because no changes have to be made to the boot statement after the Cisco IOS XE software is upgraded.

File Systems

The following table provides a list of file systems that can be seen on the Cisco Catalyst 8000 Series Edge Platform.

Table 22: Device File Systems

File System	Description
bootflash:	Boot flash memory file system.
flash:	Alias to the boot flash memory file system above.

File System	Description
harddisk:	Hard disk file system (NVME-M2-600G or USB-M2-16G or USB-M2-32G with the CLI command harddisk).
cns:	Cisco Networking Services file directory.
nvram:	Device NVRAM. You can copy the startup configuration to NVRAM or from NVRAM.
obfl:	File system for Onboard Failure Logging (OBFL) files.
system:	System memory file system, which includes the running configuration.
tar:	Archive file system.
tmpsys:	Temporary system files file system.
usb0: USB 3.0 Type-A usb1: USB 3.0 Type-B	The Universal Serial Bus (USB) flash drive file systems. **Note** The USB flash drive file system is visible only if a USB drive is installed in usb0: or usb1: ports.

Use the **?** help option, or use the **copy** command in command reference guides, if you find a file system that is not listed in the table above.

Autogenerated File Directories and Files

This section discusses the autogenerated files and directories that can be created, and how the files in these directories can be managed.

Table 23: Autogenerated Files

File or Directory	Description
crashinfo files	Crashinfo files may appear in the bootflash: file system. These files provide descriptive information of a crash and may be useful for tuning or troubleshooting purposes. However, the files are not part of device operations, and can be erased without impacting the functioning of the device.
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 device 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 device.

File or Directory	Description
tracelogs directory	The storage area for trace files. Trace files are useful for troubleshooting. If the Cisco IOS process fails, for instance, users or troubleshooting personnel can access trace files using diagnostic mode to gather information related to the Cisco IOS failure. Trace files, however, are not a part of device operations, and can be erased without impacting the device's performance.

Important Notes About Autogenerated Directories

Important information about autogenerated directories include:

- Autogenerated files on the bootflash: directory should not be deleted, renamed, moved, or altered in any way unless directed by Cisco customer support.

Note Altering autogenerating files on the bootflash: may have unpredictable consequences for system performance.

- Crashinfo, core, and trace files can be deleted.

Flash Storage

Subpackages are installed to local media storage, such as flash. For flash storage, use the **dir bootflash:** command to list the file names.

Note Flash storage is required for successful operation of a device.

Configuring the Configuration Register for Autoboot

The configuration register can be used to change behavior. This includes controlling how the device boots. Set the configuration register to 0x0 to boot into ROM, by using one of the following commands:

- In Cisco IOS configuration mode, use the **config-reg** 0x0 command.
- From the ROMMON prompt, use the **confreg** 0x0 command.

For more information about the configuration register, see Use of the Configuration Register on All Cisco Routers.

Note Setting the configuration register to 0x2102 will set the device to autoboot the Cisco IOS XE software.

Note The console baud rate is set to 9600 after changing the **confreg** to 0x2102 or 0x0. If you cannot establish a console session after setting **confreg**, or garbage output appears, change the setting on your terminal emulation software to 9600.

How to Install and Upgrade the Software

To install or upgrade the software, use one of the following methods to use the software from a consolidated package or an individual package. Also see the overview section.

- Managing and Configuring a Device to Run Using a Consolidated Package, on page 175
- Managing and Configuring a Device to Run Using Individual Packages, on page 203

Managing and Configuring a Device to Run Using a Consolidated Package

Note Do not use these procedures if you also need to install any optional subpackages or plan to upgrade individual subpackages. See Managing and Configuring a Device to Run Using Individual Packages, on page 203.

- Managing and Configuring a Consolidated Package Using Copy and Boot Commands, on page 175
- Configuring a Device to Boot the Consolidated Package via TFTP Using the Boot Command: Example, on page 177

Managing and Configuring a Consolidated Package Using Copy and Boot Commands

To upgrade a consolidated package, copy the consolidated package to the **bootflash:** directory on the router using the **copy** command. After making this copy of the consolidated package, configure the router to boot using the consolidated package file.

The following example shows the consolidated package file being copied to the **bootflash:** file system via 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:/

81921   drwx           237568   Jul 8 2020 11:17:27 -07:00  tracelogs
98305   drwx             4096  Jun 24 2020 17:26:48 -07:00  license_evlog
237569  drwx             4096  Jun 24 2020 17:26:48 -07:00  core
131073  drwx             4096  Jun 24 2020 17:26:45 -07:00  onep
16      -rw-               30  Jun 24 2020 17:26:38 -07:00  throughput_monitor_params
13      -rw-           134458  Jun 24 2020 17:26:37 -07:00  memleak.tcl
401409  drwx             4096  Jun 24 2020 17:26:23 -07:00  .dbpersist
15      -rwx             1314  Jun 24 2020 17:26:21 -07:00  trustidrootx3_ca.ca
14      -rw-            20109  Jun 24 2020 17:26:21 -07:00  ios_core.p7b
73729   drwx             4096  Jun 24 2020 17:26:19 -07:00  gs_script
```

```
12      -rw-             182  Jun 24 2020 17:26:19 -07:00  mode_event_log
221185  drwx            4096  Jun 24 2020 17:26:13 -07:00  .prst_sync
212993  drwx            4096  Jun 24 2020 17:25:59 -07:00  .ssh
368641  drwx            4096  Jun 24 2020 17:25:55 -07:00  .rollback_timer
376833  drwx            4096  Jun 24 2020 17:25:55 -07:00  .installer
458753  drwx            4096  Jun 24 2020 17:25:47 -07:00  sysboot
11      -rw-       696368193  Jun 24 2020 17:15:13 -07:00

Router# copy tftp: bootflash:Address or name of remote host []? 203.0.113.2
Source filename []? /auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin
Destination filename [c8000be-universalk9.17.03.01prd14.SPA.bin]?
Accessing tftp://203.0.113.2//auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin...
%Error opening
tftp://203.0.113.2//auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin (Timed
out)
C8300-Router#
C8300-Router#copy tftp bootflash
Address or name of remote host [203.0.113.2]? 203.0.113.2
Source filename [/auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin]?
Destination filename [c8000be-universalk9.17.03.01prd14.SPA.bin]?
Accessing tftp://203.0.113.2//auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin...
Loading /auto/tftp-ngio/test/c8000be-universalk9.17.03.01prd14.SPA.bin from 203.0.113.2
(via GigabitEthernet0/0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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!!!!!!!
[OK - 696368193 bytes]

696368193 bytes copied in 478.600 secs (1455011 bytes/sec)

Router# dir bootflash:
Directory of bootflash:/

106497  drwx            4096   Jul 8 2020 11:38:27 -07:00  tracelogs
11      -rw-       696368193   Jul 8 2020 11:34:28 -07:00
c8000be-universalk9.17.03.01prd14.SPA.bin
458753  drwx            4096  Jun 24 2020 17:25:47 -07:00  sysboot

7693897728 bytes total (5950341120 bytes free)
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# boot system flash bootflash:c8000be-universalk9.17.03.01prd14.SPA.bin
Router(config)# config-reg 0x2102
Router(config)# exit
Router# show run | include boot
boot-start-marker
boot system flash bootflash:c8000be-universalk9.17.03.01prd14.SPA.bin
boot-end-marker
diagnostic bootup level minimal
Router# copy run start
Destination filename [startup-config]?
Building configuration...
```

```
[OK]
Router# reload
```

Configuring a Device to Boot the Consolidated Package via TFTP Using the Boot Command: Example

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#boot system
tftp://10.81.116.4/auto/cebu-tftpboot/test/release/rommon/bin/test-17-3-2r
Router(config)#config-register 0x2102
Router(config)#exit
Router#
*Jul  7 01:43:52.098: %SYS-5-CONFIG_I: Configured from console by console
Router#show run | include boot
boot-start-marker
boot system bootflash:c8000be-universalk9.17.03.01prd14.SPA.bin
boot system tftp://10.81.116.4/auto/mcebu-tftpboot/test/release/rommon/bin/test-17-3-1r
boot-end-marker
license boot level network-essentials
diagnostic bootup level minimal
Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#reload
Proceed with reload? [confirm]

*Jul  7 01:55:28.639: %SYS-5-RELOAD:
Reload requested by console. Reload Reason: Reload Command.Jul  7 01:55:36.715:
%PMAN-5-EXITACvp: Process manager is exiting: process exit with reload chassis code
Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly


System Bootstrap, Version 1RU-20191104, DEVELOPMENT SOFTWARE
Copyright (c) 1994-2019  by cisco Systems, Inc.


Current image running: Boot ROM1

Last reset cause: LocalSoft
C8300-1N1S-6T platform with 8388608 Kbytes of main memory


........
Located c8000be-universalk9.17.03.01prd14.SPA.bin

############################################################################################################
############################################################################################################
############################################################################################################
############################################################################################################
############################################################################################################
############################################################################################################

Package header rev 3 structure detected
IsoSize = 655712256
```

```
Calculating SHA-1 hash...Validate package: SHA-1 hash:
        calculated DF67D179:DAB875C9:D61FB9E7:2E25B30B:48E86BFC
        expected   DF67D179:DAB875C9:D61FB9E7:2E25B30B:48E86BFC
RSA Signed RELEASE Image Signature Verification Successful.
Image validated


RSA Signed RELEASE Image Signature Verification Successful.
Image validated
Jul  7 01:58:19.327: %BOOT-5-OPMODE_LOG: R0/0: binos: System booted in AUTONOMOUS mode

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Software feature.

All TCP AO KDF Tests Pass
cisco C8300-1N1S-6T (1RU) processor with 3763047K/6147K bytes of memory.
Processor board ID FDO2320A0CF
Router operating mode: Autonomous
6 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
```

```
8388608K bytes of physical memory.
7090175K bytes of flash memory at bootflash:.
28884992K bytes of M.2 USB at harddisk:.

 Dspfarm profile 7 :: No resource, check voice card or dspfarm service is not configured
Press RETURN to get started!
Router>show version
Cisco IOS XE Software, Version 17.03.01prd8
Cisco IOS Software [Amsterdam], c8000be Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
 17.3.1prd8, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
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software.


ROM: (c)


This product contains cryptographic features and is subject to United
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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 Package License Information:

------------------------------------------------------------------
Technology     Type         Technology-package Technology-package
                            Current           Next Reboot
------------------------------------------------------------------
Smart License  Perpetual    network-essentials network-essentials
Smart License  Subscription None              None

The current crypto throughput level is 1000000 kbps


cisco C8300-1N1S-6T (1RU) processor with 3763047K/6147K bytes of memory.
Processor board ID FDO2320A0CF
Router operating mode: Autonomous
6 Gigabit Ethernet interfaces
```

```
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
7090175K bytes of flash memory at bootflash:.
28884992K bytes of M.2 USB at harddisk:.

Configuration register is 0x2102
```

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:

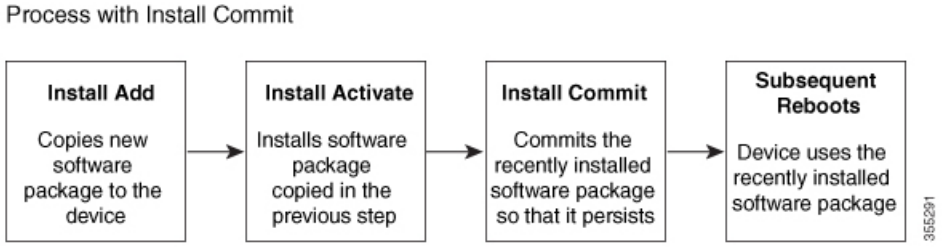
Table 24: Bundle Mode vs Install Mode

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 25: 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.
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.

Command	Syntax	Purpose
(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.
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.

Command	Syntax	Purpose
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.
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.

Command	Syntax	Purpose
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 26: 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.
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.

Command	Syntax	Purpose
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.
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.

From Cisco IOS XE 17.7.1a, these commands replace the old install workflow as the default mode on supported platforms. The installation workflow for Cisco IOS XE 17.6.x release or earlier, described in section Overview, on page 171, is supported for Cisco IOS XE 17.7.x, and is the default for Cisco Catalyst 8000 Edge platforms with Cisco IOS XE 17.6.x or earlier.

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.

	Command or Action	Purpose
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.
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
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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.
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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.

Managing and Configuring a Device to Run Using Individual Packages

To choose between running individual packages or a consolidated package, see Overview section.

The following topics are included in this section:

- Installing Subpackages from a Consolidated Package, on page 203
- Installing a Firmware Subpackage, on page 219
- Installing Subpackages from a Consolidated Package on a Flash Drive, on page 209

Installing Subpackages from a Consolidated Package

Perform the following procedure to obtain the consolidated package from a TFTP server.

Another variation of this procedure obtains the consolidated package from a USB flash drive. This is described in Installing Subpackages from a Consolidated Package on a Flash Drive.

Before you begin

Copy the consolidated package to the TFTP server.

SUMMARY STEPS

1. **show version**
2. **dir bootflash:**
3. **show platform**
4. **mkdir bootflash:** *URL-to-directory-name*
5. **request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*
6. **reload**
7. **boot** *URL-to-directory-name*/**packages.conf**
8. **show version installed**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show version**
	Example:
	`Router# show version`
	`Cisco IOS Software, IOS-XE Software`
	`Step 1`
	`(X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental`
	`Version 15.3(20120627:221639) [build_151722 111]`
	`Copyright (c) 1986-2012 by Cisco Systems, Inc.`
	`Compiled Thu 28-Jun-12 15:17 by mcpre`
	`.`
	`.`
	`.`
		Shows the version of software running on the router. This can later be compared with the version of software to be installed.

Step 2	**dir bootflash:** **Example:** `Router# dir bootflash:`	Displays the previous version of software and that a package is present.

Step 3	**show platform**
	Example:
	`Router# show platform`
	`Chassis type: c8000be/K9`
		Displays the inventory.

Step 4	**mkdir bootflash:** *URL-to-directory-name* **Example:** `Router# mkdir bootflash:mydir`	Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.
Step 5	**request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name* **Example:** `Router# request platform software package expand file bootflash:c8000be-universalk9-NIM.bin to bootflash:mydir`	Expands the software image from the TFTP server (*URL-to-consolidated-package*) into the directory used to save the image (*URL-to-directory-name*), which was created in Step 4.

Step 6	**reload**
	Example:
	`Router# reload`
	`rommon >`
		Enables ROMMON mode, which allows the software in the consolidated file to be activated.

Step 7	**boot** *URL-to-directory-name*/**packages.conf** **Example:** `rommon 1 > boot bootflash:mydir/packages.conf`	Boots the consolidated package, by specifying the path and name of the provisioning file: packages.conf.
Step 8	**show version installed** **Example:**	Displays the version of the newly installed software.

	Command or Action	Purpose
	Router# **show version installed** Package: Provisioning File, version: n/a, status: active	

Examples

The initial part of the example shows the consolidated package, c8000be-universalk9.17.03.01prd14.SPA.bin , being copied to the TFTP server. This is a prerequisite step. The remaining part of the example shows the consolidated file, packages.conf, being booted.

```
Router# copy tftp:c8000be-universalk9.17.03.01prd14.SPA.bin bootflash:
ddress or name of remote host []? 203.0.113.6
Destination filename [c8000be-universalk9.17.03.01prd14.SPA.bin]
Accessing tftp://203.0.113.6/c8000be/ic8000be-universalk9.17.03.01prd8.SPA.bin...
Loading c8000be/c8000be-universalk9.17.03.01prd14.SPA.bin from 192.0.2.4 (via
GigabitEthernet0): !!!!!!!!
[OK - 410506248 bytes]

410506248 bytes copied in 338.556 secs (1212521 bytes/sec)


Router# show version
Cisco IOS XE Software, Version 17.03.01prd14
Cisco IOS Software [Amsterdam], c8000be Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
 17.3.1prd14, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2020 by Cisco Systems, Inc.
Compiled Tue 16-Jun-20 23:44 by mcpre


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software.


ROM: 17.3(1r)

C8300-Router uptime is 15 minutes
Uptime for this control processor is 16 minutes
System returned to ROM by Reload Command
System image file is "bootflash:c8000be-universalk9.17.03.01prd14.SPA.bin"
Last reload reason: Reload Command



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```
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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: UNREGISTERED/No Licenses in Use

cisco C8300-1N1S-4T2X (1RU) processor with 3763577K/6147K bytes of memory.
Processor board ID FDO2401A038
Router operating mode: Autonomous
1 Virtual Ethernet interface
20 Gigabit Ethernet interfaces
4 2.5 Gigabit Ethernet interfaces
5 Ten Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
7573503K bytes of flash memory at bootflash:.
15253504K bytes of M.2 USB at harddisk:.
7819328K bytes of USB flash at usb0:.

Configuration register is 0x2102

Router# dir bootflash:
Directory of bootflash:/

106497  drwx            16384   Jul 8 2020 12:01:57 -07:00  tracelogs
360449  drwx             4096   Jul 8 2020 11:51:37 -07:00  license_evlog
212993  drwx             4096   Jul 8 2020 11:51:37 -07:00  core
262145  drwx             4096   Jul 8 2020 11:51:35 -07:00  onep
16      -rw-               30   Jul 8 2020 11:51:27 -07:00  throughput_monitor_params
13      -rw-           134458   Jul 8 2020 11:51:27 -07:00  memleak.tcl
311297  drwx             4096   Jul 8 2020 11:51:12 -07:00  .dbpersist
15      -rwx             1314   Jul 8 2020 11:51:10 -07:00  trustidrootx3_ca.ca
14      -rw-            20109   Jul 8 2020 11:51:10 -07:00  ios_core.p7b
327681  drwx             4096   Jul 8 2020 11:51:08 -07:00  gs_script
12      -rw-              182   Jul 8 2020 11:51:08 -07:00  mode_event_log
237569  drwx             4096   Jul 8 2020 11:51:02 -07:00  .prst_sync
114689  drwx             4096   Jul 8 2020 11:50:48 -07:00  .ssh
368641  drwx             4096   Jul 8 2020 11:50:44 -07:00  .rollback_timer
401409  drwx             4096   Jul 8 2020 11:50:44 -07:00  .installer
458753  drwx             4096   Jul 8 2020 11:50:36 -07:00  sysboot
11      -rw-        696368193   Jul 8 2020 11:34:28 -07:00
c8000be-universalk9.17.03.01prd14.SPA.bin

7693897728 bytes total (5945937920 bytes free)


Router# show platform
Chassis type: C8300-1N1S-4T2X
```

```
Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C8300-1N1S-4T2X     ok                    00:18:53
 0/0      4x1G-2xSFP+         ok                    00:18:03
 0/1      C-NIM-1X            ok                    00:18:03
1         C8300-1N1S-4T2X     ok                    00:18:53
 1/0      C-SM-X-16G4M2X        ok                    00:18:03
R0        C8300-1N1S-4T2X     ok, active            00:18:53
F0        C8300-1N1S-4T2X     ok, active            00:18:53
P0        PWR-CC1-250WAC      ok                    00:18:30
P1        Unknown             empty                 never
P2        C8300-FAN-1R        ok                    00:18:30

Slot      CPLD Version        Firmware Version
--------- ------------------- ----------------------------------------
0         20011540            17.3(1r)
1         20011540            17.3(1r)
R0        20011540            17.3(1r)
F0        20011540            17.3(1r)


Router# mkdir bootflash:c8000be-universalk9.17.03.01.dir1
Create directory filename [c8000be-universalk9.17.03.01.dir1]?
Created dir bootflash:/c8000be-universalk9.17.03.01.dir1
Router# request platform software package expand file
bootflash:c8000be-universalk9.17.03.01.NIM.bin
to bootflash:c8000be-universalk9.17.03.01.dir1
Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router# reload
Proceed with reload? [confirm]

*Jul 13 19:39:06.354: %SYS-5-RELOAD: Reload requested by console.Reload Reason: Reload
Command.

rommon 1 > boot bootflash:c8000be-universalk9.17.03.01.dir1/packages.conf

File size is 0x00002836
Located c8000be-universalk9.17.03.01.dir1/packages.conf
Image size 10294 inode num 324484, bks cnt 3 blk size 8*512
#
File is comprised of 1 fragments (33%)

is_valid_sha1hash: SHA-1 hash:
calculated 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
expected 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
File size is 0x04b3dc00
Located
c8000be-universalk9.17.03.01.dir1/c8000be-mono-universalk9.17.03.01-build_164422SSA.pkg
Image size 78896128 inode num 324491, bks cnt 19262 blk size 8*512
###############################################################################################
File is comprised of 21 fragments (0%)
.....


Router# show version installed
Package: Provisioning File, version: n/a, status: active
  Role: provisioning file
  File: bootflash:sysboot/packages.conf, on: RP0
  Built: n/a, by: n/a
```

```
  File SHA1 checksum: d86dda7aeb6f8bade683712734932e5dd4c2587b

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: rp_base
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: RP0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: rpboot, version: 17.03.01prd14, status: active
  Role: rp_boot
  File: bootflash:sysboot/c8000be-rpboot.17.03.01prd14.SPA.pkg, on: RP0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: n/a

Package: firmware_dreamliner, version: 17.03.01prd14, status: active
  Role: firmware_dreamliner
  File: bootflash:sysboot/c8000be-firmware_dreamliner.17.03.01prd14.SPA.pkg, on: RP0/0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 1ce360c1e100f86a37fd707461ea2495f8a50abd

Package: firmware_dsp_analogbri, version: 17.03.01prd14, status: active
  Role: firmware_dsp_analogbri
  File: bootflash:sysboot/c8000be-firmware_dsp_analogbri.17.03.01prd14.SPA.pkg, on: RP0/0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 33e13705ab791cb466ed2f4e787e978d40af27da

Package: firmware_dsp_sp2700, version: 17.03.01prd14, status: active
  Role: firmware_dsp_sp2700
  File: bootflash:sysboot/c8000be-firmware_dsp_sp2700.17.03.01prd14.SPA.pkg, on: RP0/0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: cdefc7b39e8383be190fca59c9a01286dc2a2842

Package: mono-universalk9, version: 17.03.01prd14, status: n/a
  Role: rp_security
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: RP1/1
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: mono-universalk9, version: 17.03.01prd14, status: n/a
  Role: rp_webui
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: RP1/1
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: fp
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: ESP0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: fp, version: unknown, status: n/a
  Role: fp
  File: unknown, on: ESP1
  Built: unknown, by: unknown
  File SHA1 checksum: unknown

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: cc_spa
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: SIP0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: cc
```

```
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: SIP0/0
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: cc
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: SIP0/1
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541

Package: cc, version: unknown, status: n/a
  Role: cc
  File: unknown, on: SIP0/2
  Built: unknown, by: unknown
  File SHA1 checksum: unknown

Package: cc, version: unknown, status: n/a
  Role: cc
  File: unknown, on: SIP0/3
  Built: unknown, by: unknown
  File SHA1 checksum: unknown

Package: cc, version: unknown, status: n/a
  Role: cc
  File: unknown, on: SIP0/4
  Built: unknown, by: unknown
  File SHA1 checksum: unknown

Package: cc, version: unknown, status: n/a
  Role: cc
  File: unknown, on: SIP0/5
  Built: unknown, by: unknown
  File SHA1 checksum: unknown

Package: mono-universalk9, version: 17.03.01prd14, status: active
  Role: cc_spa
  File: bootflash:sysboot/c8000be-mono-universalk9.17.03.01prd14.SPA.pkg, on: SIP1
  Built: 2020-06-17_00.17, by: mcpre
  File SHA1 checksum: 5621bed407a53fcbefe5e3dc567c073e0728d541
```

Installing Subpackages from a Consolidated Package on a Flash Drive

The steps for installing subpackages from a consolidated package on a USB flash drive are similar to those described in Installing Subpackages from a Consolidated Pacakage section .

Step 1 **show version**

Step 2 **dir usb***n*:

Step 3 **show platform**

Step 4 **mkdir bootflash:***URL-to-directory-name*

Step 5 **request platform software package expand fileusb***n*: ***package-name to URL-to-directory-name***

Step 6 **reload**

Step 7 **boot** *URL-to-directory-name/***packages.conf**

Step 8 **show version installed**

Upgrading the Firmware on NIMs

To upgrade the firmware on a Network Interface Module (NIM), perform these steps:

Before you begin

When you boot the device in packages.conf mode with the Cisco IOS XE image (super package) during the installation period, you can upgrade or downgrade the firmware without reloading the device. You need to follow the steps described in Installing a Firmware Subpackage section before proceeding with the firmware upgrade.

If you do not boot the device in packages.conf mode with the Cisco IOS XE image, you need to follow the below prerequisites before proceeding with the firmware upgrade:

- Copy the firmware subpackage (NIM firmware) into bootflash:/mydir.
- Send a request to the platform software package expand file *boot flash:/mydir/<IOS-XE image>* to expand the super package.
- Reload the hardware module subslot to boot the module with the new firmware.
- Verify that the module is booted up with the new firmware using the **show platform software subslot x/y module firmware** command.

SUMMARY STEPS

1. copy Cisco IOS XE image into bootflash: **mydir**.
2. **request platform software package expand file** *bootflash:/mydir /<IOS-XE image* to expand super package.
3. **reload**.
4. **boot bootflash:mydir/ /packages.conf**.
5. **copy** NIM firmware subpackage to the folder **bootflash:mydir/**.
6. **request platform software package install** *rp 0 file bootflash:/mydir/<firmware subpackage>*.
7. **hw-module subslot x/y reload** to boot the module with the new firmware.
8. **show platform software subslot 0/2 module firmware** to verify that the module is booted up with the new firmware.

DETAILED STEPS

	Command or Action	Purpose
Step 1	copy Cisco IOS XE image into bootflash: **mydir**. **Example:** `Router# mkdir bootflash:mydir`	Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.
Step 2	**request platform software package expand file** *bootflash:/mydir /<IOS-XE image* to expand super package. **Example:**	Expands the platform software package to super package.

	Command or Action	Purpose
	`Router# request platform software package expand file bootflash:/mydir/c8000be-universalk9.03.14.00.S.155-1.S-std.SPA.bin`	

Step 3	**reload**.
	Example:
	`Router# reload`
	`rommon >`
		Enables ROMMON mode, which allows the software in the super package file to be activated.

Step 4	**boot bootflash:mydir/ /packages.conf**. **Example:** `rommon 1 > boot bootflash:mydir/packages.conf`	Boots the super package by specifying the path and name of the provisioning file: packages.conf.
Step 5	**copy** NIM firmware subpackage to the folder **bootflash:mydir/**. **Example:** `Router#copy bootflash:c8000be-firmware_nim_xdsl.2020-07-01_11.05_39n.SSA.pkg bootflash:mydir/`	Copies the NIM firmware subpackage into bootflash:mydir.
Step 6	**request platform software package install** *rp 0 file bootflash:/mydir/<firmware subpackage>*. **Example:** `Router#equest platform software package install rp 0 file bootflash:mydir/c8000be-firmware_nim_xdsl.2020-07-01_11.05_39n.SSA.pkg`	Installs the software package.
Step 7	**hw-module subslot x/y reload** to boot the module with the new firmware. **Example:** `Router#hw-module subslot 0/2 reload`	Reloads the hardware module subslot and boots the module with the new firmware.

Step 8	**show platform software subslot 0/2 module firmware** to verify that the module is booted up with the new firmware.
	Example:
	`Router# show platform software subslot 0/2 module firmware`
	`Pe`
		Displays the version of the newly installed firmware.

Examples

The following example shows how to perform firmware upgrade in a device module:

```
Routermkdir bootflash:mydir
Create directory filename [mydir]?
Created dir bootflash:/mydir
Router#c
```

```
Router#copy bootflash:c8000be-universalk9.17.03.01prd14.S-std.SPA.bin bootflash:mydir/
Destination filename [mydir/c8000be-universalk9.17.03.01prd14.S-std.SPA.bin]?
Copy in progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCC
696368193 bytes copied in 478.600 secs (1455011 bytes/sec)
Router#
Router#
Router#dir bootflash:mydir
Directory of bootflash:/mydir/

632738  -rw-        425288648  Dec 12 2014 09:16:42 +00:00
c8000be-universalk9.17.03.01prd14.S-std.SPA.bin

7451738112 bytes total (474025984 bytes free)
Router#

Router#request platform software package
expand file bootflash:/mydir/c8000be-universalk9.17.03.01prd14.S-std.SPA.bin.S-std.SPA.bin
Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router#reload
Proceed with reload? [confirm]

Proceed with reload? [confirm]

*Jul  8 11:48:30.917 PDT: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload
 Command.
*Jul  8 11:48:32.768 PDT: %IOSXE_INFRA-3-RELOAD_INFO_SAVE_FAIL: Unable to save reload
information: 23: Invalid argument.
Jul  8 11:48:38.652: %PMAN-TACTION: R0/0: pvp: Process manager is exiting: process exit
with reload chassis code



Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly


System Bootstrap, Version 17.3(1r), RELEASE SOFTWARE
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Current image running: Boot ROM0

Last reset cause: LocalSoft
C8300-1N1S-4T2X platform with 8388608 Kbytes of main memory


rommon 1  boot bootflash:mydir/packages.conf

 File size is 0x000028f1
 Located mydir/packages.conf
 Image size
10481 inode num 632741, bks cnt 3 blk size 8*512
```

```
#
 File size is 0x150ae3cc
 Located mydir/c8000be-universalk9.17.03.01prd14.S-std.SPA.pkg
 Image size 353035212 inode num 356929, bks cnt 86191 blk size 8*512
 ###################################################################
###################################################################
 Boot image size = 353035212 (0x150ae3cc) bytes

 Package header rev 1 structure detected
 Calculating SHA-1 hash...done
 validate_package: SHA-1 hash:
  calculated 8e966678:8afb08f4:8a88bb8f:fe591121:8bddf4b3
  expected   8e966678:8afb08f4:8a88bb8f:fe591121:8bddf4b3

 RSA Signed RELEASE Image Signature Verification Successful.
 Package Load Test Latency : 3799 msec
 Image validated
 Dec 12 09:28:50.338 R0/0: %FLASH_CHECK-3-DISK_QUOTA: Flash disk quota exceeded
[free space is 61864 kB] - Please clean up files on bootflash.

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           170 West Tasman Drive
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 17.3.1prd14, RELEASE SOFTWARE (fc1)
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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.

cisco c8000be1-X/K9 (2RU) processor with 1681388K/6147K bytes of memory.
Processor board ID FTX1736AJUT
2 Ethernet interfaces
4 Gigabit Ethernet interfaces
2 ATM interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
7393215K bytes of flash memory at bootflash:.

Press RETURN to get started!

*Dec 12 09:28:58.922:
%IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL:
Module name = esg Next reboot level = appxk9 and License = appxk9
*Dec 12 09:28:58.943:
%IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL:
Module name = esg Next reboot level = ipbasek9 and License = ipbasek9
*Dec 12 09:28:58.981:
 %Cat_THROUGHPUT-6-LEVEL: Throughput level has been set to 1000000 kbps
*Dec 12 09:29:13.302: %SPANTREE-5-EXTENDED_SYSID: Extended SysId enabled for type vlan
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface Lsmpi0, changed state to up
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface EOBC0, changed state to up
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface GigabitEthernet0, changed state to down
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface LIIN0, changed state to up
*Dec 12 09:28:51.438: %CMRP-3-PFU_MISSING:cmand:  The platform does not detect a power
supply in slot 1
*Dec 12 09:29:01.256: %CMLIB-6-THROUGHPUT_VALUE:cmand:  Throughput license found, throughput
 set to 1000000 kbps
*Dec 12 09:29:03.223: %CPPHA-7-START:cpp_ha:  CPP 0 preparing ucode
*Dec 12 09:29:03.238: %CPPHA-7-START:cpp_ha:  CPP 0 startup init
*Dec 12 09:29:11.335: %CPPHA-7-START:cpp_ha:  CPP 0 running init
*Dec 12 09:29:11.645: %CPPHA-7-READY:cpp_ha:  CPP 0 loading and initialization complete
*Dec 12 09:29:11.711: %IOSXE-6-PLATFORM:cpp_cp:
Process CPP_PFILTER_EA_EVENT__API_CALL__REGISTER
*Dec 12 09:29:16.280:
%IOSXE_MGMTVRF-6-CREATE_SUCCESS_INFO:
Management vrf Mgmt-intf created with ID 1, ipv4 table-id 0x1, ipv6 table-id 0x1E000001
*Dec 12 09:29:16.330:
%LINEPROTO-5-UPDOWN: Line protocol on Interface Lsmpi0, changed state to up
*Dec 12 09:29:16.330:
%LINEPROTO-5-UPDOWN: Line protocol on Interface EOBC0, changed state to up
*Dec 12 09:29:16.330:
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0, changed state to down
*Dec 12 09:29:16.330:
%LINEPROTO-5-UPDOWN: Line protocol on Interface LIIN0, changed state to up
*Dec 12 09:29:17.521: %SYS-5-LOG_CONFIG_CHANGE: Buffer logging disabled
*Dec 12 09:29:18.867: %SYS-5-CONFIG_I: Configured from memory by console
*Dec 12 09:29:18.870:
%IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/0, interfaces disabled
*Dec 12 09:29:18.870:
%IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/1, interfaces disabled
*Dec 12 09:29:18.871:
%IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/2, interfaces disabled
*Dec 12 09:29:18.873:
%SPA_OIR-6-OFFLINECARD: SPA (c8000be-X-4x1GE) offline in subslot 0/0
*Dec 12 09:29:18.874: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VA-B) offline in subslot 0/1
*Dec 12 09:29:18.874: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
*Dec 12 09:29:18.876: %IOSXE_OIR-6-INSCARD: Card (fp) inserted in slot F0
```

```
*Dec 12 09:29:18.876: %IOSXE_OIR-6-ONLINECARD: Card (fp) online in slot F0
*Dec 12 09:29:18.882: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/0
*Dec 12 09:29:18.884: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/1
*Dec 12 09:29:18.884: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/2
*Dec 12 09:29:18.935: %SYS-5-RESTART: System restarted --
Cisco IOS Software, c8000be Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 15.5(1)S,
RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2014 by Cisco Systems, Inc.
Compiled Thu 20-Nov-14 18:28 by mcpre
*Dec 12 09:29:18.895: %SPA-3-ENVMON_NOT_MONITORED:iomd:  Environmental monitoring
is not enabled for c8000be-X-4x1GE[0/0]
*Dec 12 09:29:19.878: %LINK-5-CHANGED: Interface GigabitEthernet0,

changed state to administratively down
*Dec 12 09:29:22.419: %SPA_OIR-6-ONLINECARD: SPA (c8000be-X-4x1GE) online in subslot 0/0
*Dec 12 09:29:22.610: %SYS-6-BOOTTIME: Time taken to reboot after reload =  194 seconds
*Dec 12 09:29:24.354: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/0,
changed state to down
*Dec 12 09:29:24.415: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/2,
changed state to down
*Dec 12 09:29:24.417: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/3,
changed state to down
*Dec 12 09:29:30.919: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/0,
changed state to up
*Dec 12 09:29:30.925: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/2,
 changed state to up
*Dec 12 09:29:30.936: %LINK-3-UPDOWN: Interface GigabitEthernet0/0/3,
 changed state to up
*Dec 12 09:29:31.919: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/0/0, changed state to up
*Dec 12 09:29:31.930: %LINEPROTO-5-UPDOWN: Line protocol on
 Interface GigabitEthernet0/0/2, changed state to up
*Dec 12 09:29:31.936: %LINEPROTO-5-UPDOWN: Line protocol on
Interface GigabitEthernet0/0/3, changed state to up
*Dec 12 09:29:34.147: %SSH-5-ENABLED: SSH 1.99 has been enabled
*Dec 12 09:30:29.152: %SPA_OIR-6-ONLINECARD: SPA (NIM-VA-B) online in subslot 0/1
*Dec 12 09:30:29.470: %SPA_OIR-6-ONLINECARD: SPA (NIM-VAB-A) online in subslot 0/2
*Dec 12 09:30:31.152: %LINK-3-UPDOWN: Interface Ethernet0/1/0, changed state to down
*Dec 12 09:30:31.152: %LINK-3-UPDOWN: Interface ATM0/1/0, changed state to down
*Dec 12 09:30:31.470: %LINK-3-UPDOWN: Interface Ethernet0/2/0, changed state to down
*Dec 12 09:30:31.470: %LINK-3-UPDOWN: Interface ATM0/2/0, changed state to down
*Dec 12 09:31:03.074: %CONTROLLER-5-UPDOWN: Controller VDSL 0/2/0, changed state to up
*Dec 12 09:31:05.075: %LINK-3-UPDOWN: Interface Ethernet0/2/0, changed state to up
*Dec 12 09:31:06.076: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/2/0,
changed state to up
*Dec 12 09:31:12.559: %CONTROLLER-5-UPDOWN: Controller VDSL 0/1/0, changed state to up
*Dec 12 09:31:20.188: %LINK-3-UPDOWN: Interface ATM0/1/0, changed state to up
*Dec 12 09:31:21.188: %LINEPROTO-5-UPDOWN: Line protocol on Interface ATM0/1/0,
changed state to up
Router>
Router>en
Password:
Router#
Router#show controller vdsl 0/2/0
Controller VDSL 0/2/0 is UP

Daemon Status:  UP

   XTU-R (DS)  XTU-C (US)
Chip Vendor ID:  'BDCM'    'BDCM'
Chip Vendor Specific:   0x0000    0xA41B
Chip Vendor Country:    0xB500    0xB500
Modem Vendor ID: 'CSCO'    '    '
```

```
Modem Vendor Specific:  0x4602    0x0000
Modem Vendor Country:   0xB500    0x0000
Serial Number Far:
Modem Version Near:     15.5(1)S
Modem Version Far:      0xa41b

Modem Status(L1): TC Sync (Showtime!)
DSL Config Mode: VDSL2
Trained Mode(L1): G.993.2 (VDSL2) Profile 30a

TC Mode:  PTM
Selftest Result: 0x00
DELT configuration: disabled
DELT state:  not running

Failed full inits: 0
Short inits:  0
Failed short inits: 0

Modem FW  Version: 4.14L.04
Modem PHY Version: A2pv6F039h.d24o_rc1

Line 1:

   XTU-R (DS)  XTU-C (US)
Trellis:   ON    ON
SRA:     disabled   disabled
SRA count:    0    0
Bit swap:    enabled   enabled
Bit swap count:   9    0
Profile 30a:    enabled
Line Attenuation:   3.5 dB    0.0 dB
Signal Attenuation:   0.0 dB    0.0 dB
Noise Margin:   30.9 dB  12.4 dB
Attainable Rate: 200000 kbits/s   121186 kbits/s
Actual Power:  13.3 dBm   7.2 dBm
Per Band Status:        D1  D2  D3  U0  U1  U2  U3
Line Attenuation(dB):   0.9 1.5 5.5 N/A 0.1 0.9 3.8
Signal Attenuation(dB): 0.8 1.5 5.5 N/A 0.0 0.2 3.2
Noise Margin(dB):       31.1 31.0 30.9 N/A 12.3 12.4 12.5
Total FECC:  0    0
Total ES:  0    0
Total SES:  0    0
Total LOSS:  0    0
Total UAS:  51    51
Total LPRS:  0    0
Total LOFS:  0    0
Total LOLS:  0    0


     DS Channel1   DS Channel0 US Channel1   US Channel0
Speed (kbps):    NA       100014  NA       100014
SRA Previous Speed:   NA            0  NA            0
Previous Speed:    NA            0  NA            0
Reed-Solomon EC:   NA            0  NA            0
CRC Errors:    NA            0  NA            0
Header Errors:    NA            0  NA            0
Interleave (ms):   NA         9.00  NA         0.00
Actual INP:    NA         4.00  NA         0.00

Training Log : Stopped
Training Log Filename : flash:vdsllog.bin

Router#
```

```
Router#

Router#copy bootflash:c8000be-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
 bootflash:mydir/
Destination filename [mydir/c8000be-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg]?
Copy in progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
6640604 bytes copied in 1.365 secs (4864911 bytes/sec)
Router#

Router#request platform software package install rp 0 file
bootflash:mydir/c8000be-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
--- Starting local lock acquisition on R0 ---
Finished local lock acquisition on R0

--- Starting file path checking ---
Finished file path checking

--- Starting image file verification ---
Checking image file names
Locating image files and validating name syntax
  Found c8000be-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
Verifying image file locations
Inspecting image file types
Processing image file constraints
Creating candidate provisioning file
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
Checking if resulting candidate package set would be complete
Finished candidate package set construction

--- Starting ISSU compatiblity verficiation ---
Verifying image type compatibility
Checking IPC compatibility with running software
Checking candidate package set infrastructure compatibility
Checking infrastructure compatibility with running software
Checking package specific compatibility
Finished ISSU compatiblity verficiation

--- Starting impact testing ---
Checking operational impact of change
Finished impact testing

--- Starting list of software package changes ---
Old files list:
  Removed c8000be-firmware_nim_xdsl.03.14.00.S.155-1.S-std.SPA.pkg
New files list:
  Added c8000be-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
Finished list of software package changes

--- Starting commit of software changes ---
Updating provisioning rollback files
Creating pending provisioning file
Committing provisioning file
Finished commit of software changes

--- Starting analysis of software changes ---
```

```
Finished analysis of software changes

--- Starting update running software ---
Blocking peer synchronization of operating information
Creating the command set placeholder directory
  Finding latest command set
  Finding latest command shortlist lookup file
  Finding latest command shortlist file
  Assembling CLI output libraries
  Assembling CLI input libraries
Skipping soft links for firmware upgrade
Skipping soft links for firmware upgrade
  Assembling Dynamic configuration files
  Applying interim IPC and database definitions
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/
release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/
release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19
/release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
  Replacing running software
  Replacing CLI software
  Restarting software
  Applying final IPC and database definitions
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/
release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
  Generating software version information
  Notifying running software of updates
  Unblocking peer synchronization of operating information
Unmounting old packages
Cleaning temporary installation files
  Finished update running software

SUCCESS: Finished installing software.
Router#
Router#show platform software subslot 0/2 module firmware
Avg Load info
-----------------------------------------
1.83 1.78 1.44 3/45 607

Kernel distribution info
-----------------------------------------
Linux version 3.4.11-rt19 (sapanwar@blr-atg-001) (gcc version 4.6.2
(Buildroot 2011.11) ) #3 SMP PREEMPT Fri Nov 7 09:26:19 IST 2014

Module firmware versions
-----------------------------------------
Modem Fw Version: 4.14L.04
Modem Phy Version: A2pv6F039h.d24o_rc1

Boot Loader: Secondry
-----------------------------------------
Version: 1.1

Modem Up time
-----------------------------------------
0D 0H 25M 38S

Router#
```

```
Router#hw-module subslot 0/2 reload
Proceed with reload of module? [confirm]
Router#
*Dec 12 09:55:59.645: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(NIM-VAB-A)
reloaded on subslot 0/2
*Dec 12 09:55:59.646: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
*Dec 12 09:55:59.647: %CONTROLLER-5-UPDOWN: Controller VDSL 0/2/0, changed state to down
*Dec 12 09:57:22.514: new extended attributes received from iomd(slot 0 bay 2 board 0)
*Dec 12 09:57:22.514: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(NIM-VAB-A)
 reloaded on subslot 0/2
*Dec 12 09:57:22.515: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
Router#
Router#
*Dec 12 09:58:35.471: %SPA_OIR-6-ONLINECARD: SPA (NIM-VAB-A) online in subslot 0/2
*Dec 12 09:58:37.470: %LINK-3-UPDOWN: Interface Ethernet0/2/0, changed state to down
*Dec 12 09:58:37.470: %LINK-3-UPDOWN: Interface ATM0/2/0, changed state to down
Router#

Router#show platform software subslot 0/2 module firmware
Avg Load info
-----------------------------------------
0.84 0.23 0.08 1/45 598

Kernel distribution info
-----------------------------------------
Linux version 3.4.11-rt19 (sapanwar@blr-atg-001) (gcc version 4.6.2 (Buildroot 2011.11) )
#6 SMP PREEMPT Mon Nov 17 10:51:41 IST 2014

Module firmware versions
-----------------------------------------
Modem Fw Version: 4.14L.04
Modem Phy Version: A2pv6F039n.d24o_rc1

Boot Loader: Secondry
-----------------------------------------
Version: 1.1

Modem Up time
-----------------------------------------
0D 0H 0M 42S

Router#
```

Installing a Firmware Subpackage

Before you begin

Obtain a consolidated package that contains your required firmware package and expand the package. (See Managing and Configuring a Device to Run Using Individual Packages, on page 203.) Make a note of the location and name of the firmware package and use this information in the steps below for *URL-to-package-name*.

