System Management Configuration Guide, Cisco IOS XE Fuji 16.9.x (Catalyst 3650 Switches)

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CONTENTS

CHAPTER 1

Administering the Device

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for Administering the Switch

Do not use switches running the Cisco IOS XE release images as VPN termination points. Use a router or Cisco Adaptive Security Appliance (ASA) as a VPN termination point .

Information About Administering the Device

System Time and Date Management

You can manage the system time and date on your device using automatic configuration methods (RTC and NTP), or manual configuration methods.

Note For complete syntax and usage information for the commands used in this section, see the *Cisco IOS Configuration Fundamentals Command Reference*on *Cisco.com*.

System Clock

The basis of the time service is the system clock. This clock runs from the moment the system starts up and keeps track of the date and time.

The system clock can then be set from these sources:

- NTP
- Manual configuration

The system clock can provide time to these services:

- User **show** commands
- Logging and debugging messages

The system clock keeps track of time internally based on Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT). You can configure information about the local time zone and summer time (daylight saving time) so that the time appears correctly for the local time zone.

The system clock keeps track of whether the time is *authoritative* or not (that is, whether it has been set by a time source considered to be authoritative). If it is not authoritative, the time is available only for display purposes and is not redistributed.

Network Time Protocol

The NTP is designed to time-synchronize a network of devices. NTP runs over User Datagram Protocol (UDP), which runs over IP. NTP is documented in RFC 1305.

An NTP network usually gets its time from an authoritative time source, such as a radio clock or an atomic clock attached to a time server. NTP then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two devices to within a millisecond of one another.

NTP uses the concept of a *stratum* to describe how many NTP hops away a device is from an authoritative time source. A stratum 1 time server has a radio or atomic clock directly attached, a stratum 2 time server receives its time through NTP from a stratum 1 time server, and so on. A device running NTP automatically chooses as its time source the device with the lowest stratum number with which it communicates through NTP. This strategy effectively builds a self-organizing tree of NTP speakers.

NTP avoids synchronizing to a device whose time might not be accurate by never synchronizing to a device that is not synchronized. NTP also compares the time reported by several devices and does not synchronize to a device whose time is significantly different than the others, even if its stratum is lower.

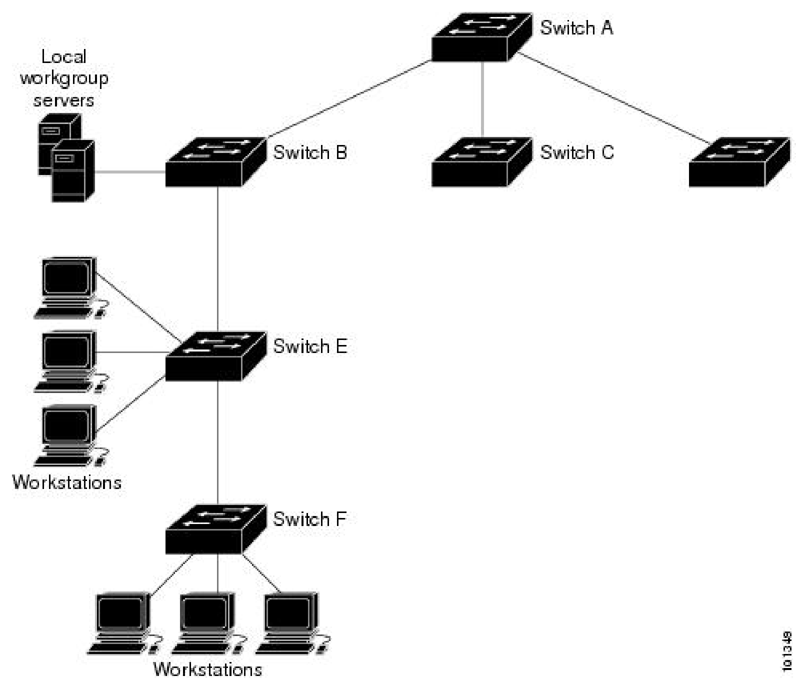
The communications between devices running NTP (known as associations) are usually statically configured; each device is given the IP address of all devices with which it should form associations. Accurate timekeeping is possible by exchanging NTP messages between each pair of devices with an association. However, in a LAN environment, NTP can be configured to use IP broadcast messages instead. This alternative reduces configuration complexity because each device can simply be configured to send or receive broadcast messages. However, in that case, information flow is one-way only.

The time kept on a device is a critical resource; you should use the security features of NTP to avoid the accidental or malicious setting of an incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

Cisco's implementation of NTP does not support stratum 1 service; it is not possible to connect to a radio or atomic clock. We recommend that the time service for your network be derived from the public NTP servers available on the IP Internet.

The figure below shows a typical network example using NTP. Device A is the NTP primary (formerly known as NTP primary), with the **Device** B, C, and D configured in NTP server mode, in server association with Device A. Device E is configured as an NTP peer to the upstream and downstream Device, Device B and Device F, respectively.

Figure 1: Typical NTP Network Configuration



If the network is isolated from the Internet, Cisco's implementation of NTP allows a device to act as if it is synchronized through NTP, when in fact it has learned the time by using other means. Other devices then synchronize to that device through NTP.

When multiple sources of time are available, NTP is always considered to be more authoritative. NTP time overrides the time set by any other method.

Several manufacturers include NTP software for their host systems, and a publicly available version for systems running UNIX and its various derivatives is also available. This software allows host systems to be time-synchronized as well.

NTP Stratum

NTP uses the concept of a *stratum* to describe how many NTP hops away a device is from an authoritative time source. A stratum 1 time server has a radio or atomic clock directly attached, a stratum 2 time server receives its time through NTP from a stratum 1 time server, and so on. A device running NTP automatically chooses as its time source the device with the lowest stratum number with which it communicates through NTP. This strategy effectively builds a self-organizing tree of NTP speakers.

NTP avoids synchronizing to a device whose time might not be accurate by never synchronizing to a device that is not synchronized. NTP also compares the time reported by several devices and does not synchronize to a device whose time is significantly different than the others, even if its stratum is lower.

NTP Associations

The communications between devices running NTP (known as *associations*) are usually statically configured; each device is given the IP address of all devices with which it should form associations. Accurate timekeeping is possible by exchanging NTP messages between each pair of devices with an association. However, in a LAN environment, NTP can be configured to use IP broadcast messages instead. This alternative reduces configuration complexity because each device can simply be configured to send or receive broadcast messages. However, in that case, information flow is one-way only.

Poll-Based NTP Associations

Networking devices running NTP can be configured to operate in variety of association modes when synchronizing time with reference time sources. A networking device can obtain time information on a network in two ways—by polling host servers and by listening to NTP broadcasts. This section focuses on the poll-based association modes. Broadcast-based NTP associations are discussed in the *Broadcast-Based NTP Associations* section.

The following are the two most commonly used poll-based association modes:

- Client mode
- Symmetric active mode

The client and the symmetric active modes should be used when NTP is required to provide a high level of time accuracy and reliability.

When a networking device is operating in the client mode, it polls its assigned time-serving hosts for the current time. The networking device will then pick a host from among all the polled time servers to synchronize with. Because the relationship that is established in this case is a client-host relationship, the host will not capture or use any time information sent by the local client device. This mode is most suited for file-server and workstation clients that are not required to provide any form of time synchronization to other local clients. Use the **ntp server** command to individually specify the time server that you want your networking device to consider synchronizing with and to set your networking device to operate in the client mode.

When a networking device is operating in the symmetric active mode, it polls its assigned time-serving hosts for the current time and it responds to polls by its hosts. Because this is a peer-to-peer relationship, the host will also retain time-related information of the local networking device that it is communicating with. This mode should be used when a number of mutually redundant servers are interconnected via diverse network paths. Most stratum 1 and stratum 2 servers on the Internet adopt this form of network setup. Use the **ntp peer** command to individually specify the time serving hosts that you want your networking device to consider synchronizing with and to set your networking device to operate in the symmetric active mode.

The specific mode that you should set for each of your networking devices depends primarily on the role that you want them to assume as a timekeeping device (server or client) and the device's proximity to a stratum 1 timekeeping server.

A networking device engages in polling when it is operating as a client or a host in the client mode or when it is acting as a peer in the symmetric active mode. Although polling does not usually place a burden on memory and CPU resources such as bandwidth, an exceedingly large number of ongoing and simultaneous polls on a system can seriously impact the performance of a system or slow the performance of a given network. To avoid having an excessive number of ongoing polls on a network, you should limit the number of direct, peer-to-peer or client-to-server associations. Instead, you should consider using NTP broadcasts to propagate time information within a localized network.

Broadcast-Based NTP Associations

Broadcast-based NTP associations should be used when time accuracy and reliability requirements are modest and if your network is localized and has more than 20 clients. Broadcast-based NTP associations are also recommended for use on networks that have limited bandwidth, system memory, or CPU resources.

A networking device operating in the broadcast client mode does not engage in any polling. Instead, it listens for NTP broadcast packets that are transmitted by broadcast time servers. Consequently, time accuracy can be marginally reduced because time information flows only one way.

Use the **ntp broadcast client** command to set your networking device to listen for NTP broadcast packets propagated through a network. For broadcast client mode to work, the broadcast server and its clients must be located on the same subnet. You must enable the time server that transmits NTP broadcast packets on the interface of the given device by using the **ntp broadcast** command.

NTP Security

The time kept on a device is a critical resource; you should use the security features of NTP to avoid the accidental or malicious setting of an incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

NTP Access Group

The access list-based restriction scheme allows you to grant or deny certain access privileges to an entire network, a subnet within a network, or a host within a subnet. To define an NTP access group, use the ntp access-group command in global configuration mode.

The access group options are scanned in the following order, from least restrictive to the most restrictive:

1. ipv4 —Configures IPv4 access lists.
2. ipv6 —Configures IPv6 access lists.
3. peer —Allows time requests and NTP control queries, and allows the system to synchronize itself to a system whose address passes the access list criteria.
4. serve —Allows time requests and NTP control queries, but does not allow the system to synchronize itself to a system whose address passes the access list criteria.
5. serve-only —Allows only time requests from a system whose address passes the access list criteria.
6. query-only —Allows only NTP control queries from a system whose address passes the access list criteria.

If the source IP address matches the access lists for more than one access type, the first type is granted access. If no access groups are specified, all access types are granted access to all systems. If any access groups are specified, only the specified access types will be granted access.

For details on NTP control queries, see RFC 1305 (NTP Version 3).

The encrypted NTP authentication scheme should be used when a reliable form of access control is required. Unlike the access list-based restriction scheme that is based on IP addresses, the encrypted authentication scheme uses authentication keys and an authentication process to determine if NTP synchronization packets sent by designated peers or servers on a local network are deemed as trusted before the time information that they carry along with them is accepted.

The authentication process begins from the moment an NTP packet is created. Cryptographic checksum keys are generated using the message digest algorithm 5 (MD5) and are embedded into the NTP synchronization packet that is sent to a receiving client. Once a packet is received by a client, its cryptographic checksum key is decrypted and checked against a list of trusted keys. If the packet contains a matching authentication key, the time-stamp information that is contained within the packet is accepted by the receiving client. NTP synchronization packets that do not contain a matching authenticator key are ignored.

Note In large networks, where many trusted keys must be configured, the Range of Trusted Key Configuration feature enables configuring multiple keys simultaneously.

It is important to note that the encryption and decryption processes used in NTP authentication can be very CPU-intensive and can seriously degrade the accuracy of the time that is propagated within a network. If your network setup permits a more comprehensive model of access control, you should consider the use of the access list-based form of control.

After NTP authentication is properly configured, your networking device will synchronize with and provide synchronization only to trusted time sources.

NTP Services on a Specific Interface

Network Time Protocol (NTP) services are disabled on all interfaces by default. NTP is enabled globally when any NTP commands are entered. You can selectively prevent NTP packets from being received through a specific interface by using the **ntp disable** command in interface configuration mode.

Source IP Address for NTP Packets

When the system sends an NTP packet, the source IP address is normally set to the address of the interface through which the NTP packet is sent. Use the **ntp source** *interface* command in global configuration mode to configure a specific interface from which the IP source address will be taken.

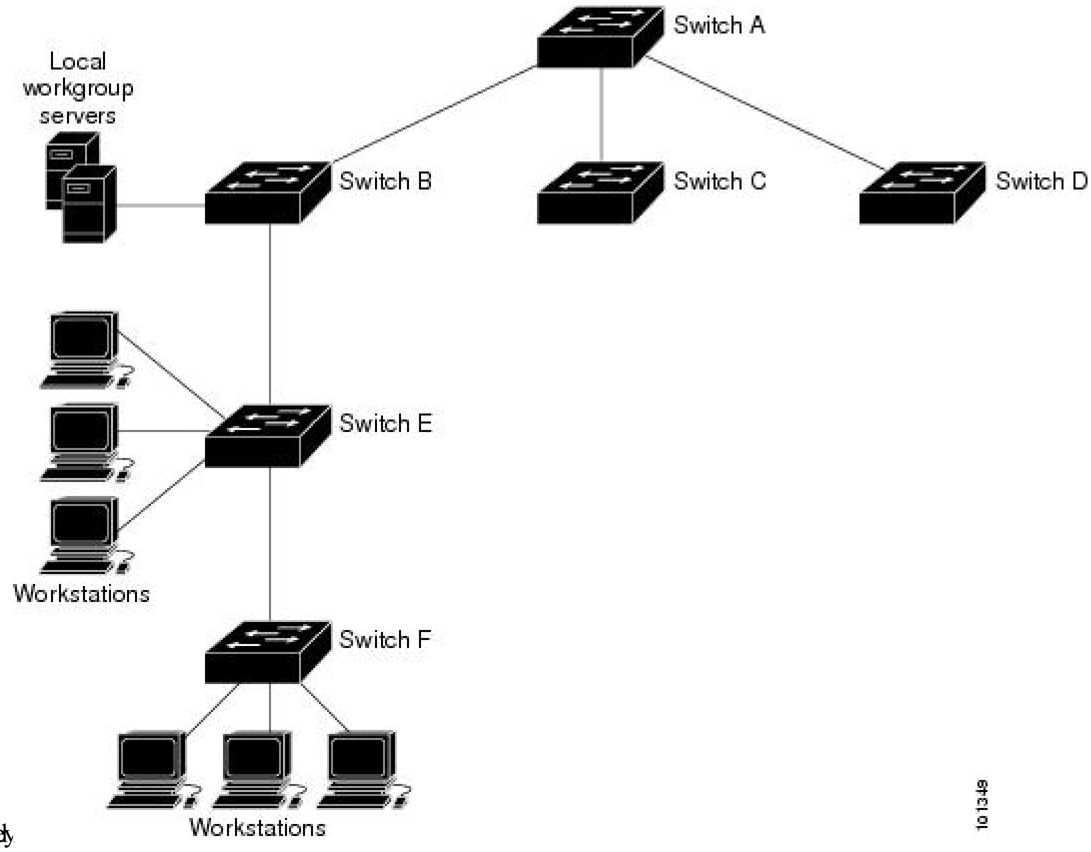
This interface will be used for the source address for all packets sent to all destinations. If a source address is to be used for a specific association, use the **source** keyword in the **ntp peer** or **ntp server** command.

NTP Implementation

Implementation of NTP does not support stratum 1 service; it is not possible to connect to a radio or atomic clock. We recommend that the time service for your network be derived from the public NTP servers available on the IP Internet.

Figure 2: Typical NTP Network Configuration

The following figure shows a typical network example using NTP. Switch A is the NTP primary, with the Switch B, C, and D configured in NTP server mode, in server association with Switch A. Switch E is configured as an NTP peer to the upstream and downstream switches, Switch B and Switch F,



respectively

If the network is isolated from the Internet, NTP allows a device to act as if it is synchronized through NTP, when in fact it has learned the time by using other means. Other devices then synchronize to that device through NTP.

When multiple sources of time are available, NTP is always considered to be more authoritative. NTP time overrides the time set by any other method.

Several manufacturers include NTP software for their host systems, and a publicly available version for systems running UNIX and its various derivatives is also available. This software allows host systems to be time-synchronized as well.

NTP Version 4

NTP version 4 is implemented on the device. NTPv4 is an extension of NTP version 3. NTPv4 supports both IPv4 and IPv6 and is backward-compatible with NTPv3.

NTPv4 provides these capabilities:

- Support for IPv6.
- Improved security compared to NTPv3. The NTPv4 protocol provides a security framework based on public key cryptography and standard X509 certificates.
- Automatic calculation of the time-distribution hierarchy for a network. Using specific multicast groups, NTPv4 automatically configures the hierarchy of the servers to achieve the best time accuracy for the lowest bandwidth cost. This feature leverages site-local IPv6 multicast addresses.

For details about configuring NTPv4, see the *Implementing NTPv4 in IPv6* chapter of the *Cisco IOS IPv6 Configuration Guide, Release 12.4T*.

System Name and Prompt

You configure the system name on the Device to identify it. By default, the system name and prompt are *Switch*.

If you have not configured a system prompt, the first 20 characters of the system name are used as the system prompt. A greater-than symbol [>] is appended. The prompt is updated whenever the system name changes.

For complete syntax and usage information for the commands used in this section, see the *Cisco IOS Configuration Fundamentals Command Reference*, *Release 12.4* and the *Cisco IOS IP Command Reference*, *Volume 2 of 3: Routing Protocols*, *Release 12.4*.

Stack System Name and Prompt

If you are accessing a stack member through the active stack, you must use the **session** *stack-member-number* privileged EXEC command. The stack member number range is . When you use this command, the stack member number is appended to the system prompt. For example, Switch-2# is the prompt in privileged EXEC mode for stack member 2, and the system prompt for the switch stack is Switch.

Default System Name and Prompt Configuration

The default switch system name and prompt is *Switch*.

DNS

The DNS protocol controls the Domain Name System (DNS), a distributed database with which you can map hostnames to IP addresses. When you configure DNS on your device, you can substitute the hostname for the IP address with all IP commands, such as **ping**, **telnet**, **connect**, and related Telnet support operations.

IP defines a hierarchical naming scheme that allows a device to be identified by its location or domain. Domain names are pieced together with periods (.) as the delimiting characters. For example, Cisco Systems is a commercial organization that IP identifies by a *com* domain name, so its domain name is *cisco.com*. A specific device in this domain, for example, the File Transfer Protocol (FTP) system is identified as *ftp.cisco.com*.

To keep track of domain names, IP has defined the concept of a domain name server, which holds a cache (or database) of names mapped to IP addresses. To map domain names to IP addresses, you must first identify the hostnames, specify the name server that is present on your network, and enable the DNS.

Default DNS Settings

Table 1: Default DNS Settings

Feature	Default Setting
DNS enable state	Enabled.
DNS default domain name	None configured.
DNS servers	No name server addresses are configured.

Login Banners

You can configure a message-of-the-day (MOTD) and a login banner. The MOTD banner is displayed on all connected terminals at login and is useful for sending messages that affect all network users (such as impending system shutdowns).

The login banner is also displayed on all connected terminals. It appears after the MOTD banner and before the login prompts.

Note For complete syntax and usage information for the commands used in this section, see the *Cisco IOS Configuration Fundamentals Command Reference, Release 12.4*.

Default Banner Configuration

The MOTD and login banners are not configured.

MAC Address Table

The MAC address table contains address information that the device uses to forward traffic between ports. All MAC addresses in the address table are associated with one or more ports. The address table includes these types of addresses:

- Dynamic address—A source MAC address that the device learns and then ages when it is not in use.
- Static address—A manually entered unicast address that does not age and that is not lost when the device resets.

The address table lists the destination MAC address, the associated VLAN ID, and port number associated with the address and the type (static or dynamic).

Note For complete syntax and usage information for the commands used in this section, see the command reference for this release.

MAC Address Table Creation

With multiple MAC addresses supported on all ports, you can connect any port on the device to other network devices. The device provides dynamic addressing by learning the source address of packets it receives on each port and adding the address and its associated port number to the address table. As devices are added or removed from the network, the device updates the address table, adding new dynamic addresses and aging out those that are not in use.

The aging interval is globally configured. However, the device maintains an address table for each VLAN, and STP can accelerate the aging interval on a per-VLAN basis.

The device sends packets between any combination of ports, based on the destination address of the received packet. Using the MAC address table, the device forwards the packet only to the port associated with the destination address. If the destination address is on the port that sent the packet, the packet is filtered and not forwarded. The device always uses the store-and-forward method: complete packets are stored and checked for errors before transmission.

MAC Addresses and VLANs

All addresses are associated with a VLAN. An address can exist in more than one VLAN and have different destinations in each. Unicast addresses, for example, could be forwarded to port 1 in VLAN 1 and ports 9, 10, and 1 in VLAN 5.

Each VLAN maintains its own logical address table. A known address in one VLAN is unknown in another until it is learned or statically associated with a port in the other VLAN.

MAC Addresses and Device Stacks

The MAC address tables on all stack members are synchronized. At any given time, each stack member has the same copy of the address tables for each VLAN. When an address ages out, the address is removed from the address tables on all stack members. When a Device joins a switch stack, that Device receives the addresses for each VLAN learned on the other stack members. When a stack member leaves the switch stack, the remaining stack members age out or remove all addresses learned by the former stack member.

Default MAC Address Table Settings

The following table shows the default settings for the MAC address table.

Table 2: Default Settings for the MAC Address

Feature	Default Setting
Aging time	300 seconds
Dynamic addresses	Automatically learned
Static addresses	None configured

ARP Table Management

To communicate with a device (over Ethernet, for example), the software first must learn the 48-bit MAC address or the local data link address of that device. The process of learning the local data link address from an IP address is called *address resolution*.

The Address Resolution Protocol (ARP) associates a host IP address with the corresponding media or MAC addresses and the VLAN ID. Using an IP address, ARP finds the associated MAC address. When a MAC address is found, the IP-MAC address association is stored in an ARP cache for rapid retrieval. Then the IP datagram is encapsulated in a link-layer frame and sent over the network. Encapsulation of IP datagrams and ARP requests and replies on IEEE 802 networks other than Ethernet is specified by the Subnetwork Access Protocol (SNAP). By default, standard Ethernet-style ARP encapsulation (represented by the **arpa** keyword) is enabled on the IP interface.

ARP entries added manually to the table do not age and must be manually removed.

For CLI procedures, see the Cisco IOS Release 12.4 documentation on *Cisco.com*.

How to Administer the Device

Configuring the Time and Date Manually

System time remains accurate through restarts and reboot, however, you can manually configure the time and date after the system is restarted.

We recommend that you use manual configuration only when necessary. If you have an outside source to which the device can synchronize, you do not need to manually set the system clock.

Setting the System Clock

If you have an outside source on the network that provides time services, such as an NTP server, you do not need to manually set the system clock.

Follow these steps to set the system clock:

SUMMARY STEPS

1. **enable**
2. Use one of the following:
   - **clock set** *hh:mm:ss day month year*
   - **clock set** *hh:mm:ss month day year*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Use one of the following: • **clock set** *hh:mm:ss day month year* • **clock set** *hh:mm:ss month day year* **Example:** `Device# clock set 13:32:00 23 March 2013`	Manually set the system clock using one of these formats: • *hh:mm:ss*—Specifies the time in hours (24-hour format), minutes, and seconds. The time specified is relative to the configured time zone. • *day*—Specifies the day by date in the month. • *month*—Specifies the month by name. • *year*—Specifies the year (no abbreviation).

Configuring the Time Zone

Follow these steps to manually configure the time zone:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **clock timezone** *zone hours-offset* [*minutes-offset*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**clock timezone** *zone hours-offset* [*minutes-offset*] **Example:** `Device(config)# clock timezone AST -3 30`	Sets the time zone. Internal time is kept in Coordinated Universal Time (UTC), so this command is used only for display purposes and when the time is manually set. • *zone*—Enters the name of the time zone to be displayed when standard time is in effect. The default is UTC. • *hours-offset*—Enters the hours offset from UTC. • (Optional) *minutes-offset*—Enters the minutes offset from UTC. This available where the local time zone is a percentage of an hour different from UTC.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.

	Command or Action	Purpose
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Summer Time (Daylight Saving Time)

To configure summer time (daylight saving time) in areas where it starts and ends on a particular day of the week each year, perform this task:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **clock summer-time** *zone* **date** *date month year hh:mm date month year hh:mm* [*offset*]]
4. **clock summer-time** *zone* **recurring** [*week day month hh:mm week day month hh:mm* [*offset*]]
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

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	**clock summer-time** *zone* **date** *date month year hh:mm date month year hh:mm* [*offset*]] **Example:** `Device(config)# clock summer-time PDT date 10 March 2013 2:00 3 November 2013 2:00`	Configures summer time to start and end on specified days every year.
Step 4	**clock summer-time** *zone* **recurring** [*week day month hh:mm week day month hh:mm* [*offset*]] **Example:**	Configures summer time to start and end on the specified days every year. All times are relative to the local time zone. The start time is relative to standard time.

	Command or Action	Purpose
	`Device(config)# clock summer-time PDT recurring 10 March 2013 2:00 3 November 2013 2:00`	The end time is relative to summer time. Summer time is disabled by default. If you specify **clock summer-time** *zone* **recurring** without parameters, the summer time rules default to the United States rules. If the starting month is after the ending month, the system assumes that you are in the southern hemisphere. • *zone*—Specifies the name of the time zone (for example, PDT) to be displayed when summer time is in effect. • (Optional) *week*— Specifies the week of the month (1 to 4, **first**, or **last**). • (Optional) *day*—Specifies the day of the week (Sunday, Monday...). • (Optional) *month*—Specifies the month (January, February...). • (Optional) *hh:mm*—Specifies the time (24-hour format) in hours and minutes. • (Optional) *offset*—Specifies the number of minutes to add during summer time. The default is 60.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Follow these steps if summer time in your area does not follow a recurring pattern (configure the exact date and time of the next summer time events):

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **clock summer-time** *zone* **date**[*month date year hh:mm month date year hh:mm* [*offset*]]or**clock summer-time** *zone* **date** [*date month year hh:mm date month year hh:mm* [*offset*]]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**clock summer-time** *zone* **date**[*month date year hh:mm month date year hh:mm* [*offset*]]or**clock summer-time** *zone* **date** [*date month year hh:mm date month year hh:mm* [*offset*]]	Configures summer time to start on the first date and end on the second date. Summer time is disabled by default. • For *zone*, specify the name of the time zone (for example, PDT) to be displayed when summer time is in effect. • (Optional) For *week*, specify the week of the month (1 to 5 or last). • (Optional) For *day*, specify the day of the week (Sunday, Monday...). • (Optional) For *month*, specify the month (January, February...). • (Optional) For *hh:mm*, specify the time (24-hour format) in hours and minutes. • (Optional) For *offset*, specify the number of minutes to add during summer time. The default is 60.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring NTP

The device does not have a hardware-supported clock and cannot function as an NTP primary clock to which peers synchronize themselves when an external NTP source is not available. The device also has no hardware support for a calendar. As a result, the **ntp update-calendar** and the **ntp master** commands in global configuration mode are not available.

These following sections provide configuration information on NTP:

Default NTP Configuration

shows the default NTP configuration.

Table 3: Default NTP Configuration

Feature	Default Setting
NTP authentication	Disabled. No authentication key is specified.
NTP peer or server associations	None configured.
NTP broadcast service	Disabled; no interface sends or receives NTP broadcast packets.
NTP access restrictions	No access control is specified.
NTP packet source IP address	The source address is set by the outgoing interface.

NTP is enabled on all interfaces by default. All interfaces receive NTP packets.

Configuring NTP Authentication

To configure NTP authentication, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**

3. **ntp authenticate**
4. **ntp authentication-key** *number* **md5** *value*
5. **ntp trusted-key** *key-number*
6. **ntp server** *ip-address* **key** *key-id* [**prefer**]
7. **end**

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	**ntp authenticate** **Example:** `Device(config)# ntp authenticate`	Enables NTP authentication. Use the **no** form of this command to disable NTP authentication
Step 4	**ntp authentication-key** *number* **md5** *value* **Example:** `Device(config)# ntp authentication-key 42 md5 aNiceKey`	Defines the authentication keys. • Each key has a key number, a type, and a value. Use the **no** form of this command to remove authentication key.
Step 5	**ntp trusted-key** *key-number* **Example:** `Device(config)# ntp trusted-key 42`	Defines trusted authentication keys that a peer NTP device must provide in its NTP packets for this device to synchronize to it. Use the **no** form of this command to disable trusted authentication.
Step 6	**ntp server** *ip-address* **key** *key-id* [**prefer**] **Example:** `Device(config)# ntp server 172.16.22.44 key 42`	Allows the software clock to be synchronized by an NTP time server. • *ip-address*: The IP address of the time server providing the clock synchronization. • *key-id*: Authentication key defined with the **ntp authentication-key** command.

	Command or Action	Purpose
		• **prefer**: Sets this peer as the preferred one that provides synchronization. This keyword reduces clock hop among peers. Use the **no** form of this command to remove a server association.
Step 7	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuring Poll-Based NTP Associations

To configure poll-based NTP associations, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. [**no**] **ntp peer** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface*] [**prefer**]
4. [**no**] **ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface*] [**prefer**]
5. **end**

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	[**no**] **ntp peer** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface*] [**prefer**] **Example:** `Device(config)# ntp peer 172.16.22.44 version 2`	Configures the device system clock to synchronize a peer or to be synchronized by a peer (peer association). • *ip-address*: The IP address of the peer providing or being provided, the clock synchronization. • *number*: NTP version number. The range is 1 to 3. By default, version 3 is selected.

	Command or Action	Purpose
		• *key-id*: Authentication key defined with the **ntp authentication-key** command. • *interface*: The interface from which to pick the IP source address. By default, the source IP address is taken from the outgoing interface. • **prefer**: Sets this peer as the preferred one that provides synchronization. This keyword reduces switching back and forth between peers. Use the **no** form of this command to remove a peer association.
Step 4	[**no**] **ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface*] [**prefer**] **Example:** `Device(config)# ntp server 172.16.22.44 version 2`	Configures the device's system clock to be synchronized by a time server (server association). • *ip-address*: The IP address of the time server providing the clock synchronization. • *number*: NTP version number. The range is 1 to 3. By default, version 3 is selected. • *key-id*: Authentication key defined with the **ntp authentication-key** command. • *interface*: The interface from which to pick the IP source address. By default, the source IP address is taken from the outgoing interface. • **prefer**: Sets this peer as the preferred one that provides synchronization. This keyword reduces clock hop among peers. Use the **no** form of this command to remove a server association.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuring Broadcast-Based NTP Associations

To configure broadcast-based NTP associations, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface-id*

4. [**no**] **ntp broadcast** [**version** *number*] [**key** *key-id*] [*destination-address*]
5. [**no**] **ntp broadcast client**
6. **exit**
7. [**no**] **ntp broadcastdelay** *microseconds*
8. **end**

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Configures an interface and enters interface configuration mode.
Step 4	[**no**] **ntp broadcast** [**version** *number*] [**key** *key-id*] [*destination-address*] **Example:** `Device(config-if)# ntp broadcast version 2`	Enables the interface to send NTP broadcast packets to a peer. • *number*: NTP version number. The range is 1 to 3. By default, version 3 is used. • *key-id*: Authentication key. • *destination-address*: IP address of the peer that is synchronizing its clock to this switch. Use the **no** form of this command to disable the interface from sending NTP broadcast packets.
Step 5	[**no**] **ntp broadcast client** **Example:** `Device(config-if)# ntp broadcast client`	Enables the interface to receive NTP broadcast packets. Use the **no** form of this command to disable the interface from receiving NTP broadcast packets.
Step 6	**exit** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Device(config-if)# exit`	
Step 7	[**no**] **ntp broadcastdelay** *microseconds* **Example:** `Device(config)# ntp broadcastdelay 100`	(Optional) Change the estimated round-trip delay between the device and the NTP broadcast server The default is 3000 microseconds. The range is from 1 to 999999. Use the **no** form of this command to disable the interface from receiving NTP broadcast packets.
Step 8	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuring NTP Access Restrictions

You can control NTP access on two levels as described in these sections:

Creating an Access Group and Assigning a Basic IP Access List

To create an access group and assign a basic IP access list, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. [**no**] **ntp access-group** {**query-only** | **serve-only** | **serve** | **peer**} *access-list-number*
4. **access-list** *access-list-number* **permit** *source* [*source-wildcard*]
5. **end**

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.

	Command or Action	Purpose
Step 3	[**no**] **ntp access-group** {**query-only** | **serve-only** | **serve** | **peer**} *access-list-number* **Example:** `Device(config)# ntp access-group peer 99`	Create an access group, and apply a basic IP access list.. • **query-only**: NTP control queries. • **serve-only**: Time requests. • **serve**: Allows time requests and NTP control queries, but does not allow the device to synchronize to the remote device. • **peer**: Allows time requests and NTP control queries and allows the device to synchronize to the remote device. • *access-list-number*: IP access list number. The range is from 1 to 99. Use the **no** form of this command to remove access control to the switch NTP services.
Step 4	**access-list** *access-list-number* **permit** *source* [*source-wildcard*] **Example:** `Device(config)# access-list 99 permit 172.20.130.5`	Create the access list. • *access-list-number*: IP access list number. The range is from 1 to 99. • **permit**: Permits access if the conditions are matched. • *source*: IP address of the device that is permitted access to the device. • *source-wildcard*: Wildcard bits to be applied to the source. **Note** When creating an access list, remember that, by default, the end of the access list contains an implicit deny statement for everything if it did not find a match before reaching the end. Use the **no** form of this command to remove authentication key.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Disabling NTP Services on a Specific Interface

To disable NTP packets from being received on an interface, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface-id*
4. [**no**] **ntp disable**
5. **end**

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Enters global configuration mode.
Step 4	[**no**] **ntp disable** **Example:** `Device(config-if)# ntp disable`	Disables NTP packets from being received on the interface. Use the **no** form of this command to re-enable receipt of NTP packets on an interface.
Step 5	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configuring a System Name

Follow these steps to manually configure a system name:

SUMMARY STEPS

1. **enable**
2. **configure terminal**

3. **hostname** *name*
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**hostname** *name* **Example:** `Device(config)# hostname remote-users`	Configures a system name. When you set the system name, it is also used as the system prompt. The default setting is Switch. The name must follow the rules for ARPANET hostnames. They must start with a letter, end with a letter or digit, and have as interior characters only letters, digits, and hyphens. Names can be up to 63 characters.

Step 4	**end**
	Example:
	`remote-users(config)#end`
	`remote-users#`
		Returns to priviliged EXEC mode.

Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Setting Up DNS

If you use the device IP address as its hostname, the IP address is used and no DNS query occurs. If you configure a hostname that contains no periods (.), a period followed by the default domain name is appended to the hostname before the DNS query is made to map the name to an IP address. The default domain name is the value set by the **ip domain-name** global configuration command. If there is a period (.) in the hostname, the Cisco IOS software looks up the IP address without appending any default domain name to the hostname.

Follow these steps to set up your switch to use the DNS:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip domain-name** *name*
4. **ip name-server** *server-address1* [*server-address2 ... server-address6*]
5. **ip domain-lookup** [**nsap** | **source-interface** *interface*]
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

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	**ip domain-name** *name* **Example:** `Device(config)# ip domain-name Cisco.com`	Defines a default domain name that the software uses to complete unqualified hostnames (names without a dotted-decimal domain name). Do not include the initial period that separates an unqualified name from the domain name. At boot time, no domain name is configured; however, if the device configuration comes from a BOOTP or Dynamic Host Configuration Protocol (DHCP) server, then the default domain name might be set by the BOOTP or DHCP server (if the servers were configured with this information).
Step 4	**ip name-server** *server-address1* [*server-address2 ... server-address6*]	Specifies the address of one or more name servers to use for name and address resolution.

	Command or Action	Purpose
	Example: `Device(config)#` **`ip name-server 192.168.1.100 192.168.1.200 192.168.1.300`**	You can specify up to six name servers. Separate each server address with a space. The first server specified is the primary server. The device sends DNS queries to the primary server first. If that query fails, the backup servers are queried.
Step 5	**ip domain-lookup** [**nsap** | **source-interface** *interface*] **Example:** `Device(config)#` **`ip domain-lookup`**	(Optional) Enables DNS-based hostname-to-address translation on your device. This feature is enabled by default. If your network devices require connectivity with devices in networks for which you do not control name assignment, you can dynamically assign device names that uniquely identify your devices by using the global Internet naming scheme (DNS).
Step 6	**end** **Example:** `Device(config)#` **`end`**	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Device#` **`show running-config`**	Verifies your entries.
Step 8	**copy running-config startup-config** **Example:** `Device#` **`copy running-config startup-config`**	(Optional) Saves your entries in the configuration file.

Configuring a Message-of-the-Day Login Banner

You can create a single or multiline message banner that appears on the screen when someone logs in to the device

Follow these steps to configure a MOTD login banner:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **banner motd** *c message c*
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**banner motd** *c message c*
	Example:
	`Device(config)# banner motd #`
	`This is a secure site. Only`
	`authorized users are allowed.`
	`For access, contact technical`
	`support.`
	`#`
		Specifies the message of the day.
		c—Enters the delimiting character of your choice, for example, a pound sign (#), and press the **Return** key. The delimiting character signifies the beginning and end of the banner text. Characters after the ending delimiter are discarded.
		message—Enters a banner message up to 255 characters. You cannot use the delimiting character in the message.

Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring a Login Banner

You can configure a login banner to be displayed on all connected terminals. This banner appears after the MOTD banner and before the login prompt.

Follow these steps to configure a login banner:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **banner login** *c message c*
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**banner login** *c message c*
	Example:
	`Device(config)# banner login $`
	`Access for authorized users only.`
	`Please enter your username and`
	`password.`
	`$`
		Specifies the login message.
		c— Enters the delimiting character of your choice, for example, a pound sign (#), and press the **Return** key. The delimiting character signifies the beginning and end of the banner text. Characters after the ending delimiter are discarded.
		message—Enters a login message up to 255 characters. You cannot use the delimiting character in the message.

Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:**	(Optional) Saves your entries in the configuration file.

	Command or Action	Purpose
	`Device# copy running-config startup-config`	

Managing the MAC Address Table

Changing the Address Aging Time

Follow these steps to configure the dynamic address table aging time:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mac address-table aging-time** [*0* \| *10-1000000*] [**routed-mac** \| **vlan** *vlan-id*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**mac address-table aging-time** [*0* | *10-1000000*] [**routed-mac** | **vlan** *vlan-id*] **Example:** `Device(config)# mac address-table aging-time 500 vlan 2`	Sets the length of time that a dynamic entry remains in the MAC address table after the entry is used or updated. The range is 10 to 1000000 seconds. The default is 300. You can also enter 0, which disables aging. Static address entries are never aged or removed from the table. *vlan-id*—Valid IDs are 1 to 4094.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring MAC Address Change Notification Traps

Follow these steps to configure the switch to send MAC address change notification traps to an NMS host:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server host** *host-addr community-string notification-type* { **informs** | **traps** } {**version** {**1** | **2c** | **3**}} {**vrf** *vrf instance name*}
4. **snmp-server enable traps mac-notification change**
5. **mac address-table notification change**
6. **mac address-table notification change** [**interval** *value*] [**history-size** *value*]
7. **interface** *interface-id*
8. **snmp trap mac-notification change** {**added** | **removed**}
9. **end**
10. **show running-config**
11. **copy running-config startup-config**

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.

	Command or Action	Purpose
Step 3	**snmp-server host** *host-addr community-string notification-type* { **informs** | **traps** } {**version** {**1** | **2c** | **3**}} {**vrf** *vrf instance name*} **Example:** `Device(config)# snmp-server host 172.20.10.10 traps private mac-notification`	Specifies the recipient of the trap message. • *host-addr*—Specifies the name or address of the NMS. • **traps** (the default)—Sends SNMP traps to the host. • **informs**—Sends SNMP informs to the host. • **version**—Specifies the SNMP version to support. Version 1, the default, is not available with informs. • *community-string*—Specifies the string to send with the notification operation. Though you can set this string by using the **snmp-server host** command, we recommend that you define this string by using the **snmp-server community** command before using the **snmp-server host** command. • *notification-type*—Uses the **mac-notification** keyword. • **vrf** *vrf instance name*—Specifies the VPN routing/forwarding instance for this host.
Step 4	**snmp-server enable traps mac-notification change** **Example:** `Device(config)# snmp-server enable traps mac-notification change`	Enables the device to send MAC address change notification traps to the NMS.
Step 5	**mac address-table notification change** **Example:** `Device(config)# mac address-table notification change`	Enables the MAC address change notification feature.

Step 6	**mac address-table notification change** [**interval** *value*] [**history-size** *value*]
	Example:
	`Device(config)# mac address-table notification change interval 123`
	`Device(config)#mac address-table notification change history-size 100`
		Enters the trap interval time and the history table size.
		• (Optional) **interval** *value*—Specifies the notification trap interval in seconds between each set of traps that are generated to the NMS. The range is 0 to 2147483647 seconds; the default is 1 second.
		• (Optional) **history-size** *value*—Specifies the maximum number of entries in the MAC notification history table. The range is 0 to 500; the default is 1.

	Command or Action	Purpose
Step 7	**interface** *interface-id* **Example:** `Device(config)# ` **`interface gigabitethernet1/0/2`**	Enters interface configuration mode, and specifies the Layer 2 interface on which to enable the SNMP MAC address notification trap.
Step 8	**snmp trap mac-notification change** {**added** | **removed**} **Example:** `Device(config-if)# ` **`snmp trap mac-notification change added`**	Enables the MAC address change notification trap on the interface. • Enables the trap when a MAC address is **added** on this interface. • Enables the trap when a MAC address is **removed** from this interface.
Step 9	**end** **Example:** `Device(config)# ` **`end`**	Returns to privileged EXEC mode.
Step 10	**show running-config** **Example:** `Device# ` **`show running-config`**	Verifies your entries.
Step 11	**copy running-config startup-config** **Example:** `Device# ` **`copy running-config startup-config`**	(Optional) Saves your entries in the configuration file.

Configuring MAC Address Move Notification Traps

When you configure MAC-move notification, an SNMP notification is generated and sent to the network management system whenever a MAC address moves from one port to another within the same VLAN.

Follow these steps to configure the device to send MAC address-move notification traps to an NMS host:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server host** *host-addr* {**traps** | **informs**} {**version** {**1** | **2c** | **3**}} *community-string notification-type*
4. **snmp-server enable traps mac-notification move**
5. **mac address-table notification mac-move**
6. **end**
7. **show running-config**

8. **copy running-config startup-config**

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	**snmp-server host** *host-addr* {**traps** | **informs**} {**version** {**1** | **2c** | **3**}} *community-string notification-type* **Example:** `Device(config)# snmp-server host 172.20.10.10 traps private mac-notification`	Specifies the recipient of the trap message. • *host-addr*—Specifies the name or address of the NMS. • **traps** (the default)—Sends SNMP traps to the host. • **informs**—Sends SNMP informs to the host. • **version**—Specifies the SNMP version to support. Version 1, the default, is not available with informs. • *community-string*—Specifies the string to send with the notification operation. Though you can set this string by using the **snmp-server host** command, we recommend that you define this string by using the **snmp-server community** command before using the **snmp-server host** command. • *notification-type*—Uses the **mac-notification** keyword.
Step 4	**snmp-server enable traps mac-notification move** **Example:** `Device(config)# snmp-server enable traps mac-notification move`	Enables the device to send MAC address move notification traps to the NMS.
Step 5	**mac address-table notification mac-move** **Example:** `Device(config)# mac address-table notification mac-move`	Enables the MAC address move notification feature.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 8	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

What to do next

To disable MAC address-move notification traps, use the **no snmp-server enable traps mac-notification move** global configuration command. To disable the MAC address-move notification feature, use the **no mac address-table notification mac-move** global configuration command.

You can verify your settings by entering the **show mac address-table notification mac-move** privileged EXEC commands.

Configuring MAC Threshold Notification Traps

When you configure MAC threshold notification, an SNMP notification is generated and sent to the network management system when a MAC address table threshold limit is reached or exceeded.

Follow these steps to configure the switch to send MAC address table threshold notification traps to an NMS host:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server host** *host-addr* {**traps** | **informs**} {**version** {**1** | **2c** | **3**}} *community-string notification-type*
4. **snmp-server enable traps mac-notification threshold**
5. **mac address-table notification threshold**
6. **mac address-table notification threshold** [**limit** *percentage*] | [**interval** *time*]
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

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	**snmp-server host** *host-addr* {**traps** | **informs**} {**version** {**1** | **2c** | **3**}} *community-string notification-type* **Example:** `Device(config)# snmp-server host 172.20.10.10 traps private mac-notification`	Specifies the recipient of the trap message. • *host-addr*—Specifies the name or address of the NMS. • **traps** (the default)—Sends SNMP traps to the host. • **informs**—Sends SNMP informs to the host. • **version**—Specifies the SNMP version to support. Version 1, the default, is not available with informs. • *community-string*—Specifies the string to send with the notification operation. You can set this string by using the **snmp-server host** command, but we recommend that you define this string by using the **snmp-server community** command before using the **snmp-server host** command. • *notification-type*—Uses the **mac-notification** keyword.
Step 4	**snmp-server enable traps mac-notification threshold** **Example:** `Device(config)# snmp-server enable traps mac-notification threshold`	Enables MAC threshold notification traps to the NMS.
Step 5	**mac address-table notification threshold** **Example:** `Device(config)# mac address-table notification threshold`	Enables the MAC address threshold notification feature.
Step 6	**mac address-table notification threshold** [**limit** *percentage*] | [**interval** *time*] **Example:**	Enters the threshold value for the MAC address threshold usage monitoring.

	Command or Action	Purpose
	`Device(config)# mac address-table notification threshold interval 123` `Device(config)# mac address-table notification threshold limit 78`	• (Optional) **limit** *percentage*—Specifies the percentage of the MAC address table use; valid values are from 1 to 100 percent. The default is 50 percent. • (Optional) **interval** *time*—Specifies the time between notifications; valid values are greater than or equal to 120 seconds. The default is 120 seconds.
Step 7	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 8	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 9	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Adding and Removing Static Address Entries

Follow these steps to add a static address:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mac address-table static** *mac-addr* **vlan** *vlan-id* **interface** *interface-id*
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**mac address-table static** *mac-addr* **vlan** *vlan-id* **interface** *interface-id* **Example:** `Device(config)# mac address-table static c2f3.220a.12f4 vlan 4 interface gigabitethernet 1/0/1`	Adds a static address to the MAC address table. • *mac-addr*—Specifies the destination MAC unicast address to add to the address table. Packets with this destination address received in the specified VLAN are forwarded to the specified interface. • *vlan-id*—Specifies the VLAN for which the packet with the specified MAC address is received. Valid VLAN IDs are 1 to 4094. • *interface-id*—Specifies the interface to which the received packet is forwarded. Valid interfaces include physical ports or port channels. For static multicast addresses, you can enter multiple interface IDs. For static unicast addresses, you can enter only one interface at a time, but you can enter the command multiple times with the same MAC address and VLAN ID.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Unicast MAC Address Filtering

Follow these steps to configure the Device to drop a source or destination unicast static address:

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **mac address-table static** *mac-addr* **vlan** *vlan-id* **drop**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

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	**mac address-table static** *mac-addr* **vlan** *vlan-id* **drop** **Example:** `Device(config)# mac address-table static c2f3.220a.12f4 vlan 4 drop`	Enables unicast MAC address filtering and configure the device to drop a packet with the specified source or destination unicast static address. • *mac-addr*—Specifies a source or destination unicast MAC address (48-bit). Packets with this MAC address are dropped. • *vlan-id*—Specifies the VLAN for which the packet with the specified MAC address is received. Valid VLAN IDs are 1 to 4094.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Monitoring and Maintaining Administration of the Device

Command	Purpose
clear mac address-table dynamic	Removes all dynamic entries.
clear mac address-table dynamic address *mac-address*	Removes a specific MAC address.
clear mac address-table dynamic interface *interface-id*	Removes all addresses on the specified physical port or port channel.
clear mac address-table dynamic vlan *vlan-id*	Removes all addresses on a specified VLAN.
show clock [*detail*]	Displays the time and date configuration.
show ip igmp snooping groups	Displays the Layer 2 multicast entries for all VLANs or the specified VLAN.
show mac address-table address *mac-address*	Displays MAC address table information for the specified MAC address.
show mac address-table aging-time	Displays the aging time in all VLANs or the specified VLAN.
show mac address-table count	Displays the number of addresses present in all VLANs or the specified VLAN.
show mac address-table dynamic	Displays only dynamic MAC address table entries.
show mac address-table interface *interface-name*	Displays the MAC address table information for the specified interface.
show mac address-table move update	Displays the MAC address table move update information.
show mac address-table multicast	Displays a list of multicast MAC addresses.
show mac address-table notification {change | mac-move | threshold}	Displays the MAC notification parameters and history table.
show mac address-table secure	Displays the secure MAC addresses.
show mac address-table static	Displays only static MAC address table entries.
show mac address-table vlan *vlan-id*	Displays the MAC address table information for the specified VLAN.

Configuration Examples for Device Administration

Example: Setting the System Clock

This example shows how to manually set the system clock:

```
Device# clock set 13:32:00 23 July 2013
```

Examples: Configuring Summer Time

This example (for daylight savings time) shows how to specify that summer time starts on March 10 at 02:00 and ends on November 3 at 02:00:

```
Device(config)# clock summer-time PDT recurring PST date
10 March 2013 2:00 3 November 2013 2:00
```

This example shows how to set summer time start and end dates:

```
Device(config)#clock summer-time PST date
20 March 2013 2:00 20 November 2013 2:00
```

Example: Configuring a MOTD Banner

This example shows how to configure a MOTD banner by using the pound sign (#) symbol as the beginning and ending delimiter:

```
Device(config)# banner motd #

This is a secure site. Only authorized users are allowed.
For access, contact technical support.

#

Device(config)#
```

This example shows the banner that appears from the previous configuration:

```
Unix> telnet 192.0.2.15

Trying 192.0.2.15...

Connected to 192.0.2.15.

Escape character is '^]'.

This is a secure site. Only authorized users are allowed.

For access, contact technical support.
```

```
User Access Verification

Password:
```

Example: Configuring a Login Banner

This example shows how to configure a login banner by using the dollar sign ($) symbol as the beginning and ending delimiter:

```
Device(config)# banner login $

Access for authorized users only. Please enter your username and password.

$

Device(config)#
```

Example: Configuring MAC Address Change Notification Traps

This example shows how to specify 172.20.10.10 as the NMS, enable MAC address notification traps to the NMS, enable the MAC address-change notification feature, set the interval time to 123 seconds, set the history-size to 100 entries, and enable traps whenever a MAC address is added on the specified port:

```
Device(config)# snmp-server host 172.20.10.10 traps private mac-notification
Device(config)# snmp-server enable traps mac-notification change
Device(config)# mac address-table notification change
Device(config)# mac address-table notification change interval 123
Device(config)# mac address-table notification change history-size 100
Device(config)# interface gigabitethernet1/2/1
Device(config-if)# snmp trap mac-notification change added
```

Example: Configuring MAC Threshold Notification Traps

This example shows how to specify 172.20.10.10 as the NMS, enable the MAC address threshold notification feature, set the interval time to 123 seconds, and set the limit to 78 per cent:

```
Device(config)# snmp-server host 172.20.10.10 traps private mac-notification
Device(config)# snmp-server enable traps mac-notification threshold
Device(config)# mac address-table notification threshold
Device(config)# mac address-table notification threshold interval 123
Device(config)# mac address-table notification threshold limit 78
```

Example: Adding the Static Address to the MAC Address Table

This example shows how to add the static address c2f3.220a.12f4 to the MAC address table. When a packet is received in VLAN 4 with this MAC address as its destination address, the packet is forwarded to the specified port:

Note You cannot associate the same static MAC address to multiple interfaces. If the command is executed again with a different interface, the static MAC address is overwritten on the new interface.

```
Device(config)# mac address-table static c2f3.220a.12f4 vlan 4 interface gigabitethernet1/1/1
```

Example: Configuring Unicast MAC Address Filtering

This example shows how to enable unicast MAC address filtering and how to configure drop packets that have a source or destination address of c2f3.220a.12f4. When a packet is received in VLAN 4 with this MAC address as its source or destination, the packet is dropped:

```
Device(config)# mac address-table static c2f3.220a.12f4 vlan 4 drop
```

Additional References for Device Administration

Related Documents

Related Topic	Document Title
System management commands	*System Management Command Reference (Catalyst 3650 Switches)*
Network management configuration	*Network Management Configuration Guide (Catalyst 3650 Switches)*
Layer 2 configuration	*Layer 2/3 Configuration Guide (Catalyst 3650 Switches)*
VLAN configuration	*VLAN Configuration Guide (Catalyst 3650 Switches)*

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for Device Administration

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.