You can install a firmware subpackage if the device has been configured using, for example, Managing and Configuring a Device to Run Using Individual Packages, on page 203.

Firmware subpackages are not released individually. You can select a firmware package from within a consolidated package after expanding the consolidated package. The firmware package can then be installed as shown in the procedure below.

Note Read the Release Notes document pertaining to the consolidated package to verify that the firmware within the consolidated package is compatible with the version of Cisco IOS XE software that is currently installed on a device.

SUMMARY STEPS

1. **show version**
2. **dir bootflash:**
3. **show platform**
4. **mkdir bootflash:** *URL-to-directory-name*
5. **request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*
6. **reload**
7. **boot** *URL-to-directory-name* **/packages.conf**
8. **show version installed**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show version**
	Example:
	`Router# show version`
	`Cisco IOS Software, IOS-XE Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental Version 15.3(20120627:221639) [build_151722 111]`
	`Copyright (c) 1986-2012 by Cisco Systems, Inc.`
	`Compiled Thu 28-Jun-12 15:17 by mcpre`
	`.`
	`.`
	`.`
		Shows the version of software running on the device. This can later be compared with the version of software to be installed.

Step 2	**dir bootflash:** **Example:** `Router# dir bootflash:`	Displays the previous version of software and that a package is present.

Step 3	**show platform**
	Example:
	`Router# show platform`
	`Chassis type: c8000be/K9`
		Checks the inventory.
		Also see the example in Installing Subpackages from a Consolidated Package section.

Step 4	**mkdir bootflash:** *URL-to-directory-name* **Example:** `Router# mkdir bootflash:mydir`	Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.
Step 5	**request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*	Expands the software image from the TFTP server (*URL-to-consolidated-package*) into the directory used to

	Command or Action	Purpose
	Example: `Router# request platform software package expand file bootflash:c8000be-universalk9-NIM.bin to bootflash:mydir`	save the image (*URL-to-directory-name*), which was created in the Step 4.

Step 6	**reload**
	Example:
	`Router# reload`
	`rommon >`
		Enables ROMMON mode, which allows the software in the consolidated file to be activated.

Step 7	**boot** *URL-to-directory-name* **/packages.conf** **Example:** `rommon 1 > boot bootflash:mydir/packages.conf`	Boots the consolidated package by specifying the path and name of the provisioning file: packages.conf.

Step 8	**show version installed**
	Example:
	`Router# show version installed`
	`Package: Provisioning File, version: n/a, status: active`
		Displays the version of the newly installed software.

Examples

The initial part of the following example shows the consolidated package, c8000be-universalk9.164422SSA.bin, being copied to the TFTP server. This is a prerequisite step. The remaining part of the example shows the consolidated file, packages.conf, being booted.

```
Router# tftp:c8000be/c8000be-universalk9.164422SSA.bin bootflash:
Address or name of remote host []? 192.0.2.1
Destination filename [c8000be-universalk9.164422SSA.bin]?
Accessing tftp://192.0.2.1/c8000be/c8000be-universalk9.164422SSA.bin...
Loading c8000be/c8000be-universalk9.164422SSA.bin from 192.0.2.1 (via GigabitEthernet0):
!!!!!!!!
[OK - 410506248 bytes]

410506248 bytes copied in 338.556 secs (1212521 bytes/sec)


Router# show version
Cisco IOS Software, IOS-XE Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental Version

15.3(20120627:221639) [build_151722 111]
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thu 28-Jun-12 15:17 by mcpre

IOS XE Version: 2012-06-28_15.31_mcpre

Cisco IOS-XE software, Copyright (c) 2005-2012 by cisco Systems, Inc.
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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: IOS-XE ROMMON

Router uptime is 0 minutes
Uptime for this control processor is 3 minutes
System returned to ROM by reload
System image file is "tftp:c8000be/c8000be.bin"
Last reload reason: Reload Command

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.

License Level: adventerprise
License Type: EvalRightToUse
Next reload license Level: adventerprise
cisco c8000be/K9 (2RU) processor with 1136676K/6147K bytes of memory.
Processor board ID FGL161611AB
4 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
7393215K bytes of Compact flash at bootflash:.

Configuration register is 0x8000

Router# dir bootflash:
Directory of bootflash:/

11 drwx 16384 May 3 2012 19:58:37 +00:00 lost+found
178465 drwx 4096 Jun 6 2012 15:20:20 +00:00 core
584065 drwx 4096 Jul 13 2012 19:19:00 +00:00 .prst_sync
405601 drwx 4096 May 3 2012 19:59:30 +00:00 .rollback_timer
113569 drwx 40960 Jul 13 2012 19:19:32 +00:00 tracelogs
64897 drwx 4096 May 3 2012 19:59:42 +00:00 .installer
13 -rw- 1305 May 7 2012 17:43:42 +00:00 startup-config
14 -rw- 1305 May 7 2012 17:43:55 +00:00 running-config
15 -r-- 1541 Jun 4 2012 18:32:41 +00:00 debug.conf
16 -rw- 1252 May 22 2012 19:58:39 +00:00 running-config-20120522
519169 drwx 4096 Jun 4 2012 15:29:01 +00:00 vman_fdb

7451738112 bytes total (7067635712 bytes free)



Router# show platform
Chassis type: c8000be/K9

Slot Type State Insert time (ago)
--------- ------------------- --------------------- -----------------
0 c8000be/K9 ok 15:57:33
```

```
0/0 c8000be-6X1GE ok 15:55:24
1 Ic8000be/K9 ok 15:57:33
1/0 SM-1T3/E3 ok 15:55:24
2 c8000be/K9 ok 15:57:33
2/0 SM-1T3/E3 ok 15:55:24
R0 c8000be/K9 ok, active 15:57:33
F0 c8000be-FP ok, active 15:57:33
P0 Unknown ps, fail never
P1 XXX-XXXX-XX ok 15:56:58
P2 ACS-4450-FANASSY ok 15:56:58

Slot CPLD Version Firmware Version
--------- ------------------- ---------------------------------------
0 12090323 15.3(01r)S [ciscouser-c8000beRO...
1 12090323 15.3(01r)S [ciscouser-c8000beRO...
2 12090323 15.3(01r)S [ciscouser-c8000beRO...
R0 12090323 15.3(01r)S [ciscouser-c8000beRO...
F0 12090323 15.3(01r)S [ciscouser-c8000beRO...

Router# mkdir bootflash:c8000be-universalk9.dir1
Create directory filename [c8000be-universalk9.dir1]?
Created dir bootflash:/c8000be-universalk9.dir1
Router# request platform software package expand file bootflash:c8000be-universalk9.NIM.bin
 to
 bootflash:c8000be-universalk9.dir1
Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router# reload
Proceed with reload? [confirm]

*Jul 13 19:39:06.354: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload
Command.

rommon 1 > boot bootflash:c8000be-universalk9.dir1/packages.conf

File size is 0x00002836
Located c8000be-universalk9.dir1/packages.conf
Image size 10294 inode num 324484, bks cnt 3 blk size 8*512
#
File is comprised of 1 fragments (33%)

is_valid_sha1hash: SHA-1 hash:
calculated 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
expected 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
File size is 0x04b3dc00
Located c8000be-universalk9.dir1/c8000be-mono-universalk9-build_164422SSA.pkg
Image size 78896128 inode num 324491, bks cnt 19262 blk size 8*512
###############################################################################################
File is comprised of 21 fragments (0%)
.....



Router# show version installed
Package: Provisioning File, version: n/a, status: active
File: bootflash:c8000be-universalk9.dir1/packages.conf, on: RP0
Built: n/a, by: n/a
File SHA1 checksum: ad09affd3f8820f4844f27acc1add502e0b8f459

Package: rpbase, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-mono-universalk9-build_164422SSA.pkg, on:
```

```
 RP0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 5e95c9cbc4eaf5a4a5a1ac846ee2d0f41d1a026b

Package: firmware_attributes, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-firmware_attributes_164422SSA.pkg, on:
RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 71614f2d9cbe7f96d3c6e99b67d514bd108c6c99

Package: firmware_dsp_sp2700, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-firmware_dsp_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 8334565edf7843fe246783b1d5c6ed933d96d79e
Package: firmware_fpge, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-firmware_fpge_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: eb72900ab32c1c50652888ff486cf370ac901dd7

Package: firmware_sm_1t3e3, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-firmware_sm_1t3e3_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 803005f15d8ea71ab088647e2766727ac2269871

Package: rpcontrol, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 980fd58fe581e9346c44417b451d1c09ebb640c2

Package: rpios-universalk9, version: dir1, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.23, by: mcpre
File SHA1 checksum: 27084f7e30a1d69d45a33e05d1b00345040799fb
Package: rpaccess, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:c8000be-universalk9.dir1/c8000be-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 0119802deda2da91c38473c47a998fb3ed423448

Package: rpcontrol, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:c8000be-universalk9.dir1/c8000be-rpcontrol-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 980fd58fe581e9346c44417b451d1c09ebb640c2

Package: rpios-universalk9, version: 2012-07-10_16.23_mcpre, status: n/a
File: bootflash:c8000be-universalk9.dir1/c8000be-rpios-universalk9-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.23, by: mcpre
File SHA1 checksum: 27084f7e30a1d69d45a33e05d1b00345040799fb

Package: rpaccess, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:c8000be-universalk9.dir1/c8000be-rpaccess-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 0119802deda2da91c38473c47a998fb3ed423448

Package: rpbase, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:c8000be-universalk9.dir1/c8000be-rpbase-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 5e95c9cbc4eaf5a4a5a1ac846ee2d0f41d1a026b


Package: firmware_fpge, version: 2012-07-10_16.22_mcpre, status: n/a
```

Configuring No Service Password-Recovery

The Cisco IOS password recovery procedure allows you to to gain access, using the console, to the ROMMON mode by using the Break key during system startup and reload. When the device software is loaded from ROMMON mode, the configuration is updated with the new password. The password recovery procedure makes anyone with console access have the ability to access the device and its network.

The No Service Password-Recovery feature is designed to prevent the service password-recovery procedure from being used to gain access to the device and network.

Configuration Registers and System Boot Configuration

The lowest four bits of the configuration register (bits 3, 2, 1, and 0) form the boot field. The boot field determines if the device boots manually from ROM or automatically from flash or the network. For example, when the configuration register boot field value is set to any value from 0x2 to 0xF, the device uses the register boot field value to form a default boot filename for autobooting from a network server.

Bit 8, when set to 1, ignores the startup configuration. Bit 6, when set to 1, enables break key detection. You must set the configuration register to autoboot to enable this feature. Any other configuration register setting will prevent the feature from being enabled.

Note By default, the no confirm prompt and messages are not displayed after reloads.

How to Enable No Service Password-Recovery

You can enable the No Service Password-Recovery in the following two ways:

- Using the **no service password-recovery** command. This option allows password recovery once it is enabled.
- Using the **no service password-recovery strict** command. This option does not allow for device recovery once it is enabled.

Note As a precaution, a valid Cisco IOS image should reside in the bootflash: before this feature is enabled.

If you plan to enter the no service password-recovery command, Cisco recommends that you save a copy of the system configuration file in a location away from the device.

Befor you beging, ensure that this feature is disabled before making any change to the device regardless of the significance of the change—such as a configuration, module, software version, or ROMMON version change.

The configuration register boot bit must be enabled to load the startup configuration by setting bit-8 to 0, to ignore the break key in Cisco IOS XE by setting bit-6 to 0, and to auto boot a Cisco IOS XE image by setting the lowest four bits 3-0, to any value from 0x2 to 0xF. Changes to the configuration register are not saved after the No Service Password-Recovery feature is enabled.

Note If Bit-8 is set to 1, the startup configuration is ignored. If Bit-6 is set to 1, break key detection is enabled in Cisco IOS XE. If both Bit-6 and Bit-8 are set to 0, the No Service Password-Recovery feature is enabled.

This example shows how to enable the No Service Password-Recovery feature:

```
Router> enable
Router# show version
Router# configure terminal
Router(config)# config-register 0x2012
Router(config)# no service password-recovery
Router(config)# exit
```

Recovering a Device with the No Service Password-Recovery Feature Enabled

To recover a device after the no service password-recovery feature is enabled using the **no service password-recovery** command, look out for the following message that appears during the boot: "PASSWORD RECOVERY FUNCTIONALITY IS DISABLED." As soon as ".. " appears, press the Break key. You are then prompted to confirm the Break key action:

- If you confirm the action, the startup configuration is erased and the device boots with the factory default configuration with the No Service Password-Recovery enabled.
- If you do not confirm the Break key action, the device boots normally with the No Service Password-Recovery feature enabled.

Note You cannot recover a device if the No Service Password-Recovery feature was enabled using the **no service password-recovery strict** command.

This example shows a Break key action being entered during boot up, followed by confirmation of the break key action. The startup configuration is erased and the device then boots with the factory default configuration with the No Service Password-Recovery feature enabled.

```
Initializing Hardware ...

Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly


System Bootstrap, Version 17.3(1r), RELEASE SOFTWARE
Copyright (c) 1994-2020  by cisco Systems, Inc.


Current image running: Boot ROM0

Last reset cause: LocalSoft
C8300-1N1S-4T2X platform with 8388608 Kbytes of main memory

PASSWORD RECOVERY FUNCTIONALITY IS DISABLED

..

telnet> send brk
```

```
..

PASSWORD RECOVERY IS DISABLED.

Do you want to reset the router to the factory default
configuration and proceed [y/n] ? y

Router clearing configuration. Please wait for ROMMON prompt...

File size is 0x17938a80

Located c8000be-universalk9.BLD_V153_3_S_XE310_THROTTLE_LATEST_20130623_234109.SSA.bin

Image size 395545216 inode num 26, bks cnt 96569 blk size 8*512
```

This example shows a Break key action being entered during boot up, followed by the non-confirmation of the break key action. The device then boots normally with the No Service Password-Recovery feature enabled.

```
Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly


System Bootstrap, Version 17.3(1r), RELEASE SOFTWARE
Copyright (c) 1994-2020  by cisco Systems, Inc.


Current image running: Boot ROM0

Last reset cause: LocalSoft
C8300-1N1S-4T2X platform with 8388608 Kbytes of main memory

PASSWORD RECOVERY FUNCTIONALITY IS DISABLED

..

telnet> send brk

...

PASSWORD RECOVERY IS DISABLED.

Do you want to reset the router to the factory default
configuration and proceed [y/n] ? n

Router continuing with existing configuration...

File size is 0x17938a80

Located c8000be-universalk9.BLD_V153_3_S_XE310_THROTTLE_LATEST_20130623_234109.SSA.bin

Image size 395545216 inode num 26, bks cnt 96569 blk size 8*512

########################################################################## …
```

Configuration Examples for No Service Password-Recovery

The following example shows how to obtain the configuration register setting (which is set to autoboot), disable password recovery capability, and then verify that the configuration persists through a system reload:

```
Router# show version

Cisco Internetwork Operating System Software
```

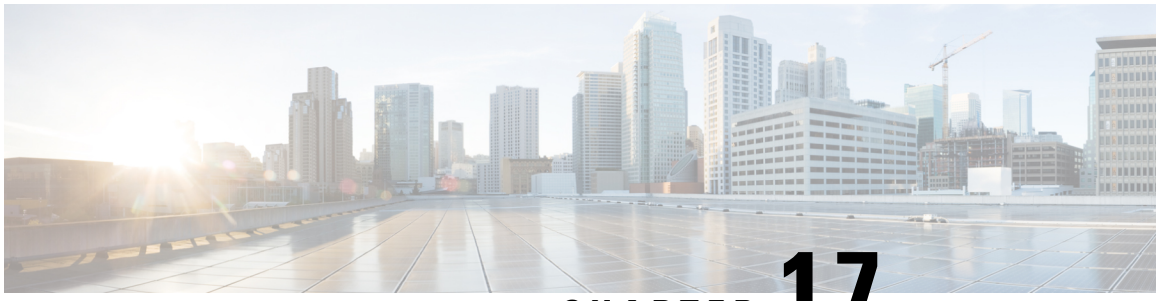
```
IOS (tm) 5300 Software (C7200-P-M), Version 12.3(8)YA, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2004 by Cisco Systems, Inc.
Compiled Wed 05-Mar-04 10:16 by xxx
Image text-base: 0x60008954, data-base: 0x61964000
ROM: System Bootstrap, Version 12.3(8)YA, RELEASE SOFTWARE (fc1)
...
125440K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
Router# configure terminal
Router(config)# no service password-recovery
WARNING:
Executing this command will disable the password recovery mechanism.
Do not execute this command without another plan for password recovery.
Are you sure you want to continue? [yes]: yes
...
Router(config)# exit
Router#
Router# reload
Proceed with reload? [confirm] yes
00:01:54: %SYS-5-RELOAD: Reload requested
System Bootstrap, Version 12.3...
Copyright (c) 1994-2004 by cisco Systems, Inc.
C7400 platform with 262144 Kbytes of main memory
PASSWORD RECOVERY FUNCTIONALITY IS DISABLED
...
```

The following example shows how to disable password recovery capability using the no service password-recovery strict command:

```
Router# configure terminal
Router(config)# no service password-recovery strict
WARNING:
Do not execute this command without another plan for password recovery.
```

```
Are you sure you want to continue? [yes]: yes

..
```



CHAPTER 17

Slot and Subslot Configuration

This chapter contains information on slots and subslots. Slots specify the chassis slot number in your device and subslots specify the slot where the service modules are installed.

For further information on the slots and subslots, see the "About Slots and Interfaces" sections:

- Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platforms
- Hardware Installation Guide for Cisco Catalyst 8200 Series Edge Platforms

The following section is included in this chapter:

Configuring the Interfaces

The following sections describe how to configure Gigabit interfaces and also provide examples of configuring the router interfaces:

Configuring Gigabit Ethernet Interfaces

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface GigabitEthernet** *slot/subslot/port*
4. **ip address** *ip-address mask* [**secondary**] **dhcp pool**
5. **negotiation auto**
6. **end**

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 GigabitEthernet** *slot/subslot/port* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Configures a GigabitEthernet interface. • **GigabitEthernet**—Type of interface. • *slot*—Chassis slot number. • */subslot*—Secondary slot number. The slash (/) is required. • /port—Port or interface number. The slash (/) is required.
Step 4	**ip address** *ip-address mask* [**secondary**] **dhcp pool** **Example:** `Router(config-if)# ip address 10.0.0.1 255.255.255.0 dhcp pool`	Assigns an IP address to the GigabitEthernet • **ip address** *ip-address*—IP address for the interface. • *mask*—Mask for the associated IP subnet. • **secondary** (optional)—Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address. • **dhcp**—IP address negotiated via DHCP. • **pool**—IP address autoconfigured from a local DHCP pool.
Step 5	**negotiation auto** **Example:** `Router(config-if)# negotiation auto`	Selects the negotiation mode. • **auto**—Performs link autonegotiation.
Step 6	**end** **Example:** `Router(config-if)# end`	Ends the current configuration session and returns to privileged EXEC mode.

Configuring the Interfaces: Example

The following example shows the **interface gigabitEthernet** command being used to add the interface and set the IP address. **0/0/0** is the slot/subslot/port. The ports are numbered 0 to 5.

```
Router# show running-config interface gigabitEthernet 0/0/0
Building configuration...
Current configuration : 71 bytes
!
interface gigabitEthernet0/0/0
no ip address
negotiation auto
end

Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface gigabitEthernet 0/0/0
```

Viewing a List of All Interfaces: Example

In this example, the **show platform software interface summary**, **show interfaces summary**, and **show platform software status control-process brief** commands are used to display all the interfaces:

```
Router# show platform software interface summary
  Interface                 IHQ  IQD  OHQ  OQD  RXBS  RXPS  TXBS  TXPS  TRTL
------------------------------------------------------------------------------
* GigabitEthernet0/0/0        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/1        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/2        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/3        0    0    0    0     0     0     0     0     0
* Te0/0/4                     0    0    0    0     0     0     0     0     0
* Te0/0/5                     0    0    0    0     0      0    0     0     0


Router# show interfaces summary
   *: interface is up
 IHQ: pkts in input hold queue     IQD: pkts dropped from input queue
 OHQ: pkts in output hold queue    OQD: pkts dropped from output queue
 RXBS: rx rate (bits/sec)          RXPS: rx rate (pkts/sec)
 TXBS: tx rate (bits/sec)          TXPS: tx rate (pkts/sec)
 TRTL: throttle count

Interface              IHQ  IQD    OHQ    OQD    RXBS    RXPS    TXBS    TXPS    TRTL
------------------------------------------------------------------------------------------

* GigabitEthernet0/0/0 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/1 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/2 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/3 0    0      0      0      0       0       0       0       0
* Te0/0/4              0    0      0      0      0       0       0       0       0
* Te0/0/5              0    0      0      0      0       0       0       0       0

Router#show platform software status control-process brief
Load Average
 Slot  Status  1-Min  5-Min 15-Min
  RP0 Healthy   0.83   0.91   0.91

Memory (kB)
 Slot  Status    Total     Used (Pct)     Free (Pct) Committed (Pct)
  RP0 Healthy  7768456  2654936 (34%)  5113520 (66%)   3115212 (40%)

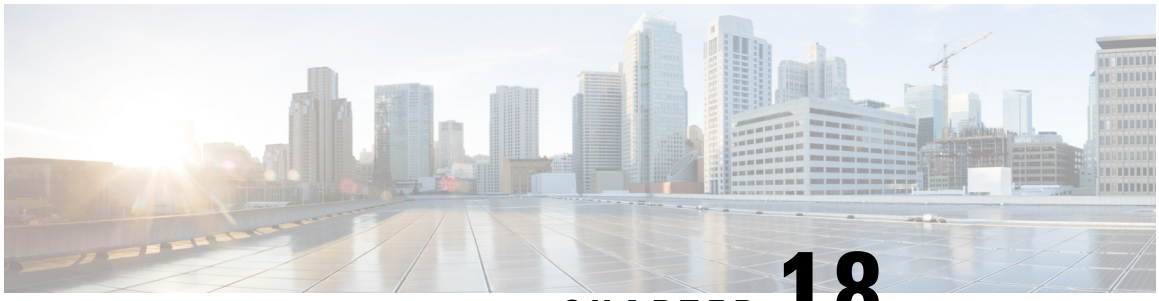
CPU Utilization
```

```
Slot  CPU   User System   Nice   Idle    IRQ   SIRQ IOwait
 RP0    0   2.70   1.70   0.00  95.59   0.00   0.00   0.00
        1   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        2   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        3   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        4   2.40   1.40   0.00  96.19   0.00   0.00   0.00
        5   0.80   1.60   0.00  97.59   0.00   0.00   0.00
        6  12.40  12.30   0.00  75.30   0.00   0.00   0.00
        7  11.20  12.40   0.00  76.40   0.00   0.00   0.00
        8   2.80   1.80   0.00  95.40   0.00   0.00   0.00
        9   0.00   0.00   0.00 100.00   0.00   0.00   0.00
       10   0.00   0.00   0.00 100.00   0.00   0.00   0.00
       11   0.00   0.00   0.00 100.00   0.00   0.00   0.00
```

Viewing Information About an Interface: Example

The following example shows how to display a brief summary of an interface's IP information and status, including the virtual interface bundle information, by using the **show ip interface brief** command:

```
Router# show ip interface brief
GigabitEthernet0/0/0   10.10.3.1       YES NVRAM  up                    up
GigabitEthernet0/0/1   192.0.5.2       YES NVRAM  up                    up
GigabitEthernet0/0/2   192.0.2.5       YES NVRAM  down                  down
GigabitEthernet0/0/3   unassigned      YES NVRAM  down                  down
Te0/0/4                unassigned      YES NVRAM  down                  down
Te0/0/5                10.20.4.8       YES NVRAM  down                  down
Te0/1/0                unassigned      YES NVRAM  down                  down
```



CHAPTER 18

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, via buffer overflows or misconfigurations). This is a practical implementation of "principle of least privilege" by enforcing Mandatory Access Control (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 for 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 config 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	Please 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:

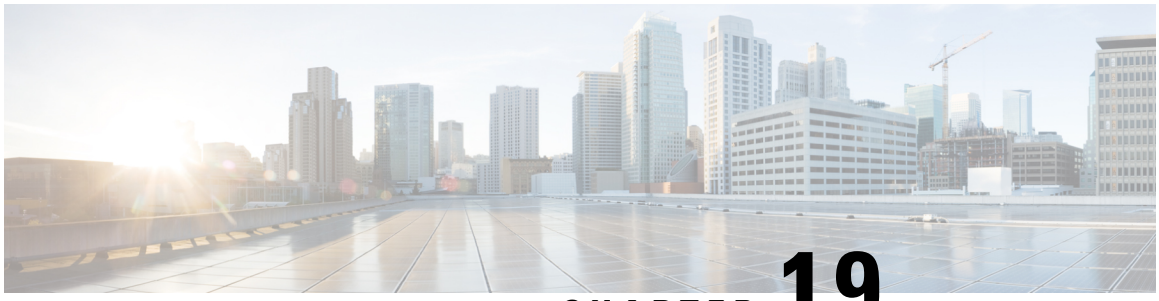
- The message exactly as it appears on the console or in the system log. e.g.,

  ```
  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 19

Cisco Thousand Eyes Enterprise Agent Application Hosting

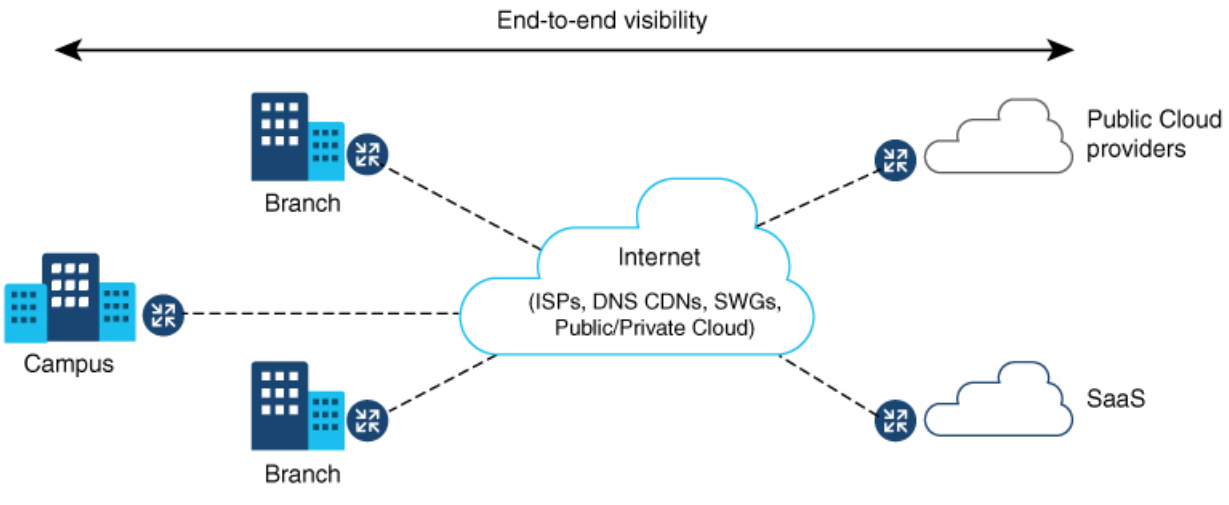
This chapter provides information on Cisco Thousand Eyes Enterprise Agent Application Hosting. The following sections are included in this chapter:

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, Cisco 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 17.6.1, you can use application-hosting capabilities to deploy the Cisco ThousandEyes Enterprise Agent as a container application on Cisco Catalyst 8300 and Catalyst 8200 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 27: Feature Information for ThousandEyes Enterprise Agent Application Hosting

Feature Name	Releases	Feature Information
Cisco ThousandEyes Enterprise Agent Application Hosting	Cisco IOS XE 17.7.1a	The Cisco ThousandEyes Enterprise Agent Application introduces the functionality to inherit the Domain Name Server (DNS) information from the device. With this enhancement, the DNS field in the vManage ThousandEyes feature template is an optional parameter.
Cisco ThousandEyes Enterprise Agent Application Hosting	Cisco IOS XE 17.6.1	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.

Table 28: Supported Platforms and System Requirements

Platforms	Bootflash	FRU Storage	DRAM
Catalyst 8300 Series Edge Platforms			
C8300-1N1S-6T	8 GB	16 GB M.2 USB (Default)	8 GB
C8300-1N1S-4T2X	8 GB	16 GB M.2 USB (Default)	8 GB
C8300-2N2S-6T	8 GB	16 GB M.2 USB (Default)	8 GB
C8300-2N2S-4T2X	8 GB	16 GB M.2 USB (Default)	8 GB
Catalyst 8200 Series Edge Platforms			
C8200-1N-4T	8 GB	16 GB M.2 USB (Default)	8 GB
C8200L-1N-4T	8 GB	16 GB M.2 USB (Recommended)	8 GB

Note The minimum DRAM and 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 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 4.0.2.

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 17.6.1 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. If 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 248.

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) 192.0.2.8     : 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's *bootflash:*.

Step 4 Create a virtual port group interface to enable the traffic path to the Cisco ThousandEyes application:

```
interface VirtualPortGroup 0
          ip address 192.0.2.22 255.255.255.0
        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 192.0.2.22 netmask 255.255.255.0
          app-default-gateway 192.0.2.22 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 192.0.2.10 □ 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 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 8 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 the 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:

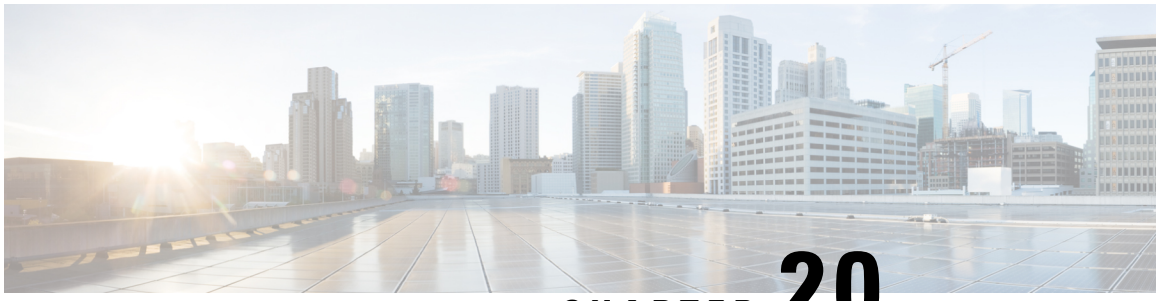
1. Connect to Cisco ThousandEyes agent application using the **app-hosting connect appid appid session /bin/bash** command.
2. Verify the configuration applied to the application */etc/te-agent.cfg*.
3. View the logs in */var/log/agent/te-agent.log*. You can use these logs to troubleshoot the configuration.

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 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.



CHAPTER 20

Process Health Monitoring

This chapter describes how to manage and monitor the health of various components of your device. It contains the following sections:

Monitoring Control Plane Resources

The following sections explain the of memory and CPU monitoring from the perspective of the Cisco IOS process and the overall control plane:

Avoiding Problems Through Regular Monitoring

Processes should provide monitoring and notification of their status/health to ensure correct operation. When a process fails, a syslog error message is displayed and either the process is restarted or the device is rebooted. A syslog error message is displayed when a monitor detects that a process is stuck or has crashed. If the process can be restarted, it is restarted; else, the device is restarted.

Monitoring system resources enables you to detect potential problems before they occur, thus avoiding outages. The following are the advantages of regular monitoring:

- Lack of memory on line cards that are in operation for a few years can lead to major outages. Monitoring memory usage helps to identify memory issues in the line cards and enables you to prevent an outage.
- Regular monitoring establishes a baseline for a normal system load. You can use this information as a basis for comparison when you upgrade hardware or software—to see if the upgrade has affected resource usage.

Cisco IOS Process Resources

You can view CPU utilization statistics on active processes and see the amount of memory being used in these processes using the **show memory** command and the **show process cpu** command. These commands provide a representation of memory and CPU utilization from the perspective of only the Cisco IOS process; they do not include information for resources on the entire platform. For example, when the **show memory** command is used in a system with 8 GB RAM running a single Cisco IOS process, the following memory usage is displayed:

```
Router# show memory
Tracekey : 1#08d3ff66f05826cb63fb2b7325fcbed0

               Head    Total(b)     Used(b)     Free(b)   Lowest(b)  Largest(b)
Processor  7FB733EC4048   3853903068   193512428   3660390640   707918492   3145727908
reserve P  7FB733EC40A0      102404          92      102312      102312      102312
 lsmpi_io  7FB7320C11A8     6295128     6294304         824         824         412
Dynamic heap limit(MB) 3000      Use(MB) 0
```

The **show process cpu** command displays Cisco IOS CPU utilization average:

```
Router# show process cpu
CPU utilization for five seconds: 1%/0%; one minute: 1%; five minutes: 1%
 PID Runtime(ms)     Invoked      uSecs   5Sec   1Min   5Min TTY Process
   1           1          14         71  0.00%  0.00%  0.00%   0 Chunk Manager
   2         127         872        145  0.00%  0.00%  0.00%   0 Load Meter
   3           0           1          0  0.00%  0.00%  0.00%   0 Policy bind Proc
   4           0           1          0  0.00%  0.00%  0.00%   0 Retransmission o
   5           0           1          0  0.00%  0.00%  0.00%   0 IPC ISSU Dispatc
   6          11          13        846  0.00%  0.00%  0.00%   0 RF Slave Main Th
   7           0           1          0  0.00%  0.00%  0.00%   0 EDDRI_MAIN
   8           0           1          0  0.00%  0.00%  0.00%   0 RO Notify Timers
   9        1092         597       1829  0.00%  0.01%  0.00%   0 Check heaps
  10           8          73        109  0.00%  0.00%  0.00%   0 Pool Manager
  11           0           1          0  0.00%  0.00%  0.00%   0 DiscardQ Backgro
  12           0           2          0  0.00%  0.00%  0.00%   0 Timers
  13           0          32          0  0.00%  0.00%  0.00%   0 WATCH_AFS
  14           0           1          0  0.00%  0.00%  0.00%   0 MEMLEAK PROCESS
  15        1227       40758         30  0.00%  0.02%  0.00%   0 ARP Input
  16          41        4568          8  0.00%  0.00%  0.00%   0 ARP Background
  17           0           2          0  0.00%  0.00%  0.00%   0 ATM Idle Timer
  18           0           1          0  0.00%  0.00%  0.00%   0 ATM ASYNC PROC
  19           0           1          0  0.00%  0.00%  0.00%   0 CEF MIB API
  20           0           1          0  0.00%  0.00%  0.00%   0 AAA_SERVER_DEADT
  21           0           1          0  0.00%  0.00%  0.00%   0 Policy Manager
  22           0           2          0  0.00%  0.00%  0.00%   0 DDR Timers
  23          60          23       2608  0.00%  0.00%  0.00%   0 Entity MIB API
  24          43          45        955  0.00%  0.00%  0.00%   0 PrstVbl
  25           0           2          0  0.00%  0.00%  0.00%   0 Serial Backgroun
  26           0           1          0  0.00%  0.00%  0.00%   0 RMI RM Notify Wa
  27           0           2          0  0.00%  0.00%  0.00%   0 ATM AutoVC Perio
  28           0           2          0  0.00%  0.00%  0.00%   0 ATM VC Auto Crea
  29          30        2181         13  0.00%  0.00%  0.00%   0 IOSXE heartbeat
  30           1           9        111  0.00%  0.00%  0.00%   0 Btrace time base
  31           5         182         27  0.00%  0.00%  0.00%   0 DB Lock Manager
  32          16        4356          3  0.00%  0.00%  0.00%   0 GraphIt
  33           0           1          0  0.00%  0.00%  0.00%   0 DB Notification
  34           0           1          0  0.00%  0.00%  0.00%   0 IPC Apps Task
  35           0           1          0  0.00%  0.00%  0.00%   0 ifIndex Receive
  36           4         873          4  0.00%  0.00%  0.00%   0 IPC Event Notifi
  37          49        4259         11  0.00%  0.00%  0.00%   0 IPC Mcast Pendin
  38           0           1          0  0.00%  0.00%  0.00%   0 Platform appsess
  39           2          73         27  0.00%  0.00%  0.00%   0 IPC Dynamic Cach
  40           5         873          5  0.00%  0.00%  0.00%   0 IPC Service NonC
```

```
 41           0           1           0  0.00%  0.00%  0.00%   0 IPC Zone Manager
 42          38        4259           8  0.00%  0.00%  0.00%   0 IPC Periodic Tim
 43          18        4259           4  0.00%  0.00%  0.00%   0 IPC Deferred Por
 44           0           1           0  0.00%  0.00%  0.00%   0 IPC Process leve
 45           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat Manager
 46           3         250          12  0.00%  0.00%  0.00%   0 IPC Check Queue
 47           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat RX Cont
 48           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat TX Cont
 49          22         437          50  0.00%  0.00%  0.00%   0 IPC Keep Alive M
 50          25         873          28  0.00%  0.00%  0.00%   0 IPC Loadometer
 51           0           1           0  0.00%  0.00%  0.00%   0 IPC Session Deta
 52           0           1           0  0.00%  0.00%  0.00%   0 SENSOR-MGR event
 53           2         437           4  0.00%  0.00%  0.00%   0 Compute SRP rate
```

Overall Control Plane Resources

Control plane memory and CPU utilization on each control processor allows you to keep a tab on the overall control plane resources. You can use the **show platform resources** command to monitor the overall system health and resource usage for the IOS XE platforms. Also, you can use the **show platform software status control-processor brief** command (summary view) or the **show platform software status control-processor** command (detailed view) to view control plane memory and CPU utilization information.

All control processors should show status, Healthy. Other possible status values are Warning and Critical. Warning indicates that the device is operational, but that the operating level should be reviewed. Critical implies that the device is nearing failure.

If you see a Warning or Critical status, take the following actions:

- Reduce the static and dynamic loads on the system by reducing the number of elements in the configuration or by limiting the capacity for dynamic services.
- Reduce the number of routes and adjacencies, limit the number of ACLs and other rules, reduce the number of VLANs, and so on.

The following sections describe the fields in the **show platform software status control-processor** command output.

Load Average

Load average represents the process queue or process contention for CPU resources. For example, on a single-core processor, an instantaneous load of 7 would mean that seven processes are ready to run, one of which is currently running. On a dual-core processor, a load of 7 would mean that seven processes are ready to run, two of which are currently running.

Memory Utilization

Memory utilization is represented by the following fields:

- Total—Total line card memory
- Used—Consumed memory
- Free—Available memory
- Committed—Virtual memory committed to processes

CPU Utilization

CPU utilization is an indication of the percentage of time the CPU is busy, and is represented by the following fields:

- CPU—Allocated processor
- User—Non-Linux kernel processes
- System—Linux kernel process
- Nice—Low-priority processes
- Idle—Percentage of time the CPU was inactive
- IRQ—Interrupts
- SIRQ—System Interrupts
- IOwait—Percentage of time CPU was waiting for I/O

Example: show platform software status control-processor Command

The following are some examples of using the **show platform software status control-processor** command:

```
Router# show platform software status control-processor
RP0: online, statistics updated 3 seconds ago
RP0: online, statistics updated 5 seconds ago
Load Average: healthy
  1-Min: 1.35, status: healthy, under 9.30
  5-Min: 1.06, status: healthy, under 9.30
  15-Min: 1.02, status: healthy, under 9.30
Memory (kb): healthy
  Total: 7768456
  Used: 2572568 (33%), status: healthy
  Free: 5195888 (67%)
  Committed: 3112968 (40%), under 90%
Per-core Statistics
CPU0: CPU Utilization (percentage of time spent)
  User:  3.00, System:  2.40, Nice:  0.00, Idle: 94.60
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU1: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU2: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU3: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU4: CPU Utilization (percentage of time spent)
  User:  7.30, System:  1.70, Nice:  0.00, Idle: 91.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU5: CPU Utilization (percentage of time spent)
  User:  3.30, System:  1.50, Nice:  0.00, Idle: 95.20
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU6: CPU Utilization (percentage of time spent)
  User: 17.91, System: 11.81, Nice:  0.00, Idle: 70.27
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU7: CPU Utilization (percentage of time spent)
  User: 11.91, System: 13.31, Nice:  0.00, Idle: 74.77
```

```
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU8: CPU Utilization (percentage of time spent)
  User:  2.70, System:  2.00, Nice:  0.00, Idle: 95.30
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU9: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU10: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU11: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
```

```
Router# show platform software status control-processor brief
Load Average
 Slot  Status  1-Min  5-Min 15-Min
  RP0 Healthy   1.14   1.07   1.02

Memory (kB)
 Slot  Status    Total     Used (Pct)     Free (Pct) Committed (Pct)
  RP0 Healthy  7768456  2573416 (33%)  5195040 (67%)   3115096 (40%)

CPU Utilization
 Slot  CPU   User System   Nice   Idle    IRQ   SIRQ IOwait
  RP0    0   2.80   1.80   0.00  95.39   0.00   0.00   0.00
         1   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         2   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         3   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         4   6.80   1.80   0.00  91.39   0.00   0.00   0.00
         5   3.20   1.60   0.00  95.19   0.00   0.00   0.00
         6  16.30  12.60   0.00  71.10   0.00   0.00   0.00
         7  12.40  13.70   0.00  73.90   0.00   0.00   0.00
         8   2.40   2.40   0.00  95.19   0.00   0.00   0.00
         9   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        10   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        11   0.00   0.00   0.00 100.00   0.00   0.00   0.00
```

Monitoring Hardware Using Alarms

Device Design and Monitoring Hardware

The router sends alarm notifications when problems are detected, allowing you to monitor the network remotely. You do not need to use **show** commands to poll devices on a routine basis; however, you can perform onsite monitoring if you choose.

BootFlash Disk Monitoring

The bootflash disk must have enough free space to store two core dumps. This condition is monitored, and if the bootflash disk is too small to store two core dumps, a syslog alarm is generated, as shown in the following example:

```
Aug 22 13:40:41.038 R0/0: %FLASH_CHECK-3-DISK_QUOTA: Flash disk quota exceeded
[free space is 7084440 kB] - Please clean up files on bootflash.
```

The size of the bootflash disk must be at least of the same size as that of the physical memory installed on the device. If this condition is not met, a syslog alarm is generated as shown in the following example:

```
%IOSXEBOOT-2-FLASH_SIZE_CHECK: (rp/0): Flash capacity (8 GB) is insufficient for fault
analysis based on
installed memory of RP (16 GB)
%IOSXEBOOT-2-FLASH_SIZE_CHECK: (rp/0): Please increase the size of installed flash to at
least 16 GB (same as
physical memory size)
```

Approaches for Monitoring Hardware Alarms

Onsite Network Administrator Responds to Audible or Visual Alarms

About Audible and Visual Alarms

An external element can be connected to a power supply using the DB-25 alarm connector on the power supply. The external element is a DC light bulb for a visual alarm and a bell for an audible alarm.

If an alarm illuminates the CRIT, MIN, or MAJ LED on the faceplate of the device, and a visual or audible alarm is wired, the alarm also activates an alarm relay in the power supply DB-25 connector, and either the bell rings or the light bulb flashes.

Clearing an Audible Alarm

To clear an audible alarm, perform one of the following tasks:

- Press the **Audible Cut Off** button on the faceplate.
- Enter the **clear facility-alarm** command.

Clearing a Visual Alarm

To clear a visual alarm, you must resolve the alarm condition. The **clear facility-alarm** command does not clear an alarm LED on the faceplate or turn off the DC light bulb. For example, if a critical alarm LED is illuminated because an active module was removed without a graceful deactivation, the only way to resolve that alarm is to replace the module.

Viewing the Console or Syslog for Alarm Messages

The network administrator can monitor alarm messages by reviewing alarm messages sent to the system console or to a system message log (syslog).

- Enabling the logging alarm Command, on page 255
- Examples of Alarm Messages, on page 255
- Reviewing and Analyzing Alarm Messages, on page 257

Enabling the logging alarm Command

The **logging alarm** command must be enabled for the system to send alarm messages to a logging device, such as the console or a syslog. This command is not enabled by default.

You can specify the severity level of the alarms to be logged. All the alarms at and above the specified threshold generate alarm messages. For example, the following command sends only critical alarm messages to logging devices:

```
Router(config)# logging alarm critical
```

If alarm severity is not specified, alarm messages for all severity levels are sent to logging devices.

Examples of Alarm Messages

The following are examples of alarm messages that are sent to the console when a module is removed before performing a graceful deactivation. The alarm is cleared when the module is reinserted.

Module Removed

```
*Aug 22 13:27:33.774: %C-SM-X-16G4M2X: Module removed from subslot 1/1, interfaces disabled
*Aug 22 13:27:33.775: %SPA_OIR-6-OFFLINECARD: Module (SPA-4XT-SERIAL) offline in subslot
1/1
```

Module Reinserted

```
*Aug 22 13:32:29.447: %CC-SM-X-16G4M2X: Module inserted in subslot 1/1
*Aug 22 13:32:34.916: %SPA_OIR-6-ONLINECARD: Module (SPA-4XT-SERIAL) online in subslot 1/1
*Aug 22 13:32:35.523: %LINK-3-UPDOWN: SIP1/1: Interface EOBC1/1, changed state to up
```

Alarms

To view alarms, use the **show facility-alarm status** command. The following example shows a critical alarm for the power supply:

```
Router# show facility-alarm status
System Totals  Critical: 1  Major: 0  Minor: 0

Source                    Time                  Severity      Description [Index]
------                    ------                --------      -------------------
```

```
Power Supply Bay 1          Jul 08 2020 11:51:34   CRITICAL      Power Supply/FAN Module
Missing [0]

POE Bay 0                   Jul 08 2020 11:51:34   INFO          Power Over Ethernet Module
 Missing [0]

POE Bay 1                   Jul 08 2020 11:51:34   INFO          Power Over Ethernet Module
 Missing [0]

xcvr container 0/0/4        Jul 08 2020 11:51:47   INFO          Transceiver Missing - Link
 Down [1]

TenGigabitEthernet0/1/0     Jul 08 2020 11:52:24   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/0        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/1        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/2        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/3        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/4        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/5        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/6        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/7        Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/17    Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/18    Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/19    Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]
```

To view critical alarms, use the **show facility-alarm status critical** command, as shown in the following example:

```
Router# show facility-alarm status critical
System Totals  Critical: 1  Major: 0  Minor: 0

Source                      Time                   Severity      Description [Index]
------                      ------                 --------      -------------------

Power Supply Bay 1          Jul 08 2020 11:51:34   CRITICAL      Power Supply/FAN Module
Missing [0]
```

To view the operational state of the major hardware components on the device, use the **show platform diag** command.

```
Router# show platform diag
Chassis type: C8300-1N1S-4T2X

Slot: 0, C8300-1N1S-4T2X
  Running state               : ok
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:24 (01:29:20 ago)
  Software declared up time   : 00:01:01 (01:28:44 ago)
  CPLD version                : 20011540
  Firmware version            : 17.3(1r)

Sub-slot: 0/0, 4x1G-2xSFP+
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:01:14 (01:28:30 ago)
  Logical insert detect time  : 00:01:14 (01:28:30 ago)

Sub-slot: 0/1, C-NIM-1X
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:01:14 (01:28:31 ago)
  Logical insert detect time  : 00:01:14 (01:28:31 ago)

Slot: 1, C8300-1N1S-4T2X
  Running state               : ok
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:24 (01:29:20 ago)
  Software declared up time   : 00:01:02 (01:28:43 ago)
  CPLD version                : 20011540
  Firmware version            : 17.3(1r)

Sub-slot: 1/0, C-SM-X-16G4M2X
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:01:14 (01:28:30 ago)
  Logical insert detect time  : 00:01:14 (01:28:30 ago)

Slot: R0, C8300-1N1S-4T2X
  Running state               : ok, active
```

Reviewing and Analyzing Alarm Messages

To facilitate the review of alarm messages, you can write scripts to analyze alarm messages sent to the console or syslog. Scripts can provide reports on events such as alarms, security alerts, and interface status.

Syslog messages can also be accessed through Simple Network Management Protocol (SNMP) using the history table defined in the CISCO-SYSLOG-MIB.

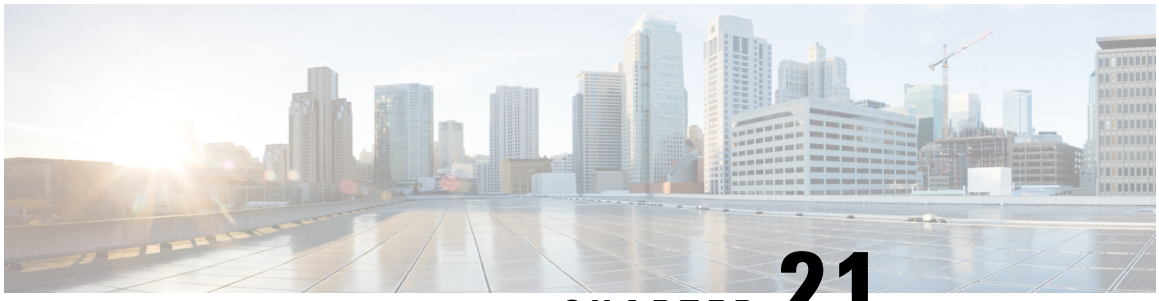
Network Management System Alerts a Network Administrator when an Alarm is Reported Through SNMP

The SNMP is an application-layer protocol that provides a standardized framework and a common language used for monitoring and managing devices in a network. Of all the approaches to monitor alarms, SNMP is the best approach to monitor more than one device in an enterprise and service provider setup.

SNMP provides notification of faults, alarms, and conditions that might affect services. It allows a network administrator to access device information through a network management system (NMS) instead of reviewing logs, polling devices, or reviewing log reports.

To use SNMP to get alarm notification, use the following MIBs:

- ENTITY-MIB, RFC 4133 (required for the CISCO-ENTITY-ALARM-MIB and CISCO-ENTITY-SENSOR-MIB to work)
- CISCO-ENTITY-ALARM-MIB
- CISCO-ENTITY-SENSOR-MIB (for transceiver environmental alarm information, which is not provided through the CISCO-ENTITY-ALARM-MIB)



CHAPTER 21

System Messages

System messages are saved in a log file or directed to other devices from the software running on a router. These messages are also known as syslog messages. System messages provide you with logging information for monitoring and troubleshooting purposes.

The following sections are included in this chapter:

Information About Process Management

You can access system messages by logging in to the console through Telnet protocol and monitoring your system components remotely from any workstation that supports the Telnet protocol.

Starting and monitoring software is referred to as process management. The process management infrastructure for a router is platform independent, and error messages are consistent across platforms running on Cisco IOS XE. You do not have to be directly involved in process management, but we recommend that you read the system messages that refer to process failures and other issues.

How to Find Error Message Details

To see further details about a process management or a syslog error message, see the System Error Messages Guide For Access and Edge Routers Guide.

The following are examples of the description and the recommended action displayed by the error messages.

Error Message: `%PMAN-0-PROCESS_NOTIFICATION : The process lifecycle notification component failed because [chars]`

Explanation	Recommended Action

The process lifecycle notification component failed, preventing proper detection of a process start and stop. This problem is likely the result of a software defect in the software subpackage.	Note the time of the message and investigate the kernel error message logs to learn more about the problem and see if it is correctable. If the problem cannot be corrected or the logs are not helpful, copy the error message exactly as it appears on the console along with the output of the **show tech-support** command and provide the gathered information to a Cisco technical support representative.

Error Message: `%PMAN-0-PROCFAILCRIT A critical process [chars] has failed (rc [dec])`

Explanation	Recommended Action
A process important to the functioning of the router has failed.	Note the time of the message and investigate the error message logs to learn more about the problem. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAILOPT An optional process [chars] has failed (rc [dec])`

Explanation	Recommended Action

A process that does not affect the forwarding of traffic has failed.	Note the time of the message and investigate the kernel error message logs to learn more about the problem. Although traffic will still be forwarded after receiving this message, certain functions on the router may be disabled because of this message and the error should be investigated. If the logs are not helpful or indicate a problem you cannot correct, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAIL The process [chars] has failed (rc [dec])`

Explanation	Recommended Action
The process has failed as the result of an error.	This message will appear with other messages related to the process. Check the other messages to determine the reason for the failures and see if corrective action can be taken. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAIL_IGNORE [chars] process exits and failures are being ignored due to debug settings. Normal router functionality will be affected. Critical router functions like RP switchover, router reload, FRU resets, etc. may not function properly.`

Explanation	Recommended Action
A process failure is being ignored due to the user-configured debug settings.	If this behavior is desired and the debug settings are set according to a user's preference, no action is needed. If the appearance of this message is viewed as a problem, change the debug settings. The router is not expected to behave normally with this debug setting. Functionalities such as SSO switchover, router reloads, FRU resets, and so on will be affected. This setting should only be used in a debug scenario. It is not normal to run the router with this setting.

Error Message: `%PMAN-3-PROCHOLDDOWN The process [chars] has been helddown (rc [dec])`

Explanation	Recommended Action
The process was restarted too many times with repeated failures and has been placed in the hold-down state.	This message will appear with other messages related to the process. Check the other messages to determine the reason for the failures and see if corrective action can be taken. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-RELOAD_RP_SB_NOT_READY : Reloading: [chars]`

Explanation	Recommended Action
The route processor is being reloaded because there is no ready standby instance.	Ensure that the reload is not due to an error condition.

Error Message: `%PMAN-3-RELOAD_RP : Reloading: [chars]`

Explanation	Recommended Action

The RP is being reloaded.	Ensure that the reload is not due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-3-RELOAD_SYSTEM : Reloading: [chars]`

Explanation	Recommended Action
The system is being reloaded.	Ensure that the reload is not due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-3-PROC_BAD_EXECUTABLE : Bad executable or permission problem with process [chars]`

Explanation	Recommended Action
The executable file used for the process is bad or has permission problem.	Ensure that the named executable is replaced with the correct executable.

Error Message: `%PMAN-3-PROC_BAD_COMMAND:Non-existent executable or bad library used for process <process name>`

Explanation	Recommended Action
The executable file used for the process is missing, or a dependent library is bad.	Ensure that the named executable is present and the dependent libraries are good.

Error Message: `%PMAN-3-PROC_EMPTY_EXEC_FILE : Empty executable used for process [chars]`

Explanation	Recommended Action
The executable file used for the process is empty.	Ensure that the named executable is non-zero in size.

Error Message: `%PMAN-5-EXITACTION : Process manager is exiting: [chars]`

Explanation	Recommended Action
The process manager is exiting.	Ensure that the process manager is not exiting due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-6-PROCSHUT : The process [chars] has shutdown`

Explanation	Recommended Action
The process has gracefully shut down.	No user action is necessary. This message is provided for informational purposes only.

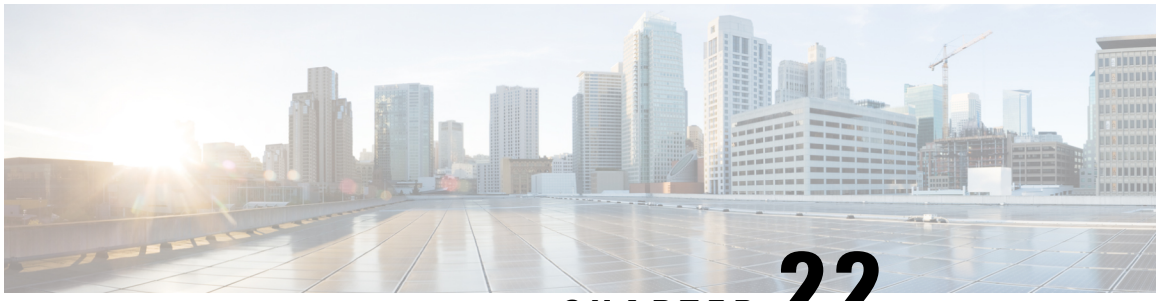
Error Message: `%PMAN-6-PROCSTART : The process [chars] has started`

Explanation	Recommended Action

The process has launched and is operating properly.	No user action is necessary. This message is provided for informational purposes only.

Error Message: `%PMAN-6-PROCSTATELESS : The process [chars] is restarting stateless`

Explanation	Recommended Action
The process has requested a stateless restart.	No user action is necessary. This message is provided for informational purposes only.



CHAPTER 22

Trace Management

The following sections are included in this chapter:

Tracing Overview

Tracing is a function that logs internal events. Trace files containing trace messages are automatically created and saved to the tracelogs directory on the hard disk: file system on the router, which stores tracing files in bootflash.

The contents of trace files are useful for the following purposes:

- Troubleshooting—Helps to locate and solve an issue with a router. The trace files can be accessed in diagnostic mode even if other system issues are occurring simultaneously.
- Debugging—Helps to obtain a detailed view of system actions and operations.

How Tracing Works

Tracing logs the contents of internal events on a router. Trace files containing all the trace output pertaining to a module are periodically created and updated and stored in the tracelog directory. Trace files can be erased from this directory to recover space on the file system without impacting system performance. The files can be copied to other destinations using file transfer functions (such as FTP and TFTP) and opened using a plain text editor.

Note Tracing cannot be disabled on a router.

Use the following commands to view trace information and set tracing levels:

- **show logging process module**—Shows the most recent trace information for a specific module. This command can be used in privileged EXEC and diagnostic modes. When used in diagnostic mode, this command can gather trace log information during a Cisco IOS XE failure.
- **set platform software trace**—Sets a tracing level that determines the types of messages that are stored in the output. For more information on tracing levels, see Tracing Levels, on page 268.

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`	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.

	Command or Action	Purpose

	`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`
		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:** `Router(config)# udf TEST_UDF_NAME_5 packet-start 120 1`	• header—Specifies the offset base configuration. • packet-start—Specifies the offset base from packet-start. packet-start" can vary depending on if 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.

	Command or Action	Purpose
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 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.

Tracing Levels

Tracing levels determine how much information should be stored about a module in the trace buffer or file.

The following table shows all the tracing levels that are available and provides descriptions of what types of messages are displayed with each tracing level.

Table 29: Tracing Levels and Descriptions

Tracing Level	Level Number	Description
Emergency	0	The message is regarding an issue that makes the system unusable.
Alert	1	The message is regarding an action that must be taken immediately.
Critical	2	The message is regarding a critical condition. This is the default setting for every module on the router.
Error	3	The message is regarding a system error.
Warning	4	The message is regarding a system warning.
Notice	5	The message is regarding a significant issue, but the router is still working normally.
Informational	6	The message is useful for informational purposes only.
Debug	7	The message provides debug-level output.
Verbose	8	All possible tracing messages are sent.
Noise	—	All possible trace messages pertaining to a module are logged. The noise level is always equal to the highest possible tracing level. Even if a future enhancement to tracing introduces a higher tracing level than verbose level, the noise level will become equal to the level of the newly introduced tracing level.

If a tracing level is set, messages are collected from both lower tracing levels and from its own level.

For example, setting the tracing level to 3 (error) means that the trace file will contain output messages for levels: 0 (emergencies), 1 (alerts), 2 (critical), and 3 (error).

If you set the trace level to 4 (warning), it results in output messages for levels: 0 (emergencies), 1 (alerts), 2 (critical), 3 (error), and 4 (warning).

The default tracing level for every module on the router is 5 (notice).

A tracing level is not set in a configuration mode, which results in tracing-level settings being returned to default values after the router reloads.

Caution Setting the tracing level of a module to debug level or higher can have a negative impact on the performance.

Caution Setting high tracing levels on a large number of modules can severely degrade performance. If a high tracing level is required in a specific context, it is almost always preferable to set the tracing level of a single module to a higher level rather than setting multiple modules to high levels.

Viewing a Tracing Level

By default, all the modules on a router are set to 5 (notice). This setting is maintained unless changed by a user.

To see the tracing level for a module on a router, enter the **show logging process** command in privileged EXEC mode or diagnostic mode.

The following example shows how the **show logging process** command is used to view the tracing levels of the forwarding manager processes on an active RP:

```
Router# showlogging process forwarding-manager rp active
Module Name                    Trace Level
-----------------------------------------------
acl                            Notice
binos                          Notice
binos/brand                    Notice
bipc                           Notice
bsignal                        Notice
btrace                         Notice
cce                            Notice
cdllib                         Notice
cef                            Notice
chasfs                         Notice
chasutil                       Notice
erspan                         Notice
ess                            Notice
ether-channel                  Notice
evlib                          Notice
evutil                         Notice
file_alloc                     Notice
fman_rp                        Notice
fpm                            Notice
fw                             Notice
icmp                           Notice
interfaces                     Notice
iosd                           Notice
ipc                            Notice
ipclog                         Notice
iphc                           Notice
IPsec                          Notice
mgmte-acl                      Notice
mlp                            Notice
```

```
mqipc                              Notice
nat                                Notice
nbar                               Notice
netflow                            Notice
om                                 Notice
peer                               Notice
qos                                Notice
route-map                          Notice
sbc                                Notice
services                           Notice
sw_wdog                            Notice
tdl_acl_config_type                Notice
tdl_acl_db_type                    Notice
tdl_cdlcore_message                Notice
tdl_cef_config_common_type         Notice
tdl_cef_config_type                Notice
tdl_dpidb_config_type              Notice
tdl_fman_rp_comm_type              Notice
tdl_fman_rp_message                Notice
tdl_fw_config_type                 Notice
tdl_hapi_tdl_type                  Notice
tdl_icmp_type                      Notice
tdl_ip_options_type                Notice
tdl_ipc_ack_type                   Notice
tdl_IPsec_db_type                  Notice
tdl_mcp_comm_type                  Notice
tdl_mlp_config_type                Notice
tdl_mlp_db_type                    Notice
tdl_om_type                        Notice
tdl_ui_message                     Notice
tdl_ui_type                        Notice
tdl_urpf_config_type               Notice
tdllib                             Notice
trans_avl                          Notice
uihandler                          Notice
uipeer                             Notice
uistatus                           Notice
urpf                               Notice
vista                              Notice
wccp                               Notice
```

Setting a Tracing Level

To set a tracing level for a module on a router, or for all the modules within a process on a router, enter the **set platform software trace** command in the privileged EXEC mode or diagnostic mode.

The following example shows the tracing level for the ACL module in the Forwarding Manager of the ESP processor in slot 0 set to `info`:

```
set platform software trace forwarding-manager F0 acl info
```

Viewing the Content of the Trace Buffer

To view the trace messages in the trace buffer or file, enter the **show logging process** command in privileged EXEC or diagnostic mode. In the following example, the trace messages for the Host Manager process in Route Processor slot 0 are viewed using the **show logging process command**:

```
Router# show logging process host-manager R0
08/23 12:09:14.408 [uipeer]: (info): Looking for a ui_req msg
08/23 12:09:14.408 [uipeer]: (info): Start of request handling for con 0x100a61c8
08/23 12:09:14.399 [uipeer]: (info): Accepted connection for 14 as 0x100a61c8
08/23 12:09:14.399 [uipeer]: (info): Received new connection 0x100a61c8 on descriptor 14
08/23 12:09:14.398 [uipeer]: (info): Accepting command connection on listen fd 7
08/23 11:53:57.440 [uipeer]: (info): Going to send a status update to the shell manager in
 slot 0
08/23 11:53:47.417 [uipeer]: (info): Going to send a status update to the shell manager in
 slot 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)

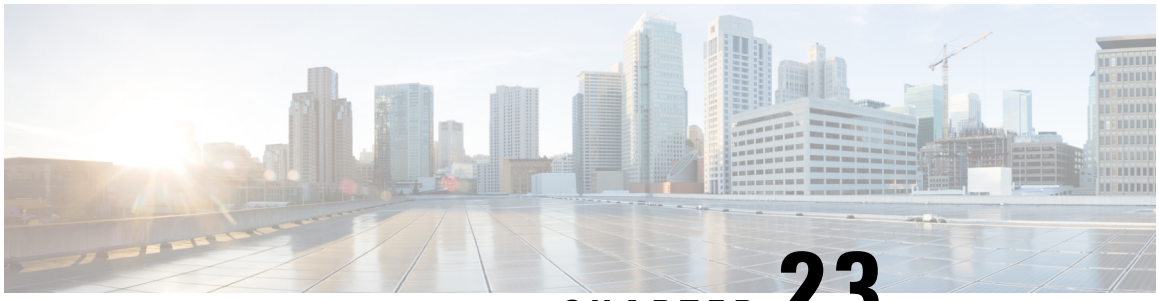

  Feature: IP
  Pkt Direction: OUTRoute out the generated packet.srcaddr: 198.51.100.38, dstaddr:
198.51.100.55

  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#
```



CHAPTER 23

Environmental Monitoring and PoE Management

The Cisco Catalyst 8300 Series Edge Platform have hardware and software features that periodically monitor the router's environment. This chapter provides information on the environmental monitoring features on your router that allow you to monitor critical events and generate statistical reports on the status of various router components. This chapter includes the following sections:

Environmental Monitoring

The router provides a robust environment-monitoring system with several sensors that monitor the system temperatures. Microprocessors generate interrupts to the HOST CPU for critical events and generate a periodic status and statistics report. The following are some of the key functions of the environmental monitoring system:

- Monitoring temperature of CPUs, motherboard, and midplane
- Monitoring fan speed
- Recording abnormal events and generating notifications
- Monitoring Simple Network Management Protocol (SNMP) traps
- Generating and collecting Onboard Failure Logging (OBFL) data
- Sending call home event notifications
- Logging system error messages
- Displaying present settings and status

Environmental Monitoring and Reporting Functions

Monitoring and reporting functions allow you to maintain normal system operation by identifying and resolving adverse conditions prior to loss of operation.

• Environmental Reporting Functions, on page 282

Environmental Monitoring Functions

Environmental monitoring functions use sensors to monitor the temperature of the cooling air as it moves through the chassis.

The local power supplies provide the ability to monitor:

- Input and output current
- Output voltage
- Input and output power
- Temperature
- Fan speed

The device is expected to meet the following environmental operating conditions:

- Operating Temperature Nominal—32°F to 104°F (0°C to 40°C)
- Operating Humidity Nominal—10% to 85% RH noncondensing
- Operating Humidity Short Term—10% to 85% RH noncondensing
- Operating Altitude—Sea level 0 ft to 10,000 ft (0 to 3000 m)
- AC Input Range—85 to 264 VAC

In addition, each power supply monitors its internal temperature and voltage. A power supply is either within tolerance (normal) or out of tolerance (critical). If an internal power supply's temperature or voltage reaches a critical level, the power supply shuts down without any interaction with the system processor.

The following table displays the levels of status conditions used by the environmental monitoring system.

Table 30: Levels of Status Conditions Used by the Environmental Monitoring System

Status Level	Description
Normal	All monitored parameters are within normal tolerance.
Warning	The system has exceeded a specified threshold. The system continues to operate, but operator action is recommended to bring the system back to a normal state.
Critical	An out-of-tolerance temperature or voltage condition exists. Although the system continues to operate, it is approaching shutdown. Immediate operator action is required.

The environmental monitoring system sends system messages to the console, for example, when the conditions described here are met:

Fan Failure

When the system power is on, all the fans should be operational. Although the system continues to operate if a fan fails, the system displays the following message:

```
%IOSXE_PEM-3-FANFAIL: The fan in slot 2/0 is encountering a failure condition
```

Sensors Out of Range

When sensors are out of range, the system displays the following message:

```
%ENVIRONMENTAL-1-ALERT: V: 1.0v PCH, Location: R0, State: Warning, Reading: 1102 mV

%ENVIRONMENTAL-1-ALERT: V: PEM Out, Location: P1, State: Warning, Reading: 0 mV

%ENVIRONMENTAL-1-ALERT: Temp: Temp 3, Location R0, State : Warning, Reading : 90C
```

Fan Tray (Slot P2) Removed

When the fan tray for slot P2 is removed, the system displays the following message:

```
%IOSXE_PEM-6-REMPEM_FM: PEM/FM slot P2 removed
```

Fan Tray (Slot P2) Reinserted

When the fan tray for slot P2 is reinserted, the system displays the following message:

```
%IOSXE_PEM-6-INSPEM_FM: PEM/FM slot P2 inserted
```

Fan Tray (Slot 2) is Working Properly

When the fan tray for slot 2 is functioning properly, the system displays the following message:

```
%IOSXE_PEM-6-PEMOK: The PEM in slot P2 is functioning properly
```

Fan 0 in Slot 2 (Fan Tray) is Not Working

When Fan 0 in the fan tray of slot 2 is not functioning properly, the system displays the following message:

```
%IOSXE_PEM-3-FANFAIL: The fan in slot 2/0 is encountering a failure condition
```

Fan 0 in Slot 2 (Fan Tray) is Working Properly

When Fan 0 in the fan tray of slot 2 is functioning properly, the system displays the following message:

```
%IOSXE_PEM-6-FANOK: The fan in slot 2/0 is functioning properly
```

Main Power Supply in Slot 1 is Powered Off

When the main power supply in slot 1 is powered off, the system displays the following message:

```
%IOSXE_PEM-3-PEMFAIL: The PEM in slot 1 is switched off or encountering a
failure condition.
```

Main Power Supply is Inserted in Slot 1

When the main power supply is inserted in slot 1, the system displays the following messages:

```
%IOSXE_PEM-6-INSPEM_FM: PEM/FM slot P1 inserted
%IOSXE_PEM-6-PEMOK: The PEM in slot 1 is functioning properly
```

Temperature and Voltage Exceed Max/Min Thresholds

The following example shows the warning messages indicating the maximum and minimum thresholds of the temperature or voltage:

```
Warnings :
--------
For all the temperature sensors (name starting with “Temp:”) above,
the critical warning threshold is 100C (100C and higher)
the warning threshold is 80C (range from 80C to 99C)
the low warning threshold is 1C (range from -inf to 1C).

For all voltage sensors (names starting with "V:"),
the high warning threshold starts at that voltage +10%. (voltage + 10% is warning)
the low warning threshold starts at the voltage -10%. (voltage - 10% is warning)
```

Environmental Reporting Functions

You can retrieve and display environmental status reports using the following commands:

- **debug environment**
- **debug platform software cman env monitor polling**
- **debug ilpower**
- **debug power** [**inline** | **main**]
- **show diag all eeprom**
- **show diag slot R0 eeprom detail**
- **show environment**
- **show environment all**
- **show inventory**
- **show platform all**
- **show platform diag**
- **show platform software status control-processor**
- **show version**
- **show power**
- **show power inline**

These commands show the current values of parameters such as temperature and voltage.

The environmental monitoring system updates the values of these parameters every 60 seconds. Brief examples of these commands are shown below:

debug environment: Example

```
Router# debug environment location P0
Environmental sensor Temp: Temp 1 P0 debugging is on
Environmental sensor Temp: Temp 2 P0 debugging is on
```

```
Environmental sensor Temp: Temp 3 P0 debugging is on
Environmental sensor V: PEM Out P0 debugging is on
Environmental sensor I: PEM In P0 debugging is on
Environmental sensor I: PEM Out P0 debugging is on
Environmental sensor W: In pwr P0 debugging is on
Environmental sensor W: Out pwr P0 debugging is on
Environmental sensor RPM: fan0 P0 debugging is on

*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 1 P0, In queue 1
*Jul  8 21:49:23.292 PDT:     State=Normal  Reading=35
*Jul  8 21:49:23.292 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 1 P0  State=Normal Reading=35
*Jul  8 21:49:23.292 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.292 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 2 P0, In queue 1
*Jul  8 21:49:23.292 PDT:     State=Normal  Reading=40
*Jul  8 21:49:23.292 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 2 P0  State=Normal Reading=40
*Jul  8 21:49:23.292 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.292 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 3 P0, In queue 1
*Jul  8 21:49:23.292 PDT:     State=Normal  Reading=44
*Jul  8 21:49:23.292 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.292 PDT:     Sensor: Temp: Temp 3 P0  State=Normal Reading=44
*Jul  8 21:49:23.292 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.292 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.292 PDT:     Sensor: V: PEM In P0, In queue 1
*Jul  8 21:49:23.292 PDT:     State=Normal  Reading=118501
*Jul  8 21:49:23.292 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: V: PEM In P0  State=Normal Reading=118501
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: V: PEM Out P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=12000
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: V: PEM Out P0  State=Normal Reading=12000
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: I: PEM In P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=820
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: I: PEM In P0  State=Normal Reading=828
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: I: PEM Out P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=7200
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: I: PEM Out P0  State=Normal Reading=7100
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: P: In pwr P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=97
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: P: In pwr P0  State=Normal Reading=98
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: P: Out pwr P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=87
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: P: Out pwr P0  State=Normal Reading=89
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:23.293 PDT:     Sensor: RPM: fan0 P0, In queue 1
*Jul  8 21:49:23.293 PDT:     State=Normal  Reading=5824
```

```
*Jul  8 21:49:23.293 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:23.293 PDT:     Sensor: RPM: fan0 P0  State=Normal Reading=5824
*Jul  8 21:49:23.293 PDT:     Inserting into queue 1 on spoke 189.
*Jul  8 21:49:23.293 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:43.296 PDT:     Sensor: Temp: Temp 1 P0, In queue 1
*Jul  8 21:49:43.296 PDT:     State=Normal  Reading=35
*Jul  8 21:49:43.296 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:43.296 PDT:     Sensor: Temp: Temp 1 P0  State=Normal Reading=35
*Jul  8 21:49:43.296 PDT:     Inserting into queue 1 on spoke 209.
*Jul  8 21:49:43.296 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:43.296 PDT:     Sensor: Temp: Temp 2 P0, In queue 1
*Jul  8 21:49:43.296 PDT:     State=Normal  Reading=40
*Jul  8 21:49:43.296 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:49:43.296 PDT:     Sensor: Temp: Temp 2 P0  State=Normal Reading=40
*Jul  8 21:49:43.296 PDT:     Inserting into queue 1 on spoke 209.
*Jul  8 21:49:43.296 PDT:     Rotation count=20 Displacement=0
*Jul  8 21:49:43.296 PDT:     Sensor: Temp: Temp 3 P0, In queue 1
*Jul  8 21:49:43.296 PDT:     State=Normal  Reading=44
*Jul  8 21:49:43.296 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:53:43.329 PDT:     State=Normal  Reading=5824
*Jul  8 21:53:43.329 PDT:     Rotation count=0  Poll period=20000
*Jul  8 21:53:43.329 PDT:     Sensor: RPM: fan0 P0  State=Normal Reading=5824
*Jul  8 21:53:43.329 PDT:     Inserting into queue 1 on spoke 149.
*Jul  8 21:53:43.329 PDT:     Rotation count=20 Displacement=0
```

debug platform software cman env monitor polling: Example

```
Router# debug platform software cman env monitor polling
platform software cman env monitor polling debugging is on
Router#
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 1 P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=35
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Temp 1, P0, 35
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 1 P0  State=Normal Reading=35
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 2 P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=40
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Temp 2, P0, 40
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 2 P0  State=Normal Reading=40
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 3 P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=44
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Temp 3, P0, 44
*Jul  8 21:56:23.351 PDT: Sensor: Temp: Temp 3 P0  State=Normal Reading=44
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: V: PEM In P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=118501
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback V: PEM In, P0, 118501
*Jul  8 21:56:23.351 PDT: Sensor: V: PEM In P0  State=Normal Reading=118501
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: V: PEM Out P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=12100
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback V: PEM Out, P0, 12000
```

```
*Jul  8 21:56:23.351 PDT: Sensor: V: PEM Out P0  State=Normal Reading=12000
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: I: PEM In P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=820
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback I: PEM In, P0, 828
*Jul  8 21:56:23.351 PDT: Sensor: I: PEM In P0  State=Normal Reading=828
*Jul  8 21:56:23.351 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.351 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.351 PDT: Sensor: I: PEM Out P0, In queue 1
*Jul  8 21:56:23.351 PDT: State=Normal  Reading=7200
*Jul  8 21:56:23.351 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.351 PDT: IOS-RP-ENVMON: sensor READ callback I: PEM Out, P0, 7100
*Jul  8 21:56:23.352 PDT: Sensor: I: PEM Out P0  State=Normal Reading=7100
*Jul  8 21:56:23.352 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.352 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.352 PDT: Sensor: P: In pwr P0, In queue 1
*Jul  8 21:56:23.352 PDT: State=Normal  Reading=97
*Jul  8 21:56:23.352 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback P: In pwr, P0, 98
*Jul  8 21:56:23.352 PDT: Sensor: P: In pwr P0  State=Normal Reading=98
*Jul  8 21:56:23.352 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.352 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.352 PDT: Sensor: P: Out pwr P0, In queue 1
*Jul  8 21:56:23.352 PDT: State=Normal  Reading=88
*Jul  8 21:56:23.352 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback P: Out pwr, P0, 88
*Jul  8 21:56:23.352 PDT: Sensor: P: Out pwr P0  State=Normal Reading=88
*Jul  8 21:56:23.352 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.352 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.352 PDT: Sensor: RPM: fan0 P0, In queue 1
*Jul  8 21:56:23.352 PDT: State=Normal  Reading=5888
*Jul  8 21:56:23.352 PDT: Rotation count=0  Poll period=20000
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback RPM: fan0, P0, 5888
*Jul  8 21:56:23.352 PDT: Sensor: RPM: fan0 P0  State=Normal Reading=5888
*Jul  8 21:56:23.352 PDT: Inserting into queue 1 on spoke 9.
*Jul  8 21:56:23.352 PDT: Rotation count=20 Displacement=0
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback RPM: fan0, P2, 12600
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback RPM: fan1, P2, 12840
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback RPM: fan2, P2, 12900
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback P: pwr, P2, 8
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Inlet 1, R0, 29
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Inlet 2, R0, 30
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Outlet 1, R0, 35
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback Temp: Outlet 2, R0, 36
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback Temp: CP-CPU, R0, 42
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 12v, R0, 12127
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 5v, R0, 5022
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 3.3v, R0, 3308
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 3.0v, R0, 3023
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 2.5v, R0, 2490
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.8v, R0, 1798
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.2v, R0, 1203
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.2v_CPU, R0, 1201
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.05v_CPU, R0, 1052
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.05v, R0, 1062
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 1.0v, R0, 1002
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback V: 0.6v, R0, 593
*Jul  8 21:56:23.352 PDT: IOS-RP-ENVMON: sensor READ callback P: pwr, R0, 86
*Jul  8 21:56:25.352 PDT: IOS-RP-ENVMON: sensor READ callback P: pwr: Pwr, 0/1, 5
*Jul  8 21:56:32.354 PDT: IOS-RP-ENVMON: sensor READ callback P: pwr: Pwr, 1/0, 27
```

debug ilpower: Example

```
Router# debug ilpower ?
  cdp         ILPOWER CDP messages
  controller  ILPOWER controller
  event       ILPOWER event
  ha          ILPOWER High-Availability
  port        ILPOWER port management
  powerman    ILPOWER powerman
  registries  ILPOWER registries
  scp         ILPOWER SCP messages
  upoe        ILPOWER upoe
```

debug power [inline|main]: Example

In this example, there is one 1000W power supply and one 450W power supply. Inline and main power output is shown.

```
Router# debug power ?
  inline  ILPM inline power related
  main    Main power related
  <cr>    <cr>
Router# debug power
POWER all debug debugging is on

Router# show debugging | include POWER
POWER:
POWER main debugging is on
POWER inline debugging is on
Router#
..

*Jul  8 21:56:23.351: %ENVIRONMENTAL-6-NOTICE: V: PEM Out, Location: P1, State: Warning,
Reading: 0 mV
*Jul  8 21:56:23.351: %IOSXE_PEM-6-PEMOK: The PEM in slot P1 is functioning properly
*Jul  8 21:56:23.351: %PLATFORM_POWER-6-MODEMATCH: Main power is in Boost mode
*Jul  8 21:56:23.351: Power M: Received Msg for 12V/Main, total power 1450, Run same as cfg
 Yes
*Jul  8 21:56:23.351: Power M: Received Msg for POE/ILPM, total power 500, Run same as cfg
 No
*Jul  8 21:56:23.351: Power I: Updating pool power is 500 watts
*Jul  8 21:56:23.351: Power I: Intimating modules of total power 500 watts
*Jul  8 21:56:23.351: Power M: Received Msg for 12V/Main, total power 1450, Run same as cfg
 Yes
*Jul  8 21:56:23.351: Power M: Received Msg for POE/ILPM, total power 500, Run same as cfg
 No
*Jul  8 21:56:23.351: Power I: Updating pool power is 500 watts
*Jul  8 21:56:23.351: Power I: Intimating modules of total power 500 watts
Router#
```

show diag all eeprom: Example

```
Router# show diag all eeprom
MIDPLANE EEPROM data:

        Product Identifier (PID) : C8300-1N1S-6T
        Version Identifier (VID) : V00
        PCB Serial Number        : FDO231403QE
        Hardware Revision        : 1.0
```

```
        CLEI Code                : TBDTBDTBDT
Power/Fan Module P0 EEPROM data:

        Product Identifier (PID) : PWR-4430-AC
        Version Identifier (VID) : V02
        PCB Serial Number        : LIT23032XFS
        CLEI Code                : IPUPAMFAAB
Power/Fan Module P1 EEPROM data is not initialized

External PoE Module POE0 EEPROM data is not initialized

External PoE Module POE1 EEPROM data is not initialized

Internal PoE is not present

Slot R0 EEPROM data:

        Product Identifier (PID) : C8300-1N1S-6T
        Version Identifier (VID) : V00
        PCB Serial Number        : FDO231403QE
        Hardware Revision        : 1.0
        CLEI Code                : TBDTBDTBDT
Slot F0 EEPROM data:

        Product Identifier (PID) : C8300-1N1S-6T
        Version Identifier (VID) : V00
        PCB Serial Number        : FDO231403QE
        Hardware Revision        : 1.0
        CLEI Code                : TBDTBDTBDT
Slot 0 EEPROM data:

        Product Identifier (PID) : C8300-1N1S-6T
        Version Identifier (VID) : V00
        PCB Serial Number        : FDO231403QE
        Hardware Revision        : 1.0
        CLEI Code                : TBDTBDTBDT
Slot 1 EEPROM data:

        Product Identifier (PID) : C8300-1N1S-6T
        Version Identifier (VID) : V00
        PCB Serial Number        : FDO231403QE
        Hardware Revision        : 1.0
        CLEI Code                : TBDTBDTBDT
SPA EEPROM data for subslot 0/0:

        Product Identifier (PID) : 4x1G-2xSFP
        Version Identifier (VID) : V01
        PCB Serial Number        :
        Top Assy. Part Number    : 68-2236-01
        Top Assy. Revision       : A0
        Hardware Revision        : 2.2
        CLEI Code                : CNUIAHSAAA
SPA EEPROM data for subslot 0/1 is not available

SPA EEPROM data for subslot 0/2 is not available

SPA EEPROM data for subslot 0/3 is not available

SPA EEPROM data for subslot 0/4 is not available

SPA EEPROM data for subslot 0/5 is not available

SPA EEPROM data for subslot 1/0 is not available
```

```
SPA EEPROM data for subslot 1/1 is not available

SPA EEPROM data for subslot 1/2 is not available

SPA EEPROM data for subslot 1/3 is not available

SPA EEPROM data for subslot 1/4 is not available

SPA EEPROM data for subslot 1/5 is not available
```