CHAPTER 2

Boot Integrity Visibility

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Boot Integrity Visibility

Boot integrity visibility allows Cisco's platform identity and software integrity information to be visible and actionable. Platform identity provides the platform's manufacturing installed identity, and software integrity exposes boot integrity measurements that can be used to assess whether the platform has booted trusted code.

During the boot process, the software creates a checksum record of each stage of the boot loader activities.

You can retrieve this record and compare it with a Cisco-certified record to verify if your software image is genuine. If the checksum values do not match, you may be running a software image that is either not certified by Cisco or has been altered by an unauthorized party.

Verifying the software image and hardware

This task describes how to retrieve the checksum record that was created during switch bootup. Enter the following commands in privileged EXEC mode.

> **Note**
> On executing the following commands, you might see the message **% Please Try After Few Seconds** displayed on the CLI. This does not indicate a CLI failure, but indicates setting up of underlying infrastructure required to get the required output. It is recommended to wait for few minutes and then try the command again.

The messages **% Error retrieving SUDI certificate** and **% Error retrieving integrity data** signify a real CLI failure.

SUMMARY STEPS

1. **show platform sudi certificate** [**sign** [**nonce** *nonce*]]
2. **show platform integrity** [**sign** [**nonce** *nonce*]]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show platform sudi certificate** [**sign** [**nonce** *nonce*]] **Example:** `Device# show platform sudi certificate sign nonce 123`	Displays checksum record for the specific SUDI. • (Optional) **sign** - Show signature • (Optional) **nonce** - Enter a nonce value
Step 2	**show platform integrity** [**sign** [**nonce** *nonce*]] **Example:** `Device# show platform integrity sign nonce 123`	Displays checksum record for boot stages. • (Optional) **sign** - Show signature • (Optional) **nonce** - Enter a nonce value

Verifying Platform Identity and Software Integrity

Verifying Platform Identity

The following example displays the Secure Unique Device Identity (SUDI) chain in PEM format. The first certificate is the Cisco Root CA 2048 and the second is the Cisco subordinate CA (ACT2 SUDI CA). Both certificates can be verified to match those published on https://www.cisco.com/security/pki/. The third is the SUDI certificate.

```
Device#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
BQADggEBAJ2dhISjQal8dwy3U8pORFBi71R803UXHOjgxkhLtv5MOhmBVrBW7hmW
Yqpao2TB9k5UM8Z3/sUcuuVdJcr18JOagxEu5sv4dEX+5wW4q+ffy0vhN4TauYuX
cB7w4ovXsNgOnbFp1iqRe6lJT37mjpXYgyc81WhJDtSd9i7rp77rMKSsH0T8lasz
Bvt9YAretIpjsJyp8qS5UwGH0GikJ3+r/+n6yUA4iGe0OcaEb1fJU9u6ju7AQ7L4
CYNu/2bPPu8Xs1gYJQk0XuPL1hS27PKSb3TkL4Eq1ZKR4OCXPDJoBYVL0fdX4lId
kxpUnwVwwEpxYB5DC2Ae/qPOgRnhCzU=
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
MIIEPDCCAySgAwIBAgIKYQlufQAAAAAADDANBgkqhkiG9w0BAQUFADA1MRYwFAYD
VQQKEw1DaXNjbyBTeXN0ZW1zMRswGQYDVQQDExJDaXNjbyBSb290IENBIDIwNDgw
HhcNMTEwNjMwMTc1NjU3WhcNMjkwNTE0MjAyNTQyWjAnMQ4wDAYDVQQKEwVDaXNj
bzEVMBMGA1UEAxMMQUNUMiBTVURJIENBMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8A
MIIBCgKCAQEA0m5l3THIxA9tN/hS5qR/6UZRpdd+9aE2JbFkNjht6gfHKd477AkS
5XAtUs5oxDYVt/zEbslZq3+LR6qrqKKQVu6JYvH05UYLBqCj38s76NLk53905Wzp
9pRcmRCPuX+a6tHF/qRuOiJ44mdeDYZo3qPCpxzprWJDPclM4iYKHumMQMqmgmg+
xghHIooWS80BOcdiynEbeP5rZ7qRuewKMpl1TiI3WdBNjZjnpfjg66F+P4SaDkGb
BXdGj13oVeF+EyFWLrFjj97fL2+8oauV43Qrvnf3d/GfqXj7ew+z/sXlXtEOjSXJ
URsyMEj53Rdd9tJwHky8neapszS+r+kdVQIDAQABo4IBWjCCAVYwCwYDVR0PBAQD
AgHGMB0GA1UdDgQWBBRI2PHxwnDVW7t8cwmTr7i4MAP4fzAfBgNVHSMEGDAWgBQn
88gVHm6aAgkWrSugiWBf2nsvqjBDBgNVHR8EPDA6MDigNqA0hjJodHRwOi8vd3d3
LmNpc2NvLmNvbS9zZWN1cml0eS9wa2kvY3JsL2NyY2EyMDQ4LmNybDBQBggrBgEF
BQcBAQREMEIwQAYIKwYBBQUHMAKGNGh0dHA6Ly93d3cuY2lzY28uY29tL3NlY3Vy
aXR5L3BraS9jZXJ0cy9jcmNhMjA0OC5jZXIwXAYDVR0gBFUwUzBRBgorBgEEAQkV
AQwAMEMwQQYIKwYBBQUHAgEWNWh0dHA6Ly93d3cuY2lzY28uY29tL3NlY3VyaXR5
L3BraS9wb2xpY2llcy9pbmRleC5odG1sMBIGA1UdEwEB/wQIMAYBAf8CAQAwDQYJ
KoZIhvcNAQEFBQADggEBAGh1qclr9tx4hzWgDERm371yeuEmqcIfi9b9+GbMSJbi
ZHc/CcCl0lJu0a9zTXA9w47H9/t6leduGxb4WeLxcwCiUgvFtCa51Iklt8nNbcKY
/4dw1ex+7amATUQO4QggIE67wVIPu6bgAE3Ja/nRS3xKYSnj8H5TehimBSv6TECi
i5jUhOWryAK4dVo8hCjkjEkzu3ufBTJapnv89g9OE+H3VKM4L+/KdkUO+52djFKn
hyl47d7cZR4DY4LIuFM2P1As8YyjzoNpK/urSRI14WdIlplR1nH7KNDl5618yfVP
0IFJZBGrooCRBjOSwFv8cpWCbmWdPaCQT2nwIjTfY8c=
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
MIIDhzCCAm+gAwIBAgIEAJT3DDANBgkqhkiG9w0BAQsFADAnMQ4wDAYDVQQKEwVD
aXNjbzEVMBMGA1UEAxMMQUNUMiBTVURJIENBMB4XDTE1MTExNDA5MzMzN1oXDTI1
MTExNDA5MzMzN1owczEsMCoGA1UEBRMjUElEOldTLUMzNjUwLTEyWDQ4VVEgU046
RkRPMTk0NkJHMDUxDjAMBgNVBAoTBUNpc2NvMRgwFgYDVQQLEw9BQ1QtMiBMaXRl
IFNVREkxGTAXBgNVBAMTEFdTLUMzNjUwLTEyWDQ4VVEwggEiMA0GCSqGSIb3DQEB
AQUAA4IBDwAwggEKAoIBAQC6SARWyImWrRV/x7XQogAE+02WmzKki+4arMVBvl9o
GgvJfkoJDdaHOROSUkEE3qXtd8N3lfKy3TZ+jtHD85m2aGz6+IRx/e/lLsQzi6dl
WIB+N94pgecFBONPR9wJriox1IGD3B43b0hMLkmro4R5Zrs8XFkDo9k1tBU7F2O7
GEzb/WkO5NLexznef2Niglx9fCDL0HC27BbsR5+03p8jhG0+mvrp8M9du1HKiGin
ZIV4XgTMp1/k/TVaIepEGZuWM3hxdUZjkNGG1c1m+oB8vLX3UlSL76sDBBoiaprD
rjXBgBIozyFW8tTjh50jMDG84hKD5s31ifOe4KpqEcnVAgMBAAGjbzBtMA4GA1Ud
DwEB/wQEAwIF4DAMBgNVHRMBAf8EAjAAME0GA1UdEQRGMESgQgYJKwYBBAEJFQID
oDUTM0NoaXBJRD1VWUpOTlZJMENBUkhVM1Z1SUVSbFl5QXlPQ0F4TXpvek5Ub3lN
U0EwS0NnPTANBgkqhkiG9w0BAQsFAAOCAQEADjtM8vdlf+p1WKSKX1C1qQ4aEnD5
p8T5e4iTer7Y1fbCrHIEEm3mnip+568j299z0H8V7PDp1ljuLHyMFTC+945F9RfA
eAuVWVb5A9dnGL8MssBJe2lVSnZwrWkT1EIdxLYrTiPAQHtll6CN77S4u/f71oYE
tzPE5AGfyGw7ro1MEPVGffaQmYUDAwKFNBH1uI7c2S1qlwk4WWZ6xxci+lhaQnIG
pWzapaiAYL1XrcBz4KwFc1ZZpQT6hHw24jzYaYimvCo+/kSKuA9xNdtSu18ycox0
zKnXQ17s6aChMMt7Y8Nh4iz9BDejoOF6/b3sM0wRi+2/4j+6/GhcMRs0Og==
-----END CERTIFICATE-----

Signature version: 1
Signature:
405C770D802B73947EDBF8DD0D2C8180F10D4B3EF9699444514219C579D2ED52F7D5
83E0F4408133FC4E9F549B2EB1C21725F7CB1C79F98271E47E780E703E674723880F
B52D4963E1D1FB9787B38E28B8E696570A180B7A2F1311B1F174EAA79F55DB4765DF
67386126D899E07EDF6C26E0A81272EAA114437DD03F26992937082756AE1F1BFAFB
```

```
BFACD6BE9CF9C84C961FACE9FA0FEE64D85AE4FA0086969D0702C536ABDB8FBFDC47
C14C17D02FEBF4F7F5BB24D2932FA876F56B4C07816270AA0B4195C53D975C85AEAE
3A74F2DBF293F52423ECB7B8539667080A9C57DA3E4B08B2B2CA623B2CBAF7080A0A
EB09B222E5B756970A3AA27E0F1D17C8A243
```

The optional RSA 2048 signature is across the three certificates, the signature version and the user-provided nonce

```
RSA PKCS#1v1.5 Sign {<Nonce (UINT64)> || <Signature Version (UINT32)> || <Cisco Root CA
2048 cert (DER)> ||
<Cisco subordinate CA (DER)> || <SUDI certificate (DER)> }
```

Cisco management solutions are equipped with the ability to interpret the above output. However, a simple script using OpenSSL commands can also be used to display the identity of the platform and to verify the signature, thereby ensuring its Cisco unique device identity.

```
[linux-host:~]openssl x509 -in sudicert.pem -subject -noout
subject= /serialNumber=PID:WS-C3650-12X48UQ SN:FDO1946BG05/O=Cisco/OU=ACT-2 Lite
SUDI/CN=WS-C3650-12X48UQ
```

Verifying Software Integrity

The following example displays the checksum record for the boot stages. The hash measurements are displayed for each of the three stages of software successively booted. These hashes can be compared against Cisco-provided reference values. An option to sign the output gives a verifier the ability to ensure the output is genuine and is not altered. A nonce can be provided to protect against replay attacks.

```
Device #show platform integrity sign nonce 456

Platform: WS-C3650-12X48UQ
Boot Loader Version: CAT3K_CAA Boot Loader (CAT3K_CAA-HBOOT-M) Version 4.16, engineering
software (D)
Boot Loader Hash: DB5A686E9F4CE358481DE3AF8B9C762F0A604E3B4764DF2A351F176E3D7
D3C60EB85C02906BD8CF28228C0DFC2AA8960CAFE6675D696E4ABA0CD687C0609E7E2
Boot 0 Version: F01062R15.0508d68fa2015-09-15
Boot 0 Hash: 6EF15CD54D3C66A8B644194A67B7ED57044C8C2E0EECB69736A7FFEC1F6D0EAD
OS Version: 2016-10-18_10.57_mundru
OS Hash: 4C85AECC88DAA49D940BBF65B1F17269F55C8D98DEFB4140F981923AA961140293E1
3B3E6E68CE3F8ED7F596CD858ACDD4BEF6538F59C1E243C351353026E6CD
PCR0: 90214167AAF35C06B2AC97292596E5669EAB72578FCDAD0B91746683BAA7B2B0
PCR8: FC2CE1BAC397F97008936DF372A2218BB16A798222B8FF55A7B6AEDA8018EDF5
Signature version: 1
Signature:
632A724F1AB6ADE134F6B0E8724D2052B3157F45B47E547763EE224A848E807CD737600587FF68
2526A8FE354A116CC9EDEBD9C659B9927336542EE4295084368327D01BD22AB4849BB3C007B6EB
B67708685FD6BC85DD045431E19A389FEB358894D4FBCF7C0FC960AC9133B61099DFD507F316C1
BF82F7F98687C7E7E8F99355DC1A95BD511B0B8DCB0CA909828F9EFBDF18847930392A8E3D072D
F3D90536880BAE9B7D7CF0E301D3F5AF16E7517FC2700E2F75911B836D6559A18E15B4CF452555
91656DF22DFF73392F777AEB796BCF9AC046C581ADEF19CA48A98F620BB58A79B32DA8B3BFB1CF
8399468A096E2F0C54B8B3ECD15EE3FE2C5ABDB5A029
```

The optional RSA 2048 signature is produced with the SUDI private key and can be verified with the SUDI public key contained in the SUDI certificate. The signature across PCR values, the signature version and the user-provided nonce is displayed.

```
RSA PKCS# 1 v1.5 Sign { <Nonce (UINT64)> || <Signature Version (UINT32)> || <PCR0 (32 bytes)>
 || <PCR8 (32 bytes)> }
```

Cisco management solutions are equipped with the ability to interpret the above output, compare the results against published Cisco values, and to verify the signature.

CHAPTER 3

Performing Device Setup Configuration

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Performing Device Setup Configuration

Review the sections in this module before performing your initial device configuration tasks that include IP address assignments and DHCP autoconfiguration.

Device Boot Process

To start your device, you need to follow the procedures in the hardware installation guide for installing and powering on the device and setting up the initial device configuration (IP address, subnet mask, default gateway, secret and Telnet passwords, and so forth).

The normal boot process involves the operation of the boot loader software and includes these activities:

- Performs low-level CPU initialization. It initializes the CPU registers, which control where physical memory is mapped, its quantity, its speed, and so forth.

- Performs power-on self-test (POST) for the CPU subsystem and tests the system DRAM.
- Initializes the file systems on the system board.
- Loads a default operating system software image into memory and boots up the device.

The boot loader provides access to the file systems before the operating system is loaded. Normally, the boot loader is used only to load, decompress, and start the operating system. After the boot loader gives the operating system control of the CPU, the boot loader is not active until the next system reset or power-on.

The boot loader also provides trap-door access into the system if the operating system has problems serious enough that it cannot be used. The trap-door mechanism provides enough access to the system so that if it is necessary, you can reinstall the operating system software image by using the Xmodem Protocol, recover from a lost or forgotten password, and finally restart the operating system.

Before you can assign device information, make sure you have connected a PC or terminal to the console port or a PC to the Ethernet management port, and make sure you have configured the PC or terminal-emulation software baud rate and character format to match these of the device console port:

- Baud rate default is 9600.
- Data bits default is 8.

Note If the data bits option is set to 8, set the parity option to none.

- Stop bits default is 2 (minor).
- Parity settings default is none.

Software Installer Features

The following software installer features are supported on your switch:

- Software bundle installation on a standalone switch, a switch stack, or a subset of switches in a stack. The default is installation on all the switches if a switch stack is configured.
- Software rollback to a previously installed package set.
- Emergency installation in the event that no valid installed packages reside on the boot flash.
- Auto-upgrade of a switch that joins the switch stack with incompatible software.
- Installation using packages on one switch as the source for installing packages on another switch in the switch stack.

Note Software installation and rollback must be performed while running only in installed mode. You can use the **request platform software package expand** EXEC command to convert bundle boot mode to install mode.

Software Boot Modes

Your device supports two modes to boot the software packages:

- Installed mode
- Bundle mode

Installed Boot Mode

You can boot your device in installed mode by booting the software package provisioning file that resides in flash:

```
Switch: boot flash:packages.conf
```

The provisioning file contains a list of software packages to boot, mount, and run. The ISO file system in each installed package is mounted to the root file system directly from flash.

Note The packages and provisioning file used to boot in installed mode must reside in flash. Booting in installed mode from usbflash0: or tftp: is not supported.

Bundle Boot Mode

You can boot your device in bundle boot mode by booting the bundle (.bin) file:

The provisioning file contained in a bundle is used to decide which packages to boot, mount, and run. Packages are extracted from the bundle and copied to RAM. The ISO file system in each package is mounted to the root file system.

Unlike install boot mode, additional memory that is equivalent to the size of the bundle is used when booting in bundle mode.

Note Auto install and smart install functionality is not supported in bundle boot mode.

Boot Mode for a Switch Stack

All the switches in a stack must be running in installed mode or bundle boot mode. A mixed mode stack is not supported. If a new switch tries to join the stack in a different boot mode then the active switch, the new switch is given a V-mismatch state.

If a mixed mode switch stack is booted at the same time, then only those switches that boot up in a different mode than the active go to the V-mismatch state. If the boot mode does not support auto-upgrade, then the switch stack members must be re-booted in the same boot mode as the active switch.

If the stack is running in installed mode, the auto-upgrade feature can be used to automatically upgrade the new switch that is attempting to join the switch stack.

The auto-upgrade feature changes the boot mode of the new switch to installed mode. If the stack is running in bundle boot mode, the auto-upgrade feature is not available. You will be required to use the bundle mode to boot the new switch so that it can join the switch stack.

This is an example of the state of a switch that attempts to join the switch stack when the boot mode is not compatible with the active switch:

```
Device# show switch

Switch/Stack Mac Address : 6400.f125.1100 - Local Mac Address
Mac persistency wait time: Indefinite
H/W Current
Switch#   Role   Mac Address    Priority Version   State
------------------------------------------------------------
 1       Member 6400 f125.1a00   1        0        V-Mismatch
*2       Active 6400.f125.1100   1        V01      Ready
Device
```

Devices Information Assignment

You can assign IP information through the device setup program, through a DHCP server, or manually.

Use the device setup program if you want to be prompted for specific IP information. With this program, you can also configure a hostname and an enable secret password.

It gives you the option of assigning a Telnet password (to provide security during remote management) and configuring your switch as a command or member switch of a cluster or as a standalone switch.

Use a DHCP server for centralized control and automatic assignment of IP information after the server is configured.

Note If you are using DHCP, do not respond to any of the questions in the setup program until the device receives the dynamically assigned IP address and reads the configuration file.

If you are an experienced user familiar with the device configuration steps, manually configure the device. Otherwise, use the setup program described in the *Boot Process* section.

Default Switch Information

Table 4: Default Switch Information

Feature	Default Setting
IP address and subnet mask	No IP address or subnet mask are defined.
Default gateway	No default gateway is defined.
Enable secret password	No password is defined.
Hostname	The factory-assigned default hostname is Device.

Feature	Default Setting
Telnet password	No password is defined.
Cluster command switch functionality	Disabled.
Cluster name	No cluster name is defined.

DHCP-Based Autoconfiguration Overview

DHCP provides configuration information to Internet hosts and internetworking devices. This protocol consists of two components: one for delivering configuration parameters from a DHCP server to a device and an operation for allocating network addresses to devices. DHCP is built on a client-server model, in which designated DHCP servers allocate network addresses and deliver configuration parameters to dynamically configured devices. The device can act as both a DHCP client and a DHCP server.

During DHCP-based autoconfiguration, your device (DHCP client) is automatically configured at startup with IP address information and a configuration file.

With DHCP-based autoconfiguration, no DHCP client-side configuration is needed on your device. However, you need to configure the DHCP server for various lease options associated with IP addresses.

If you want to use DHCP to relay the configuration file location on the network, you might also need to configure a Trivial File Transfer Protocol (TFTP) server and a Domain Name System (DNS) server.

Note We recommend a redundant connection between a switch stack and the DHCP, DNS, and TFTP servers. This is to help ensure that these servers remain accessible in case one of the connected stack members is removed from the switch stack.

The DHCP server for your device can be on the same LAN or on a different LAN than the device. If the DHCP server is running on a different LAN, you should configure a DHCP relay device between your device and the DHCP server. A relay device forwards broadcast traffic between two directly connected LANs. A router does not forward broadcast packets, but it forwards packets based on the destination IP address in the received packet.

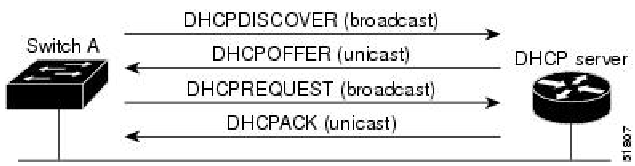
DHCP-based autoconfiguration replaces the BOOTP client functionality on your device.

DHCP Client Request Process

When you boot up your device, the DHCP client is invoked and requests configuration information from a DHCP server when the configuration file is not present on the device. If the configuration file is present and the configuration includes the **ip address dhcp** interface configuration command on specific routed interfaces, the DHCP client is invoked and requests the IP address information for those interfaces.

This is the sequence of messages that are exchanged between the DHCP client and the DHCP server.

Figure 3: DHCP Client and Server Message Exchange



The client, Device A, broadcasts a DHCPDISCOVER message to locate a DHCP server. The DHCP server offers configuration parameters (such as an IP address, subnet mask, gateway IP address, DNS IP address, a lease for the IP address, and so forth) to the client in a DHCPOFFER unicast message.

In a DHCPREQUEST broadcast message, the client returns a formal request for the offered configuration information to the DHCP server. The formal request is broadcast so that all other DHCP servers that received the DHCPDISCOVER broadcast message from the client can reclaim the IP addresses that they offered to the client.

The DHCP server confirms that the IP address has been allocated to the client by returning a DHCPACK unicast message to the client. With this message, the client and server are bound, and the client uses configuration information received from the server. The amount of information the device receives depends on how you configure the DHCP server.

If the configuration parameters sent to the client in the DHCPOFFER unicast message are invalid (a configuration error exists), the client returns a DHCPDECLINE broadcast message to the DHCP server.

The DHCP server sends the client a DHCPNAK denial broadcast message, which means that the offered configuration parameters have not been assigned, that an error has occurred during the negotiation of the parameters, or that the client has been slow in responding to the DHCPOFFER message (the DHCP server assigned the parameters to another client).

A DHCP client might receive offers from multiple DHCP or BOOTP servers and can accept any of the offers; however, the client usually accepts the first offer it receives. The offer from the DHCP server is not a guarantee that the IP address is allocated to the client; however, the server usually reserves the address until the client has had a chance to formally request the address. If the device accepts replies from a BOOTP server and configures itself, the device broadcasts, instead of unicasts, TFTP requests to obtain the device configuration file.

The DHCP hostname option allows a group of devices to obtain hostnames and a standard configuration from the central management DHCP server. A client (device) includes in its DCHPDISCOVER message an option 12 field used to request a hostname and other configuration parameters from the DHCP server. The configuration files on all clients are identical except for their DHCP-obtained hostnames.

If a client has a default hostname (the **hostname** *name* global configuration command is not configured or the **no hostname** global configuration command is entered to remove the hostname), the DHCP hostname option is not included in the packet when you enter the **ip address dhcp** interface configuration command. In this case, if the client receives the DCHP hostname option from the DHCP interaction while acquiring an IP address for an interface, the client accepts the DHCP hostname option and sets the flag to show that the system now has a hostname configured.

DHCP-based Autoconfiguration and Image Update

You can use the DHCP image upgrade features to configure a DHCP server to download both a new image and a new configuration file to one or more devices in a network. Simultaneous image and configuration upgrade for all switches in the network helps ensure that each new device added to a network receives the same image and configuration.

There are two types of DHCP image upgrades: DHCP autoconfiguration and DHCP auto-image update.

Restrictions for DHCP-based Autoconfiguration

- The DHCP-based autoconfiguration with a saved configuration process stops if there is not at least one Layer 3 interface in an up state without an assigned IP address in the network.
- Unless you configure a timeout, the DHCP-based autoconfiguration with a saved configuration feature tries indefinitely to download an IP address.
- The auto-install process stops if a configuration file cannot be downloaded or if the configuration file is corrupted.
- The configuration file that is downloaded from TFTP is merged with the existing configuration in the running configuration but is not saved in the NVRAM unless you enter the **write memory** or **copy running-configuration startup-configuration** privileged EXEC command. If the downloaded configuration is saved to the startup configuration, the feature is not triggered during subsequent system restarts.

DHCP Autoconfiguration

DHCP autoconfiguration downloads a configuration file to one or more devices in your network from a DHCP server. The downloaded configuration file becomes the running configuration of the device. It does not over write the bootup configuration saved in the flash, until you reload the device.

DHCP Auto-Image Update

You can use DHCP auto-image upgrade with DHCP autoconfiguration to download both a configuration and a new image to one or more devices in your network. The device (or devices) downloading the new configuration and the new image can be blank (or only have a default factory configuration loaded).

If the new configuration is downloaded to a switch that already has a configuration, the downloaded configuration is appended to the configuration file stored on the switch. (Any existing configuration is not overwritten by the downloaded one.)

To enable a DHCP auto-image update on the device, the TFTP server where the image and configuration files are located must be configured with the correct option 67 (the configuration filename), option 66 (the DHCP server hostname) option 150 (the TFTP server address), and option 125 (description of the Cisco IOS image file) settings.

After you install the device in your network, the auto-image update feature starts. The downloaded configuration file is saved in the running configuration of the device, and the new image is downloaded and installed on the device. When you reboot the device, the configuration is stored in the saved configuration on the device.

DHCP Server Configuration Guidelines

Follow these guidelines if you are configuring a device as a DHCP server:

- You should configure the DHCP server with reserved leases that are bound to each device by the device hardware address.
- If you want the device to receive IP address information, you must configure the DHCP server with these lease options:
    - IP address of the client (required)

    - Subnet mask of the client (required)
    - DNS server IP address (optional)
    - Router IP address (default gateway address to be used by the device) (required)

- If you want the device to receive the configuration file from a TFTP server, you must configure the DHCP server with these lease options:
    - TFTP server name (required)
    - Boot filename (the name of the configuration file that the client needs) (recommended)
    - Hostname (optional)
- Depending on the settings of the DHCP server, the device can receive IP address information, the configuration file, or both.
- If you do not configure the DHCP server with the lease options described previously, it replies to client requests with only those parameters that are configured. If the IP address and the subnet mask are not in the reply, the device is not configured. If the router IP address or the TFTP server name are not found, the device might send broadcast, instead of unicast, TFTP requests. Unavailability of other lease options does not affect autoconfiguration.
- The device can act as a DHCP server. By default, the Cisco IOS DHCP server and relay agent features are enabled on your device but are not configured. (These features are not operational.)

Purpose of the TFTP Server

Based on the DHCP server configuration, the device attempts to download one or more configuration files from the TFTP server. If you configured the DHCP server to respond to the device with all the options required for IP connectivity to the TFTP server, and if you configured the DHCP server with a TFTP server name, address, and configuration filename, the device attempts to download the specified configuration file from the specified TFTP server.

If you did not specify the configuration filename, the TFTP server, or if the configuration file could not be downloaded, the device attempts to download a configuration file by using various combinations of filenames and TFTP server addresses. The files include the specified configuration filename (if any) and these files: network-config, cisconet.cfg, *hostname*.config, or *hostname*.cfg, where *hostname* is the device's current hostname. The TFTP server addresses used include the specified TFTP server address (if any) and the broadcast address (255.255.255.255).

For the device to successfully download a configuration file, the TFTP server must contain one or more configuration files in its base directory. The files can include these files:

- The configuration file named in the DHCP reply (the actual device configuration file).
- The network-confg or the cisconet.cfg file (known as the default configuration files).
- The router-confg or the ciscortr.cfg file (These files contain commands common to all devices. Normally, if the DHCP and TFTP servers are properly configured, these files are not accessed.)

If you specify the TFTP server name in the DHCP server-lease database, you must also configure the TFTP server name-to-IP-address mapping in the DNS-server database.

If the TFTP server to be used is on a different LAN from the device, or if it is to be accessed by the device through the broadcast address (which occurs if the DHCP server response does not contain all the required information described previously), a relay must be configured to forward the TFTP packets to the TFTP server. The preferred solution is to configure the DHCP server with all the required information.

Purpose of the DNS Server

The DHCP server uses the DNS server to resolve the TFTP server name to an IP address. You must configure the TFTP server name-to-IP address map on the DNS server. The TFTP server contains the configuration files for the device.

You can configure the IP addresses of the DNS servers in the lease database of the DHCP server from where the DHCP replies will retrieve them. You can enter up to two DNS server IP addresses in the lease database.

The DNS server can be on the same LAN or on a different LAN from the device. If it is on a different LAN, the device must be able to access it through a router.

How to Obtain Configuration Files

Depending on the availability of the IP address and the configuration filename in the DHCP reserved lease, the device obtains its configuration information in these ways:

- The IP address and the configuration filename is reserved for the device and provided in the DHCP reply (one-file read method).

  The device receives its IP address, subnet mask, TFTP server address, and the configuration filename from the DHCP server. The device sends a unicast message to the TFTP server to retrieve the named configuration file from the base directory of the server and upon receipt, it completes its boot up process.

- The IP address and the configuration filename is reserved for the device, but the TFTP server address is not provided in the DHCP reply (one-file read method).

  The device receives its IP address, subnet mask, and the configuration filename from the DHCP server. The device sends a broadcast message to a TFTP server to retrieve the named configuration file from the base directory of the server, and upon receipt, it completes its boot-up process.

- Only the IP address is reserved for the device and provided in the DHCP reply. The configuration filename is not provided (two-file read method).

  The device receives its IP address, subnet mask, and the TFTP server address from the DHCP server. The device sends a unicast message to the TFTP server to retrieve the network-confg or cisconet.cfg default configuration file. (If the network-confg file cannot be read, the device reads the cisconet.cfg file.)

  The default configuration file contains the hostnames-to-IP-address mapping for the device. The device fills its host table with the information in the file and obtains its hostname. If the hostname is not found in the file, the device uses the hostname in the DHCP reply. If the hostname is not specified in the DHCP reply, the device uses the default *Switch* as its hostname.

  After obtaining its hostname from the default configuration file or the DHCP reply, the device reads the configuration file that has the same name as its hostname (*hostname*-confg or *hostname*.cfg, depending on whether network-confg or cisconet.cfg was read earlier) from the TFTP server. If the cisconet.cfg file is read, the filename of the host is truncated to eight characters.

  If the device cannot read the network-confg, cisconet.cfg, or the hostname file, it reads the router-confg file. If the device cannot read the router-confg file, it reads the ciscortr.cfg file.

Note The device broadcasts TFTP server requests if the TFTP server is not obtained from the DHCP replies, if all attempts to read the configuration file through unicast transmissions fail, or if the TFTP server name cannot be resolved to an IP address.

How to Control Environment Variables

With a normally operating device, you enter the boot loader mode only through the console connection configured for 9600 bps. Unplug the device power cord, and press the **Mode** button while reconnecting the power cord. You can release the **Mode** button after all the amber system LEDs turn on and remain solid. The boot loader device prompt then appears.

The device boot loader software provides support for nonvolatile environment variables, which can be used to control how the boot loader, or any other software running on the system, operates. Boot loader environment variables are similar to environment variables that can be set on UNIX or DOS systems.

Environment variables that have values are stored in flash memory outside of the flash file system.

Each line in these files contains an environment variable name and an equal sign followed by the value of the variable. A variable has no value if it is not present; it has a value if it is listed even if the value is a null string. A variable that is set to a null string (for example, “ ”) is a variable with a value. Many environment variables are predefined and have default values.

You can change the settings of the environment variables by accessing the boot loader or by using Cisco IOS commands. Under normal circumstances, it is not necessary to alter the setting of the environment variables.

Environment Variables for TFTP

When the switch is connected to a PC through the Ethernet management port, you can download or upload a configuration file to the boot loader by using TFTP. Make sure the environment variables in this table are configured.

Table 5: Environment Variables for TFTP

Variable	Description
MAC_ADDR	Specifies the MAC address of the switch. **Note** We recommend that you do not modify this variable. However, if you modify this variable after the boot loader is up or the value is different from the saved value, enter this command before using TFTP. A reset is required for the new value to take effect.
IP_ADDRESS	Specifies the IP address and the subnet mask for the associated IP subnet of the switch.
DEFAULT_ROUTER	Specifies the IP address and subnet mask of the default gateway.

Scheduled Reload of the Software Image

You can schedule a reload of the software image to occur on the device at a later time (for example, late at night or during the weekend when the device is used less), or you can synchronize a reload network-wide (for example, to perform a software upgrade on all devices in the network).

Note A scheduled reload must take place within approximately 24 days.

You have these reload options:

- Reload of the software to take affect in the specified minutes or hours and minutes. The reload must take place within approximately 24 hours. You can specify the reason for the reload in a string up to 255 characters in length.
- Reload of the software to take place at the specified time (using a 24-hour clock). If you specify the month and day, the reload is scheduled to take place at the specified time and date. If you do not specify the month and day, the reload takes place at the specified time on the current day (if the specified time is later than the current time) or on the next day (if the specified time is earlier than the current time). Specifying 00:00 schedules the reload for midnight.

The **reload** command halts the system. If the system is not set to manually boot up, it reboots itself.

If your device is configured for manual booting, do not reload it from a virtual terminal. This restriction prevents the device from entering the boot loader mode and then taking it from the remote user's control.

If you modify your configuration file, the device prompts you to save the configuration before reloading. During the save operation, the system requests whether you want to proceed with the save if the CONFIG_FILE environment variable points to a startup configuration file that no longer exists. If you proceed in this situation, the system enters setup mode upon reload.

To cancel a previously scheduled reload, use the **reload cancel** privileged EXEC command.

How to Perform Device Setup Configuration

Using DHCP to download a new image and a new configuration to a device requires that you configure at least two devices. One device acts as a DHCP and TFTP server and the second device (client) is configured to download either a new configuration file or a new configuration file and a new image file.

Configuring DHCP Autoconfiguration (Only Configuration File)

This task describes how to configure DHCP autoconfiguration of the TFTP and DHCP settings on an existing device in the network so that it can support the autoconfiguration of a new device.

SUMMARY STEPS

1. **configure terminal**
2. **ip dhcp pool** *poolname*
3. **boot** *filename*
4. **network** *network-number mask prefix-length*

5. **default-router** *address*
6. **option 150** *address*
7. **exit**
8. **tftp-server flash**:*filename.text*
9. **interface** *interface-id*
10. **no switchport**
11. **ip address** *address mask*
12. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip dhcp pool** *poolname* **Example:** `Device(config)# ip dhcp pool pool`	Creates a name for the DHCP server address pool, and enters DHCP pool configuration mode.
Step 3	**boot** *filename* **Example:** `Device(dhcp-config)# boot config-boot.text`	Specifies the name of the configuration file that is used as a boot image.
Step 4	**network** *network-number mask prefix-length* **Example:** `Device(dhcp-config)# network 10.10.10.0 255.255.255.0`	Specifies the subnet network number and mask of the DHCP address pool. **Note** The prefix length specifies the number of bits that comprise the address prefix. The prefix is an alternative way of specifying the network mask of the client. The prefix length must be preceded by a forward slash (/).
Step 5	**default-router** *address* **Example:** `Device(dhcp-config)# default-router 10.10.10.1`	Specifies the IP address of the default router for a DHCP client.
Step 6	**option 150** *address* **Example:**	Specifies the IP address of the TFTP server.

	Command or Action	Purpose
	`Device(dhcp-config)# option 150 10.10.10.1`	
Step 7	**exit** **Example:** `Device(dhcp-config)# exit`	Returns to global configuration mode.
Step 8	**tftp-server flash**:*filename.text* **Example:** `Device(config)# tftp-server flash:config-boot.text`	Specifies the configuration file on the TFTP server.
Step 9	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/4`	Specifies the address of the client that will receive the configuration file.
Step 10	**no switchport** **Example:** `Device(config-if)# no switchport`	Puts the interface into Layer 3 mode.
Step 11	**ip address** *address mask* **Example:** `Device(config-if)# ip address 10.10.10.1 255.255.255.0`	Specifies the IP address and mask for the interface.
Step 12	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configuring DHCP Auto-Image Update (Configuration File and Image)

This task describes DHCP autoconfiguration to configure TFTP and DHCP settings on an existing device to support the installation of a new switch.

Before you begin

You must first create a text file (for example, autoinstall_dhcp) that will be uploaded to the device. In the text file, put the name of the image that you want to download (forexample, c3750e-ipservices-mz.122-44.3.SE.tarc3750x-ipservices-mz.122-53.3.SE2.tar). This image must be a tar and not a bin file.

SUMMARY STEPS

1. **configure terminal**
2. **ip dhcp pool** *poolname*
3. **boot** *filename*
4. **network** *network-number mask prefix-length*
5. **default-router** *address*
6. **option 150** *address*
7. **option 125** *hex*
8. **copy tftp flash** *filename.txt*
9. **copy tftp flash** *imagename.bin*
10. **exit**
11. **tftp-server flash:** *config.text*
12. **tftp-server flash:** *imagename.bin*
13. **tftp-server flash:** *filename.txt*
14. **interface** *interface-id*
15. **no switchport**
16. **ip address** *address mask*
17. **end**
18. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip dhcp pool** *poolname* **Example:** `Device(config)# ip dhcp pool pool1`	Creates a name for the DHCP server address pool and enter DHCP pool configuration mode.
Step 3	**boot** *filename* **Example:** `Device(dhcp-config)# boot config-boot.text`	Specifies the name of the file that is used as a boot image.

	Command or Action	Purpose
Step 4	**network** *network-number mask prefix-length* **Example:** `Device(dhcp-config)# network 10.10.10.0 255.255.255.0`	Specifies the subnet network number and mask of the DHCP address pool. **Note** The prefix length specifies the number of bits that comprise the address prefix. The prefix is an alternative way of specifying the network mask of the client. The prefix length must be preceded by a forward slash (/).
Step 5	**default-router** *address* **Example:** `Device(dhcp-config)# default-router 10.10.10.1`	Specifies the IP address of the default router for a DHCP client.
Step 6	**option 150** *address* **Example:** `Device(dhcp-config)# option 150 10.10.10.1`	Specifies the IP address of the TFTP server.
Step 7	**option 125** *hex* **Example:** `Device(dhcp-config)# option 125 hex 0000.0009.0a05.08661.7574.6f69.6e73.7461.6c6c.5f64.686370`	Specifies the path to the text file that describes the path to the image file.
Step 8	**copy tftp flash** *filename.txt* **Example:** `Device(config)# copy tftp flash image.bin`	Uploads the text file to the device.
Step 9	**copy tftp flash** *imagename.bin* **Example:** `Device(config)# copy tftp flash image.bin`	Uploads the tar file for the new image to the device.
Step 10	**exit** **Example:** `Device(dhcp-config)# exit`	Returns to global configuration mode.
Step 11	**tftp-server flash:** *config.text* **Example:**	Specifies the Cisco IOS configuration file on the TFTP server.

	Command or Action	Purpose
	`Device(config)# tftp-server flash:config-boot.text`	
Step 12	**tftp-server flash:** *imagename.bin* **Example:** `Device(config)# tftp-server flash:image.bin`	Specifies the image name on the TFTP server.
Step 13	**tftp-server flash:** *filename.txt* **Example:** `Device(config)# tftp-server flash:boot-config.text`	Specifies the text file that contains the name of the image file to download
Step 14	**interface** *interface-id* **Example:** `Device(config)# interface gigabitEthernet1/0/4`	Specifies the address of the client that will receive the configuration file.
Step 15	**no switchport** **Example:** `Device(config-if)# no switchport`	Puts the interface into Layer 3 mode.
Step 16	**ip address** *address mask* **Example:** `Device(config-if)# ip address 10.10.10.1 255.255.255.0`	Specifies the IP address and mask for the interface.
Step 17	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 18	**copy running-config startup-config** **Example:** `Device(config-if)# end`	(Optional) Saves your entries in the configuration file.

Configuring the Client to Download Files from DHCP Server

Note You should only configure and enable the Layer 3 interface. Do not assign an IP address or DHCP-based autoconfiguration with a saved configuration.

SUMMARY STEPS

1. **configure terminal**
2. **boot host dhcp**
3. **boot host retry timeout** *timeout-value*
4. **banner config-save ^C** *warning-message* **^C**
5. **end**
6. **show boot**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**boot host dhcp** **Example:** `Device(conf)# boot host dhcp`	Enables autoconfiguration with a saved configuration.
Step 3	**boot host retry timeout** *timeout-value* **Example:** `Device(conf)# boot host retry timeout 300`	(Optional) Sets the amount of time the system tries to download a configuration file. **Note** If you do not set a timeout, the system will try indefinitely to obtain an IP address from the DHCP server.
Step 4	**banner config-save ^C** *warning-message* **^C** **Example:** `Device(conf)# banner config-save ^C Caution - Saving Configuration File to NVRAM May Cause You to No longer Automatically Download Configuration Files at Reboot^C`	(Optional) Creates warning messages to be displayed when you try to save the configuration file to NVRAM.
Step 5	**end** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Device(config-if)# end`	
Step 6	**show boot** **Example:** `Device# show boot`	Verifies the configuration.

Manually Assigning IP Information to Multiple SVIs

This task describes how to manually assign IP information to multiple switched virtual interfaces (SVIs):

SUMMARY STEPS

1. **configure terminal**
2. **interface vlan** *vlan-id*
3. **ip address** *ip-address subnet-mask*
4. **exit**
5. **ip default-gateway** *ip-address*
6. **end**
7. **show interfaces vlan** *vlan-id*
8. **show ip redirects**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface vlan** *vlan-id* **Example:** `Device(config)# interface vlan 99`	Enters interface configuration mode, and enters the VLAN to which the IP information is assigned. The range is 1 to 4094.
Step 3	**ip address** *ip-address subnet-mask* **Example:** `Device(config-vlan)# ip address 10.10.10.2 255.255.255.0`	Enters the IP address and subnet mask.

	Command or Action	Purpose
Step 4	**exit** **Example:** `Device(config-vlan)# exit`	Returns to global configuration mode.
Step 5	**ip default-gateway** *ip-address* **Example:** `Device(config)# ip default-gateway 10.10.10.1`	Enters the IP address of the next-hop router interface that is directly connected to the device where a default gateway is being configured. The default gateway receives IP packets with unresolved destination IP addresses from the device. Once the default gateway is configured, the device has connectivity to the remote networks with which a host needs to communicate. **Note** When your device is configured to route with IP, it does not need to have a default gateway set. **Note** The device capwap relays on default-gateway configuration to support routed access point join the device.
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show interfaces vlan** *vlan-id* **Example:** `Device# show interfaces vlan 99`	Verifies the configured IP address.
Step 8	**show ip redirects** **Example:** `Device# show ip redirects`	Verifies the configured default gateway.

Modifying the Device Startup Configuration

Specifying the Filename to Read and Write the System Configuration

By default, the Cisco IOS software uses the config.text file to read and write a nonvolatile copy of the system configuration. However, you can specify a different filename, which will be loaded during the next boot cycle.

Before you begin

Use a standalone device for this task.

SUMMARY STEPS

1. **configure terminal**
2. **boot flash**:*/file-url*
3. **end**
4. **show boot**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**boot flash**:*/file-url* **Example:** `Switch(config)# boot flash:config.text`	Specifies the configuration file to load during the next boot cycle. *file-url*—The path (directory) and the configuration filename. Filenames and directory names are case-sensitive.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show boot** **Example:** `Switch# show boot`	Verifies your entries. The **boot** global configuration command changes the setting of the CONFIG_FILE environment variable.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Manually Booting the Switch

By default, the switch automatically boots up; however, you can configure it to manually boot up.

Before you begin

Use a standalone switch for this task.

SUMMARY STEPS

1. **configure terminal**
2. **boot manual**
3. **end**
4. **show boot**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**boot manual** **Example:** `Device(config)# boot manual`	Enables the switch to manually boot up during the next boot cycle.
Step 3	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 4	**show boot** **Example:** `Device# show boot`	Verifies your entries. The **boot manual** global command changes the setting of the MANUAL_BOOT environment variable. The next time you reboot the system, the switch is in boot loader mode, shown by the *switch:* prompt. To boot up the system, use the **boot** *filesystem:/file-url* boot loader command. • *filesystem*:—Uses flash: for the system board flash device. `Switch: boot flash:` • For *file-url*—Specifies the path (directory) and the name of the bootable image. Filenames and directory names are case-sensitive.

	Command or Action	Purpose
Step 5	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Booting the Device in Installed Mode

SUMMARY STEPS

1. **cp** *source_file_path destination_file_path*
2. **request platform software package expand switch all file** *source_file_path to flash*
3. **reload**
4. **boot flash:packages.conf**
5. **show version**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**cp** *source_file_path destination_file_path*
	Example:
	`Switch#`
	`copy`
	`tftp://10.0.0.6/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin`
	`flash:`
		(Optional) Copies the bin file (`image.bin`) from the FTP or TFTP server to USB flash.

Step 2	**request platform software package expand switch all file** *source_file_path to flash*
	Example:
	Expanding the bin file from the TFTP server:
	`Switch# request platform software package expand`
	`switch all file`
	`tftp://10.0.0.2/cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.EXP.bin`
	` to flash:`
	`Preparing expand operation ...`
	`[1]: Downloading file`
	`tftp://10.0.0.2/cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.EXP.bin`
	` to active switch 1`
	`[1]: Finished downloading file`
	`tftp://10.0.0.2/cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.`
	`EXP.bin to active switch 1`
	`[1]: Copying software from active switch 1 to`
	`switch 2`
	`[1]: Finished copying software to switch 2`
	`[1 2]: Expanding bundle`
	`cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.EXP.bin`
	`[1 2]: Copying package files`
	`[1 2]: Package files copied`
	`[1 2]: Finished expanding bundle`
	`cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.EXP.bin`
		Expands the bin file stored in flash, FTP, TFTP, HTTP, or HTTPS server on the booted device.
		Note Ensure that the `packages.conf` file is available in the expanded list.

	Command or Action	Purpose
	18 -rw- 74387812 Dec 7 2012 05:55:43 +00:00 cat3k_caa-base.SSA.03.09.37.EXP.pkg 19 -rw- 2738868 Dec 7 2012 05:55:44 +00:00 cat3k_caa-drivers.SSA.03.09.37.EXP.pkg 20 -rw- 32465772 Dec 7 2012 05:55:44 +00:00 cat3k_caa-infra.SSA.03.09.37.EXP.pkg 21 -rw- 30389036 Dec 7 2012 05:55:44 +00:00 cat3k_caa-iosd-universalk9.SSA.150-9.37.EXP.pkg 22 -rw- 18342624 Dec 7 2012 05:55:44 +00:00 cat3k_caa-platform.SSA.03.09.37.EXP.pkg 23 -rw- 63374028 Dec 7 2012 05:55:44 +00:00 cat3k_caa-wcm.SSA.10.0.10.14.pkg 17 -rw- 1239 Dec 7 2012 05:56:29 +00:00 packages.conf	
Step 3	**reload** **Example:** `Switch# reload`	Reloads the device. **Note** You can boot the device manually or automatically using the `packages.conf` file. If you are booting manually, you can proceed to Step 4. Otherwise, the device boots up automatically.
Step 4	**boot flash:packages.conf** **Example:** `Switch: boot flash:packages.conf`	Boots the device with the `packages.conf` file.
Step 5	**show version** **Example:**	Verifies that the device is in the **INSTALL** mode.

Booting the Device in Bundle Mode

There are several methods by which you can boot the device—either by copying the bin file from the TFTP server and then boot the device, or by booting the device straight from flash or USB flash using the commands **boot flash:<image.bin>** or **boot usbflash0:<image.bin>** .

The following procedure explains how to boot the device from the TFTP server in the bundle mode.

SUMMARY STEPS

1. **switch:BOOT=<source path of .bin file>**
2. **boot**
3. **show version**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**switch:BOOT=<source path of .bin file>** **Example:**	Sets the boot parameters.

	Command or Action	Purpose
	`switch:BOOT=tftp://10.0.0.2/cat3k_caa-universalk9.SSA.03.09.37.EXP.150-9.37.EXP.bin`	
Step 2	**boot** **Example:** `switch: boot`	Boots the device.
Step 3	**show version** **Example:** `switch# show version`	Verifies that the device is in the **BUNDLE** mode.

Booting a Specific Software Image On a Switch Stack

By default, the switch attempts to automatically boot up the system using information in the BOOT environment variable. If this variable is not set, the switch attempts to load and execute the first executable image it can by performing a recursive, depth-first search throughout the flash file system. In a depth-first search of a directory, each encountered subdirectory is completely searched before continuing the search in the original directory. However, you can specify a specific image to boot up.

SUMMARY STEPS

1. **configure terminal**
2. **boot system switch** {*number* | **all**}
3. **end**
4. **show boot system**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**boot system switch** {*number* | **all**} **Example:** `Switch(config)#`	(Optional) For switches in a stack, specifies the switch members on which the system image is loaded during the next boot cycle: • Use *number* to specify a stack member. (Specify only one stack member.) • Use **all** to specify all stack members.
Step 3	**end** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Switch(config)# end`	
Step 4	**show boot system** **Example:** `Switch# show boot system`	Verifies your entries. The **boot system** global command changes the setting of the BOOT environment variable. During the next boot cycle, the switch attempts to automatically boot up the system using information in the BOOT environment variable.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring a Scheduled Software Image Reload

This task describes how to configure your device to reload the software image at a later time.