show environment: Example

In this example, note the output for the slots POE0 and POE1.

```
Router# show environment
 Number of Critical alarms:  0
Number of Major alarms:     0
Number of Minor alarms:     0

 Slot        Sensor          Current State   Reading
Threshold(Minor,Major,Critical,Shutdown)
 ----------  --------------  --------------- ------------
---------------------------------------
 P0          Temp: Temp 1    Normal          34   Celsius       (na ,na ,na ,na )(Celsius)
 P0          Temp: Temp 2    Normal          39   Celsius       (na ,na ,na ,na )(Celsius)
 P0          Temp: Temp 3    Normal          43   Celsius       (na ,na ,na ,na )(Celsius)
 P0          V: PEM In       Normal          119001mV           na
 P0          V: PEM Out      Normal          12100mV            na
 P0          I: PEM In       Normal          820  mA            na
 P0          I: PEM Out      Normal          7200 mA            na
 P0          P: In pwr       Normal          97   Watts         na
 P0          P: Out pwr      Normal          88   Watts         na
 P0          RPM: fan0       Normal          5760 RPM           na
 P2          RPM: fan0       Normal          12600RPM           na
 P2          RPM: fan1       Normal          12900RPM           na
 P2          RPM: fan2       Normal          12840RPM           na
 P2          P: pwr          Normal          8    Watts         na
 R0          Temp: Inlet 1   Normal          29   Celsius       (na ,na ,48 ,na )(Celsius)
 R0          Temp: Inlet 2   Normal          30   Celsius       (na ,na ,na ,na )(Celsius)
 R0          Temp: Outlet 1  Normal          34   Celsius       (na ,na ,81 ,na )(Celsius)
 R0          Temp: Outlet 2  Normal          35   Celsius       (na ,na ,81 ,na )(Celsius)
 R0          Temp: CP-CPU    Normal          42   Celsius       (na ,na ,97 ,na )(Celsius)
 R0          V: 12v          Normal          12119mV            na
 R0          V: 5v           Normal          5022 mV            na
 R0          V: 3.3v         Normal          3308 mV            na
 R0          V: 3.0v         Normal          3023 mV            na
 R0          V: 2.5v         Normal          2490 mV            na
 R0          V: 1.8v         Normal          1798 mV            na
 R0          V: 1.2v         Normal          1203 mV            na
 R0          V: 1.2v_CPU     Normal          1201 mV            na
 R0          V: 1.05v_CPU    Normal          1054 mV            na
 R0          V: 1.05v        Normal          1060 mV            na
 R0          V: 1.0v         Normal          1002 mV            na
 R0          V: 0.6v         Normal          592  mV            na
 R0          P: pwr          Normal          85   Watts         na
 0/1         P: pwr: Pwr     Normal          5    Watts         na
 1/0         P: pwr: Pwr     Normal          28   Watts         na
```

show environment all: Example

```
Router# show environment all
Sensor List:  Environmental Monitoring
 Sensor           Location          State             Reading
 Temp: Temp 1     P0                Normal            36 Celsius
 Temp: Temp 2     P0                Normal            38 Celsius
 Temp: Temp 3     P0                Normal            38 Celsius
 V: PEM In        P0                Normal            206502 mV
 V: PEM Out       P0                Normal            12000 mV
 I: PEM In        P0                Normal            281 mA
 I: PEM Out       P0                Normal            3500 mA
 P: In pwr        P0                Normal            53 Watts
 P: Out pwr       P0                Normal            43 Watts
 RPM: fan0        P0                Normal            3712 RPM
 RPM: fan0        P2                Normal            7260 RPM
 RPM: fan1        P2                Normal            7260 RPM
 RPM: fan2        P2                Normal            7200 RPM
 P: pwr           P2                Normal            3 Watts
 Temp: Inlet 1    R0                Normal            19 Celsius
 Temp: Inlet 2    R0                Normal            21 Celsius
 Temp: Outlet 1   R0                Normal            25 Celsius
 Temp: Outlet 2   R0                Normal            23 Celsius
 Temp: CP-CPU     R0                Normal            29 Celsius
 V: 12v           R0                Normal            11984 mV
 V: 5v            R0                Normal            5018 mV
 V: 3.3v          R0                Normal            3311 mV
 V: 3.0v          R0                Normal            2992 mV
 V: 2.5v          R0                Normal            2488 mV
 V: 1.8v          R0                Normal            1785 mV
 V: 1.2v          R0                Normal            1201 mV
 V: 1.2v_CPU      R0                Normal            1200 mV
 V: 1.05v_CPU     R0                Normal            1051 mV
 V: 1.05v         R0                Normal            1058 mV
 V: 1.0v          R0                Normal            1001 mV
 V: 0.6v          R0                Normal            595 mV
 P: pwr           R0                Normal            45 Watts
```

show inventory: Example

```
Router# show inventory



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

NAME: "Chassis", DESCR: "Cisco C8300-1N1S-6T Chassis"
PID: C8300-1N1S-6T     , VID: V00  , SN: FDO2320A0C

NAME: "Fan Tray", DESCR: "Cisco C8300 1RU Fan Assembly"
PID: C8300-FAN-1R      , VID:      , SN:

NAME: "module 0", DESCR: "Cisco C8300-1N1S-6T Built-In NIM controller"
PID: C8300-1N1S-6T     , VID:      , SN:

NAME: "NIM subslot 0/0", DESCR: "Front Panel 6 ports Gigabitethernet Module"
PID: 4x1G-2xSFP        , VID: V01  , SN:

NAME: "module 1", DESCR: "Cisco C8300-1N1S-6T Built-In SM controller"
```

```
PID: C8300-1N1S-6T     , VID:      , SN:

NAME: "module R0", DESCR: "Cisco C8300-1N1S-6T Route Processor"
PID: C8300-1N1S-6T     , VID: V00  , SN: FDO231403QE

NAME: "module F0", DESCR: "Cisco C8300-1N1S-6T Forwarding Processor"
PID: C8300-1N1S-6T     , VID:      , SN:
```

show platform: Example

```
Router# show platform
 Chassis type: C8300-1N1S-6T

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C8300-1N1S-6T       ok                    2d03h
 0/0      4x1G-2xSFP          ok                    2d03h
1         C8300-1N1S-6T       ok                    2d03h
R0        C8300-1N1S-6T       ok, active            2d03h
F0        C8300-1N1S-6T       ok, active            2d03h
P0        PWR-4430-AC         ok                    2d03h
P1        Unknown             empty                 never
P2        C8300-FAN-1R        ok                    2d03h

Slot      CPLD Version        Firmware Version
--------- ------------------- ----------------------------------------
0         19121329            1RU-20191104
1         19121329            1RU-20191104
R0        19121329            1RU-20191104
F0        19121329            1RU-20191104
```

show platform diag: Example

```
Router# show platform diag
Chassis type: C8300-1N1S-6T

Slot: 0, C8300-1N1S-6T
  Running state               : ok
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:29 (2d03h ago)
  Software declared up time   : 00:01:05 (2d03h ago)
  CPLD version                : 19121329
  Firmware version            : 1RU-20191104

Sub-slot: 0/0, 4x1G-2xSFP
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:01:27 (2d03h ago)
  Logical insert detect time  : 00:01:27 (2d03h ago)

Slot: 1, C8300-1N1S-6T
  Running state               : ok
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:29 (2d03h ago)
  Software declared up time   : 00:01:06 (2d03h ago)
  CPLD version                : 19121329
```

```
  Firmware version            : 1RU-20191104

Slot: R0, C8300-1N1S-6T
  Running state               : ok, active
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:29 (2d03h ago)
  Software declared up time   : 00:00:29 (2d03h ago)
  CPLD version                : 19121329
  Firmware version            : 1RU-20191104

Slot: F0, C8300-1N1S-6T
  Running state               : ok, active
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:29 (2d03h ago)
  Software declared up time   : 00:01:00 (2d03h ago)
  Hardware ready signal time  : 00:00:58 (2d03h ago)
  Packet ready signal time    : 00:01:05 (2d03h ago)
  CPLD version                : 19121329
  Firmware version            : 1RU-20191104

Slot: P0, PWR-4430-AC
  State                       : ok
  Physical insert detect time : 00:00:52 (2d03h ago)

Slot: P1, Unknown
  State                       : empty
  Physical insert detect time : 00:00:00 (never ago)

Slot: P2, C8300-FAN-1R
  State                       : ok
  Physical insert detect time : 00:00:52 (2d03h ago)

Slot: POE0, Unknown
  State                       : empty
  Physical insert detect time : 00:00:00 (never ago)

Slot: POE1, Unknown
  State                       : empty
  Physical insert detect time : 00:00:00 (never ago)

Slot: GE-POE, Unknown
  State                       : NA
  Physical insert detect time : 00:00:00 (never ago)
```

show platform software status control-processor: Example

```
Router# show platform software status control-processor
RP0: online, statistics updated 10 seconds ago
Load Average: healthy
  1-Min: 0.53, status: healthy, under 5.00
  5-Min: 0.90, status: healthy, under 5.00
  15-Min: 0.87, status: healthy, under 5.00
Memory (kb): healthy
  Total: 3884836
  Used: 1976928 (51%), status: healthy
  Free: 1907908 (49%)
  Committed: 3165956 (81%), under 90%
Per-core Statistics
CPU0: CPU Utilization (percentage of time spent)
```

```
  User:  2.10, System:  2.20, Nice:  0.00, Idle: 95.69
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU1: CPU Utilization (percentage of time spent)
  User:  2.80, System:  2.60, Nice:  0.00, Idle: 94.50
  IRQ:  0.00, SIRQ:  0.10, IOwait:  0.00
CPU2: CPU Utilization (percentage of time spent)
  User:  1.90, System:  2.10, Nice:  0.00, Idle: 96.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU3: CPU Utilization (percentage of time spent)
  User: 10.12, System:  0.60, Nice:  0.00, Idle: 89.27
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
```

show diag slot R0 eeprom detail: Example

```
Router# show diag slot R0 eeprom detail
Slot R0 EEPROM data:

        EEPROM version           : 4
        Compatible Type          : 0xFF
        PCB Serial Number        : FDO23470DHV
        Controller Type          : 4268
        Hardware Revision        : 1.0
        PCB Part Number          : 73-19423-07
        Board Revision           : A0
        Top Assy. Part Number    : 800-105842-02
        Deviation Number         : 551831
        Fab Version              : 07
        Product Identifier (PID) : C8300-1N1S-4T2X
        Version Identifier (VID) : V01
        CLEI Code                : CMM6J00ARA
        Processor type           : D0
        Chassis Serial Number    : FDO2401A038
        Chassis MAC Address      : c4b2.399e.b6c0
        MAC Address block size   : 144
        Manufacturing Test Data  : 00 00 00 00 00 00 00 00
        Asset ID                 :
```

show version: Example

```
Router# show version

Cisco IOS XE Software, Version 17.03.01prd8
Cisco IOS Software [Amsterdam], c8000be Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
 17.3.1prd8, RELEASE SOFTWARE
 (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2020 by Cisco Systems, Inc.
Compiled Tue 19-May-20 12:00 by mcpre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documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.
```

```
ROM: (c)

Router uptime is 2 days, 3 hours, 26 minutes
Uptime for this control processor is 2 days, 3 hours, 27 minutes
System returned to ROM by Reload Command
System image file is "bootflash:c8000be-universalk9.17.03.01prd8.SPA.bin"
Last reload reason: Reload Command



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    network-essentials network-essentials
Smart License  Subscription None              None

The current crypto throughput level is 1000000 kbps


Smart Licensing Status: UNREGISTERED/EVAL MODE

cisco C8300-1N1S-6T (1RU) processor with 3763047K/6147K bytes of memory.
Processor board ID FDO2320A0CF
Router operating mode: Autonomous
6 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
7090175K bytes of flash memory at bootflash:.
28884992K bytes of M.2 USB at harddisk:.

Configuration register is 0x2102
```

Configuring Power Supply Mode

You can configure the power supplies of both the device and a connected Power over Ethernet (PoE) module.

- Configuring the Edge Platforms Power Supply Mode, on page 294
- Configuring the External PoE Service Module Power Supply Mode, on page 294

For more information on the Power Supply Mode, See the Overview of the Power Options section.

- Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platform
- Hardware Installation Guide for Cisco Catalyst 8200 Series Edge Platforms

Configuring the Edge Platforms Power Supply Mode

Configure the main power supply on the Edge Platforms using the **power main redundant** command:

- **power main redundant**—Sets the main power supply in redundant mode.
- **no power main redundant**—Sets the main power supply in boost mode.

  The boost mode is supported only on C8300-2N2S-4T2X and C8300-2N2S-6T platforms.

Note The default mode for the device power supply is redundant mode.

Configuring the External PoE Service Module Power Supply Mode

Configure the power supply of an external PoE service module using the **power inline redundant** command:

- **power inline redundant**—Sets the external PoE service module power supply in redundant mode.
- **no power inline redundant**—Sets the external PoE service module power supply in boost mode. The boost mode is supported only on C8300-2N2S-4T2X and C8300-2N2S-6T platforms.

Note The default mode for the external PoE service module power supply is redundant mode.

The **show power** command shows whether boost or redundant mode is configured and whether this mode is currently running on the system.

Examples for Configuring Power Supply Mode

Example—Configured Mode of Boost for Main PSU and PoE Module

The Boost mode is supported only on C8300-2N2S-4T2X and C8300-2N2S-6T platforms. In this example, the **show power** command shows the configured mode as `Boost`, which is also the current runtime state. The `Main PSU` shows information about the main power supply. The `POE Module` shows information about the inline/PoE power. In this example, the current run-time state for the main power supply is the same as the configured state (`Boost` mode).

```
Router# show power
Main PSU :
```

```
    Configured Mode : Boost
    Current runtime state same : Yes
    Total power available : 2000 Watts
POE Module :
    Configured Mode : Boost
    Current runtime state same : Yes
    Total power available : 1000 Watts
Router#
```

Example—Configured Mode of Boost for Main PSU and PoE Module

In this example, the **show power** command shows the power supplies that are present in the device. The Main PSU and POE Module are configured to the `Boost` mode, which differs from the current runtime state. The current runtime state is the `Redundant` mode. A likely explanation for this is that there is only one main power supply present in the router. See mode example 4 in the table titled "Modes of Operation" in Available PoE Power, on page 296.

You can enter the **show platform** command to show the power supplies that are present in the device.

```
Router# show power
Main PSU :
    Configured Mode : Boost
    Current runtime state same : No
    Total power available : 1000 Watts
POE Module :
    Configured Mode : Boost
    Current runtime state same : No
    Total power available : 500 Watts
Router#
```

Example—Configured Mode of Redundant for Main PSU and PoE Module

In this example, the **show power** command shows the configured mode is `Redundant` for both the main and inline power. The system has one 450 W and one 100 W power supply.

```
Router# show powerMain PSU :
    Configured Mode : Redundant
    Current runtime state same : No
    Total power available : 250 Watts
POE Module :
    Configured Mode : Redundant
    Current runtime state same : No
    Total power available : 0 Watts

Router#
```

Example—Configured Mode of Boost for Main Power

In this example, the main power is configured to be in `boost` mode by using the **no** form of the **power main redundant** command. This sets the main power to `boost` mode with 1450 W and inline power to `redundant` mode with 500 W.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# no power main redundant
Router(config)#
*Jan 31 03:35:22.284: %PLATFORM_POWER-6-MODEMATCH: Inline power is in Redundant mode
```

```
Router(config)#
Router(config)# exit
Router#
*Jan 31 03:36:13.111: %SYS-5-CONFIG_I: Configured from console by console
Router# show power
Main PSU :
    Configured Mode : Boost
    Current runtime state same : Yes
    Total power available : 1450 Watts
POE Module :
    Configured Mode : Redundant
    Current runtime state same : Yes
    Total power available : 500 Watts
Router#
```

Example—Configured Mode of Boost for PoE Power

In this example, an attempt is made to configure the inline power in boost mode by using the **no** form of the **power inline redundant** command. The inline power mode is **not** changed to boost mode because that would require a total power available in redundant mode of 1000 W. The inline power mode is redundant and is shown by the following values for the PoE Module:

- `Configured Mode : Boost`
- `Current runtime state same : No`

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# no power inline redundant
Router(config)#
*Jan 31 03:42:40.947: %PLATFORM_POWER-6-MODEMISMATCH: Inline power not in Boost mode
Router(config)#
Router(config)# exit
Router#
*Jan 31 03:36:13.111: %SYS-5-CONFIG_I: Configured from console by console
Router# show power
Main PSU :
    Configured Mode : Boost
    Current runtime state same : Yes
    Total power available : 1450 Watts
POE Module :
    Configured Mode : Boost
    Current runtime state same : No
    Total power available : 500 Watts
Router#
```

Available PoE Power

For the PoE feature to be available on the external PoE module, the total power from the power supplies must be 500 W or higher.

Note To ensure the PoE feature is functional on the external PoE module, verify the availability of PoE power on your router using the **show platform** and **show power** commands.

To determine there is enough PoE power for use by an external PoE service module, use the **show platform** and **show power** commands to calculate the available PoE power based on the wattage values of the main power supplies and PoE inverters.

Take the values of your main P0 and P1 power supplies to give the Total Power (for main power supplies.) Then take the values of your PoE1 and PoE2 power inverters to calculate the Total PoE Power.

The following table shows example modes of operation, which may be similar to your configuration.

The Total PoE Power value, in the final column of the table needs to be 500 W or higher for the PoE feature to be functional on a connected PoE service module.

Note Add power inverters to the router before inserting an external PoE module. Otherwise, even if the Total PoE Power is sufficient, the PoE power will not be used by the external PoE module and the module will need to be re-booted for the PoE feature to be functional.

Configuring a power mode of boost or redundant on the main power supplies, or PoE inverters, may affect the value for Total PoE Power.

The following table shows all power values in Watts. The wattage ratings of the main power supplies are shown in columns Main P0 and Main P1. The wattage ratings of the PoE inverters are shown in columns PoE0 and PoE1.

Table 31: Modes of Operation

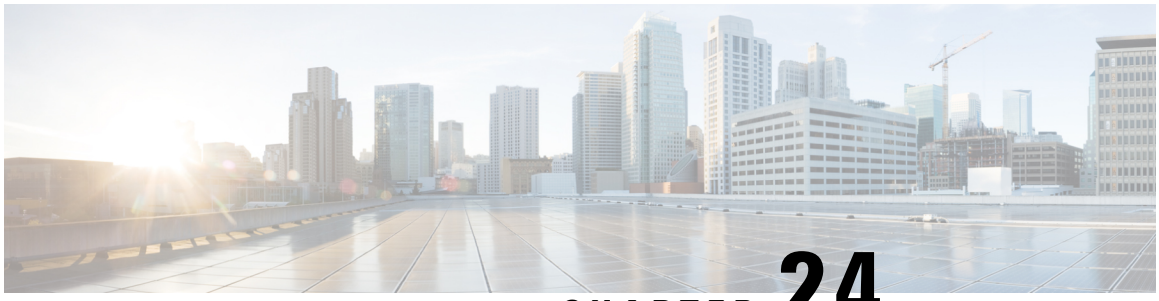
Mode Example	Main P0	Main P1	Config Mode	Total Power (Main)	PoE0	PoE1	Config Mode	Total PoE Power
1	450	None	Redundant or Boost	450	None	500	Redundant or Boost	0 (None)
2	450	450	Boost	900	None	500	Redundant or Boost	0 (None)
3	450	450	Redundant	450	500	None	Redundant or Boost	0 (None)
4	1000	None	Redundant or Boost	1000	500	None	Redundant or Boost	500
5	1000	450	Redundant	450	500	500	Redundant or Boost	0 (None)
6	1000	450	Boost	1450	500	500	Boost	500
7	1000	1000	Redundant	1000	500	500	Boost	500
8	1000	1000	Boost	2000	500	500	Boost	1000

Note In the table above, for 500 W or higher Total PoE Power to be available, the "Total Power" (of the main power supplies) must be 1000 W or higher.

For 1000 W Total PoE Power (see Mode Example 8 above), there must be two 1000 W main power supplies (in `Boost` mode) and two PoE inverters (also in `Boost` mode).

Caution Care should be taken while removing the power supplies and power inverters (especially in `Boost` mode of operation). If the total power consumption is higher than can be supported by one power supply alone and in this condition a power supply is removed, the hardware can be damaged. This may then result in the system being unstable or unusable.

Similarly, in the case where there is only one PoE inverter providing PoE power to a service module, and in this condition the PoE inverter is removed, the hardware may be damaged, and may result in the system being unstable or unusable.



CHAPTER 24

Configuring High Availability

The Cisco High Availability (HA) technology enable network-wide protection by providing quick recovery from disruptions that may occur in any part of a network. A network's hardware and software work together with Cisco High Availability technology, which besides enabling quick recovery from disruptions, ensures fault transparency to users and network applications.

The following sections describe how to configure Cisco High Availability features on your device:

About Cisco High Availability

The unique hardware and software architecture of your router is designed to maximize router uptime during any network event, and thereby provide maximum uptime and resilience within any network scenario.

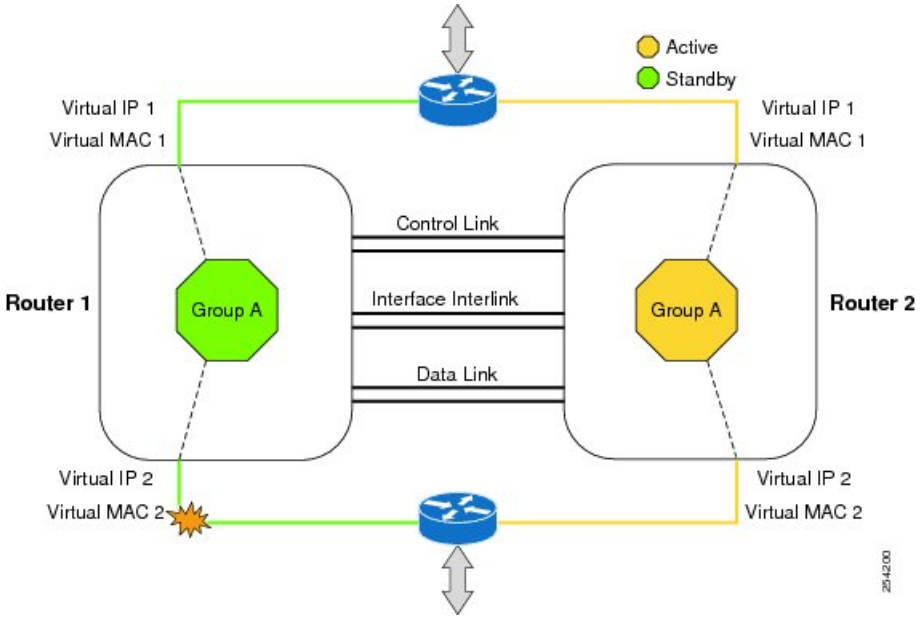
This section covers some aspects of Cisco High Availability that may be used on the Cisco Catalyst 8300 Series Edge Platform:

Interchassis High Availability

The Interchassis High Availability feature is also known as the box-to-box redundancy feature. Interchassis High Availability enables the configuration of pairs of devices to act as backup for each other. This feature can be configured to determine the active device based on several failover conditions. When a failover occurs, the standby device seamlessly takes over and starts processing call signaling and performing media forwarding tasks.

Groups of redundant interfaces are known as redundancy groups. The following figure depicts the active-standby device scenario. It shows how the redundancy group is configured for a pair of devices that have a single outgoing interface.

Figure 5: Redundancy Group Configuration



The device are joined by a configurable control link and data synchronization link. The control link is used to communicate the status of the devices. The data synchronization link is used to transfer stateful information to synchronize the stateful database for the calls and media flows. Each pair of redundant interfaces are configured with the same unique ID number, also known as the RII. For information on configuring Interchassis HA on your device, see Configuring Interchassis High Availability, on page 301.

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 a network administrator can use BFD to detect forwarding path failures at a uniform rate rather than variable rates for different routing protocol hello mechanisms, network profiling and planning is easier, and reconvergence time is consistent and predictable.

For more information on BFD, see the “Bidirectional Forwarding Detection” section in the IP Routing: BFD Configuration Guide .

Bidirectional Forwarding Detection Offload

The Bidirectional Forwarding Detection Offload feature allows the offload of BFD session management to the forwarding engine for improved failure detection times. BFD offload reduces the overall network convergence time by sending rapid failure detection packets (messages) to the routing protocols for recalculating the routing table. See Configuring BFD Offload, on page 302.

Configuring Cisco High Availability

Configuring Interchassis High Availability

Prerequisites

- The active device and the standby device must run on the identical version of the Cisco IOS XE software.
- The active device and the standby device must be connected through an L2 connection for the control path.
- Either the Network Time Protocol (NTP) must be configured or the clock must be set identical on both devices to allow timestamps and call timers to match.
- Virtual Routing and Forwarding (VRF) must be defined in the same order on both active and standby devices for an accurate synchronization of data.
- The latency times must be minimal on all control and data links to prevent timeouts.
- Physically redundant links, such as Gigabit EtherChannel, must be used for the control and data paths.

Restrictions

- The failover time for a box-to-box application is higher for a non-box-to-box application.
- LAN and MESH scenarios are not supported.
- VRFs are not supported and cannot be configured under ZBFW High Availability data and control interfaces.
- The maximum number of virtual MACs supported by the Front Panel Gigabit Ethernet (FPGE) interfaces depends on the platform. For information about the FPGE interfaces, see the Hardware Installation Guide for Cisco Catalyst 8300 Edge Platform.
- When the configuration is replicated to the standby device, it is not committed to the startup configuration; it is in the running configuration. A user must run the **write memory** command to commit the changes that have been synchronized from the active device, on the standby device.

How to Configure Interchassis High Availability

For more information on configuring Interchassis High Availability on the device, see the IP Addressing: NAT Configuration Guide, Cisco IOS XE Release 3S.

Configuring Bidirectional Forwarding

For information on configuring BFD on your device, see the IP Routing BFD Configuration Guide.

For BFD commands, see the Cisco IOS IP Routing: Protocol-Independent Command Reference document.

Configuring BFD Offload

Restrictions

- Only BFD version 1 is supported.
- When configured, only offloaded BFD sessions are supported;, BFD session on RP are not supported.
- Only Asynchronous mode or no echo mode of BFD is supported.
- 511 asynchronous BFD sessions are supported.
- BFD hardware offload is supported for IPv4 sessions with non-echo mode only.
- BFD offload is supported only on port-channel interfaces.
- BFD offload is supported only for the Ethernet interface.
- BFD offload is not supported for IPv6 BFD sessions.
- BFD offload is not supported for BFD with TE/FRR.

How to Configure BFD Offload

BFD offload functionality is enabled by default. You can configure BFD hardware offload on the route processor. For more information, see Configuring BFD and the IP Routing BFD Configuration Guide.

Verifying Interchassis High Availability

Use the following **show** commands to verify the Interchassis High Availability.

Note Prerequisites and links to additional documentation configuring Interchassis High Availability are listed in Configuring Interchassis High Availability, on page 301.

- **show redundancy application group [group-id | all]**
- **show redundancy application transport {client | group [group-id]}**
- **show redundancy application control-interface group [group-id]**
- **show redundancy application faults group [group-id]**
- **show redundancy application protocol {protocol-id | group [group-id]}**
- **show redundancy application if-mgr group [group-id]**
- **show redundancy application data-interface group [group-id]**

The following example shows the redundancy application groups configured on the device:

```
Router# show redundancy application group
Group ID    Group Name                    State
--------    ----------                    -----
1           Generic-Redundancy-1          STANDBY
2           Generic-Redundancy2           ACTIVE
```

The following example shows the details of redundancy application group 1:

```
Router# show redundancy application group 1
Group ID:1
Group Name:Generic-Redundancy-1

Administrative State: No Shutdown
Aggregate operational state : Up
My Role: STANDBY
Peer Role: ACTIVE
Peer Presence: Yes
Peer Comm: Yes
Peer Progression Started: Yes

RF Domain: btob-one
RF state: STANDBY HOT
Peer RF state: ACTIVE
```

The following example shows the details of redundancy application group 2:

```
Router# show redundancy application group 2
Group ID:2
Group Name:Generic-Redundancy2

Administrative State: No Shutdown
Aggregate operational state : Up
My Role: ACTIVE
Peer Role: STANDBY
Peer Presence: Yes
Peer Comm: Yes
Peer Progression Started: Yes

RF Domain: btob-two
RF state: ACTIVE
Peer RF state: STANDBY HOT
```

The following example shows details of the redundancy application transport client:

```
Router# show redundancy application transport client
Client          Conn#  Priority   Interface   L3        L4
( 0)RF            0      1         CTRL       IPV4      SCTP

( 1)MCP_HA        1      1         DATA       IPV4      UDP_REL

( 4)AR            0      1         ASYM       IPV4      UDP

( 5)CF            0      1         DATA       IPV4      SCTP
```

The following example shows configuration details for the redundancy application transport group:

```
Router# show redundancy application transport group
Transport Information for RG (1)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
0    0       192.0.2.8       59000    192.0.2.4       59000    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
1    1       10.10.2.10      53000    10.10.6.9       53000    DATA    IPV4    UDP_REL
```

```
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
2    0       192.0.2.3       0       192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
3    0       10.10.2.10      59001    10.10.6.9       59001    DATA    IPV4    SCTP
Transport Information for RG (2)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
8    0       192.0.2.8       59004    192.0.2.2       59004    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
9    1       10.10.2.10      53002    10.10.6.9       53002    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
10   0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
11   0       10.10.2.10      59005    10.10.6.9       59005    DATA    IPV4    SCTP
```

The following example shows the configuration details of redundancy application transport group 1:

```
Router# show redundancy application transport group 1
Transport Information for RG (1)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
0    0       192.0.2.8       59000    192.0.2.4       59000    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
1    1       10.10.2.10      53000    10.10.2.10      53000    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
2    0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
3    0       10.10.2.10      59001    10.10.2.10      59001    DATA    IPV4    SCTP
```

The following example shows configuration details of redundancy application transport group 2:

```
Router# show redundancy application transport group 2
Transport Information for RG (2)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
8    0       192.0.2.8       59004    192.0.2.4       59004    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
9    1       10.10.2.10      53002    10.10.2.10      53002    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
10   0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
11   0       10.10.2.10      59005    10.10.2.10      59005    DATA    IPV4    SCTP
```

The following example shows configuration details of the redundancy application control-interface group:

```
Router# show redundancy application control-interface group
The control interface for rg[1] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0

The control interface for rg[2] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
```

```
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application control-interface group 1:

```
Router# show redundancy application control-interface group 1
The control interface for rg[1] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application control-interface group 2:

```
Router# show redundancy application control-interface group 2
The control interface for rg[2] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application faults group:

```
Router# show redundancy application faults group
Faults states Group 1 info:
Runtime priority: [50]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
Faults states Group 2 info:
Runtime priority: [135]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details specific to redundancy application faults group 1:

```
Router# show redundancy application faults group 1
Faults states Group 1 info:
Runtime priority: [50]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details specific to redundancy application faults group 2:

```
Router# show redundancy application faults group 2
Faults states Group 2 info:
Runtime priority: [135]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details for the redundancy application protocol group:

```
Router# show redundancy application protocol group
RG Protocol RG 1
------------------
Role: Standby
Negotiation: Enabled
Priority: 50
Protocol state: Standby-hot
Ctrl Intf(s) state: Up
Active Peer: address 192.0.4.2, priority 150, intf Gi0/0/0
Standby Peer: Local
Log counters:
```

```
role change to active: 0
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 1
--------------------------
Ctx State: Standby
Protocol ID: 1
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 117, Bytes 7254, HA Seq 0, Seq Number 117, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 0
Active Peer: Present. Hold Timer: 10000
Pkts 115, Bytes 3910, HA Seq 0, Seq Number 1453975, Pkt Loss 0



RG Protocol RG 2
------------------
Role: Active
Negotiation: Enabled
Priority: 135
Protocol state: Active
Ctrl Intf(s) state: Up
Active Peer: Local
Standby Peer: address 192.0.4.2, priority 130, intf Gi0/0/0
Log counters:
role change to active: 1
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 2
--------------------------
Ctx State: Active
Protocol ID: 2
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 118, Bytes 7316, HA Seq 0, Seq Number 118, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 1
Standby Peer: Present. Hold Timer: 10000
Pkts 102, Bytes 3468, HA Seq 0, Seq Number 1453977, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol group 1:

```
Router# show redundancy application protocol group 1
RG Protocol RG 1
------------------
```

```
Role: Standby
Negotiation: Enabled
Priority: 50
Protocol state: Standby-hot
Ctrl Intf(s) state: Up
Active Peer: address 192.0.4.2, priority 150, intf Gi0/0/0
Standby Peer: Local
Log counters:
role change to active: 0
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 1
--------------------------
Ctx State: Standby
Protocol ID: 1
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 120, Bytes 7440, HA Seq 0, Seq Number 120, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 0
Active Peer: Present. Hold Timer: 10000
Pkts 118, Bytes 4012, HA Seq 0, Seq Number 1453978, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol group 2:

```
Router# show redundancy application protocol group 2
RG Protocol RG 2
-----------------
Role: Active
Negotiation: Enabled
Priority: 135
Protocol state: Active
Ctrl Intf(s) state: Up
Active Peer: Local
Standby Peer: address 192.0.4.2, priority 130, intf Gi0/0/0
Log counters:
role change to active: 1
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 2
--------------------------
Ctx State: Active
Protocol ID: 2
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 123, Bytes 7626, HA Seq 0, Seq Number 123, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
```

```
Resign: TX 0, RX 1
Standby Peer: Present. Hold Timer: 10000
Pkts 107, Bytes 3638, HA Seq 0, Seq Number 1453982, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol 1:

```
Router# show redundancy application protocol 1
Protocol id: 1, name: rg-protocol-1
BFD: ENABLE
Hello timer in msecs: 3000
Hold timer in msecs: 10000
OVLD-1#show redundancy application protocol 2
Protocol id: 2, name: rg-protocol-2
BFD: ENABLE
Hello timer in msecs: 3000
Hold timer in msecs: 10000
```

The following example shows configuration details for redundancy application interface manager group:

```
Router# show redundancy application if-mgr group
 RG ID: 1
 ==========

 interface      GigabitEthernet0/0/3.152
 ---------------------------------------
 VMAC           0007.b421.4e21
 VIP            203.0.113.1
 Shut           shut
 Decrement      10

 interface      GigabitEthernet0/0/2.152
 ---------------------------------------
 VMAC           0007.b421.5209
 VIP            203.0.113.4
 Shut           shut
 Decrement      10


 RG ID: 2
 ==========

 interface      GigabitEthernet0/0/3.166
 ---------------------------------------
 VMAC           0007.b422.14d6
 VIP            203.0.113.6
 Shut           no shut
 Decrement      10

 interface      GigabitEthernet0/0/2.166
 ---------------------------------------
 VMAC           0007.b422.0d06
 VIP            203.0.113.9
 Shut           no shut
 Decrement      10
```

The following examples shows configuration details for redundancy application interface manager group 1 and group 2:

```
Router# show redundancy application if-mgr group 1

 RG ID: 1
 ==========

 interface      GigabitEthernet0/0/3.152
 ---------------------------------------
```

```
 VMAC            0007.b421.4e21
 VIP             203.0.113.3
 Shut            shut
 Decrement       10

 interface       GigabitEthernet0/0/2.152
 ----------------------------------------
 VMAC            0007.b421.5209
 VIP             203.0.113.2
 Shut            shut
 Decrement       10

Router# show redundancy application if-mgr group 2
 RG ID: 2
 ==========

 interface       GigabitEthernet0/0/3.166
 ----------------------------------------
 VMAC            0007.b422.14d6
 VIP             203.0.113.5
 Shut            no shut
 Decrement       10

 interface       GigabitEthernet0/0/2.166
 ----------------------------------------
 VMAC            0007.b422.0d06
 VIP             203.0.113.7
 Shut            no shut
 Decrement       10
```

The following example shows configuration details for redundancy application data-interface group:

```
Router# show redundancy application data-interface group
The data interface for rg[1] is GigabitEthernet0/0/1
The data interface for rg[2] is GigabitEthernet0/0/1
```

The following examples show configuration details specific to redundancy application data-interface group 1 and group 2:

```
Router# show redundancy application data-interface group 1
The data interface for rg[1] is GigabitEthernet0/0/1

Router # show redundancy application data-interface group 2
The data interface for rg[2] is GigabitEthernet0/0/1
```

Verifying BFD Offload

Use the following commands to verify and monitor BFD offload feature on your device.

Note Configuration of BFD Offload is described in Configuring Bidirectional Forwarding, on page 302.

- **show bfd neighbors [details]**
- **debug bfd [packet | event]**
- **debug bfd event**

The **show bfd neighbors** command displays the BFD adjacency database:

```
Router# show bfd neighbor

IPv4 Sessions
NeighAddr                              LD/RD         RH/RS     State     Int
192.0.2.1                             362/1277       Up        Up        Gi0/0/1.2
192.0.2.5                             445/1278       Up        Up        Gi0/0/1.3
192.0.2.3                            1093/961        Up        Up        Gi0/0/1.4
192.0.2.2                            1244/946        Up        Up        Gi0/0/1.5
192.0.2.6                            1094/937        Up        Up        Gi0/0/1.6
192.0.2.7                            1097/1260       Up        Up        Gi0/0/1.7
192.0.2.4                            1098/929        Up        Up        Gi0/0/1.8
192.0.2.9                            1111/928        Up        Up        Gi0/0/1.9
192.0.2.8                            1100/1254       Up        Up        Gi0/0/1.10
```

The **debug bfd neighbor detail** command displays the debugging information related to BFD packets:

```
Router# show bfd neighbor detail

IPv4 Sessions
NeighAddr                              LD/RD         RH/RS     State     Int
192.0.2.1                             362/1277       Up        Up        Gi0/0/1.2
Session state is UP and not using echo function.
Session Host: Hardware
OurAddr: 192.0.2.2
Handle: 33
Local Diag: 0, Demand mode: 0, Poll bit: 0
MinTxInt: 50000, MinRxInt: 50000, Multiplier: 3
Received MinRxInt: 50000, Received Multiplier: 3
Holddown (hits): 0(0), Hello (hits): 50(0)
Rx Count: 3465, Rx Interval (ms) min/max/avg: 42/51/46
Tx Count: 3466, Tx Interval (ms) min/max/avg: 39/52/46
Elapsed time watermarks: 0 0 (last: 0)
Registered protocols: CEF EIGRP
Uptime: 00:02:50
Last packet: Version: 1                  - Diagnostic: 0
             State bit: Up               - Demand bit: 0
             Poll bit: 0                 - Final bit: 0
             C bit: 1
             Multiplier: 3               - Length: 24
             My Discr.: 1277             - Your Discr.: 362
             Min tx interval: 50000      - Min rx interval: 50000
             Min Echo interval: 0
```

The **show bfd summary** command displays the BFD summary:

```
Router# show bfd summary

                    Session          Up          Down

Total                   400         400             0
```

The **show bfd drops** command displays the number of packets dropped in BFD:

```
Router# show bfd drops
BFD Drop Statistics
                       IPV4     IPV6    IPV4-M    IPV6-M    MPLS_PW   MPLS_TP_LSP
Invalid TTL              0        0         0         0         0         0
BFD Not Configured       0        0         0         0         0         0
No BFD Adjacency        33        0         0         0         0         0
Invalid Header Bits      0        0         0         0         0         0
Invalid Discriminator    1        0         0         0         0         0
Session AdminDown       94        0         0         0         0         0
Authen invalid BFD ver   0        0         0         0         0         0
Authen invalid len       0        0         0         0         0         0
Authen invalid seq       0        0         0         0         0         0
Authen failed            0        0         0         0         0         0
```

The **debug bfd packet** command displays debugging information about BFD control packets.

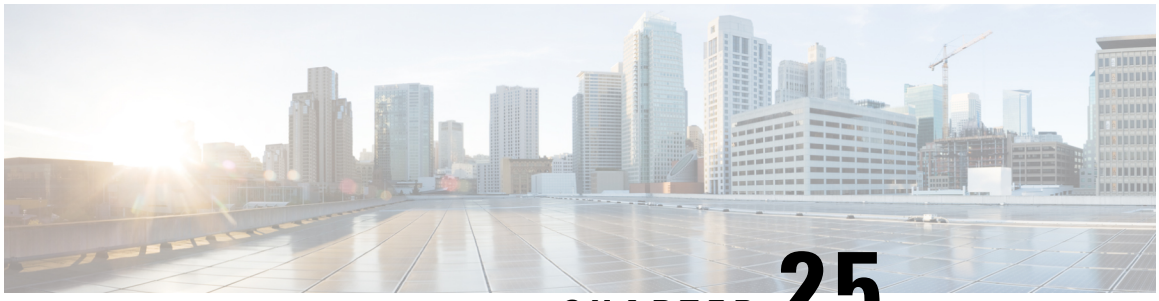
```
Router# debug bfd packet
*Nov 12 23:08:27.982: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/0 diag:0(No Diagnostic)
 Down C cnt:4 ttl:254 (0)
*Nov 12 23:08:27.982: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:3(Neighbor
Signaled Session Down) Init  C cnt:44 (0)
*Nov 12 23:08:28.007: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up PC cnt:4 ttl:254 (0)
*Nov 12 23:08:28.007: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:0(No Diagnostic)
 Up F C cnt:0 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up FC cnt:0 ttl:254 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:0(No Diagnostic)
 Up  C cnt:0 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/0 diag:0(No Diagnostic)
 Down C cnt:3 ttl:254 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:3(Neighbor
Signaled Session Down) Init  C cnt:43 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
*Nov 12 23:08:28.626: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up PC cnt:3 ttl:254 (0)
*Nov 12 23:08:28.626: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:0(No Diagnostic)
 Up F C cnt:0 (0)
*Nov 12 23:08:28.645: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
*Nov 12 23:08:28.700: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up FC cnt:0 ttl:254 (0)
*Nov 12 23:08:28.700: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:0(No Diagnostic)
 Up  C cnt:0 (0)
*Nov 12 23:08:28.993: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
```

The **debug bfd event** displays debugging information about BFD state transitions:

```
Router# deb bfd event

*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.6, ld:1401, handle:77,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.6, ld:1401, handle:77,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.10, ld:1400, handle:39,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.10, ld:1400, handle:39,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.8, ld:1399, handle:25,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.8, ld:1399, handle:25,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.5, ld:1403, handle:173,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.6, ld:1403, handle:173,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.4, ld:1402, handle:95,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.4, ld:1402, handle:95,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Timers: Tx timer 1000000 Detect timer 0
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Flags: Poll 0 Final 0
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Buffer: 0x23480318 0x0000057C 0x00000000
0x000F4240 0x000F4240 0x00000000 size 24
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Timers: Tx timer 1000000 Detect timer 0
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Flags: Poll 0 Final 0
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Buffer: 0x23480318 0x0000057D 0x00000000
```

```
0x000F4240 0x000F4240 0x00000000 size 24
*Nov 12 23:11:30.649: BFD-DEBUG Packet: Rx IP:192.0.2.6 ld/rd:1601/1404
diag:7(Administratively Down) AdminDown C cnt:0 ttl:254 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: V1 FSM ld:1404 handle:207 event:RX ADMINDOWN state:UP
 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: resetting timestamps ld:1404 handle:207 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.1, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:1404/0 diag:3(Neighbor Signaled
 Session Down) Down C cnt:0 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1620/1405
diag:7(Administratively Down) AdminDown C cnt:0 ttl:254 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: V1 FSM ld:1405 handle:209 event:RX ADMINDOWN state:UP
 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: resetting timestamps ld:1405 handle:209 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.1, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Tx IP:192.0.2.7 ld/rd:1405/0 diag:3(Neighbor Signaled
 Session Down) Down C cnt:0 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.7, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.7, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.7, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.7, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:31.035: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 192.0.2.8
```



CHAPTER 25

Configuring Secure Storage

Secure Storage feature allows you to secure critical configuration information by encrypting it. It encrypts VPN, IPSec, and other asymmetric key-pairs, pre-shared secrets, the type 6 password encryption key and certain credentials. An instance-unique encryption key is stored in the hardware trust anchor to prevent it from being compromised.

By default, this feature is enabled on platforms that come with a hardware trust anchor. This feature is not supported on platforms that do not have hardware trust anchor.

Enabling Secure Storage

Before you begin

By default, this feature is enabled on a platform. Use this procedure on a platform where it is disabled.

SUMMARY STEPS

1. Config terminal
2. service private-config-encryption
3. do write memory

DETAILED STEPS

	Command or Action	Purpose
Step 1	Config terminal **Example:** `router#config terminal`	Enters the configuration mode.
Step 2	service private-config-encryption **Example:**	Enables the Secure Storage feature on your platform.

	Command or Action	Purpose
	`router(config)# service private-config-encryption`	
Step 3	do write memory **Example:** `router(config)# do write memory`	Encrypts the private-config file and saves the file in an encrypted format.

Example

The following example shows how to enable Secure Storage:

```
router#config terminal
router(config)# service private-config-encryption
router(config)# do write memory
```

Disabling Secure Storage

Before you begin

To disable Secure Storage feature on a platform, perform this task:

SUMMARY STEPS

1. Config terminal
2. no service private-config-encryption
3. do write memory

DETAILED STEPS

	Command or Action	Purpose
Step 1	Config terminal **Example:** `router#config terminal`	Enters the configuration mode.
Step 2	no service private-config-encryption **Example:** `router(config)# no service private-config-encryption`	Disables the Secure Storage feature on your platform.
Step 3	do write memory **Example:** `router(config)# do write memory`	Decrypts the private-config file and saves the file in plane format.

Example

The following example shows how to disable Secure Storage:

```
router#config terminal
router(config)# no service private-config-encryption
router(config)# do write memory
```

Verifying the Status of Encryption

Use the **show parser encrypt file status** command to verify the status of encryption. The following command output indicates that the feature is available but the file is not encrypted. The file is in 'plain text' format.