SUMMARY STEPS

1. **configure terminal**
2. **copy running-config startup-config**
3. **reload in** [*hh*:]*mm* [*text*]
4. **reload at** *hh*: *mm* [*month day* | *day month*] [*text*]
5. **reload cancel**
6. **show reload**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**copy running-config startup-config** **Example:** `copy running-config startup-config`	Saves your device configuration information to the startup configuration before you use the **reload** command.
Step 3	**reload in** [*hh*:]*mm* [*text*] **Example:** `Device(config)# reload in 12`	Schedules a reload of the software to take affect in the specified minutes or hours and minutes. The reload must take place within approximately 24 days. You can specify

	Command or Action	Purpose
	`System configuration has been modified. Save? [yes/no]: y`	the reason for the reload in a string up to 255 characters in length.
Step 4	**reload at** *hh*: *mm* [*month day* | *day month*] [*text*] **Example:** `Device(config)# reload at 14:00`	Specifies the time in hours and minutes for the reload to occur. **Note** Use the **at** keyword only if the device system clock has been set (through Network Time Protocol (NTP), the hardware calendar, or manually). The time is relative to the configured time zone on the device. To schedule reloads across several devices to occur simultaneously, the time on each device must be synchronized with NTP.
Step 5	**reload cancel** **Example:** `Device(config)# reload cancel`	Cancels a previously scheduled reload.
Step 6	**show reload** **Example:** `show reload`	Displays information about a previously scheduled reload or identifies if a reload has been scheduled on the device.

Monitoring Device Setup Configuration

Example: Verifying the Device Running Configuration

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

Current configuration: 1363 bytes
!
version 12.4
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Stack1
!
enable secret 5 $1$ej9.$DMUvAUnZOAmvmgqBEzIxE0
!
.
<output truncated>
.
interface gigabitethernet6/0/2
mvr type source
```

```
<output truncated>

...!
interface VLAN1
 ip address 172.20.137.50 255.255.255.0
 no ip directed-broadcast
!
ip default-gateway 172.20.137.1 !
!
snmp-server community private RW
snmp-server community public RO
snmp-server community private@es0 RW
snmp-server community public@es0 RO
snmp-server chassis-id 0x12
!
end
```

Examples: Displaying Software Bootup in Install Mode

This example displays software bootup in install mode:

```
switch: boot flash:packages.conf

Getting rest of image
Reading full image into memory....done
Reading full base package into memory...: done = 74596432
Nova Bundle Image
--------------------------------------
Kernel Address : 0x6042f354
Kernel Size : 0x318412/3245074
Initramfs Address : 0x60747768
Initramfs Size : 0xdc08e8/14420200
Compression Format: .mzip

Bootable image at @ ram:0x6042f354
Bootable image segment 0 address range [0x81100000, 0x81b80000] is in range [0x80180000,
0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@boot_system:
 377
Loading Linux kernel with entry point 0x811060f0 ...
Bootloader: Done loading app on core_mask: 0xf

### Launching Linux Kernel (flags = 0x5)

All packages are Digitally Signed
Starting System Services
Nov 7 09:57:05 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-DISC_START: Switch 2 is
starting stack discovery
#######################################################################################################################
Nov 7 09:59:07 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-DISC_DONE: Switch 2 has
finished stack discovery
Nov 7 09:59:07 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-SWITCH_ADDED: Switch 2 has
 been added to the stack
Nov 7 09:59:14 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-ACTIVE_ELECTED: Switch 2
has been elected ACTIVE

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cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706



Cisco IOS Software, IOS-XE Software, Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M),

Version 03.09.12.EMD EARLY DEPLOYMENT ENGINEERING NOVA_WEEKLY BUILD, synced to
DSGS_PI2_POSTPC_FLO_DSBU7_NG3K_1105
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Sun 04-Nov-12 22:53 by gereddy
License level to iosd is ipservices
```

This example displays software bootup in bundle mode:

```
switch: boot flash:cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin


Reading full image into
memory..................................................................done
Nova Bundle Image
--------------------------------------
Kernel Address : 0x6042ff38
Kernel Size : 0x318412/3245074
Initramfs Address : 0x6074834c
Initramfs Size : 0xdc08e8/14420200
Compression Format: .mzip

Bootable image at @ ram:0x6042ff38
Bootable image segment 0 address range [0x81100000, 0x81b80000] is in range [0x80180000,
0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
File "flash:cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin" uncompressed and
installed, entry point: 0x811060f0
Loading Linux kernel with entry point 0x811060f0 ...
Bootloader: Done loading app on core_mask: 0xf

### Launching Linux Kernel (flags = 0x5)

All packages are Digitally Signed
Starting System Services
Nov 7 09:45:49 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-DISC_START: Switch 2 is
starting stack discovery
#######################################################################################################################
Nov 7 09:47:50 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-DISC_DONE: Switch 2 has
finished stack discovery
Nov 7 09:47:50 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-SWITCH_ADDED: Switch 2 has
 been added to the stack
Nov 7 09:47:58 %IOSXE-1-PLATFORM: process stack-mgr: %STACKMGR-1-ACTIVE_ELECTED: Switch 2
has been elected ACTIVE

Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
```

```
cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706


Cisco IOS Software, IOS-XE Software, Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M),
 Version 03.09.12.EMD
EARLY DEPLOYMENT ENGINEERING NOVA_WEEKLY BUILD, synced to DSGS_PI2_POSTPC_FLO_DSBU7_NG3K_1105
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Sun 04-Nov-12 22:53 by gereddy
License level to iosd is ipservices
```

Example: Emergency Installation

This sample output is an example when the **emergency-install** boot command is initiated:

```
switch: emergency-install
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin


The bootflash will be erased during install operation, continue (y/n)?y
Starting emergency recovery
(tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin)...
Reading full image into memory......................done
Nova Bundle Image
--------------------------------------
Kernel Address : 0x6042e5cc
Kernel Size : 0x318261/3244641
Initramfs Address : 0x60746830
Initramfs Size : 0xdb0fb9/14356409
Compression Format: .mzip

Bootable image at @ ram:0x6042e5cc
Bootable image segment 0 address range [0x81100000, 0x81b80000] is in range [0x80180000,
0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
File "sda9:c3850-recovery.bin" uncompressed and installed, entry point: 0x811060f0
Loading Linux kernel with entry point 0x811060f0 ...
Bootloader: Done loading app on core_mask: 0xf

### Launching Linux Kernel (flags = 0x5)



Initiating Emergency Installation of bundle
tftp://172.19.211.47/cstohs/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin


Downloading bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin...
Validating bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin...
Installing bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin...
Verifying bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.09.12.EMD.150-9.12.EMD.bin...
Package cat3k_caa-base.SSA.03.09.12.EMD.pkg is Digitally Signed
Package cat3k_caa-drivers.SSA.03.09.12.EMD.pkg is Digitally Signed
```

```
Package cat3k_caa-infra.SSA.03.09.12.EMD.pkg is Digitally Signed
Package cat3k_caa-iosd-universalk9.SSA.150-9.12.EMD.pkg is Digitally Signed
Package cat3k_caa-platform.SSA.03.09.12.EMD.pkg is Digitally Signed
Package cat3k_caa-wcm.SSA.03.09.12.EMD.pkg is Digitally Signed
Preparing flash...
Syncing device...
Emergency Install successful... Rebooting
Restarting system.


Booting...(use DDR clock 667 MHz)Initializing and Testing RAM +++@@@@####...++@@++@@++@@++@
```

Configuration Examples for Performing Device Setup

Example: Configuring a Device as a DHCP Server

```
Device# configure terminal
Device(config)# ip dhcp pool pool1
Device(dhcp-config)# network 10.10.10.0 255.255.255.0
Device(dhcp-config)# boot config-boot.text
Device(dhcp-config)# default-router 10.10.10.1
Device(dhcp-config)# option 150 10.10.10.1
Device(dhcp-config)# exit
Device(config)# tftp-server flash:config-boot.text
Device(config)# interface gigabitethernet1/0/4
Device(config-if)# no switchport
Device(config-if)# ip address 10.10.10.1 255.255.255.0
Device(config-if)# end
```

Example: Configuring DHCP Auto-Image Update

Example: Configuring a Device to Download Configurations from a DHCP Server

This example uses a Layer 3 SVI interface on VLAN 99 to enable DHCP-based autoconfiguration with a saved configuration:

```
Device# configure terminal
Device(config)# boot host dhcp
Device(config)# boot host retry timeout 300
Device(config)# banner config-save ^C Caution - Saving Configuration File to NVRAM May Cause
 You to No longer Automatically Download Configuration Files at Reboot^C
Device(config)# vlan 99
Device(config-vlan)# interface vlan 99
Device(config-if)# no shutdown
Device(config-if)# end
Device# show boot
BOOT path-list:
Config file:          flash:/config.text
```

```
Private Config file:  flash:/private-config.text
Enable Break:         no
Manual Boot:          no
HELPER path-list:
NVRAM/Config file
      buffer size:    32768
Timeout for Config
          Download:    300 seconds
Config Download
       via DHCP:       enabled (next boot: enabled)
Device#
```

Examples: Scheduling Software Image Reload

This example shows how to reload the software on the device on the current day at 7:30 p.m:

```
Device# reload at 19:30
Reload scheduled for 19:30:00 UTC Wed Jun 5 2013 (in 2 hours and 25 minutes)
Proceed with reload? [confirm]
```

This example shows how to reload the software on the device at a future time:

```
Device# reload at 02:00 jun 20
Reload scheduled for 02:00:00 UTC Thu Jun 20 2013 (in 344 hours and 53 minutes)
Proceed with reload? [confirm]
```

Additional References For Performing Device Setup

Related Documents

Related Topic	Document Title
Device setup commands Boot loader commands	

Standards and RFCs

Standard/RFC	Title
None	—

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information For Performing Device Setup Configuration

Command History

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.

CHAPTER 4

Configuring Smart Licensing

Prerequisites for Configuring Smart Licensing

You must have the following in CSSM:

- Cisco Smart Account
- One or more Virtual Account
- User role with proper access rights
- You should have accepted the Smart Software Licensing Agreement on CSSM to register devices.
- Network reachability to https://tools.cisco.com.

Introduction to Smart Licensing

Cisco Smart Licensing is a flexible licensing model that provides you with an easier, faster, and more consistent way to purchase and manage software across the Cisco portfolio and across your organization. And it's secure – you control what users can access. With Smart Licensing you get:

- Easy Activation: Smart Licensing establishes a pool of software licenses that can be used across the entire organization—no more PAKs (Product Activation Keys).

- Unified Management: My Cisco Entitlements (MCE) provides a complete view into all of your Cisco products and services in an easy-to-use portal, so you always know what you have and what you are using.
- License Flexibility: Your software is not node-locked to your hardware, so you can easily use and transfer licenses as needed.

To use Smart Licensing, you must first set up a Smart Account on Cisco Software Central (software.cisco.com).

For a more detailed overview on Cisco Licensing, go to cisco.com/go/licensingguide.

Note Licenses are managed as *Smart licenses* from Cisco IOS XE Fuji 16.9.1 and later. Right-to-Use licenses are deprecated from Cisco IOS XE Fuji 16.9.1.

Overview of CSSM

CSSM enables you to manage all your Cisco smart software licenses from one centralized portal. With CSSM, you can organize and view your licenses in groups called virtual accounts (collections of licenses and product instances).

You can access the CSSM on https://software.cisco.com/#, by clicking the **Smart Software Licensing** link under the **License** tab.

Note Use a Chrome 32.0, Firefox 25.0, or Safari 6.0.5 web browser to access CSSM. Also, ensure that Javascript 1.5 or a later version is enabled in your browser.

Use the CSSM to do the following tasks:

- Create, manage, or view virtual accounts.
- Create and manage Product Instance Registration Tokens.
- Transfer licenses between virtual accounts or view licenses.
- Transfer, remove, or view product instances.
- Run reports against your virtual accounts.
- Modify your email notification settings.
- View overall account information.

CSSM Help describes the procedures for carrying out these tasks.

Overview of License Conversion Feature

The license conversion feature migrates the traditional licenses that are installed on Cisco Catalyst 3850 and Cisco Catalyst 3650 switches, from Cisco IOS XE Fuji 16.8.x or earlier to Cisco IOS XE Fuji 16.9.1or later. Subscription-based add-on licenses, that is DNA Advantage and DNA Essentials, are deposited in your Cisco smart account if purchased.

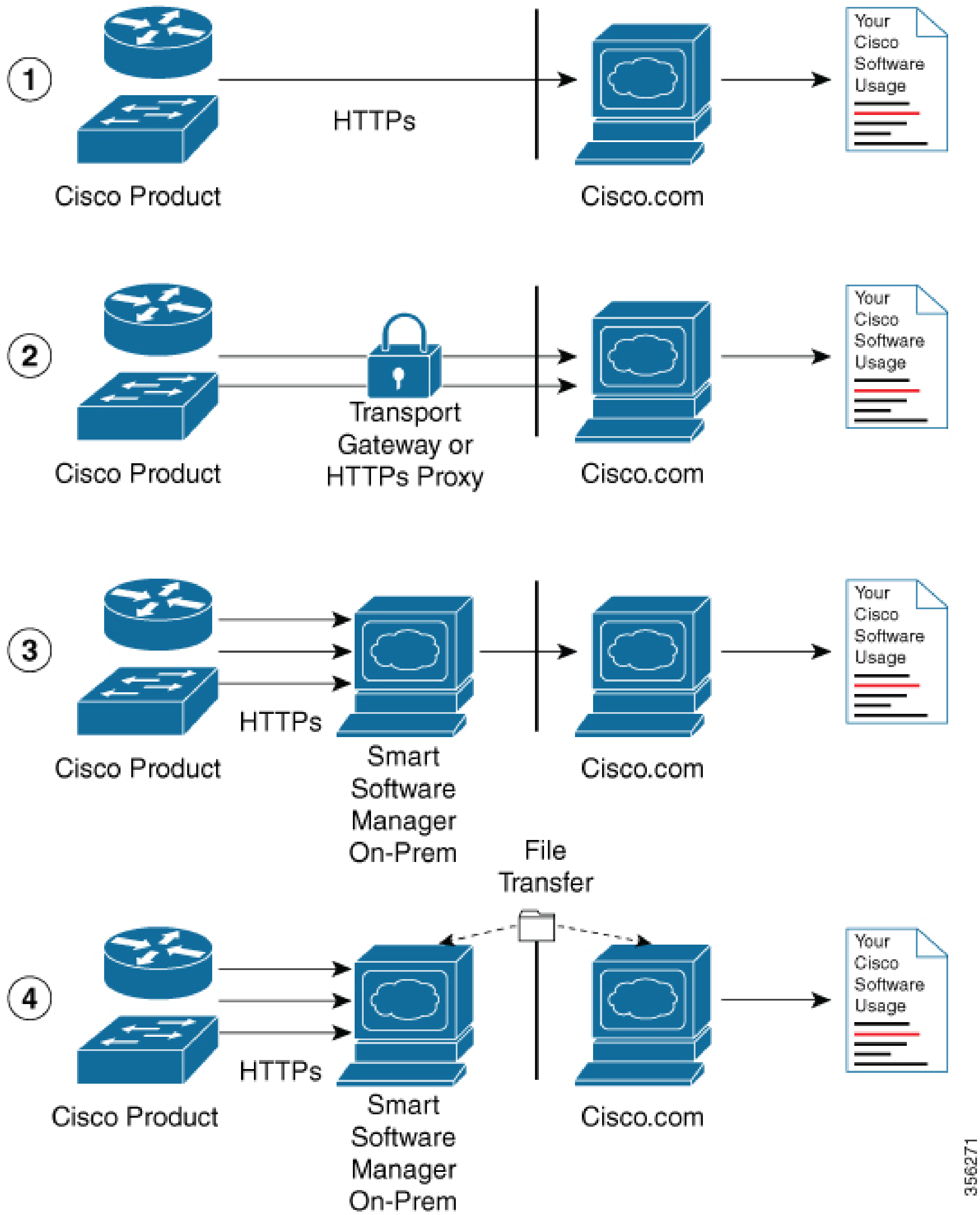
The license conversion feature migrates all the installed traditional licenses from the device to the Cisco Smart Software Manager. On initiating license conversion, the device converts the traditional licenses and sends the migration data to the Cisco Smart Software Manager, which in turn, creates license entitlements and deposits them in the user account.

Note The license conversion process takes an hour or more to complete. Use the **show license summary** command to confirm that the license conversion is completed successfully.

Connecting to CSSM

The following illustration shows the various options available to connect to CSSM:

Figure 4: Connection Options



1. Direct cloud access: In this method, Cisco products send usage information directly over the internet to Cisco.com; no additional components are needed for the connection.

2. Direct cloud access through an HTTPs proxy: In this method, Cisco products send usage information over the internet through a proxy server - either a Call Home Transport Gateway or an off-the-shelf proxy (such as Apache) to Cisco.com.
3. Mediated access through a connected on-premises collector: In this method, Cisco products send usage information to a locally-connected collector, which acts as a local license authority. Periodically, this information is exchanged to keep the databases synchronized.
4. Mediated access through a disconnected on-premises collector: In this method, Cisco products send usage information to a local disconnected collector, which acts as a local license authority. Exchange of human-readable information takes place occasionally (maybe once a month) to keep the databases synchronized.

Options 1 and 2 provide an easy connection option, and options 3 and 4 provide a secure environment connection option. Cisco Smart Software Manager On-Prem (formerly known as Cisco Smart Software Manager satellite) provides support for options 3 and 4.

Configuring a Connection to CSSM and Setting Up the License Level

The following sections provide information about how to set up a connection to CSSM and set up the license level.

Setting Up a Connection to CSSM

The following steps show how to set up a Layer 3 connection to CSSM to verify network reachability. Skip this section if you already have Layer 3 connectivity to CSSM.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. {**ip** | **ipv6**} **name-server** *server-address 1* [*server-address 2*] [*server-address 3*] [*server-address 4*] [*server-address 5*] [*server-address 6*]
4. **ip name-server vrf Mgmt-vrf** *server-address 1* [*server-address 2*] [*server-address 3*] [*server-address 4*] [*server-address 5*] [*server-address 6*]
5. **ip domain lookup source-interface** *interface-type interface-number*
6. **ip domain name example.com**
7. **ip host tools.cisco.com** *ip-address*
8. **interface** *vlan_id*
9. **ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**prefer**]
10. **switchport access vlan** *vlan_id*
11. **ip route** *ip-address ip-mask subnet mask*
12. **license smart transport callhome**
13. **ip http client source-interface** *interface-type interface-number*
14. **exit**
15. **copy running-config startup-config**

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	{**ip** | **ipv6**} **name-server** *server-address 1* [*server-address 2*] [*server-address 3*] [*server-address 4*] [*server-address 5*] [*server-address 6*] **Example:** `Device(config)# ip name-server 209.165.201.1 209.165.200.225 209.165.201.14 209.165.200.230`	Configures Domain Name System (DNS).
Step 4	**ip name-server vrf Mgmt-vrf** *server-address 1* [*server-address 2*] [*server-address 3*] [*server-address 4*] [*server-address 5*] [*server-address 6*] **Example:** `Device(config)# ip name-server vrf Mgmt-vrf 209.165.201.1 209.165.200.225 209.165.201.14 209.165.200.230`	(Optional) Configures DNS on the VRF interface. **Note** You should configure this command as an alternative to the **ip name-server** command.
Step 5	**ip domain lookup source-interface** *interface-type interface-number* **Example:** `Device(config)# ip domain lookup source-interface Vlan100`	(Optional) Configures the source interface for the DNS domain lookup.
Step 6	**ip domain name example.com** **Example:** `Device(config)# ip domain name example.com`	Configures the domain name.
Step 7	**ip host tools.cisco.com** *ip-address* **Example:** `Device(config)# ip host tools.cisco.com 209.165.201.30`	(Optional) Configures static hostname-to-address mappings in the DNS hostname cache if automatic DNS mapping is not available.

Step 8	**interface** *vlan_id*
	
	Example:
	
	`Device(config)# interface Vlan100`
	`Device(config-if)# ip address 192.0.2.10 255.255.255.0`
	`Device(config-if)# exit`
		Configures a Layer 3 interface.

	Command or Action	Purpose
Step 9	**ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**prefer**] **Example:** `Device(config)# ntp server 198.51.100.100 version 2 prefer`	Forms a server association with the specified system. **Note** The **ntp server** command is mandatory to ensure that the device time is synchronized with CSSM.

Step 10	**switchport access vlan** *vlan_id*
	
	Example:
	
	`Device(config)# interface GigabitEthernet1/0/1`
	`Device(config-if)# switchport access vlan 100`
	`Device(config-if)# switchport mode access`
	`Device(config-if)# exit`
	`Device(config)#`
		(Optional) Enables the VLAN for which this access port carries traffic and sets the interface as a nontrunking nontagged single-VLAN Ethernet interface.
		
		Note This step is to be configured only if the switchport access mode is required.

Step 11	**ip route** *ip-address ip-mask subnet mask* **Example:** `Device(config)# ip route 192.0.2.0 255.255.255.255 192.0.2.1`	Configures a route on the device. **Note** You can configure either a static route or a dynamic route.
Step 12	**license smart transport callhome** **Example:** `Device(config)# license smart transport callhome`	Enables the transport mode as Call Home. **Note** The **license smart transport callhome** command is mandatory.
Step 13	**ip http client source-interface** *interface-type interface-number* **Example:** `Device(config)# ip http client source-interface Vlan100`	Configures a source interface for the HTTP client. **Note** The **ip http client source-interface** *interface-type interface-number* command is mandatory.
Step 14	**exit** **Example:** `Device(config)# exit`	(Optional) Exits global configuration mode and returns to privileged EXEC mode.
Step 15	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Call Home Service for Direct Cloud Access

Note By default, the CiscoTAC-1 profile is already set up on the device. Use the **show call-home profile all** command to check the profile status.

The Call Home service provides email-based and web-based notification of critical system events to CSSM.

To configure and enable the Call Home service, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **call-home**
4. **no http secure server-identity-check**
5. **contact-email-address** *email-address*
6. **profile CiscoTAC-1**
7. **destination transport-method http**
8. **destination address http** *url*
9. **active**
10. **no destination transport-method email**
11. **exit**
12. **exit**
13. **service call-home**
14. **exit**
15. **copy running-config startup-config**

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	**call-home** **Example:** `Device(config)# call-home`	Enters Call Home configuration mode.
Step 4	**no http secure server-identity-check** **Example:** `Device(config-call-home)# no http secure server-identity-check`	Disables server identity check when HTTP connection is established.
Step 5	**contact-email-address** *email-address* **Example:** `Device(config-call-home)# contact-email-addr username@example.com`	Assigns customer's email address. You can enter up to 200 characters in email address format with no spaces.

	Command or Action	Purpose
Step 6	**profile CiscoTAC-1** **Example:** `Device(config-call-home)# profile CiscoTAC-1`	By default, the CiscoTAC-1 profile is inactive. To use this profile with the Call Home service, you must enable the profile.
Step 7	**destination transport-method http** **Example:** `Device(config-call-home-profile)# destination transport-method http`	Enables the Call Home service via HTTP.
Step 8	**destination address http** *url* **Example:** `Device(config-call-home-profile)# destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService`	Connects to CSSM.
Step 9	**active** **Example:** `Device(config-call-home-profile)# active`	Enables the destination profile.
Step 10	**no destination transport-method email** **Example:** `Device(config-call-home-profile)# no destination transport-method email`	Disables the Call Home service via email.
Step 11	**exit** **Example:** `Device(config-call-home-profile)# exit`	Exits Call Home destination profile configuration mode and returns to Call Home configuration mode.
Step 12	**exit** **Example:** `Device(config-call-home)# exit`	Exits Call Home configuration mode and returns to global configuration mode.
Step 13	**service call-home** **Example:** `Device(config)# service call-home`	Enables the Call Home feature.
Step 14	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 15	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Call Home Service for Direct Cloud Access through an HTTPs Proxy Server

The Call Home service can be configured through an HTTPs proxy server. This configuration requires no user authentication to connect to CSSM.

Note Authenticated HTTPs proxy configurations are not supported.

To configure and enable the Call Home service through an HTTPs proxy, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **call-home**
4. **contact-email-address** *email-address*
5. **http-proxy** *proxy-address* **proxy-port** *port-number*
6. **profile CiscoTAC-1**
7. **destination transport-method http**
8. **no destination transport-method email**
9. **profile** *name*
10. **reporting smart-licensing-data**
11. **destination transport-method http**
12. **destination address http** *url*
13. **active**
14. **exit**
15. **exit**
16. **service call-home**
17. **ip http client proxy-server** *proxy-address* **proxy-port** *port-number*
18. **exit**
19. **copy running-config startup-config**

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.

	Command or Action	Purpose
Step 3	**call-home** **Example:** `Device(config)# call-home`	Enters Call Home configuration mode.
Step 4	**contact-email-address** *email-address* **Example:** `Device(config-call-home)# contact-email-addr sch-smart-licensing@cisco.com`	Configures the default email address as sch-smart-licensing@cisco.com.
Step 5	**http-proxy** *proxy-address* **proxy-port** *port-number* **Example:** `Device(config-call-home)# http-proxy 198.51.100.10 port 3128`	Configures the proxy server information to the Call Home service.
Step 6	**profile CiscoTAC-1** **Example:** `Device(config-call-home)# profile CiscoTAC-1`	By default, the CiscoTAC-1 profile is inactive. To use this profile with the Call Home service, you must enable the profile.
Step 7	**destination transport-method http** **Example:** `Device(config-call-home-profile)# destination transport-method http`	Enables the Call Home service via HTTP.
Step 8	**no destination transport-method email** **Example:** `Device(config-call-home-profile)# no destination transport-method email`	Disables the Call Home service via email.
Step 9	**profile** *name* **Example:** `Device(config-call-home)# profile test1`	Enters Call Home destination profile configuration mode for the specified destination profile name. If the specified destination profile does not exist, it is created.
Step 10	**reporting smart-licensing-data** **Example:** `Device(config-call-home-profile)# reporting smart-licensing-data`	Enables data sharing with the Call Home service via HTTP.
Step 11	**destination transport-method http** **Example:** `Device(config-call-home-profile)# destination transport-method http`	Enables the HTTP message transport method.
Step 12	**destination address http** *url* **Example:**	Connects to CSSM.

	Command or Action	Purpose
	`Device(config-call-home-profile)# destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService`	
Step 13	**active** **Example:** `Device(config-call-home-profile)# active`	Enables the destination profile.
Step 14	**exit** **Example:** `Device(config-call-home-profile)# exit`	Exits Call Home destination profile configuration mode and returns to Call Home configuration mode.
Step 15	**exit** **Example:** `Device(config-call-home)# exit`	Exits Call Home configuration mode and returns to global configuration mode.
Step 16	**service call-home** **Example:** `Device(config)# service call-home`	Enables the Call Home feature.
Step 17	**ip http client proxy-server** *proxy-address* **proxy-port** *port-number* **Example:** `Device(config)# ip http client proxy-server 198.51.100.10 port 3128`	Enables the Call Home feature.
Step 18	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 19	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Call Home Service for Cisco Smart Software Manager On-Prem

For information about Cisco Smart Software Manager On-Prem (formerly known as Cisco Smart Software Manager satellite), see https://www.cisco.com/c/en/us/buy/smart-accounts/software-manager-satellite.html.

To configure the Call Home service for the Cisco Smart Software Manager On-Prem, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **call-home**

4. **no http secure server-identity-check**
5. **profile** *name*
6. **reporting smart-licensing-data**
7. **destination transport-method http**
8. **destination address http** *url*
9. **destination preferred-msg-format** {**long-text** | **short-text** | **xml**}
10. **active**
11. **exit**
12. **exit**
13. **ip http client source-interface** *interface-type interface-number*
14. **crypto pki trustpoint** *name*
15. **revocation-check none**
16. **end**
17. **copy running-config startup-config**

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	**call-home** **Example:** `Device(config)# call-home`	Enters Call Home configuration mode.
Step 4	**no http secure server-identity-check** **Example:** `Device(config-call-home)# no http secure server-identity-check`	Disables server identity check when HTTP connection is established.
Step 5	**profile** *name* **Example:** `Device(config-call-home)# profile test1`	Enters Call Home destination profile configuration mode for the specified destination profile name. If the specified destination profile does not exist, it is created.
Step 6	**reporting smart-licensing-data** **Example:** `Device (config-call-home-profile)# reporting smart-licensing-data`	Enables data sharing with the Call Home service via HTTP.
Step 7	**destination transport-method http** **Example:**	Configures the destination URL (CSSM) to which Call Home messages are sent.

	Command or Action	Purpose
	`Device(config-call-home-profile)#` **`destination address http`** **`https://209.165.201.15:443/Transportgateway/services/DeviceRequestHandler`** or `Device(config-call-home-profile)#` **`destination address http`** **`http://209.165.201.15:80/Transportgateway/services/DeviceRequestHandler`**	**Note** Ensure the IP address or the fully qualified domain name (FQDN) in the destination URL matches the IP address or the FQDN as configured for the **Satellite Name** on the Cisco Smart Software Manager On-Prem.
Step 8	**destination address http** *url* **Example:** `Device(config-call-home-profile)#` **`destination address http https://url.example.com`**	Configures the destination URL (CSSM) to which Call Home messages are sent.
Step 9	**destination preferred-msg-format** {**long-text** | **short-text** | **xml**} **Example:** `Device(config-call-home-profile)#` **`destination preferred-msg-format xml`**	(Optional) Configures a preferred message format. The default is XML.
Step 10	**active** **Example:** `Device(config-call-home-profile)#` **`active`**	Enables the destination profile. By default, a profile is enabled when it is created.
Step 11	**exit** **Example:** `Device(config-call-home-profile)#` **`exit`**	Exits Call Home destination profile configuration mode and returns to Call Home configuration mode.
Step 12	**exit** **Example:** `Device(config-call-home)#` **`exit`**	Exits Call Home configuration mode and returns to global configuration mode.
Step 13	**ip http client source-interface** *interface-type interface-number* **Example:** `Device(config)#` **`ip http client source-interface Vlan100`**	Configures a source interface for the HTTP client. **Note** The **ip http client source-interface** *interface-type interface-number* command is mandatory for a vrf interface.
Step 14	**crypto pki trustpoint** *name* **Example:** `Device(config)#` **`crypto pki trustpoint SLA-TrustPoint`**	(Optional) Declares the trustpoint and a given name and enters ca-trustpoint configuration mode.
Step 15	**revocation-check none** **Example:** `Device(ca-trustpoint)#` **`revocation-check none`**	(Optional) Specifies that certificate checking is ignored.

	Command or Action	Purpose
Step 16	**end** **Example:** `Device(ca-trustpoint)# end`	(Optional) Exits ca-trustpoint configuration mode and returns to privileged EXEC mode.
Step 17	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the License Level

This procedure is optional. You can use this procedure to:

- Downgrade or upgrade licenses.
- Enable or disable an evaluation or extension license.
- Clear an upgrade license.

Configure the required license levels on the device before registering. The following are the license levels available for Cisco Catalyst 3000 Series Switches:

Base licenses

- LAN Base—Supports Layer 2 features.
- IP Base—Supports Layer 2 and Layer 3 features.
- IP Services—Supports Layer 2, Layer 3, and IPv6 features.

Add-on licenses—These licenses can be subscribed for a fixed term of three, five, or seven years.

- Digital Networking Architecture (DNA) Essentials
- DNA Advantage (includes DNA Essentials)

To configure the license levels, follow this procedure:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **license boot level** *license_level*
4. **exit**
5. **write memory**
6. **show version**
7. **reload**

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	**license boot level** *license_level* **Example:** `Device(config)# license boot level ipservices`	Activates the licenses on the switch.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**write memory** **Example:** `Device# write memory`	Saves the license information on the switch.

Step 6	**show version**
	Example:
	`Device# show version`
	`Snippet`
	`Technology-package Current     Type        Technology-package Next reboot`
	`ipbasek9                        Smart License               ipservicesk9`
	`None                            Subscription Smart License       None`
		Shows license-level information.

Step 7	**reload** **Example:** `Device# reload`	Reloads the device.

Registering a Device in CSSM

The following sections provide information about how to register a device in CSSM.

Generating a New Token from CSSM

Tokens are generated to register new product instances to the virtual account.

Step 1 Log in to CSSM from https://software.cisco.com/#.

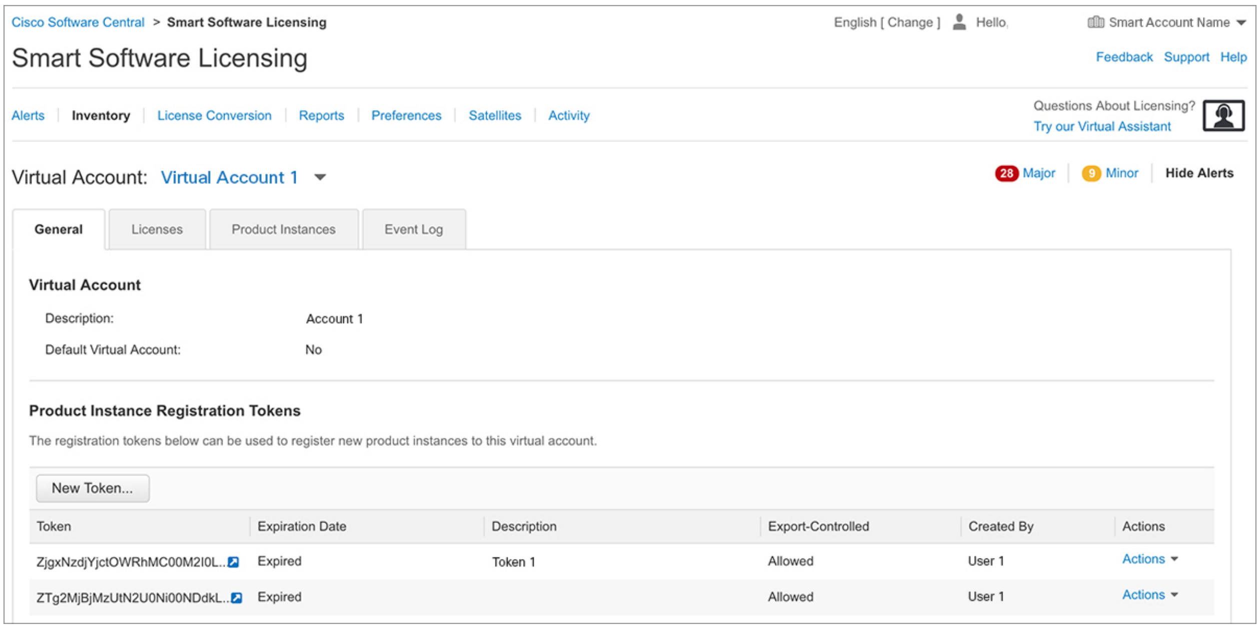
You must log in to the portal using the username and password provided by Cisco.

Step 2 Click the **Inventory** tab.

Step 3 From the **Virtual Account** drop-down list, choose the required virtual account.

Step 4 Click the **General** tab.

Step 5 Click **New Token**.

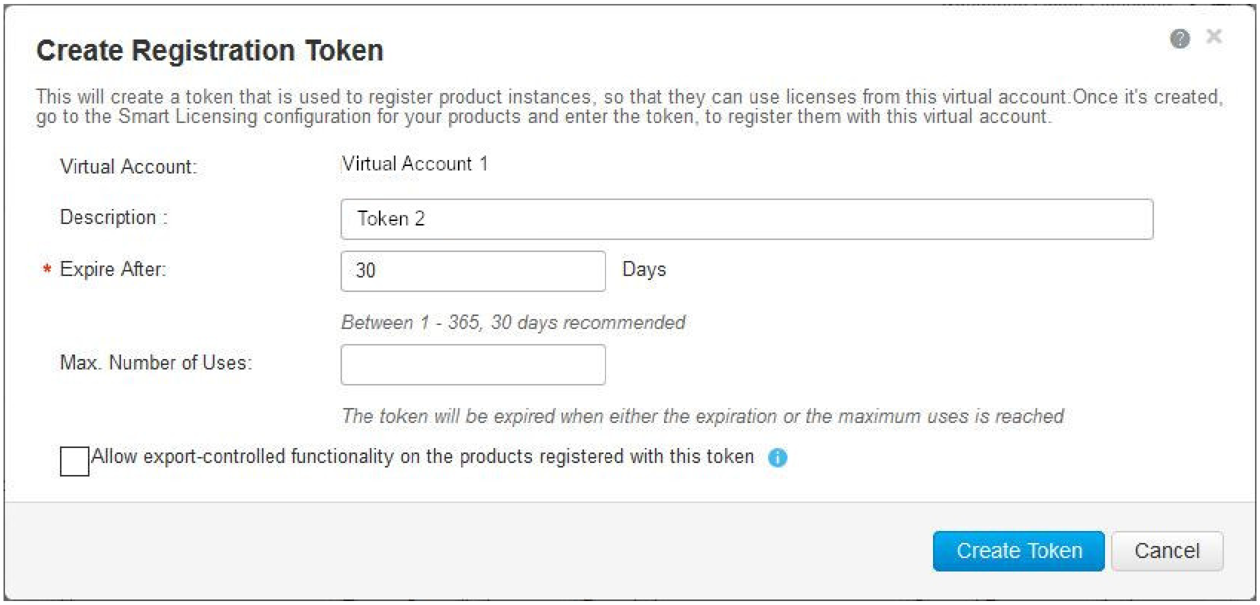


The **Create Registration Token** window is displayed.

Step 6 In the **Description** field, enter the token description.

Step 7 In the **Expire After** field, enter the number of days the token must be active.

Step 8 (Optional) In the **Max. Number of Uses** field, enter the maximum number of uses allowed after which the token expires.

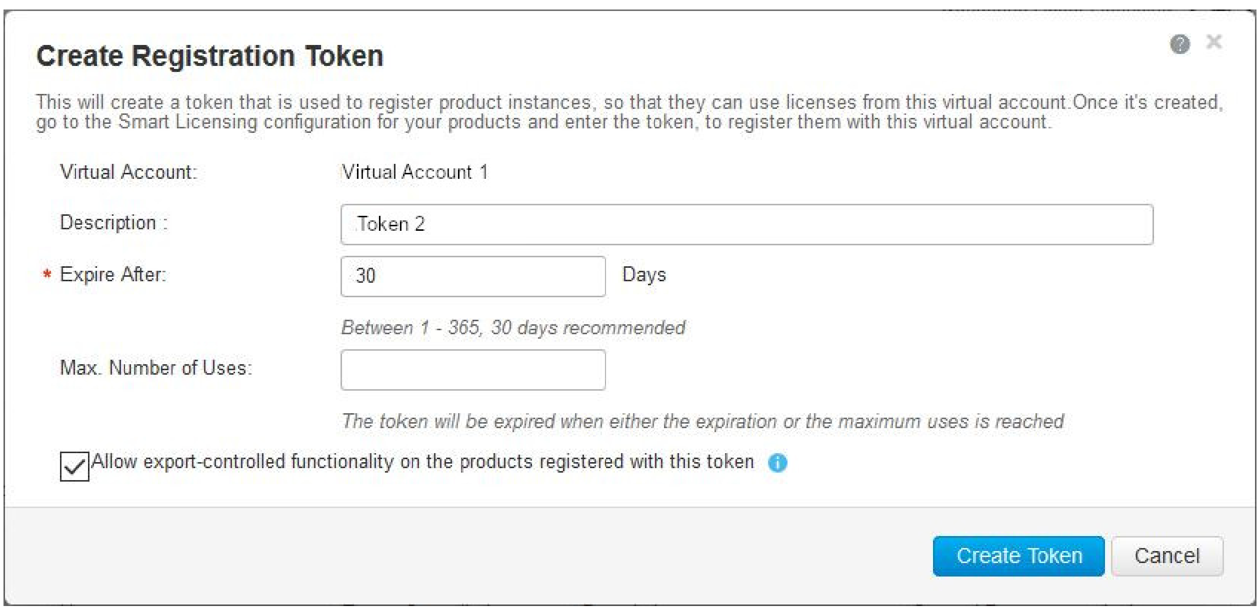


Step 9 Check the **Allow export-controlled functionality on the products registered with this token** checkbox.

Enabling this checkbox ensures Cisco compliance with US and country-specific export policies and guidelines. For more information, see https://www.cisco.com/c/en/us/about/legal/global-export-trade.html.

Step 10 Click **Create Token** to create a token.

Step 11 After the token is created, click **Copy** to copy the newly created token.



What to do next

Registering a Device with the New Token

Registering a Device with the New Token

To register a device with the new token, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **license smart register idtoken** *token_ID*
3. **write memory**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**license smart register idtoken** *token_ID* **Example:** `Device# license smart register idtoken $Tl4UytrNXBzbEs1ck8veUtWaG5abnZJOFdDa1FwbVRa%0AblRMbz0%3D%0A`	Registers the device with the back-end server using the token generated from CSSM.
Step 3	**write memory** **Example:** `Device# write memory`	Saves the license information on the device.

Verifying the License Status After Registration

To verify the status of a license after registration, use the **show license all** command.

```
Device> enable
Device# show license all
Smart Licensing Status
======================

Smart Licensing is ENABLED

Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Initial Registration: SUCCEEDED on Jul 09 10:08:19 2018 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:19 2019 UTC
  Registration Expires: Jul 09 10:02:35 2019 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC
  Last Communication Attempt: SUCCEEDED on Jul 09 10:08:25 2018 UTC
  Next Communication Attempt: Jul 09 22:08:24 2018 UTC
  Communication Deadline: Oct 07 10:02:43 2018 UTC
```

```
License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Not started
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

License Usage
==============

C3850-DNA-E-24 (C3850-24 DNA Essentials):
  Description: C3850-DNA-E
  Count: 3
  Version: 1.0
  Status: AUTHORIZED

C3850_24_Lanbase (C3850-24 LAN Base):
  Description: C3850 24 Port Lanbase
  Count: 3
  Version: 1.0
  Status: OUT OF COMPLIANCE

Product Information
===================
UDI: PID:WS-C3850-24P,SN:FOC1842U0FC

HA UDI List:
    Active:PID:WS-C3850-24P,SN:FOC1842U0FC
    Standby:PID:WS-C3850-24P,SN:FOC1842U0CZ
    Member:PID:WS-C3850-24P,SN:FOC1842X0FD

Agent Version
=============
Smart Agent for Licensing: 4.4.13_rel/116
Component Versions: SA:(1_3_dev)1.0.15, SI:(dev22)1.2.1, CH:(rel5)1.0.3, PK:(dev18)1.0.3

Reservation Info
================
License reservation: DISABLED
```

Canceling a Device's Registration in CSSM

When your device is taken off the inventory, shipped elsewhere for redeployment, or returned to Cisco for replacement using the return merchandise authorization (RMA) process, you can use the **deregister** command to cancel the registration of your device.

To cancel device registration, follow this procedure:

Before you begin

Layer 3 connection to CSSM must be available to successfully deregister the device.

SUMMARY STEPS

1. **enable**
2. **license smart deregister**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**license smart deregister** **Example:** `Device# license smart deregister`	Cancels the device's registration, and sends the device into evaluation mode. All smart licensing entitlements and certificates on the corresponding platform are removed. The device product instance stored on CSSM is also removed.

Migrating a License with License Conversion Feature

The following sections provide information about how to enable license conversion in CSSM and convert licenses on a device using license conversion.

Enabling License Conversion in CSSM

License conversion must be enabled before starting the conversion. Failure to enable license conversion will result in the CSSM displaying an insufficient licenses error.

Before you begin

You must be logged in as a Smart Account administrator.

Step 1 Log in to CSSM from https://software.cisco.com/#.

You must log in to the portal using the username and password provided by Cisco.

Step 2 Click the **Convert to Smart Licensing** tab.

Step 3 Click the **Conversion Settings** tab.

Step 4 In the **Device Led Conversion to Smart Licensing** pane, select **Enabled** in the drop-down list.

Converting Licenses on a Device Using License Conversion

To convert licenses on a device using license conversion, perform this procedure:

SUMMARY STEPS

1. **enable**
2. **license smart conversion start**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**license smart conversion start** **Example:** `Device# license smart conversion start`	Migrates the license to CSSM.

Monitoring Smart Licensing Configuration

Use the following commands in privileged EXEC mode to monitor smart licensing configuration.

Table 6: Commands to Monitor Smart Licensing Configuration

Command	Purpose
show license status	Displays the compliance status of smart licensing. The following is the list of possible statuses: • Enabled: Indicates that smart licensing is enabled. • Waiting: Indicates the initial state after your device has made a license entitlement request. The device establishes communication with Cisco and successfully registers itself with the CSSM. • Registered: Indicates that your device is able to communicate with the CSSM, and is authorized to initiate requests for license entitlements. • Authorized: Indicates that your device is in Compliance status and is authorized to use the requested type and count of licenses. The Authorization status has a lifetime of 90 days. At the end of 30 days, the device will send a new entitlement authorization request to the CSSM to renew the authorization. • Out Of Compliance: Indicates that one or more of your licenses are out of compliance. You must buy additional licenses. • Eval Mode: You must register the device with the CSSM within 90 days (of device usage). Otherwise, your device's evaluation period will expire. • Evaluation Period Expired: At the end of 90 days, if your device has not registered, the device enters Evaluation Expired mode.
show license all	Displays all the entitlements in use. Additionally, it shows the associated licensing certificates, compliance status, UDI, and other details.
show tech-support license	Displays the detailed debug output.
show license usage	Displays the license usage information.

Command	Purpose
show license summary	Displays the summary of all the active licenses.

Configuration Examples for Smart Licensing

The following sections provide various Smart Licensing configuration examples.

Example: Viewing the Call Home Profile

Example

To display the Call Home profile, use the **show call-home profile all** command:

```
Device> enable
Device# show call-home profile all
Profile Name: CiscoTAC-1
    Profile status: ACTIVE
    Profile mode: Full Reporting
    Reporting Data: Smart Call Home, Smart Licensing
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: http
    HTTP  address(es): https://tools.cisco.com/its/service/oddce/services/DDCEService
    Other address(es): default

    Periodic configuration info message is scheduled every 1 day of the month at 09:15

    Periodic inventory info message is scheduled every 1 day of the month at 09:00

    Alert-group               Severity
    ------------------------  ------------
    crash                     debug
    diagnostic                minor
    environment               warning
    inventory                 normal

    Syslog-Pattern            Severity
    ------------------------  ------------
    APF-.-WLC_.*              warning
    .*                        major
```

Example: Viewing the License Information Before Registering

Example

To display the license entitlements, use the **show license all** command:

```
Device> enable
Device# show license all
Smart Licensing Status
```

```
======================

Smart Licensing is ENABLED

Registration:
  Status: UNREGISTERED
  Export-Controlled Functionality: Not Allowed

License Authorization:
  Status: EVAL MODE
  Evaluation Period Remaining: 88 days, 21 hours, 58 minutes, 12 seconds

License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Not started
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

License Usage
==============

(C3850-24 DNA Essentials):
  Description:
  Count: 3
  Version: 1.0
  Status: EVAL MODE

(C3850-24 LAN Base):
  Description:
  Count: 3
  Version: 1.0
  Status: EVAL MODE

Product Information
===================
UDI: PID:WS-C3850-24P,SN:FOC1842U0FC

HA UDI List:
    Active:PID:WS-C3850-24P,SN:FOC1842U0FC
    Standby:PID:WS-C3850-24P,SN:FOC1842U0CZ
    Member:PID:WS-C3850-24P,SN:FOC1842X0FD

Agent Version
=============
Smart Agent for Licensing: 4.4.13_rel/116
Component Versions: SA:(1_3_dev)1.0.15, SI:(dev22)1.2.1, CH:(rel5)1.0.3, PK:(dev18)1.0.3

Reservation Info
```

```
================
License reservation: DISABLED
```

Example

To display the license usage information, use the **show license usage** command:

```
Device> enable
Device# show license usage
License Authorization:
  Status: EVAL MODE
  Evaluation Period Remaining: 88 days, 21 hours, 57 minutes, 31 seconds

(C3850-24 DNA Essentials):
  Description:
  Count: 3
  Version: 1.0
  Status: EVAL MODE

(C3850-24 LAN Base):
  Description:
  Count: 3
  Version: 1.0
  Status: EVAL MODE
```

Example

To display all the license summaries, use the **show license summary** command:

```
Device> enable
Device# show license summary
Smart Licensing is ENABLED

Registration:
  Status: UNREGISTERED
  Export-Controlled Functionality: Not Allowed

License Authorization:
  Status: EVAL MODE
  Evaluation Period Remaining: 88 days, 21 hours, 57 minutes, 23 seconds

License Usage:
  License                 Entitlement tag              Count Status
  -----------------------------------------------------------------------------
                          (C3850-24 DNA Essentials)        3 EVAL MODE
                          (C3850-24 LAN Base)              3 EVAL MODE
```

Example

To display the license status information, use the **show license status** command:

```
Device> enable
Device# show license status
Smart Licensing is ENABLED

Utility:
```

```
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

Registration:
  Status: UNREGISTERED
  Export-Controlled Functionality: Not Allowed

License Authorization:
  Status: EVAL MODE
  Evaluation Period Remaining: 88 days, 21 hours, 57 minutes, 15 seconds

License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Not started
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started
```

Example: Registering a Device

Example

To register a device, use the **license smart register idtoken** command:

```
Device> enable
Device# license smart register idtoken
Tl4UytrNXBzbEs1ck8veUtWaG5abnZJOFdDa1FwbVRa%0AblRMbz0%3D%0A
Device# write memory
```

Example: Viewing the License Status After Registering

After registration, but before license conversion, a device is not authorized to use the perpetual license, and its status will be shown as Out Of Compliance.

Example

To display the license entitlements, use the **show license all** command:

```
Device> enable
Device# show license all
Smart Licensing Status
======================

Smart Licensing is ENABLED
```

```
Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Initial Registration: SUCCEEDED on Jul 09 10:08:19 2018 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:19 2019 UTC
  Registration Expires: Jul 09 10:02:35 2019 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC
  Last Communication Attempt: SUCCEEDED on Jul 09 10:08:25 2018 UTC
  Next Communication Attempt: Jul 09 22:08:24 2018 UTC
  Communication Deadline: Oct 07 10:02:43 2018 UTC

License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Not started
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

License Usage
==============

C3850-DNA-E-24 (C3850-24 DNA Essentials):
  Description: C3850-DNA-E
  Count: 3
  Version: 1.0
  Status: AUTHORIZED

C3850_24_Lanbase (C3850-24 LAN Base):
  Description: C3850 24 Port Lanbase
  Count: 3
  Version: 1.0
  Status: OUT OF COMPLIANCE

Product Information
===================
UDI: PID:WS-C3850-24P,SN:FOC1842U0FC

HA UDI List:
    Active:PID:WS-C3850-24P,SN:FOC1842U0FC
    Standby:PID:WS-C3850-24P,SN:FOC1842U0CZ
    Member:PID:WS-C3850-24P,SN:FOC1842X0FD

Agent Version
=============
Smart Agent for Licensing: 4.4.13_rel/116
```

```
Component Versions: SA:(1_3_dev)1.0.15, SI:(dev22)1.2.1, CH:(rel5)1.0.3, PK:(dev18)1.0.3

Reservation Info
================
License reservation: DISABLED
```

Example

To display license usage information, use the **show license usage** command:

```
Device> enable
Device# show license usage
License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC

C3850-DNA-E-24 (C3850-24 DNA Essentials):
  Description: C3850-DNA-E
  Count: 3
  Version: 1.0
  Status: AUTHORIZED

C3850_24_Lanbase (C3850-24 LAN Base):
  Description: C3850 24 Port Lanbase
  Count: 3
  Version: 1.0
  Status: OUT OF COMPLIANCE
```

Example

To display all the license summaries, use the **show license summary** command:

```
Device> enable
Device# show license summary
Smart Licensing is ENABLED

Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:19 2019 UTC

License Authorization:
  Status: OUT OF COMPLIANCE
  Last Communication Attempt: SUCCEEDED
  Next Communication Attempt: Jul 09 22:08:24 2018 UTC

License Usage:
  License                 Entitlement tag               Count Status
  -----------------------------------------------------------------------------
  C3850-DNA-E-24          (C3850-24 DNA Essentials)         3 AUTHORIZED
  C3850_24_Lanbase        (C3850-24 LAN Base)               3 OUT OF COMPLIANCE
```

Example

To display the license status information, use the **show license status** command:

```
Device> enable
Device# show license status
Smart Licensing is ENABLED

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Initial Registration: SUCCEEDED on Jul 09 10:08:19 2018 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:20 2019 UTC
  Registration Expires: Jul 09 10:02:36 2019 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC
  Last Communication Attempt: SUCCEEDED on Jul 09 10:08:25 2018 UTC
  Next Communication Attempt: Jul 09 22:08:25 2018 UTC
  Communication Deadline: Oct 07 10:02:44 2018 UTC

License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Not started
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started
```

Example: Migrating License Using License Conversion

Note Use the **license smart conversion start** command only for migrating license information of Cisco Catalyst 3650 and Cisco Catalyst 3850 Switch upgraded to Cisco IOS XE Fuji 16.9.1.

License conversion takes an hour or more to complete.

To start license conversion use the **license smart conversion start** command.

```
Device> enable
Device# license smart conversion start
```

Example: Viewing License Information on Initiating License Conversion

Example

To display the license usage information, use the **show license usage** command:

```
Device> enable
Device# show license usage
License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC

C3850-DNA-E-24 (C3850-24 DNA Essentials):
  Description: C3850-DNA-E
  Count: 3
  Version: 1.0
  Status: AUTHORIZED

C3850_24_Lanbase (C3850-24 LAN Base):
  Description: C3850 24 Port Lanbase
  Count: 3
  Version: 1.0
  Status: OUT OF COMPLIANCE
```

Example

To display the license status information, use the **show license status** command:

```
Device> enable
Device# show license status
Smart Licensing is ENABLED

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Initial Registration: SUCCEEDED on Jul 09 10:08:19 2018 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:19 2019 UTC
  Registration Expires: Jul 09 10:02:35 2019 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 09 10:08:25 2018 UTC
  Last Communication Attempt: SUCCEEDED on Jul 09 10:14:50 2018 UTC
  Next Communication Attempt: Jul 09 22:14:49 2018 UTC
  Communication Deadline: Oct 07 10:09:08 2018 UTC
```

```
License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Polling on Jul 09 10:16:01 2018 UTC
  Next response check: Jul 09 11:16:05 2018 UTC
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Not started
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Not started
```

Example: Viewing the License Status After License Conversion

After license conversion is completed, the device is authorized to use the perpetual license and the status will change to Authorized.

Example

To display license usage information, use the **show license usage** command:

```
Device> enable
Device# show license usage
License Authorization:
  Status: AUTHORIZED on Jul 09 11:16:10 2018 UTC

C3850-DNA-E-24 (C3850-24 DNA Essentials):
  Description: C3850-DNA-E
  Count: 3
  Version: 1.0
  Status: AUTHORIZED

C3850_24_Lanbase (C3850-24 LAN Base):
  Description: C3850 24 Port Lanbase
  Count: 3
  Version: 1.0
  Status: AUTHORIZED
```

Example

To display the license status information, use the **show license status** command:

```
Device> enable
Device# show license status
Smart Licensing is ENABLED

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
    Callhome hostname privacy: DISABLED
    Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome
```

```
Registration:
  Status: REGISTERED
  Smart Account: Smart Account Name
  Virtual Account: Virtual Account 1
  Export-Controlled Functionality: Allowed
  Initial Registration: SUCCEEDED on Jul 09 10:08:19 2018 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 05 10:08:19 2019 UTC
  Registration Expires: Jul 09 10:02:35 2019 UTC

License Authorization:
  Status: AUTHORIZED on Jul 09 11:16:10 2018 UTC
  Last Communication Attempt: SUCCEEDED on Jul 09 11:16:10 2018 UTC
  Next Communication Attempt: Aug 08 11:16:09 2018 UTC
  Communication Deadline: Oct 07 11:10:28 2018 UTC

License Conversion:
  Automatic Conversion Enabled: False
  Active: PID:WS-C3850-24P,SN:FOC1842U0FC
  Status: Successful on Jul 09 11:16:06 2018 UTC
  Standby: PID:WS-C3850-24P,SN:FOC1842U0CZ
  Status: Successful on Jul 09 11:16:06 2018 UTC
  Member: PID:WS-C3850-24P,SN:FOC1842X0FD
  Status: Successful on Jul 09 11:16:06 2018 UTC
```

Additional References

Related Documents

Related Topic	Document Title
Cisco Smart Software Manager Help	Smart Software Manager Help
Cisco Smart Software Manager On-Prem	Cisco Smart Software Manager On-Prem
Configuring Call Home service	Smart Call Home Guide

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature Information for Smart Licensing

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 7: Feature Information for Smart Licensing

CHAPTER 5

Configuring Application Visibility and Control in a Wired Network

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

Information About Application Visibility and Control in a Wired Network

Application Visibility and Control (AVC) is a critical part of Cisco's efforts to evolve its Branch and Campus solutions from being strictly packet and connection based to being application-aware and application-intelligent. Application Visibility and Control (AVC) classifies applications using deep packet inspection techniques with the Network-Based Application Recognition (NBAR2) engine. AVC can be configured on wired access ports for standalone switches as well as for a switch stack. NBAR2 can be activated either explicitly on the interface by enabling protocol-discovery or implicitly by attaching a QoS policy that contains **match protocol** classifier. Wired AVC Flexible NetFlow (FNF) can be configured on an interface to provide client, server and application statistics per interface. The record is similar to **application-client-server-stats** traffic monitor which is available in **application-statistics** and **application-performance** profiles in Easy Performance Monitor (Easy perf-mon or ezPM).

Supported AVC Class Map and Policy Map Formats

Supported AVC Class Map Format

Class Map Format	Class Map Example	Direction
match protocol *protocol name*	`class-map match-any NBAR-VOICE` `match protocol ms-lync-audio`	Both ingress and egress

Combination filters	`class-map match-any NBAR-VOICE`
	`match protocol ms-lync-audio`
	`match dscp ef`
		Both ingress and egress

Supported AVC Policy Format

Policy Format	QoS Action
Egress policy based on match protocol filter	Mark and police
Ingress policy based on match protocol filter	Mark and police

The following table describes the detailed AVC policy format with an example:

AVC Policy Format	AVC Policy Example	Direction

Basic set	`policy-map MARKING-IN`
	`class NBAR-MM_CONFERENCING`
	`set dscp af41`
		Ingress and egress

Basic police	`policy-map POLICING-IN`
	`class NBAR-MM_CONFERENCING`
	`police cir 600000`
	`set dscp af41`
		Ingress and egress

Basic set and police	`policy-map webex-policy`
	`class webex-class`
	`set dscp ef`
	`cos police 5000000`
		Ingress and egress

Multiple set and police including default	`policy-map webex-policy`
	`class webex-class`
	`set dscp af31`
	`cos police 4000000`
	`class class-webex-category`
	`set dscp ef`
	`cos police 6000000`
	`class class-default`
	`set dscp <>`
		Ingress and egress

AVC Policy Format	AVC Policy Example	Direction

Hierarchical police	`policy-map webex-policy`
	` class webex-class`
	` police 5000000`
	` service-policy client-in-police-only`
	
	` policy-map client-in-police-only`
	` class webex-class`
	` police 100000`
	` class class-webex-category`
	` set dscp ef`
	` cos police 200000`
		Ingress and egress

Hierarchical set and police	`policy-map webex-policy`
	` class class-default`
	` police 1500000`
	` service policy client-up-child`
	` policy-map webex-policy`
	` class webex-class`
	` police 100000`
	` set dscp ef`
	` class class-webex-category`
	` police 200000`
	` set dscp af31`	

Restrictions for Wired Application Visibility and Control

- NBAR based QoS policy configuration is allowed only on wired physical ports. Policy configuration is not supported on virtual interfaces, for example, VLAN, Port-Channel and other logical interfaces.
- Only one of the NBAR based QoS mechanisms are allowed to be attached to any port at the same time, either protocol based or attributes based. Only the following two attributes are supported :
    - traffic-class
    - business-relevance
- The legacy WDAVC QoS limitations are still applicable:
    - Only marking and policing are supported.
    - Supports only physical interfaces.
    - There is a delay in the QoS classification since the application classification is done offline (while the initial packet/s of the flow are meanwhile forwarded before the correct QoS classification).
- NBAR2 based match criteria **match protocol** will be allowed only with marking or policing actions. NBAR2 match criteria will not be allowed in a policy that has queuing features configured.
- ‘Match Protocol’: up to 255 concurrent different protocols in all policies (8 bits HW limitation).
- AVC is not supported on management port (Gig 0/0).
- IPv6 packet classification is not supported.

- Only IPv4 unicast(TCP/UDP) is supported.
- Web UI: You can configure application visibility and perform application monitoring from the Web UI. Application Control can only be done using the CLI. It is not supported on the Web UI.

  To manage and check wired AVC traffic on the Web UI, you must first configure **ip http authentication local** and **ip nbar http-service** commands using the CLI.
- NBAR and ACL logging cannot be configured together on the same switch.
- Wired AVC is not supported on LAN Base license.
- Protocol-discovery, application-based QoS, and wired AVC FNF cannot be configured together at the same time on the same interface with the non-application-based FNF. However, these wired AVC features can be configured with each other. For example, protocol-discovery, application-based QoS and wired AVC FNF can be configured together on the same interface at the same time.
- Up to two wired AVC monitors with dfifferent records can be attached to an interface at the same time. Prior to Cisco IOS XE Fuji 16.9.1, only a single predefined record was supported with wired AVC FNF.
- Attachment should be done only on physical Layer2 (Access/Trunk) and Layer3 ports. Uplink can be attached as long as it is a single uplink and is not part of a port channel.
- Performance: Each switch member is able to handle 500 connections per second (CPS) at less than 50% CPU utilization.
- Scale: Able to handle up to 10,000 bi-directional flows per 48 access ports and 5000 bi-directional flows per 24 access ports. (~200 flows per access port).

How to Configure Application Visibility and Control

Configuring Application Visibility and Control in a Wired Network

To configure application visibility and control on wired ports, follow these steps:

Configuring Visibility :

- Activate NBAR2 engine by enabling protocol-discovery on the interface using the **ip nbar protocol-discovery** command in the interface configuration mode. See the *Enabling Application Recognition on an Interface* section.

Configuring Control : Configure QoS policies based on application by

1. Creating an AVC QoS policy.
2. Applying AVC QoS policy to the interface.

Configuring application-based Flexible Netflow :

- Create a flow record by specifying key and non-key fields to the flow.
- Create a flow exporter to export the flow record.
- Create a flow monitor based on the flow record and the flow exporter.

- Attach the flow monitor to the interface.

Protocol-Discovery, application-based QoS and application-based FNF are all independent features. They can be configured independently or together on the same interface at the same time.

Enabling Application Recognition on an interface

To enable application recognition on an interface, follow these steps:

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip nbar protocol-discovery**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	Specifies the interface for which you are enabling protocol-discovery and enters interface configuration mode.
Step 3	**ip nbar protocol-discovery** **Example:** `Device(config-if)# ip nbar protocol-discovery`	Enables application recognition on the interface by activating NBAR2 engine.
Step 4	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Creating AVC QoS Policy

To create AVC QoS policy, perform these general steps:

1. Create a class map with match protocol filters.
2. Create a policy map.

3. Apply the policy map to the interface.

Creating a Class Map

You need to create a class map before configuring any match protocol filter. The QoS actions such as marking and policing can be applied to the traffic. The AVC match protocol filters are applied to the wired access ports. For more information about the protocols that are supported, see http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos_nbar/prot_lib/config_library/nbar-prot-pack-library.html.

SUMMARY STEPS

1. **configure terminal**
2. **class-map** *class-map-name*
3. **match protocol** *application-name*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**class-map** *class-map-name* **Example:** `Device(config)# class-map webex-class`	Creates a class map.

Step 3	**match protocol** *application-name*
	Example:
	`Device(config)# class-map webex-class`
	`Device(config-cmap)# match protocol webex-media`
		Specifies match to the application name.

Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Creating a Policy Map

SUMMARY STEPS

1. **configure terminal**
2. **policy-map** *policy-map-name*
3. **class** [*class-map-name* | **class-default**]
4. **police** *rate-bps burst-byte*
5. **set** {**dscp** *new-dscp* | **cos** *cos-value*}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**policy-map** *policy-map-name* **Example:** `Device(config)# policy-map webex-policy`	Creates a policy map by entering the policy map name, and enters policy-map configuration mode. By default, no policy maps are defined. The default behavior of a policy map is to set the DSCP to 0 if the packet is an IP packet and to set the CoS to 0 if the packet is tagged. No policing is performed. **Note** To delete an existing policy map, use the **no policy-map** *policy-map-name* global configuration command.
Step 3	**class** [*class-map-name* | **class-default**] **Example:** `Device(config-pmap)# class webex-class`	Defines a traffic classification, and enters policy-map class configuration mode. By default, no policy map and class maps are defined. If a traffic class has already been defined by using the **class-map** global configuration command, specify its name for *class-map-name* in this command. A **class-default** traffic class is predefined and can be added to any policy. It is always placed at the end of a policy map. With an implied **match any** is included in the **class-default** class, all packets that have not already matched the other traffic classes will match **class-default**. **Note** To delete an existing class map, use the **no class** *class-map-name* policy-map configuration command.
Step 4	**police** *rate-bps burst-byte* **Example:** `Device(config-pmap-c)# police 100000 80000`	Defines a policer for the classified traffic. By default, no policer is defined. • For *rate-bps*, specify an average traffic rate in bits per second (b/s). The range is 8000 to 10000000000. • For *burst-byte,* specify the normal burst size in bytes. The range is 8000 to 1000000.
Step 5	**set** {**dscp** *new-dscp* | **cos** *cos-value*} **Example:** `Device(config-pmap-c)# set dscp 45`	Classifies IP traffic by setting a new value in the packet. • For **dscp** *new-dscp*, enter a new DSCP value to be assigned to the classified traffic. The range is 0 to 63.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Applying a QoS Policy to the switch port

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **service-policy input** *policymapname*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface Gigabitethernet 1/0/1`	Enters the interface configuration mode.
Step 3	**service-policy input** *policymapname* **Example:** `Device(config-if)# service-policy input MARKING_IN`	Applies local policy to interface.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Creating Attribute-based QoS (EasyQoS) Policy

Legacy wired AVC QoS defines classes based on specific NBAR protocols using the command **match protocol** *nbar-protocol-name*. This requires explicitly defining match statements and hence TCAM entries per relevant protocol. The number of match statements per class is limited, and specifically that the overall number of protocols that may be matched is limited to 255. These limitations in addition to the fact that relevant supported protocols might change between protocol pack releases, further jeopardizes the usefulness of QoS which is based on specific NBAR protocols.

To accommodate practically equivalent functionality, a much more useful and efficient, QoS NBAR defines a set of attributes that each protocol is classified to (with defaults, which may be overwritten in CLI as described further in this chapter), e.g. business-relevance and traffic-class. QoS classes and policies may be defined based on such general NBAR attributes instead of specific protocols.

Starting with Cisco IOS XE Fuji 16.8.1a, support for defining QoS classes and policies based on such NBAR attributes is available, with a few limitations.

A class map can be defined according to certain NBAR attributes, using match-all or match-any, and a policy-map can be defined based on such a class-map. This policy-map can be attached to wired ports. Such classes and policies may be intermixed with other legacy match operations (e.g. packet fields, ACLs, etc.). Following are the limitations for defining class maps and policy maps.

Creating a Class Map

SUMMARY STEPS

1. **configure terminal**
2. **[no] class-map** {**match-all** | **match-any** }
3. **match protocol attribute** *attribute-type attribute-value*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**[no] class-map** {**match-all** | **match-any** }	Creates a class map with NBAR attributes.
Step 3	**match protocol attribute** *attribute-type attribute-value*	Configures the specified protocol attribute as the match criterion.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Creating a Policy Map

SUMMARY STEPS

1. **configure terminal**
2. **[no] policy-map** *policy-map-name*
3. **[no] class** {*class-map-name* | **class-default**}
4. **police** *rate-bps burst-byte*
5. **set** {**dscp** *new-dscp* | **cos** *cos-value*}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**[no] policy-map** *policy-map-name*	Creates a policy map based on a class-map based on NBAR attributes.
Step 3	**[no] class** {*class-map-name* | **class-default**} **Example:** `Device(config-pmap)# class webex-class`	Defines a traffic classification, and enters policy-map class configuration mode. By default, no policy map and class maps are defined. If a traffic class has already been defined by using the **class-map** global configuration command, specify its name for *class-map-name* in this command.
Step 4	**police** *rate-bps burst-byte* **Example:** `Device(config-pmap-c)# police 100000 80000`	Defines a policer for the classified traffic. By default, no policer is defined. • For *rate-bps*, specify an average traffic rate in bits per second (b/s). The range is 8000 to 10000000000. • For *burst-byte,* specify the normal burst size in bytes. The range is 8000 to 1000000.
Step 5	**set** {**dscp** *new-dscp* | **cos** *cos-value*} **Example:** `Device(config-pmap-c)# set dscp 45`	Classifies IP traffic by setting a new value in the packet. • For **dscp** *new-dscp*, enter a new DSCP value to be assigned to the classified traffic. The range is 0 to 63.
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Applying a QoS Policy to the switch port

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **service-policy {input | output}** *policy-map-name*
4. **end**
5. **show class-map**
6. **show policy-map interface**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface Gigabitethernet 1/0/1`	Enters the interface configuration mode.
Step 3	**service-policy {input | output}** *policy-map-name* **Example:** `Device(config-if)# service-policy input MARKING_IN`	Applies local policy to interface.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 5	**show class-map** **Example:** `Device# show class-map`	Displays the class maps.
Step 6	**show policy-map interface** **Example:** `Device# show policy-map interface`	Displays the statistics status and the configured policy map on all the interfaces.

Creating NBAR Attribute Map

SUMMARY STEPS

1. **configure terminal**
2. **[no] ip nbar** *attribute-map attribute-map-name*
3. **[no] attribute** *attribute-type attribute-value*
4. **[no] ip nbar attribute-set** *protocol-name attribute-map-name*
5. **end**
6. **show ip nbar attribute**
7. **show ip nbar protocol-attribute**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**[no] ip nbar** *attribute-map attribute-map-name*	Enters attribute configuration mode.
Step 3	**[no] attribute** *attribute-type attribute-value*	Defines an attribute-map that can be applied to specific protocols, in order to override their default attribute settings.
Step 4	**[no] ip nbar attribute-set** *protocol-name attribute-map-name*	Sets an attribute map to a specific protocol to override their default attribute settings.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 6	**show ip nbar attribute**	Displays overall attributes information.
Step 7	**show ip nbar protocol-attribute**	Displays the current protocol attribute settings.

Rules in the EasyQoS Policy Map

There are 24 rules in the EasyQoS policy map:

- 11 rules for the 10 Business Relevant Queues and Scavenger for applications that NBAR does not support and are defined through ACL.
- 11 rules for the 10 Business Relevant Queues and scavenger for NBAR defined through a combination of attributes.
- **class-default** to mark all the rest as DSCP 0.

Configuring Wired AVC Flexible Netflow

Creating a Flow Record

Wired AVC FNF supports two types of predefined flow records — Legacy Bidirectional flow records and Directional flow records (ingress and egress). A total of four different predefined flow records, two bidirectional flow records and two directional flow records, can be configured and associated with a flow monitor. The legacy bidirectional records are client/server application statistics records, and the new directional records are application-stats for input/output.

- Bidirectional Flow Records, on page 128
- Directional Flow Records, on page 135

Bidirectional Flow Records

Flow Record 1 - Bidirectional Flow Record

SUMMARY STEPS

1. **configure terminal**
2. **flow record** *flow_record_name*
3. **description** *description*
4. **match ipv4 version**
5. **match ipv4 protocol**
6. **match application name**
7. **match connection client ipv4 address**
8. **match connection server ipv4 address**
9. **match connection server transport port**
10. **match flow observation point**
11. **collect flow direction**
12. **collect connection initiator**
13. **collect connection new-connections**
14. **collect connection client counter packets long**
15. **collect connection client counter bytes network long**
16. **collect connection server counter packets long**
17. **collect connection server counter bytes network long**
18. **collect timestamp absolute first**
19. **collect timestamp absolute last**
20. **end**
21. **show flow record**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow record** *flow_record_name* **Example:** `Device(config)# flow record fr-wdavc-1`	Enters flow record configuration mode.
Step 3	**description** *description* **Example:** `Device(config-flow-record)# description fr-wdavc-1`	(Optional) Creates a description for the flow record.
Step 4	**match ipv4 version** **Example:** `Device (config-flow-record)# match ipv4 version`	Specifies a match to the IP version from the IPv4 header.
Step 5	**match ipv4 protocol** **Example:**	Specifies a match to the IPv4 protocol.

	Command or Action	Purpose
	Device (config-flow-record)# **match ipv4 protocol**	
Step 6	**match application name** **Example:** Device (config-flow-record)# **match application name**	Specifies a match to the application name. **Note** This action is mandatory for AVC support, as this allows the flow to be matched against the application.
Step 7	**match connection client ipv4 address** **Example:** Device (config-flow-record)# **match connection client ipv4 address**	Specifies a match to the IPv4 address of the client (flow initiator).
Step 8	**match connection server ipv4 address** **Example:** Device (config-flow-record)# **match connection server ipv4 address**	Specifies a match to the IPv4 address of the server (flow responder).
Step 9	**match connection server transport port** **Example:** Device (config-flow-record)# **match connection server transport port**	Specifies a match to the transport port of the server.
Step 10	**match flow observation point** **Example:** Device (config-flow-record)# **match flow observation point**	Specifies a match to the observation point ID for flow observation metrics.
Step 11	**collect flow direction** **Example:** Device (config-flow-record)# **collect flow direction**	Specifies to collect the direction — Ingress or Egress — of the relevant side — Initiator or Responder — of the bi-directional flow that is specified by the **initiator** keyword in the **collect connection initiator** command in the step below. Depending on the value specified by the **initiator** keyword, the **flow direction** keyword takes the following values : • 0x01 = Ingress Flow • 0x02 = Egress Flow When the **initiator** keyword is set to initiator, the flow direction is specified from the initiator side of the flow. When the initiator keyword is set to responder, the flow direction is specified from the responder side of the flow. For wired AVC, the **initiator** keyword is always set to initiator.
Step 12	**collect connection initiator** **Example:**	Specifies to collect the side of the flow — Initiator or Responder — relevant to the direction of the flow specified by the **collect flow direction** command. The **initiator**

	Command or Action	Purpose
	`Device (config-flow-record)# collect connection initiator`	keyword provides the following information about the direction of the flow : • 0x01 = Initiator - the flow source is the initiator of the connection For wired AVC, the **initiator** keyword is always set to initiator.
Step 13	**collect connection new-connections** **Example:** `Device (config-flow-record)# collect connection new-connections`	Specifies to collect the number of connection initiations observed.
Step 14	**collect connection client counter packets long** **Example:** `Device (config-flow-record)# collect connection client counter packets long`	Specifies to collect the number of packets sent by the client.
Step 15	**collect connection client counter bytes network long** **Example:** `Device (config-flow-record)# collect connection client counter bytes network long`	Specifies to collect the total number of bytes transmitted by the client.
Step 16	**collect connection server counter packets long** **Example:** `Device (config-flow-record)# collect connection server counter packets long`	Specifies to collect the number of packets sent by the server.
Step 17	**collect connection server counter bytes network long** **Example:** `Device (config-flow-record)# collect connection server counter bytes network long`	Specifies to collect the total number of bytes transmitted by the server.
Step 18	**collect timestamp absolute first** **Example:** `Device (config-flow-record)# collect timestamp absolute first`	Specifies to collect the time, in milliseconds, when the first packet was seen in the flow.
Step 19	**collect timestamp absolute last** **Example:** `Device (config-flow-record)# collect timestamp absolute last`	Specifies to collect the time, in milliseconds, when the most recent packet was seen in the flow.
Step 20	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

	Command or Action	Purpose
Step 21	**show flow record** **Example:** `Device # show flow record`	Displays information about all the flow records.

Flow Record 2 - Bidirectional Flow Record

SUMMARY STEPS

1. **configure terminal**
2. **flow record** *flow_record_name*
3. **description** *description*
4. **match ipv4 version**
5. **match ipv4 protocol**
6. **match application name**
7. **match connection client ipv4 address**
8. **match connection client transport port**
9. **match connection server ipv4 address**
10. **match connection server transport port**
11. **match flow observation point**
12. **collect flow direction**
13. **collect connection initiator**
14. **collect connection new-connections**
15. **collect connection client counter packets long**
16. **collect connection client counter bytes network long**
17. **collect connection server counter packets long**
18. **collect connection server counter bytes network long**
19. **collect timestamp absolute first**
20. **collect timestamp absolute last**
21. **end**
22. **show flow record**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow record** *flow_record_name* **Example:** `Device(config)# flow record fr-wdavc-1`	Enters flow record configuration mode.

	Command or Action	Purpose
Step 3	**description** *description* **Example:** `Device(config-flow-record)# description fr-wdavc-1`	(Optional) Creates a description for the flow record.
Step 4	**match ipv4 version** **Example:** `Device (config-flow-record)# match ipv4 version`	Specifies a match to the IP version from the IPv4 header.
Step 5	**match ipv4 protocol** **Example:** `Device (config-flow-record)# match ipv4 protocol`	Specifies a match to the IPv4 protocol.
Step 6	**match application name** **Example:** `Device (config-flow-record)# match application name`	Specifies a match to the application name. **Note** This action is mandatory for AVC support, as this allows the flow to be matched against the application.
Step 7	**match connection client ipv4 address** **Example:** `Device (config-flow-record)# match connection client ipv4 address`	Specifies a match to the IPv4 address of the client (flow initiator).
Step 8	**match connection client transport port** **Example:** `Device (config-flow-record)# match connection client transport port`	(Optional) Specifies a match to the connection port of the client as a key field for a flow record.
Step 9	**match connection server ipv4 address** **Example:** `Device (config-flow-record)# match connection server ipv4 address`	Specifies a match to the IPv4 address of the server (flow responder).
Step 10	**match connection server transport port** **Example:** `Device (config-flow-record)# match connection server transport port`	Specifies a match to the transport port of the server.
Step 11	**match flow observation point** **Example:** `Device (config-flow-record)# match flow observation point`	Specifies a match to the observation point ID for flow observation metrics.
Step 12	**collect flow direction** **Example:**	Specifies to collect the direction — Ingress or Egress — of the relevant side — Initiator or Responder — of the bi-directional flow that is specified by the **initiator**

	Command or Action	Purpose
	`Device (config-flow-record)# collect flow direction`	keyword in the **collect connection initiator** command in the step below. Depending on the value specified by the **initiator** keyword, the **flow direction** keyword takes the following values : • 0x01 = Ingress Flow • 0x02 = Egress Flow When the **initiator** keyword is set to initiator, the flow direction is specified from the initiator side of the flow. When the initiator keyword is set to responder, the flow direction is specified from the responder side of the flow. For wired AVC, the **initiator** keyword is always set to initiator.
Step 13	**collect connection initiator** **Example:** `Device (config-flow-record)# collect connection initiator`	Specifies to collect the side of the flow — Initiator or Responder — relevant to the direction of the flow specified by the **collect flow direction** command. The **initiator** keyword provides the following information about the direction of the flow : • 0x01 = Initiator - the flow source is the initiator of the connection For wired AVC, the **initiator** keyword is always set to initiator.
Step 14	**collect connection new-connections** **Example:** `Device (config-flow-record)# collect connection new-connections`	Specifies to collect the number of connection initiations observed.
Step 15	**collect connection client counter packets long** **Example:** `Device (config-flow-record)# collect connection client counter packets long`	Specifies to collect the number of packets sent by the client.
Step 16	**collect connection client counter bytes network long** **Example:** `Device (config-flow-record)# collect connection client counter bytes network long`	Specifies to collect the total number of bytes transmitted by the client.
Step 17	**collect connection server counter packets long** **Example:** `Device (config-flow-record)# collect connection server counter packets long`	Specifies to collect the number of packets sent by the server.
Step 18	**collect connection server counter bytes network long** **Example:**	Specifies to collect the total number of bytes transmitted by the server.

	Command or Action	Purpose
	`Device (config-flow-record)# collect connection server counter bytes network long`	
Step 19	**collect timestamp absolute first** **Example:** `Device (config-flow-record)# collect timestamp absolute first`	Specifies to collect the time, in milliseconds, when the first packet was seen in the flow.
Step 20	**collect timestamp absolute last** **Example:** `Device (config-flow-record)# collect timestamp absolute last`	Specifies to collect the time, in milliseconds, when the most recent packet was seen in the flow.
Step 21	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 22	**show flow record** **Example:** `Device # show flow record`	Displays information about all the flow records.

Directional Flow Records

Flow Record 3 - Directional Flow Record - Ingress

SUMMARY STEPS

1. **configure terminal**
2. **flow record** *flow_record_name*
3. **description** *description*
4. **match ipv4 version**
5. **match ipv4 protocol**
6. **match ipv4 source address**
7. **match ipv4 destination address**
8. **match transport source-port**
9. **match transport destination-port**
10. **match interface input**
11. **match application name**
12. **collect interface output**
13. **collect counter bytes long**
14. **collect counter packets long**
15. **collect timestamp absolute first**
16. **collect timestamp absolute last**
17. **end**
18. **show flow record**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow record** *flow_record_name* **Example:** `Device(config)# flow record fr-wdavc-3`	Enters flow record configuration mode.
Step 3	**description** *description* **Example:** `Device(config-flow-record)# description flow-record-1`	(Optional) Creates a description for the flow record.
Step 4	**match ipv4 version** **Example:** `Device (config-flow-record)# match ipv4 version`	Specifies a match to the IP version from the IPv4 header.
Step 5	**match ipv4 protocol** **Example:** `Device (config-flow-record)# match ipv4 protocol`	Specifies a match to the IPv4 protocol.
Step 6	**match ipv4 source address** **Example:** `Device (config-flow-record)# match ipv4 source address`	Specifies a match to the IPv4 source address as a key field.
Step 7	**match ipv4 destination address** **Example:** `Device (config-flow-record)# match ipv4 destination address`	Specifies a match to the IPv4 destination address as a key field.
Step 8	**match transport source-port** **Example:** `Device (config-flow-record)# match transport source-port`	Specifies a match to the transport source port as a key field.
Step 9	**match transport destination-port** **Example:** `Device (config-flow-record)# match transport destination-port`	Specifies a match to the transport destination port as a key field.
Step 10	**match interface input** **Example:**	Specifies a match to the input interface as a key field.

	Command or Action	Purpose
	Device (config-flow-record)# **match interface input**	
Step 11	**match application name** **Example:** `Device (config-flow-record)# match application name`	Specifies a match to the application name. **Note** This action is mandatory for AVC support, as this allows the flow to be matched against the application.
Step 12	**collect interface output** **Example:** `Device (config-flow-record)# collect interface output`	Specifies to collect the output interface from the flows.
Step 13	**collect counter bytes long** **Example:** `Device (config-flow-record)# collect counter bytes long`	Specifies to collect the number of bytes in a flow.
Step 14	**collect counter packets long** **Example:** `Device (config-flow-record)# collect counter packets long`	Specifies to collect the number of packets in a flow.
Step 15	**collect timestamp absolute first** **Example:** `Device (config-flow-record)# collect timestamp absolute first`	Specifies to collect the time, in milliseconds, when the first packet was seen in the flow.
Step 16	**collect timestamp absolute last** **Example:** `Device (config-flow-record)# collect timestamp absolute last`	Specifies to collect the time, in milliseconds, when the most recent packet was seen in the flow.
Step 17	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 18	**show flow record** **Example:** `Device # show flow record`	Displays information about all the flow records.

Flow Record 4 - Directional Flow Record - Egress

SUMMARY STEPS

1. **configure terminal**

2. **flow record** *flow_record_name*
3. **description** *description*
4. **match ipv4 version**
5. **match ipv4 protocol**
6. **match ipv4 source address**
7. **match ipv4 destination address**
8. **match transport source-port**
9. **match transport destination-port**
10. **match interface output**
11. **match application name**
12. **collect interface input**
13. **collect counter bytes long**
14. **collect counter packets long**
15. **collect timestamp absolute first**
16. **collect timestamp absolute last**
17. **end**
18. **show flow record**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow record** *flow_record_name* **Example:** `Device(config)# flow record fr-wdavc-4`	Enters flow record configuration mode.
Step 3	**description** *description* **Example:** `Device(config-flow-record)# description flow-record-1`	(Optional) Creates a description for the flow record.
Step 4	**match ipv4 version** **Example:** `Device (config-flow-record)# match ipv4 version`	Specifies a match to the IP version from the IPv4 header.
Step 5	**match ipv4 protocol** **Example:** `Device (config-flow-record)# match ipv4 protocol`	Specifies a match to the IPv4 protocol.
Step 6	**match ipv4 source address** **Example:** `Device (config-flow-record)# match ipv4 source address`	Specifies a match to the IPv4 source address as a key field.

	Command or Action	Purpose
Step 7	**match ipv4 destination address** **Example:** `Device (config-flow-record)# match ipv4 destination address`	Specifies a match to the IPv4 destination address as a key field.
Step 8	**match transport source-port** **Example:** `Device (config-flow-record)# match transport source-port`	Specifies a match to the transport source port as a key field.
Step 9	**match transport destination-port** **Example:** `Device (config-flow-record)# match transport destination-port`	Specifies a match to the transport destination port as a key field.
Step 10	**match interface output** **Example:** `Device (config-flow-record)# match interface output`	Specifies a match to the output interface as a key field.
Step 11	**match application name** **Example:** `Device (config-flow-record)# match application name`	Specifies a match to the application name. **Note** This action is mandatory for AVC support, as this allows the flow to be matched against the application.
Step 12	**collect interface input** **Example:** `Device (config-flow-record)# collect interface input`	Specifies to collect the input interface from the flows.
Step 13	**collect counter bytes long** **Example:** `Device (config-flow-record)# collect counter bytes long`	Specifies to collect the number of bytes in a flow.
Step 14	**collect counter packets long** **Example:** `Device (config-flow-record)# collect counter packets long`	Specifies to collect the number of packets in a flow.
Step 15	**collect timestamp absolute first** **Example:** `Device (config-flow-record)# collect timestamp absolute first`	Specifies to collect the time, in milliseconds, when the first packet was seen in the flow.

	Command or Action	Purpose
Step 16	**collect timestamp absolute last** **Example:** `Device (config-flow-record)# collect timestamp absolute last`	Specifies to collect the time, in milliseconds, when the most recent packet was seen in the flow.
Step 17	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 18	**show flow record** **Example:** `Device # show flow record`	Displays information about all the flow records.

Creating a Flow Exporter

You can create a flow exporter to define the export parameters for a flow.

SUMMARY STEPS

1. **configure terminal**
2. **flow exporter** *flow_exporter_name*
3. **description** *description*
4. **destination** { *hostname* | *ipv4-address* | *ipv6-address* }
5. **option application-table** [**timeout** *seconds*]
6. **end**
7. **show flow exporter**
8. **show flow exporter statistics**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow exporter** *flow_exporter_name* **Example:** `Device(config)# flow exporter flow-exporter-1`	Enters flow exporter configuration mode.
Step 3	**description** *description* **Example:** `Device(config-flow-exporter)# description flow-exporter-1`	(Optional) Creates a description for the flow exporter.

	Command or Action	Purpose
Step 4	**destination** { *hostname* | *ipv4-address* | *ipv6-address* } **Example:** `Device (config-flow-exporter)# destination 10.10.1.1`	Specifies the hostname, IPv4 or IPv6 address of the system to which the exporter sends data.
Step 5	**option application-table** [**timeout** *seconds*] **Example:** `Device (config-flow-exporter)# option application-table timeout 500`	(Optional) Configures the application table option for the flow exporter. The **timeout** option configures the resend time in seconds for the flow exporter. The valid range is from 1 to 86400 seconds.
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 7	**show flow exporter** **Example:** `Device # show flow exporter`	Displays information about all the flow exporters.
Step 8	**show flow exporter statistics** **Example:** `Device # show flow exporter statistics`	Displays flow exporter statistics.

Creating a Flow Monitor

You can create a flow monitor and associate it with a flow record.

SUMMARY STEPS

1. **configure terminal**
2. **flow monitor** *monitor-name*
3. **description** *description*
4. **record** *record-name*
5. **exporter** *exporter-name*
6. **cache** { **entries** *number-of-entries* | **timeout** {**active** | **inactive**} | **type normal** }
7. **end**
8. **show flow monitor**
9. **show flow monitor** *flow-monitor-name*
10. **show flow monitor** *flow-monitor-name* **statistics**
11. **clear flow monitor** *flow-monitor-name* **statistics**
12. **show flow monitor** *flow-monitor-name* **cache format table**
13. **show flow monitor** *flow-monitor-name* **cache format record**
14. **show flow monitor** *flow-monitor-name* **cache format csv**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**flow monitor** *monitor-name* **Example:** `Device (config)# flow monitor flow-monitor-1`	Creates a flow monitor and enters flow monitor configuration mode.
Step 3	**description** *description* **Example:** `Device (config-flow-monitor)# description flow-monitor-1`	(Optional) Creates a description for the flow monitor.
Step 4	**record** *record-name* **Example:** `Device (config-flow-monitor)# record flow-record-1`	Specifies the name of a record that was created previously.
Step 5	**exporter** *exporter-name* **Example:** `Device (config-flow-monitor)# exporter flow-exporter-1`	Specifies the name of an exporter that was created previously.

Step 6	**cache** { **entries** *number-of-entries* | **timeout** {**active** | **inactive**} | **type normal** }
	Example:
	`Device (config-flow-monitor)# cache timeout active 1800`
	Example:
	`Device (config-flow-monitor)# cache timeout inactive 200`
	Example:
	`Device (config-flow-monitor)# cache type normal`
		(Optional) Specifies to configure flow cache parameters.
		• **entries** *number-of-entries* — Specifies the maximum number of flow entries in the flow cache in the range from 16 to 65536.
		Note Only normal cache type is supported.

Step 7	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 8	**show flow monitor** **Example:** `Device # show flow monitor`	Displays information about all the flow monitors.
Step 9	**show flow monitor** *flow-monitor-name* **Example:**	Displays information about the specified wired AVC flow monitor.

	Command or Action	Purpose
	Device # **show flow monitor flow-monitor-1**	
Step 10	**show flow monitor** *flow-monitor-name* **statistics** **Example:** `Device# show flow monitor flow-monitor-1 statistics`	Displays statistics for wired AVC flow monitor.
Step 11	**clear flow monitor** *flow-monitor-name* **statistics** **Example:** `Device# clear flow monitor flow-monitor-1 statistics`	Clears the statistics of the specified flow monitor. Use the **show flow monitor flow-monitor-1 statistics** command after using the **clear flow monitor flow-monitor-1 statistics** to verify that all the statistics have been reset.
Step 12	**show flow monitor** *flow-monitor-name* **cache format table** **Example:** `Device# show flow monitor flow-monitor-1 cache format table`	Displays flow cache contents in a tabular format.
Step 13	**show flow monitor** *flow-monitor-name* **cache format record** **Example:** `Device# show flow monitor flow-monitor-1 cache format record`	Displays flow cache contents in similar format as the flow record.
Step 14	**show flow monitor** *flow-monitor-name* **cache format csv** **Example:** `Device# show flow monitor flow-monitor-1 cache format csv`	Displays flow cache contents in CSV format.

Associating Flow Monitor to an interface

You can attach two different wired AVC monitors with different predefined records to an interface at the same time.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip flow monitor** *monitor-name* { **input** | **output** }
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface Gigabitethernet 1/0/1`	Enters the interface configuration mode.
Step 3	**ip flow monitor** *monitor-name* { **input** | **output** } **Example:** `Device (config-if) # ip flow monitor flow-monitor-1 input`	Associates a flow monitor to the interface for input and/or output packets.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

NBAR2 Custom Applications

NBAR2 supports the use of custom protocols to identify custom applications. Custom protocols support protocols and applications that NBAR2 does not currently support.

In every deployment, there are local and specific applications which are not covered by the NBAR2 protocol pack provided by Cisco. Local applications are mainly categorized as:

- Specific applications to an organization
- Applications specific to a geography

NBAR2 provides a way to manually customize such local applications. You can manually customize applications using the command **ip nbar custom** *myappname* in global configuration mode. Custom applications take precedence over built-in protocols. For each custom protocol, user can define a selector ID that can be used for reporting purposes.

There are various types of application customization:

Generic protocol customization

- HTTP
- SSL
- DNS

Composite : Customization based on multiple underlying protocols – **server-name**

Layer3/Layer4 customization

- IPv4 address
- DSCP values
- TCP/UDP ports
- Flow source or destination direction

Byte Offset : Customization based on specific byte values in the payload

HTTP Customization

HTTP customization could be based on a combination of HTTP fields from:

- **cookie** - HTTP Cookie
- **host** - Host name of Origin Server containing resource
- **method** - HTTP method
- **referrer** - Address the resource request was obtained from
- **url** - Uniform Resource Locator path
- **user-agent** - Software used by agent sending the request
- **version** - HTTP version
- **via** - HTTP via field

HTTP Customization

Custom application called MYHTTP using the HTTP host "*mydomain.com" with Selector ID 10.

```
Device# configure terminal
Device(config)# ip nbar custom MYHTTP http host *mydomain.com id 10
```

SSL Customization

Customization can be done for SSL encrypted traffic using information extracted from the SSL Server Name Indication (SNI) or Common Name (CN).

SSL Customization

Custom application called MYSSL using SSL unique-name "mydomain.com" with selector ID 11.

```
Device# configure terminal
Device(config)#ip nbar custom MYSSL ssl unique-name *mydomain.com id 11
```

DNS Customization

NBAR2 examines DNS request and response traffic, and can correlate the DNS response to an application. The IP address returned from the DNS response is cached and used for later packet flows associated with that specific application.

The command **ip nbar custom** *application-name* **dns** *domain-name* **id** *application-id* is used for DNS customization. To extend an existing application, use the command **ip nbar custom** *application-name* **dns domain-name** *domain-name* **extends** *existing-application*.

For more information on DNS based customization, see http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos_nbar/configuration/xe-3s/asr1000/qos-nbar-xe-3s-asr-1000-book/nbar-custapp-dns-xe.html .

DNS Customization

Custom application called MYDNS using the DNS domain name "mydomain.com" with selector ID 12.

```
Device# configure terminal
Device(config)# ip nbar custom MYDNS dns domain-name *mydomain.com id 12
```

Composite Customization

NBAR2 provides a way to customize applications based on domain names appearing in HTTP, SSL or DNS.

Composite Customization

Custom application called MYDOMAIN using HTTP, SSL or DNS domain name "mydomain.com" with selector ID 13.

```
Device# configure terminal
Device(config)# ip nbar custom MYDOMAIN composite server-name *mydomain.com id 13
```

L3/L4 Customization

Layer3/Layer4 customization is based on the packet tuple and is always matched on the first packet of a flow.

L3/L4 Customization

Custom application called LAYER4CUSTOM matching IP addresses 10.56.1.10 and 10.56.1.11, TCP and DSCP ef with selector ID 14.

```
Device# configure terminal
Device(config)# ip nbar custom LAYER4CUSTOM transport tcp id 14
Device(config-custom)# ip address 10.56.1.10 10.56.1.11
Device(config-custom)# dscp ef
```

Examples: Monitoring Custom Applications

Show Commands for Monitoring Custom Applications

show ip nbar protocol-id | inc Custom

```
Device# show ip nbar  protocol-id | inc Custom
LAYER4CUSTOM             14            Custom
MYDNS                    12            Custom
MYDOMAIN                 13            Custom
MYHTTP                   10            Custom
MYSSL                    11            Custom
```

show ip nbar protocol-discovery protocol *CUSTOM_APP*

```
WSW-157# show ip nbar  protocol-id MYSSL
Protocol Name             id            type
----------------------------------------------
MYSSL                    11            Custom
```

NBAR2 Dynamic Hitless Protocol Pack Upgrade

Protocol packs are software packages that update the NBAR2 protocol support on a device without replacing the Cisco software on the device. A protocol pack contains information on applications officially supported by NBAR2 which are compiled and packed together. For each application, the protocol-pack includes information on application signatures and application attributes. Each software release has a built-in protocol-pack bundled with it.

Protocol packs provide the following features:

- They are easy and fast to load.
- They are easy to upgrade to a higher version protocol pack or revert to a lower version protocol pack.
- They do not require the switch to be reloaded.

NBAR2 protocol packs are available for download on Cisco Software Center from this URL: https://software.cisco.com/download/navigator.html .

Prerequisites for the NBAR2 Protocol Pack

Before loading a new protocol pack, you must copy the protocol pack to the flash on all the switch members.

To load a protocol pack, see Examples: Loading the NBAR2 Protocol Pack, on page 148 .

Loading the NBAR2 Protocol Pack

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar protocol-pack** *protocol-pack* [**force**]
4. **exit**
5. **show ip nbar protocol-pack** {protocol-pack | **active**} [**detail**]

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	**ip nbar protocol-pack** *protocol-pack* [**force**] **Example:**	Loads the protocol pack. • Use the **force** keyword to specify and load a protocol pack of a lower version, which is different from the

	Command or Action	Purpose

	`Device(config)# ip nbar protocol-pack flash:defProtoPack`
	Example:
	`Device(config)# default ip nbar protocol-pack`
		base protocol pack version. This also removes the configuration that is not supported by the current protocol pack on the switch.
		For reverting to the built-in protocol pack, use the following command:

Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show ip nbar protocol-pack** {protocol-pack | **active**} [**detail**] **Example:** `Device# show ip nbar protocol-pack active`	Displays the protocol pack information. • Verify the loaded protocol pack version, publisher, and other details using this command. • Use the *protocol-pack* argument to display information about the specified protocol pack. • Use the **active** keyword to display active protocol pack information. • Use the **detail** keyword to display detailed protocol pack information.

Examples: Loading the NBAR2 Protocol Pack

The following example shows how to load a new protocol pack:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar protocol-pack flash:newDefProtoPack
Device(config)# exit
```

The following example shows how to use the **force** keyword to load a protocol pack of a lower version:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar protocol-pack flash:OldDefProtoPack force
Device(config)# exit
```

The following example shows how to revert to the built-in protocol pack:

```
Device> enable
Device# configure terminal
Device(config)# default ip nbar protocol-pack
Device(config)# exit
```

Monitoring Application Visibility and Control

Monitoring Application Visibility and Control (CLI)

This section describes the new commands for application visibility.

The following commands can be used to monitor application visibility on the and access ports.

Table 8: Monitoring Application Visibility Commands on the

Command	Purpose
show ip nbar protocol-discovery [**interface** *interface-type interface-number*] [**stats**{**byte-count** | **bit-rate** | **packet-count** | **max-bit-rate**}] [**protocol** *protocol-name* | **top-n** *number*]	Displays the statistics gathered by the NBAR Protocol Discovery feature. • (Optional) Enter keywords and arguments to fine-tune the statistics displayed. For more information on each of the keywords, refer to the **show ip nbar protocol-discovery**command in Cisco IOS Quality of Service Solutions Command Reference.
show policy-map interface *interface-type interface-number*	Displays information about policy map applied to the interface.
show platform software fed switch *switch id* **wdavc flows**	Displays statistics about all flows on the specified switch.

Examples: Application Visibility and Control

Examples: Application Visibility and Control Configuration

This example shows how to create class maps with apply match protocol filters for application name:

```
Device# configure terminal
Device(config)# class-map match-any NBAR-VOICE
Device(config-cmap)# match protocol ms-lync-audio
Device(config-cmap)#end
```

This example shows how to create policy maps and define existing class maps for egress QoS:

```
Device# configure terminal
Device(config)# policy-map test-avc-up
Device(config-pmap)# class cat-browsing
Device(config-pmap-c)# police 150000
Device(config-pmap-c)# set dscp 12
Device(config-pmap-c)#end
```

This example shows how to create policy maps and define existing class maps for ingress QoS:

```
Device# configure terminal
Device(config)# policy-map test-avc-down
Device(config-pmap)# class cat-browsing
```

```
Device(config-pmap-c)# police 200000
Device(config-pmap-c)# set dscp 10
Device(config-pmap-c)#end
```

This example shows how to apply policy maps to a switch port:

```
Device# configure terminal
Device(config)# interface GigabitEthernet 1/0/1
Device(config-if)# switchport mode access
Device(config-if)# switchport access vlan 20
Device(config-if)# service-policy input POLICING_IN
Device(config-if)#end
```

This example shows how to create class maps based on NBAR attributes.

```
Device# configure terminal
Device(config)# class-map match-all rel-relevant
Device(config-cmap)# match protocol attribute business-relevance business-relevant

Device(config)# class-map match-all rel-irrelevant
Device(config-cmap)# match protocol attribute business-relevance business-irrelevant

Device(config)# class-map match-all rel-default
Device(config-cmap)# match protocol attribute business-relevance default

Device(config)# class-map match-all class--ops-admin-and-rel
Device(config-cmap)# match protocol attribute traffic-class ops-admin-mgmt
Device(config-cmap)# match protocol attribute business-relevance business-relevant
```

This example shows how to create policy maps based on class maps based on NBAR attributes.