```
router#show parser encrypt file status
Feature: Enabled
File Format: Plain Text
Encryption Version: Ver1
```

The following command output indicates that the feature is enabled and the file is encrypted. The file is in 'cipher text' format.

```
router#show parser encrypt file status
Feature: Enabled
File Format: Cipher Text
Encryption Version: Ver1
```

Verifying the Platform Identity

Use the **show platform sudi certificate** command to display the SUDI certificate in standard PEM format. The command output helps you verify the platform identity.

In the command output, the first certificate is the Cisco Root CA 2048 and the second is the Cisco subordinate CA (ACT2 SUDI CA). The third is the SUDI certificate.

```
router#show platform sudi certificate sign nonce 123
-----BEGIN CERTIFICATE-----
MIIDQzCCAiugAwIBAgIQX/h7KCtU3I1CoxW1aMmt/zANBgkqhkiG9w0BAQUFADA1
MRYwFAYDVQQKEw1DaXNjbyBTeXN0ZW1zMRswGQYDVQQDExJDaXNjbyBSb290IENB
IDIwNDgwHhcNMDQwNTE0MjAxNzEyWhcNMjkwNTE0MjAyNTQyWjA1MRYwFAYDVQQK
Ew1DaXNjbyBTeXN0ZW1zMRswGQYDVQQDExJDaXNjbyBSb290IENBIDIwNDgwggEg
MA0GCSqGSIb3DQEBAQUAA4IBDQAwggEIAoIBAQCwmrmrp68Kd6ficba0ZmKUeIhH
xmJVhEAyv8CrLqUccda8bnuoqrpu0hWISEWdovyD0My5jOAmaHBKeN8hF570YQXJ
FcjPFto1YYmUQ6iEqDGYeJu5Tm8sUxJszR2tKyS7McQr/4NEb7Y9JHcJ6r8qqB9q
VvYgDxFUl4F1pyXOWWqCZe+36ufijXWLbvLdT6ZeYpzPEApk0E5tzivMW/VgpSdH
jWn0f84bcN5wGyDWbs2mAag8EtKpP6BrXruOIIt6keO1aO6g58QBdKhTCytKmg9l
Eg6CTY5j/e/rmxrbU6YTYK/CfdfHbBcl1HP7R2RQgYCUTOG/rksc35LtLgXfAgED
o1EwTzALBgNVHQ8EBAMCAYYwDwYDVR0TAQH/BAUwAwEB/zAdBgNVHQ4EFgQUJ/PI
FR5umgIJFq0roIlgX9p7L6owEAYJKwYBBAGCNxUBBAMCAQAwDQYJKoZIhvcNAQEF
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```

```
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Signature:
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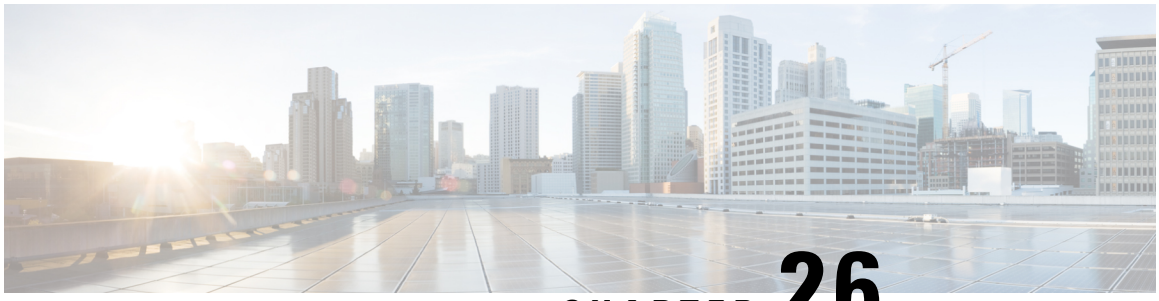
```



CHAPTER 26

Configuring Call Home

The Call Home feature provides e-mail-based and web-based notification of critical system events. A versatile range of message formats are available for optimal compatibility with pager services, standard e-mail, or XML-based automated parsing applications. Common uses of this feature may include direct paging of a network support engineer, e-mail notification to a Network Operations Center, XML delivery to a support website, and use of Cisco Smart Call Home services for direct case generation with the Cisco Systems Technical Assistance Center (TAC).

This chapter includes the following sections:

Finding Feature Information

Your software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use the Cisco Feature Navigator to find information about platform support and Cisco IOS and Catalyst OS software image support. To access Cisco Feature Navigator, see http://tools.cisco.com/ITDIT/CFN/. A Cisco account is not required to access the Cisco Feature Navigator.

Prerequisites for Call Home

The following are the prerequisites before you configure Call Home:

- Contact e-mail address (required for full registration with Smart Call Home, optional if Call Home is enabled in anonymous mode), phone number (optional), and street address information (optional) should be configured so that the receiver can determine the origin of messages received.

- At least one destination profile (predefined or user-defined) must be configured. The destination profile you use depends on whether the receiving entity is a pager, an e-mail address, or an automated service such as Cisco Smart Call Home.

  If the destination profile uses e-mail message delivery, you must specify a Simple Mail Transfer Protocol (SMTP) server.

- The router must have IP connectivity to an e-mail server or the destination HTTP server.
- If Cisco Smart Call Home is used, an active service contract covering the device is required to provide full Cisco Smart Call Home service.

Information About Call Home

The Call Home feature can deliver alert messages containing information on configuration, environmental conditions, inventory, syslog, snapshot, and crash events. It provides these alert messages as either e-mail-based or web-based messages. Multiple message formats are available, allowing for compatibility with pager services, standard e-mail, or XML-based automated parsing applications. This feature can deliver alerts to multiple recipients, referred to as Call Home destination profiles, each with configurable message formats and content categories. A predefined destination profile is provided for sending alerts to the Cisco TAC (callhome@cisco.com). You can also define your own destination profiles.

Flexible message delivery and format options make it easy to integrate specific support requirements.

This section contains the following subsections:

- Benefits of Using Call Home
- Obtaining Smart Call Home Services

Benefits of Using Call Home

The Call Home feature offers the following benefits:

- Multiple message-format options, which include:
  - Short Text—Suitable for pagers or printed reports.
  - Plain Text—Full formatted message information suitable for human reading.
  - XML—Machine-readable format using XML and Adaptive Markup Language (AML) document type definitions (DTDs). The XML format enables communication with the Cisco TAC.
- Multiple concurrent message destinations.
- Multiple message categories including configuration, environmental conditions, inventory, syslog, snapshot, and crash events.
- Filtering of messages by severity and pattern matching.
- Scheduling of periodic message sending.

Obtaining Smart Call Home Services

If you have a service contract directly with Cisco, you can register for the Smart Call Home service. Smart Call Home analyzes Smart Call Home messages and provides background information and recommendations. For known issues, particularly online diagnostics failures, Automatic Service Requests are generated with the Cisco TAC.

Smart Call Home offers the following features:

- Continuous device health monitoring and real-time diagnostic alerts.
- Analysis of Smart Call Home messages and, if needed, Automatic Service Request generation routed to the correct TAC team, including detailed diagnostic information to speed problem resolution.
- Secure message transport directly from your device or through an HTTP proxy server or a downloadable Transport Gateway (TG). You can use a TG aggregation point to support multiple devices or in cases where security dictates that your devices may not be connected directly to the Internet.
- Web-based access to Smart Call Home messages and recommendations, inventory, and configuration information for all Smart Call Home devices provides access to associated field notices, security advisories, and end-of-life information.

You need the following items to register for Smart Call Home:

- SMARTnet contract number for your router
- Your e-mail address
- Your Cisco.com username

For more information about Smart Call Home, see https://supportforums.cisco.com/community/4816/smart-call-home.

Anonymous Reporting

Smart Call Home is a service capability included with many Cisco service contracts and is designed to assist customers resolve problems more quickly. In addition, the information gained from crash messages helps Cisco understand equipment and issues occurring in the field. If you decide not to use Smart Call Home, you can still enable Anonymous Reporting to allow Cisco to securely receive minimal error and health information from the device. If you enable Anonymous Reporting, your customer identity will remain anonymous, and no identifying information will be sent.

Note When you enable Anonymous Reporting, you acknowledge your consent to transfer the specified data to Cisco or to vendors operating on behalf of Cisco (including countries outside the United States). Cisco maintains the privacy of all customers. For information about how Cisco treats personal information, see the Cisco Privacy Statement at http://www.cisco.com/web/siteassets/legal/privacy.html.

When Call Home is configured in an anonymous way, only crash, inventory, and test messages are sent to Cisco. No customer identifying information is sent.

For more information about what is sent in these messages, see Alert Group Trigger Events and Commands, on page 356.

How to Configure Call Home

The following sections show how to configure Call Home using a single command:

The following sections show detailed or optional configurations:

Configuring Smart Call Home (Single Command)

To enable all Call Home basic configurations using a single command, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home reporting** {**anonymous** | **contact-email-addr** *email-address*} [**http-proxy** {*ipv4-address* | *ipv6-address* | *name*} **port** *port-number*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home reporting** {**anonymous** | **contact-email-addr** *email-address*} [**http-proxy** {*ipv4-address* | *ipv6-address* | *name*} **port** *port-number*]	Enables the basic configurations for Call Home using a single command.

	Command or Action	Purpose
	Example: `Router(config)# call-home reporting contact-email-addr email@company.com`	• **anonymous**—Enables Call-Home TAC profile to send only crash, inventory, and test messages and send the messages anonymously. • **contact-email-addr**—Enables Smart Call Home service full reporting capability and sends a full inventory message from Call-Home TAC profile to Smart Call Home server to start full registration process. • **http-proxy** {*ipv4-address* | *ipv6-address* | *name*}—Configures an ipv4 or ipv6 address or server name. Maximum length is 64 characters. • **port** *port-number*—Port number. Range is 1 to 65535. **Note** The HTTP proxy option allows you to make use of your own proxy server to buffer and secure Internet connections from your devices. **Note** After successfully enabling Call Home either in anonymous or full registration mode using the **call-home reporting** command, an inventory message is sent out. If Call Home is enabled in full registration mode, a Full Inventory message for full registration mode is sent out. If Call Home is enabled in anonymous mode, an anonymous inventory message is sent out. For more information about what is sent in these messages, see Alert Group Trigger Events and Commands, on page 356.

Configuring and Enabling Smart Call Home

For application and configuration information about the Cisco Smart Call Home service, see the "Getting Started" section of the Smart Call Home User Guide at https://supportforums.cisco.com/community/4816/smart-call-home. This document includes configuration examples for sending Smart Call Home messages directly from your device or through a transport gateway (TG) aggregation point.

Note For security reasons, we recommend that you use the HTTPS transport options, due to the additional payload encryption that HTTPS offers. The Transport Gateway software is downloadable from Cisco.com and is available if you require an aggregation point or a proxy for connection to the Internet.

Enabling and Disabling Call Home

To enable or disable the Call Home feature, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **service call-home**
3. **no service call-home**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**service call-home** **Example:** `Router(config)# service call-home`	Enables the Call Home feature.
Step 3	**no service call-home** **Example:** `Router(config)# no service call-home`	Disables the Call Home feature.

Configuring Contact Information

Each router must include a contact e-mail address (except if Call Home is enabled in anonymous mode). You can optionally include a phone number, street address, contract ID, customer ID, and site ID.

To assign the contact information, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **contact-email-addr** *email-address*
4. **phone-number** *+phone-number*
5. **street-address** *street-address*
6. **customer-id** *text*
7. **site-id** *text*
8. **contract-id** *text*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters the Call Home configuration submode.
Step 3	**contact-email-addr** *email-address* **Example:** `Router(cfg-call-home)# contact-email-addr username@example.com`	Designates your e-mail address. Enter up to 200 characters in e-mail address format with no spaces.
Step 4	**phone-number** *+phone-number* **Example:** `Router(cfg-call-home)# phone-number +1-800-555-4567`	(Optional) Assigns your phone number. **Note** The number must begin with a plus (+) prefix and may contain only dashes (-) and numbers. Enter up to 17 characters. If you include spaces, you must enclose your entry in quotes (“”).
Step 5	**street-address** *street-address* **Example:** `Router(cfg-call-home)# street-address "1234 Picaboo Street, Any city, Any state, 12345"`	(Optional) Assigns your street address where RMA equipment can be shipped. Enter up to 200 characters. If you include spaces, you must enclose your entry in quotes (“”).
Step 6	**customer-id** *text* **Example:** `Router(cfg-call-home)# customer-id Customer1234`	(Optional) Identifies customer ID. Enter up to 64 characters. If you include spaces, you must enclose your entry in quotes (“”).
Step 7	**site-id** *text* **Example:** `Router(cfg-call-home)# site-id Site1ManhattanNY`	(Optional) Identifies customer site ID. Enter up to 200 characters. If you include spaces, you must enclose your entry in quotes (“”).
Step 8	**contract-id** *text* **Example:** `Router(cfg-call-home)# contract-id Company1234`	(Optional) Identifies your contract ID for the router. Enter up to 64 characters. If you include spaces, you must enclose your entry in quotes (“”).

Example

The following example shows how to configure contact information:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# call-home
```

```
Router(cfg-call-home)# contact-email-addr username@example.com
Router(cfg-call-home)# phone-number +1-800-555-4567
Router(cfg-call-home)# street-address "1234 Picaboo Street, Any city, Any state, 12345"
Router(cfg-call-home)# customer-id Customer1234
Router(cfg-call-home)# site-id Site1ManhattanNY
Router(cfg-call-home)# contract-id Company1234
Router(cfg-call-home)# exit
```

Configuring Destination Profiles

A destination profile contains the required delivery information for an alert notification. At least one destination profile is required. You can configure multiple destination profiles of one or more types.

You can create and define a new destination profile or copy and use the predefined destination profile. If you define a new destination profile, you must assign a profile name.

Note If you use the Cisco Smart Call Home service, the destination profile must use the XML message format.

You can configure the following attributes for a destination profile:

- Profile name—String that uniquely identifies each user-defined destination profile. The profile name is limited to 31 characters and is not case-sensitive.

Note You cannot use **all** as a profile name.

- Transport method—Transport mechanism, either e-mail or HTTP (including HTTPS), for delivery of alerts.
  - For user-defined destination profiles, e-mail is the default, and you can enable either or both transport mechanisms. If you disable both methods, e-mail is enabled.
  - For the predefined Cisco TAC profile, you can enable either transport mechanism, but not both.
- Destination address—The actual address related to the transport method to which the alert should be sent.
- Message formatting—The message format used for sending the alert. The format options for a user-defined destination profile are long-text, short-text, or XML. The default is XML. For the predefined Cisco TAC profile, only XML is allowed.
- Message size—The maximum destination message size. The valid range is 50 to 3,145,728 Bytes. The default is 3,145,728 Bytes.

  Anonymous reporting—You can choose for your customer identity to remain anonymous, and no identifying information is sent.
- Subscribing to interesting alert-groups—You can choose to subscribe to alert-groups highlighting your interests.

This section contains the following subsections:

Creating a New Destination Profile

To create and configure a new destination profile, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **profile** *name*
4. [**no**] **destination transport-method** {**email** | **http**}
5. **destination address** {**email** *email-address* | **http** *url*}
6. **destination preferred-msg-format** {**long-text** | **short-text** | **xml**}
7. **destination message-size-limit** *bytes*
8. **active**
9. **end**
10. **show call-home profile** {*name* | **all**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters the Call Home configuration submode.
Step 3	**profile** *name* **Example:** `Router(config-call-home)# profile profile1`	Enters the Call Home destination profile configuration submode for the specified destination profile. If the specified destination profile does not exist, it is created.
Step 4	[**no**] **destination transport-method** {**email** | **http**} **Example:** `Router(cfg-call-home-profile)# destination transport-method email`	(Optional) Enables the message transport method. The **no** option disables the method.
Step 5	**destination address** {**email** *email-address* | **http** *url*} **Example:** `Router(cfg-call-home-profile)# destination address email myaddress@example.com`	Configures the destination e-mail address or URL to which Call Home messages are sent. **Note** When entering a destination URL, include either **http://** or **https://**, depending on whether the server is a secure server.

	Command or Action	Purpose
Step 6	**destination preferred-msg-format** {**long-text** | **short-text** | **xml**} **Example:** `Router(cfg-call-home-profile)# destination preferred-msg-format xml`	(Optional) Configures a preferred message format. The default is XML.
Step 7	**destination message-size-limit** *bytes* **Example:** `Router(cfg-call-home-profile)# destination message-size-limit 3145728`	(Optional) Configures a maximum destination message size for the destination profile.
Step 8	**active** **Example:** `Router(cfg-call-home-profile)# active`	Enables the destination profile. By default, the profile is enabled when it is created.
Step 9	**end** **Example:** `Router(cfg-call-home-profile)# end`	Returns to privileged EXEC mode.
Step 10	**show call-home profile** {*name* | **all**} **Example:** `Router# show call-home profile profile1`	Displays the destination profile configuration for the specified profile or all configured profiles.

Copying a Destination Profile

To create a new destination profile by copying an existing profile, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **copy profile** *source-profile target-profile*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters the Call Home configuration submode.

	Command or Action	Purpose
Step 3	**copy profile** *source-profile target-profile* **Example:** `Router(cfg-call-home)# copy profile profile1 profile2`	Creates a new destination profile with the same configuration settings as the existing destination profile.

Setting Profiles to Anonymous Mode

To set an anonymous profile, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **profile** *name*
4. **anonymous-reporting-only**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters the Call Home configuration submode.
Step 3	**profile** *name* **Example:** `Router(cfg-call-home) profile Profile-1`	Enables the profile configuration mode.
Step 4	**anonymous-reporting-only** **Example:** `Router(cfg-call-home-profile)# anonymous-reporting-only`	Sets the profile to anonymous mode. **Note** By default, Call Home sends a full report of all types of events subscribed in the profile. When **anonymous-reporting-only** is set, only crash, inventory, and test messages will be sent.

Subscribing to Alert Groups

An alert group is a predefined subset of Call Home alerts supported in all routers. Different types of Call Home alerts are grouped into different alert groups depending on their type. The following alert groups are available:

- Crash

- Configuration
- Environment
- Inventory
- Snapshot
- Syslog

This section contains the following subsections:

- Periodic Notification, on page 330
- Message Severity Threshold, on page 331
- Configuring a Snapshot Command List, on page 331

The triggering events for each alert group are listed in Alert Group Trigger Events and Commands, on page 356, and the contents of the alert group messages are listed in Message Contents, on page 363.

You can select one or more alert groups to be received by a destination profile.

Note A Call Home alert is only sent to destination profiles that have subscribed to the alert group containing that Call Home alert. In addition, the alert group must be enabled.

To subscribe a destination profile to one or more alert groups, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **alert-group** {**all** | **configuration** | **environment** | **inventory** | **syslog** | **crash** | **snapshot**}
4. **profile** *name*
5. **subscribe-to-alert-group all**
6. **subscribe-to-alert-group configuration** [**periodic** {**daily** *hh:mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*}]
7. **subscribe-to-alert-group environment** [**severity** {**catastrophic** | **disaster** | **fatal** | **critical** | **major** | **minor** | **warning** | **notification** | **normal** | **debugging**}]
8. **subscribe-to-alert-group inventory** [**periodic** {**daily** *hh:mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*}]
9. **subscribe-to-alert-group syslog** [**severity** {**catastrophic** | **disaster** | **fatal** | **critical** | **major** | **minor** | **warning** | **notification** | **normal** | **debugging**}]
10. **subscribe-to-alert-group crash**
11. **subscribe-to-alert-group snapshot periodic** {**daily** *hh:mm* | **hourly** *mm* | **interval** *mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*}
12. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**alert-group** {**all** | **configuration** | **environment** | **inventory** | **syslog** | **crash** | **snapshot**} **Example:** `Router(cfg-call-home)# alert-group all`	Enables the specified alert group. Use the keyword **all** to enable all alert groups. By default, all alert groups are enabled.
Step 4	**profile** *name* **Example:** `Router(cfg-call-home)# profile profile1`	Enters the Call Home destination profile configuration submode for the specified destination profile.
Step 5	**subscribe-to-alert-group all** **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group all`	Subscribes to all available alert groups using the lowest severity. You can subscribe to alert groups individually by specific type, as described in Step 6 through Step 11. **Note** This command subscribes to the syslog debug default severity. This causes a large number of syslog messages to generate. You should subscribe to alert groups individually, using appropriate severity levels and patterns when possible.
Step 6	**subscribe-to-alert-group configuration** [**periodic** {**daily** *hh:mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*}] **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group configuration periodic daily 12:00`	Subscribes this destination profile to the Configuration alert group. The Configuration alert group can be configured for periodic notification, as described in Periodic Notification, on page 330.
Step 7	**subscribe-to-alert-group environment** [**severity** {**catastrophic** | **disaster** | **fatal** | **critical** | **major** | **minor** | **warning** | **notification** | **normal** | **debugging**}] **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group environment severity major`	Subscribes this destination profile to the Environment alert group. The Environment alert group can be configured to filter messages based on severity, as described in Message Severity Threshold, on page 331.

	Command or Action	Purpose
Step 8	**subscribe-to-alert-group inventory** [**periodic** {**daily** *hh:mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*}] **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group inventory periodic monthly 1 12:00`	Subscribes this destination profile to the Inventory alert group. The Inventory alert group can be configured for periodic notification, as described in Periodic Notification, on page 330.
Step 9	**subscribe-to-alert-group syslog** [**severity** {**catastrophic** | **disaster** | **fatal** | **critical** | **major** | **minor** | **warning** | **notification** | **normal** | **debugging**}] **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group environment severity major`	Subscribes this destination profile to the Syslog alert group. The Syslog alert group can be configured to filter messages based on severity, as described in Message Severity Threshold, on page 331. You can specify a text pattern to be matched within each syslog message. If you configure a pattern, a Syslog alert group message is sent only if it contains the specified pattern and meets the severity threshold. If the pattern contains spaces, you must enclose it in quotes (“”). You can specify up to five patterns for each destination profile.
Step 10	**subscribe-to-alert-group crash** **Example:** `Router(cfg-call-home-profile)# [no | default] subscribe-to-alert-group crash`	Subscribes to the Crash alert group in user profile. By default, TAC profile subscribes to the Crash alert group and cannot be unsubscribed.
Step 11	**subscribe-to-alert-group snapshot periodic** {**daily** *hh:mm* | **hourly** *mm* | **interval** *mm* | **monthly** *date hh:mm* | **weekly** *day hh:mm*} **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group snapshot periodic daily 12:00`	Subscribes this destination profile to the Snapshot alert group. The Snapshot alert group can be configured for periodic notification, as described in Periodic Notification, on page 330. By default, the Snapshot alert group has no command to run. You can add commands into the alert group, as described in Configuring a Snapshot Command List, on page 331. In doing so, the output of the commands added in the Snapshot alert group will be included in the snapshot message.
Step 12	**exit** **Example:** `Router(cfg-call-home-profile)# exit`	Exits the Call Home destination profile configuration submode.

Periodic Notification

When you subscribe a destination profile to the Configuration, Inventory, or Snapshot alert group, you can choose to receive the alert group messages asynchronously or periodically at a specified time. The sending period can be one of the following:

- Daily—Specifies the time of day to send, using an hour:minute format *hh:mm*, with a 24-hour clock (for example, 14:30).

- Weekly—Specifies the day of the week and time of day in the format *day hh:mm*, where the day of the week is spelled out (for example, Monday).
- Monthly—Specifies the numeric date, from 1 to 31, and the time of day, in the format *date hh:mm*.
- Interval—Specifies the interval at which the periodic message is sent, from 1 to 60 minutes.
- Hourly—Specifies the minute of the hour at which the periodic message is sent, from 0 to 59 minutes.

Note Hourly and by interval periodic notifications are available for the Snapshot alert group only.

Message Severity Threshold

When you subscribe a destination profile to the Environment or Syslog alert group, you can set a threshold for the sending of alert group messages based on the level of severity of the message. Any message with a value lower than the destination profile specified threshold is not sent to the destination.

The severity threshold is configured using the keywords listed in the following table. The severity threshold ranges from catastrophic (level 9, highest level of urgency) to debugging (level 0, lowest level of urgency). If no severity threshold is configured for the Syslog or Environment alert groups, the default is debugging (level 0). The Configuration and Inventory alert groups do not allow severity configuration; severity is always set as normal.

Note Call Home severity levels are not the same as system message logging severity levels.

Table 32: Severity and Syslog Level Mapping

Level	Keyword	Syslog Level	Description
9	catastrophic	—	Network-wide catastrophic failure.
8	disaster	—	Significant network impact.
7	fatal	Emergency (0)	System is unusable.
6	critical	Alert (1)	Critical conditions, immediate attention needed.
5	major	Critical (2)	Major conditions.
4	minor	Error (3)	Minor conditions.
3	warning	Warning (4)	Warning conditions.
2	notification	Notice (5)	Basic notification and informational messages. Possibly independently insignificant.
1	normal	Information (6)	Normal event signifying return to normal state.
0	debugging	Debug (7)	Debugging messages.

Configuring a Snapshot Command List

To configure a snapshot command list, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. [**no** | **default**] **alert-group-config snapshot**
4. [**no** | **default**] **add-command** *command string*
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	[**no** | **default**] **alert-group-config snapshot** **Example:** `Router(cfg-call-home)# alert-group-config snapshot`	Enters snapshot configuration mode. The **no** or **default** command will remove all snapshot command.
Step 4	[**no** | **default**] **add-command** *command string* **Example:** `Router(cfg-call-home-snapshot)# add-command "show version"`	Adds the command to the Snapshot alert group. The **no** or **default** command removes the corresponding command. • *command string*—IOS command. Maximum length is 128.
Step 5	**exit** **Example:** `Router(cfg-call-home-snapshot)# exit`	Exits and saves the configuration.

Configuring General E-Mail Options

To use the e-mail message transport, you must configure at least one Simple Mail Transfer Protocol (SMTP) e-mail server address. You can configure the from and reply-to e-mail addresses, and you can specify up to four backup e-mail servers.

Note the following guidelines when configuring general e-mail options:

- Backup e-mail servers can be defined by repeating the **mail-server** command using different priority numbers.
- The **mail-server priority** number parameter can be configured from 1 to 100. The server with the highest priority (lowest priority number) is tried first.

To configure general e-mail options, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **mail-server** [{*ipv4-address* | *ipv6-address*} | *name*] **priority** *number*
4. **sender from** *email-address*
5. **sender reply-to** *email-address*
6. **source-interface** *interface-name*
7. **vrf** *vrf-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**mail-server** [{*ipv4-address* | *ipv6-address*} | *name*] **priority** *number* **Example:** `Router(cfg-call-home)# mail-server stmp.example.com priority 1`	Assigns an e-mail server address and its relative priority among configured e-mail servers. Provide either of these: • The e-mail server's IP address. • The e-mail server's fully qualified domain name (FQDN) of 64 characters or less. Assign a priority number between 1 (highest priority) and 100 (lowest priority).
Step 4	**sender from** *email-address* **Example:** `Router(cfg-call-home)# sender from username@example.com`	(Optional) Assigns the e-mail address that appears in the from field in Call Home e-mail messages. If no address is specified, the contact e-mail address is used.
Step 5	**sender reply-to** *email-address* **Example:** `Router(cfg-call-home)# sender reply-to username@example.com`	(Optional) Assigns the e-mail address that appears in the reply-to field in Call Home e-mail messages.
Step 6	**source-interface** *interface-name* **Example:** `Router(cfg-call-home)# source-interface loopback1`	Assigns the source interface name to send call-home messages. • *interface-name*—Source interface name. Maximum length is 64.

	Command or Action	Purpose
		Note For HTTP messages, use the **ip http client source-interface** *interface-name* command in global configuration mode to configure the source interface name. This allows all HTTP clients on the device to use the same source interface.
Step 7	**vrf** *vrf-name* **Example:** `Router(cfg-call-home)# vrf vpn1`	(Optional) Specifies the VRF instance to send call-home e-mail messages. If no vrf is specified, the global routing table is used. **Note** For HTTP messages, if the source interface is associated with a VRF, use the **ip http client source-interface** *interface-name* command in global configuration mode to specify the VRF instance that will be used for all HTTP clients on the device.

Example

The following example shows the configuration of general e-mail parameters, including a primary and secondary e-mail server:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# call-home
Router(cfg-call-home)# mail-server smtp.example.com priority 1
Router(cfg-call-home)# mail-server 192.0.2.1 priority 2
Router(cfg-call-home)# sender from username@example.com
Router(cfg-call-home)# sender reply-to username@example.com
Router(cfg-call-home)# source-interface loopback1
Router(cfg-call-home)# vrf vpn1
Router(cfg-call-home)# exit
Router(config)#
```

Specifying Rate Limit for Sending Call Home Messages

To specify the rate limit for sending Call Home messages, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **rate-limit** *number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**rate-limit** *number* **Example:** `Router(cfg-call-home)# rate-limit 40`	Specifies a limit on the number of messages sent per minute. • *number*—Range is 1 to 60. The default is 20.

Specifying HTTP Proxy Server

To specify an HTTP proxy server for sending Call Home HTTP(S) messages to a destination, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **http-proxy** {*ipv4-address* | *ipv6-address* | *name*} **port** *port-number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**http-proxy** {*ipv4-address* | *ipv6-address* | *name*} **port** *port-number* **Example:** `Router(cfg-call-home)# http-proxy 192.0.2.1 port 1`	Specifies the proxy server for the HTTP request.

Enabling AAA Authorization to Run IOS Commands for Call Home Messages

To specify an HTTP proxy server for sending Call Home HTTP(S) messages to a destination, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **aaa-authorization**
4. **aaa-authorization** [**username** *username*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**aaa-authorization** **Example:** `Router(cfg-call-home)# aaa-authorization`	Enables AAA authorization. **Note** By default, AAA authorization is disabled for Call Home.
Step 4	**aaa-authorization** [**username** *username*] **Example:** `Router(cfg-call-home)# aaa-authorization username user`	Specifies the username for authorization. • **username** *username*—Default username is callhome. Maximum length is 64.

Configuring Syslog Throttling

To specify an HTTP proxy server for sending Call Home HTTP(S) messages to a destination, perform the following steps:

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. [**no**] **syslog-throttling**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	[**no**] **syslog-throttling** **Example:** `Router(cfg-call-home)# syslog-throttling`	Enables or disables call-home syslog message throttling and avoids sending repetitive call-home syslog messages. **Note** By default, syslog message throttling is enabled.

Configuring Call Home Data Privacy

The data-privacy command scrubs data, such as IP addresses, from running configuration files to protect the privacy of customers. Enabling the data-privacy command can affect CPU utilization when scrubbing a large amount of data. Currently, the **show** command output is not being scrubbed except for configuration messages in the outputs for the **show running-config all** and the**show startup-config data** commands.

SUMMARY STEPS

1. **configure terminal**
2. **call-home**
3. **data-privacy** {**level** {**normal** | **high**} | **hostname**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**call-home** **Example:** `Router(config)# call-home`	Enters Call Home configuration submode.
Step 3	**data-privacy** {**level** {**normal**	**high**}	**hostname**} **Example:** `Router(cfg-call-home)# data-privacy level high`	Scrubs data from running configuration file to protect the privacy of the user. The default data-privacy level is normal. **Note** Enabling the data-privacy command can affect CPU utilization when scrubbing a large amount of data.

	Command or Action	Purpose
		• **normal**—Scrubs all normal-level commands. • **high**—Scrubs all normal-level commands plus the IP domain name and IP address commands. • **hostname**—Scrubs all high-level commands plus the hostname command. **Note** Scrubbing the hostname from configuration messages can cause Smart Call Home processing failure on some platforms.

Sending Call Home Communications Manually

You can manually send several types of Call Home communications. To send Call Home communications, perform the tasks in this section. This section contains the following subsections:

Sending a Call Home Test Message Manually

You can use the **call-home test** command to send a user-defined Call Home test message.

To manually send a Call Home test message, perform the following step:

SUMMARY STEPS

1. **call-home test** [*"test-message"*] **profile** *name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**call-home test** [*"test-message"*] **profile** *name* **Example:** `Router# call-home test profile profile1`	Sends a test message to the specified destination profile. The user-defined test message text is optional but must be enclosed in quotes ("") if it contains spaces. If no user-defined message is configured, a default message is sent.

Sending Call Home Alert Group Messages Manually

You can use the **call-home send** command to manually send a specific alert group message.

Note the following guidelines when manually sending a Call Home alert group message:

- Only the crash, snapshot, configuration, and inventory alert groups can be sent manually.

- When you manually trigger a crash, snapshot, configuration, or inventory alert group message and you specify a destination profile name, a message is sent to the destination profile regardless of the profile's active status, subscription status, or severity setting.
- When you manually trigger a crash, snapshot, configuration, or inventory alert group message and do not specify a destination profile name, a message is sent to all active profiles that have either a normal or periodic subscription to the specified alert group.

To manually trigger Call Home alert group messages, perform the following steps:

SUMMARY STEPS

1. **call-home send alert-group snapshot** [**profile** *name*]
2. **call-home send alert-group crash** [**profile** *name*]
3. **call-home send alert-group configuration** [**profile** *name*]
4. **call-home send alert-group inventory** [**profile** *name*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**call-home send alert-group snapshot** [**profile** *name*] **Example:** `Router# call-home send alert-group snapshot profile profile1`	Sends a snapshot alert group message to one destination profile if specified, or to all subscribed destination profiles.
Step 2	**call-home send alert-group crash** [**profile** *name*] **Example:** `Router# call-home send alert-group crash profile profile1`	Sends a crash alert group message to one destination profile if specified, or to all subscribed destination profiles.
Step 3	**call-home send alert-group configuration** [**profile** *name*] **Example:** `Router# call-home send alert-group configuration profile profile1`	Sends a configuration alert group message to one destination profile if specified, or to all subscribed destination profiles.
Step 4	**call-home send alert-group inventory** [**profile** *name*] **Example:** `Router# call-home send alert-group inventory profile profile1`	Sends an inventory alert group message to one destination profile if specified, or to all subscribed destination profiles.

Submitting Call Home Analysis and Report Requests

You can use the **call-home request** command to submit information about your system to Cisco to receive helpful analysis and report information specific to your system. You can request a variety of reports, including security alerts, known bugs, best practices, and command references.

Note the following guidelines when manually sending Call Home analysis and report requests:

- If a **profile** *name* is specified, the request is sent to the profile. If no profile is specified, the request is sent to the Cisco TAC profile. The recipient profile does not need to be enabled for the call-home request. The profile should specify the e-mail address where the transport gateway is configured so that the request message can be forwarded to the Cisco TAC and the user can receive the reply from the Smart Call Home service.
- The **ccoid** *user-id* is the registered identifier of the Smart Call Home user. If the *user-id* is specified, the response is sent to the e-mail address of the registered user. If no *user-id* is specified, the response is sent to the contact e-mail address of the device.
- Based on the keyword specifying the type of report requested, the following information is returned:
  - **config-sanity**—Information on best practices as related to the current running configuration.
  - **bugs-list**—Known bugs in the running version and in the currently applied features.
  - **command-reference**—Reference links to all commands in the running configuration.
  - **product-advisory**—Product Security Incident Response Team (PSIRT) notices, End of Life (EOL) or End of Sales (EOS) notices, or field notices (FN) that may affect the devices in your network.

To submit a request for analysis and report information from the Cisco Output Interpreter tool, perform the following steps:

SUMMARY STEPS

1. **call-home request output-analysis** *"show-command"* [**profile** *name*] [**ccoid** *user-id*]
2. **call-home request** {**config-sanity** | **bugs-list** | **command-reference** | **product-advisory**} [**profile** *name*] [**ccoid** *user-id*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**call-home request output-analysis** *"show-command"* [**profile** *name*] [**ccoid** *user-id*] **Example:** `Router# call-home request output-analysis "show diag" profile TG`	Sends the output of the specified show command for analysis. The show command must be contained in quotes ("").
Step 2	**call-home request** {**config-sanity** | **bugs-list** | **command-reference** | **product-advisory**} [**profile** *name*] [**ccoid** *user-id*] **Example:** `Router# call-home request config-sanity profile TG`	Sends the output of a predetermined set of commands such as the **show running-config all**, **show version** or **show module** commands, for analysis. In addition, the **call home request product-advisory** sub-command includes all inventory alert group commands. The keyword specified after **request** specifies the type of report requested.

Example

The following example shows a request for analysis of a user-specified **show** command:

```
Router# call-home request output-analysis "show diag" profile TG
```

Manually Sending Command Output Message for One Command or a Command List

You can use the **call-home send** command to execute an IOS command or a list of IOS commands and send the command output through HTTP or e-mail protocol.

Note the following guidelines when sending the output of a command:

- The specified IOS command or list of IOS commands can be any run command, including commands for all modules. The command must be contained in quotes (“”).
- If the e-mail option is selected using the “email” keyword and an e-mail address is specified, the command output is sent to that address. If neither the e-mail nor the HTTP option is specified, the output is sent in long-text format with the specified service request number to the Cisco TAC (attach@cisco.com).
- If neither the “email” nor the “http” keyword is specified, the service request number is required for both long-text and XML message formats and is provided in the subject line of the e-mail.
- If the HTTP option is specified, the CiscoTac-1 profile destination HTTP or HTTPS URL is used as the destination. The destination e-mail address can be specified so that Smart Call Home can forward the message to the e-mail address. The user must specify either the destination e-mail address or an SR number but they can also specify both.

To execute a command and send the command output, perform the following step:

SUMMARY STEPS

1. **call-home send** {*cli command* | *cli list*} [**email** *email* **msg-format** {**long-text** | **xml**} | **http** {**destination-email-address** *email*}] [**tac-service-request** *SR#*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**call-home send** {*cli command* | *cli list*} [**email** *email* **msg-format** {**long-text** | **xml**} | **http** {**destination-email-address** *email*}] [**tac-service-request** *SR#*] **Example:** `Router# call-home send “show version;show running-config;show inventory” email support@example.com msg-format xml`	Executes the CLI or CLI list and sends output via e-mail or HTTP. • {*cli command* | *cli list*}—Specifies the IOS command or list of IOS commands (separated by ‘;’). It can be any run command, including commands for all modules. The commands must be contained in quotes (“”). • **email** *email* **msg-format {long-text | xml}**—If the **email** option is selected, the command output will be sent to the specified e-mail address in long-text or XML format with the service request number in the subject. The e-mail address, the service request number, or both must be specified. The service request number is required if the e-mail address is not specified (default is attach@cisco.com for long-text format and callhome@cisco.com for XML format). • **http** {**destination-email-address** *email*}—If the **http** option is selected, the command output will be sent to

	Command or Action	Purpose
		Smart Call Home backend server (URL specified in TAC profile) in XML format. **destination-email-address** *email* can be specified so that the backend server can forward the message to the e-mail address. The e-mail address, the service request number, or both must be specified. • **tac-service-request** *SR#*—Specifies the service request number. The service request number is required if the e-mail address is not specified.

Example

The following example shows how to send the output of a command to a user-specified e-mail address:

```
Router# call-home send "show diag" email support@example.com
```

The following example shows the command output sent in long-text format to attach@cisco.com, with the SR number specified:

```
Router# call-home send "show version; show run" tac-service-request 123456
```

The following example shows the command output sent in XML message format to callhome@cisco.com:

```
Router# call-home send "show version; show run" email callhome@cisco.com msg-format xml
```

The following example shows the command output sent in XML message format to the Cisco TAC backend server, with the SR number specified:

```
Router# call-home send "show version; show run" http tac-service-request 123456
```

The following example shows the command output sent to the Cisco TAC backend server through the HTTP protocol and forwarded to a user-specified email address:

```
Router# call-home send "show version; show run" http destination-email-address
user@company.com
```

Configuring Diagnostic Signatures

The Diagnostic Signatures feature downloads digitally signed signatures to devices. Diagnostic Signatures (DS) files are formatted files that collate knowledge of diagnostic events and provide methods to troubleshoot them without a need to upgrade the Cisco software. The aim of DS is to deliver flexible intelligence that can detect and collect troubleshooting information that can be used to resolve known problems in customers networks.

Information About Diagnostic Signatures

Diagnostic Signatures Overview

Diagnostic signatures (DS) for the Call Home system provides a flexible framework that allows the defining of new events and corresponding CLIs that can analyze these events without upgrading the Cisco software.

DSs provide the ability to define more types of events and trigger types than the standard Call Home feature supports. The DS subsystem downloads and processes files on a device as well as handles callbacks for diagnostic signature events.

The Diagnostic Signature feature downloads digitally signed signatures that are in the form of files to devices. DS files are formatted files that collate the knowledge of diagnostic events and provide methods to troubleshoot these events.

DS files contain XML data to specify the event description, and these files include CLI commands or scripts to perform required actions. These files are digitally signed by Cisco or a third party to certify their integrity, reliability, and security.

The structure of a DS file can be one of the following formats:

- Metadata-based simple signature that specifies the event type and contains other information that can be used to match the event and perform actions such as collecting information by using the CLI. The signature can also change configurations on the device as a workaround for certain bugs.
- Embedded Event Manager (EEM) Tool Command Language (Tcl) script-based signature that specifies new events in the event register line and additional action in the Tcl script.
- Combination of both the formats above.