```
Device# configure terminal
Device(config)# policy-map attrib--rel-types
Device(config-pmap)# class rel-relevant
Device(config-pmap-c)# set dscp ef
Device(config-pmap-c)# class rel-irrelevant
Device(config-pmap-c)# set dscp af11
Device(config-pmap-c)# class rel-default
Device(config-pmap-c)# set dscp default

Device(config)# policy-map attrib--ops-admin-and-rel
Device(config-pmap)# class class--ops-admin-and-rel
Device(config-pmap-c)# set dscp cs5
```

This example shows how to attach a policy map based on NBAR attributes to a wired port:

```
Device# configure terminal
Device(config)# interface GigabitEthernet1/0/2
Device(config-if)# service-policy input attrib--rel-types
```

Show Commands for Viewing the Configuration

show ip nbar protocol-discovery

Displays a report of the Protocol Discovery statistics per interface.

The following is a sample output for the statistics per interface:

```
Deviceqos-cat9k-reg2-r1# show ip nbar protocol-discovery int GigabitEthernet1/0/1


GigabitEthernet1/0/1
Last clearing of "show ip nbar protocol-discovery" counters 00:03:16
```

```
                                  Input
Output
                                  -----
------
Protocol                          Packet Count
Packet Count
                                  Byte Count
Byte Count
                                  30sec Bit Rate (bps)
30sec Bit Rate (bps)
                                  30sec Max Bit Rate (bps)
30sec Max Bit Rate (bps)
------------------------ ------------------------
---------------------------------------------------
ms-lync                           60580
55911
                                  31174777
28774864
                                  3613000
93000
                                  3613000
3437000
Total                             60580
55911
                                  31174777
28774864
                                  3613000
93000
                                  3613000
3437000
```

show policy-map interface

Displays the QoS statistics and the configured policy maps on all interfaces.

The following is a sample output for the policy-maps configured on all the interfaces:

```
Deviceqos-cat9k-reg2-r1# show policy-map int


GigabitEthernet1/0/1
 Service-policy input: MARKING-IN

   Class-map: NBAR-VOICE (match-any)
     718 packets
     Match: protocol ms-lync-audio
       0 packets, 0 bytes
       30 second rate 0 bps
     QoS Set
       dscp ef

   Class-map: NBAR-MM_CONFERENCING (match-any)
     6451 packets
     Match: protocol ms-lync
```

```
      0 packets, 0 bytes
      30 second rate 0 bps
    Match: protocol ms-lync-video
      0 packets, 0 bytes
      30 second rate 0 bps
    QoS Set
      dscp af41

  Class-map: class-default (match-any)
    34 packets
    Match: any
```

Show Commands for Viewing Attributes-based QoS Configuration

show policy-map interface

Displays the attribute-based QoS statistics and the configured policy maps on all interfaces.

The following is a sample output for the policy-maps configured on all the interfaces:

```
Device# show policy-map interface gigabitEthernet 1/0/2
 GigabitEthernet1/0/2

  Service-policy input: attrib--rel-types

    Class-map: rel-relevant (match-all)
      20 packets
      Match: protocol attribute business-relevance business-relevant
      QoS Set
        dscp ef

    Class-map: rel-irrelevant (match-all)
      0 packets
      Match: protocol attribute business-relevance business-irrelevant
      QoS Set
        dscp af11

    Class-map: rel-default (match-all)
      14 packets
      Match: protocol attribute business-relevance default
      QoS Set
        dscp default

    Class-map: class-default (match-any)
      0 packets
      Match: any
```

show ip nbar protocol-attribute

Displays all the protocol attributes used by NBAR.

The following shows sample output for some of the attributes:

```
Device# show ip nbar protocol-attribute cisco-jabber-im
          Protocol Name : cisco-jabber-im
               encrypted : encrypted-yes
```

```
                 tunnel : tunnel-no
               category : voice-and-video
           sub-category : enterprise-media-conferencing
      application-group : cisco-jabber-group
         p2p-technology : p2p-tech-no
          traffic-class : transactional-data
     business-relevance : business-relevant
        application-set : collaboration-apps
```

```
Device# show ip nbar protocol-attribute google-services
          Protocol Name : google-services
              encrypted : encrypted-yes
                 tunnel : tunnel-no
               category : other
           sub-category : other
      application-group : google-group
         p2p-technology : p2p-tech-yes
          traffic-class : transactional-data
     business-relevance : default
        application-set : general-browsing
```

```
Device# show ip nbar protocol-attribute dns
          Protocol Name : google-services
              encrypted : encrypted-yes
                 tunnel : tunnel-no
               category : other
           sub-category : other
      application-group : google-group
         p2p-technology : p2p-tech-yes
          traffic-class : transactional-data
     business-relevance : default
        application-set : general-browsing
```

```
Device# show ip nbar protocol-attribute unknown
          Protocol Name : unknown
              encrypted : encrypted-no
                 tunnel : tunnel-no
               category : other
           sub-category : other
      application-group : other
         p2p-technology : p2p-tech-no
          traffic-class : bulk-data
     business-relevance : default
        application-set : general-misc
```

Show Commands for Viewing Flow Monitor Configuration

show flow monitor wdavc

Displays information about the specified wired AVC flow monitor.

```
Device # show flow monitor wdavc

Flow Monitor wdavc:
  Description:       User defined
```

```
  Flow Record:       wdavc
  Flow Exporter:     wdavc-exp (inactive)
  Cache:
    Type:                 normal (Platform cache)
    Status:               not allocated
    Size:                 12000 entries
    Inactive Timeout:     15 secs
    Active Timeout:       1800 secs
```

show flow monitor wdavc statistics

Displays statistics for wired AVC flow monitor.

```
Device# show flow monitor wdavc statistics
  Cache type:                               Normal (Platform cache)
  Cache size:                                12000
  Current entries:                              13

  Flows added:                                  26
  Flows aged:                                   13
    - Active timeout      (  1800 secs)          1
    - Inactive timeout    (    15 secs)         12
```

clear flow monitor wdavc statistics

Clears the statistics of the specified flow monitor. Use the **show flow monitor wdavc statistics** command after using the **clear flow monitor wdavc statistics** to verify that all the statistics have been reset. The following is a sample output of the **show flow monitor wdavc statistics** command after clearing flow monitor statistics.

```
Device# show flow monitor wdavc statistics
  Cache type:                               Normal (Platform cache)
  Cache size:                                12000
  Current entries:                               0

  Flows added:                                   0
  Flows aged:                                    0
```

Show Commands for Viewing Cache Contents

show flow monitor wdavc cache format table

Displays flow cache contents in a tabular format.

```
Device# show flow monitor wdavc cache format table
  Cache type:                               Normal (Platform cache)
  Cache size:                                12000
  Current entries:                              13

  Flows added:                                  26
  Flows aged:                                   13
    - Active timeout      (  1800 secs)          1
    - Inactive timeout    (    15 secs)         12

CONN IPV4 INITIATOR ADDR  CONN IPV4 RESPONDER ADDR  CONN RESPONDER PORT
 FLOW OBSPOINT ID  IP VERSION  IP PROT  APP NAME                     flow
```

```
 dirn ..................
------------------------  ------------------------  -------------------
 ----------------  ----------  -------  ---------------------------
---------
64.103.125.147            144.254.71.184                              53
       4294967305          4       17  port dns                    Input
     ....................
64.103.121.103            10.1.1.2                                    67
       4294967305          4       17  layer7 dhcp                 Input
     ....contd...........
64.103.125.3              64.103.125.97                               68
       4294967305          4       17  layer7 dhcp                 Input
     ....................
10.0.2.6                  157.55.40.149                              443
       4294967305          4        6  layer7 ms-lync              Input
     ....................
64.103.126.28             66.163.36.139                              443
       4294967305          4        6  layer7 cisco-jabber-im      Input
     ....contd...........
64.103.125.2              64.103.125.29                               68
       4294967305          4       17  layer7 dhcp                 Input
     ....................
64.103.125.97             64.103.101.181                              67
       4294967305          4       17  layer7 dhcp                 Input
     ....................
192.168.100.6             10.10.20.1                                5060
       4294967305          4       17  layer7 cisco-jabber-control  Input
     ....contd...........
64.103.125.3              64.103.125.29                               68
       4294967305          4       17  layer7 dhcp                 Input
     ....................
10.80.101.18              10.80.101.6                               5060
       4294967305          4        6  layer7 cisco-collab-control  Input
     ....................
10.1.11.4                 66.102.11.99                                80
       4294967305          4        6  layer7 google-services      Input
     ....contd...........
64.103.125.2              64.103.125.97                               68
       4294967305          4       17  layer7 dhcp                 Input
     ....................
64.103.125.29             64.103.101.181                              67
       4294967305          4       17  layer7 dhcp                 Input
     ....................
```

show flow monitor wdavc cache format record

Displays flow cache contents in similar format as the flow record.

```
Device# show flow monitor wdavc cache format record
  Cache type:                               Normal (Platform cache)
  Cache size:                                12000
  Current entries:                              13
```

```
  Flows added:                                     26
  Flows aged:                                      13
    - Active timeout      (  1800 secs)             1
    - Inactive timeout    (    15 secs)            12

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.147
CONNECTION IPV4 RESPONDER ADDRESS:        144.254.71.184
CONNECTION RESPONDER PORT:                53
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         port dns
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:46.917
connection initiator:                     Initiator
connection count new:                     2
connection server packets counter:        1
connection client packets counter:        1
connection server network bytes counter:  190
connection client network bytes counter:  106

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.121.103
CONNECTION IPV4 RESPONDER ADDRESS:        10.1.1.2
CONNECTION RESPONDER PORT:                67
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     1
connection server packets counter:        0
connection client packets counter:        1
connection server network bytes counter:  0
connection client network bytes counter:  350

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.3
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.125.97
CONNECTION RESPONDER PORT:                68
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:53.917
connection initiator:                     Initiator
connection count new:                     1
```

```
connection server packets counter:        0
connection client packets counter:        4
connection server network bytes counter:  0
connection client network bytes counter:  1412

CONNECTION IPV4 INITIATOR ADDRESS:        10.0.2.6
CONNECTION IPV4 RESPONDER ADDRESS:        157.55.40.149
CONNECTION RESPONDER PORT:                443
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              6
APPLICATION NAME:                         layer7 ms-lync
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:46.917
connection initiator:                     Initiator
connection count new:                     2
connection server packets counter:        10
connection client packets counter:        14
connection server network bytes counter:  6490
connection client network bytes counter:  1639

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.126.28
CONNECTION IPV4 RESPONDER ADDRESS:        66.163.36.139
CONNECTION RESPONDER PORT:                443
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              6
APPLICATION NAME:                         layer7 cisco-jabber-im
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:46.917
connection initiator:                     Initiator
connection count new:                     2
connection server packets counter:        12
connection client packets counter:        10
connection server network bytes counter:  5871
connection client network bytes counter:  2088

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.2
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.125.29
CONNECTION RESPONDER PORT:                68
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     1
```

```
connection server packets counter:        0
connection client packets counter:        2
connection server network bytes counter:  0
connection client network bytes counter:  712

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.97
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.101.181
CONNECTION RESPONDER PORT:                67
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     1
connection server packets counter:        0
connection client packets counter:        1
connection server network bytes counter:  0
connection client network bytes counter:  350

CONNECTION IPV4 INITIATOR ADDRESS:        192.168.100.6
CONNECTION IPV4 RESPONDER ADDRESS:        10.10.20.1
CONNECTION RESPONDER PORT:                5060
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 cisco-jabber-control
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:46.917
connection initiator:                     Initiator
connection count new:                     1
connection server packets counter:        0
connection client packets counter:        2
connection server network bytes counter:  0
connection client network bytes counter:  2046

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.3
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.125.29
CONNECTION RESPONDER PORT:                68
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     1
```

```
connection server packets counter:       0
connection client packets counter:       2
connection server network bytes counter:  0
connection client network bytes counter:  712

CONNECTION IPV4 INITIATOR ADDRESS:        10.80.101.18
CONNECTION IPV4 RESPONDER ADDRESS:        10.80.101.6
CONNECTION RESPONDER PORT:                5060
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              6
APPLICATION NAME:                         layer7 cisco-collab-control
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     2
connection server packets counter:        23
connection client packets counter:        27
connection server network bytes counter:  12752
connection client network bytes counter:  8773

CONNECTION IPV4 INITIATOR ADDRESS:        10.1.11.4
CONNECTION IPV4 RESPONDER ADDRESS:        66.102.11.99
CONNECTION RESPONDER PORT:                80
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              6
APPLICATION NAME:                         layer7 google-services
flow direction:                           Input
timestamp abs first:                      08:55:46.917
timestamp abs last:                       08:55:46.917
connection initiator:                     Initiator
connection count new:                     2
connection server packets counter:        3
connection client packets counter:        5
connection server network bytes counter:  1733
connection client network bytes counter:  663

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.2
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.125.97
CONNECTION RESPONDER PORT:                68
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:53.917
connection initiator:                     Initiator
connection count new:                     1
```

```
connection server packets counter:        0
connection client packets counter:        4
connection server network bytes counter:  0
connection client network bytes counter:  1412

CONNECTION IPV4 INITIATOR ADDRESS:        64.103.125.29
CONNECTION IPV4 RESPONDER ADDRESS:        64.103.101.181
CONNECTION RESPONDER PORT:                67
FLOW OBSPOINT ID:                         4294967305
IP VERSION:                               4
IP PROTOCOL:                              17
APPLICATION NAME:                         layer7 dhcp
flow direction:                           Input
timestamp abs first:                      08:55:47.917
timestamp abs last:                       08:55:47.917
connection initiator:                     Initiator
connection count new:                     1
connection server packets counter:        0
connection client packets counter:        1
connection server network bytes counter:  0
connection client network bytes counter:  350
```

show flow monitor wdavc cache format csv

Displays flow cache contents in CSV format.

```
Device# show flow monitor wdavc cache format csv
  Cache type:                                   Normal (Platform cache)
  Cache size:                                    12000
  Current entries:                                  13

  Flows added:                                      26
  Flows aged:                                       13
    - Active timeout      (  1800 secs)              1
    - Inactive timeout    (    15 secs)             12

CONN IPV4 INITIATOR ADDR,CONN IPV4 RESPONDER ADDR,CONN RESPONDER PORT,FLOW
 OBSPOINT ID,IP VERSION,IP
PROT,APP NAME,flow dirn,time abs first,time abs last,conn initiator,conn
 count new,conn server packets
cnt,conn client packets cnt,conn server network bytes cnt,conn client
network bytes cnt
64.103.125.147,144.254.71.184,53,4294967305,4,17,port
dns,Input,08:55:46.917,08:55:46.917,Initiator,2,1,1,190,106
64.103.121.103,10.1.1.2,67,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:47.917,Initiator,1,0,1,0,350
64.103.125.3,64.103.125.97,68,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:53.917,Initiator,1,0,4,0,1412
10.0.2.6,157.55.40.149,443,4294967305,4,6,layer7 ms-
lync,Input,08:55:46.917,08:55:46.917,Initiator,2,10,14,6490,1639
64.103.126.28,66.163.36.139,443,4294967305,4,6,layer7 cisco-jabber-
im,Input,08:55:46.917,08:55:46.917,Initiator,2,12,10,5871,2088
64.103.125.2,64.103.125.29,68,4294967305,4,17,layer7
```

```
dhcp,Input,08:55:47.917,08:55:47.917,Initiator,1,0,2,0,712
64.103.125.97,64.103.101.181,67,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:47.917,Initiator,1,0,1,0,350
192.168.100.6,10.10.20.1,5060,4294967305,4,17,layer7 cisco-jabber-
control,Input,08:55:46.917,08:55:46.917,Initiator,1,0,2,0,2046
64.103.125.3,64.103.125.29,68,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:47.917,Initiator,1,0,2,0,712
10.80.101.18,10.80.101.6,5060,4294967305,4,6,layer7 cisco-collab-
control,Input,08:55:46.917,08:55:47.917,Initiator,2,23,27,12752,8773
10.1.11.4,66.102.11.99,80,4294967305,4,6,layer7 google-
services,Input,08:55:46.917,08:55:46.917,Initiator,2,3,5,1733,663
64.103.125.2,64.103.125.97,68,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:53.917,Initiator,1,0,4,0,1412
64.103.125.29,64.103.101.181,67,4294967305,4,17,layer7
dhcp,Input,08:55:47.917,08:55:47.917,Initiator,1,0,1,0,350
```

Basic Troubleshooting(Questions and Answers)

Following are the basic questions and answers for troubleshooting wired Application Visibility and Control:

1. **Question:** My IPv6 traffic is not being classified.

   Answer: Currently only IPv4 traffic is supported.

2. **Question:** My multicast traffic is not being classified

   Answer: Currently only unicast traffic is supported

3. **Question:** I send ping but I don’t see them being classified

   Answer: Only TCP/UDP protocols are supported

4. **Question:** Why can’t I attach NBAR to an SVI?

   Answer: NBAR is only supported on physical interfaces.

5. **Question:** I see that most of my traffic is CAPWAP traffic, why?

   Answer: Make sure that you have enabled NBAR on an access port that is not connected to a wireless access port. All traffic coming from APs will be classified as capwap. Actual classification in this case happens either on the AP or WLC.

6. **Question:** In protocol-discovery, I see traffic only on one side. Along with that, there are a lot of unknown traffic.

   Answer: This usually indicates that NBAR sees asymmetric traffic: one side of the traffic is classified in one switch member and the other on a different member. The recommendation is to attach NBAR only on access ports where we see both sides of the traffic. If you have multiple uplinks, you can’t attach NBAR on them due to this issue. Similar issue happens if you configure NBAR on an interface that is part of a port channel.

7. **Question:** With protocol-discovery, I see an aggregate view of all application. How can I see traffic distribution over time?

   Answer: WebUI will give you view of traffic over time for the last 48 hours.

8. **Question:** I can't configure queue-based egress policy with **match protocol** *protocol-name* command.

   Answer: Only **shape** and **set DSCP** are supported in a policy with NBAR2 based classifiers. Common practice is to set DSCP on ingress and perform shaping on egress based on DSCP.

9. **Question:** I don't have NBAR2 attached to any interface but I still see that NBAR2 is activated.

   Answer: If you have any class-map with **match protocol** *protocol-name*, NBAR will be globally activated on the stack but no traffic will be subjected to NBAR classification. This is an expected behavior and it does not consume any resources.

10. **Question:** I see some traffic under the default QOS queue. Why?

    Answer: For each new flow, it takes a few packets to classify it and install the result in the hardware. During this time, the classification would be 'unknown' and traffic will fall under the default queue.

Additional References for Application Visibility and Control

Related Documents

Related Topic	Document Title
QoS	*NBAR Configuration Guide, Cisco IOS XE Release 16 .x*
NBAR2 Protocol Pack Hitless Upgrade	*NBAR Configuration Guide, Cisco IOS XE Release 16.x*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information For Application Visibility and Control in a Wired Network

Release	Feature Information
Cisco IOS XE Denali 16.3.2	Wired AVC Flexible NetFlow (FNF) — The feature uses a flow record with an application name as the key, to provide client, server and application statistics, per interface.
Cisco IOS XE Denali 16.3.1	This feature was introduced.

CHAPTER 6

Configuring SDM Templates

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Configuring SDM Templates

SDM Templates

You can use SDM templates to configure system resources to optimize support for specific features, depending on how your device is used in the network. You can select a template to provide maximum system usage for some functions.

These templates are supported on your device:

- Advanced—The advanced template is available on all supported images for this release. It maximizes system resources for features like netflow, multicast groups, security ACEs, QoS ACEs, and so on.

- VLAN—The VLAN template is available only on the LAN Base license. The VLAN template disables routing and supports the maximum number of unicast MAC addresses. It would typically be selected for a Layer 2 device.

After you change the template and the system reboots, you can use the **show sdm prefer** privileged EXEC command to verify the new template configuration. If you enter the **show sdm prefer** command before you enter the **reload** privileged EXEC command, the **show sdm prefer** command shows the template currently in use and the template that will become active after a reload.

The default is the advanced template.

Table 9: Approximate Number of Feature Resources Allowed by Templates

Resource	Advanced	VLAN
Number of VLANs	4094	4094
Unicast MAC addresses	32 K	32 K
Overflow unicast MAC addresses	512	512
IGMP groups and multicast routes	4 K	4 K
Overflow IGMP groups and multicast routes	512	512
• Directly connected routes	16K	16 K
• Indirectly connected IP hosts	7 K	7 K
Policy-based routing ACEs	1024	0
QoS classification ACEs	3 K	3 K
Security ACEs	3 K	3 K
Netflow ACEs	1024	1024
Input Microflow policer ACEs:	256 K	0
Output Microflow policer ACEs:	256 K	0
FSPAN ACEs	256	256
Tunnels:	256	0
Control Plane Entries:	512	512
Input Netflow flows:	8 K	8 K
Output Netflow flows:	16 K	16 K
SGT/DGT entries:	4 K	4 K
SGT/DGT Overflow entries:	0	512

Note SDM templates do not create VLANs. You must create the VLANs before adding commands to the SDM templates.

The tables represent approximate hardware boundaries set when a template is selected. If a section of a hardware resource is full, all processing overflow is sent to the CPU, seriously impacting switch performance.

SDM Templates and Switch Stacks

In a switch stack, all stack members must use the same SDM template that is stored on the active switch. When a new switch is added to a stack, the SDM configuration that is stored on the active switch overrides the template configured on an individual switch.

You can use the **show switch** privileged EXEC command to see if any stack members are in SDM mismatch mode.

How to Configure SDM Templates

Configuring SDM Templates

Configuring the Switch SDM Template

Setting the SDM Template

Follow these steps to use the SDM template to maximize feature usage:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **sdm prefer** { **advanced** | **vlan** }
4. **end**
5. **reload**

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	**sdm prefer** { **advanced** | **vlan** } **Example:**	Specifies the SDM template to be used on the switch. The keywords have these meanings:

	Command or Action	Purpose
	`Device(config)# sdm prefer advanced`	• **advanced** —Supports advanced features such as Netflow. • **vlan** —Maximizes VLAN configuration on the switch with no routing supported in hardware. **Note** The **no sdm prefer** command and a default template is not supported.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**reload** **Example:** `Device# reload`	Reloads the operating system.

Monitoring and Maintaining SDM Templates

Command	Purpose
show sdm prefer	Displays the SDM template in use.
reload	Reloads the switch to activate the newly configured SDM template.
no sdm prefer	Sets the default SDM template.

Note The SDM templates contain only those commands that are defined as part of the templates. If a template enables another related command that is not defined in the template, then this other command will be visible when the **show running config** command is entered. For example, if the SDM template enables the **switchport voice vlan** command, then the **spanning-tree portfast edge** command may also be enabled (although it is not defined on the SDM template).

If the SDM template is removed, then other such related commands are also removed and have to be reconfigured explicitly.

Configuration Examples for SDM Templates

Examples: Configuring SDM Templates

Examples: Displaying SDM Templates

This is an example output showing the advanced template information:

```
Device# show sdm prefer

Showing SDM Template Info

This is the Advanced template.
  Number of VLANs:                                  4094
  Unicast MAC addresses:                            32768
  Overflow Unicast MAC addresses:                   512
  IGMP and Multicast groups:                        8192
  Overflow IGMP and Multicast groups:               512
  Directly connected routes:                        32768
  Indirect routes:                                  8192
  Security Access Control Entries:                  3072
  QoS Access Control Entries:                       2816
  Policy Based Routing ACEs:                        1024
  Netflow ACEs:                                     1024
  Input Microflow policer ACEs:                     256
  Output Microflow policer ACEs:                    256
  Flow SPAN ACEs:                                   256
  Tunnels:                                          256
  Control Plane Entries:                            512
  Input Netflow flows:                              8192
  Output Netflow flows:                             16384
These numbers are typical for L2 and IPv4 features.
Some features such as IPv6, use up double the entry size;
so only half as many entries can be created.
```

This is an example output showing the VLAN template information:

```
Device# show sdm prefer vlan

Showing SDM Template Info

This is the VLAN template for a typical Layer 2 network.
  Number of VLANs:                                  4094
  Unicast MAC addresses:                            32768
  Overflow Unicast MAC addresses:                   512
  IGMP and Multicast groups:                        8192
  Overflow IGMP and Multicast groups:               512
  Directly connected routes:                        32768
  Indirect routes:                                  8192
  Security Access Control Entries:                  3072
  QoS Access Control Entries:                       3072
  Policy Based Routing ACEs:                        0
  Netflow ACEs:                                     1024
  Input Microflow policer ACEs:                     0
  Output Microflow policer ACEs:                    0
```

```
  Flow SPAN ACEs:                                     256
  Tunnels:                                            0
  Control Plane Entries:                              512
  Input Netflow flows:                                16384
  Output Netflow flows:                               8192
These numbers are typical for L2 and IPv4 features.
Some features such as IPv6, use up double the entry size;
so only half as many entries can be created.
```

Feature History and Information for Configuring SDM Templates

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.

CHAPTER 7

Configuring System Message Logs

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Configuring System Message Logs

System Messsage Logging

By default, a switch sends the output from system messages and **debug** privileged EXEC commands to a logging process. . The logging process controls the distribution of logging messages to various destinations, such as the logging buffer, terminal lines, or a UNIX syslog server, depending on your configuration. The process also sends messages to the console.

When the logging process is disabled, messages are sent only to the console. The messages are sent as they are generated, so message and debug output are interspersed with prompts or output from other commands. Messages appear on the active consoles after the process that generated them has finished.

You can set the severity level of the messages to control the type of messages displayed on the consoles and each of the destinations. You can time-stamp log messages or set the syslog source address to enhance real-time debugging and management. For information on possible messages, see the system message guide for this release.

You can access logged system messages by using the switch command-line interface (CLI) or by saving them to a properly configured syslog server. The switch software saves syslog messages in an internal buffer on a standalone switch. If a standalone switch , the log is lost unless you had saved it to flash memory.

You can remotely monitor system messages by viewing the logs on a syslog server or by accessing the switch through Telnet, through the console port, or through the Ethernet management port.

Note The syslog format is compatible with 4.3 BSD UNIX.

System Log Message Format

System log messages can contain up to 80 characters and a percent sign (%), which follows the optional sequence number or time-stamp information, if configured. Depending on the switch, messages appear in one of these formats:

- *seq no:timestamp: %facility-severity-MNEMONIC:description (hostname-n)*
- *seq no:timestamp: %facility-severity-MNEMONIC:description*

The part of the message preceding the percent sign depends on the setting of these global configuration commands:

- **service sequence-numbers**
- **service timestamps log datetime**
- **service timestamps log datetime** [**localtime**] [**msec**] [**show-timezone**]
- **service timestamps log uptime**

Table 10: System Log Message Elements

Element	Description
seq no:	Stamps log messages with a sequence number only if the **service sequence-numbers** global configuration command is configured.
timestamp formats: *mm/dd h h:mm:ss* or *hh:mm:ss* (short uptime) or *d h* (long uptime)	Date and time of the message or event. This information appears only if the **service timestamps log** [**datetime** | **log**] global configuration command is configured.
facility	The facility to which the message refers (for example, SNMP, SYS, and so forth).

Element	Description
severity	Single-digit code from 0 to 7 that is the severity of the message.
MNEMONIC	Text string that uniquely describes the message.
description	Text string containing detailed information about the event being reported.
hostname-n	Hostname of a stack member and its switch number in the stack. Though the is a stack member, it does *not* append its hostname to system messages.

Default System Message Logging Settings

Table 11: Default System Message Logging Settings

Feature	Default Setting
System message logging to the console	Enabled.
Console severity	Debugging.
Logging file configuration	No filename specified.
Logging buffer size	4096 bytes.[1]
Logging history size	1 message.
Time stamps	Disabled.
Synchronous logging	Disabled.
Logging server	Disabled.
Syslog server IP address	None configured.
Server facility	Local7
Server severity	Informational.

[1] For Cisco IOS XE 3.6E release, the default logging buffer size is 16384 bytes.

Syslog Message Limits

If you enabled syslog message traps to be sent to an SNMP network management station by using the **snmp-server enable trap** global configuration command, you can change the level of messages sent and stored in the switch history table. You also can change the number of messages that are stored in the history table.

Messages are stored in the history table because SNMP traps are not guaranteed to reach their destination. By default, one message of the level **warning** and numerically lower levels are stored in the history table even if syslog traps are not enabled.

When the history table is full (it contains the maximum number of message entries specified with the **logging history size** global configuration command), the oldest message entry is deleted from the table to allow the new message entry to be stored.

The history table lists the level keywords and severity level. For SNMP usage, the severity level values increase by 1. For example, *emergencies* equal 1, not 0, and *critical* equals 3, not 2.

How to Configure System Message Logs

Setting the Message Display Destination Device

If message logging is enabled, you can send messages to specific locations in addition to the console.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **logging buffered** [*size*]
3. **logging** *host*
4. **logging file flash:** *filename* [*max-file-size* [*min-file-size*]] [*severity-level-number* | *type*]
5. **end**
6. **terminal monitor**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**logging buffered** [*size*] **Example:** `Device(config)# logging buffered 8192`	Logs messages to an internal buffer on the switch or on a standalone switch or, in the case of a switch stack, on the active switch. The range is 4096 to 2147483647 bytes. The default buffer size is 4096 bytes. If a standalone switch or the active switch fails, the log file is lost unless you previously saved it to flash memory. See Step 4. **Note** Do not make the buffer size too large because the switch could run out of memory for other tasks. Use the **show memory** privileged EXEC command to view the free processor memory on the switch. However, this value is the maximum available, and the buffer size should *not* be set to this amount.

	Command or Action	Purpose
Step 3	**logging** *host* **Example:** `Device(config)# logging 125.1.1.100`	Logs messages to a UNIX syslog server host. *host* specifies the name or IP address of the host to be used as the syslog server. To build a list of syslog servers that receive logging messages, enter this command more than once.
Step 4	**logging file flash:** *filename* [*max-file-size* [*min-file-size*]] [*severity-level-number* | *type*] **Example:** `Device(config)# logging file flash:log_msg.txt 40960 4096 3`	Stores log messages in a file in flash memory on a standalone switch or, in the case of a switch stack, on the active switch. • *filename*—Enters the log message filename. • (Optional) **max-file-size** —Specifies the maximum logging file size. The range is 4096 to 2147483647. The default is 4096 bytes. • (Optional) *min-file-size*—Specifies the minimum logging file size. The range is 1024 to 2147483647. The default is 2048 bytes. • (Optional) *severity-level-number* | *type*—Specifies either the logging severity level or the logging type. The severity range is 0 to 7.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**terminal monitor** **Example:** `Device# terminal monitor`	Logs messages to a nonconsole terminal during the current session. Terminal parameter-setting commands are set locally and do not remain in effect after the session has ended. You must perform this step for each session to see the debugging messages.

Synchronizing Log Messages

You can synchronize unsolicited messages and **debug** privileged EXEC command output with solicited device output and prompts for a specific console port line or virtual terminal line. You can identify the types of messages to be output asynchronously based on the level of severity. You can also configure the maximum number of buffers for storing asynchronous messages for the terminal after which messages are dropped.

When synchronous logging of unsolicited messages and **debug** command output is enabled, unsolicited device output appears on the console or printed after solicited device output appears or is printed. Unsolicited messages and **debug** command output appears on the console after the prompt for user input is returned. Therefore, unsolicited messages and **debug** command output are not interspersed with solicited device output and prompts. After the unsolicited messages appear, the console again displays the user prompt.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **line** [**console** | **vty**] *line-number* [*ending-line-number*]
3. **logging synchronous** [**level** [*severity-level* | **all**] | **limit** *number-of-buffers*]
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**line** [**console** | **vty**] *line-number* [*ending-line-number*] **Example:** `Device(config)# line console`	Specifies the line to be configured for synchronous logging of messages. • **console** —Specifies configurations that occur through the switch console port or the Ethernet management port. • **line vty** *line-number*—Specifies which vty lines are to have synchronous logging enabled. You use a vty connection for configurations that occur through a Telnet session. The range of line numbers is from 0 to 15. You can change the setting of all 16 vty lines at once by entering: line vty 0 15 You can also change the setting of the single vty line being used for your current connection. For example, to change the setting for vty line 2, enter: line vty 2 When you enter this command, the mode changes to line configuration.
Step 3	**logging synchronous** [**level** [*severity-level* | **all**] | **limit** *number-of-buffers*] **Example:** `Device(config)# logging synchronous level 3 limit 1000`	Enables synchronous logging of messages. • (Optional) **level** *severity-level*—Specifies the message severity level. Messages with a severity level equal to or higher than this value are printed asynchronously. Low numbers mean greater severity and high numbers mean lesser severity. The default is 2.

	Command or Action	Purpose
		• (Optional) **level all**—Specifies that all messages are printed asynchronously regardless of the severity level. • (Optional) **limit** *number-of-buffers*—Specifies the number of buffers to be queued for the terminal after which new messages are dropped. The range is 0 to 2147483647. The default is 20.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Disabling Message Logging

Message logging is enabled by default. It must be enabled to send messages to any destination other than the console. When enabled, log messages are sent to a logging process, which logs messages to designated locations asynchronously to the processes that generated the messages.

Disabling the logging process can slow down the switch because a process must wait until the messages are written to the console before continuing. When the logging process is disabled, messages appear on the console as soon as they are produced, often appearing in the middle of command output.

The **logging synchronous** global configuration command also affects the display of messages to the console. When this command is enabled, messages appear only after you press **Return**.

To reenable message logging after it has been disabled, use the **logging on** global configuration command.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **no logging console**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**no logging console** **Example:**	Disables message logging.

	Command or Action	Purpose
	`Device(config)# no logging console`	
Step 3	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Enabling and Disabling Time Stamps on Log Messages

By default, log messages are not time-stamped.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. Use one of these commands:
   - **service timestamps log uptime**
   - **service timestamps log datetime**[**msec** | **localtime** | **show-timezone**]
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 2	Use one of these commands:
	• **service timestamps log uptime**
	• **service timestamps log datetime**[**msec** | **localtime** | **show-timezone**]
	Example:
	`Device(config)# service timestamps log uptime`
	or
	`Device(config)# service timestamps log datetime`
		Enables log time stamps.
		• **log uptime**—Enables time stamps on log messages, showing the time since the system was rebooted.
		• **log datetime**—Enables time stamps on log messages. Depending on the options selected, the time stamp can include the date, time in milliseconds relative to the local time zone, and the time zone name.

Step 3	**end** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Device(config)# end`	

Enabling and Disabling Sequence Numbers in Log Messages

If there is more than one log message with the same time stamp, you can display messages with sequence numbers to view these messages. By default, sequence numbers in log messages are not displayed.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **service sequence-numbers**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**service sequence-numbers** **Example:** `Device(config)# service sequence-numbers`	Enables sequence numbers.
Step 3	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Defining the Message Severity Level

Limit messages displayed to the selected device by specifying the severity level of the message.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **logging console** *level*

3. **logging monitor** *level*
4. **logging trap** *level*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**logging console** *level* **Example:** `Device(config)# logging console 3`	Limits messages logged to the console. By default, the console receives debugging messages and numerically lower levels.
Step 3	**logging monitor** *level* **Example:** `Device(config)# logging monitor 3`	Limits messages logged to the terminal lines. By default, the terminal receives debugging messages and numerically lower levels.
Step 4	**logging trap** *level* **Example:** `Device(config)# logging trap 3`	Limits messages logged to the syslog servers. By default, syslog servers receive informational messages and numerically lower levels.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Limiting Syslog Messages Sent to the History Table and to SNMP

This task explains how to limit syslog messages that are sent to the history table and to SNMP.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **logging history** *level*
3. **logging history size** *number*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**logging history** *level* **Example:** `Device(config)# logging history 3`	Changes the default level of syslog messages stored in the history file and sent to the SNMP server. By default, **warnings**, **errors**, **critical**, **alerts**, and **emergencies** messages are sent.
Step 3	**logging history size** *number* **Example:** `Device(config)# logging history size 200`	Specifies the number of syslog messages that can be stored in the history table. The default is to store one message. The range is 0 to 500 messages.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Logging Messages to a UNIX Syslog Daemon

This task is optional.

Note Some recent versions of UNIX syslog daemons no longer accept by default syslog packets from the network. If this is the case with your system, use the UNIX **man syslogd** command to decide what options must be added to or removed from the syslog command line to enable logging of remote syslog messages.

Before you begin

- Log in as root.
- Before you can send system log messages to a UNIX syslog server, you must configure the syslog daemon on a UNIX server.

SUMMARY STEPS

1. Add a line to the file /etc/syslog.conf.
2. Enter these commands at the UNIX shell prompt.
3. Make sure the syslog daemon reads the new changes.

DETAILED STEPS

	Command or Action	Purpose
Step 1	Add a line to the file /etc/syslog.conf. **Example:** `local7.debug /usr/adm/logs/cisco.log`	• **local7**—Specifies the logging facility. • **debug**—Specifies the syslog level. The file must already exist, and the syslog daemon must have permission to write to it.

Step 2	Enter these commands at the UNIX shell prompt.
	Example:
	`$ touch /var/log/cisco.log`
	`$ chmod 666 /var/log/cisco.log`
		Creates the log file. The syslog daemon sends messages at this level or at a more severe level to this file.

Step 3	Make sure the syslog daemon reads the new changes. **Example:** ``$ kill -HUP `cat /etc/syslog.pid` ``	For more information, see the **man syslog.conf** and **man syslogd** commands on your UNIX system.

Monitoring and Maintaining System Message Logs

Monitoring Configuration Archive Logs

Command	Purpose
show archive log config {**all** | **number** [*end-number*] | **user** *username* [**session** *number*] *number* [*end-number*] | **statistics**} [**provisioning**]	Displays the entire configuration log or the log for specified parameters.

Configuration Examples for System Message Logs

Example: Stacking System Message

This example shows a partial switch system message for active stack and a stack member (hostname *Switch-2*):

```
00:00:46: %LINK-3-UPDOWN: Interface Port-channel1, changed state to up
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/1, changed state to up
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/2, changed state to up
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed
state to down 2
*Mar  1 18:46:11: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)
```

```
18:47:02: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)
*Mar  1 18:48:50.483 UTC: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)

00:00:46: %LINK-3-UPDOWN: Interface Port-channel1, changed state to up (Switch-2)
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet2/0/1, changed state to up (Switch-2)
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet2/0/2, changed state to up (Switch-2)
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
(Switch-2)
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet2/0/1, changed
state to down 2 (Switch-2)
```

Example: Switch System Message

This example shows a partial switch system message on a switch:

```
00:00:46: %LINK-3-UPDOWN: Interface Port-channel1, changed state to up
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to up
00:00:47: %LINK-3-UPDOWN: Interface GigabitEthernet0/2, changed state to up
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
00:00:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state
 to down 2
*Mar  1 18:46:11: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)
18:47:02: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)
*Mar  1 18:48:50.483 UTC: %SYS-5-CONFIG_I: Configured from console by vty2 (10.34.195.36)
```

Additional References for System Message Logs

Related Documents

Related Topic	Document Title
System management commands	
Platform-independent command references	*IP Addressing Configuration Guide Library, Cisco IOS XE Release 3S (Catalyst 3650 Switches)*
Platform-independent configuration information	*IP Addressing Configuration Guide Library, Cisco IOS XE Release 3S (Catalyst 3650 Switches)* *Configuration Fundamentals Configuration Guide, Cisco IOS XE Release 3S (Catalyst 3650 Switches)*

Standards and RFCs

Standard/RFC	Title
None	—

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information For System Message Logs

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.

CHAPTER 8

Configuring Online Diagnostics

Information About Configuring Online Diagnostics

Online Diagnostics

With online diagnostics, you can test and verify the hardware functionality of the Device while the Device is connected to a live network.

The online diagnostics contain packet switching tests that check different hardware components and verify the data path and the control signals.

The online diagnostics detect problems in these areas:

- Hardware components
- Interfaces (Ethernet ports and so forth)
- Solder joints

Online diagnostics are categorized as on-demand, scheduled, or health-monitoring diagnostics. On-demand diagnostics run from the CLI; scheduled diagnostics run at user-designated intervals or at specified times when the Device is connected to a live network; and health-monitoring runs in the background with user-defined intervals. By default, the health-monitoring test runs for every 30 seconds.

After you configure online diagnostics, you can manually start diagnostic tests or display the test results. You can also see which tests are configured for the Device or switch stack and the diagnostic tests that have already run.

How to Configure Online Diagnostics

Starting Online Diagnostic Tests

After you configure diagnostic tests to run on the Device, use the **diagnostic start** privileged EXEC command to begin diagnostic testing.

After starting the tests, you cannot stop the testing process.

Use this privileged EXEC command to manually start online diagnostic testing:

SUMMARY STEPS

1. **diagnostic start switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all** | **basic** | **complete** | **minimal** | **non-disruptive** | **per-port**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**diagnostic start switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all** | **basic** | **complete** | **minimal** | **non-disruptive** | **per-port**} **Example:** `Device# diagnostic start switch 2 test basic`	Starts the diagnostic tests. The **switch** *number* keyword is supported only on stacking Device. You can specify the tests by using one of these options: • *name*—Enters the name of the test. • *test-id*—Enters the ID number of the test. • *test-id-range*—Enters the range of test IDs by using integers separated by a comma and a hyphen. • **all**—Starts all of the tests. • **basic**— Starts the basic test suite. • **complete**—Starts the complete test suite. • **minimal**—Starts the minimal bootup test suite. • **non-disruptive**—Starts the non-disruptive test suite. • **per-port**—Starts the per-port test suite.

Configuring Online Diagnostics

You must configure the failure threshold and the interval between tests before enabling diagnostic monitoring.

Scheduling Online Diagnostics

You can schedule online diagnostics to run at a designated time of day or on a daily, weekly, or monthly basis for a Device. Use the **no** form of this command to remove the scheduling.

SUMMARY STEPS

1. **configure terminal**
2. **diagnostic schedule switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all** | **basic** | **complete** | **minimal** | **non-disruptive** | **per-port**} {**daily** | **on** *mm dd yyyy hh:mm* | **port** *inter-port-number port-number-list* | **weekly** *day-of-week hh:mm*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**diagnostic schedule switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all** | **basic** | **complete** | **minimal** | **non-disruptive** | **per-port**} {**daily** | **on** *mm dd yyyy hh:mm* | **port** *inter-port-number port-number-list* | **weekly** *day-of-week hh:mm*} **Example:** `Device(config)# diagnostic schedule switch 3 test 1-5 on July 3 2013 23:10`	Schedules on-demand diagnostic tests for a specific day and time. The **switch** *number* keyword is supported only on stacking switches. The range is from 1 to 4. When specifying the tests to be scheduled, use these options: • *name*—Name of the test that appears in the **show diagnostic content** command output. • *test-id*—ID number of the test that appears in the **show diagnostic content** command output. • *test-id-range*—ID numbers of the tests that appear in the **show diagnostic content** command output. • **all**—All test IDs. • **basic**—Starts the basic on-demand diagnostic tests. • **complete**—Starts the complete test suite. • **minimal**—Starts the minimal bootup test suite. • **non-disruptive**—Starts the non-disruptive test suite. • **per-port**—Starts the per-port test suite. You can schedule the tests as follows: • Daily—Use the **daily** *hh:mm* parameter. • Specific day and time—Use the **on** *mm dd yyyy hh:mm* parameter.

	Command or Action	Purpose
		• Weekly—Use the **weekly** *day-of-week hh:mm* parameter.

Configuring Health-Monitoring Diagnostics

You can configure health-monitoring diagnostic testing on a Device while it is connected to a live network. You can configure the execution interval for each health-monitoring test, enable the Device to generate a syslog message because of a test failure, and enable a specific test.

Use the **no** form of this command to disable testing.

By default, health monitoring is disabled, but the Device generates a syslog message when a test fails.

Follow these steps to configure and enable the health-monitoring diagnostic tests:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **diagnostic monitor interval switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all**} *hh:mm:ss milliseconds day*
4. **diagnostic monitor syslog**
5. **diagnostic monitor threshold switch** *number number* **test** {*name* | *test-id* | *test-id-range* | **all**} **failure count** *count*
6. **diagnostic monitor switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all**}
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

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	**diagnostic monitor interval switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all**} *hh:mm:ss milliseconds day* **Example:**	Configures the health-monitoring interval of the specified tests.

	Command or Action	Purpose
	`Device(config)# diagnostic monitor interval switch 2 test 1 12:30:00 750 5`	The **switch** *number* keyword is supported only on stacking switches. The range is from 1 to 9. When specifying the tests, use one of these parameters: • *name*—Name of the test that appears in the **show diagnostic content** command output. • *test-id*—ID number of the test that appears in the **show diagnostic content** command output. • *test-id-range*—ID numbers of the tests that appear in the **show diagnostic content** command output. • **all**—All of the diagnostic tests. When specifying the interval, set these parameters: • *hh:mm:ss*—Monitoring interval in hours, minutes, and seconds. The range for *hh* is 0 to 24, and the range for *mm* and *ss* is 0 to 60. • *milliseconds*—Monitoring interval in milliseconds (ms). The range is from 0 to 999. • *day*—Monitoring interval in the number of days. The range is from 0 to 20.
Step 4	**diagnostic monitor syslog** **Example:** `Device(config)# diagnostic monitor syslog`	(Optional) Configures the switch to generate a syslog message when a health-monitoring test fails.
Step 5	**diagnostic monitor threshold switch** *number number* **test** {*name* | *test-id* | *test-id-range* | **all**} **failure count** *count* **Example:** `Device(config)# diagnostic monitor threshold switch 2 test 1 failure count 20`	(Optional) Sets the failure threshold for the health-monitoring tests. The **switch** *number* keyword is supported only on stacking switches. The range is from 1 to 9. When specifying the tests, use one of these parameters: • *name*—Name of the test that appears in the **show diagnostic content** command output. • *test-id*—ID number of the test that appears in the **show diagnostic content** command output. • *test-id-range*—ID numbers of the tests that appear in the **show diagnostic content** command output. • **all**—All of the diagnostic tests. The range for the failure threshold *count* is 0 to 99.

	Command or Action	Purpose
Step 6	**diagnostic monitor switch** *number* **test** {*name* | *test-id* | *test-id-range* | **all**} **Example:** `Device(config)# diagnostic monitor switch 2 test 1`	Enables the specified health-monitoring tests. The **switch** *number* keyword is supported only on stacking switches. The range is from 1 to 9. When specifying the tests, use one of these parameters: • *name*—Name of the test that appears in the **show diagnostic content** command output. • *test-id*—ID number of the test that appears in the **show diagnostic content** command output. • *test-id-range*—ID numbers of the tests that appear in the **show diagnostic content** command output. • **all**—All of the diagnostic tests.
Step 7	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 8	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 9	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

What to do next

Use the **no diagnostic monitor interval test***test-id* | *test-id-range* } global configuration command to change the interval to the default value or to zero. Use the **no diagnostic monitor syslog** command to disable generation of syslog messages when a health-monitoring test fails. Use the **diagnostic monitor threshold test***test-id* | *test-id-range* }**failure count**command to remove the failure threshold.

Monitoring and Maintaining Online Diagnostics

Displaying Online Diagnostic Tests and Test Results

You can display the online diagnostic tests that are configured for the Device or Device stack and check the test results by using the privileged EXEC **show** commands in this table:

Table 12: Commands for Diagnostic Test Configuration and Results

Command	Purpose
show diagnostic content switch [*number* | **all**]	Displays the online diagnostics configured for a switch.
show diagnostic status	Displays the currently running diagnostic tests.
show diagnostic result switch [*number* | **all**] [**detail** | **test** {*name* | *test-id* | *test-id-range* | **all**} [**detail**]]	Displays the online diagnostics test results.
show diagnostic switch [*number* | **all**] [**detail**]	Displays the online diagnostics test results.
show diagnostic schedule switch [*number* | **all**]	Displays the online diagnostics test schedule.
show diagnostic post	Displays the POST results. (The output is the same as the **show post** command output.)

Configuration Examples for Online Diagnostic Tests

Examples: Start Diagnostic Tests

This example shows how to start a diagnostic test by using the test name:

```
Device# diagnostic start switch 2 test TestInlinePwrCtlr
```

This example shows how to start all of the basic diagnostic tests:

```
Device# diagnostic start switch 1 test all
```

Example: Configure a Health Monitoring Test

This example shows how to configure a health-monitoring test:

```
Device(config)# diagnostic monitor threshold switch 1 test 1 failure count 50
Device(config)# diagnostic monitor interval switch 1 test TestPortAsicStackPortLoopback
```

Examples: Schedule Diagnostic Test

This example shows how to schedule diagnostic testing for a specific day and time on a specific switch:

```
Device(config)# diagnostic schedule test DiagThermalTest on June 3 2013  22:25
```

This example shows how to schedule diagnostic testing to occur weekly at a certain time on a specific switch:

```
Device(config)# diagnostic schedule switch 1 test 1,2,4-6 weekly saturday 10:30
```

Examples: Displaying Online Diagnostics

This example shows how to display on demand diagnostic settings:

```
Device# show diagnostic ondemand settings

Test iterations = 1
Action on test failure = continue
```

This example shows how to display diagnostic events for errors:

```
Device# show diagnostic events event-type error

Diagnostic events (storage for 500 events, 0 events recorded)
Number of events matching above criteria = 0

No diagnostic log entry exists.
```

This example shows how to display the description for a diagnostic test:

```
Device# show diagnostic description switch 1 test all

DiagGoldPktTest :
        The GOLD packet Loopback test verifies the MAC level loopback
        functionality. In this test, a GOLD packet, for which doppler
        provides the support in hardware, is sent. The packet loops back
        at MAC level and is matched against the stored packet. It is a non
        -disruptive test.

DiagThermalTest :
        This test verifies the temperature reading from the sensor is below the yellow
        temperature threshold. It is a non-disruptive test and can be run as a health
monitoring test.

DiagFanTest :
        This test verifies all fan modules have been inserted and working properly on the
board
        It is a non-disruptive test and can be run as a health monitoring test.

DiagPhyLoopbackTest :
        The PHY Loopback test verifies the PHY level loopback
        functionality. In this test, a packet is sent which loops back
        at PHY level and is matched against the stored packet. It is a
        disruptive test and cannot be run as a health monitoring test.

DiagScratchRegisterTest :
        The Scratch Register test monitors the health of application-specific
        integrated circuits (ASICs) by writing values into registers and reading
        back the values from these registers. It is a non-disruptive test and can
        be run as a health monitoring test.

DiagPoETest :
        This test checks the PoE controller functionality. This is a disruptive test
        and should not be performed during normal switch operation.
```

```
DiagStackCableTest :
        This test verifies the stack ring loopback functionality
        in the stacking environment. It is a disruptive test and
        cannot be run as a health monitoring test.

DiagMemoryTest :
        This test runs the exhaustive ASIC memory test during normal switch operation
        NG3K utilizes mbist for this test. Memory test is very disruptive
        in nature and requires switch reboot after the test.