The following basic information is contained in a DS file:

- **ID (unique number)**—Unique key that represents a DS file that can be used to search a DS.
- **Name (ShortDescription)**—Unique description of the DS file that can be used in lists for selection.
- **Description**—Long description about the signature.
- **Revision**—Version number, which increments when the DS content is updated.
- **Event & Action**—Defines the event to be detected and the action to be performed after the event happens.

Prerequisites for Diagnostic Signatures

Before you download and configure diagnostic signatures (DSs) on a device, you must ensure that the following conditions are met:

- You must assign one or more DSs to the device. For more information on how to assign DSs to devices, see Downloading Diagnostic Signatures, on page 344.
- HTTP/Secure HTTP (HTTPS) transport is required for downloading DS files. You must install the certification authority (CA) certificate to enable the authentication of the destination HTTPS server.

Note If you configure the trustpool feature, the CA certificate is not required.

Downloading Diagnostic Signatures

To download the diagnostic signature (DS) file, you require the secure HTTP (HTTPS) protocol. If you have already configured an email transport method to download files on your device, you must change your assigned profile transport method to HTTPS to download and use DS.

Cisco software uses a PKI Trustpool Management feature, which is enabled by default on devices, to create a scheme to provision, store, and manage a pool of certificates from known certification authorities (CAs). The trustpool feature installs the CA certificate automatically. The CA certificate is required for the authentication of the destination HTTPS servers.

There are two types of DS update requests to download DS files: regular and forced-download. Regular download requests DS files that were recently updated. You can trigger a regular download request either by using a periodic configuration or by initiating an on-demand CLI. The regular download update happens only when the version of the requested DS is different from the version of the DS on the device. Periodic download is only started after there is any DS assigned to the device from DS web portal. After the assignment happens, the response to the periodic inventory message from the same device will include a field to notify device to start its periodic DS download/update. In a DS update request message, the status and revision number of the DS is included such that only a DS with the latest revision number is downloaded.

Forced-download downloads a specific DS or a set of DSes. You can trigger the forced-download update request only by initiating an on-demand CLI. In a force-download update request, the latest version of the DS file is downloaded irrespective of the current DS file version on the device.

The DS file is digitally signed, and signature verification is performed on every downloaded DS file to make sure it is from a trusted source.

Diagnostic Signature Workflow

The diagnostic signature feature is enabled by default in Cisco software. The following is the workflow for using diagnostic signatures:

- Find the DS(es) you want to download and assign them to the device. This step is mandatory for regular periodic download, but not required for forced download.
- The device downloads all assigned DS(es) or a specific DS by regular periodic download or by on-demand forced download.

- The device verifies the digital signature of every single DS. If verification passes, the device stores the DS file into a non-removable disk, such as bootflash or hard disk, so that DS files can be read after the device is reloaded. On the router, the DS file is stored in the bootflash:/call home directory.
- The device continues sending periodic regular DS download requests to get the latest revision of DS and replace the older one in device.
- The device monitors the event and executes the actions defined in the DS when the event happens.

Diagnostic Signature Events and Actions

The events and actions sections are the key areas used in diagnostic signatures. The event section defines all event attributes that are used for event detection. The action section lists all actions which should be performed after the event happens, such as collecting show command outputs and sending them to Smart Call Home to parse.

Diagnostic Signature Event Detection

Event detection in a DS is defined in two ways: single event detection and multiple event detection.

Single Event Detection

In single event detection, only one event detector is defined within a DS. The event specification format is one of the following two types:

- DS event specification type: syslog, periodic, configuration, Online Insertion Removal (OIR) immediate, and call home are the supported event types, where “immediate” indicates that this type of DS does not detect any events, its actions are performed once it is downloaded, and the call-home type modifies the current CLI commands defined for existing alert-group.
- The Embedded Event Manager (EEM) specification type: supports any new EEM event detector without having to modify the Cisco software.

  Other than using EEM to detect events, a DS is triggered when a Tool Command Language (Tcl) script is used to specify event detection types.

Multiple Event Detection

Multiple event detection involves defining two or more event detectors, two ore more corresponding tracked object states, and a time period for the events to occur. The specification format for multiple event detection can include complex event correlation for tracked event detectors. For example, three event detectors (syslog, OIR, and IPSLA) are defined during the creation of a DS file. The correlation that is specified for these event detectors is that the DS will execute its action if both syslog and OIR events are triggered simultaneously, or if IPSLA is triggered alone.

Diagnostic Signature Actions

The diagnostic signature (DS) file consists of various actions that must be initiated when an event occurs. The action type indicates the kind of action that will be initiated in response to a certain event.

Variables are elements within a DS that are used to customize the files.

DS actions are categorized into the following four types:

- call-home

- command
- emailto
- script

DS action types call-home and emailto collect event data and send a message to call-home servers or to the defined email addresses. The message uses “diagnostic-signature” as its message type and DS ID as the message sub-type.

The commands defined for the DS action type initiate CLI commands that can change configuration of the device, collect show command outputs, or run any EXEC command on the device. The DS action type script executes Tcl scripts.

Diagnostic Signature Variables

Variables are referenced within a DS and are used to customize the DS file. All DS variable names have the prefix ds_ to separate them from other variables. The following are the supported DS variable types:

- System variable: variables assigned automatically by the device without any configuration changes. The Diagnostic Signatures feature supports two system variables: ds_hostname and ds_signature_id.
- Environment variable: values assigned manually by using the **environment** *variable-name variable-value* command in call-home diagnostic-signature configuration mode. Use the **show call-home diagnostic-signature** command to display the name and value of all DS environment variables. If the DS file contains unresolved environment variables, this DS will stay in pending status until the variable gets resolved.
- Prompt variable: values assigned manually by using the **call-home diagnostic-signature install** *ds-id* command in privileged EXEC mode. If you do not set this value, the status of the DS indicates pending.
- Regular expression variable: values assigned from a regular expression pattern match with predefined CLI command outputs. The value is assigned during the DS run.
- Syslog event variable: values assigned during a syslog event detection in the DS file. This variable is valid only for syslog event detection.

How to Configure Diagnostic Signatures

- Configuring the Call Home Service for Diagnostic Signatures, on page 346
- Configuring Diagnostic Signatures, on page 348

Configuring the Call Home Service for Diagnostic Signatures

Configure the Call Home Service feature to set attributes such as the contact email address where notifications related with diagnostic signatures (DS) are sent and destination HTTP/secure HTTP (HTTPS) URL to download the DS files from.

You can also create a new user profile, configure correct attributes and assign it as the DS profile. For periodic downloads, the request is sent out just following full inventory message. By changing the inventory periodic configuration, the DS periodic download also gets rescheduled.

Note The predefined CiscoTAC-1 profile is enabled as a DS profile by default and we recommend that you use it. If used, you only need to change the destination transport-method to the **http** setting.

SUMMARY STEPS

1. **configure terminal**
2. **service call-home**
3. **call-home**
4. **contact-email-addr** *email-address*
5. **mail-server** {*ipv4-addr* | *name*} **priority** *number*
6. **profile** *profile-name*
7. **destination transport-method** {**email** | **http**}
8. **destination address** {**email** *address* | **http** *url*}
9. **subscribe-to-alert-group inventory** [**periodic** {**daily** *hh:mm* | **monthly** *day hh:mm* | **weekly** *day hh:mm*}]
10. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**service call-home** **Example:** `Router(config)# service call-home`	Enables Call Home service on a device.
Step 3	**call-home** **Example:** `Router(config)# call-home`	Enters call-home configuration mode for the configuration of Call Home settings.
Step 4	**contact-email-addr** *email-address* **Example:** `Router(cfg-call-home)# contact-email-addr userid@example.com`	(Optional) Assigns an email address to be used for Call Home customer contact.
Step 5	**mail-server** {*ipv4-addr* | *name*} **priority** *number* **Example:** `Router(cfg-call-home)# mail-server 10.1.1.1 priority 4`	(Optional) Configures a Simple Mail Transfer Protocol (SMTP) email server address for Call Home. This command is only used when sending email is part of the actions defined in any DS.
Step 6	**profile** *profile-name* **Example:**	Configures a destination profile for Call Home and enters call-home profile configuration mode.

	Command or Action	Purpose
	`Router(cfg-call-home)# profile user1`	
Step 7	**destination transport-method** {**email** | **http**} **Example:** `Router(cfg-call-home-profile)# destination transport-method http`	Specifies a transport method for a destination profile in the Call Home. **Note** To configure diagnostic signatures, you must use the **http** option.
Step 8	**destination address** {**email** *address* | **http** *url*} **Example:** `Router(cfg-call-home-profile)# destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService`	Configures the address type and location to which call-home messages are sent. **Note** To configure diagnostic signatures, you must use the **http** option.
Step 9	**subscribe-to-alert-group inventory** [**periodic** {**daily** *hh:mm* | **monthly** *day hh:mm* | **weekly** *day hh:mm*}] **Example:** `Router(cfg-call-home-profile)# subscribe-to-alert-group inventory periodic daily 14:30`	Configures a destination profile to send messages for the Inventory alert group for Call Home. • This command is used only for the periodic downloading of DS files.
Step 10	**exit** **Example:** `Router(cfg-call-home-profile)# exit`	Exits call-home profile configuration mode and returns to call-home configuration mode.

What to do next

Set the profile configured in the previous procedure as the DS profile and configure other DS parameters.

Configuring Diagnostic Signatures

Before you begin

Configure the Call Home feature to set attributes for the Call Home profile. You can either use the default CiscoTAC-1 profile or use the newly-created user profile.

SUMMARY STEPS

1. **call-home**
2. **diagnostic-signature**
3. **profile** *ds-profile-name*
4. **environment** *ds_env-var-name ds-env-var-value*
5. **end**
6. **call-home diagnostic-signature** [{**deinstall** \| **download**} {*ds-id* \| **all**} \| **install** *ds-id*]
7. **show call-home diagnostic-signature** [*ds-id* {**actions** \| **events** \| **prerequisite** \| **prompt** \| **variables** \| **failure** \| **statistics** \| **download**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**call-home** **Example:** `Router(config)# call-home`	Enters call-home configuration mode for the configuration of Call Home settings.
Step 2	**diagnostic-signature** **Example:** `Router(cfg-call-home)# diagnostic-signature`	Enters call-home diagnostic signature mode.
Step 3	**profile** *ds-profile-name* **Example:** `Router(cfg-call-home-diag-sign)# profile user1`	Specifies the destination profile on a device that DS uses.
Step 4	**environment** *ds_env-var-name ds-env-var-value* **Example:** `Router(cfg-call-home-diag-sign)# environment ds_env1 envarval`	Sets the environment variable value for DS on a device.
Step 5	**end** **Example:** `Router(cfg-call-home-diag-sign)# end`	Exits call-home diagnostic signature mode and returns to privileged EXEC mode.
Step 6	**call-home diagnostic-signature** [{**deinstall** | **download**} {*ds-id* | **all**} | **install** *ds-id*] **Example:** `Router# call-home diagnostic-signature download 6030`	Downloads, installs, and uninstalls diagnostic signature files on a device.
Step 7	**show call-home diagnostic-signature** [*ds-id* {**actions** | **events** | **prerequisite** | **prompt** | **variables** | **failure** | **statistics** | **download**}] **Example:** `Router# show call-home diagnostic-signature actions`	Displays the call-home diagnostic signature information.

Configuration Examples for Diagnostic Signatures

The following example shows how to enable the periodic downloading request for diagnostic signature (DS) files. This configuration will send download requests to the service call-home server daily at 2:30 p.m. to check for updated DS files. The transport method is set to HTTP.

```
Router> enable
Router# configure terminal
Router(config)# service call-home
Router(config)# call-home
Router(cfg-call-home)# contact-email-addr userid@example.com
Router(cfg-call-home)# mail-server 10.1.1.1 priority 4
Router(cfg-call-home)# profile user-1
```

```
Router(cfg-call-home-profile)# destination transport-method http
Router(cfg-call-home-profile)# destination address http
https://tools.cisco.com/its/service/oddce/services/DDCEService
Router(cfg-call-home-profile)# subscribe-to-alert-group inventory periodic daily 14:30
Router(cfg-call-home-profile)# exit
Router(cfg-call-home)# diagnostic-signature
Router(cfg-call-home-diag-sign)# profile user1
Router(cfg-call-home-diag-sign)# environment ds_env1 envarval
Router(cfg-call-home-diag-sign)# end
```

The following is sample output from the **show call-home diagnostic-signature** command for the configuration displayed above:

```
outer# show call-home diagnostic-signature

Current diagnostic-signature settings:
Diagnostic-signature: enabled
Profile: user1 (status: ACTIVE)
Environment variable:
ds_env1: abc
Downloaded DSes:
DS ID    DS Name                          Revision Status     Last Update (GMT+00:00)
-------- -------------------------------- -------- ---------- -------------------
6015     CronInterval                     1.0      registered 2013-01-16 04:49:52
6030     ActCH                            1.0      registered 2013-01-16 06:10:22
6032     MultiEvents                      1.0      registered 2013-01-16 06:10:37
6033     PureTCL                          1.0      registered 2013-01-16 06:11:48
```

Displaying Call Home Configuration Information

You can use variations of the **show call-home** command to display Call Home configuration information.

To display the configured Call Home information, perform the following:

SUMMARY STEPS

1. **show call-home**
2. **show call-home detail**
3. **show call-home alert-group**
4. **show call-home mail-server status**
5. **show call-home profile** {**all** | *name*}
6. **show call-home statistics** [**detail** | **profile** *profile_name*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show call-home** **Example:** `Router# show call-home`	Displays the Call Home configuration in summary.
Step 2	**show call-home detail** **Example:**	Displays the Call Home configuration in detail.

	Command or Action	Purpose
	`Router# show call-home detail`	
Step 3	**show call-home alert-group** **Example:** `Router# show call-home alert-group`	Displays the available alert groups and their status.
Step 4	**show call-home mail-server status** **Example:** `Router# show call-home mail-server status`	Checks and displays the availability of the configured e-mail server(s).
Step 5	**show call-home profile** {**all** | *name*} **Example:** `Router# show call-home profile all`	Displays the configuration of the specified destination profile. Use the **all** keyword to display the configuration of all destination profiles.
Step 6	**show call-home statistics** [**detail** | **profile** *profile_name*] **Example:** `Router# show call-home statistics`	Displays the statistics of Call Home events.

Examples

Call Home Information in Summary

Call Home Information in Detail

Available Call Home Alert Groups

E-Mail Server Status Information

Information for All Destination Profiles

Information for a User-Defined Destination Profile

Call Home Statistics

The following examples show the sample output when using different options of the **show call-home** command.

```
Router# show call-home
Current call home settings:
    call home feature : enable
    call home message's from address: router@example.com
    call home message's reply-to address: support@example.com

    vrf for call-home messages: Not yet set up

    contact person's email address: technical@example.com
```

```
    contact person's phone number: +1-408-555-1234
    street address: 1234 Picaboo Street, Any city, Any state, 12345
    customer ID: ExampleCorp
    contract ID: X123456789
    site ID: SantaClara

    source ip address: Not yet set up
    source interface: GigabitEthernet0/0
    Mail-server[1]: Address: 192.0.2.1 Priority: 1
    Mail-server[2]: Address: 209.165.202.254 Priority: 2
    http proxy: 192.0.2.2:80

    aaa-authorization: disable
    aaa-authorization username: callhome (default)
    data-privacy: normal
    syslog throttling: enable

    Rate-limit: 20 message(s) per minute

    Snapshot command[0]: show version
    Snapshot command[1]: show clock

Available alert groups:
    Keyword                  State   Description
    ------------------------ ------- --------------------------------
    configuration            Enable  configuration info
    crash                    Enable  crash and traceback info
    environment              Enable  environmental info
    inventory                Enable  inventory info
    snapshot                 Enable  snapshot info
    syslog                   Enable  syslog info

Profiles:
    Profile Name: campus-noc
    Profile Name: CiscoTAC-1
Router#
```

```
Router# show call-home detail
Current call home settings:
    call home feature : enable
    call home message's from address: router@example.com
    call home message's reply-to address: support@example.com

    vrf for call-home messages: Not yet set up

    contact person's email address: technical@example.com

    contact person's phone number: +1-408-555-1234
    street address: 1234 Picaboo Street, Any city, Any state, 12345
    customer ID: ExampleCorp
    contract ID: X123456789
    site ID: SantaClara

    source ip address: Not yet set up
    source interface: GigabitEthernet0/0
    Mail-server[1]: Address: 192.0.2.1 Priority: 1
    Mail-server[2]: Address: 209.165.202.254 Priority: 2
    http proxy: 192.0.2.2:80

    aaa-authorization: disable
    aaa-authorization username: callhome (default)
    data-privacy: normal
    syslog throttling: enable

    Rate-limit: 20 message(s) per minute
```

```
    Snapshot command[0]: show version
    Snapshot command[1]: show clock

Available alert groups:
    Keyword                  State   Description
    ------------------------ ------- --------------------------------
    configuration            Enable  configuration info
    crash                    Enable  crash and traceback info
    environment              Enable  environmental info
    inventory                Enable  inventory info
    snapshot                 Enable  snapshot info
    syslog                   Enable  syslog info

Profiles:

Profile Name: campus-noc
    Profile status: ACTIVE
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: email
    Email address(es): noc@example.com
    HTTP  address(es): Not yet set up

    Alert-group               Severity
    ------------------------  ------------
    configuration             normal
    crash                     normal
    environment               debug
    inventory                 normal

    Syslog-Pattern            Severity
    ------------------------  ------------
 .*CALL_LOOP.*             debug

Profile Name: CiscoTAC-1
    Profile status: INACTIVE
    Profile mode: Full Reporting
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: email
    Email address(es): callhome@cisco.com
    HTTP  address(es): https://tools.cisco.com/its/service/oddce/services/DDCEService

    Periodic configuration info message is scheduled every 14 day of the month at 11:12

    Periodic inventory info message is scheduled every 14 day of the month at 10:57

    Alert-group               Severity
    ------------------------  ------------
    crash                     normal
    environment               minor

    Syslog-Pattern            Severity
    ------------------------  ------------
 .*CALL_LOOP.*             debug
Router#

Router# show call-home alert-group
Available alert groups:
    Keyword                  State   Description
    ------------------------ ------- --------------------------------
    configuration            Enable  configuration info
    crash                    Enable  crash and traceback info
    environment              Enable  environmental info
```

```
    inventory               Enable  inventory info
    snapshot                Enable  snapshot info
    syslog                  Enable  syslog info
Router#

Router# show call-home mail-server status
Please wait. Checking for mail server status ...

    Mail-server[1]: Address: 192.0.2.1 Priority: 1 [Not Available]
    Mail-server[2]: Address: 209.165.202.254 Priority: 2 [Available]
Router#

Router# show call-home profile all

Profile Name: campus-noc
    Profile status: ACTIVE
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: email
    Email address(es): noc@example.com
    HTTP  address(es): Not yet set up

    Alert-group               Severity
    ------------------------  ------------
    configuration             normal
    crash                     normal
    environment               debug
    inventory                 normal

    Syslog-Pattern            Severity
    ------------------------  ------------
 .*CALL_LOOP.*             debug

Profile Name: CiscoTAC-1
    Profile status: INACTIVE
    Profile mode: Full Reporting
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: email
    Email address(es): callhome@cisco.com
    HTTP  address(es): https://tools.cisco.com/its/service/oddce/services/DDCEService

    Periodic configuration info message is scheduled every 14 day of the month at 11:12

    Periodic inventory info message is scheduled every 14 day of the month at 10:57

    Alert-group               Severity
    ------------------------  ------------
    crash                     normal
    environment               minor

    Syslog-Pattern            Severity
    ------------------------  ------------
 .*CALL_LOOP.*             debug
Router#

Router# show call-home profile campus-noc
Profile Name: campus-noc
    Profile status: ACTIVE
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: email
    Email address(es): noc@example.com
    HTTP  address(es): Not yet set up
```

```
    Alert-group               Severity
    ------------------------  ------------
    configuration             normal
    crash                     normal
    environment               debug
    inventory                 normal

    Syslog-Pattern            Severity
    ------------------------  ------------
 .*CALL_LOOP.*             debug

Router#

Router# show call-home statistics
Message Types    Total                Email                HTTP
-------------   -------------------- -------------------- ------------------
Total Success   3                    3                    0
    Config      3                    3                    0
    Crash       0                    0                    0
    Environment 0                    0                    0
    Inventory   0                    0                    0
    Snapshot    0                    0                    0
    SysLog      0                    0                    0
    Test        0                    0                    0
    Request     0                    0                    0
    Send-CLI    0                    0                    0

Total In-Queue  0                    0                    0
    Config      0                    0                    0
    Crash       0                    0                    0
    Environment 0                    0                    0
    Inventory   0                    0                    0
    Snapshot    0                    0                    0
    SysLog      0                    0                    0
    Test        0                    0                    0
    Request     0                    0                    0
    Send-CLI    0                    0                    0

Total Failed    0                    0                    0
    Config      0                    0                    0
    Crash       0                    0                    0
    Environment 0                    0                    0
    Inventory   0                    0                    0
    Snapshot    0                    0                    0
    SysLog      0                    0                    0
    Test        0                    0                    0
    Request     0                    0                    0
    Send-CLI    0                    0                    0

Total Ratelimit
      -dropped  0                    0                    0
    Config      0                    0                    0
    Crash       0                    0                    0
    Environment 0                    0                    0
    Inventory   0                    0                    0
    Snapshot    0                    0                    0
    SysLog      0                    0                    0
    Test        0                    0                    0
    Request     0                    0                    0
    Send-CLI    0                    0                    0

Last call-home message sent time: 2011-09-26 23:26:50 GMT-08:00
Router#
```

Default Call Home Settings

The following table lists the default Call Home settings.

Table 33: Default Call Home Settings

Parameters	Default
Call Home feature status	Disabled
User-defined profile status	Active
Predefined Cisco TAC profile status	Inactive
Transport method	E-mail
Message format type	XML
Destination message size for a message sent in long text, short text, or XML format	3,145,728
Alert group status	Enabled
Call Home message severity threshold	Debug
Message rate limit for messages per minute	20
AAA Authorization	Disabled
Call Home syslog message throttling	Enabled
Data privacy level	Normal

Alert Group Trigger Events and Commands

Call Home trigger events are grouped into alert groups, with each alert group assigned commands to execute when an event occurs. The command output is included in the transmitted message. The following table lists the trigger events included in each alert group, including the severity level of each event and the executed commands for the alert group.

Table 34: Call Home Alert Groups, Events, and Actions

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
Crash	SYSTEM_ CRASH	–	–	Events related to software crash. The following commands are executed: **show version** **show logging** **show region** **show inventory** **show stack** **crashinfo file** (this command shows the contents of the crashinfo file)
–	TRACEBACK	–	–	Detects software traceback events. The following commands are executed: **show version** **show logging** **show region** **show stack**

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
Configuration	–	–	–	User-generated request for configuration or configuration change event. The following commands are executed: **show platform** **show inventory** **show running-config all** **show startup-config** **show version**
Environmental	–	–	–	Events related to power, fan, and environment sensing elements such as temperature alarms. The following commands are executed: **show environment** **show inventory** **show platform** **show logging**
–	–	SHUT	0	Environmental Monitor initiated shutdown.
–	–	ENVCRIT	2	Temperature or voltage measurement exceeded critical threshold.
–	–	BLOWER	3	Required number of fan trays is not present.

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
–	–	ENVWARN	4	Temperature or voltage measurement exceeded warning threshold.
–	–	RPSFAIL	4	Power supply may have a failed channel.
–	ENVM	PSCHANGE	6	Power supply name change.
–	–	PSLEV	6	Power supply state change.
–	–	PSOK	6	Power supply now appears to be working correctly.

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
Inventory	–	–	–	

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
				Inventory status should be provided whenever a unit is cold-booted or when FRUs are inserted or removed. This is considered a noncritical event, and the information is used for status and entitlement. Commands executed for all Inventory messages sent in anonymous mode and for Delta Inventory message sent in full registration mode: **show diag all eeprom detail** **show version** **show inventory oid** **show platform** Commands executed for Full Inventory message sent in full registration mode: **show platform** **show diag all eeprom detail** **show version** **show inventory oid** **show bootflash: all** **show data-corruption** **show interfaces** **show file systems** **show memory statistics**

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
				show process memory **show process cpu** **show process cpu history** **show license udi** **show license detail** **show buffers**
–	HARDWARE_ REMOVAL	REMCARD	6	Card removed from slot %d, interfaces disabled.
–	HARDWARE_ INSERTION	INSCARD	6	Card inserted in slot %d, interfaces administratively shut down.
Syslog	–	–	–	Event logged to syslog. The following commands are executed: **show inventory** **show logging**
–	SYSLOG	LOG_EMERG	0	System is unusable.
–	SYSLOG	LOG_ALERT	1	Action must be taken immediately.
–	SYSLOG	LOG_CRIT	2	Critical conditions.
–	SYSLOG	LOG_ERR	3	Error conditions.
–	SYSLOG	LOG_WARNING	4	Warning conditions.
–	SYSLOG	LOG_NOTICE	5	Normal but signification condition.
–	SYSLOG	LOG_INFO	6	Informational.
–	SYSLOG	LOG_DEBUG	7	Debug-level messages.

Alert Group	Call Home Trigger Event	Syslog Event	Severity	Description and Commands Executed
Test	–	TEST	–	User-generated test message. The following commands are executed: **show platform** **show inventory** **show version**

Message Contents

This section consists of tables which list the content formats of alert group messages.

The following table lists the content fields of a short text message.

Table 35: Format for a Short Text Message

Data Item	Description
Device identification	Configured device name
Date/time stamp	Time stamp of the triggering event
Error isolation message	Plain English description of triggering event
Alarm urgency level	Error level such as that applied to a system message

The following table shows the content fields that are common to all long text and XML messages. The fields specific to a particular alert group message are inserted at a point between the common fields. The insertion point is identified in the table.

Table 36: Common Fields for All Long Text and XML Messages

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
Time stamp	Date and time stamp of event in ISO time notation: *YYYY-MM-DD HH:MM:SS GMT+HH:MM*.	CallHome/EventTime
Message name	Name of message. Specific event names are listed in the Alert Group Trigger Events and Commands, on page 356.	For short text message only
Message type	Specifically “Call Home”.	CallHome/Event/Type

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
Message subtype	Specific type of message: full, delta, test	CallHome/Event/SubType
Message group	Specifically “reactive”. Optional because default is “reactive”.	For long-text message only
Severity level	Severity level of message (see Message Severity Threshold, on page 331).	Body/Block/Severity
Source ID	Product type for routing through the workflow engine. This is typically the product family name.	For long-text message only
Device ID	Unique device identifier (UDI) for end device generating message. This field should be empty if the message is nonspecific to a fabric switch. The format is *type@Sid@serial*. • *type* is the product model number from backplane IDPROM. • @ is a separator character. • *Sid* is C, identifying the serial ID as a chassis serial number. • *serial* is the number identified by the Sid field. Example: CISCO3845@C@12345678	CallHome/CustomerData/ ContractData/DeviceId
Customer ID	Optional user-configurable field used for contract information or other ID by any support service.	CallHome/CustomerData/ ContractData/CustomerId
Contract ID	Optional user-configurable field used for contract information or other ID by any support service.	CallHome/CustomerData/ ContractData/CustomerId
Site ID	Optional user-configurable field used for Cisco-supplied site ID or other data meaningful to alternate support service.	CallHome/CustomerData/ ContractData/CustomerId

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
Server ID	If the message is generated from the fabric switch, this is the unique device identifier (UDI) of the switch. • *type* is the product model number from backplane IDPROM. • @ is a separator character. • *Sid* is C, identifying the serial ID as a chassis serial number. • *serial* is the number identified by the Sid field. Example: CISCO3845@C@12345678	For long text message only.
Message description	Short text describing the error.	CallHome/MessageDescription
Device name	Node that experienced the event. This is the host name of the device.	CallHome/CustomerData/ SystemInfo/NameName
Contact name	Name of person to contact for issues associated with the node experiencing the event.	CallHome/CustomerData/ SystemInfo/Contact
Contact e-mail	E-mail address of person identified as contact for this unit.	CallHome/CustomerData/ SystemInfo/ContactEmail
Contact phone number	Phone number of the person identified as the contact for this unit.	CallHome/CustomerData/ SystemInfo/ContactPhoneNumber
Street address	Optional field containing street address for RMA part shipments associated with this unit.	CallHome/CustomerData/ SystemInfo/StreetAddress
Model name	Model name of the router. This is the “specific model as part of a product family name.	CallHome/Device/Cisco_Chassis/Model
Serial number	Chassis serial number of the unit.	CallHome/Device/Cisco_Chassis/ SerialNumber
Chassis part number	Top assembly number of the chassis.	CallHome/Device/ Cisco_Chassis/AdditionalInformation/ AD@name=“PartNumber”

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
System object ID	System Object ID that uniquely identifies the system.	CallHome/Device/ Cisco_Chassis/AdditionalInformation/ AD@name="sysObjectID"
System description	System description for the managed element.	CallHome/Device/ Cisco_Chassis/AdditionalInformation/ AD@name="sysDescr"

The following table shows the inserted fields specific to a particular alert group message.

Note The following fields may be repeated if multiple commands are executed for this alert group.

Table 37: Inserted Fields Specific to a Particular Alert Group Message

Command output name	Exact name of the issued command.	/aml/Attachments/Attachment/Name
Attachment type	Attachment type. Usually "inline".	/aml/Attachments/Attachment@type
MIME type	Normally "text" or "plain" or encoding type.	/aml/Attachments/Attachment/ Data@encoding
Command output text	Output of command automatically executed (see Alert Group Trigger Events and Commands, on page 356).	/mml/attachments/attachment/atdata

The following table shows the inserted content fields for reactive messages (system failures that require a TAC case) and proactive messages (issues that might result in degraded system performance).

Table 38: Inserted Fields for a Reactive or Proactive Event Message

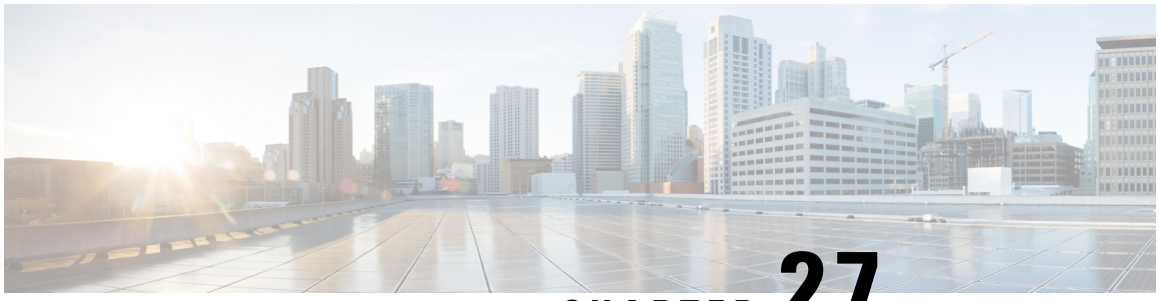
Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
Chassis hardware version	Hardware version of chassis	CallHome/Device/Cisco_Chassis/ HardwareVersion
Supervisor module software version	Top-level software version	CallHome/Device/Cisco_Chassis/ AdditionalInformation/AD@name= "SoftwareVersion"
Affected FRU name	Name of the affected FRU generating the event message	CallHome/Device/Cisco_Chassis/ Cisco_Card/Model
Affected FRU serial number	Serial number of affected FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/SerialNumber
Affected FRU part number	Part number of affected FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/PartNumber

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
FRU slot	Slot number of FRU generating the event message	CallHome/Device/Cisco_Chassis/ Cisco_Card/LocationWithinContainer
FRU hardware version	Hardware version of affected FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/HardwareVersion
FRU software version	Software version(s) running on affected FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/SoftwareIdentity/ VersionString

The following table shows the inserted content fields for an inventory message.

Table 39: Inserted Fields for an Inventory Event Message

Data Item (Plain Text and XML)	Description (Plain Text and XML)	Call-Home Message Tag (XML Only)
Chassis hardware version	Hardware version of chassis	CallHome/Device/Cisco_Chassis/ HardwareVersion
Supervisor module software version	Top-level software version	CallHome/Device/Cisco_Chassis/ AdditionalInformation/AD@name= “SoftwareVersion”
FRU name	Name of the affected FRU generating the event message	CallHome/Device/Cisco_Chassis/ Cisco_Card/Model
FRU s/n	Serial number of FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/SerialNumber
FRU part number	Part number of FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/PartNumber
FRU slot	Slot number of FRU	CallHome/Device/Cisco_Chassis/ Cisco_Card/LocationWithinContainer
FRU hardware version	Hardware version of FRU	CallHome/Device/Cisco_Chassis/ CiscoCard/HardwareVersion
FRU software version	Software version(s) running on FRU	CallHome/Device/Cisco_Chassis /Cisco_Card/SoftwareIdentity/ VersionString



CHAPTER 27

Managing Cisco Enhanced Services and Network Interface Modules

The router supports Cisco Enhanced Services Modules (SMs) and Cisco Network Interface Modules (NIMs). The modules are inserted into the router using an adapter, or carrier card, into various slots. For more information, see the following documents:

- Hardware Installation Guide for the Cisco Catalyst 8300 Series Edge Platform.
- Hardware Installation Guide for Cisco Catalyst 8200 Series Edge Platforms

The following sections are included in this chapter:

Information About Cisco Service Modules and Network Interface Modules

The router configures, manages, and controls the supported Cisco Service Modules (SMs), Network Interface Modules (NIMs) and PIM (Pluggable Interface Modules) using the module management facility built in its architecture. This new centralized module management facility provides a common way to control and monitor all the modules in the system regardless of their type and application. All Cisco Enhanced Service and Network Interface Modules supported on your router use standard IP protocols to interact with the host router. Cisco IOS software uses alien data path integration to switch between the modules.

- Modules Supported, on page 370
- Network Interface Modules and Enhanced Service Modules, on page 370

Modules Supported

For information about the interfaces and modules supported by the Cisco Catalyst 8000 Edge Platform, see Hardware Installation Guide for Cisco Catalyst 8000 Series Edge Platform.

Network Interface Modules and Enhanced Service Modules

For more information on the supported Network Interface Modules and Service Modules, refer to the Cisco Catalyst 8300 Series Edge Platforms datasheet.

Implementing SMs and NIMs on Your Platforms

Downloading the Module Firmware

Module firmware must be loaded to the router to be able to use a service module. For more information, see Installing a Firmware Subpackage, on page 219.

The modules connect to the RP via the internal eth0 interface to download the firmware. Initially, the module gets an IP address for itself via BOOTP. The BOOTP also provides the address of the TFTP server used to download the image. After the image is loaded and the module is booted, the module provides an IP address for the running image via DHCP.

Installing SMs and NIMs

For more information, see "Installing and Removing NIMs and SMs" in the Hardware Installation Guide for Cisco Catalyst 8300 Edge Platform and Hardware Installation Guide for Cisco Catalyst 8200 Series Edge Platforms.

Note Service modules are not supported on Cisco Catalyst 8200 Series Edge Platforms.

Accessing Your Module Through a Console Connection or Telnet

Before you can access the modules, you must connect to the host router through the router console or through Telnet. After you are connected to the router, you must configure an IP address on the Gigabit Ethernet interface connected to your module. Open a session to your module using the **hw-module session** command in privileged EXEC mode on the router.

To establish a connection to the module, connect to the router console using Telnet or Secure Shell (SSH) and open a session to the switch using the **hw-module session** *slot/subslot* command in privileged EXEC mode on the router.

Use the following configuration examples to establish a connection:

- The following example shows how to open a session from the router using the **hw-module session** command:

```
Router# hw-module session slot/card
Router# hw-module session 0/1 endpoint 0

Establishing session connect to subslot 0/1
```

- The following example shows how to exit a session from the router, by pressing **Ctrl-A** followed by **Ctrl-Q** on your keyboard:

```
type ^a^q
picocom v1.4

port is        : /dev/ttyDASH2
flowcontrol    : none
baudrate is    : 9600
parity is      : none
databits are   : 8
escape is      : C-a
noinit is      : no
noreset is     : no
nolock is      : yes
send_cmd is    : ascii_xfr -s -v -l10
receive_cmd is : rz -vv
```

Online Insertion and Removal

The router supports online insertion and removal (OIR) of Cisco Enhanced Services Modules and Cisco Network Interface Modules. You can perform the following tasks using the OIR function:

Preparing for Online Removal of a Module

The router supports the OIR of a module, independent of removing another module installed in your router. This means that an active module can remain installed in your router, while you remove another module from one of the subslots. If you are not planning to immediately replace a module, ensure that you install a blank filler plate in the subslot.

Deactivating a Module

A module can be removed from the router without first being deactivated. However, we recommend that you perform a graceful deactivation (or graceful power down) of the module before removing it. To perform a graceful deactivation, use the **hw-module subslot** *slot/subslot* **stop** command in EXEC mode.

Note When you are preparing for an OIR of a module, it is not necessary to independently shut down each of the interfaces before deactivating the module. The **hw-module subslot** *slot/subslot* **stop** command in EXEC mode automatically stops traffic on the interfaces and deactivates them along with the module in preparation for OIR. Similarly, you do not have to independently restart any of the interfaces on a module after OIR.

The following example shows how to use the **show facility-alarm status** command to verify if any critical alarm is generated when a module is removed from the system:

```
Router# show facility-alarm status
System Totals  Critical: 18  Major: 0  Minor: 0

Source                    Time                  Severity      Description [Index]
------                    ------                --------      -------------------

Power Supply Bay 1        Sep 28 2020 10:02:34   CRITICAL      Power Supply/FAN Module
Missing [0]
POE Bay 0                 Sep 28 2020 10:02:34   INFO          Power Over Ethernet Module
 Missing [0]
POE Bay 1                 Sep 28 2020 10:02:34   INFO          Power Over Ethernet Module
 Missing [0]
GigabitEthernet0/0/2      Sep 28 2020 10:02:46   INFO         Physical Port Administrative
 State Down [2]
GigabitEthernet0/0/3      Sep 28 2020 10:02:46   INFO         Physical Port Administrative
 State Down [2
xcvr container 0/0/4      Sep 28 2020 10:02:46   INFO          Transceiver Missing - Link
 Down [1]
TenGigabitEthernet0/0/5   Sep 28 2020 10:02:54   CRITICAL      Physical Port Link Down [1]
TenGigabitEthernet0/1/0   Sep 28 2020 10:03:26   INFO         Physical Port Administrative
 State Down [2]
GigabitEthernet1/0/0      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
GigabitEthernet1/0/1      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
GigabitEthernet1/0/2      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
GigabitEthernet1/0/3      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
GigabitEthernet1/0/4      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
GigabitEthernet1/0/5      Sep 28 2020 10:07:35   CRITICAL      Physical Port Link Down [1]
TwoGigabitEthernet1/0/16  Sep 28 2020 10:07:35   INFO         Physical Port Administrative
 State Down [2]
TwoGigabitEthernet1/0/17  Sep 28 2020 10:07:35   INFO         Physical Port Administrative
 State Down [2]
TwoGigabitEthernet1/0/18  Sep 28 2020 10:07:35   INFO         Physical Port Administrative
 State Down [2]
TwoGigabitEthernet1/0/19  Sep 28 2020 10:07:35   INFO         Physical Port Administrative
 State Down [2]
xcvr container 1/0/20     Sep 28 2020 10:04:00   INFO          Transceiver Missing - Link
 Down [1]
xcvr container 1/0/21     Sep 28 2020 10:04:00   INFO          Transceiver Missing - Link
 Down [1]1]
```

Note A critical alarm (Active Card Removed OIR Alarm) is generated even if a module is removed after performing graceful deactivation.

Deactivating Modules and Interfaces in Different Command Modes

You can deactivate a module and its interfaces using the **hw-module subslot** command in one of the following modes:

- If you choose to deactivate your module and its interfaces by executing the **hw-module subslot** *slot/subslot* **shutdown unpowered** command in global configuration mode, you are able to change the configuration in such a way that no matter how many times the router is rebooted, the module does not boot. This command is useful when you need to shut down a module located in a remote location and ensure that it does not boot automatically when the router is rebooted.
- If you choose to use the **hw-module subslot** *slot/subslot* **stop** command in EXEC mode, you cause the module to gracefully shut down. The module is rebooted when the **hw-module subslot** *slot/subslot* **start** command is executed.

To deactivate a module and all of its interfaces before removing the module, use one of the following commands in global configuration mode.

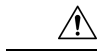
Procedure

	Command or Action	Purpose
Step 1	**hw-module subslot** *slot*/*subslot* **shutdown unpowered** **Example:** `Router# hw-module subslot 0/2 shutdown unpowered`	Deactivates the module located in the specified slot and subslot of the router, where: • *slot*—Specifies the chassis slot number where the module is installed. • *subslot*—Specifies the subslot number of the chassis where the module is installed. • **shutdown**—Shuts down the specified module. • **unpowered**—Removes all interfaces on the module from the running configuration and the module is powered off.
Step 2	**hw-module subslot** *slot*/*subslot* [**reload** | **stop** | **start**] **Example:** `Router# hw-module subslot 0/2 stop`	Deactivates the module in the specified slot and subslot, where: • *slot*—Specifies the chassis slot number where the module is installed. • *subslot*—Specifies the subslot number of the chassis where the module is installed. • **reload**—Stops and restarts the specified module. • **stop**—Removes all interfaces from the module and the module is powered off. • **start**—Powers on the module similar to a physically inserted module in the specified slot. The module firmware reboots and the entire module initialization sequence is executed in the IOSd and Input/Output Module daemon (IOMd) processes.

Deactivating and Reactivating an SSD/HDD Carrier Card NIM

The following restrictions apply:

- Deactivating or reactivating an SSD/HDD Carrier Card NIM without an SSD or HDD disk is not supported.
- Only a single (SSD or HDD) Carrier Card NIM can be plugged into a bay. If you plug an additional (SSD or HDD) Carrier Card NIM into another bay, the module powers down and kernel, log, or error messages are displayed on the Cisco IOS console. In rare cases, the file system may get corrupted on the additional drive.



Caution Deactivation of an SSD/HDD Carrier Card NIM may cause loss of data.

To deactivate an SSD/HDD Carrier Card NIM, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**virtual-service** *name* **Example:** `Router(config)# virtual-service my-kwaas-instance`	Identifies the kWAAS service (by name), supported on your router, in preparation for the router to be shut down by the **no activate** command. We recommend that you use this command before reseating or replacing an SSD or HDD.
Step 2	**no activate** **Example:** `Router(config-virt-serv)# no activate`	Shuts down the kWAAS instance on your router. kWAAS services remain installed. The service will have to be reactivated after the HDD/SSD NIM (module) is restarted.