Device#
```

This example shows how to display the boot up level:

```
Device# show diagnostic bootup level

Current bootup diagnostic level: minimal

Device#
```

Additional References for Online Diagnostics

Related Documents

Related Topic	Document Title
System management commands	*System Management Command Reference (Catalyst 3650 Switches)*

Standards and RFCs

Standard/RFC	Title
None	—

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for Configuring Online Diagnostics

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.

CHAPTER 9

Managing Configuration Files

Prerequisites for Managing Configuration Files

- You should have at least a basic familiarity with the Cisco IOS environment and the command-line interface.
- You should have at least a minimal configuration running on your system. You can create a basic configuration file using the **setup** command.

Restrictions for Managing Configuration Files

- Many of the Cisco IOS commands described in this document are available and function only in certain configuration modes on the device.
- Some of the Cisco IOS configuration commands are only available on certain device platforms, and the command syntax may vary on different platforms.

Information About Managing Configuration Files

Types of Configuration Files

Configuration files contain the Cisco IOS software commands used to customize the functionality of your Cisco device. Commands are parsed (translated and executed) by the Cisco IOS software when the system is booted (from the startup-config file) or when you enter commands at the CLI in a configuration mode.

Startup configuration files (startup-config) are used during system startup to configure the software. Running configuration files (running-config) contain the current configuration of the software. The two configuration files can be different. For example, you may want to change the configuration for a short time period rather than permanently. In this case, you would change the running configuration using the **configure terminal** EXEC command but not save the configuration using the **copy running-config startup-config** EXEC command.

To change the running configuration, use the **configure terminal** command, as described in the Modifying the Configuration File section. As you use the Cisco IOS configuration modes, commands generally are executed immediately and are saved to the running configuration file either immediately after you enter them or when you exit a configuration mode.

To change the startup configuration file, you can either save the running configuration file to the startup configuration using the **copy running-config startup-config** EXEC command or copy a configuration file from a file server to the startup configuration (see the Copying a Configuration File from a TFTP Server to the Device section for more information).

Configuration Mode and Selecting a Configuration Source

To enter configuration mode on the device, enter the **configure** command at the privileged EXEC prompt. The Cisco IOS software responds with the following prompt asking you to specify the terminal, memory, or a file stored on a network server (network) as the source of configuration commands:

```
Configuring from terminal, memory, or network [terminal]?
```

Configuring from the terminal allows you to enter configuration commands at the command line, as described in the following section. See the Re-executing the Configuration Commands in the Startup Configuration File section for more information.

Configuring from the network allows you to load and execute configuration commands over the network. See the Copying a Configuration File from a TFTP Server to the Device section for more information.

Configuration File Changes Using the CLI

The Cisco IOS software accepts one configuration command per line. You can enter as many configuration commands as you want. You can add comments to a configuration file describing the commands you have entered. Precede a comment with an exclamation point (!). Because comments are *not* stored in NVRAM or in the active copy of the configuration file, comments do not appear when you list the active configuration with the **show running-config** or **more system:running-config** EXEC command. Comments are not displayed when you list the startup configuration with the **show startup-config** or **more nvram:startup-config** EXEC mode command. Comments are stripped out of the configuration file when it is loaded onto the device. However, you can list the comments in configuration files stored on a File Transfer Protocol (FTP), Remote Copy Protocol (RCP), or Trivial File Transfer Protocol (TFTP) server. When you configure the software using the CLI, the software executes the commands as you enter them.

Location of Configuration Files

Configuration files are stored in the following locations:

- The running configuration is stored in RAM.
- On all platforms except the Class A Flash file system platforms, the startup configuration is stored in nonvolatile random-access memory (NVRAM).

- On Class A Flash file system platforms, the startup configuration is stored in the location specified by the CONFIG_FILE environment variable (see the Specifying the CONFIG_FILE Environment Variable on Class A Flash File Systems section). The CONFIG_FILE variable defaults to NVRAM and can be a file in the following file systems:
  - **nvram:** (NVRAM)
  - **flash:** (internal flash memory)
  - **usbflash0:** (external usbflash file system)

Copy Configuration Files from a Network Server to the Device

You can copy configuration files from a TFTP, rcp, or FTP server to the running configuration or startup configuration of the device. You may want to perform this function for one of the following reasons:

- To restore a backed-up configuration file.
- To use the configuration file for another device. For example, you may add another device to your network and want it to have a similar configuration to the original device. By copying the file to the new device, you can change the relevant parts rather than recreating the whole file.
- To load the same configuration commands on to all of the devicees in your network so that all of the devicees have similar configurations.

The **copy**{**ftp:** | **rcp:** | **tftp:system:running-config**} EXEC command loads the configuration files into the device as if you were typing the commands on the command line. The device does not erase the existing running configuration before adding the commands. If a command in the copied configuration file replaces a command in the existing configuration file, the existing command is erased. For example, if the copied configuration file contains a different IP address in a particular command than the existing configuration, the IP address in the copied configuration is used. However, some commands in the existing configuration may not be replaced or negated. In this case, the resulting configuration file is a mixture of the existing configuration file and the copied configuration file, with the copied configuration file having precedence.

To restore a configuration file to an exact copy of a file stored on a server, you need to copy the configuration file directly to the startup configuration (using the **copy ftp:**| **rcp:**| **tftp:**} **nvram:startup-config** command) and reload the device.

To copy configuration files from a server to a device, perform the tasks described in the following sections.

The protocol that you use depends on which type of server you are using. The FTP and rcp transport mechanisms provide faster performance and more reliable delivery of data than TFTP. These improvements are possible because the FTP and rcp transport mechanisms are built on and use the TCP/IP stack, which is connection-oriented.

Copying a Configuration File from the Device to a TFTP Server

In some implementations of TFTP, you must create a dummy file on the TFTP server and give it read, write, and execute permissions before copying a file over it. Refer to your TFTP documentation for more information.

Copying a Configuration File from the Device to an RCP Server

You can copy a configuration file from the device to an RCP server.

One of the first attempts to use the network as a resource in the UNIX community resulted in the design and implementation of the remote shell protocol, which included the remote shell (rsh) and remote copy (rcp) functions. Rsh and rcp give users the ability to execute commands remotely and copy files to and from a file system residing on a remote host or server on the network. The Cisco implementation of rsh and rcp interoperates with standard implementations.

The rcp **copy** commands rely on the rsh server (or daemon) on the remote system. To copy files using rcp, you need not create a server for file distribution, as you do with TFTP. You need only to have access to a server that supports the remote shell (rsh). (Most UNIX systems support rsh.) Because you are copying a file from one place to another, you must have read permission on the source file and write permission on the destination file. If the destination file does not exist, rcp creates it for you.

Although the Cisco rcp implementation emulates the functions of the UNIX rcp implementation—copying files among systems on the network—the Cisco command syntax differs from the UNIX rcp command syntax. The Cisco rcp support offers a set of **copy** commands that use rcp as the transport mechanism. These rcp **copy** commands are similar in style to the Cisco TFTP **copy** commands, but they offer an alternative that provides faster performance and reliable delivery of data. These improvements are possible because the rcp transport mechanism is built on and uses the TCP/IP stack, which is connection-oriented. You can use rcp commands to copy system images and configuration files from the device to a network server and vice versa.

You also can enable rcp support to allow users on remote systems to copy files to and from the device.

To configure the Cisco IOS software to allow remote users to copy files to and from the device, use the **ip rcmd rcp-enable** global configuration command.

Restrictions

The RCP protocol requires a client to send a remote username on each RCP request to a server. When you copy a configuration file from the device to a server using RCP, the Cisco IOS software sends the first valid username it encounters in the following sequence:

1. The username specified in the **copy** EXEC command, if a username is specified.
2. The username set by the **ip rcmd remote-username** global configuration command, if the command is configured.
3. The remote username associated with the current tty (terminal) process. For example, if the user is connected to the device through Telnet and was authenticated through the **username** command, the device software sends the Telnet username as the remote username.
4. The device host name.

For the RCP copy request to execute successfully, an account must be defined on the network server for the remote username. If the server has a directory structure, the configuration file or image is written to or copied from the directory associated with the remote username on the server. For example, if the system image resides in the home directory of a user on the server, you can specify that user name as the remote username.

Use the **ip rcmd remote-username** command to specify a username for all copies. (Rcmd is a UNIX routine used at the super-user level to execute commands on a remote machine using an authentication scheme based on reserved port numbers. Rcmd stands for “remote command”). Include the username in the **copy** command if you want to specify a username for that copy operation only.

If you are writing to the server, the RCP server must be properly configured to accept the RCP write request from the user on the device. For UNIX systems, you must add an entry to the .rhosts file for the remote user on the RCP server. For example, suppose the device contains the following configuration lines:

```
hostname Device1
ip rcmd remote-username User0
```

If the device IP address translates to device1.example.com, then the .rhosts file for User0 on the RCP server should contain the following line:

```
Device1.example.com Device1
```

Requirements for the RCP Username

The RCP protocol requires a client to send a remote username on each RCP request to a server. When you copy a configuration file from the device to a server using RCP, the Cisco IOS software sends the first valid username it encounters in the following sequence:

1. The username specified in the **copy** EXEC command, if a username is specified.
2. The username set by the **ip rcmd remote-username** global configuration command, if the command is configured.
3. The remote username associated with the current tty (terminal) process. For example, if the user is connected to the device through Telnet and is authenticated through the **username** command, the device software sends the Telnet username as the remote username.
4. The device host name.

For the RCP copy request to execute, an account must be defined on the network server for the remote username. If the server has a directory structure, the configuration file or image is written to or copied from the directory associated with the remote username on the server. For example, if the system image resides in the home directory of a user on the server, specify that user name as the remote username.

Refer to the documentation for your RCP server for more information.

Copying a Configuration File from the Device to an FTP Server

You can copy a configuration file from the device to an FTP server.

Understanding the FTP Username and Password

Note The password must not contain the special character '@'. If the character '@' is used, the copy fails to parse the IP address of the server.

The FTP protocol requires a client to send a remote username and password on each FTP request to a server. When you copy a configuration file from the device to a server using FTP, the Cisco IOS software sends the first valid username it encounters in the following sequence:

1. The username specified in the **copy** EXEC command, if a username is specified.
2. The username set by the **ip ftp username** global configuration command, if the command is configured.
3. Anonymous.

The device sends the first valid password it encounters in the following sequence:

1. The password specified in the **copy** command, if a password is specified.
2. The password set by the **ip ftp password** command, if the command is configured.
3. The device forms a password *username @devicename.domain* . The variable *username* is the username associated with the current session, *devicename* is the configured host name, and *domain* is the domain of the device.

The username and password must be associated with an account on the FTP server. If you are writing to the server, the FTP server must be properly configured to accept the FTP write request from the user on the device.

If the server has a directory structure, the configuration file or image is written to or copied from the directory associated with the username on the server. For example, if the system image resides in the home directory of a user on the server, specify that user name as the remote username.

Refer to the documentation for your FTP server for more information.

Use the **ip ftp username** and **ip ftp password** global configuration commands to specify a username and password for all copies. Include the username in the **copy** EXEC command if you want to specify a username for that copy operation only.

Copying files through a VRF

You can copy files through a VRF interface specified in the **copy** command. Specifying the VRF in the **copy** command is easier and more efficient as you can directly change the source interface without using a change request for the configuration.

Example

The following example shows how to copy files through a VRF, using the **copy** command:

```
Device# copy scp: flash-1: vrf test-vrf
Address or name of remote host [10.1.2.3]?
Source username [ScpUser]?
Source filename [/auto/tftp-server/ScpUser/vrf_test.txt]?
Destination filename [vrf_test.txt]?
Getting the vrf name as test-vrf
Password:
Sending file modes: C0644 10 vrf_test.txt
!
223 bytes copied in 22.740 secs (10 bytes/sec)
```

Copy Configuration Files from a Switch to Another Switch

You can copy the configurations from one switch to another. This is a 2-step process - Copy the configurations from the switch to the TFTP server, and then from TFTP to another switch.

To copy your current configurations from the switch, run the command **copy startup-config tftp:** and follow the instructions. The configurations are copied onto the TFTP server.

Then, login to another switch and run the command **copy tftp: startup-config** and follow the instructions. The configurations are now copied onto the other switch.

After the configurations are copied, to save your configurations, use **write memory** command and then either reload the switch or run the **copy startup-config running-config** command

Configuration Files Larger than NVRAM

To maintain a configuration file that exceeds the size of NVRAM, you should be aware of the information in the following sections.

Compressing the Configuration File

The **service compress-config** global configuration command specifies that the configuration file be stored compressed in NVRAM. Once the configuration file has been compressed, the device functions normally. When the system is booted, it recognizes that the configuration file is compressed, expands it, and proceeds normally. The **more nvram:startup-config** EXEC command expands the configuration before displaying it.

Before you compress configuration files, refer to the appropriate hardware installation and maintenance publication. Verify that your system's ROMs support file compression. If not, you can install new ROMs that support file compression.

The size of the configuration must not exceed three times the NVRAM size. For a 128-KB size NVRAM, the largest expanded configuration file size is 384 KB.

The **service compress-config** global configuration command works only if you have Cisco IOS software Release 10.0 or later release boot ROMs. Installing new ROMs is a one-time operation and is necessary only if you do not already have Cisco IOS Release 10.0 in ROM. If the boot ROMs do not recognize a compressed configuration, the following message is displayed:

```
Boot ROMs do not support NVRAM compression Config NOT written to NVRAM
```

Storing the Configuration in Flash Memory on Class A Flash File Systems

On class A Flash file system devicees, you can store the startup configuration in flash memory by setting the **CONFIG_FILE** environment variable to a file in internal flash memory or flash memory in a PCMCIA slot.

See the Specifying the CONFIG_FILE Environment Variable on Class A Flash File Systems section for more information.

Care must be taken when editing or changing a large configuration. Flash memory space is used every time a **copy system:running-config nvram:startup-config** EXEC command is issued. Because file management for flash memory (such as optimizing free space) is not done automatically, you must pay close attention to available flash memory. Use the **squeeze** command to reclaim used space. We recommend that you use a large-capacity Flash card of at least 20 MB.

Loading the Configuration Commands from the Network

You can also store large configurations on FTP, RCP, or TFTP servers and download them at system startup. To use a network server to store large configurations, see the Copying a Configuration File from the Device to a TFTP Server and Configuring the Device to Download Configuration Files sections for more information on these commands.

Configuring the Device to Download Configuration Files

You can configure the device to load one or two configuration files at system startup. The configuration files are loaded into memory and read in as if you were typing the commands at the command line. Thus, the configuration for the device is a mixture of the original startup configuration and the one or two downloaded configuration files.

Network Versus Host Configuration Files

For historical reasons, the first file the device downloads is called the network configuration file. The second file the device downloads is called the host configuration file. Two configuration files can be used when all of the devicees on a network use many of the same commands. The network configuration file contains the standard commands used to configure all of the devicees. The host configuration files contain the commands specific to one particular host. If you are loading two configuration files, the host configuration file should be the configuration file you want to have precedence over the other file. Both the network and host configuration files must reside on a network server reachable via TFTP, RCP, or FTP, and must be readable.

How to Manage Configuration File Information

Displaying Configuration File Information

To display information about configuration files, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **show boot**
3. **more** *file-url*
4. **show running-config**
5. **show startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show boot** **Example:** `Device# show boot`	Lists the contents of the BOOT environment variable (if set), the name of the configuration file pointed to by the CONFIG_FILE environment variable, and the contents of the BOOTLDR environment variable.
Step 3	**more** *file-url* **Example:** `Device# more 10.1.1.1`	Displays the contents of a specified file.

	Command or Action	Purpose
Step 4	**show running-config** **Example:** `Device# show running-config`	Displays the contents of the running configuration file. (Command alias for the **more system:running-config** command.)
Step 5	**show startup-config** **Example:** `Device# show startup-config`	Displays the contents of the startup configuration file. (Command alias for the **more nvram:startup-config** command.) On all platforms except the Class A Flash file system platforms, the default startup-config file usually is stored in NVRAM. On the Class A Flash file system platforms, the CONFIG_FILE environment variable points to the default startup-config file. The CONFIG_FILE variable defaults to NVRAM.

Modifying the Configuration File

The Cisco IOS software accepts one configuration command per line. You can enter as many configuration commands as you want. You can add comments to a configuration file describing the commands you have entered. Precede a comment with an exclamation point (!). Because comments are *not* stored in NVRAM or in the active copy of the configuration file, comments do not appear when you list the active configuration with the **show running-config** or **more system:running-config** EXEC commands. Comments do not display when you list the startup configuration with the **show startup-config** or **more nvram:startup-config** EXEC mode commands. Comments are stripped out of the configuration file when it is loaded onto the device. However, you can list the comments in configuration files stored on a File Transfer Protocol (FTP), Remote Copy Protocol (RCP), or Trivial File Transfer Protocol (TFTP) server. When you configure the software using the CLI, the software executes the commands as you enter them. To configure the software using the CLI, use the following commands in privileged EXEC mode:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **configuration command**
4. Do one of the following:
   - **end**
   - **^Z**
5. **copy system:running-config nvram:startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**configuration command** **Example:** `Device(config)# configuration command`	Enter the necessary configuration commands. The Cisco IOS documentation set describes configuration commands organized by technology.
Step 4	Do one of the following: • **end** • **^Z** **Example:** `Device(config)# end`	Ends the configuration session and exits to EXEC mode. **Note** When you press the Ctrl and Z keys simultaneously, ^Z is displayed to the screen.
Step 5	**copy system:running-config nvram:startup-config** **Example:** `Device# copy system:running-config nvram:startup-config`	Saves the running configuration file as the startup configuration file. You may also use the **copy running-config startup-config** command alias, but you should be aware that this command is less precise. On most platforms, this command saves the configuration to NVRAM. On the Class A Flash file system platforms, this step saves the configuration to the location specified by the CONFIG_FILE environment variable (the default CONFIG_FILE variable specifies that the file should be saved to NVRAM).

Examples

In the following example, the device prompt name of the device is configured. The comment line, indicated by the exclamation mark (!), does not execute any command. The **hostname** command is used to change the device name from device to new_name. By pressing Ctrl-Z (^Z) or entering the **end** command, the user quits configuration mode. The **copy system:running-config nvram:startup-config** command saves the current configuration to the startup configuration.

```
Device# configure terminal
Device(config)# !The following command provides the switch host name.
Device(config)# hostname new_name
new_name(config)# end
new_name# copy system:running-config nvram:startup-config
```

When the startup configuration is NVRAM, it stores the current configuration information in text format as configuration commands, recording only non-default settings. The memory is checksummed to guard against corrupted data.

Note Some specific commands might not get saved to NVRAM. You need to enter these commands again if you reboot the machine. These commands are noted in the documentation. We recommend that you keep a list of these settings so that you can quickly reconfigure your device after rebooting.

Copying a Configuration File from the Device to a TFTP Server

To copy configuration information on a TFTP network server, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy system:running-config tftp:** [[[//*location*]/*directory*]/*filename*]
3. **copy nvram:startup-config tftp:** [[[//*location*]/*directory*]/*filename*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy system:running-config tftp:** [[[//*location*]/*directory*]/*filename*] **Example:** `Device# copy system:running-config tftp: //server1/topdir/file10`	Copies the running configuration file to a TFTP server.
Step 3	**copy nvram:startup-config tftp:** [[[//*location*]/*directory*]/*filename*] **Example:** `Device# copy nvram:startup-config tftp: //server1/1stdir/file10`	Copies the startup configuration file to a TFTP server.

Examples

The following example copies a configuration file from a device to a TFTP server:

```
Device# copy system:running-config tftp://172.16.2.155/tokyo-confg
```

```
Write file tokyo-confg on host 172.16.2.155? [confirm] Y
Writing tokyo-confg!!! [OK]
```

What to Do Next

After you have issued the **copy** command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from the Device to an RCP Server

To copy a startup configuration file or a running configuration file from the device to an RCP server, use the following commands beginning in privileged EXEC mode:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip rcmd remote-username** *username*
4. **end**
5. Do one of the following:
   - **copy system:running-config rcp:** [[[//[*username@*]*location*]/*directory*]/*filename*]
   - **copy nvram:startup-config rcp:** [[[//[*username@*]*location*]/*directory*]/*filename*]

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	**ip rcmd remote-username** *username* **Example:** `Device(config)# ip rcmd remote-username NetAdmin1`	(Optional) Changes the default remote username.
Step 4	**end** **Example:** `Device(config)# end`	(Optional) Exits global configuration mode.

	Command or Action	Purpose
Step 5	Do one of the following: • **copy system:running-config rcp:** [[[//[*username@*]*location*]/*directory*]/*filename*] • **copy nvram:startup-config rcp:** [[[//[*username@*]*location*]/*directory*]/*filename*] **Example:** `Device# copy system:running-config rcp: //NetAdmin1@example.com/dir-files/file1`	• Specifies that the device running configuration file is to be stored on an RCP server or • Specifies that the device startup configuration file is to be stored on an RCP server

Examples

Storing a Running Configuration File on an RCP Server

The following example copies the running configuration file named runfile2-confg to the netadmin1 directory on the remote host with an IP address of 172.16.101.101:

```
Device# copy system:running-config rcp://netadmin1@172.16.101.101/runfile2-confg
Write file runfile2-confg on host 172.16.101.101?[confirm]
Building configuration...[OK]
Connected to 172.16.101.101
Device#
```

Storing a Startup Configuration File on an RCP Server

The following example shows how to store a startup configuration file on a server by using RCP to copy the file:

```
Device# configure terminal

Device(config)# ip rcmd remote-username netadmin2

Device(config)# end

Device# copy nvram:startup-config rcp:

Remote host[]? 172.16.101.101

Name of configuration file to write [start-confg]?
Write file start-confg on host 172.16.101.101?[confirm]
![OK]
```

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from the Device to the FTP Server

To copy a startup configuration file or a running configuration file from the device to an FTP server, complete the following tasks:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip ftp username** *username*
4. **ip ftp password** *password*
5. **end**
6. Do one of the following:
   - **copy system:running-config ftp:** [[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*]
   or
   - **copy nvram:startup-config ftp:** [[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*]

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 on the device.
Step 3	**ip ftp username** *username* **Example:** `Device(config)# ip ftp username NetAdmin1`	(Optional) Specifies the default remote username.
Step 4	**ip ftp password** *password* **Example:** `Device(config)# ip ftp password adminpassword`	(Optional) Specifies the default password.
Step 5	**end** **Example:** `Device(config)# end`	(Optional) Exits global configuration mode. This step is required only if you override the default remote username or password (see Steps 2 and 3).

	Command or Action	Purpose
Step 6	Do one of the following: • **copy system:running-config ftp:** [[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] or • **copy nvram:startup-config ftp:** [[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] **Example:** `Device# copy system:running-config ftp:`	Copies the running configuration or startup configuration file to the specified location on the FTP server.

Examples

Storing a Running Configuration File on an FTP Server

The following example copies the running configuration file named runfile-confg to the netadmin1 directory on the remote host with an IP address of 172.16.101.101:

```
Device# copy system:running-config ftp://netadmin1:mypass@172.16.101.101/runfile-confg
Write file runfile-confg on host 172.16.101.101?[confirm]
Building configuration...[OK]
Connected to 172.16.101.101
Device#
```

Storing a Startup Configuration File on an FTP Server

The following example shows how to store a startup configuration file on a server by using FTP to copy the file:

```
Device# configure terminal

Device(config)# ip ftp username netadmin2

Device(config)# ip ftp password mypass

Device(config)# end

Device# copy nvram:startup-config ftp:

Remote host[]? 172.16.101.101

Name of configuration file to write [start-confg]?
Write file start-confg on host 172.16.101.101?[confirm]
![OK]
```

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from a TFTP Server to the Device

To copy a configuration file from a TFTP server to the device, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy tftp:** [[[//*location*]/*directory*]/*filename*] **system:running-config**
3. **copy tftp:** [[[//*location*]/*directory*]/*filename*] **nvram:startup-config**
4. **copy tftp:** [[[//*location*]/*directory*]/*filename*]**flash-[n]:/directory/startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy tftp:** [[[//*location*]/*directory*]/*filename*] **system:running-config** **Example:** `Device# copy tftp://server1/dir10/datasource system:running-config`	Copies a configuration file from a TFTP server to the running configuration.
Step 3	**copy tftp:** [[[//*location*]/*directory*]/*filename*] **nvram:startup-config** **Example:** `Device# copy tftp://server1/dir10/datasource nvram:startup-config`	Copies a configuration file from a TFTP server to the startup configuration.
Step 4	**copy tftp:** [[[//*location*]/*directory*]/*filename*]**flash-[n]:/directory/startup-config** **Example:** `Device# copy tftp://server1/dir10/datasource flash:startup-config`	Copies a configuration file from a TFTP server to the startup configuration.

Examples

In the following example, the software is configured from the file named **tokyo-confg** at IP address 172.16.2.155:

```
Device# copy tftp://172.16.2.155/tokyo-confg system:running-config

Configure using tokyo-confg from 172.16.2.155? [confirm] Y
```

```
Booting tokyo-confg from 172.16.2.155:!!! [OK - 874/16000 bytes]
```

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from the rcp Server to the Device

To copy a configuration file from an rcp server to the running configuration or startup configuration, complete the following tasks:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip rcmd remote-username** *username*
4. **end**
5. Do one of the following:
   - **copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*]**system:running-config**
   - **copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*]**nvram:startup-config**

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`	(Optional) Enters configuration mode from the terminal. This step is required only if you override the default remote username (see Step 3).
Step 3	**ip rcmd remote-username** *username* **Example:** `Device(config)# ip rcmd remote-username NetAdmin1`	(Optional) Specifies the remote username.
Step 4	**end** **Example:** `Device(config)# end`	(Optional) Exits global configuration mode. This step is required only if you override the default remote username (see Step 2).

	Command or Action	Purpose
Step 5	Do one of the following: • **copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*]**system:running-config** • **copy rcp:**[[[//[*username*@]*location*]/*directory*]/*filename*]**nvram:startup-config** **Example:** `Device# copy rcp://[user1@example.com/dir10/fileone] nvram:startup-config`	Copies the configuration file from an rcp server to the running configuration or startup configuration.

Examples

Copy RCP Running-Config

The following example copies a configuration file named host1-confg from the netadmin1 directory on the remote server with an IP address of 172.16.101.101, and loads and runs the commands on the device:

```
Device# copy rcp://netadmin1@172.16.101.101/host1-confg system:running-config
Configure using host1-confg from 172.16.101.101? [confirm]
Connected to 172.16.101.101
Loading 1112 byte file host1-confg:![OK]
Device#
%SYS-5-CONFIG: Configured from host1-config by rcp from 172.16.101.101
```

Copy RCP Startup-Config

The following example specifies a remote username of netadmin1. Then it copies the configuration file named host2-confg from the netadmin1 directory on the remote server with an IP address of 172.16.101.101 to the startup configuration.

```
Device# configure terminal
Device(config)# ip rcmd remote-username netadmin1
Device(config)# end
Device# copy rcp: nvram:startup-config
Address of remote host [255.255.255.255]? 172.16.101.101
Name of configuration file[rtr2-confg]? host2-confg
Configure using host2-confg from 172.16.101.101?[confirm]
Connected to 172.16.101.101
Loading 1112 byte file host2-confg:![OK]
[OK]
Device#
%SYS-5-CONFIG_NV:Non-volatile store configured from host2-config by rcp from 172.16.101.101
```

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from an FTP Server to the Device

To copy a configuration file from an FTP server to the running configuration or startup configuration, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip ftp username** *username*
4. **ip ftp password** *password*
5. **end**
6. Do one of the following:
    - **copy ftp:** [[[//[*username*[**:***password*]**@**]*location*] /*directory*]/*filename*]**system:running-config**
    - **copy ftp:** [[[//[*username*[**:***password*]**@**]*location*]/*directory*]/*filename*]**nvram:startup-config**

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`	(Optional) Allows you to enter global configuration mode. This step is required only if you want to override the default remote username or password (see Steps 3 and 4).
Step 3	**ip ftp username** *username* **Example:** `Device(config)# ip ftp username NetAdmin1`	(Optional) Specifies the default remote username.
Step 4	**ip ftp password** *password* **Example:** `Device(config)# ip ftp password adminpassword`	(Optional) Specifies the default password.
Step 5	**end** **Example:** `Device(config)# end`	(Optional) Exits global configuration mode. This step is required only if you override the default remote username or password (see Steps 3 and 4).
Step 6	Do one of the following: • **copy ftp:** [[[//[*username*[**:***password*]**@**]*location*] /*directory*]/*filename*]**system:running-config**	Using FTP copies the configuration file from a network server to running memory or the startup configuration.

	Command or Action	Purpose
	• **copy ftp:** [[[*//[username[:password]@]location]/directory]/filename*]**nvram:startup-config** **Example:** `Device# copy ftp:nvram:startup-config`	

Examples

Copy FTP Running-Config

The following example copies a host configuration file named host1-confg from the netadmin1 directory on the remote server with an IP address of 172.16.101.101, and loads and runs the commands on the device:

```
Device# copy ftp://netadmin1:mypass@172.16.101.101/host1-confg system:running-config
Configure using host1-confg from 172.16.101.101? [confirm]
Connected to 172.16.101.101
Loading 1112 byte file host1-confg:![OK]
Device#
%SYS-5-CONFIG: Configured from host1-config by ftp from 172.16.101.101
```

Copy FTP Startup-Config

The following example specifies a remote username of netadmin1. Then it copies the configuration file named host2-confg from the netadmin1 directory on the remote server with an IP address of 172.16.101.101 to the startup configuration:

```
Device# configure terminal
Device(config)# ip ftp username netadmin1
Device(config)# ip ftp password mypass
Device(config)# end
Device# copy ftp: nvram:startup-config
Address of remote host [255.255.255.255]? 172.16.101.101
Name of configuration file[host1-confg]? host2-confg
Configure using host2-confg from 172.16.101.101?[confirm]
Connected to 172.16.101.101
Loading 1112 byte file host2-confg:![OK]
[OK]
Device#
%SYS-5-CONFIG_NV:Non-volatile store configured from host2-config by ftp from 172.16.101.101
```

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Maintaining Configuration Files Larger than NVRAM

To maintain a configuration file that exceeds the size of NVRAM, perform the tasks described in the following sections:

Compressing the Configuration File

To compress configuration files, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **service compress-config**
4. **end**
5. Do one of the following:
   - Use FTP, RCP, or TFTP to copy the new configuration.
   - **configure terminal**
6. **copy system:running-config nvram:startup-config**

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	**service compress-config** **Example:** `Device(config)# service compress-config`	Specifies that the configuration file be compressed.
Step 4	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 5	Do one of the following: • Use FTP, RCP, or TFTP to copy the new configuration. • **configure terminal** **Example:** `Device# configure terminal`	Enters the new configuration: • If you try to load a configuration that is more than three times larger than the NVRAM size, the following error message is displayed: "[buffer overflow - *file-size* /*buffer-size* bytes]."

	Command or Action	Purpose
Step 6	**copy system:running-config nvram:startup-config** **Example:** `Device(config)# copy system:running-config nvram:startup-config`	When you have finished changing the running-configuration, save the new configuration.

Examples

The following example compresses a 129-KB configuration file to 11 KB:

```
Device# configure terminal

Device(config)# service compress-config

Device(config)# end

Device# copy tftp://172.16.2.15/tokyo-confg system:running-config

Configure using tokyo-confg from 172.16.2.155? [confirm] y

Booting tokyo-confg from 172.16.2.155:!!! [OK - 874/16000 bytes]
Device# copy system:running-config nvram:startup-config

Building configuration...
Compressing configuration from 129648 bytes to 11077 bytes
[OK]
```

Storing the Configuration in Flash Memory on Class A Flash File Systems

To store the startup configuration in flash memory, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy nvram:startup-config** *flash-filesystem:filename*
3. **configure terminal**
4. **boot config flash-filesystem:** *filename*
5. **end**
6. Do one of the following:
   - Use FTP, RCP, or TFTP to copy the new configuration. If you try to load a configuration that is more than three times larger than the NVRAM size, the following error message is displayed: “[buffer overflow - *file-size* /*buffer-size* bytes]. ”
   - **configure terminal**
7. **copy system:running-config nvram:startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy nvram:startup-config** *flash-filesystem:filename* **Example:** `Device# copy nvram:startup-config usbflash0:switch-config`	Copies the current startup configuration to the new location to create the configuration file.
Step 3	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 4	**boot config flash-filesystem:** *filename* **Example:** `Device(config)# boot config usbflash0:switch-config`	Specifies that the startup configuration file be stored in flash memory by setting the CONFIG_FILE variable.
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 6	Do one of the following: • Use FTP, RCP, or TFTP to copy the new configuration. If you try to load a configuration that is more than three times larger than the NVRAM size, the following error message is displayed: “[buffer overflow - *file-size* /*buffer-size* bytes]. ” • **configure terminal** **Example:** `Device# configure terminal`	Enters the new configuration.
Step 7	**copy system:running-config nvram:startup-config** **Example:** `Device(config)# copy system:running-config nvram:startup-config`	When you have finished changing the running-configuration, save the new configuration.

Examples

The following example stores the configuration file in usbflash0:

```
Device# copy nvram:startup-config usbflash0:switch-config
Device# configure terminal
Device(config)# boot config usbflash0:switch-config
Device(config)# end
Device# copy system:running-config nvram:startup-config
```

Loading the Configuration Commands from the Network

To use a network server to store large configurations, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy system:running-config** {**ftp:** | **rcp:** | **tftp:**}
3. **configure terminal**
4. **boot network** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*]}
5. **service config**
6. **end**
7. **copy system:running-config nvram:startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy system:running-config** {**ftp:** | **rcp:** | **tftp:**} **Example:** `Device# copy system:running-config ftp:`	Saves the running configuration to an FTP, RCP, or TFTP server.
Step 3	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 4	**boot network** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*]} **Example:** `Device(config)# boot network ftp://user1:guessme@example.com/dir10/file1`	Specifies that the startup configuration file be loaded from the network server at startup.
Step 5	**service config** **Example:** `Device(config)# service config`	Enables the switch to download configuration files at system startup.
Step 6	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 7	**copy system:running-config nvram:startup-config** **Example:** `Device# copy system:running-config nvram:startup-config`	Saves the configuration.

Copying Configuration Files from Flash Memory to the Startup or Running Configuration

To copy a configuration file from flash memory directly to your startup configuration in NVRAM or your running configuration, enter one of the commands in Step 2:

SUMMARY STEPS

1. **enable**
2. Do one of the following:
   - **copy** *filesystem*: [*partition-number***:**][*filename*] **nvram:startup-config**
   - **copy** *filesystem*: [*partition-number***:**][*filename*] **system:running-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	Do one of the following: • **copy** *filesystem*: [*partition-number***:**][*filename*] **nvram:startup-config** • **copy** *filesystem*: [*partition-number***:**][*filename*] **system:running-config** **Example:** `Device# copy usbflash0:4:ios-upgrade-1 nvram:startup-config`	• Loads a configuration file directly into NVRAM or • Copies a configuration file to your running configuration

Examples

The following example copies the file named ios-upgrade-1 from partition 4 of the flash memory PC Card in usbflash0 to the device startup configurations:

```
Device# copy usbflash0:4:ios-upgrade-1 nvram:startup-config

Copy 'ios-upgrade-1' from flash device as 'startup-config' ? [yes/no] yes

[OK]
```

Copying Configuration Files Between Flash Memory File Systems

On platforms with multiple flash memory file systems, you can copy files from one flash memory file system, such as internal flash memory to another flash memory file system. Copying files to different flash memory file systems lets you create backup copies of working configurations and duplicate configurations for other devices. To copy a configuration file between flash memory file systems, use the following commands in EXEC mode:

SUMMARY STEPS

1. **enable**
2. **show** *source-filesystem*:
3. **copy** *source-filesystem*: [*partition-number***:**][*filename*] *dest-filesystem***:**[*partition-number***:**][*filename*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show** *source-filesystem*: **Example:**	Displays the layout and contents of flash memory to verify the filename.

	Command or Action	Purpose
	`Device# show flash:`	
Step 3	**copy** *source-filesystem*: [*partition-number***:**][*filename*] *dest-filesystem***:**[*partition-number***:**][*filename*] **Example:** `Device# copy flash: usbflash0:`	Copies a configuration file between flash memory devices. • The source device and the destination device cannot be the same. For example, the **copy usbflash0: usbflash0:** command is invalid.

Example

The following example copies the file named running-config from partition 1 on internal flash memory to partition 1 of usbflash0 on a device. In this example, the source partition is not specified, so the device prompts for the partition number:

```
Device# copy flash: usbflash0:

System flash
Partition   Size    Used      Free      Bank-Size  State          Copy Mode
  1         4096K   3070K     1025K     4096K      Read/Write     Direct
  2        16384K   1671K    14712K     8192K      Read/Write     Direct
[Type ?<no> for partition directory; ? for full directory; q to abort]
Which partition? [default = 1]
System flash directory, partition 1:
File  Length   Name/status
  1   3142748  dirt/network/mars-test/c3600-j-mz.latest
  2   850      running-config
[3143728 bytes used, 1050576 available, 4194304 total]
usbflash0 flash directory:
File  Length   Name/status
  1   1711088  dirt/gate/c3600-i-mz
  2   850      running-config
[1712068 bytes used, 2482236 available, 4194304 total]
Source file name? running-config

Destination file name [running-config]?
Verifying checksum for 'running-config' (file # 2)...  OK
Erase flash device before writing? [confirm]
Flash contains files. Are you sure you want to erase? [confirm]
Copy 'running-config' from flash: device
  as 'running-config' into usbflash0: device WITH erase? [yes/no] yes

Erasing device... eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee ...erased!

 [OK - 850/4194304 bytes]
Flash device copy took 00:00:30 [hh:mm:ss]
Verifying checksum...  OK (0x16)
```

Copying a Configuration File from an FTP Server to Flash Memory Devices

To copy a configuration file from an FTP server to a flash memory device, complete the task in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip ftp username** *username*
4. **ip ftp password** *password*
5. **end**
6. **copy ftp:** [[//*location*]/*directory*]/*bundle_name* **flash:**

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`	(Optional) Enters global configuration mode. This step is required only if you override the default remote username or password (see Steps 3 and 4).
Step 3	**ip ftp username** *username* **Example:** `Device(config)# ip ftp username Admin01`	(Optional) Specifies the remote username.
Step 4	**ip ftp password** *password* **Example:** `Device(config)# ip ftp password adminpassword`	(Optional) Specifies the remote password.
Step 5	**end** **Example:** `Device(config)# end`	(Optional) Exits configuration mode. This step is required only if you override the default remote username (see Steps 3 and 4).

Step 6	**copy ftp:** [[//*location*]/*directory*]/*bundle_name* **flash:**
	Example:
	`Device>copy`
	`ftp:/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin`
	`flash:`
		Copies the configuration file from a network server to the flash memory device using FTP.

What to Do Next

After you have issued the **copy** EXEC command, you may be prompted for additional information or for confirmation of the action. The prompt displayed depends on how much information you provide in the **copy** command and the current setting of the **file prompt** global configuration command.

Copying a Configuration File from an RCP Server to Flash Memory Devices

To copy a configuration file from an RCP server to a flash memory device, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip rcmd remote-username** *username*
4. **end**
5. **copy rcp:** [[[//[*username*@]*location*]/*directory*] /*bundle_name*] **flash:**

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`	(Optional) Enters global configuration mode. This step is required only if you override the default remote username or password (see Step 3).
Step 3	**ip rcmd remote-username** *username* **Example:** `Device(config)# ip rcmd remote-username Admin01`	(Optional) Specifies the remote username.
Step 4	**end** **Example:** `Device(config)# end`	(Optional) Exits configuration mode. This step is required only if you override the default remote username or password (see Step 3).
Step 5	**copy rcp:** [[[//[*username*@]*location*]/*directory*] /*bundle_name*] **flash:** **Example:** `Device# copy rcp://netadmin@172.16.101.101/bundle1 flash:`	Copies the configuration file from a network server to the flash memory device using RCP. Respond to any device prompts for additional information or confirmation. Prompting depends on how much information you provide in the **copy** command and the current setting of the **file prompt** command.

Copying a Configuration File from a TFTP Server to Flash Memory Devices

To copy a configuration file from a TFTP server to a flash memory device, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy tftp:** [[[//*location*]/*directory*]/bundle_name **flash:**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

Step 2	**copy tftp:** [[[//*location*]/*directory*]/bundle_name **flash:**
	Example:
	`Device#`
	`copy`
	`tftp:/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin`
	`flash:`
		Copies the file from a TFTP server to the flash memory device. Reply to any device prompts for additional information or confirmation. Prompting depends on how much information you provide in the **copy** command and the current setting of the **file prompt** command.

Examples

The following example shows the copying of the configuration file named switch-config from a TFTP server to the flash memory card inserted in usbflash0. The copied file is renamed new-config.

```
Device#
copy tftp:switch-config usbflash0:new-config
```

Re-executing the Configuration Commands in the Startup Configuration File

To re-execute the commands located in the startup configuration file, complete the task in this section:

SUMMARY STEPS

1. **enable**
2. **configure memory**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure memory** **Example:** `Device# configure memory`	Re-executes the configuration commands located in the startup configuration file.

Clearing the Startup Configuration

You can clear the configuration information from the startup configuration. If you reboot the device with no startup configuration, the device enters the Setup command facility so that you can configure the device from scratch. To clear the contents of your startup configuration, complete the task in this section:

SUMMARY STEPS

1. **enable**
2. **erase nvram**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**erase nvram** **Example:** `Device# erase nvram`	Clears the contents of your startup configuration. **Note** For all platforms except the Class A Flash file system platforms, this command erases NVRAM. The startup configuration file cannot be restored once it has been deleted. On Class A Flash file system platforms, when you use the **erase startup-config** EXEC command, the device erases or deletes the configuration pointed to by the CONFIG_FILE environment variable. If this variable points to NVRAM, the device erases NVRAM. If the CONFIG_FILE environment variable specifies a flash memory device and configuration filename, the device deletes the configuration file. That is, the device marks the file as “deleted,” rather than erasing it. This feature allows you to recover a deleted file.

Deleting a Specified Configuration File

To delete a specified configuration on a specific flash device, complete the task in this section:

SUMMARY STEPS

1. **enable**
2. **delete** *flash-filesystem***:***filename*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**delete** *flash-filesystem***:***filename* **Example:** `Device# delete usbflash0:myconfig`	Deletes the specified configuration file on the specified flash device. **Note** On Class A and B Flash file systems, when you delete a specific file in flash memory, the system marks the file as deleted, allowing you to later recover a deleted file using the **undelete** EXEC command. Erased files cannot be recovered. To permanently erase the configuration file, use the **squeeze** EXEC command. On Class C Flash file systems, you cannot recover a file that has been deleted. If you attempt to erase or delete the configuration file specified by the CONFIG_FILE environment variable, the system prompts you to confirm the deletion.

Specifying the CONFIG_FILE Environment Variable on Class A Flash File Systems

On Class A flash file systems, you can configure the Cisco IOS software to load the startup configuration file specified by the CONFIG_FILE environment variable. The CONFIG_FILE variable defaults to NVRAM. To change the CONFIG_FILE environment variable, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **copy** [*flash-url* | *ftp-url* | *rcp-url* | *tftp-url* | **system:running-config** | **nvram:startup-config**] *dest-flash-url*
3. **configure terminal**
4. **boot config** *dest-flash-url*
5. **end**
6. **copy system:running-config nvram:startup-config**
7. **show boot**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy** [*flash-url* | *ftp-url* | *rcp-url* | *tftp-url* | **system:running-config** | **nvram:startup-config**] *dest-flash-url* **Example:** `Device# copy system:running-config nvram:startup-config`	Copies the configuration file to the flash file system from which the device loads the file on restart.
Step 3	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 4	**boot config** *dest-flash-url* **Example:** `Device(config)# boot config 172.16.1.1`	Sets the CONFIG_FILE environment variable. This step modifies the runtime CONFIG_FILE environment variable.
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 6	**copy system:running-config nvram:startup-config** **Example:** `Device# copy system:running-config nvram:startup-config`	Saves the configuration performed in Step 3 to the startup configuration.
Step 7	**show boot** **Example:** `Device# show boot`	(Optional) Allows you to verify the contents of the CONFIG_FILE environment variable.

Examples

The following example copies the running configuration file to the device. This configuration is then used as the startup configuration when the system is restarted:

```
Device# copy system:running-config usbflash0:config2
```

```
Device# configure terminal
Device(config)# boot config usbflash0:config2
Device(config)# end
Device# copy system:running-config nvram:startup-config
[ok]
Device# show boot
BOOT variable = usbflash0:rsp-boot-m
CONFIG_FILE variable = nvram:
Current CONFIG_FILE variable = usbflash0:config2
Configuration register is 0x010F
```

What to Do Next

After you specify a location for the startup configuration file, the **nvram:startup-config** command is aliased to the new location of the startup configuration file. The **more nvram:startup-config** EXEC command displays the startup configuration, regardless of its location. The **erase nvram:startup-config** EXEC command erases the contents of NVRAM and deletes the file pointed to by the CONFIG_FILE environment variable.

When you save the configuration using the **copy system:running-config nvram:startup-config** command, the device saves a complete version of the configuration file to the location specified by the CONFIG_FILE environment variable and a distilled version to NVRAM. A distilled version is one that does not contain access list information. If NVRAM contains a complete configuration file, the device prompts you to confirm your overwrite of the complete version with the distilled version. If NVRAM contains a distilled configuration, the device does not prompt you for confirmation and proceeds with overwriting the existing distilled configuration file in NVRAM.

Note If you specify a file in a flash device as the CONFIG_FILE environment variable, every time you save your configuration file with the **copy system:running-config nvram:startup-config** command, the old configuration file is marked as "deleted," and the new configuration file is saved to that device. Eventually, Flash memory fills up as the old configuration files still take up memory. Use the **squeeze** EXEC command to permanently delete the old configuration files and reclaim the space.

Configuring the Device to Download Configuration Files

You can specify an ordered list of network configuration and host configuration filenames. The Cisco IOS XE software scans this list until it loads the appropriate network or host configuration file.

To configure the device to download configuration files at system startup, perform at least one of the tasks described in the following sections:

- Configuring the Device to Download the Network Configuration File
- Configuring the Device to Download the Host Configuration File

If the device fails to load a configuration file during startup, it tries again every 10 minutes (the default setting) until a host provides the requested files. With each failed attempt, the device displays the following message on the console terminal:

```
Booting host-confg... [timed out]
```

If there are any problems with the startup configuration file, or if the configuration register is set to ignore NVRAM, the device enters the Setup command facility.

Configuring the Device to Download the Network Configuration File

To configure the Cisco IOS software to download a network configuration file from a server at startup, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **boot network** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*]}
4. **service config**
5. **end**
6. **copy system:running-config nvram:startup-config**

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	**boot network** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*]} **Example:** `Device(config)# boot network tftp:hostfile1`	Specifies the network configuration file to download at startup, and the protocol to be used (TFTP, RCP, or FTP). • If you do not specify a network configuration filename, the Cisco IOS software uses the default filename network-confg. If you omit the address, the device uses the broadcast address. • You can specify more than one network configuration file. The software tries them in order entered until it loads one. This procedure can be useful for keeping files with different configuration information loaded on a network server.
Step 4	**service config** **Example:** `Device(config)# service config`	Enables the system to automatically load the network file on restart.

	Command or Action	Purpose
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 6	**copy system:running-config nvram:startup-config** **Example:** `Device# copy system:running-config nvram:startup-config`	Saves the running configuration to the startup configuration file.

Configuring the Device to Download the Host Configuration File

To configure the Cisco IOS software to download a host configuration file from a server at startup, complete the tasks in this section:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **boot host** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*] }
4. **service config**
5. **end**
6. **copy system:running-config nvram:startup-config**

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	**boot host** {**ftp:**[[[//[*username* [**:***password*]**@**]*location*]/*directory*]/*filename*] | **rcp:**[[[//[*username***@**]*location*]/*directory*]/*filename*] | **tftp:**[[[//*location*]/*directory*]/*filename*] } **Example:** `Device(config)# boot host tftp:hostfile1`	Specifies the host configuration file to download at startup, and the protocol to be used (FTP, RCP, or TFTP): • If you do not specify a host configuration filename, the device uses its own name to form a host configuration filename by converting the name to all lowercase letters, removing all domain information, and appending “-confg.” If no host name information is available, the software uses the default host

	Command or Action	Purpose
		configuration filename device-confg. If you omit the address, the device uses the broadcast address. • You can specify more than one host configuration file. The Cisco IOS software tries them in order entered until it loads one. This procedure can be useful for keeping files with different configuration information loaded on a network server.
Step 4	**service config** **Example:** `Device(config)# service config`	Enables the system to automatically load the host file upon restart.
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode.
Step 6	**copy system:running-config nvram:startup-config** **Example:** `Device# copy system:running-config nvram:startup-config`	Saves the running configuration to the startup configuration file.

Example

In the following example, a device is configured to download the host configuration file named hostfile1 and the network configuration file named networkfile1. The device uses TFTP and the broadcast address to obtain the file:

```
Device# configure terminal
Device(config)# boot host tftp:hostfile1
Device(config)# boot network tftp:networkfile1
Device(config)# service config
Device(config)# end
Device# copy system:running-config nvram:startup-config
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS configuration commands	*Cisco IOS Configuration Fundamentals Command Reference*

Error Message Decoder

Description	Link
To help you research and resolve system error messages in this release, use the Error Message Decoder tool.	https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified	--

MIBs

MIB	MIBs Link
• No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 10

Configuration Replace and Configuration Rollback

Prerequisites for Configuration Replace and Configuration Rollback

The format of the configuration files used as input by the Configuration Replace and Configuration Rollback feature must comply with standard Cisco software configuration file indentation rules as follows:

- Start all commands on a new line with no indentation, unless the command is within a configuration submode.
- Indent commands within a first-level configuration submode one space.
- Indent commands within a second-level configuration submode two spaces.
- Indent commands within subsequent submodes accordingly.

These indentation rules describe how the software creates configuration files for such commands as **show running-config** or **copy running-config** *destination-url*. Any configuration file generated on a Cisco device complies with these rules.

Free memory larger than the combined size of the two configuration files (the current running configuration and the saved replacement configuration) is required.

Restrictions for Configuration Replace and Configuration Rollback

If the device does not have free memory larger than the combined size of the two configuration files (the current running configuration and the saved replacement configuration), the configuration replace operation is not performed.

Certain Cisco configuration commands such as those pertaining to physical components of a networking device (for example, physical interfaces) cannot be added or removed from the running configuration. For example, a configuration replace operation cannot remove the **interface ethernet 0** command line from the current running configuration if that interface is physically present on the device. Similarly, the **interface ethernet 1** command line cannot be added to the running configuration if no such interface is physically present on the device. A configuration replace operation that attempts to perform these types of changes results in error messages indicating that these specific command lines failed.

In very rare cases, certain Cisco configuration commands cannot be removed from the running configuration without reloading the device. A configuration replace operation that attempts to remove this type of command results in error messages indicating that these specific command lines failed.

Information About Configuration Replace and Configuration Rollback

Configuration Archive

The Cisco IOS configuration archive is intended to provide a mechanism to store, organize, and manage an archive of Cisco IOS configuration files to enhance the configuration rollback capability provided by the **configure replace** command. Before this feature was introduced, you could save copies of the running configuration using the **copy running-config** *destination-url* command, storing the replacement file either locally or remotely. However, this method lacked any automated file management. On the other hand, the Configuration Replace and Configuration Rollback feature provides the capability to automatically save copies of the running configuration to the Cisco IOS configuration archive. These archived files serve as checkpoint configuration references and can be used by the **configure replace** command to revert to previous configuration states.

The **archive config** command allows you to save Cisco IOS configurations in the configuration archive using a standard location and filename prefix that is automatically appended with an incremental version number (and optional timestamp) as each consecutive file is saved. This functionality provides a means for consistent identification of saved Cisco IOS configuration files. You can specify how many versions of the running configuration are kept in the archive. After the maximum number of files are saved in the archive, the oldest file is automatically deleted when the next, most recent file is saved. The **show archive** command displays information for all configuration files saved in the Cisco IOS configuration archive.

The Cisco IOS configuration archive, in which the configuration files are stored and available for use with the **configure replace** command, can be located on the following file systems: FTP, HTTP, RCP, TFTP.

Configuration Replace

The **configure replace** privileged EXEC command provides the capability to replace the current running configuration with any saved Cisco IOS configuration file. This functionality can be used to revert to a previous configuration state, effectively rolling back any configuration changes that were made since the previous configuration state was saved.

When using the **configure replace** command, you must specify a saved Cisco IOS configuration as the replacement configuration file for the current running configuration. The replacement file must be a complete configuration generated by a Cisco IOS device (for example, a configuration generated by the **copy running-config** *destination-url* command), or, if generated externally, the replacement file must comply with the format of files generated by Cisco IOS devices. When the **configure replace** command is entered, the current running configuration is compared with the specified replacement configuration and a set of diffs is generated. The algorithm used to compare the two files is the same as that employed by the **show archive config differences** command. The resulting diffs are then applied by the Cisco IOS parser to achieve the replacement configuration state. Only the diffs are applied, avoiding potential service disruption from reapplying configuration commands that already exist in the current running configuration. This algorithm effectively handles configuration changes to order-dependent commands (such as access lists) through a multiple pass process. Under normal circumstances, no more than three passes are needed to complete a configuration replace operation, and a limit of five passes is performed to preclude any looping behavior.

The Cisco IOS **copy** *source-url* **running-config** privileged EXEC command is often used to copy a stored Cisco IOS configuration file to the running configuration. When using the **copy** *source-url* **running-config** command as an alternative to the **configure replace** *target-url* privileged EXEC command, the following major differences should be noted:

- The **copy** *source-url* **running-config** command is a merge operation and preserves all of the commands from both the source file and the current running configuration. This command does not remove commands from the current running configuration that are not present in the source file. In contrast, the **configure replace** *target-url* command removes commands from the current running configuration that are not present in the replacement file and adds commands to the current running configuration that need to be added.
- The **copy** *source-url* **running-config** command applies every command in the source file, whether or not the command is already present in the current running configuration. This algorithm is inefficient and, in some cases, can result in service outages. In contrast, the **configure replace** *target-url* command only applies the commands that need to be applied—no existing commands in the current running configuration are reapplied.
- A partial configuration file may be used as the source file for the **copy** *source-url* **running-config** command, whereas a complete Cisco IOS configuration file must be used as the replacement file for the **configure replace** *target-url* command.

A locking feature for the configuration replace operation was introduced. When the **configure replace** command is used, the running configuration file is locked by default for the duration of the configuration replace operation. This locking mechanism prevents other users from changing the running configuration while the replacement operation is taking place, which might otherwise cause the replacement operation to terminate unsuccessfully. You can disable the locking of the running configuration by using the **no lock** keyword when issuing the **configure replace** command.

The running configuration lock is automatically cleared at the end of the configuration replace operation. You can display any locks that may be currently applied to the running configuration using the **show configuration lock** command.

Configuration Rollback

The concept of rollback comes from the transactional processing model common to database operations. In a database transaction, you might make a set of changes to a given database table. You then must choose whether to commit the changes (apply the changes permanently) or to roll back the changes (discard the changes and revert to the previous state of the table). In this context, rollback means that a journal file containing a log of the changes is discarded, and no changes are applied. The result of the rollback operation is to revert to the previous state, before any changes were applied.

The **configure replace** command allows you to revert to a previous configuration state, effectively rolling back changes that were made since the previous configuration state was saved. Instead of basing the rollback operation on a specific set of changes that were applied, the Cisco IOS configuration rollback capability uses the concept of reverting to a specific configuration state based on a saved Cisco IOS configuration file. This concept is similar to the database idea of saving a checkpoint (a saved version of the database) to preserve a specific state.

If the configuration rollback capability is desired, you must save the Cisco IOS running configuration before making any configuration changes. Then, after entering configuration changes, you can use that saved configuration file to roll back the changes (using the **configure replace** *target-url* command). Furthermore, because you can specify any saved Cisco IOS configuration file as the replacement configuration, you are not limited to a fixed number of rollbacks, as is the case in some rollback models.

Configuration Rollback Confirmed Change

The Configuration Rollback Confirmed Change feature allows configuration changes to be performed with an optional requirement that they be confirmed. If this confirmation is not received, the configuration is returned to the state prior to the changes being applied. The mechanism provides a safeguard against inadvertent loss of connectivity between a network device and the user or management application due to configuration changes.

Benefits of Configuration Replace and Configuration Rollback

- Allows you to revert to a previous configuration state, effectively rolling back configuration changes.
- Allows you to replace the current running configuration file with the startup configuration file without having to reload the device or manually undo CLI changes to the running configuration file, therefore reducing system downtime.
- Allows you to revert to any saved Cisco IOS configuration state.
- Simplifies configuration changes by allowing you to apply a complete configuration file to the device, where only the commands that need to be added or removed are affected.
- When using the **configure replace** command as an alternative to the **copy** *source-url* **running-config** command, increases efficiency and prevents risk of service outages by not reapplying existing commands in the current running configuration.

How to Use Configuration Replace and Configuration Rollback

Creating a Configuration Archive

No prerequisite configuration is needed to use the **configure replace** command. Using the **configure replace** command in conjunction with the Cisco IOS configuration archive and the **archive config** command is optional but offers significant benefit for configuration rollback scenarios. Before using the **archive config** command, the configuration archive must be configured. Perform this task to configure the characteristics of the configuration archive.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **archive**
4. **path** *url*
5. **maximum** *number*
6. **time-period** *minutes*
7. **end**
8. **archive config**

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	**archive** **Example:** `Device(config)# archive`	Enters archive configuration mode.
Step 4	**path** *url* **Example:** `Device(config-archive)# path flash:myconfiguration`	Specifies the location and filename prefix for the files in the Cisco IOS configuration archive. **Note** If a directory is specified in the path instead of file, the directory name must be followed by a forward slash as follows: path flash:/directory/. The forward slash is not necessary after a filename; it is only necessary when specifying a directory.

	Command or Action	Purpose
Step 5	**maximum** *number* **Example:** `Device(config-archive)# maximum 14`	(Optional) Sets the maximum number of archive files of the running configuration to be saved in the Cisco IOS configuration archive. • The *number* argument is the maximum number of archive files of the running configuration to be saved in the Cisco IOS configuration archive. Valid values are from 1 to 14. The default is 10. **Note** Before using this command, you must configure the **path** command to specify the location and filename prefix for the files in the Cisco IOS configuration archive.
Step 6	**time-period** *minutes* **Example:** `Device(config-archive)# time-period 1440`	(Optional) Sets the time increment for automatically saving an archive file of the current running configuration in the Cisco IOS configuration archive. • The *minutes* argument specifies how often, in minutes, to automatically save an archive file of the current running configuration in the Cisco IOS configuration archive. **Note** Before using this command, you must configure the **path** command to specify the location and filename prefix for the files in the Cisco IOS configuration archive.
Step 7	**end** **Example:** `Device(config-archive)# end`	Exits to privileged EXEC mode.
Step 8	**archive config** **Example:** `Device# archive config`	Saves the current running configuration file to the configuration archive. **Note** The **path** command must be configured before using this command.

Performing a Configuration Replace or Configuration Rollback Operation

Perform this task to replace the current running configuration file with a saved Cisco IOS configuration file.

Note You must create a configuration archive before performing this procedure. See Creating a Configuration Archive for detailed steps. The following procedure details how to return to that archived configuration in the event of a problem with the current running configuration.

SUMMARY STEPS

1. **enable**
2. **configure replace** *target-url* [**nolock**] [**list**] [**force**] [**ignore case**] [**revert trigger** [**error**] [**timer** *minutes*] | **time** *minutes*]]
3. **configure revert** { **now** | **timer** {*minutes* | **idle** *minutes*} }
4. **configure confirm**
5. **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 replace** *target-url* [**nolock**] [**list**] [**force**] [**ignore case**] [**revert trigger** [**error**] [**timer** *minutes*] | **time** *minutes*]] **Example:** `Device# configure replace flash: startup-config time 120`	Replaces the current running configuration file with a saved Cisco IOS configuration file. • The *target - url* argument is a URL (accessible by the Cisco IOS file system) of the saved Cisco IOS configuration file that is to replace the current running configuration, such as the configuration file created using the **archive config** command. • The **list** keyword displays a list of the command lines applied by the Cisco IOS software parser during each pass of the configuration replace operation. The total number of passes performed is also displayed. • The **force** keyword replaces the current running configuration file with the specified saved Cisco IOS configuration file without prompting you for confirmation. • The **time** *minutes* keyword and argument specify the time (in minutes) within which you must enter the **configure confirm** command to confirm replacement of the current running configuration file. If the **configure confirm** command is not entered within the specified time limit, the configuration replace operation is automatically reversed (in other words, the current running configuration file is restored to the configuration state that existed prior to entering the **configure replace** command). • The **nolock** keyword disables the locking of the running configuration file that prevents other users from changing the running configuration during a configuration replace operation.

	Command or Action	Purpose

		• The **revert trigger** keywords set the following triggers for reverting to the original configuration:
		  • **error** —Reverts to the original configuration upon error.
		  • **timer** *minutes* —Reverts to the original configuration if specified time elapses.
		• The **ignore case** keyword allows the configuration to ignore the case of the confirmation command.

Step 3	**configure revert** { **now** | **timer** {*minutes* | **idle** *minutes*} }
	Example:
	`Device# configure revert now`
		(Optional) To cancel the timed rollback and trigger the rollback immediately, or to reset parameters for the timed rollback, use the **configure revert**command in privileged EXEC mode.
		• **now** —Triggers the rollback immediately.
		• **timer** —Resets the configuration revert timer.
		  • Use the *minutes* argument with the **timer** keyword to specify a new revert time in minutes.
		  • Use the **idle** keyword along with a time in minutes to set the maximum allowable time period of no activity before reverting to the saved configuration.

Step 4	**configure confirm** **Example:** `Device# configure confirm`	(Optional) Confirms replacement of the current running configuration file with a saved Cisco IOS configuration file. **Note** Use this command only if the **time** *seconds* keyword and argument of the **configure replace** command are specified.
Step 5	**exit** **Example:** `Device# exit`	Exits to user EXEC mode.

Monitoring and Troubleshooting the Feature

Perform this task to monitor and troubleshoot the Configuration Replace and Configuration Rollback feature.

SUMMARY STEPS

1. **enable**
2. **show archive**
3. **debug archive versioning**
4. **debug archive config timestamp**

5. **exit**

DETAILED STEPS

Step 1 **enable**

Use this command to enable privileged EXEC mode. Enter your password if prompted.

Example:

```
Device> enable
Device#
```

Step 2 **show archive**

Use this command to display information about the files saved in the Cisco IOS configuration archive.

Example:

```
Device# show archive
There are currently 1 archive configurations saved.
The next archive file will be named flash:myconfiguration-2
 Archive #  Name
   0
   1       flash:myconfiguration-1 <- Most Recent
   2
   3
   4
   5
   6
   7
   8
   9
   10
   11
   12
   13
   14
```

The following is sample output from the **show archive** command after several archive files of the running configuration have been saved. In this example, the maximum number of archive files to be saved is set to three.

Example:

```
Device# show archive
There are currently 3 archive configurations saved.
The next archive file will be named flash:myconfiguration-8
 Archive #  Name
   0
   1       :Deleted
   2       :Deleted
   3       :Deleted
   4       :Deleted
   5       flash:myconfiguration-5
   6       flash:myconfiguration-6
   7       flash:myconfiguration-7 <- Most Recent
   8
   9
   10
   11
```

```
12
13
14
```

Step 3 **debug archive versioning**

Use this command to enable debugging of the Cisco IOS configuration archive activities to help monitor and troubleshoot configuration replace and rollback.

Example:

```
Device# debug archive versioning
Jan  9 06:46:28.419:backup_running_config
Jan  9 06:46:28.419:Current = 7
Jan  9 06:46:28.443:Writing backup file flash:myconfiguration-7
Jan  9 06:46:29.547: backup worked
```

Step 4 **debug archive config timestamp**

Use this command to enable debugging of the processing time for each integral step of a configuration replace operation and the size of the configuration files being handled.

Example:

```
Device# debug archive config timestamp
Device# configure replace flash:myconfiguration force
Timing Debug Statistics for IOS Config Replace operation:
       Time to read file usbflash0:sample_2.cfg = 0 msec (0 sec)
       Number of lines read:55
       Size of file        :1054
Starting Pass 1
       Time to read file system:running-config = 0 msec (0 sec)
       Number of lines read:93
       Size of file        :2539
       Time taken for positive rollback pass = 320 msec (0 sec)
       Time taken for negative rollback pass = 0 msec (0 sec)
       Time taken for negative incremental diffs pass = 59 msec (0 sec)
       Time taken by PI to apply changes = 0 msec (0 sec)
       Time taken for Pass 1 = 380 msec (0 sec)
Starting Pass 2
       Time to read file system:running-config = 0 msec (0 sec)
       Number of lines read:55
       Size of file        :1054
       Time taken for positive rollback pass = 0 msec (0 sec)
       Time taken for negative rollback pass = 0 msec (0 sec)
       Time taken for Pass 2 = 0 msec (0 sec)
Total number of passes:1
Rollback Done
```

Step 5 **exit**

Use this command to exit to user EXEC mode.

Example:

```
Device# exit
Device>
```

Configuration Examples for Configuration Replace and Configuration Rollback

Creating a Configuration Archive

The following example shows how to perform the initial configuration of the Cisco IOS configuration archive. In this example, flash:myconfiguration is specified as the location and filename prefix for the files in the configuration archive and a value of 10 is set as the maximum number of archive files to be saved.

```
configure terminal
!
archive
 path flash:myconfiguration
 maximum 10
end
```

Replacing the Current Running Configuration with a Saved Cisco IOS Configuration File

The following example shows how to replace the current running configuration with a saved Cisco IOS configuration file named flash:myconfiguration. The **configure replace** command interactively prompts you to confirm the operation.

```
Device# configure replace flash:myconfiguration
This will apply all necessary additions and deletions
to replace the current running configuration with the
contents of the specified configuration file, which is
assumed to be a complete configuration, not a partial
configuration. Enter Y if you are sure you want to proceed. ? [no]: Y
Total number of passes: 1
Rollback Done
```

In the following example, the **list** keyword is specified in order to display the command lines that were applied during the configuration replace operation:

```
Device# configure replace flash:myconfiguration list
This will apply all necessary additions and deletions
to replace the current running configuration with the
contents of the specified configuration file, which is
assumed to be a complete configuration, not a partial
configuration. Enter Y if you are sure you want to proceed. ? [no]: Y
!Pass 1
!List of Commands:
no snmp-server community public ro
snmp-server community mystring ro

end
Total number of passes: 1
Rollback Done
```

Reverting to the Startup Configuration File

The following example shows how to revert to the Cisco IOS startup configuration file using the **configure replace** command. This example also shows the use of the optional **force** keyword to override the interactive user prompt:

```
Device# configure replace flash:startup-config force
Total number of passes: 1
Rollback Done
```

Performing a Configuration Replace Operation with the configure confirm Command

The following example shows the use of the **configure replace** command with the **time** *minutes* keyword and argument. You must enter the **configure confirm** command within the specified time limit to confirm replacement of the current running configuration file. If the **configure confirm** command is not entered within the specified time limit, the configuration replace operation is automatically reversed (in other words, the current running configuration file is restored to the configuration state that existed prior to entering the **configure replace** command).

```
Device# configure replace flash:startup-config time 120
This will apply all necessary additions and deletions
to replace the current running configuration with the
contents of the specified configuration file, which is
assumed to be a complete configuration, not a partial
configuration. Enter Y if you are sure you want to proceed. ? [no]: Y
Total number of passes: 1
Rollback Done
Device# configure confirm
```

The following example shows the use of the **configure revert** command with the **timer** keyword. You must enter the **configure revert** command to cancel the timed rollback and trigger the rollback immediately, or to reset parameters for the timed rollback.

```
Device# configure revert timer 100
```

Performing a Configuration Rollback Operation

The following example shows how to make changes to the current running configuration and then roll back the changes. As part of the configuration rollback operation, you must save the current running configuration before making changes to the file. In this example, the **archive config** command is used to save the current running configuration. The generated output of the **configure replace** command indicates that only one pass was performed to complete the rollback operation.

Note Before using the **archive config** command, you must configure the **path** command to specify the location and filename prefix for the files in the Cisco IOS configuration archive.

You first save the current running configuration in the configuration archive as follows:

```
archive config
```

You then enter configuration changes as shown in the following example:

```
configure terminal
!
user netops2 password rain
user netops3 password snow
exit
```

After having made changes to the running configuration file, assume you now want to roll back these changes and revert to the configuration that existed before the changes were made. The **show archive** command is used to verify the version of the configuration to be used as a replacement file. The **configure replace** command is then used to revert to the replacement configuration file as shown in the following example:

```
Device# show archive
There are currently 1 archive configurations saved.
The next archive file will be named flash:myconfiguration-2
 Archive #  Name
   0
   1       flash:myconfiguration-1 <- Most Recent
   2
   3
   4
   5
   6
   7
   8
   9
   10
Device# configure replace flash:myconfiguration-1
Total number of passes: 1
Rollback Done
```

Additional References

Related Documents

Related Topic	Document Title
Configuration Locking	*Exclusive Configuration Change Access and Access Session Locking*
Commands for managing configuration files	*Cisco IOS Configuration Fundamentals Command Reference*
Information about managing configuration files	*Managing Configuration Files*

Error Message Decoder

Description	Link
To help you research and resolve system error messages in this release, use the Error Message Decoder tool.	https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 11

Working with the Flash File System

Information About the Flash File System

The flash file system is a single flash device on which you can store files. It also provides several commands to help you manage software bundles and configuration files. The default flash file system on the device is named flash:.

As viewed from the active device, or any stack member, flash: refers to the local flash device, which is the device attached to the same device on which the file system is being viewed. In a device stack, each of the flash devices from the various stack members can be viewed from the active device. The names of these flash file systems include the corresponding device member numbers. For example, flash-3:, as viewed from the active device, refers to the same file system as does flash: on stack member 3. Use the **show file systems** privileged EXEC command to list all file systems, including the flash file systems in the device stack.

Only one user at a time can manage the software bundles and configuration files for a device stack .

Displaying Available File Systems

To display the available file systems on your device, use the **show file systems** privileged EXEC command as shown in this example for a standalone device:

```
Device# show file systems
File Systems:
     Size(b)      Free(b)        Type    Flags    Prefixes
*   15998976      5135872       flash      rw     flash:
           -            -      opaque      rw     bs:
           -            -      opaque      rw     vb:
```

```
     524288      520138      nvram     rw     nvram:
          -           -    network     rw     tftp:
          -           -     opaque     rw     null:
          -           -     opaque     rw     system:
          -           -     opaque     ro     xmodem:
          -           -     opaque     ro     ymodem:
```

This example shows a device stack. In this example, the active device is stack member 1; the file system on stack member 2 is displayed as flash-2:, the file system on stack member 3 is displayed as flash-3: and so on up to stack member 9, displayed as flash-9: for a 9-member stack. The example also shows the crashinfo directories and a USB flash drive plugged into the active device:

```
Device# show file systems
File Systems:
      Size(b)        Free(b)       Type   Flags   Prefixes
     145898496      5479424       disk     rw    crashinfo:crashinfo-1:
     248512512     85983232       disk     rw    crashinfo-2:stby-crashinfo:
     146014208     17301504       disk     rw    crashinfo-3:
     146014208            0       disk     rw    crashinfo-4:
     146014208      1572864       disk     rw    crashinfo-5:
     248512512     30932992       disk     rw    crashinfo-6:
     146014208      6291456       disk     rw    crashinfo-7:
     146276352     15728640       disk     rw    crashinfo-8:
     146276352     73400320       disk     rw    crashinfo-9:
*    741621760    481730560       disk     rw    flash:flash-1:
    1622147072   1360527360       disk     rw    flash-2:stby-flash:
     729546752    469762048       disk     rw    flash-3:
     729546752    469762048       disk     rw    flash-4:
     729546752    469762048       disk     rw    flash-5:
    1622147072   1340604416       disk     rw    flash-6:
     729546752    469762048       disk     rw    flash-7:
    1749549056   1487929344       disk     rw    flash-8:
    1749549056   1487929344       disk     rw    flash-9:
             0            0       disk     rw    unix:
             -            -       disk     rw    usbflash0:usbflash0-1:
             -            -       disk     rw    usbflash0-2: stby-usbflash0:
             -            -       disk     rw    usbflash0-3:
             -            -       disk     rw    usbflash0-4:
             -            -       disk     rw    usbflash0-5:
             -            -       disk     rw    usbflash0-6:
             -            -       disk     rw    usbflash0-7:
             -            -       disk     rw    usbflash0-8:
             -            -       disk     rw    usbflash0-9:
             0            0       disk     ro    webui:
             -            -     opaque     rw    system:
             -            -     opaque     rw    tmpsys:
       2097152      2055643      nvram     rw    stby-nvram:
             -            -      nvram     rw    stby-rcsf:
             -            -     opaque     rw    null:
             -            -     opaque     ro    tar:
             -            -    network     rw    tftp:
       2097152      2055643      nvram     rw    nvram:
             -            -     opaque     wo    syslog:
             -            -    network     rw    rcp:
             -            -    network     rw    http:
             -            -    network     rw    ftp:
             -            -    network     rw    scp:
             -            -    network     rw    https:
             -            -     opaque     ro    cns:
             -            -     opaque     rw    revrcsf:
```

Table 13: show file systems Field Descriptions

Field	Value
Size(b)	Amount of memory in the file system in bytes.
Free(b)	Amount of free memory in the file system in bytes.
Type	Type of file system. **disk**—The file system is for a flash memory device, USB flash, and crashinfo file. **network**—The file system for network devices; for example, an FTP server or and HTTP server. **nvram**—The file system is for a NVRAM device. **opaque**—The file system is a locally generated pseudo file system (for example, the system) or a download interface, such as brimux. **unknown**—The file system is an unknown type.
Flags	Permission for file system. **ro**—read-only. **rw**—read/write. **wo**—write-only.

Field	Value
Prefixes	Alias for file system. **crashinfo:**—Crashinfo file. **flash:**—Flash file system. **ftp:**—FTP server. **http:**—HTTP server. **https:**—Secure HTTP server. **nvram:**—NVRAM. **null:**—Null destination for copies. You can copy a remote file to null to find its size. **rcp:**—Remote Copy Protocol (RCP) server. **scp:**—Session Control Protocol (SCP) server. **system:**—Contains the system memory, including the running configuration. **tftp:**—TFTP network server. **usbflash0:**—USB flash memory. **xmodem:**—Obtain the file from a network machine by using the Xmodem protocol. **ymodem:**—Obtain the file from a network machine by using the Ymodem protocol.

Setting the Default File System

You can specify the file system or directory that the system uses as the default file system by using the **cd** *filesystem:* privileged EXEC command. You can set the default file system to omit the *filesystem:* argument from related commands. For example, for all privileged EXEC commands that have the optional *filesystem:* argument, the system uses the file system specified by the **cd** command.

By default, the default file system is *flash:*.

You can display the current default file system as specified by the **cd** command by using the **pwd** privileged EXEC command.

Displaying Information About Files on a File System

You can view a list of the contents of a file system before manipulating its contents. For example, before copying a new configuration file to flash memory, you might want to verify that the file system does not already contain a configuration file with the same name. Similarly, before copying a flash configuration file to another location, you might want to verify its filename for use in another command. To display information about files on a file system, use one of the privileged EXEC commands listed in the following table.

Table 14: Commands for Displaying Information About Files

Command	Description
dir [/all] [*filesystem:filename***]**	Displays a list of files on a file system.
show file systems	Displays more information about each of the files on a file system.
show file information *file-url*	Displays information about a specific file.
show file descriptors	Displays a list of open file descriptors. File descriptors are the internal representations of open files. You can use this command to see if another user has a file open.

For example, to display a list of all files in a file system, use the **dir** privileged EXEC command:

```
device# dir flash:
Directory of flash:/
7386  -rwx     2097152 Jan 23 2013 14:06:49 +00:00 nvram_config
7378  drwx        4096 Jan 23 2013 09:35:11 +00:00 mnt
7385  -rw-   221775876 Jan 23 2013 14:15:13 +00:00
cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin
7389  -rwx         556 Jan 21 2013 20:47:30 +00:00 vlan.dat
712413184 bytes total (445063168 bytes free)
device#
```

Changing Directories and Displaying the Working Directory

Follow these steps to change directories and to display the working directory:

SUMMARY STEPS

1. **enable**
2. **dir** *filesystem:*
3. **cd** *directory_name*
4. **pwd**
5. **cd**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**dir** *filesystem:* **Example:**	Displays the directories on the specified file system. For *filesystem:*, use flash: for the system board flash device.

	Command or Action	Purpose
	`Device# dir flash:`	To access flash partitions of device members in a stack, use flash-*n* where *n* is the stack member number. For example, flash-4.
Step 3	**cd** *directory_name* **Example:** `Device# cd new_configs`	Navigates to the specified directory. The command example shows how to navigate to the directory named *new_configs*.
Step 4	**pwd** **Example:** `Device# pwd`	Displays the working directory.
Step 5	**cd** **Example:** `Device# cd`	Navigates to the default directory.

Creating Directories

Beginning in privileged EXEC mode, follow these steps to create a directory:

SUMMARY STEPS

1. **dir** *filesystem:*
2. **mkdir** *directory_name*
3. **dir** *filesystem:*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dir** *filesystem:* **Example:** `Device# dir flash:`	Displays the directories on the specified file system. For *filesystem:*, use flash: for the system board flash device.
Step 2	**mkdir** *directory_name* **Example:** `Device# mkdir new_configs`	Creates a new directory. Directory names are case sensitive and are limited to 45 characters between the slashes (/); the name cannot contain control characters, spaces, slashes, quotes, semicolons, or colons.
Step 3	**dir** *filesystem:* **Example:**	Verifies your entry.

	Command or Action	Purpose
	`Device# dir flash:`	

Removing Directories

To remove a directory with all its files and subdirectories, use the **delete /force /recursive** *filesystem:/file-url* privileged EXEC command.

Use the **/recursive** keyword to delete the named directory and all subdirectories and the files contained in it. Use the **/force** keyword to suppress the prompting that confirms a deletion of each file in the directory. You are prompted only once at the beginning of this deletion process.

For *filesystem*, use **flash:** for the system board flash device. For *file-url*, enter the name of the directory to be deleted. All of the files in the directory and the directory are removed.

Caution When directories are deleted, their contents cannot be recovered.

Copying Files

To copy a file from a source to a destination, use the **copy** *source-url destination-url* privileged EXEC command. For the source and destination URLs, you can use **running-config** and **startup-config** keyword shortcuts. For example, the **copy running-config startup-config** command saves the currently running configuration file to the NVRAM section of flash memory to be used as the configuration during system initialization.

You can also copy from special file systems (**xmodem:**, **ymodem:**) as the source for the file from a network machine that uses the Xmodem or Ymodem protocol.

Network file system URLs include ftp:, rcp:, tftp:, scp:, http:, and https: and have these syntaxes:

- FTP—ftp:[[//username [:password]@location]/directory]/filename
- RCP—rcp:[[//username@location]/directory]/filename
- TFTP—tftp:[[//location]/directory]/filename
- SCP—scp:[[//username [:password]@location]/directory]/filename
- HTTP—http:[[//username [:password]@location]/directory]/filename
- HTTPS—https:[[//username [:password]@location]/directory]/filename

Note The password must not contain the special character '@'. If the character '@' is used, the copy fails to parse the IP address of the server.

Local writable file systems include flash:.

Some invalid combinations of source and destination exist. Specifically, you cannot copy these combinations:

- From a running configuration to a running configuration
- From a startup configuration to a startup configuration
- From a device to the same device (for example, the **copy flash: flash:** command is invalid)

Copying Files from One Device in a Stack to Another Device in the Same Stack

To copy a file from one device in a stack to another device in the same stack, use the **flash-X:** notation, where **X** is the device number.

To view all devicees in a stack, use the **show switch** command in privileged EXEC mode, as in the following example of a 9-member device stack:

```
Device# show switch
Switch/Stack Mac Address : 0006.f6b9.b580 - Local Mac Address Mac persistency wait time:
Indefinite
                                             H/W   Current
Switch#   Role    Mac Address     Priority Version  State
------------------------------------------------------------
*1       Active   0006.f6b9.b580     15     P3B     Ready
 2       Standby  0006.f6ba.0c80     14     P3B     Ready
 3       Member   0006.f6ba.3300     7      P3B     Ready
 4       Member   0006.f6b9.df80     6      P3B     Ready
 5       Member   0006.f6ba.3880     13     P1A     Ready
 6       Member   1ce6.c7b6.ef00     4      PP      Ready
 7       Member   2037.06ce.2580     3      P2A     Ready
 8       Member   2037.0653.7e00     2      P5A     Ready
 9       Member   2037.0653.9280     1      P5B     Ready
```

To view all file systems available to copy on a specific device, use the **copy** command as in the following example of a 5-member stack:

```
Device# copy flash: ?
  crashinfo-1:     Copy to crashinfo-1: file system
  crashinfo-2:     Copy to crashinfo-2: file system
  crashinfo-3:     Copy to crashinfo-3: file system
  crashinfo-4:     Copy to crashinfo-4: file system
  crashinfo-5:     Copy to crashinfo-5: file system
  crashinfo:       Copy to crashinfo: file system
  flash-1:         Copy to flash-1: file system
  flash-2:         Copy to flash-2: file system
  flash-3:         Copy to flash-3: file system
  flash-4:         Copy to flash-4: file system
  flash-5:         Copy to flash-5: file system
  flash:           Copy to flash: file system
  ftp:             Copy to ftp: file system
  http:            Copy to http: file system
  https:           Copy to https: file system
  null:            Copy to null: file system
  nvram:           Copy to nvram: file system
  rcp:             Copy to rcp: file system
  revrcsf:         Copy to revrcsf: file system
  running-config   Update (merge with) current system configuration
  scp:             Copy to scp: file system
  startup-config   Copy to startup configuration
  stby-crashinfo:  Copy to stby-crashinfo: file system
  stby-flash:      Copy to stby-flash: file system
  stby-nvram:      Copy to stby-nvram: file system
```

```
  stby-rcsf:        Copy to stby-rcsf: file system
  stby-usbflash0:   Copy to stby-usbflash0: file system
  syslog:           Copy to syslog: file system
  system:           Copy to system: file system
  tftp:             Copy to tftp: file system
  tmpsys:           Copy to tmpsys: file system
  usbflash0-1:      Copy to usbflash0-1: file system
  usbflash0-2:      Copy to usbflash0-2: file system
  usbflash0-3:      Copy to usbflash0-3: file system
  usbflash0-4:      Copy to usbflash0-4: file system
  usbflash0-5:      Copy to usbflash0-5: file system
  usbflash0:        Copy to usbflash0: file system

Device#
```

This example shows how to copy a config file stored in the flash partition of device 2 to the flash partition of device 4. It assumes that device 2 and device 4 are in the same stack.

```
Device# copy flash-2:config.txt flash-4:config.txt
```

Deleting Files

When you no longer need a file on a flash memory device, you can permanently delete it. To delete a file or directory from a specified flash device, use the **delete** [**/force**] [**/recursive**] [*filesystem:*]*/file-url* privileged EXEC command.

Use the **/recursive** keyword for deleting a directory and all subdirectories and the files contained in it. Use the **/force** keyword to suppress the prompting that confirms a deletion of each file in the directory. You are prompted only once at the beginning of this deletion process. Use the **/force** and **/recursive** keywords for deleting old software images that were installed by using the **archive download-sw** command but are no longer needed.

If you omit the *filesystem:* option, the device uses the default device specified by the **cd** command. For *file-url*, you specify the path (directory) and the name of the file to be deleted.

When you attempt to delete any files, the system prompts you to confirm the deletion.

Caution When files are deleted, their contents cannot be recovered.

This example shows how to delete the file *myconfig* from the default flash memory device:

```
Device# delete myconfig
```

Creating, Displaying and Extracting Files

You can create a file and write files into it, list the files in a file, and extract the files from a file as described in the next sections.

Beginning in privileged EXEC mode, follow these steps to create a file, display the contents, and extract it:

SUMMARY STEPS

1. **archive tar /create** *destination-url* **flash:** */file-url*
2. **archive tar /table** *source-url*
3. **archive tar /xtract** *source-url* **flash:**/*file-url* [*dir/file...*]
4. **more** [/**ascii** | /**binary** | /**ebcdic**] /*file-url*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**archive tar /create** *destination-url* **flash:** */file-url* **Example:** `device# archive tar /create tftp:172.20.10.30/saved. flash:/new-configs`	Creates a file and adds files to it. For destination-url, specify the destination URL alias for the local or network file system and the name of the file to create: • Local flash file system syntax: **flash:** • FTP syntax: **ftp**:[[//*username*[:*password*]@*location*]/*directory*]/-*filename*. • RCP syntax: **rcp**:[[//*username@location*]/*directory*]/-*filename*. • TFTP syntax: **tftp**:[[//*location*]/*directory*]/-*filename*. For **flash:**/*file-url*, specify the location on the local flash file system in which the new file is created. You can also specify an optional list of files or directories within the source directory to add to the new file. If none are specified, all files and directories at this level are written to the newly created file.
Step 2	**archive tar /table** *source-url* **Example:** `device# archive tar /table flash: /new_configs`	Displays the contents of a file. For *source-url*, specify the source URL alias for the local or network file system. The -*filename.* is the file to display. These options are supported: • Local flash file system syntax: **flash:** • FTP syntax: **ftp**:[[//*username*[:*password*]@*location*]/*directory*]/-*filename*. • RCP syntax: **rcp**:[[//*username@location*]/*directory*]/-*filename*. • TFTP syntax: **tftp**:[[//*location*]/*directory*]/-*filename*.

	Command or Action	Purpose
		You can also limit the file displays by specifying a list of files or directories after the file. Only those files appear. If none are specified, all files and directories appear.
Step 3	**archive tar /xtract** *source-url* **flash:**/*file-url* [*dir/file...*] **Example:** `device# archive tar /xtract tftp:/172.20.10.30/saved. flash:/new-configs`	Extracts a file into a directory on the flash file system. For *source-url*, specify the source URL alias for the local file system. The *-filename.* is the file from which to extract files. These options are supported: • Local flash file system syntax: **flash:** • FTP syntax: **ftp**:[[//*username*[:*password*]@*location*]/*directory*]/*-filename*. • RCP syntax: **rcp**:[[//*username*@*location*]/*directory*]/*-filename*. • TFTP syntax: **tftp**:[[//*location*]/*directory*]/*-filename*. For **flash:**/*file-url* [*dir/file...*], specify the location on the local flash file system from which the file is extracted. Use the *dir/file...* option to specify a list of files or directories within the file to be extracted. If none are specified, all files and directories are extracted.
Step 4	**more** [/**ascii** | /**binary** | /**ebcdic**] /*file-url* **Example:** `device# more flash:/new-configs`	Displays the contents of any readable file, including a file on a remote file system.

Additional References

Related Documents

Related Topic	Document Title
Commands for managing flash: file systems	*Cisco IOS Configuration Fundamentals Command Reference*

Error Message Decoder

Description	Link
To help you research and resolve system error messages in this release, use the Error Message Decoder tool.	https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 12

Software Maintenance Upgrade

The Software Maintenance Upgrade (SMU) is a package that can be installed on a system to provide a fix or a security resolution to a released image.

Restrictions for Software Maintenance Upgrade

- SMU supports patching using install mode only.
- In Service Software Upgrade (ISSU) is not supported.

Information About Software Maintenance Upgrade

SMU Overview

The Software Maintenance Upgrade (SMU) is a package that can be installed on a system to provide a patch fix or a security resolution to a released image.

An SMU package is provided on a per release and per component basis, and is specific to the platform.

An SMU provides a significant benefit over classic IOS software as it allows you to address the network issue quickly while reducing the time and scope of the testing required. The Cisco IOS XE platform internally validates the SMU compatibility and does not allow you to install non-compatible SMUs.

All SMUs are integrated into the subsequent Cisco IOS XE software maintenance releases. An SMU is an independent and self-sufficient package and it does not have any prerequisites or dependencies. You can choose which SMUs to install or uninstall in any order.

Starting from Cisco IOS XE Everest 16.6.1, SMUs are supported only on Extended Maintenance releases and for the full lifecycle of the underlying software release.

The following are three basic steps to install an SMU:

- Adding the SMU to the filesystem.
- Activating the SMU on the system.
- Committing the SMU changes so that it is persistent across reloads.

Software Maintenance Upgrade Package

The SMU package contains a small set of files for patching the release along with meta data that describes the contents of the package.

SMU Workflow

The SMU process is initiated with a request to the SMU committee. Contact your customer support to raise an SMU request.

At release time, the SMU package is posted to the Cisco Software Download page and can be downloaded and installed.

SMU Package

An SMU package contains the metadata and fix for the reported issue that the SMU is requested for.

SMU Reload

The SMU type describes the effect to a system after installing the SMU. SMUs can be non-traffic affecting or can result in device restart, reload, or switchover.

All SMUs require a cold reload of the system during activation. A cold reload is the complete reload of the operating system. This action affects the traffic flow for the duration of the reload (~5 min currently). This reload ensures that all processes are started with the correct libraries and files that are installed as part of the SMU.

How to Manage Software Maintenance Updates

The following sections provide information about managing SMUs.

You can install, activate, and commit an SMU package using a single command or using separate commands .

Managing an SMU Package

SUMMARY STEPS

1. **enable**
2. **install add file** *location filename*
3. **install activate file** *location filename*
4. **install commit file** *location filename*
5. **install rollback to** {**base** | **committed** | **id** *commit-ID*}

6. **install deactivate file** *location filename*
7. **install remove** {**file** *location filename* | **inactive**}
8. **show version**
9. **show install summary**

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 tftp://172.16.0.1//tftpboot/folder1/cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin`	Copies the maintenance update package from a remote location to the device, and performs a compatibility check for the platform and image versions. • This command runs base compatibility checks on a file to ensure that the SMU package is supported on the platform. It also adds an entry in the package/SMU.sta file, so that its status can be monitored and maintained.
Step 3	**install activate file** *location filename* **Example:** `Device# install activate file tftp://172.16.0.1//tftpboot/folder1/cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin`	Runs compatibility checks, installs the package, and updates the package status details. • For a restartable package, the command triggers the appropriate post-install scripts to restart the necessary processes, and for non-restartable packages it triggers a reload.
Step 4	**install commit file** *location filename* **Example:** `Device# install commit file tftp://172.16.0.1//tftpboot/folder1/cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin`	Commits the activation changes to be persistent across reloads. • The commit can be done after activation while the system is up, or after the first reload. If a package is activated but not committed, it remains active after the first reload, but not after the second reload.
Step 5	**install rollback to** {**base** | **committed** | **id** *commit-ID*} **Example:** `Device# install rollback to committed`	Returns the device to the previous installation state. • After the rollback, a reload is required.
Step 6	**install deactivate file** *location filename* **Example:** `Device# install deactivate file tftp://172.16.0.1//tftpboot/folder1/cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin`	Deactivates an active package, updates the package status, and triggers a process to restart or reload.

	Command or Action	Purpose
Step 7	**install remove** {**file** *location filename* | **inactive**} **Example:** `Device# install remove file tftp://172.16.0.1//tftpboot/folder1/cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin`	Deletes all or the specified inactive SMU package from the file system.
Step 8	**show version** **Example:** `Device# show version`	Displays the image version on the device.
Step 9	**show install summary** **Example:** `Device# show install summary`	Displays information about the active package. • The output of this command varies according to the **install** commands that are configured.

Configuration Examples for Software Maintenance Upgrade

Example: Managing an SMU

The following example shows how to copy an SMU file to TFTP:

```
Device# copy tftp://172.16.0.1//tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin

tftp:Destination filename [cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin]?

Accessing tftp://172.16.0.1//auto/tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin...
Loading /auto/tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin from
172.16.0.1 (via GigabitEthernet0): !
[OK - 17668 bytes]
17668 bytes copied in 0.058 secs (304621 bytes/sec)
```

The following is sample output from the **show install summary** command:

```
Device# show install summary

[ Switch 1 ] Installed Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------------------
Type St Filename/Version
--------------------------------------------------------------------------------
SMU C flash:cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin
IMG C 16.6.3.0
```

The following example shows how to add a maintenance update package file:

```
Device# install add file tftp://172.16.0.1//tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin

install_add: START Sat Feb 26 14:06:04 PST 2017
SUCCESS: install_add tftp://172.16.0.1//tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin Sat Feb
26 14:06:12 PST 2017
Device#
```

The following is sample output from the **show install summary** command after adding an SMU package file to the device:

```
Device# show install summary

Active Packages:
No packages
Inactive Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin
Committed Packages:
No packages
Uncommitted Packages:
No packages
Device#
```

The following example shows how to activate an added SMU package file:

```
Device# install activate file tftp://172.16.0.1//tftpboot/folder1/cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin

install_activate: START Sat Feb 26 14:10:55 PST 2017
The activation step would require a reload. Do you want to proceed? [y/n]y
Regular SMU. Reloading the box to complete activation of the SMU...
Feb 26 14:11:23.873 R0/0: %PMAN-5-EXITACTION: Process manager is exiting:
reload action requested
Initializing Hardware ...
Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly
<after reload>
Device#
```

The following sample output from the **show version** command:

```
Device# show version

Cisco IOS XE Software, Version BLD_POLARIS_DEV_SMU_LATEST_20170110_13.15.1 -
SMU-PATCHED
Cisco IOS Software [Everest], Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M),
Experimental Version 16.6.20170110_13.15.1 [BLD_V166_SMU_LATEST_20170127_13.15.1 SMU-PATCHED]
Copyright (c) 1986-2017 by Cisco Systems, Inc.
Compiled Sat 26-Feb-17 16:07 by mcpre
...
```

The following sample output from the **show install summary** command displays the status of the model package as active and uncommitted:

```
Device# show install summary

Active Packages:
    tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
Inactive Packages:
```

```
   No packages
Committed Packages:
    tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
Uncommitted Packages:
   No packages
Device#
```

The following is sample output from the **show install active** command:

```
Device# show install active

Active Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
```

The following example shows how to execute the **install commit** command:

```
Device# install commit

install_commit: START Sat Feb 26 06:46:48 UTC 2017
SUCCESS: install_commit Sat Feb 26 06:46:52 UTC 2017
Device#
```

The following sample output from the **show install summary** command displays that the update package is now committed, and that it will be persistent across reloads:

```
Device# show install summary

Active Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
Inactive Packages:
No packages
Committed Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
Uncommitted Packages:
No packages
Device#
```

The following example shows how to rollback an update package to the committed package:

```
Device# install rollback to base

install_rollback: START Sat Feb 26 11:27:41 PST 2017
This rollback would require a reload. Do you want to proceed? [y/n]y
2 install_rollback: Reloading the box to take effect

Initializing Hardware ...
<after reload>
Device#
```

The following is sample output from the **show install summary** command:

```
Device# show install summary

Active Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxx.SSA.dmp.bin
Inactive Packages:
No packages
Committed Packages:
tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin
Uncommitted Packages:
No packages
```

```
Device#
```

The following is sample output from the **show install log** command:

```
Device# show install log

[0|install_op_boot]: START Sat Feb 26 19:31:50 Universal 2017
[0|install_op_boot]: END SUCCESS Sat Feb 26 19:31:56 Universal 2017
```

The following example shows how to deactivate an SMU package file:

```
Device# install deactivate file tftp:cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin

install_deactivate: START Sat Feb 26 10:49:07 PST 2017
The activation step would require a reload. Do you want to proceed? [y/n]y
Regular SMU. Reloading the box to complete activation of the SMU...

Initializing Hardware...
...
<after reload>
Device#
```

The following is sample output from the **show install summary** command:

```
Device# show install summary

Active Packages:
No packages
Inactive Packages:tftp:cat3k-universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin
Committed Packages:
No packages
Uncommitted Packages:
No packages
Device#
```

The following example shows how to remove an SMU from the device:

```
Device# install remove file tftp:cat3k-
universalk9.2017-01-10_13.15.1.CSCxxxxxxx.SSA.dmp.bin

install_remove: START Sat Feb 26 12:09:43 PST 2017
SUCCESS: install_remove /tftp/cat3k-universalk9.2017-01-10_13.15.1.
CSCxxxxxxx.SSA.dmp.bin Sat Feb 26 12:09:49 PST 2017
Device#
```

The following is sample output from the **show install summary** command:

```
Device# show install summary

Active Packages:
No packages
Inactive Packages:
No packages
Committed Packages:
No packages
Uncommitted Packages:
No packages
```

Feature Information for Software Maintenance Upgrade

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 15: Feature Information for Software Maintenance Upgrade

Release	Modification
Cisco IOS XE Fuji 16.8.1a	This feature was introduced The SMU is a package that can be installed on a system in order to provide a patch fix or a security resolution to a released image The following commands were introduced or updated: **install**, **show install**.

CHAPTER 13

Conditional Debug and Radioactive Tracing

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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Introduction to Conditional Debugging

The Conditional Debugging feature allows you to selectively enable debugging and logging for specific features based on the set of conditions you define. This feature is useful in systems where a large number of features are supported.

Note In Cisco IOS XE Denali 16.1.1, only Control Plane Tracing is supported.

The Conditional debug allows granular debugging in a network that is operating at a large scale with a large number of features. It allows you to observe detailed debugs for granular instances within the system. This is very useful when we need to debug only a particular session among thousands of sessions. It is also possible to specify multiple conditions.

A condition refers to a feature or identity, where identity could be an interface, IP Address, or a MAC address and so on.

Note In Cisco IOS XE Denali 16.1.1, MAC address is the only supported condition. The support for other features will be introduced in the releases that follow.

This is in contrast to the general debug command, that produces its output without discriminating on the feature objects that are being processed. General debug command consumes a lot of system resources and impacts the system performance.

Note To enable debug for wireless IPs, use the **debug platform condition feature wireless ip** *ip-address* command.

Introduction to Radioactive Tracing

Radioactive tracing provides the ability to stitch together a chain of execution for operations of interest across the system, at an increased verbosity level. This provides a way to conditionally print debug information (up to DEBUG Level or a specified level) across threads, processes and function calls.

Note In Cisco IOS XE Denali 16.1.1 the default level is **DEBUG**. The users cannot change this to another level. The support for other levels will be introduced in the releases that follow.

Note The radioactive tracing supports First-Hop Security (FHS).

For more information on First Hop Security features, see *System Management > Wireless Multicast > Information About Wireless Multicast > Information About IPv6 Snooping*.

Conditional Debugging and Radioactive Tracing

Radioactive Tracing when coupled with Conditional Debugging, enable us to have a single debug CLI to debug all execution contexts related to the condition. This can be done without being aware of the various control flow processes of the feature within the box and without having to issue debugs at these processes individually.

Location of Tracefiles

By default the tracefile logs will be generated for each process and saved into either the **/tmp/rp/trace** or **/tmp/fp/trace** directory. In this temp directory, the trace logs are written to files, which are of 1 MB size each. The directory can hold up to a maximum of 25 such files for a given process. When a tracefile in the **/tmp** directory reaches its 1MB limit or whatever size was configured for it during the boot time, it is rotated out to an archive location in the **/crashinfo** partition under **tracelogs** directory.

The **/tmp** directory holds only a single tracefile for a given process. Once the file reaches its file size limit it is rotated out to **/crashinfo/tracelogs**. In the archive directory, up to 25 files are accumulated, after which the oldest one is replaced by the newly rotated file from **/tmp**.

The tracefiles in the crashinfo directory are located in the following formats:

1. Process-name_Process-ID_running-counter.timestamp.gz

   Example: IOSRP_R0-0.bin_0.14239.20151101234827.gz

2. Process-name_pmanlog_Process-ID_running-counter.timestamp.bin.gz

   Example: wcm_pmanlog_R0-0.30360_0.20151028233007.bin.gz

Configuring Conditional Debugging

To configure conditional debugging, follow the steps given below:

SUMMARY STEPS

1. **enable**
2. **debug platform condition mac** {*mac-address*}
3. **debug platform condition start**
4. **show platform condition** OR **show debug**
5. **debug platform condition stop**
6. **request platform software trace archive** [**last** {*number*} **days**] [**target** {*crashinfo:* | *flashinfo:*}]
7. **show platform software trace** [**filter-binary** | **level** | **message**]
8. **clear platform condition all**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**debug platform condition mac** {*mac-address*} **Example:**	Configures conditional debugging for the MAC Address specified.

	Command or Action	Purpose
	`Device# debug platform condition mac bc16.6509.3314`	
Step 3	**debug platform condition start** **Example:** `Device# debug platform condition start`	Starts conditional debugging (this will start radioactive tracing if there is a match on one of the conditions above).

Step 4	**show platform condition** OR **show debug**
	Example:
	`Device# show platform condition`
	`Device# show debug`
		Displays the current conditions set.

Step 5	**debug platform condition stop** **Example:** `Device# debug platform condition stop`	Stops conditional debugging (this will stop radioactive tracing).
Step 6	**request platform software trace archive** [**last** {*number*} **days**] [**target** {*crashinfo:* | *flashinfo:*}] **Example:** `Device# request platform software trace archive last 2 days`	(Optional) Displays historical logs of merged tracefiles on the system. Filter on any combination of number of days or location.
Step 7	**show platform software trace** [**filter-binary** | **level** | **message**] **Example:** `Device# show platform software trace message`	(Optional) Displays logs merged from the latest tracefile. Filter on any combination of application condition, trace module name, and trace level. • **filter-binary** - Filter the modules to be collated • **level** - Show trace levels • **message** - Show trace message ring contents **Note** On Box: • Available from IOS console in addition to linux shell. • Generates a file with merged logs on the box. • Displays merged logs only from staging area
Step 8	**clear platform condition all** **Example:** `Device# clear platform condition all`	Clears all conditions.

What to do next

Note The commands **request platform software trace filter-binary** and **show platform software trace filter-binary** work in a similar way. The only difference is:

- **request platform software trace filter-binary** - Sources the data from historical logs.
- **show platform software trace filter-binary** – Sources the data from the flash Temp directory.

Of these, *mac_log <..date..>* is the most important file, as it gives the messages for the MAC we are debugging. The command **show platform software trace filter-binary** also generates the same flash files, and also prints the mac_log on the screen.

Radioactive Tracing for L2 Multicast

To identify a specific multicast receiver, specify the MAC address of the joiner or the receiver client, Group Multicast IP address and Snooping VLAN. Additionally, enable the trace level for the debug. The debug level will provide detailed traces and better visibility into the system.

debug platform condition feature multicast controlplane mac *client MAC address* **ip** *Group IP address* **vlan** *id* **level** *debug level*

Recommended Workflow for Trace files

The Recommended Workflow for Trace files is listed below:

1. To request the tracelogs for a specific time period.

   EXAMPLE 1 day.

   Use the command:

   Device#**`request platform software trace archive last 1 day`**

2. The system generates a tar ball (.gz file) of the tracelogs in the location /flash:
3. Copy the file off the switch. By copying the file, the tracelogs can be used to work offline. For more details on copying files, see section below.
4. Delete the tracelog file (.gz) file from /flash: location. This will ensure enough space on the switch for other operations.

Copying tracefiles off the box

An example of the tracefile is shown below:

```
Device# dir crashinfo:/tracelogs
Directory of crashinfo:/tracelogs/
```

```
50664 -rwx 760 Sep 22 2015 11:12:21 +00:00 plogd_F0-0.bin_0.gz
50603 -rwx 991 Sep 22 2015 11:12:08 +00:00 fed_pmanlog_F0-0.bin_0.9558.20150922111208.gz
50610 -rw- 11 Nov 2 2015 00:15:59 +00:00 timestamp
50611 -rwx 1443 Sep 22 2015 11:11:31 +00:00
auto_upgrade_client_sh_pmanlog_R0-.bin_0.3817.20150922111130.gz
50669 -rwx 589 Sep 30 2015 03:59:04 +00:00 cfgwr-8021_R0-0.bin_0.gz
50612 -rwx 1136 Sep 22 2015 11:11:46 +00:00 reflector_803_R0-0.bin_0.1312.20150922111116.gz
50794 -rwx 4239 Nov 2 2015 00:04:32 +00:00 IOSRP_R0-0.bin_0.14239.20151101234827.gz
50615 -rwx 131072 Nov 2 2015 00:19:59 +00:00 linux_iosd_image_pmanlog_R0-0.bin_0
--More—
```

The trace files can be copied using one of the various options shown below:

```
Device# copy crashinfo:/tracelogs ?
  crashinfo: Copy to crashinfo: file system
  flash: Copy to flash: file system
  ftp: Copy to ftp: file system
  http: Copy to http: file system
  https: Copy to https: file system
  null: Copy to null: file system
  nvram: Copy to nvram: file system
  rcp: Copy to rcp: file system
  running-config Update (merge with) current system configuration
  scp: Copy to scp: file system
  startup-config Copy to startup configuration
  syslog: Copy to syslog: file system
  system: Copy to system: file system
  tftp: Copy to tftp: file system
  tmpsys: Copy to tmpsys: file system
```

The general syntax for copying onto a TFTP server is as follows:

```
Device# copy source: tftp:
Device# copy crashinfo:/tracelogs/IOSRP_R0-0.bin_0.14239.20151101234827.gz tftp:
Address or name of remote host []? 2.2.2.2
Destination filename [IOSRP_R0-0.bin_0.14239.20151101234827.gz]?
```

Note It is important to clear the generated report or archive files off the switch in order to have flash space available for tracelog and other purposes.