Step 3	**hw-module subslot** *slot*/*subslot* [**reload** | **stop** | **start**]
	Example:
	`Router# hw-module subslot 0/2 stop`
	`Proceed with stop of module? [confirm]`
	`Router#`
	`*Mar 6 15:13:23.997: %SPA_OIR-6-OFFLINECARD: SPA (NIM-SSD) offline in subslot 0/2`
	`...`
		Deactivates or reactivates the module in the specified slot and subslot.
		• *slot*—The chassis slot number where the module is installed.
		• *subslot*—The subslot number of the chassis where the module is installed.
		• **reload**—Deactivates and reactivates (stops and restarts) the specified module.
		• **stop**—Removes all interfaces from the module and the module is powered off.
		• **start**—Powers on the module similar to a physically inserted module in the specified slot. The module firmware reboots and the entire module initialization sequence is executed in the IOSd and IOMd processes.

Step 4	Wait for the EN (Enable) LED to turn off, and then remove the SSD/HDD Carrier Card NIM.	

Reactivating a Module

If, after deactivating a module using the **hw-module subslot** *slot/subslot* **stop** command, you want to reactivate it without performing an OIR, use one of the following commands (in privileged EXEC mode):

- **hw-module subslot** *slot/subslot* **start**
- **hw-module subslot** *slot/subslot* **reload**

Verifying the Deactivation and Activation of a Module

When you deactivate a module, the corresponding interfaces are also deactivated. This means that these interfaces will no longer appear in the output of the **show interface** command.

1. To verify the deactivation of a module, enter the **show hw-module subslot all oir** command in privileged EXEC configuration mode.

   Observe the "Operational Status" field associated with the module that you want to verify. In the following example, the module located in subslot 1 of the router is administratively down.

```
Router# show hw-module subslot all oir

 Module                   Model                Operational Status
----------------------- -------------------- ------------------------
subslot 0/0              4x1G-2xSFP+          ok
subslot 0/1              C-NIM-1X             ok
subslot 1/0              SM-X-16G4M2X         ok

RadiumPP#
```

2. To verify activation and proper operation of a module, enter the **show hw-module subslot all oir** command and observe "ok" in the **Operational Status** field as shown in the following example:

```
Router# show hw-module subslot all oir

 Module                   Model                Operational Status
----------------------- -------------------- ------------------------
subslot 0/0              4x1G-2xSFP+          ok
subslot 0/1              C-NIM-1X             ok
subslot 1/0              SM-X-16G4M2X         ok

RadiumPP#
Router# show platform hardware backplaneswitch-manager R0 status
slot  bay   port   enable   link status   speed(Mbps)   duplex   autoneg   pause_tx
pause_rx   mtu
-------------------------------------------------------------------------------------------------------
0      0     CP     True      Up           1000          Full    ENABLED    ENABLED
ENABLED   10240
1      0     GE1    True      Up           1000          Full    DISABLED   ENABLED
ENABLED   10240
1      0     GE0    True      Up           1000          Full    DISABLED   ENABLED
ENABLED   10240
2      0     GE1    True      Up           1000          Full    DISABLED   ENABLED
ENABLED   10240
2      0     GE0    True      Up           1000          Full    DISABLED   ENABLED
ENABLED   10240
0      1     GE1    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      1     GE0    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      2     GE1    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
```

```
0      2     GE0    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      3     GE1    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      3     GE0    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      4     GE1    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      4     GE0    True     Down          1000          Full    DISABLED   ENABLED
ENABLED   10240
0      0     FFP    True       Up         10000          Full    ENABLED    DISABLED
DISABLED  10240
slot  bay   port            mac    vid   modid     flags - Layer 2
--------------------------------------------------------------------------------
0      0    FFP  2c54.2dd2.661b   2351       1              0x20
0      0    FFP  2c54.2dd2.661b   2352       1              0x20
0      0     CP  2c54.2dd2.661e   2351       0              0xC60
0      0     CP  2c54.2dd2.661e   2352       0              0x20
1      0    GE0  58bf.ea3a.00f6   2350       0              0x460
0      0    FFP  2c54.2dd2.661b   2350       1              0x20
1      0    GE0  58bf.ea3a.00f6   2352       0              0x20
0      0     CP  2c54.2dd2.661e   2350       0              0x20
1      0    GE0  58bf.ea3a.00f6   2351       0              0xC60
Port block masks: rows=from port, columns=to port, u=unknown unicast, m=unknown multicast,
 b=broadcast, A=all

           CP    FFP  1/0/1  1/0/0  2/0/1  2/0/0  0/1/1  0/1/0  0/2/1  0/2/0  0/3/1
0/3/0  0/4/1 0/4/0 drops
-------------------------------------------------------------------------------------------------------
CP          -     A     um     um     um     um     um     um     um     um     um
um     um     um     1
FFP         A     -     -      -      -      -      -      -      -      -      -
 -      -      -     0
1/0/1       um    umb    -     umb    umb    umb    umb    umb    umb    umb    umb
umb    umb    umb     0
1/0/0       um    umb   umb     -     umb    umb    umb    umb    umb    umb    umb
umb    umb    umb     6
2/0/1       um    umb   umb    umb     -     umb    umb    umb    umb    umb    umb
umb    umb    umb     0
2/0/0       um    umb   umb    umb    umb     -     umb    umb    umb    umb    umb
umb    umb    umb     6
0/1/1       um    umb   umb    umb    umb    umb     -     umb    umb    umb    umb
umb    umb    umb     0
0/1/0       um    umb   umb    umb    umb    umb    umb      -     umb    umb    umb
umb    umb    umb     0
0/2/1       um    umb   umb    umb    umb    umb    umb    umb     -     umb    umb
umb    umb    umb     0
0/2/0       um    umb   umb    umb    umb    umb    umb    umb    umb     -      umb
umb    umb    umb     0
0/3/1       um    umb   umb    umb    umb    umb    umb    umb    umb    umb     -
umb    umb    umb     0
0/3/0       um    umb   umb    umb    umb    umb    umb    umb    umb    umb    umb
-     umb    umb     0
0/4/1       um    umb   umb    umb    umb    umb    umb    umb    umb    umb    umb
umb     -     umb     0
0/4/0       um    umb   umb    umb    umb    umb    umb    umb    umb    umb    umb
umb    umb     -      0

Port VLAN membership: [untagged vlan] U=untagged T=tagged <VLAN range begin>-<VLAN range
 end>

   CP [2352] U:0001-0001 T:0002-2351 U:2352-2352 T:2353-4095
  FFP [2352] T:0001-4095
1/0/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
```

```
    1/0/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    2/0/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    2/0/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/1/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/1/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/2/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/2/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/3/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/3/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/4/1 [2352] T:0002-2351 U:2352-2352 T:2353-4095
    0/4/0 [2352] T:0002-2351 U:2352-2352 T:2353-4095
```

show platform hardware backplaneswitch-manager rp active ffp statistics: Example

```
Router# show platform hardware backplaneswitch-manager rp active ffp statistics
Broadcom 10G port(e.g: FFP) status:
                         Rx pkts         Rx Bytes          Tx Pkts         Tx Bytes
-------------------------------------------------------------------------------------
All                            0                0                0                0
  =64                          0                                 0
  65~127                       0                                 0
  128~255                      0                                 0
  256~511                      0                                 0
  512~1023                     0                                 0
  1024~1518                    0                                 0
  1519~2047                    0                                 0
  2048~4095                    0                                 0
  4096~9216                    0                                 0
  9217~16383                   0                                 0
  Max                          0                                 0
Good                           0                                 0
  CoS 0                                                          0                0
  CoS 1                                                          0                0
  CoS 2                                                          0                0
  CoS 3                                                          0                0
  CoS 4                                                          0                0
  CoS 5                                                          0                0
  CoS 6                                                          0                0
  CoS 7                                                          0                0
  Unicast                      0                                 0
  Multicast                    0                                 0
  Broadcast                    0                                 0
  Control                      0
Errored
  FCS                          0                                 0
  Undersize                    0
  Ether len                    0
  Fragment                     0                                 0
  Jabber                       0
  MTU ck, good                 0
  MTU ck, bad                  0
  Tx underflow                                                                    0
  err symbol                   0
  frame err                    0
  junk                         0
Drops
  CoS 0                                                          0                0
  CoS 1                                                          0                0
  CoS 2                                                          0                0
  CoS 3                                                          0                0
  CoS 4                                                          0                0
  CoS 5                                                          0                0
```

```
  CoS 6                                                    0                0
  CoS 7                                                    0                0
  STP                    0
  backpress              0
  congest                0                0
  purge/cell             0
  no destination         0
Pause PFC                0                0
  CoS 0                  0
  CoS 1                  0
  CoS 2                  0
  CoS 3                  0
  CoS 4                  0
  CoS 5                  0
  CoS 6                  0
  CoS 7                  0
```

Managing Modules and Interfaces

The router supports various modules. For a list of supported modules, see Modules Supported, on page 370. The module management process involves bringing up the modules so that their resources can be utilized. This process consists of tasks such as module detection, authentication, configuration by clients, status reporting, and recovery.

For a list of small-form-factor pluggable (SFP) modules supported on your router, see the "Installing and Upgrading Internal Modules and FRUs" section in the Hardware Installation Guide for Cisco Catalyst 8300 Edge Platform.

The following sections provide additional information on managing the modules and interfaces:

- Managing Module Interfaces, on page 378

Managing Module Interfaces

After a module is in service, you can control and monitor its module interface. Interface management includes configuring clients with **shut** or **no shut** commands and reporting on the state of the interface and the interface-level statistics.

Configuration Examples

This section provides examples of deactivating and activating modules.

Deactivating a Module Configuration: Example

You can deactivate a module to perform OIR of that module. The following example shows how to deactivate a module (and its interfaces) and remove power to the module. In this example, the module is installed in subslot 0 of the router.

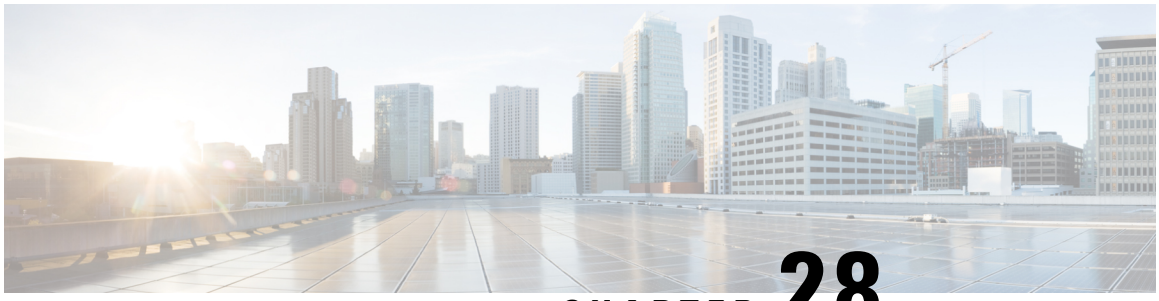
```
Router(config)# hw-module slot 1 subslot 1/0 shutdown unpowered
```

Activating a Module Configuration: Example

You can activate a module if you have previously deactivated it. If you have not deactivated a module and its interfaces during OIR, then the module is automatically reactivated upon reactivation of the router.

The following example shows how to activate a module. In this example, the module is installed in subslot 0, located in slot 1 of the router:

```
Router(config)# hw-module slot 1 subslot 1/0 start
```



CHAPTER 28

Cellular IPv6 Address

This chapter provides an overview of the IPv6 addresses and describes how to configure Cellular IPv6 address on Cisco Catalyst 8000 Series Edge Platform.

This chapter includes this section:

Cellular IPv6 Address

IPv6 addresses are represented as a series of 16-bit hexadecimal fields separated by colons (:) in the format: x:x:x:x:x:x:x:x. Following are two examples of IPv6 addresses:

- 2001:CDBA:0000:0000:0000:0000:3257:9652
- 2001:CDBA::3257:9652 (zeros can be omitted)

IPv6 addresses commonly contain successive hexadecimal fields of zeros. Two colons (::) may be used to compress successive hexadecimal fields of zeros at the beginning, middle, or end of an IPv6 address (the colons represent successive hexadecimal fields of zeros). The table below lists compressed IPv6 address formats.

An IPv6 address prefix, in the format ipv6-prefix/prefix-length, can be used to represent bit-wise contiguous blocks of the entire address space. The ipv6-prefix must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons. The prefix length is a decimal value that indicates how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). For example, 2001:cdba::3257:9652 /64 is a valid IPv6 prefix.

IPv6 Unicast Routing

An IPv6 unicast address is an identifier for a single interface, on a single node. A packet that is sent to a unicast address is delivered to the interface identified by that address.

Cisco Catalyst 8300 Edge Platform support the following address types:

Link-Lock Address

A link-local address is an IPv6 unicast address that can be automatically configured on any interface using the link-local prefix FE80::/10 (1111 1110 10) and the interface identifier in the modified EUI-64 format. An link-local address is automatically configured on the cellular interface when an IPv6 address is enabled.

After the data call is established, the link-local address on the celluar interface is updated with the host generated link-local address that consists of the link-local prefix FF80::/10 (1111 1110 10) and the auto-generated interface identifier from the USB hardware address.

Global Address

A global IPv6 unicast address is defined by a global routing prefix, a subnet ID, and an interface ID. The routing prefix is obtained from the PGW. The Interface Identifier is automatically generated from the USB hardware address using the interface identifier in the modified EUI-64 format. The USB hardware address changes after the router reloads.

Configuring Cellular IPv6 Address

To configure the cellular IPv6 address, perform these steps:

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 unicast-routing**
3. **interface Cellular** {**type** | **number**}
4. ip address negotiated
5. load-interval***seonds***
6. dialer in-band
7. dialer idle-timeout ***seonds***
8. dialer-group**group-number**
9. no peer default ip address
10. ipv6 address autoconfig or ipv6 enable
11. **dialer-listdialer-groupprotocolprotocol-name** {**permit** | deny|**list** | *access-list-number* | *access-group* }
12. **ipv6 route** *ipv6-prefix/prefix-length 128*
13. **End**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 unicast-routing** **Example:** `Router(config)# ipv6 unicast-routing`	Enables forwarding of IPv6 unicast data packets.

	Command or Action	Purpose
Step 3	**interface Cellular** {**type** | **number**} **Example:** `Router(config)# interface cellular 0/1/0`	Specifies the cellular interface.
Step 4	ip address negotiated **Example:** `Router(config-if)# ip address negotiated`	Specifies that the IP address for a particular interface is dynamically obtained.
Step 5	load-interval***seonds*** **Example:** `Router(config-if)# load-interval 30`	Specifies the length of time for which data is used to compute load statistics.
Step 6	dialer in-band **Example:** `Router(config-if)# dialer in-band`	Enables DDR and configures the specified serial interface to use in-band dialing.
Step 7	dialer idle-timeout ***seonds*** **Example:** `Router(config-if)# dialer idle-timeout 0`	Specifies the dialer idle timeout period.
Step 8	dialer-group**group-number** **Example:** `Router(config-if)# dialer-group 1`	Specifies the number of the dialer access group to which the specific interface belongs.
Step 9	no peer default ip address **Example:** `Router(config-if)# no peer default ip address`	Removes the default address from your configuration.

Step 10	ipv6 address autoconfig or ipv6 enable
	Example:
	`Router(config-if)# ipv6 address autoconfig`
	or
	`Router(config-if)# ipv6 enable`
		Enables automatic configuration of IPv6 addresses using stateless autoconfiguration on an interface and enables IPv6 processing on the interface.

Step 11	**dialer-listdialer-groupprotocolprotocol-name** {**permit** | deny|**list** | *access-list-number* | *access-group* } **Example:** `Router(config)# dialer-list 1 protocol ipv6 permit`	Defines a dial-on-demand routing (DDR) dialer list for dialing by protocol or by a combination of a protocol and a previously defined access list.
Step 12	**ipv6 route** *ipv6-prefix/prefix-length 128* **Example:** `Router(config)#ipv6 route 2001:1234:1234::3/128 Cellular0/1/0`	

	Command or Action	Purpose
Step 13	**End** **Example:** `Router(config-if)#end`	Exits to global configuration mode.

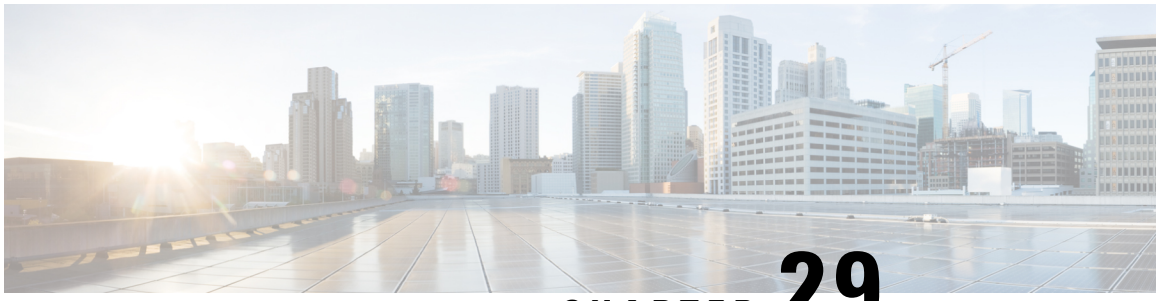
Examples

The following example shows the Cellular IPv6 configuration for NIM-LTEA-EA and NIM-LTEA-LA modules.

```
Router(config)# interface Cellular0/1/0
ip address negotiated
load-interval 30
dialer in-band
dialer idle-timeout 0
lte dialer-group 1
no peer default ip address
ipv6 address autoconfig
!
interface Cellular0/1/1
ip address negotiated
load-interval 30
dialer in-band
dialer idle-timeout 0
dialer-group 1
no peer default ip address
ipv6 address autoconfig
```

The following example shows the Cellular IPv6 configuration for P-LTEAP18-GL, P-LTEA-XX, and P-LTE-XX modules.

```
Router(config)# interface Cellular0/2/0
ip address negotiated
load-interval 30
dialer in-band
dialer idle-timeout 0
lte dialer-group 1
no peer default ip address
ipv6 enable
!
interface Cellular0/2/1
ip address negotiated
load-interval 30
dialer in-band
dialer idle-timeout 0
dialer-group 1
no peer default ip address
ipv6 enable
```



CHAPTER 29

Radio Aware Routing

Radio-Aware Routing (RAR) is a mechanism that uses radios to interact with the routing protocol OSPFv3 to signal the appearance, disappearance, and link conditions of one-hop routing neighbors.

In a large mobile networks, connections to the routing neighbors are often interrupted due to distance and radio obstructions. When these signals do not reach the routing protocols, protocol timers are used to update the status of a neighbor. Routing protocols have lengthy timer, which is not recommended in mobile networks.

Benefits of Radio Aware Routing

The Radio Aware Routing feature offers the following benefits:

- Provides faster network convergence through immediate recognition of changes.
- Enables routing for failing or fading radio links.
- Allows easy routing between line-of-sight and non-line-of-sight paths.
- Provides faster convergence and optimal route selection so that delay-sensitive traffic, such as voice and video, is not disrupted
- Provides efficient radio resources and bandwidth usage.
- Reduces impact on the radio links by performing congestion control in the router.
- Allows route selection based on radio power conservation.
- Enables decoupling of the routing and radio functionalities.
- Provides simple Ethernet connection to RFC 5578, R2CP, and DLEP compliant radios.

Restrictions and Limitations

The Radio Aware Routing feature has the following restrictions and limitations:

- The DLEP and R2CP protocols are not supported on Cisco Catalyst 8300 Edge Platform.
- Multicast traffic is not supported in aggregate mode.
- Cisco High Availability (HA) technology is not supported.

License Requirements

This feature is made available with the AppX license.

System Components

The Radio Aware Routing (RAR) feature is implemented using the MANET (Mobile adhoc network) infrastructure comprising of different components such as PPPoE, Virtual multipoint interface (VMI), QoS, routing protocol interface and RAR protocols.

Point-to-Point Protocol over Ethernet PPPoE or PPPoE

PPPoE is a well-defined communication mechanism between the client and the server. In the RAR implementation, radio takes the role of the PPPoE client and router takes the role of the PPPoE server. This allows a loose coupling of radio and router, while providing a well-defined and predictable communication mechanism.

As PPPoE is a session or a connection oriented protocol, it extends the point-to-point radio frequency (RF) link from an external radio to an IOS router.

PPPoE Extensions

PPPoE extensions are used when the router communicates with the radio. In the Cisco IOS implementation of PPPoE, each individual session is represented by virtual access interface (connectivity to a radio neighbor) on which, QoS can be applied with these PPPoE extensions.

RFC5578 provides extensions to PPPoE to support credit-based flow control and session-based real time link metrics, which are very useful for connections with variable bandwidth and limited buffering capabilities (such as radio links).

Virtual Multipoint Interface (VMI)

Though PPPoE Extensions provides the most of the setup to communicate between a router and a radio, VMI addresses the need to manage and translate events that higher layers (example, routing protocols) consume. In addition, VMI operates in the Bypass mode.

In Bypass mode, every Virtual Access Interface (VAI) representing a radio neighbor is exposed to routing protocols OSPFv3 and EIGRP, so that, the routing protocol directly communicates with the respective VAI for both unicast and multicast routing protocol traffic.

In Aggregae mode, VMI is exposed to the routing protocols (OSPF) so that the routing protocols can leverage VMI for their optimum efficiency. When the network neighbors are viewed as a collection of networks on a point-to-multipoint link with broadcast and multicast capability at VMI, VMI helps in aggregating the multiple virtual access interfaces created from PPPoE. VMI presents a single multi access layer 2 broadcast capable interface. The VMI layer handles re-directs unicast routing protocol traffic to the appropriate P2P link (Virtual-Access interface), and replicats any Multicast/Broadcast traffic that needs to flow. Since the routing protocol communicates to a single interface, the size of the topology database is reduced, without impacting the integrity of the network.

QoS Provisioning on PPPoE Extension Session

The following example describes QoS provisioning on PPPoE extension session:

```
policy-map rar_policer
 class class-default
  police 10000 2000 1000 conform-action transmit  exceed-action drop  violate-action drop
policy-map rar_shaper
 class class-default
  shape average percent 1

interface Virtual-Template2
 ip address 192.0.2.7 255.255.255.0
 no peer default ip address
 no keepalive
 service-policy input rar_policer
end
```

Example: Configuring the RAR Feature in Bypass Mode

The following example is an end-to-end configuration of RAR in the bypass mode:

Note Before you being the RAR configuration, you must first configure the **subscriber authorization enable** command to bring up the RAR session. Without enbaling authorization, the Point-to-Point protocol does not recognize this as a RAR session and may not tag *manet_radio* in presentation of a PPPoE Active Discovery Initiate (PADI). By default, bypass mode does not appears in the configuration. It appears only if the mode is configured as bypass.

Configure a Service for RAR

```
policy-map type service rar-lab
 pppoe service manet_radio //note: Enter the pppoe service policy name as manet_radio
!
```

Configure Broadband

```
bba-group pppoe VMI2
 virtual-template 2
service profile rar-lab
!
interface GigabitEthernet0/0/0
```

```
 description Connected to Client1
  negotiation auto
  pppoe enable group VMI2
!
```

Configure a Service for RAR

```
policy-map type service rar-lab
 pppoe service manet_radio //note: Enter the pppoe service policy name as manet_radio
!
```

Configuration in Bypass Mode

- IP Address Configured under Virtual-Template Explicitly

```
interface Virtual-Template2
ip address 192.0.2.7 255.255.255.0
no ip redirects
peer default ip address pool PPPoEpool2
ipv6 enable
ospfv3 1 network manet
ospfv3 1 ipv4 area 0
ospfv3 1 ipv6 area 0
no keepalive
service-policy input rar_policer Or/And
service-policy output rar_shaper
```

- VMI Unnumbered Configured under Virtual Template

```
interface Virtual-Template2
ip unnumbered vmi2
no ip redirects
peer default ip address pool PPPoEpool2
ipv6 enable
ospfv3 1 network manet
ospfv3 1 ipv4 area 0
ospfv3 1 ipv6 area 0
no keepalive
service-policy input rar_policer Or/And
service-policy output rar_shaper
```

Configure the Virtual Multipoint Interface in Bypass Mode

```
interface vmi2 //configure the virtual multi interface
ip address 192.0.2.5 255.255.255.0
physical-interface GigabitEthernet0/0/0
mode bypass

interface vmi3//configure the virtual multi interface
 ip address 192.0.2.6 255.255.255.0
 physical-interface GigabitEthernet0/0/1
mode bypass
```

Configure OSPF Routing

```
router ospfv3 1
 router-id 192.0.2.1
```

```
!
 address-family ipv4 unicast
  redistribute connected metric 1 metric-type 1
  log-adjacency-changes
 exit-address-family
 !
 address-family ipv6 unicast
  redistribute connected metric-type 1
  log-adjacency-changes
 exit-address-family
!
ip local pool PPPoEpool2 192.0.2.8 192.0.2.4
```

Example: Configuring the RAR Feature in Aggregate Mode

The following example is an end-to-end configuration of RAR in the aggregate mode:

Note Before you being the RAR configuration, you must first configure the **subscriber authorization enable** command to bring up the RAR session. Without enabling authorization, the Point-to-Point protocol does not recognize this as a RAR session and may not tag *manet_radio* in PADI.

Configure a Service for RAR

```
policy-map type service rar-lab
 pppoe service manet_radio //note: Enter the pppoe service policy name as manet_radio
!
```

Configure Broadband

```
bba-group pppoe VMI2
 virtual-template 2
service profile rar-lab

!
interface GigabitEthernet0/0/0
 description Connected to Client1
  negotiation auto
  pppoe enable group VMI2

!
```

Configure a Service for RAR

```
policy-map type service rar-lab
 pppoe service manet_radio //note: Enter the pppoe service policy name as manet_radio
!
```

Configuration in Aggregate Mode

```
interface Virtual-Template2
ip unnumbered vmi2
no ip redirects
```

```
no peer default ip address
ipv6 enable
no keepalive
service-policy input rar_policer Or/And
service-policy output rar_shaper
```

Configure the Virtual Multipoint Interface in Aggregate Mode

```
interface vmi2 //configure the virtual multi interface
ip address 192.0.2.8 255.255.255.0
physical-interface GigabitEthernet0/0/0
mode aggregate
```

```
interface vmi3//configure the virtual multi interface
 ip address 192.0.2.4 255.255.255.0
 no ip redirects
 no ip split-horizon eigrp 1
 physical-interface GigabitEthernet0/0/1
mode aggregate
```

Configure OSPF Routing

```
router ospfv3 1
 router-id 192.0.2.1
!
 address-family ipv4 unicast
  redistribute connected metric 1 metric-type 1
  log-adjacency-changes
 exit-address-family
 !
 address-family ipv6 unicast
  redistribute connected metric-type 1
  log-adjacency-changes
 exit-address-family
!
ip local pool PPPoEpool2 192.0.2.4 192.0.2.8
ip local pool PPPoEpool3 192.0.2.6 192.0.2.2
```

Verifying RAR Session Details

To retrieve RAR session details, use the following show commands:

```
Router#show pppoe session packets all
Total PPPoE sessions 2

session id: 9
local MAC address: 006b.f10e.a5e0, remote MAC address: 0050.56bc.424a
virtual access interface: Vi2.1, outgoing interface: Gi0/0/0
    1646 packets sent, 2439363 received
    176216 bytes sent, 117250290 received

PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 32928     PADG Timer index: 0
 PADG last rcvd Seq Num: 17313
```

```
 PADG last nonzero Seq Num: 17306
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 33308  rcvd: 17313
 PADC xmit: 17313  rcvd: 19709
 In-band credit pkt xmit: 7 rcvd: 2434422
 Last credit packet snapshot
  PADG xmit: seq_num = 32928, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 32928, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 17313, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 17313, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 61, bcn = 65533
  In-band credit pkt rcvd: fcn = 0, bcn = 65534
    ==== PADQ Statistics ====
     PADQ xmit: 0  rcvd: 0


session id: 10
local MAC address: 006b.f10e.a5e1, remote MAC address: 0050.56bc.7dcb
virtual access interface: Vi2.2, outgoing interface: Gi0/0/1
    1389302 packets sent, 1852 received
    77869522 bytes sent, 142156 received

PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 18787     PADG Timer index: 0
 PADG last rcvd Seq Num: 18784
 PADG last nonzero Seq Num: 18768
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 18787  rcvd: 18784
 PADC xmit: 18784  rcvd: 18787
 In-band credit pkt xmit: 1387764 rcvd: 956
 Last credit packet snapshot
  PADG xmit: seq_num = 18787, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 18787, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 18784, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 18784, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 0, bcn = 64222
  In-band credit pkt rcvd: fcn = 0, bcn = 65534
    ==== PADQ Statistics ====
     PADQ xmit: 0  rcvd: 1


Router#show pppoe session packets
Total PPPoE sessions 2

SID     Pkts-In         Pkts-Out        Bytes-In        Bytes-Out
9       2439391         1651            117252098       176714
10      1858            1389306         142580          77869914


Router#show vmi counters
Interface vmi2: - Last Clear Time =

Input Counts:
  Process Enqueue      =          0 (VMI)
  Fastswitch           =          0
  VMI Punt Drop:
       Queue Full      =          0

Output Counts:
```

```
  Transmit:
       VMI Process DQ  =       4280
       Fastswitch VA   =          0
       Fastswitch VMI  =          0
  Drops:
       Total           =          0
       QOS Error       =          0
       VMI State Error =          0
       Mcast NBR Error =          0
       Ucast NBR Error =          0
Interface vmi3: - Last Clear Time =

Input Counts:
  Process Enqueue      =          0 (VMI)
  Fastswitch           =          0
  VMI Punt Drop:
       Queue Full      =          0

Output Counts:
  Transmit:
       VMI Process DQ  =       2956
       Fastswitch VA   =          0
       Fastswitch VMI  =          0
  Drops:
       Total           =          0
       QOS Error       =          0
       VMI State Error =          0
       Mcast NBR Error =          0
       Ucast NBR Error =          0
Interface vmi4: - Last Clear Time =

Input Counts:
  Process Enqueue      =          0 (VMI)
  Fastswitch           =          0
  VMI Punt Drop:
       Queue Full      =          0

Output Counts:
  Transmit:
       VMI Process DQ  =          0
       Fastswitch VA   =          0
       Fastswitch VMI  =          0
  Drops:
       Total           =          0
       QOS Error       =          0
       VMI State Error =          0
       Mcast NBR Error =          0
       Ucast NBR Error =          0
Router#


Router#show vmi neighbor details
1 vmi2 Neighbors
      1 vmi3 Neighbors
      0 vmi4 Neighbors
      2 Total Neighbors

vmi2   IPV6 Address=FE80::21E:E6FF:FE43:F500
       IPV6 Global Addr=::
       IPV4 Address=192.0.2.6, Uptime=05:15:01
       Output pkts=89, Input pkts=0
       No Session Metrics have been received for this neighbor.
       Transport PPPoE, Session ID=9
       INTERFACE STATS:
```

```
          VMI Interface=vmi2,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          V-Access intf=Virtual-Access2.1,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          Physical intf=GigabitEthernet0/0/0,
             Input qcount=0, drops=0, Output qcount=0, drops=0

PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 33038     PADG Timer index: 0
 PADG last rcvd Seq Num: 17423
 PADG last nonzero Seq Num: 17420
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 33418  rcvd: 17423
 PADC xmit: 17423  rcvd: 19819
 In-band credit pkt xmit: 7 rcvd: 2434446
 Last credit packet snapshot
  PADG xmit: seq_num = 33038, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 33038, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 17423, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 17423, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 61, bcn = 65533
  In-band credit pkt rcvd: fcn = 0, bcn = 65534
    ==== PADQ Statistics ====
     PADQ xmit: 0  rcvd: 0


vmi3   IPV6 Address=FE80::21E:7AFF:FE68:6100
       IPV6 Global Addr=::
       IPV4 Address=192.0.2.10, Uptime=05:14:55
       Output pkts=6, Input pkts=0
       METRIC DATA: Total rcvd=1, Avg arrival rate (ms)=0
          CURRENT: MDR=128000 bps, CDR=128000 bps
                   Lat=0 ms, Res=100, RLQ=100, load=0
          MDR      Max=128000 bps, Min=128000 bps, Avg=128000 bps
          CDR      Max=128000 bps, Min=128000 bps, Avg=128000 bps
          Latency  Max=0, Min=0, Avg=0 (ms)
          Resource Max=100%, Min=100%, Avg=100%
          RLQ      Max=100, Min=100, Avg=100
          Load     Max=0%, Min=0%, Avg=0%
       Transport PPPoE, Session ID=10
       INTERFACE STATS:
          VMI Interface=vmi3,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          V-Access intf=Virtual-Access2.2,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          Physical intf=GigabitEthernet0/0/1,
             Input qcount=0, drops=0, Output qcount=0, drops=0

PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 18896     PADG Timer index: 0
 PADG last rcvd Seq Num: 18894
 PADG last nonzero Seq Num: 18884
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 18896  rcvd: 18894
 PADC xmit: 18894  rcvd: 18896
 In-band credit pkt xmit: 1387764 rcvd: 961
```

```
 Last credit packet snapshot
  PADG xmit: seq_num = 18896, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 18896, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 18894, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 18894, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 0, bcn = 64222
  In-band credit pkt rcvd: fcn = 0, bcn = 65534
    ==== PADQ Statistics ====
     PADQ xmit: 0  rcvd: 1


Router#show vmi neighbor details vmi 2
              1 vmi2 Neighbors

vmi2   IPV6 Address=FE80::21E:E6FF:FE43:F500
       IPV6 Global Addr=::
       IPV4 Address=192.0.2.4, Uptime=05:16:03
       Output pkts=89, Input pkts=0
       No Session Metrics have been received for this neighbor.
       Transport PPPoE, Session ID=9
       INTERFACE STATS:
          VMI Interface=vmi2,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          V-Access intf=Virtual-Access2.1,
             Input qcount=0, drops=0, Output qcount=0, drops=0
          Physical intf=GigabitEthernet0/0/0,
             Input qcount=0, drops=0, Output qcount=0, drops=0

PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 33100     PADG Timer index: 0
 PADG last rcvd Seq Num: 17485
 PADG last nonzero Seq Num: 17449
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 33480  rcvd: 17485
 PADC xmit: 17485  rcvd: 19881
 In-band credit pkt xmit: 7 rcvd: 2434460
 Last credit packet snapshot
  PADG xmit: seq_num = 33100, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 33100, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 17485, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 17485, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 61, bcn = 65533
  In-band credit pkt rcvd: fcn = 0, bcn = 65534
    ==== PADQ Statistics ====
     PADQ xmit: 0  rcvd: 0


Router#show platform hardware qfp active feature ess session
Current number sessions: 2
Current number TC flow: 0
Feature Type: A=Accounting D=Policing(DRL) F=FFR M=DSCP Marking L=L4redirect P=Portbundle
T=TC

   Session    Type      Segment1      SegType1      Segment2      SegType2 Feature Other
-------------------------------------------------------------------------------------
        21     PPP 0x0000001500001022    PPPOE 0x0000001500002023    LTERM -------
        24     PPP 0x0000001800003026    PPPOE 0x0000001800004027    LTERM -------
```

```
Router#show platform software subscriber pppoe_fctl evsi 21
PPPoE Flow Control Stats
 Local Credits: 65535   Peer Credits: 65535   Local Scaling Value 64 bytes
 Credit Grant Threshold: 28000    Max Credits per grant: 65535
 Credit Starved Packets: 0
 PADG xmit Seq Num: 33215     PADG Timer index: 0
 PADG last rcvd Seq Num: 17600
 PADG last nonzero Seq Num: 17554
 PADG last nonzero rcvd amount: 2
 PADG Timers: (ms)   [0]-1000    [1]-2000    [2]-3000    [3]-4000    [4]-5000
 PADG xmit: 33595  rcvd: 17600
 PADC xmit: 17600  rcvd: 19996
 In-band credit pkt xmit: 7 rcvd: 2434485
 Last credit packet snapshot
  PADG xmit: seq_num = 33215, fcn = 0, bcn = 65535
  PADC rcvd: seq_num = 33215, fcn = 65535, bcn = 65535
  PADG rcvd: seq_num = 17600, fcn = 0, bcn = 65535
  PADC xmit: seq_num = 17600, fcn = 65535, bcn = 65535
  In-band credit pkt xmit: fcn = 61, bcn = 65533
  In-band credit pkt rcvd: fcn = 0, bcn = 65534

BQS buffer statistics
 Current packets in BQS buffer: 0
 Total en-queue packets: 0 de-queue packets: 0
 Total dropped packets: 0

Internal flags: 0x0


Router#show platform hardware qfp active feature ess session id 21
Session ID: 21

  EVSI type: PPP
  SIP Segment ID: 0x1500001022
  SIP Segment type: PPPOE
  FSP Segment ID: 0x1500002023
  FSP Segment type: LTERM
  QFP if handle: 16
  QFP interface name: EVSI21
  SIP TX Seq num: 0
  SIP RX Seq num: 0
  FSP TX Seq num: 0
  FSP RX Seq num: 0
  Condition Debug: 0x00000000
    session


Router#show ospfv3 neighbor

          OSPFv3 1 address-family ipv4 (router-id 192.0.2.3)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
192.0.2.1         0   FULL/  -        00:01:32    19              Virtual-Access2.1

          OSPFv3 1 address-family ipv6 (router-id 192.0.2.3)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
192.0.2.1         0   FULL/  -        00:01:52    19              Virtual-Access2.1
Router#
```

```
Router#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

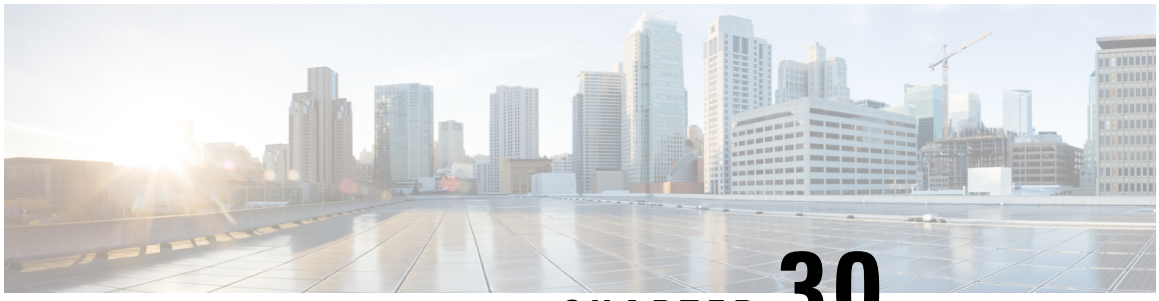
Gateway of last resort is not set

      192.0.2.8/8 is variably subnetted, 3 subnets, 2 masks
C        192.0.2.5/24 is directly connected, Virtual-Access2.1
O        192.0.2.6/32 [110/1] via 192.0.2.22, 00:00:03, Virtual-Access2.1
L        192.0.2.7/32 is directly connected, Virtual-Access2.1
      192.0.2.12/32 is subnetted, 1 subnets
C        192.0.2.20 is directly connected, Virtual-Access2.1
```

Troubleshooting Radio Aware Routing

To troubleshoot the RAR, use the following debug commands:

- **debug pppoe errors**
- **debug pppoe events**
- **debug ppp error**
- **debug vmi error**
- **debug vmi neighbor**
- **debug vmi packet**
- **debug vmi pppoe**
- **debug vmi registries**
- **debug vmi multicast**
- **debug vtemplate cloning**
- **debug vtemplate event**
- **debug vtemplate error**
- **debug plat hard qfp ac feature subscriber datapath pppoe detail**



CHAPTER 30

Configuring Voice Functionality

This chapter provides information about configuring the voice functionality in the Cisco Catalyst 8000 Edge Platforms.

This chapter includes these sections:

Call Waiting

With the Call Waiting feature, you can receive a second call while you are on the phone attending to another call. When you receive a second call, you hear a call-waiting tone (a tone with a 300 ms duration). Caller ID appears on phones that support caller ID. You can use hookflash to answer a waiting call and place the previously active call on hold. By using hookflash, you can toggle between the active and a call that is on hold. If the Call Waiting feature is disabled, and you hang up the current call, the second call will hear a busy tone. For more information on Call Waiting, see the https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/voice/sip/configuration/15-mt/sip-config-15-mt-book/voi-sip-hookflash.html

Call Transfers

Call transfers are when active calls are put on hold while a second call is established between two users. After you establish the second call and terminate the active call, the call on hold will hear a ringback. The Call Transfer feature supports all three types of call transfers—blind, semi-attended, and attended.

Feature Group D Configuration

To configure the Feature Group D signaling, perform these steps:

Before you begin

Feature Group D service is a trunk side connection that enables telephone customers to choose their long distance network and use the same number of digits irrespective of carrier they use. Routers interface with interexchange carriers using Feature Group D to support voice traffic in the carrier environment.

Before you attempt this configuration, ensure that you meet these prerequisites:

- The platform must be using Digital T1/E1 Packet Voice Trunk Network Modules.
- The Digital T1/E1 Packet Voice Trunk Network Module can have one or two slots for voice/WAN Interface Network Modules (NIMs); NIM supports one to eight ports. Only the dual-mode (voice/WAN) multiple trunk cards are supported in the digital E1 packet voice trunk network module, not older VICs.
- Drop-and-Insert capability is supported only between two ports on the same multiple card.

SUMMARY STEPS

1. **configure terminal** {*ip-address* | *interface-type interface-number* [*ip-address*]}
2. **voice-card slot/subslot**
3. **controller T1/E1 slot/subslot/port**
4. **framing** {*sf* | *esf* }
5. **linecode** {*b8zs* | *ami*}
6. **ds0-group** *ds0-group-no***timeslots** `timeslot-list type`{*e&m-fgd* | *fgd-eana*}
7. **no shutdown**
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** {*ip-address* | *interface-type interface-number* [*ip-address*]} **Example:** `Router(config)# configure terminal`	Enters global configuration mode.
Step 2	**voice-card slot/subslot** **Example:** `Router(config)# voice-card slot/subslot`	Enters voice card interface configuration mode and specify the slot location by using a value from 0 to 5, depending upon your router.
Step 3	**controller T1/E1 slot/subslot/port** **Example:** `Router(config)# controller T1 slot/subslot/port`	Enters controller configuration mode for the T1 controller at the specified slot/port location. Valid values for slot and port are 0 and 1.
Step 4	**framing** {*sf* | *esf* } **Example:** `Router(config)# framing {sf | esf}`	Sets the framing according to your service provider's instructions. Choose Extended Superframe (ESF) format or Superframe (SF) format.

	Command or Action	Purpose
Step 5	**linecode** {*b8zs* | *ami*}	Sets the line encoding according to your service provider's instructions. Bipolar-8 zero substitution (B8ZS) encodes a sequence of eight zeros in a unique binary sequence to detect line coding violations. Alternate mark inversion (AMI) represents zeros using a 01 during each bit cell, and ones are represented by 11 or 00, alternately, during each bit cell. AMI requires that the sending device maintain ones density. Ones density is not maintained independent of the data stream.
Step 6	**ds0-group** *ds0-group-no* **timeslots** *timeslot-list* *type*{*e&m-fgd* | *fgd-eana*}	Defines the T1 channels for use by compressed voice calls as well as the signaling method the router uses to connect to the PBX or CO. ds0-group-no is a value from 0 to 23 that identifies the DS0 group. Note The ds0-group command automatically creates a logical voice port that is numbered as follows: slot/port:ds0-group-no. Although only one voice port is created, applicable calls are routed to any channel in the group. timeslot-list is a single number, numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of timeslots. For T1, allowable values are from 1 to 24. To map individual DS0 timeslots, define additional groups. The system maps additional voice ports for each defined group. The signaling method selection for type depends on the connection that you are making. The e&m-fgd setting allows E&M interface connections for PBX trunk lines (tie lines) and telephone equipment to use feature group D switched-access service. The fgd-eana setting supports the exchange access North American (EANA) signaling.
Step 7	**no shutdown**	Activates the controller.
Step 8	**exit**	Exits controller configuration mode. Skip the next step if you are not setting up Drop and Insert .

Media and Signaling Authentication and Encryption

The Media and Signaling Authentication and Encryption Feature for Cisco IOS MGCP Gateways feature implements voice security features that include signaling authentication along with media and signaling encryption on MGCP gateways. For more information on Media and Signaling Authentication and Encryption Feature, see the http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/voice/mgcp/configuration/15-mt/vm-15-mt-book/vm-gw-med-sig.html

Multicast Music-on-Hold

The Music-on-Hold (MOH) feature enables you to subscribe to a music streaming service when you are using a Cisco IOS MGCP voice gateway. Music streams from an MOH server to the voice interfaces of on-net and

off-net callers that have been placed on hold. Cisco Communications Manager supports the capability to place callers on hold with music supplied from a streaming multicast MOH server.

By means of a preconfigured multicast address on the Cisco Unified Communications Manager or gateway, the gateway can "listen" for Real-Time Transport Protocol (RTP) packets that are broadcast from a default router in the network and can relay the packets to designated voice interfaces in the network. You can initiate the call on hold. However, you cannot initiate music on hold on a MGCP controlled analog phone. Whenever a called party places a calling party on hold, Cisco Communications Manager requests the MOH server to stream RTP packets to the "on-hold" interface through the preconfigured multicast address. In this way, RTP packets are relayed to appropriately configured voice interfaces that have been placed on hold. When you configure a multicast address on a gateway, the gateway sends an Internet Gateway Management Protocol (IGMP) "join" message to the default router, indicating to the default router that the gateway is ready to receive RTP multicast packets.

Multiple MOH servers can be present in the same network, but each server must have a different Class D IP address, and the address must be configured in Cisco Communications Manager and the MGCP voice gateways. For more information on configuring MOH, see the http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/voice/cminterop/configuration/15-0m/vc-15-0m-book/vc-ucm-mgcp-gw.html#GUID-A3461142-2F05-4420-AEE6-032FCA3B7952

TLS 1.2 support on SCCP Gateways

The TLS 1.2 support on SCCP Gateways feature details the configuration of TLS 1.2 on SCCP protocol for digital signal processor (DSP) farm including Unicast conference bridge

(CFB), Media Termination Point (MTP), and SCCP telephony control (STC) application (STCAPP).

DSP on gateways can be used as media resources for transrating or transcoding. Each media resource uses Secure Skinny Client Control Protocol (SCCP) to communicate with Cisco Unified Communications Manager. Currently SSL 3.1, which is equivalent to TLS1.0, is used for sending secure signals. This feature enhances the support to TLS 1.2. From Cisco IOS XE Cupertino 17.7.1a, TLS 1.2 is enhanced to support the Next-Generation Encryption (NGE) cipher suites.

Note Cisco Unified Communications Manager (CUCM) Version 14SU2 has been enhanced to support Secured SCCP gateways with the Subject Name field (CN Name) with or without colons, for example, AA:22:BB:44:55 or AA22BB4455.

CUCM checks the CN field of the incoming certificate from the SCCP Gateway and verifies it against the DeviceName configured in CUCM for this gateway. DeviceName contains MAC address of the gateway. CUCM converts the MAC address in the DeviceName to MAC address with colons (for example: AA:22:BB:44:55) and validates with the CN name in the Gateway's certificate. Therefore, CUCM mandates Gateway to use MAC address with colons for the CN field in the certificate, that is, subject name.

Due to new guidelines from Defense Information Systems Agency (DISA), it is a requirement not to use colons for the subject name field CN. For example, AA22BB4455.

SCCP TLS connection

CiscoSSL is based on OpenSSL. SCCP uses CiscoSSL to secure the communication signals.

If a resource is configured in the secure mode, the SCCP application initiates a process to complete Transport Layer Security (TLS) handshaking. During the handshake, the server sends information to CiscoSSL about the TLS version and cipher suites supported. Previously, only SSL3.1 was supported for SCCP secure signalling. SSL3.1 is equivalent to TLS 1.0. The TLS 1.2 Support feature introduces TLS1.2 support to SCCP secure signalling.

After TLS handshaking is complete, SCCP is notified and SCCP kills the process.

If the handshaking is completed successfully, a REGISTER message is sent to Cisco Unified Communications Manager through the secure tunnel. If handshaking fails and a retry is needed, a new process is initiated.

Note For SCCP-based signalling, only TLS_RSA_WITH_AES_128_CBC_SHA cipher suite is supported.

Cipher Suites

For SCCP-based signaling, TLS_RSA_WITH_AES_128_CBC_SHA cipher suite is supported.

From Cisco IOS XE Cupertino 17.7.1a, the following NGE cipher suites are also supported:

- ECDHE-RSA-AES128-GCM-SHA256
- ECDHE-RSA-AES256-GCM-SHA384

These cipher suites enable secure voice signaling for both the STCAPP analog phone and the SCCP DSPFarm conferencing service. The cipher suite selection is negotiated between gateway and CUCM.

The following prerequisites are applicable for using NGE cipher suites:

- Configure TLS 1.2. For more information, see Configuring TLS Version for STC application, on page 401.
- Use CUCM Release 14.1 SU1 or later, and Voice Gateways or platforms that support TLS 1.2.
- From the CUCM Web UI, navigate to **Cipher Management** and set the **CIPHER switch** as **NGE**. For more information, see Cipher Management.

For more information about verifying cipher suites, see Verifying TLS Version and Cipher Suites, on page 402.

For the SRTP-encrypted media, you can use higher-grade cipher suites - AEAD-AES-128-GCM or AEAD-AES-256-GCM. The selection of these cipher suites is automatically negotiated between GW and CUCM for both secure analog voice and hardware conference bridge voice media. Authenticated Encryption with Associated Data (AEAD) ciphers simultaneously provide confidentiality, integrity, and authenticity, without built-in SHA algorithms to validate message integrity.

Supported Platforms

The TLS 1.2 support on the SCCP Gateways feature is supported on the following platforms:

- Cisco Catalyst 8200 and 8300 Series Edge Platforms

Configuring TLS Version for STC application

Perform the following task to configure a TLS version for the STC application:

```
enable
configure terminal
stcapp security tls-version v1.2
exit
```

Note The stcapp security tls command sets the TLS version to v.1.0, v1.1, or v1.2 only. If not configured explicitly, TLS v1.0 is selected by default.

Configuring TLS Version in Secure Mode for DSP Farm Profile

Perform the following task to configure the TLS version in secure mode for DSP farm profile:

```
enable
configure terminal
dspfarm profile 7 conference security
  tls-version v1.2
  exit
```

Note Note: The **tls** command can be configured only in security mode.

Verifying TLS Version and Cipher Suites

Perform the following task to verify the TLS version and cipher suite:

```
# show dspfarm profile 100
Dspfarm Profile Configuration

 Profile ID = 100, Service = CONFERENCING, Resource ID = 2
 Profile Service Mode : secure
 Trustpoint : Overlord_DSPFarm_GW
 TLS Version  : v1.2
 TLS Cipher   : ECDHE-RSA-AES256-GCM-SHA384
 Profile Admin State : UP
 Profile Operation State : ACTIVE
 Application : SCCP   Status : ASSOCIATED
 Resource Provider : FLEX_DSPRM   Status : UP
 Total Number of Resources Configured : 10
 Total Number of Resources Available : 10
 Total Number of Resources Out of Service : 0
 Total Number of Resources Active : 0
 Maximum conference participants : 8
 Codec Configuration: num_of_codecs:6
 Codec : g711ulaw, Maximum Packetization Period : 30 , Transcoder: Not Required
 Codec : g711alaw, Maximum Packetization Period : 30 , Transcoder: Not Required
 Codec : g729ar8, Maximum Packetization Period : 60 , Transcoder: Not Required
 Codec : g729abr8, Maximum Packetization Period : 60 , Transcoder: Not Required
 Codec : g729r8, Maximum Packetization Period : 60 , Transcoder: Not Required
 Codec : g729br8, Maximum Packetization Period : 60 , Transcoder: Not Required
```

Verifying STCAPP Application TLS Version

Perform the following tasks to verify TLS version of the STCAPP application:

```
Device# show call application voice stcapp
App Status: Active
CCM Status: UP
```

```
CCM Group: 120
Registration Mode: CCM
Total Devices: 0
Total Calls in Progress: 0
Total Call Legs in Use: 0
ROH Timeout: 45
TLS Version: v1.2

# show stcapp dev voice 0/1/0
Port Identifier:  0/1/0
Device Type:      ALG
Device Id:        585
Device Name:      ANB3176C85F0080
Device Security Mode : Encrypted
  TLS version        : TLS version 1.2
  TLS cipher         : ECDHE-RSA-AES256-GCM-SHA384
Modem Capability: None
Device State:     IS
Diagnostic:       None
Directory Number: 80010
Dial Peer(s):     100
Dialtone after remote onhook feature: activated
Busytone after remote onhook feature: not activated
Last Event:       STCAPP_CC_EV_CALL_MODIFY_DONE
Line State:       ACTIVE
Line Mode:        CALL_CONF
Hook State:       OFFHOOK
mwi:              DISABLE
vmwi:             OFF
mwi config:       Both
Privacy:          Not configured
HG Status:        Unknown
PLAR:             DISABLE
Callback State:   DISABLED
CWT Repetition Interval: 0 second(s) (no repetition)
Number of CCBs:   1
Global call info:
    Total CCB count      = 3
    Total call leg count = 6

Call State for Connection 2 (ACTIVE): TsConnected
Connected Call Info:
   Call Reference: 33535871
   Call ID (DSP):  187
   Local IP Addr:  198.51.100.2
   Local IP Port:  8234
   Remote IP Addr: 198.51.100.20
   Remote IP Port: 8154
   Calling Number: 80010
   Called Number:
   Codec:          g711ulaw
   SRTP:           on
   RX Cipher:      AEAD_AES_256_GCM
   TX Cipher:      AEAD_AES_256_GCM
```

Perform the following task to verify the sRTP cipher suite for the DSPfarm connection.

```
# show sccp connection detail

bridge-info(bid, cid) - Normal bridge information(Bridge id, Calleg id)
mmbridge-info(bid, cid) - Mixed mode bridge information(Bridge id, Calleg id)

sess_id    conn_id    call-id    codec   pkt-period dtmf_method    type
bridge-info(bid, cid)   mmbridge-info(bid, cid) srtp_cryptosuite          dscp
```

```
                    call_ref   spid       conn_id_tx

16778224   -        125        N/A     N/A        rfc2833_pthru     confmsp   All RTPSPI
 Callegs      All MM-MSP Callegs      N/A                      N/A
                    -          -          -

16778224   16777232   126        g711u   20         rfc2833_pthru  s- rtpspi    (101,125)
              N/A                      AEAD_AES_256_GCM          184
                    30751576   16777219   -

16778224   16777231   124        g711u   20         rfc2833_pthru  s- rtpspi    (100,125)
              N/A                      AEAD_AES_256_GCM          184
                    30751576   16777219   -


Total number of active session(s) 1, connection(s) 2, and callegs 3
```

Verifying Call Information

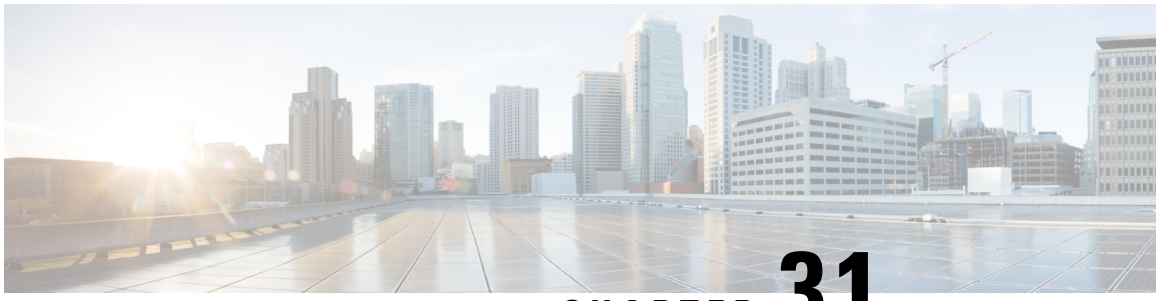
To display call information for TDM and IVR calls stored in the Forwarding Plane Interface (FPI), use the **showvoipfpi calls** command. You can select a call ID and verify the cipher suite using the **show voip fpi calls confID** *call_id_number* command. In this example, cipher suite 6 is AES_256_GCM.

```
#show voip fpi calls
Number of Calls : 2
---------- ---------- ---------- ---------- --------------- ---------------
    confID correlator    AcallID     BcallID           state           event
---------- ---------- ---------- ---------- --------------- ---------------
         1          1         87         88       ALLOCATED DETAIL_STAT_RSP
        21         21         89         90       ALLOCATED DETAIL_STAT_RSP

#show voip fpi calls confID 1
--------------------------------------------------------------------------------
VoIP-FPI call entry details:
--------------------------------------------------------------------------------
Call Type        :           TDM_IP     confID          :                1
correlator       :                1     call_state      :        ALLOCATED
last_event       :  DETAIL_STAT_RSP     alloc_start_time :      1796860810
modify_start_time:                0     delete_start_time:               0
Media Type(SideA):             SRTP     cipher suite    :                6
--------------------------------------------------------------------------------
FPI State Machine Stats:
------------------------
create_req_call_entry_inserted             :         1
.........
```

Table 40: Feature Information for TLS 1.2 support on SCCP Gateways

Feature Name	Releases	Feature Information
Support for NGE Cipher Suites	Cisco IOS XE Cupertino 17.7.1a	This feature supports NGE cipher suites for secure voice signaling and secure media. These cipher suites are applicable for both the STCAPP analog phone and the SCCP DSPFarm conferencing service.



CHAPTER 31

Support for Software Media Termination Point

The Support for Software Media Termination Point (MTP) feature bridges the media streams between two connections, allowing Cisco Unified Communications Manager (CUCM) to relay the calls that are routed through SIP or H.323 endpoints through Skinny Client Control Protocol (SCCP) commands. These commands allow CUCM to establish an MTP for call signaling.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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.

Information About Support for Software Media Termination Point

This feature extends the software MTP support to the Cisco Unified Border Element (Enterprise). Software MTP is an essential component of large-scale deployments of Cisco UCM. This feature enables new capabilities so that the Cisco UBE can function as an Enterprise Edge Cisco Session Border Controller for large-scale deployments that are moving to SIP trunking.

Prerequisites for Software Media Termination Point

- For the software MTP to function properly, codec and packetization must be configured the same way on both in call legs and out call legs.

Restrictions for Software Media Termination Point

- RSVP Agent is not supported in software MTP.
- Software MTP for repacketization is not supported.
- Call Threshold is not supported for standalone software MTP.
- Per-call debugging is not supported.
- Multiple concurrent Synchronisation Sources (SSRCs) with the same destination IP and port are not supported.

SRTP-DTMF Interworking

From Cisco IOS XE 17.10.1a, Secure Real-time Transport Protocol (SRTP) Dual-Tone Multi-Frequency (DTMF) interworking is supported with Software MTP in pass through mode. SMTP supports DTMF Interworking for nonsecure calls, and this feature adds support for SRTP DTMF interworking for secure calls.

CUCM support for this feature is expected to be implemented in a later release.

Restrictions for SRTP-DTMF Interworking

- The SRTP-DTMF Interworking feature supports only the codec-passthrough format.
- The SRTP-DTMF Interworking feature does not support multiple concurrent Synchronised Sources (SSRCs) with the same destination IP and port.
- The calls that support SRTP-DTMF Interworking may have a minor performance impact as compared to calls supported on nonsecure DTMF interworking.

Supported Platforms for SRTP-DTMF Interworking

From Cisco IOS XE 17.10.1a, the following platforms support SRTP DTMF interworking with SMTP:

- Cisco 4461 Integrated Services Router (ISR)
- Cisco Catalyst 8200 Edge Series Platforms
- Cisco Catalyst 8300 Edge Series Platforms
- Cisco Catalyst 8000V Edge Software

Configuring Support for Software Media Termination Point

Perform the following tasks to enable and configure the support for Software Media Termination Point feature.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **sccp local** *interface-type interface-number* [**port** *port-number*]

4. **sccp ccm** {*ipv4-address* | *ipv6-address* | *dns*} **identifier** *identifier-number* [**port** *port-number*] **version** *version-number*
5. **sccp**
6. **sccp ccm group** *group-number*
7. **associate ccm** *identifier-number* **priority** *number*
8. **associate profile** *profile-identifier* **register** *device-name*
9. **dspfarm profile** *profile-identifier* {**conference** | **mtp** | **transcode**} [**security**]
10. **trustpoint** *trustpoint-label*
11. **codec** *codec*
12. **maximum sessions** {**hardware** | **software**} *number*
13. **associate application sccp**
14. **no shutdown**

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	**sccp local** *interface-type interface-number* [**port** *port-number*] **Example:** `Router(config)# sccp local gigabitethernet0/0/0`	Selects the local interface that SCCP applications (transcoding and conferencing) use to register with Cisco UCM. • *interface type*: Can be an interface address or a virtual-interface address such as Ethernet. • *interface number*: Interface number that the SCCP application uses to register with Cisco UCM. • (Optional) **port** *port-number*: Port number used by the selected interface. Range is 1025 to 65535. Default is 2000.
Step 4	**sccp ccm** {*ipv4-address* | *ipv6-address* | *dns*} **identifier** *identifier-number* [**port** *port-number*] **version** *version-number* **Example:** `Router(config)# sccp ccm 10.1.1.1 identifier 1 version 7.0+`	Adds a Cisco UCM server to the list of available servers and sets the following parameters: • *ipv4-address*: IP version 4 address of the Cisco UCM server. • *ipv6-address*: IP version 6 address of the Cisco UCM server. • *dns*: DNS name.

	Command or Action	Purpose
		• **identifier**: Specifies the number that identifies the Cisco UCM server. Range is 1 to 65535. • **port** *port-number* (Optional): Specifies the TCP port number. Range is 1025 to 65535. Default is 2000. • **version** *version-number*: Cisco UCM version. Valid versions are 3.0, 3.1, 3.2, 3.3, 4.0, 4.1, 5.0.1, 6.0, and 7.0+. There is no default value.
Step 5	**sccp** **Example:** `Router(config)# sccp`	Enables the Skinny Client Control Protocol (SCCP) and its related applications (transcoding and conferencing).
Step 6	**sccp ccm group** *group-number* **Example:** `Router(config)# sccp ccm group 10`	Creates a Cisco UCM group and enters SCCP Cisco UCM configuration mode. • *group-number*: Identifies the Cisco UCM group. Range is 1 to 50.
Step 7	**associate ccm** *identifier-number* **priority** *number* **Example:** `Router(config-sccp-ccm)# associate ccm 10 priority 3`	Associates a Cisco UCM with a Cisco UCM group and establishes its priority within the group: • *identifier-number*: Identifies the Cisco UCM. Range is 1 to 65535. There is no default value. • **priority** *number*: Priority of the Cisco UCM within the Cisco UCM group. Range is 1 to 4. There is no default value. The highest priority is 1.
Step 8	**associate profile** *profile-identifier* **register** *device-name* **Example:** `Router(config-sccp-ccm)# associate profile 1 register MTP0011`	Associates a DSP farm profile with a Cisco UCM group: • *profile-identifier*: Identifies the DSP farm profile. Range is 1 to 65535. There is no default value. • **register** *device-name*: Device name in Cisco UCM. A maximum of 15 characters can be entered for the device name.
Step 9	**dspfarm profile** *profile-identifier* {**conference** | **mtp** | **transcode**} [**security**] **Example:** `Router(config-sccp-ccm)# dspfarm profile 1 mtp`	Enters DSP farm profile configuration mode and defines a profile for DSP farm services: • *profile-identifier*: Number that uniquely identifies a profile. Range is 1 to 65535. There is no default. • **conference**: Enables a profile for conferencing. • **mtp**: Enables a profile for MTP. • **transcode**: Enables a profile for transcoding.

	Command or Action	Purpose
		• **security**(Optional): Enables a profile for secure DSP farm services. For more information on configuration examples, see section #unique_447 unique_447_Connect_42_GUID-5FB6A48E-204C-45AA-AE63-413B075A7871, on page 409.
Step 10	**trustpoint** *trustpoint-label* **Example:** `Router(config-dspfarm-profile)# trustpoint dspfarm`	(Optional) Associates a trustpoint with a DSP farm profile.
Step 11	**codec** *codec* **Example:** `Router(config-dspfarm-profile)# codec g711ulaw`	Specifies the codecs supported by a DSP farm profile. • codec-type: Specifies the preferred codec. Enter ? for a list of supported codecs Repeat this step for each supported codec.
Step 12	**maximum sessions** {**hardware** | **software**} *number* **Example:** `Router(config-dspfarm-profile)# maximum sessions software 10`	Specifies the maximum number of sessions that are supported by the profile. • **hardware**: Number of sessions that MTP hardware resources can support. • **software**: Number of sessions that MTP software resources can support. • *number*: Number of sessions that are supported by the profile. Range is 0 to x. Default is 0. The x value is determined at run time depending on the number of resources available with the resource provider.
Step 13	**associate application sccp** **Example:** `Router(config-dspfarm-profile)# associate application sccp`	Associates SCCP to the DSP farm profile.
Step 14	**no shutdown** **Example:** `Router(config-dspfarm-profile)# no shutdown`	Changes the status of the interface to the UP state.

Examples: Support for Software Media Termination Point

The following example shows a sample configuration for the Support for Software Media Termination Point feature:

```
sccp local GigabitEthernet0/0/1
```

```
sccp ccm 10.13.40.148 identifier 1 version 6.0
sccp
!
sccp ccm group 1
 bind interface GigabitEthernet0/0/1
 associate ccm 1 priority 1
 associate profile 6 register RR_RLS6
!
 dspfarm profile 6 mtp
 codec g711ulaw
 maximum sessions software 100
 associate application SCCP
!
!
gateway
media-inactivity-criteria all
timer receive-rtp 400
```

The following example shows a sample configuration for the SRTP-DTMF Interworking feature-with secure dspfarm profile:

```
sccp local GigabitEthernet0/0/0
sccp ccm 172.18.151.125 identifier 1 version 7.0
sccp
!
sccp ccm group 1
 bind interface GigabitEthernet0/0/0
 associate ccm 1 priority 1
 associate profile 1 register Router
!
dspfarm profile 1 mtp security
 trustpoint IOSCA
 codec g711ulaw
 codec pass-through
 tls-version v1.2
 maximum sessions software 5000
 associate application SCCP
```

Note SR-TP traffic can pass through an SMTP resource when the dspfarm profile is provisioned with codec pass-through, and if it does not have TLS and security-related configuration. For traffic flows that require SRTP-DTMF interworking support, the SMTP dspfarm profile must include the **security** keyword and the TLS and codec pass-through configuration. This dspfarm resource profile can also pass through SRTP traffic independent of SRTP-DTMF interworking support.

Verifying Software Media Termination Point Configuration

To verify and troubleshoot this feature, use the following **show** commands.

- To verify information about SCCP, use the **show sccp** command:

```
Router# show sccp

SCCP Admin State: UP
Gateway IP Address: 10.13.40.157, Port Number: 2000
IP Precedence: 5
User Masked Codec list: None
```

```
Call Manager: 10.13.40.148, Port Number: 2000
               Priority: N/A, Version: 6.0, Identifier: 1
               Trustpoint: N/A
```

- To verify information about the DSPfarm profile, use the **show dspfarm profile** command:

```
Router# show dspfarm profile 6

Dspfarm Profile Configuration
 Profile ID = 6, Service = MTP, Resource ID = 1
 Profile Description :
 Profile Service Mode : Non Secure
 Profile Admin State : UP
 Profile Operation State : ACTIVE
 Application : SCCP   Status : ASSOCIATED
 Resource Provider : NONE   Status : NONE
 Number of Resource Configured : 100
 Number of Resource Available : 100
 Hardware Configured Resources : 0
 Hardware Available Resources : 0
 Software Resources : 100
 Codec Configuration
 Codec : g711ulaw, Maximum Packetization Period : 30
```

- To verify information about the secure DSPfarm profile status, use the **show dspfarm profile** command and check that the secure service mode is set:

```
Router# show dspfarm profile 2
Dspfarm Profile Configuration
 Profile ID = 2, Service = MTP, Resource ID = 2
 Profile Service Mode : secure
 Trustpoint : IOSCA
 TLS Version  : v1.2
 TLS Cipher   : AES128-SHA
 Profile Admin State : UP
 Profile Operation State : ACTIVE
 Application : SCCP   Status : ASSOCIATED
 Resource Provider : NONE   Status : NONE
 Total Number of Resources Configured : 8000
 Total Number of Resources Available : 8000
 Total Number of Resources Out of Service : 0
 Total Number of Resources Active : 0
 Hardware Configured Resources : 0
 Hardware Resources Out of Service: 0
 Software Configured Resources : 8000
 Number of Hardware Resources Active : 0
 Number of Software Resources Active : 0
 Codec Configuration: num_of_codecs:2
 Codec : pass-through, Maximum Packetization Period : 0
 Codec : g711ulaw, Maximum Packetization Period : 30
```

- To display statistics for the SCCP connections, use the **show sccp connections** command:

```
Router# show sccp connections

sess_id   conn_id    stype  mode       codec    ripaddr        rport   sport
16808048  16789079    mtp   sendrecv   g711u    10.13.40.20    17510   7242
16808048  16789078    mtp   sendrecv   g711u    10.13.40.157   6900    18050
```

For SMTP secure DTMF, the **show sccp connections** command displays the codec type (pass-th), the s-type (s-mtp), and information about the DTMF method (rfc2833_pthru):

```
Router# show sccp connections

sess_id   conn_id   stype   mode      codec    sport  rport   ripaddr conn_id_tx   dtmf_method
16791234  16777308  s-mtp   sendrecv  pass_th  8006   24610   172.18.153.37
rfc2833_pthru
16791234  16777306  s-mtp   sendrecv  pass_th  8004   17576   172.18.154.2
rfc2833_report

Total number of active session(s) 1, and connection(s) 2
```

- To display information about RTP connections, use the **show rtpspi call** command:

```
Router# show rtpspi call
RTP Service Provider info:
No. CallId  dstCallId   Mode      LocalRTP  RmtRTP  LocalIP     RemoteIP    SRTP
1    22      19         Snd-Rcv   7242      17510   0x90D080F   0x90D0814    0
2    19      22         Snd-Rcv   18050     6900    0x90D080F   0x90D080F    0
```

If SRTP DTMF interworking is active, the SRTP field shows a non-zero value:

```
Router# show rtpspi call
RTP Service Provider info:
No. CallId  dstCallId   Mode      LocalRTP  RmtRTP  LocalIP     RemoteIP    SRTP
1   13      14          Snd-Rcv   8024      18270   0xA7A5355   0xAC129A02   1
2   14      13          Snd-Rcv   8026      24768   0xA7A5355   0xAC129925   1
```

- To display information about VoIP RTP connections, use the **show voip rtp connections** command:

```
Router# show voip rtp connections
VoIP RTP Port Usage Information
Max Ports Available: 30000, Ports Reserved: 100, Ports in Use: 102
Port range not configured, Min: 5500, Max: 65499
VoIP RTP active connections :
No. CallId    dstCallId  LocalRTP  RmtRTP    LocalIP         RemoteIP
1     114       117        19822    24556   10.13.40.157     10.13.40.157
2     115       116        24556    19822   10.13.40.157     10.13.40.157
3     116       115        19176    52625   10.13.40.157     10.13.40.20
4     117       114        16526    52624   10.13.40.157     10.13.40.20
```

- Additional, more specific, **show** commands that can be used include the following:
  - **show sccp connection callid**
  - **show sccp connection connid**
  - **show sccp connection sessionid**
  - **show rtpspi call callid**
  - **show rtpspi stat callid**
  - **show voip rtp connection callid**
  - **show voip rtp connection type**
  - **show platform hardware qfp active feature sbc global**
- To isolate specific problems, use the **debug sccp** command:
  - **debug sccp** [**all** | **config** | **errors** | **events** | **keepalive** | **messages** | **packets** | **parser** | **tls**]

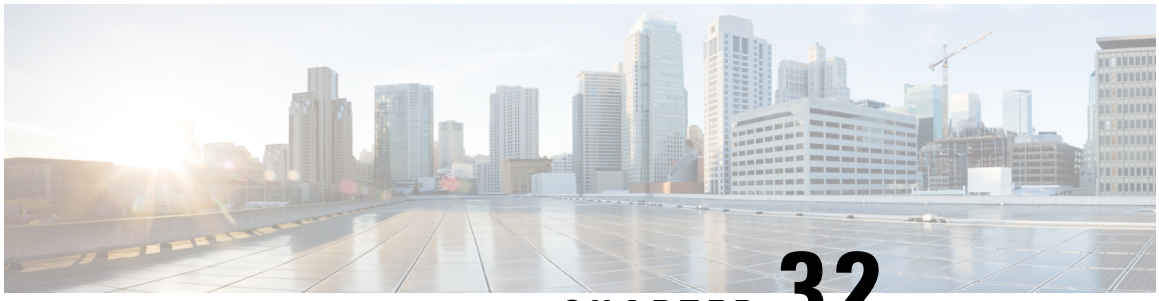
Feature Information for Support for Software Media Termination Point

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 41: Feature Information for Support for Software Media Termination Point

Feature Name	Releases	Feature Information
Support for Software Media Termination Point	Cisco IOS XE Release 2.6 S	Software Media Termination Point (MTP) provides the capability for Cisco Unified Communications Manager (Cisco UCM) to interact with a voice gateway via Skinny Client Control Protocol (SCCP) commands. These commands allow the Cisco UCM to establish an MTP for call signaling.
Support for Secure Real-time Transport Protocol (SRTP) Dual-Tone Multi-Frequency (DTMF) Interworking	Cisco IOS XE Dublin 17.10.1a	The Secure Real-time Transport Protocol (SRTP) Dual-Tone Multi-Frequency (DTMF) feature provides support for DTMF interworking between Secure Software MTP in pass-through mode only and CUCM.



CHAPTER 32

Dying Gasp Through SNMP, Syslog and Ethernet OAM

A dying gasp is a message (or signal) sent by a Customer Premises Equipment (CPE) to equipment managed by an Internet Service Provider to indicate that the CPE has lost power. The message is sent when one of the following occurs:

- System reload
- Interface shutdown
- Power failure—supported on specific platforms

This type of condition is vendor specific. An Ethernet Operations, Administration, and Maintenance (OAM) notification about the condition may be sent immediately.

Prerequisites for Dying Gasp Support

You must enable Ethernet OAM before configuring Simple Network Management Protocol (SNMP) for dying gasp feature. For more information, see Enabling Ethernet OAM on an Interface.

Restrictions for Dying Gasp Support

- The dying gasp feature is not supported if you remove the power supply unit (PSU) from the system.
- SNMP trap is sent only on power failure or removal of power supply cable on selected platforms.
- The dying gasp support feature cannot be configured using CLI. To configure hosts using SNMP, refer to the SNMP host configuration examples below.

Information About Dying Gasp Through SNMP, Syslog and Ethernet OAM

Dying Gasp

One of the OAM features as defined by IEEE 802.3ah is Remote Failure Indication, which helps in detecting faults in Ethernet connectivity that are caused by slowly deteriorating quality. Ethernet OAM provides a mechanism for an OAM entity to convey these failure conditions to its peer via specific flags in the OAM PDU. One of the failure condition method to communicate is Dying Gasp, which indicates that an unrecoverable condition has occurred; for example, when an interface is shut down. This type of condition is vendor specific. A notification about the condition may be sent immediately and continuously.

How to Configure Dying Gasp Through SNMP, Syslog and Ethernet OAM

Dying Gasp Trap Support for Different SNMP Server Host/Port Configurations

Note You can configure up to five different SNMP server host/port configurations.

Environmental Settings on the Network Management Server

```
setenv SR_TRAP_TEST_PORT UDP port
setenv SR_UTIL_COMMUNITY public
setenv SR_UTIL_SNMP_VERSION v2c
setenv SR_MGR_CONF_DIR Path to the executable snmpinfo.DAT file
```

The following example shows SNMP trap configuration on the host:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)# snmp-server host 192.0.2.12 vrf Mgmt-intf version 2c public udp-port 6264
Router(config)#
Router(config)# ^Z
Router#
```

After performing a power cycle, the following output is displayed on the router console:

```
Router#
ystem Bootstrap, Version 17.3(1.2r), RELEASE SOFTWARE
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1994-2020 by cisco Systems, Inc.
Current image running: Boot ROM0
Last reset cause: LocalSoft
C8300-2N2S-4T2X platform with 8388608 Kbytes of main memory
rommon 1 >

======================================
Dying Gasp Trap Received for the Power failure event:
------------------------------------------------------
  Trap on the Host
++++++++++++++

snmp-server host = 192.0.2.12 (nms1-lnx)  and SR_TRAP_TEST_PORT=6264
/auto/sw/packages/snmpr/192.0.2.9/bin> /auto/sw/packages/snmpr/192.0.2.9/bin/traprcv
Waiting for traps.
Received SNMPv2c Trap:
Community: public
From: 192.0.2.34
snmpTrapOID.0 = ciscoMgmt.305.1.3.5.0.2
ciscoMgmt.305.1.3.6 = Dying Gasp - Shutdown due to power loss
```

Message Displayed on the Peer Router on Receiving Dying Gasp Notification

```
001689: *May 30 14:16:47.746 IST: %ETHERNET_OAM-6-RFI: The client on interface Gi0/0/0 has
 received a remote failure indication from its remote peer(failure reason = remote client
power failure action = )
```

Displaying SNMP Configuration for Receiving Dying Gasp Notification

Use the show running-config command to display the SNMP configuration for receiving dying gasp notification:

```
Router# show running-config | i snmp
snmp-server community public RW
snmp-server host 192.0.2.20 vrf Mgmt-intf version 2c public udp-port 6264
Router#
```

Configuration Examples for Dying Gasp Through SNMP, Syslog and Ethernet OAM

Example: Configuring SNMP Community Strings on a Router

Setting up the community access string to permit access to the SNMP:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server community public RW
Router(config)# exit
```

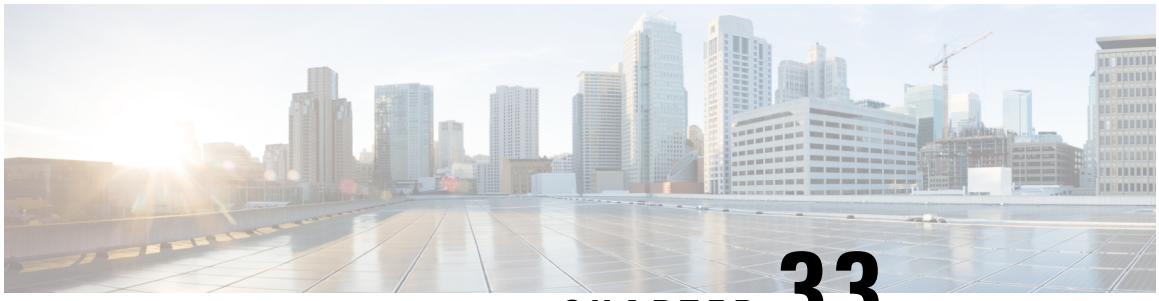
For more information on command syntax and examples, refer to the Cisco IOS Network Management Command Reference.

Example: Configuring SNMP-Server Host Details on the Router Console

Specifying the recipient of a SNMP notification operation:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server host X.X.X.XXX vrf mgmt-intf version 2c public udp-port 9800
Router(config)# exit
```

For more information on command syntax and examples, refer to the Cisco IOS Network Management Command Reference.



CHAPTER 33

Troubleshooting

Troubleshooting

System Report

System reports or crashinfo files save information that helps Cisco technical support representatives to debug problems that caused the Cisco IOS image to crash. It is necessary to collect critical crash information quickly and reliably and bundle it in a way that it can be identified with a specific crash occurrence. System reports are generated and saved into the '/core' directory, either on harddisk: or flash: filesystem. The system does not generate reports in case of a reload.

In case of a system crash, the following details are collected:

1. Full process core
    - IOSd core file and IOS crashinfo file if there was an IOSd process crash
2. Tracelogs
3. System process information
4. Bootup logs
5. Certain types of /proc information

This report is generated before the router goes down to rommon/bootloader. The information is stored in separate files which are then archived and compressed into the tar.gz bundle. This makes it convenient to get a crash snapshot in one place, and can be then moved off the box for analysis.

Device hostname, the ID of the module that generated the system report and its creation timestamp are embedded in the file name:

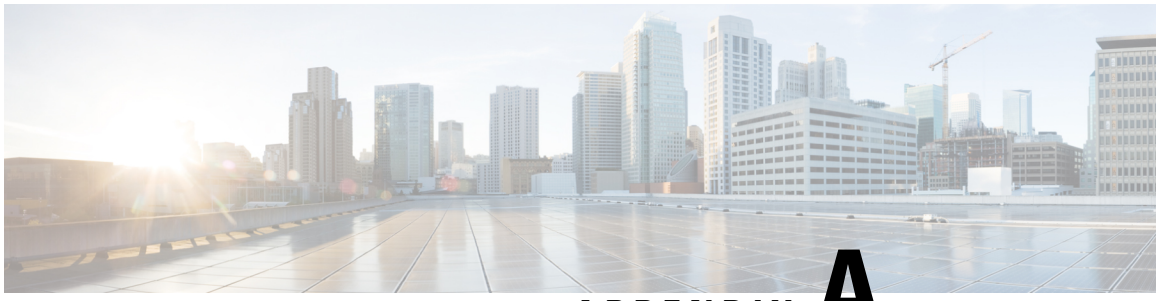
```
<hostname>_<moduleID>-system-report_<timestamp>.tar.gz
```

Example:

Router1_RP_0-system-report_20210204-163559-UTC

A device with hostname Router1 experienced an unexpected reload of RP0 module and the system-report was generated on 4th February 2021 at 4:39:59 PM UTC.

```
├── bootflash/
│   └── pd_info/
│       ├── dmesg_output-20210204-163538-UTC.log
│       ├── filesystems-20210204-163538-UTC.log
│       ├── memaudit-20210204-163538-UTC.log
│       ├── proc_cpuinfo-20210204-163538-UTC.log
│       ├── proc_diskstats-20210204-163538-UTC.log
│       ├── proc_interrupts-20210204-163538-UTC.log
│       ├── proc_oom_stats-20210204-163538-UTC.log
│       ├── proc_softirqs-20210204-163538-UTC.log
│       ├── system_report_trigger.log
│       └── top_output-20210204-163538-UTC.log
├── harddisk/
│   ├── core/
│   │   └── Router1_RP_0_hman_17716_20210212-123836-UTC.core.gz
│   └── tracelogs/
├── tmp/
│   ├── fp/
│   │   └── trace/
│   ├── maroon_stats/
│   ├── rp/
│   │   └── trace/
│   └── Router1_RP_0-bootuplog-20210204-163559-UTC.log
└── var/
    └── log/
        └── audit/
            └── audit.log
```



APPENDIX A

Unsupported Commands

The C8000 Series routers contain a series of commands with the **logging** or **platform** keywords that either produce no output or produce output that is not useful for customer purposes. Such commands that are not useful for customer purposes are considered as unsupported commands. You will not find any further Cisco documentation for the unsupported commands.

The following is a list of unsupported commands for the C8000 Series routers:

- backplaneswitchport
- clear logging onboard slot f0 dram
- clear logging onboard slot f0 voltage
- clear logging onboard slot f0 temperature
- show logging onboard slot f0 dram
- show logging onboard slot f0 serdes
- show logging onboard slot f0 status
- show logging onboard slot f0 temperature
- show logging onboard slot f0 uptime
- show logging onboard slot f0 uptime latest
- show logging onboard slot f0 voltage
- show logging onboard slot 0 dram
- show logging onboard slot 0 serdes
- show logging onboard slot 0 status
- show logging onboard slot 0 temperature
- show logging onboard slot 0 uptime
- show logging onboard slot 0 uptime latest
- show logging onboard slot 0 voltage
- show platform software adjacency r0 special

- show platform software adjacency rp active special
- show platform hardware backplaneswitch-manager RP active summary
- show platform hardware backplaneswitch-manager RP active subslot GEO statistics
- show platform software backplaneswitch-manager RP [active [detail]]
- show platform hardware backplaneswitch-manager [R0 [status] | RP]
- show platform hardware backplaneswitch-manager RPactive CP statistics
- platform hardware backplaneswitch-manager rp active subslot GEO statistics
- show platform software ethernet rp active l2cp
- show platform software ethernet rp active l2cp interface GigabitEthernet0
- show platform software ethernet rp active loopback
- show platform software ethernet rp active vfi
- show platform software ethernet r0 vfi
- show platform software ethernet r0 vfi id 0
- show platform software ethernet r0 vfi name GigabitEthernet0
- show platform software ethernet r0 l2cp
- show platform software ethernet r0 l2cp interface GigabitEthernet0
- show platform software ethernet r0 bridge-domain statistics
- show platform software flow r0 exporter name GigabitEthernet0
- show platform software flow r0 exporter statistics
- show platform software flow r0 global
- show platform software flow r0 flow-def
- show platform software flow r0 interface
- show platform software flow r0 ios
- show platform software flow r0 monitor
- show platform software flow r0 sampler
- show platform hardware qfp active classification feature-manager label GigabitEthernet 0 0
- show platform software interface f0 del-track
- show platform software interface fp active del-track
- show platform software rg r0 services
- show platform software rg r0 services rg-id 0
- show platform software rg r0 services rg-id 0 verbose
- show platform software rg r0 services verbose

- show platform software rg r0 statistics
- show platform software rg rp active services
- show platform software rg rp active services rg-id 0
- show platform software rg rp active services rg-id 0 verbose
- show platform software rg rp active statistics
- show platform hardware slot 0 dram statistics
- show platform hardware slot f0 dram statistics
- show platform hardware slot 0 eobc interface primary rmon
- show platform hardware slot 0 eobc interface primary status
- show platform hardware slot 0 eobc interface standby rmon
- show platform hardware slot 0 eobc interface standby status
- show platform hardware slot f0 eobc interface primary rmon
- show platform hardware slot f0 eobc interface primary status
- show platform hardware slot f0 eobc interface standby rmon
- show platform hardware slot f0 eobc interface standby status
- show platform hardware slot f0 sensor consumer
- show platform hardware slot f0 sensor producer

Unsupported Commands