Configuration Examples for Conditional Debugging

The following is an output example of the *show platform condition* command.

```
Device# show platform condition
Conditional Debug Global State: Stop
Conditions Direction
-------------------------------------------------------------------------------------------|---------
MAC Address 0024.D7C7.0054 N/A
Feature Condition Type Value
-----------------------|------------------------|---------------------------------
Device#
```

The following is an output example of the *show debug* command.

```
Device# show debug
IOSXE Conditional Debug Configs:
Conditional Debug Global State: Start
Conditions Direction
----------------------------------------------------------------------------------|---------
MAC Address 0024.D7C7.0054 N/A
Feature Condition Type Value
-----------------------|-----------------------|--------------------------------
Packet Infra debugs:
Ip Address Port
------------------------------------------------------|----------
Device#
```

The following is a sample of the *debug platform condition stop* command.

```
Device# debug platform condition stop
Conditional Debug Global State: Stop
```

Monitoring Conditional Debugging

The table shown below lists the various commands that can be used to monitor conditional debugging.

Command	Purpose
show platform condition	Displays the current conditions set.
show debug	Displays the current debug conditions set.
show platform software trace filter-binary	Displays logs merged from the latest tracefile.
request platform software trace filter-binary	Displays historical logs of merged tracefiles on the system.

CHAPTER 14

Performing Factory Reset

Prerequisites for Performing Factory Reset

- Ensure that all the software images, configurations, and personal data are backed up before performing the Factory Reset operation.
- Ensure that the device is not in the stacking mode as Factory Reset is supported only in the standalone mode.
- Ensure that there is uninterrupted power supply when the process is in progress.
- Ensure that you take a backup of the current image before you begin the Factory Reset process.
- Ensure that neither In-Service Software Upgrade (ISSU) nor In-Service Software Downgrade (ISSD) is in progress before starting the Factory Reset process.

Limitations for Performing Factory Reset

- Software patches, if any, that are installed on the switch will not be restored after the Factory Reset operation.
- If the Factory Reset command is issued through a vty session, the session is not restored after completion of the Factory Reset process.

Information About Factory Reset

Factory Reset removes all the customer specific data that has been added to the device since the time of its shipping. Data erased includes configurations, log files, boot variables, and core files.

The following table provides details about the data that is erased and retained during the Factory Reset process:

Table 16: Data Erased and Retained During Factory Reset

Data Erased	Data Retained
All Cisco IOS images, including the current boot image	Data from Remote field-replaceable units (FRUs)
Crash information and logs	Value of the configuration register
User data, and startup and running configuration	Contents of USB
Onboard Failure Logging(OBFL) logs	Credentials (Secure Unique Device Identifier [SUDI] certificates, public key infrastructure (PKI) keys, and FIPS-related keys)
ROMMON variables added by the user	Licenses

The device reloads to perform the Factory Reset task. Note that this reload results in a ROMMON mode.

After the Factory Reset operation is complete, you can load the Cisco ISO image either through a a USB or TFTP.

The Factory Reset process can be used in the following scenarios:

- Return Material Authorization (RMA) for a device—If you have to return a device to Cisco for RMA, remove all the customer-specific data before obtaining an RMA certificate for the device.
- Recovering the compromised device— If the key material or credentials stored on a device is compromised, reset the device to factory configuration, and then reconfigure the device.

How to Perform Factory Reset

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**factory-reset** {**all** | **config** | **boot-vars**} **Example:** `Device# factory-reset all`	Use the command with all options enabled. No system configuration is required to use the **factory reset** command. Erases all the content from the NVRAM, all the Cisco IOS images, including the current boot image, boot variables, startup and running configuration data, and user data. After the Factory Reset process is successfully completed, the device reboots and stops at ROMMON mode.

Feature History and Information for Factory Reset

Release	Feature Information
Cisco IOS XE 16.6.1	This feature was introduced.

CHAPTER 15

Troubleshooting the Software Configuration

This chapter describes how to identify and resolve software problems related to the Cisco IOS software on the switch. Depending on the nature of the problem, you can use the command-line interface (CLI), Device Manager, or Network Assistant to identify and solve problems.

Additional troubleshooting information, such as LED descriptions, is provided in the hardware installation guide.

Information About Troubleshooting the Software Configuration

Software Failure on a Switch

Switch software can be corrupted during an upgrade by downloading the incorrect file to the switch, and by deleting the image file. In all of these cases, the switch does not pass the power-on self-test (POST), and there is no connectivity.

Lost or Forgotten Password on a Device

The default configuration for the device allows an end user with physical access to the device to recover from a lost password by interrupting the boot process during power-on and by entering a new password. These recovery procedures require that you have physical access to the device.

Note On these devices, a system administrator can disable some of the functionality of this feature by allowing an end user to reset a password only by agreeing to return to the default configuration. If you are an end user trying to reset a password when password recovery has been disabled, a status message reminds you to return to the default configuration during the recovery process.

Note You cannot recover encryption password key, when Cisco WLC configuration is copied from one Cisco WLC to another (in case of an RMA).

Power over Ethernet Ports

A Power over Ethernet (PoE) switch port automatically supplies power to one of these connected devices if the switch detects that there is no power on the circuit:

- a Cisco pre-standard powered device (such as a Cisco IP Phone or a Cisco Aironet Access Point)
- an IEEE 802.3af-compliant powered device
- an IEEE 802.3at-compliant powered device

A powered device can receive redundant power when it is connected to a PoE switch port and to an AC power source. The device does not receive redundant power when it is only connected to the PoE port.

After the switch detects a powered device, the switch determines the device power requirements and then grants or denies power to the device. The switch can also detect the real-time power consumption of the device by monitoring and policing the power usage.

For more information, see the "Configuring PoE" chapter in the *Interface and Hardware Component Configuration Guide (Catalyst 3650 Switches)* .

Disabled Port Caused by Power Loss

If a powered device (such as a Cisco IP Phone 7910) that is connected to a PoE Device port and powered by an AC power source loses power from the AC power source, the device might enter an error-disabled state. To recover from an error-disabled state, enter the **shutdown** interface configuration command, and then enter the **no shutdown** interface command. You can also configure automatic recovery on the Device to recover from the error-disabled state.

On a Device, the **errdisable recovery cause loopback** and the **errdisable recovery interval** *seconds* global configuration commands automatically take the interface out of the error-disabled state after the specified period of time.

Disabled Port Caused by False Link-Up

If a Cisco powered device is connected to a port and you configure the port by using the **power inline never** interface configuration command, a false link-up can occur, placing the port into an error-disabled state. To take the port out of the error-disabled state, enter the **shutdown** and the **no shutdown** interface configuration commands.

You should not connect a Cisco powered device to a port that has been configured with the **power inline never** command.

Ping

The Device supports IP ping, which you can use to test connectivity to remote hosts. Ping sends an echo request packet to an address and waits for a reply. Ping returns one of these responses:

- Normal response—The normal response (*hostname* is alive) occurs in 1 to 10 seconds, depending on network traffic.
- Destination does not respond—If the host does not respond, a *no-answer* message is returned.
- Unknown host—If the host does not exist, an *unknown host* message is returned.
- Destination unreachable—If the default gateway cannot reach the specified network, a *destination-unreachable* message is returned.
- Network or host unreachable—If there is no entry in the route table for the host or network, a *network or host unreachable* message is returned.

Layer 2 Traceroute

The Layer 2 traceroute feature allows the switch to identify the physical path that a packet takes from a source device to a destination device. Layer 2 traceroute supports only unicast source and destination MAC addresses. Traceroute finds the path by using the MAC address tables of the Device in the path. When the Device detects a device in the path that does not support Layer 2 traceroute, the Device continues to send Layer 2 trace queries and lets them time out.

The Device can only identify the path from the source device to the destination device. It cannot identify the path that a packet takes from source host to the source device or from the destination device to the destination host.

Layer 2 Traceroute Guidelines

- Cisco Discovery Protocol (CDP) must be enabled on all the devices in the network. For Layer 2 traceroute to function properly, do not disable CDP.

  If any devices in the physical path are transparent to CDP, the switch cannot identify the path through these devices.
- A Device is reachable from another Device when you can test connectivity by using the **ping** privileged EXEC command. All Device in the physical path must be reachable from each other.
- The maximum number of hops identified in the path is ten.
- You can enter the **traceroute mac** or the **traceroute mac ip** privileged EXEC command on a Device that is not in the physical path from the source device to the destination device. All Device in the path must be reachable from this switch.
- The **traceroute mac** command output shows the Layer 2 path only when the specified source and destination MAC addresses belong to the same VLAN. If you specify source and destination MAC addresses that belong to different VLANs, the Layer 2 path is not identified, and an error message appears.
- If you specify a multicast source or destination MAC address, the path is not identified, and an error message appears.
- If the source or destination MAC address belongs to multiple VLANs, you must specify the VLAN to which both the source and destination MAC addresses belong. If the VLAN is not specified, the path is not identified, and an error message appears.
- The **traceroute mac ip** command output shows the Layer 2 path when the specified source and destination IP addresses belong to the same subnet. When you specify the IP addresses, the Device uses the Address

Resolution Protocol (ARP) to associate the IP addresses with the corresponding MAC addresses and the VLAN IDs.

  - If an ARP entry exists for the specified IP address, the Device uses the associated MAC address and identifies the physical path.
  - If an ARP entry does not exist, the Device sends an ARP query and tries to resolve the IP address. If the IP address is not resolved, the path is not identified, and an error message appears.

- When multiple devices are attached to one port through hubs (for example, multiple CDP neighbors are detected on a port), the Layer 2 traceroute feature is not supported. When more than one CDP neighbor is detected on a port, the Layer 2 path is not identified, and an error message appears.
- This feature is not supported in Token Ring VLANs.
- Layer 2 traceroute opens a listening socket on the User Datagram Protocol (UDP) port 2228 that can be accessed remotely with any IPv4 address, and does not require any authentication. This UDP socket allows to read VLAN information, links, presence of particular MAC addresses, and CDP neighbor information, from the device. This information can be used to eventually build a complete picture of the Layer 2 network topology.
- Layer 2 traceroute is enabled by default and can be disabled by running the **no l2 traceroute** command in global configuration mode. To re-enable Layer 2 traceroute, use the **l2 traceroute** command in global configuration mode.

IP Traceroute

You can use IP traceroute to identify the path that packets take through the network on a hop-by-hop basis. The command output displays all network layer (Layer 3) devices, such as routers, that the traffic passes through on the way to the destination.

Your Device can participate as the source or destination of the **traceroute** privileged EXEC command and might or might not appear as a hop in the **traceroute** command output. If the Device is the destination of the traceroute, it is displayed as the final destination in the traceroute output. Intermediate Device do not show up in the traceroute output if they are only bridging the packet from one port to another within the same VLAN. However, if the intermediate Device is a multilayer Device that is routing a particular packet, this Device shows up as a hop in the traceroute output.

The **traceroute** privileged EXEC command uses the Time To Live (TTL) field in the IP header to cause routers and servers to generate specific return messages. Traceroute starts by sending a User Datagram Protocol (UDP) datagram to the destination host with the TTL field set to 1. If a router finds a TTL value of 1 or 0, it drops the datagram and sends an Internet Control Message Protocol (ICMP) time-to-live-exceeded message to the sender. Traceroute finds the address of the first hop by examining the source address field of the ICMP time-to-live-exceeded message.

To identify the next hop, traceroute sends a UDP packet with a TTL value of 2. The first router decrements the TTL field by 1 and sends the datagram to the next router. The second router sees a TTL value of 1, discards the datagram, and returns the time-to-live-exceeded message to the source. This process continues until the TTL is incremented to a value large enough for the datagram to reach the destination host (or until the maximum TTL is reached).

To learn when a datagram reaches its destination, traceroute sets the UDP destination port number in the datagram to a very large value that the destination host is unlikely to be using. When a host receives a datagram destined to itself containing a destination port number that is unused locally, it sends an ICMP *port-unreachable* error to the source. Because all errors except port-unreachable errors come from intermediate hops, the receipt of a port-unreachable error means that this message was sent by the destination port.

Time Domain Reflector Guidelines

You can use the Time Domain Reflector (TDR) feature to diagnose and resolve cabling problems. When running TDR, a local device sends a signal through a cable and compares the reflected signal to the initial signal.

TDR is supported on 10/100/1000 copper Ethernet ports and on Multigigabit Ethernet (100Mbps/1/2.5/5/10 Gbps) ports. It is not supported on SFP module ports.

TDR can detect these cabling problems:

- Open, broken, or cut twisted-pair wires—The wires are not connected to the wires from the remote device.
- Shorted twisted-pair wires—The wires are touching each other or the wires from the remote device. For example, a shorted twisted pair can occur if one wire of the twisted pair is soldered to the other wire.

  If one of the twisted-pair wires is open, TDR can find the length at which the wire is open.

Note When using the feature with Multigigabit Ethernet ports, the cable length is displayed only when an open or short condition is detected.

Use TDR to diagnose and resolve cabling problems in these situations:

- Replacing a Device
- Setting up a wiring closet
- Troubleshooting a connection between two devices when a link cannot be established or when it is not operating properly

When you run TDR, the Device reports accurate information in these situations:

- The cable for the gigabit link is a solid-core cable.
- The open-ended cable is not terminated.

When you run TDR, the Device does not report accurate information in these situations:

- The cable for the gigabit link is a twisted-pair cable or is in series with a solid-core cable.
- The link is a 10-megabit or a 100-megabit link.
- The cable is a stranded cable.
- The link partner is a Cisco IP Phone.
- The link partner is not IEEE 802.3 compliant.

Debug Commands

> **Caution** Because debugging output is assigned high priority in the CPU process, it can render the system unusable. For this reason, use **debug** commands only to troubleshoot specific problems or during troubleshooting sessions with Cisco technical support staff. It is best to use **debug** commands during periods of lower network traffic and fewer users. Debugging during these periods decreases the likelihood that increased **debug** command processing overhead will affect system use.

All **debug** commands are entered in privileged EXEC mode, and most **debug** commands take no arguments.

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 fail (crash). It is necessary to quickly and reliably collect critical crash information with high fidelity and integrity. Further, it is necessary to collect this information and bundle it in a way that it can be associated or identified with a specific crash occurrence.

System reports are generated in these situations:

- In case of a switch failure—A system report is generated on the member that failed; reports are not generated on other members in the stack.
- In case of a switchover—System reports are generated only on high availability (HA) member switches. reports are not generated for non-HA members.

The system does not generate reports in case of a reload.

During a process crash, the following is collected locally from the switch:

1. Full process core
2. Tracelogs
3. IOS syslogs (not guaranteed in case of non-active crashes)
4. System process information
5. Bootup logs
6. Reload logs
7. Certain types of /proc information

This information is stored in separate files which are then archived and compressed into one bundle. This makes it convenient to get a crash snapshot in one place, and can be then moved off the box for analysis. This report is generated before the switch goes down to rommon/bootloader.

Except for the full core and tracelogs, everything else is a text file.

Crashinfo Files

By default the system report file will be generated and saved into the /crashinfo directory. Ifit cannot be saved to the crashinfo partition for lack of space, then it will be saved to the /flash directory.

To display the files, enter the **dir crashinfo:** command. The following is sample output of a crashinfo directory:

```
Switch#dir crashinfo:
Directory of crashinfo:/
46553 drwx 1024 Jun 29 2015 14:52:09 +00:00 ap_crash
12 -rw- 0 Jan 1 1970 00:00:11 +00:00 koops.dat
11 -rw- 0 Mar 22 2013 07:50:30 +00:00 deleted_crash_files
13 -rwx 594269 Mar 22 2013 07:50:30 +00:00 crashinfo_platform_mgr_20130322-075017-UTC
14 -rw- 44 Sep 9 2015 09:28:47 +00:00 last_crashinfo
15 -rw- 355 Sep 9 2015 09:29:31 +00:00 last_systemreport_log
16 -rw- 105753 Mar 22 2013 07:50:47 +00:00 system-report_1_20130322-075017-UTC.gz
17 -rw- 39 Sep 9 2015 09:29:31 +00:00 last_systemreport
18 -rwx 585996 Mar 22 2013 08:01:58 +00:00 crashinfo_platform_mgr_20130322-080144-UTC
19 -rw- 105065 Mar 22 2013 08:02:15 +00:00 system-report_1_20130322-080144-UTC.gz
20 -rwx 3426209 Sep 9 2015 06:49:12 +00:00 crashinfo_iosd_20150909-064754-UTC
21 -rwx 9540376 Sep 9 2015 06:49:13 +00:00 fullcore_iosd_20150909-064754-UTC
22 -rw- 469476 Sep 9 2015 06:49:56 +00:00 system-report_1_20150909-064754-UTC.gz
23 -rwx 3425350 Sep 9 2015 09:28:47 +00:00 crashinfo_iosd_20150909-092728-UTC
24 -rwx 9535535 Sep 9 2015 09:28:47 +00:00 fullcore_iosd_20150909-092728-UTC
25 -rw- 459709 Sep 9 2015 09:29:28 +00:00 system-report_1_20150909-092728-UTC.gz
26 -rw- 0 Sep 22 2015 11:11:33 +00:00 tracelogs.J8C

50601 drwx 10240 Oct 28 2015 22:42:50 +00:00 tracelogs

248354816 bytes total (204800000 bytes free)
```

System reports are located in the crashinfo directory in the following format:

```
system-report_[switch number]_[date]-[timestamp]-UTC.gz
```

After a switch crashes, check for a system report file. The name of the most recently generated system report file is stored in the last_systemreport file under the crashinfo directory. The system report and crashinfo files assist TAC while troubleshooting the issue.

The system report generated can be further copied using TFTP, HTTP and few other options.

```
Switch#copy crashinfo: ?
crashinfo:     Copy to crashinfo: file system
flash:         Copy to flash: file system
ftp:           Copy to ftp: file system
http:          Copy to http: file system
https:         Copy to https: file system
null:          Copy to null: file system
nvram:         Copy to nvram: file system
rcp:           Copy to rcp: file system
running-config Update (merge with) current system configuration
scp:           Copy to scp: file system
startup-config Copy to startup configuration
syslog:        Copy to syslog: file system
system:        Copy to system: file system
tftp:          Copy to tftp: file system
tmpsys:        Copy to tmpsys: file system
```

The general syntax for copying onto TFTP server is as follows:

```
Switch#copy crashinfo: tftp:
Source filename [system-report_1_20150909-092728-UTC.gz]?
Address or name of remote host []? 1.1.1.1
Destination filename [system-report_1_20150909-092728-UTC.gz]?
```

The tracelogs from all members in the stack can be collected by issuing a trace archive command. This command provides time period options. The command syntax is as follows:

```
Switch#request platform software trace archive ?
last     Archive trace files of last x days
target   Location and name for the archive file
```

The tracelogs stored in crashinfo: or flash: directory from within the last 3650 days can be collected.

```
Switch# request platform software trace archive last ?
<1-3650> Number of days (1-3650)
Switch#request platform software trace archive last 3650 days target ?
crashinfo: Archive file name and location
flash:     Archive file name and location
```

Note It is important to clear the system reports or trace archives from flash or crashinfo directory once they are copied out, in order to have space available for tracelogs and other purposes.

Onboard Failure Logging on the Switch

You can use the onboard failure logging (OBFL) feature to collect information about the Device. The information includes uptime, temperature, and voltage information and helps Cisco technical support representatives to troubleshoot Device problems. We recommend that you keep OBFL enabled and do not erase the data stored in the flash memory.

By default, OBFL is enabled. It collects information about the Device and small form-factor pluggable (SFP) modules. The Device stores this information in the flash memory:

- CLI commands—Record of the OBFL CLI commands that are entered on a standalone Device or a switch stack member.
- Message—Record of the hardware-related system messages generated by a standalone Device or a switch stack member.
- Power over Ethernet (PoE)—Record of the power consumption of PoE ports on a standalone Device or a switch stack member.
- Temperature—Temperature of a standalone Device or a switch stack member.
- Uptime data—Time when a standalone Device starts, the reason the Device restarts, and the length of time the Device has been running since it last restarted.
- Voltage—System voltages of a standalone Device .

You should manually set the system clock or configure it by using Network Time Protocol (NTP).

When the Device is running, you can retrieve the OBFL data by using the **show logging onboard** privileged EXEC commands. If the Device fails, contact your Cisco technical support representative to find out how to retrieve the data.

When an OBFL-enabled Device is restarted, there is a 10-minute delay before logging of new data begins.

Fan Failures

By default, the feature is disabled. When more than one of the fans fails in a field-replaceable unit (FRU) or in a power supply, the Device does not shut down, and this error message appears:

```
Multiple fan(FRU/PS) failure detected. System may get overheated. Change fan quickly.
```

The Device might overheat and shut down.

To enable the fan failures feature, enter the **system env fan-fail-action shut** privileged EXEC command. If more than one fan in the Device fails, the Device automatically shuts down, and this error message appears:

```
Faulty (FRU/PS) fans detected, shutting down system!
```

After the first fan shuts down, if the Device detects a second fan failure, the Device waits for 20 seconds before it shuts down.

To restart the Device, it must be power cycled.

Possible Symptoms of High CPU Utilization

Excessive CPU utilization might result in these symptoms, but the symptoms might also result from other causes:

- Spanning tree topology changes
- EtherChannel links brought down due to loss of communication
- Failure to respond to management requests (ICMP ping, SNMP timeouts, slow Telnet or SSH sessions)
- UDLD flapping
- IP SLAs failures because of SLAs responses beyond an acceptable threshold
- DHCP or IEEE 802.1x failures if the switch does not forward or respond to requests

How to Troubleshoot the Software Configuration

Recovering from a Software Failure

Before you begin

This recovery procedure requires that you have physical access to the switch.

This procedure uses boot loader commands and TFTP to recover from a corrupted or incorrect image file.

Step 1 From your PC, download the software image file (*image.bin*) from Cisco.com.

Step 2 Load the software image to your TFTP server.

Step 3 Connect your PC to the switch Ethernet management port.

Step 4 Unplug the switch power cord.

Step 5 Press the **Mode** button, and at the same time, reconnect the power cord to the switch.

Step 6 From the bootloader (ROMMON) prompt, ensure that you can ping your TFTP server.

a) Set the IP address **switch: set IP_ADDRESS** *ip_address subnet_mask*

Example:

```
switch: set IP_ADDRESS 192.0.2.123/255.255.255.0
```

b) Set the default router IP address **switch: set DEFAULT_ROUTER** *ip_address*

Example:

```
switch: set DEFAULT_ROUTER 192.0.2.1
```

c) Verify that you can ping the TFTP server **switch: ping** *ip_address_of_TFTP_server*

Example:

```
switch: ping 192.0.2.15
ping 192.0.2.1 with 32 bytes of data...
Host 192.0.2.1 is alive.
switch:
```

Step 7 Verify that you have a recovery image in your recovery partition (sda9:).

This recovery image is required for recovery using the emergency-install feature.

Example:

```
switch: dir sda9:
Directory of sda9:/

    2  drwx  1024       .
    2  drwx  1024       ..
   11  -rw-  18923068   c3850-recovery.bin

36939776 bytes available (20830208 bytes used)
switch:
```

Step 8 From the bootloader (ROMMON) prompt, initiate the emergency-install feature that assists you in recovering the software image on your switch.

WARNING: The emergency install command will erase your entire boot flash!

Example:

```
Switch#
emergency-install
tftp://192.0.2.47/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin

The bootflash will be erased during install operation, continue (y/n)?y
Starting emergency recovery
(tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SPA.03.02.00.SE.150-1.EX.bin)...
Reading full image into memory......................done
Nova Bundle Image
--------------------------------------
Kernel Address : 0x6042e5cc
Kernel Size : 0x318261/3244641
Initramfs Address : 0x60746830
Initramfs Size : 0xdb0fb9/14356409
Compression Format: .mzip

Bootable image at @ ram:0x6042e5cc
Bootable image segment 0 address range [0x81100000, 0x81b80000] is in range [0x80180000, 0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
File "sda9:c3850-recovery.bin" uncompressed and installed, entry point: 0x811060f0
Loading Linux kernel with entry point 0x811060f0 ...
Bootloader: Done loading app on core_mask: 0xf

### Launching Linux Kernel (flags = 0x5)
```

```
Initiating Emergency Installation of bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin


Downloading bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin...
Validating bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin...
Installing bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin...
Verifying bundle
tftp://192.0.2.47/cat3k/cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin...
Package cat3k_caa-base..pkg is Digitally Signed
Package cat3k_caa-drivers.SPA.03.02.00.SE.pkg is Digitally Signed
Package cat3k_caa-infra.SPA.03.02.00.SE.pkg is Digitally Signed
Package cat3k_caa-iosd-universalk9.SPA.03.02.00.SE.pkg is Digitally Signed
Package cat3k_caa-platform.SPA.03.02.00.SE.pkg is Digitally Signed
Package cat3k_caa-wcm.SPA.03.02.00.SE.pkg is Digitally Signed
Preparing flash...
Syncing device...
Emergency Install successful... Rebooting
Restarting system.



Booting...(use DDR clock 667 MHz)Initializing and Testing RAM +++@@@@####...++@@++@@++@@++@
```

Recovering from a Lost or Forgotten Password

The default configuration for the switch allows an end user with physical access to the switch to recover from a lost password by interrupting the boot process during power-on and by entering a new password. These recovery procedures require that you have physical access to the switch.

Note On these switches, a system administrator can disable some of the functionality of this feature by allowing an end user to reset a password only by agreeing to return to the default configuration. If you are an end user trying to reset a password when password recovery has been disabled, a status message shows this during the recovery process.

SUMMARY STEPS

1. Connect a terminal or PC to the switch.
2. Set the line speed on the emulation software to 9600 baud.
3. Power off the standalone switch or the entire switch stack.
4. Reconnect the power cord to the or the . Within 15 seconds, press the **Mode** button while the System LED is still flashing green. Continue pressing the **Mode** button until a prompt is seen; then release the **Mode** button.

5. After recovering the password, reload the switch or the .

DETAILED STEPS

Step 1 Connect a terminal or PC to the switch.

- Connect a terminal or a PC with terminal-emulation software to the switch console port.
- Connect a PC to the Ethernet management port.

Step 2 Set the line speed on the emulation software to 9600 baud.

Step 3 Power off the standalone switch or the entire switch stack.

Step 4 Reconnect the power cord to the or the . Within 15 seconds, press the **Mode** button while the System LED is still flashing green. Continue pressing the **Mode** button until a prompt is seen; then release the **Mode** button.

```
Switch:
Xmodem file system is available.
Base ethernet MAC Address: 20:37:06:4d:e9:80
Verifying bootloader digital signature.


The system has been interrupted prior to loading the operating
system software, console will be reset to 9600 baud rate.
```

Proceed to the *Procedure with Password Recovery Enabled* section, and follow the steps.

Step 5 After recovering the password, reload the switch or the .

On a switch:

```
Switch> reload
Proceed with reload? [confirm] y
```

Procedure with Password Recovery Enabled

If the password-recovery operation is enabled, this message appears:

Step 1 Initialize the flash file system.

```
Switch: flash_init
```

Step 2 Ignore the startup configuration with the following command:

```
Switch: SWITCH_IGNORE_STARTUP_CFG=1
```

Step 3 Boot the switch with the *packages.conf* file from flash.

```
Switch: boot flash:packages.conf
```

Step 4 Terminate the initial configuration dialog by answering **No**.

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

Step 5 At the switch prompt, enter privileged EXEC mode.

```
Switch> enable
Switch#
```

Step 6 Copy the startup configuration to running configuration.

```
Switch# copy startup-config running-config Destination filename [running-config]?
```

Press Return in response to the confirmation prompts. The configuration file is now reloaded, and you can change the password.

Step 7 Enter global configuration mode and change the **enable** password.

```
Switch# configure terminal
Switch(config)#
```

Step 8 Write the running configuration to the startup configuration file.

```
Switch(config)# copy running-config startup-config
```

Step 9 Confirm that manual boot mode is enabled.

```
Switch# show boot

 BOOT variable = flash:packages.conf;
 Manual Boot = yes
 Enable Break = yes
```

Step 10 Reload the device.

```
Switch# reload
```

Step 11 Return the Bootloader parameters (previously changed in Steps 2 and 3) to their original values.

```
switch: SWITCH_IGNORE_STARTUP_CFG=0
```

Step 12 Boot the device with the *packages.conf* file from flash.

```
Switch: boot flash:packages.conf
```

Step 13 After the device boots up, disable manual boot on the device.

```
Switch(config)# no boot manual
```

Procedure with Password Recovery Disabled

If the password-recovery mechanism is disabled, this message appears:

```
The password-recovery mechanism has been triggered, but
is currently disabled.  Access to the boot loader prompt
through the password-recovery mechanism is disallowed at
this point.  However, if you agree to let the system be
reset back to the default system configuration, access
to the boot loader prompt can still be allowed.

Would you like to reset the system back to the default configuration (y/n)?
```

Caution Returning the device to the default configuration results in the loss of all existing configurations. We recommend that you contact your system administrator to verify if there are backup device and VLAN configuration files.

- If you enter **n** (no), the normal boot process continues as if the **Mode** button had not been pressed; you cannot access the boot loader prompt, and you cannot enter a new password. You see the message:

  ```
  Press Enter to continue........
  ```

- If you enter **y** (yes), the configuration file in flash memory and the VLAN database file are deleted. When the default configuration loads, you can reset the password.

Step 1 Choose to continue with password recovery and delete the existing configuration:

```
Would you like to reset the system back to the default configuration (y/n)? Y
```

Step 2 Display the contents of flash memory:

```
Device: dir flash:
```

The device file system appears.

```
Directory of flash:/
.
.
```

```
.i'
15494  drwx        4096   Jan 1 2000 00:20:20 +00:00  kirch
15508  -rw-   258065648   Sep 4 2013 14:19:03 +00:00
cat3k_caa-universalk9.SSA.03.12.02.EZP.150-12.02.EZP.150-12.02.EZP.bin
162196684
```

Step 3 Boot up the system:

```
Device: boot
```

You are prompted to start the setup program. To continue with password recovery, enter **N** at the prompt:

```
Continue with the configuration dialog? [yes/no]: N
```

Step 4 At the device prompt, enter privileged EXEC mode:

```
Device> enable
```

Step 5 Enter global configuration mode:

```
Device# configure terminal
```

Step 6 Change the password:

```
Device(config)# enable secret password
```

The secret password can be from 1 to 25 alphanumeric characters, can start with a number, is case sensitive, and allows spaces but ignores leading spaces.

Step 7 Return to privileged EXEC mode:

```
Device(config)# exit
Device#
```

Note Before continuing to Step 9, power on any connected stack members and wait until they have completely initialized.

Step 8 Write the running configuration to the startup configuration file:

```
Device# copy running-config startup-config
```

The new password is now in the startup configuration.

Step 9 You must now reconfigure the device. If the system administrator has the backup device and VLAN configuration files available, you should use those.

Preventing Switch Stack Problems

To prevent switch stack problems, you should do the following:

- Make sure that the Device that you add to or remove from the switch stack are powered off. For all powering considerations in switch stacks, see the “Switch Installation” chapter in the hardware installation guide.

- Press the **Mode** button on a stack member until the Stack mode LED is on. The last two port LEDs on the Device should be green. Depending on the Device model, the last two ports are either 10/100/1000 ports or small form-factor pluggable (SFP) module. If one or both of the last two port LEDs are not green, the stack is not operating at full bandwidth.
- We recommend using only one CLI session when managing the switch stack. Be careful when using multiple CLI sessions to the active stack. Commands that you enter in one session are not displayed in the other sessions. Therefore, it is possible that you might not be able to identify the session from which you entered a command.
- Manually assigning stack member numbers according to the placement of the Device in the stack can make it easier to remotely troubleshoot the switch stack. However, you need to remember that the Device have manually assigned numbers if you add, remove, or rearrange Device later. Use the **switch** *current-stack-member-number* **renumber** *new-stack-member-number* global configuration command to manually assign a stack member number.

If you replace a stack member with an identical model, the new Device functions with the exact same configuration as the replaced Device. This is also assuming the new Device is using the same member number as the replaced Device.

Removing powered-on stack members causes the switch stack to divide (partition) into two or more switch stacks, each with the same configuration. If you want the switch stacks to remain separate, change the IP address or addresses of the newly created switch stacks. To recover from a partitioned switch stack, follow these steps:

1. Power off the newly created switch stacks.
2. Reconnect them to the original switch stack through their StackWise Plus ports.
3. Power on the Device.

For the commands that you can use to monitor the switch stack and its members, see the *Displaying Switch Stack Information* section.

Preventing Autonegotiation Mismatches

The IEEE 802.3ab autonegotiation protocol manages the Device settings for speed (10 Mb/s, 100 Mb/s, and 1000 Mb/s, excluding SFP module ports) and duplex (half or full). There are situations when this protocol can incorrectly align these settings, reducing performance. A mismatch occurs under these circumstances:

- A manually set speed or duplex parameter is different from the manually set speed or duplex parameter on the connected port.
- A port is set to autonegotiate, and the connected port is set to full duplex with no autonegotiation.

To maximize Device performance and ensure a link, follow one of these guidelines when changing the settings for duplex and speed:

- Let both ports autonegotiate both speed and duplex.
- Manually set the speed and duplex parameters for the ports on both ends of the connection.

Note If a remote device does not autonegotiate, configure the duplex settings on the two ports to match. The speed parameter can adjust itself even if the connected port does not autonegotiate.

Troubleshooting SFP Module Security and Identification

Cisco small form-factor pluggable (SFP) modules have a serial EEPROM that contains the module serial number, the vendor name and ID, a unique security code, and cyclic redundancy check (CRC). When an SFP module is inserted in the Device, the Device software reads the EEPROM to verify the serial number, vendor name and vendor ID, and recompute the security code and CRC. If the serial number, the vendor name or vendor ID, the security code, or CRC is invalid, the software generates a security error message and places the interface in an error-disabled state.

Note The security error message references the GBIC_SECURITY facility. The Device supports SFP modules and does not support GBIC modules. Although the error message text refers to GBIC interfaces and modules, the security messages actually refer to the SFP modules and module interfaces.

If you are using a non-Cisco SFP module, remove the SFP module from the Device, and replace it with a Cisco module. After inserting a Cisco SFP module, use the **errdisable recovery cause gbic-invalid** global configuration command to verify the port status, and enter a time interval for recovering from the error-disabled state. After the elapsed interval, the Device brings the interface out of the error-disabled state and retries the operation. For more information about the **errdisable recovery** command, see the command reference for this release.

If the module is identified as a Cisco SFP module, but the system is unable to read vendor-data information to verify its accuracy, an SFP module error message is generated. In this case, you should remove and reinsert the SFP module. If it continues to fail, the SFP module might be defective.

Monitoring SFP Module Status

You can check the physical or operational status of an SFP module by using the **show interfaces transceiver** privileged EXEC command. This command shows the operational status, such as the temperature and the current for an SFP module on a specific interface and the alarm status. You can also use the command to check the speed and the duplex settings on an SFP module. For more information, see the **show interfaces transceiver** command in the command reference for this release.

Executing Ping

If you attempt to ping a host in a different IP subnetwork, you must define a static route to the network or have IP routing configured to route between those subnets.

IP routing is disabled by default on all Device.

Note Though other protocol keywords are available with the **ping** command, they are not supported in this release.

Use this command to ping another device on the network from the Device:

Command	Purpose
ping ip *host* | *address* `Device# ping 172.20.52.3`	Pings a remote host through IP or by supplying the hostname or network address.

Monitoring Temperature

The Device monitors the temperature conditions and uses the temperature information to control the fans.

Use the **show env temperature status** privileged EXEC command to display the temperature value, state, and thresholds. The temperature value is the temperature in the Device (not the external temperature).You can configure only the yellow threshold level (in Celsius) by using the **system env temperature threshold yellow** *value* global configuration command to set the difference between the yellow and red thresholds. You cannot configure the green or red thresholds. For more information, see the command reference for this release.

Monitoring the Physical Path

You can monitor the physical path that a packet takes from a source device to a destination device by using one of these privileged EXEC commands:

Table 17: Monitoring the Physical Path

Command	Purpose
tracetroute mac [**interface** *interface-id*] {*source-mac-address*} [**interface** *interface-id*] {*destination-mac-address*} [**vlan** *vlan-id*] [**detail**]	Displays the Layer 2 path taken by the packets from the specified source MAC address to the specified destination MAC address.
tracetroute mac ip {*source-ip-address* | *source-hostname*}{*destination-ip-address* | *destination-hostname*} [**detail**]	Displays the Layer 2 path taken by the packets from the specified source IP address or hostname to the specified destination IP address or hostname.

Executing IP Traceroute

Note Though other protocol keywords are available with the **traceroute** privileged EXEC command, they are not supported in this release.

Command	Purpose
traceroute ip *host* `Device# traceroute ip 192.51.100.1`	Traces the path that packets take through the network.

Running TDR and Displaying the Results

To run TDR, enter the **test cable-diagnostics tdr interface** *interface-id* privileged EXEC command.

To display the results, enter the **show cable-diagnostics tdr interface** *interface-id* privileged EXEC command.

Redirecting Debug and Error Message Output

By default, the network server sends the output from **debug** commands and system error messages to the console. If you use this default, you can use a virtual terminal connection to monitor debug output instead of connecting to the console port or the Ethernet management port.

Possible destinations include the console, virtual terminals, internal buffer, and UNIX hosts running a syslog server. The syslog format is compatible with 4.3 Berkeley Standard Distribution (BSD) UNIX and its derivatives.

Note Be aware that the debugging destination you use affects system overhead. When you log messages to the console, very high overhead occurs. When you log messages to a virtual terminal, less overhead occurs. Logging messages to a syslog server produces even less, and logging to an internal buffer produces the least overhead of any method.

For more information about system message logging, see *Configuring System Message Logging*.

Using the show platform forward Command

The output from the **show platform forward** privileged EXEC command provides some useful information about the forwarding results if a packet entering an interface is sent through the system. Depending upon the parameters entered about the packet, the output provides lookup table results and port maps used to calculate forwarding destinations, bitmaps, and egress information.

Most of the information in the output from the command is useful mainly for technical support personnel, who have access to detailed information about the Device application-specific integrated circuits (ASICs). However, packet forwarding information can also be helpful in troubleshooting.

Using the show debug command

The **show debug** command is entered in privileged EXEC mode. This command displays all debug options available on the switch.

To view all conditional debug options run the command **show debug condition** The commands can be listed by selecting either a condition identifier *<1-1000>* or *all* conditions.

To disable debugging, use the **no debug all** command.

Caution Because debugging output is assigned high priority in the CPU process, it can render the system unusable. For this reason, use **debug** commands only to troubleshoot specific problems or during troubleshooting sessions with Cisco technical support staff. Moreover, it is best to use **debug** commands during periods of lower network traffic and fewer users. Debugging during these periods decreases the likelihood that increased **debug** command processing overhead will affect system use.

Configuring OBFL

Caution We recommend that you do not disable OBFL and that you do not remove the data stored in the flash memory.

- To enable OBFL, use the **hw-switch switch** *switch-number* **logging onboard message** command in global configuration mode. On switches, the range for *switch-number* is from 1 to 9.
- To copy the OBFL data to the local network or a specific file system, use the **copy onboard switch** *switch-number* **url** *url-destination* privileged EXEC command.
- To disable OBFL, use the **no hw-switch switch** *switch-number* **logging onboard message** command in global configuration mode.
- To clear all the OBFL data in the flash memory except for the uptime and CLI command information, use the **clear onboard switch** *switch-number* privileged EXEC command.
- To enable OBFL on a standalone switch or on all stack members in a switch stack, use the **hw-switch switch** *switch-number* **logging onboard message** command in global configuration mode.
- You can enable or disable OBFL on a member switch from the active stack.

Verifying Troubleshooting of the Software Configuration

Displaying OBFL Information

Table 18: Commands for Displaying OBFL Information

Command	Purpose
show onboard switch *switch-number* **clilog** `Device# show onboard switch 1 clilog`	Displays the OBFL CLI commands that were entered on a standalone switch or the specified stack members.
show onboard switch *switch-number* **environment** `Device# show onboard switch 1 environment`	Displays the UDI information for a standalone switch or the specified stack members and for all the connected FRU devices: the PID, the VID, and the serial number.

Command	Purpose
show onboard switch *switch-number* **message** `Device# show onboard switch 1 message`	Displays the hardware-related messages generated by a standalone switch or the specified stack members.
show onboard switch *switch-number* **counter** `Device# show onboard switch 1 counter`	Displays the counter information on a standalone switch or the specified stack members.
show onboard switch *switch-number* **temperature** `Device# show onboard switch 1 temperature`	Displays the temperature of a standalone switch or the specified switch stack members.
show onboard switch *switch-number* **uptime** `Device# show onboard switch 1 uptime`	Displays the time when a standalone switch or the specified stack members start, the reason the standalone switch or specified stack members restart, and the length of time that the standalone switch or specified stack members have been running since they last restarted.
show onboard switch *switch-number* **voltage** `Device# show onboard switch 1 voltage`	Displays the system voltages of a standalone switch or the specified stack members.
show onboard switch *switch-number* **status** `Device# show onboard switch 1 status`	Displays the status of a standalone switch or the specified stack members.

Example: Verifying the Problem and Cause for High CPU Utilization

To determine if high CPU utilization is a problem, enter the **show processes cpu sorted** privileged EXEC command. Note the underlined information in the first line of the output example.

```
Device# show processes cpu sorted
CPU utilization for five seconds: 8%/0%; one minute: 7%; five minutes: 8%
PID Runtime(ms) Invoked uSecs 5Sec 1Min 5Min TTY Process
309 42289103 752750 56180 1.75% 1.20% 1.22% 0 RIP Timers
140 8820183 4942081 1784 0.63% 0.37% 0.30% 0 HRPC qos request
100 3427318 16150534 212 0.47% 0.14% 0.11% 0 HRPC pm-counters
192 3093252 14081112 219 0.31% 0.14% 0.11% 0 Spanning Tree
143 8 37 216 0.15% 0.01% 0.00% 0 Exec
...
<output truncated>
```

This example shows normal CPU utilization. The output shows that utilization for the last 5 seconds is 8%/0%, which has this meaning:

- The total CPU utilization is 8 percent, including both time running Cisco IOS processes and time spent handling interrupts.
- The time spent handling interrupts is zero percent.

Table 19: Troubleshooting CPU Utilization Problems

Type of Problem	Cause	Corrective Action
Interrupt percentage value is almost as high as total CPU utilization value.	The CPU is receiving too many packets from the network.	Determine the source of the network packet. Stop the flow, or change the switch configuration. See the section on “Analyzing Network Traffic.”
Total CPU utilization is greater than 50% with minimal time spent on interrupts.	One or more Cisco IOS process is consuming too much CPU time. This is usually triggered by an event that activated the process.	Identify the unusual event, and troubleshoot the root cause. See the section on “Debugging Active Processes.”

Scenarios for Troubleshooting the Software Configuration

Scenarios to Troubleshoot Power over Ethernet (PoE)

Table 20: Power over Ethernet Troubleshooting Scenarios

Symptom or Problem	Possible Cause and Solution
Only one port does not have PoE. Trouble is on only one switch port. PoE and non-PoE devices do not work on this port, but do on other ports.	Verify that the powered device works on another PoE port. Use the **show run**, or **show interface status** user EXEC commands to verify that the port is not shut down or error-disabled. **Note** Most switches turn off port power when the port is shut down, even though the IEEE specifications make this optional. Verify that **power inline never** is not configured on that interface or port. Verify that the Ethernet cable from the powered device to the switch port is good: Connect a known good non-PoE Ethernet device to the Ethernet cable, and make sure that the powered device establishes a link and exchanges traffic with another host. **Note** Cisco powered device works only with straight cable and not with crossover one. Verify that the total cable length from the switch front panel to the powered device is not more than 100 meters. Disconnect the Ethernet cable from the switch port. Use a short Ethernet cable to connect a known good Ethernet device directly to this port on the switch front panel (not on a patch panel). Verify that it can establish an Ethernet link and exchange traffic with another host, or ping the port VLAN SVI. Next, connect a powered device to this port, and verify that it powers on. If a powered device does not power on when connected with a patch cord to the switch port, compare the total number of connected powered devices to the switch power budget (available PoE). Use the **show power inline** command to verify the amount of available power.

Symptom or Problem	Possible Cause and Solution
No PoE on all ports or a group of ports. Trouble is on all switch ports. Nonpowered Ethernet devices cannot establish an Ethernet link on any port, and PoE devices do not power on.	If there is a continuous, intermittent, or reoccurring alarm related to power, replace the power supply if possible it is a field-replaceable unit. Otherwise, replace the switch. If the problem is on a consecutive group of ports but not all ports, the power supply is probably not defective, and the problem could be related to PoE regulators in the switch. Use the **show log** privileged EXEC command to review alarms or system messages that previously reported PoE conditions or status changes. If there are no alarms, use the **show interface status** command to verify that the ports are not shut down or error-disabled. If ports are error-disabled, use the **shut** and **no shut** interface configuration commands to reenable the ports. Use the **show env power** and **show power inline** privileged EXEC commands to review the PoE status and power budget (available PoE). Review the running configuration to verify that **power inline never** is not configured on the ports. Connect a nonpowered Ethernet device directly to a switch port. Use only a short patch cord. Do not use the existing distribution cables. Enter the **shut** and **no shut** interface configuration commands, and verify that an Ethernet link is established. If this connection is good, use a short patch cord to connect a powered device to this port and verify that it powers on. If the device powers on, verify that all intermediate patch panels are correctly connected. Disconnect all but one of the Ethernet cables from switch ports. Using a short patch cord, connect a powered device to only one PoE port. Verify the powered device does not require more power than can be delivered by the switch port. Use the **show power inline** privileged EXEC command to verify that the powered device can receive power when the port is not shut down. Alternatively, watch the powered device to verify that it powers on. If a powered device can power on when only one powered device is connected to the switch, enter the **shut** and **no shut** interface configuration commands on the remaining ports, and then reconnect the Ethernet cables one at a time to the switch PoE ports. Use the **show interface status** and **show power inline** privileged EXEC commands to monitor inline power statistics and port status. If there is still no PoE at any port, a fuse might be open in the PoE section of the power supply. This normally produces an alarm. Check the log again for alarms reported earlier by system messages.

Symptom or Problem	Possible Cause and Solution
Cisco pre-standard powered device disconnects or resets. After working normally, a Cisco phone or wireless access point intermittently reloads or disconnects from PoE.	Verify all electrical connections from the switch to the powered device. Any unreliable connection results in power interruptions and irregular powered device functioning such as erratic powered device disconnects and reloads. Verify that the cable length is not more than 100 meters from the switch port to the powered device. Notice what changes in the electrical environment at the switch location or what happens at the powered device when the disconnect occurs. Notice whether any error messages appear at the same time a disconnect occurs. Use the **show log** privileged EXEC command to review error messages. Verify that an IP phone is not losing access to the Call Manager immediately before the reload occurs. (It might be a network problem and not a PoE problem.) Replace the powered device with a non-PoE device, and verify that the device works correctly. If a non-PoE device has link problems or a high error rate, the problem might be an unreliable cable connection between the switch port and the powered device.
IEEE 802.3af-compliant or IEEE 802.3at-compliant powered devices do not work on Cisco PoE switch. A non-Cisco powered device is connected to a Cisco PoE switch, but never powers on or powers on and then quickly powers off. Non-PoE devices work normally.	Use the **show power inline** command to verify that the switch power budget (available PoE) is not depleted before or after the powered device is connected. Verify that sufficient power is available for the powered device type before you connect it. Use the **show interface status** command to verify that the switch detects the connected powered device. Use the **show log** command to review system messages that reported an overcurrent condition on the port. Identify the symptom precisely: Does the powered device initially power on, but then disconnect? If so, the problem might be an initial surge-in (or *inrush*) current that exceeds a current-limit threshold for the port.

Configuration Examples for Troubleshooting Software

Example: Pinging an IP Host

This example shows how to ping an IP host:

```
Device# ping 172.20.52.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 172.20.52.3, timeout is 2 seconds:
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
Device#
```

Table 21: Ping Output Display Characters

Character	Description
!	Each exclamation point means receipt of a reply.
.	Each period means the network server timed out while waiting for a reply.
U	A destination unreachable error PDU was received.
C	A congestion experienced packet was received.
I	User interrupted test.
?	Unknown packet type.
&	Packet lifetime exceeded.

To end a ping session, enter the escape sequence (**Ctrl-^ X** by default). Simultaneously press and release the **Ctrl**, **Shift**, and **6** keys and then press the **X** key.

Example: Performing a Traceroute to an IP Host

This example shows how to perform a **traceroute** to an IP host:

```
Device# traceroute ip 192.0.2.10

Type escape sequence to abort.
Tracing the route to 192.0.2.10

  1 192.0.2.1 0 msec 0 msec 4 msec
  2 192.0.2.203 12 msec 8 msec 0 msec
  3 192.0.2.100 4 msec 0 msec 0 msec
  4 192.0.2.10 0 msec 4 msec 0 msec
```

The display shows the hop count, the IP address of the router, and the round-trip time in milliseconds for each of the three probes that are sent.

Table 22: Traceroute Output Display Characters

Character	Description
*	The probe timed out.
?	Unknown packet type.
A	Administratively unreachable. Usually, this output means that an access list is blocking traffic.
H	Host unreachable.
N	Network unreachable.

Character	Description
P	Protocol unreachable.
Q	Source quench.
U	Port unreachable.

To end a trace in progress, enter the escape sequence (**Ctrl-^ X** by default). Simultaneously press and release the **Ctrl**, **Shift**, and **6** keys and then press the **X** key.

Example: Enabling All System Diagnostics

Caution Because debugging output takes priority over other network traffic, and because the **debug all** privileged EXEC command generates more output than any other **debug** command, it can severely diminish switch performance or even render it unusable. In virtually all cases, it is best to use more specific **debug** commands.

This command disables all-system diagnostics:

```
Device# debug all
```

The **no debug all** privileged EXEC command disables all diagnostic output. Using the **no debug all** command is a convenient way to ensure that you have not accidentally left any **debug** commands enabled.

Additional References for Troubleshooting Software Configuration

Related Documents

Related Topic	Document Title
System management commands	
Platform-independent command reference	*Configuration Fundamentals Command Reference, Cisco IOS XE Release 3S (Catalyst 3650 Switches)*
Platform_independent configuration information	*Configuration Fundamentals Configuration Guide, Cisco IOS XE Release 3S (Catalyst 3650 Switches)*

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for Troubleshooting Software Configuration

Release	Modification
Cisco IOS XE 3.3SECisco IOS XE 3.3SE	This feature was introduced.