IPv6 Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)

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Preface

Document Conventions

This document uses the following conventions:

Convention	Description
^ or Ctrl	Both the ^ symbol and Ctrl represent the Control (Ctrl) key on a keyboard. For example, the key combination **^D** or **Ctrl-D** means that you hold down the Control key while you press the D key. (Keys are indicated in capital letters but are not case sensitive.)
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
`Courier` font	Terminal sessions and information the system displays appear in `courier` font.
`Bold Courier` font	**`Bold Courier`** font indicates text that the user must enter.
[x]	Elements in square brackets are optional.
...	An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.
|	A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.
[x | y]	Optional alternative keywords are grouped in brackets and separated by vertical bars.

Convention	Description
{x | y}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Reader Alert Conventions

This document may use the following conventions for reader alerts:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Tip Means *the following information will help you solve a problem.*

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

Timesaver Means *the described action saves time.* You can save time by performing the action described in the paragraph.

Warning **Means *reader be warned.* In this situation, you might perform an action that could result in bodily injury.**

Related Documentation

Note Before installing or upgrading the switch, refer to the switch release notes.

- Cisco Catalyst 3650 Switch documentation, located at:

  http://www.cisco.com/go/cat3650_docs

- Cisco SFP and SFP+ modules documentation, including compatibility matrixes, located at:

  http://www.cisco.com/en/US/products/hw/modules/ps5455/tsd_products_support_series_home.html

- Error Message Decoder, located at:

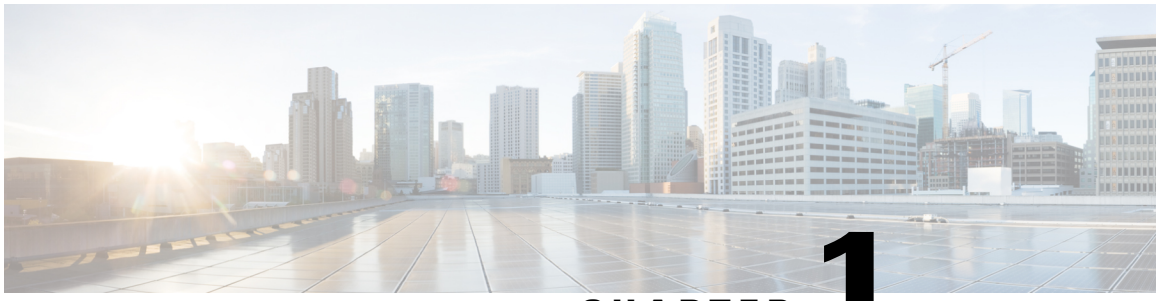
  https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.



CHAPTER 1

Using the Command-Line Interface

This chapter contains the following topics:

Information About Using the Command-Line Interface

Command Modes

The Cisco IOS user interface is divided into many different modes. The commands available to you depend on which mode you are currently in. Enter a question mark (?) at the system prompt to obtain a list of commands available for each command mode.

You can start a CLI session through a console connection, through Telnet, a SSH, or by using the browser.

When you start a session, you begin in user mode, often called user EXEC mode. Only a limited subset of the commands are available in user EXEC mode. For example, most of the user EXEC commands are one-time commands, such as **show** commands, which show the current configuration status, and **clear** commands, which clear counters or interfaces. The user EXEC commands are not saved when the switch reboots.

To have access to all commands, you must enter privileged EXEC mode. Normally, you must enter a password to enter privileged EXEC mode. From this mode, you can enter any privileged EXEC command or enter global configuration mode.

Using the configuration modes (global, interface, and line), you can make changes to the running configuration. If you save the configuration, these commands are stored and used when the switch reboots. To access the various configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and line configuration mode.

This table describes the main command modes, how to access each one, the prompt you see in that mode, and how to exit the mode.

Table 1: Command Mode Summary

Mode	Access Method	Prompt	Exit Method	About This Mode
User EXEC	Begin a session using Telnet, SSH, or console.	`Switch>`	Enter **logout** or **quit**.	Use this mode to • Change terminal settings. • Perform basic tests. • Display system information.
Privileged EXEC	While in user EXEC mode, enter the **enable** command.	`Switch#`	Enter **disable** to exit.	Use this mode to verify commands that you have entered. Use a password to protect access to this mode.
Global configuration	While in privileged EXEC mode, enter the **configure** command.	`Switch(config)#`	To exit to privileged EXEC mode, enter **exit** or **end**, or press **Ctrl-Z**.	Use this mode to configure parameters that apply to the entire switch.
VLAN configuration	While in global configuration mode, enter the **vlan** *vlan-id* command.	`Switch(config-vlan)#`	To exit to global configuration mode, enter the **exit** command. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure VLAN parameters. When VTP mode is transparent, you can create extended-range VLANs (VLAN IDs greater than 1005) and save configurations in the switch startup configuration file.
Interface configuration	While in global configuration mode, enter the **interface** command (with a specific interface).	`Switch(config-if)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the Ethernet ports.

Mode	Access Method	Prompt	Exit Method	About This Mode
Line configuration	While in global configuration mode, specify a line with the **line vty** or **line console** command.	`Switch(config-line)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the terminal line.

Using the Help System

You can enter a question mark (?) at the system prompt to display a list of commands available for each command mode. You can also obtain a list of associated keywords and arguments for any command.

SUMMARY STEPS

1. **help**
2. *abbreviated-command-entry* **?**
3. *abbreviated-command-entry* <Tab>
4. **?**
5. *command* **?**
6. *command keyword* **?**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**help** **Example:** `Switch# help`	Obtains a brief description of the help system in any command mode.

Step 2	*abbreviated-command-entry* **?**
	Example:
	`Switch# di?`
	`dir disable disconnect`
		Obtains a list of commands that begin with a particular character string.

Step 3	*abbreviated-command-entry* <Tab>
	Example:
	`Switch# sh conf<tab>`
	`Switch# show configuration`
		Completes a partial command name.

	Command or Action	Purpose
Step 4	**?** **Example:** `Switch> ?`	Lists all commands available for a particular command mode.
Step 5	*command* **?** **Example:** `Switch> show ?`	Lists the associated keywords for a command.

Step 6	*command keyword* **?**
	
	Example:
	`Switch(config)# cdp holdtime ?`
	`  <10-255> Length of time (in sec) that receiver must keep this packet`
		Lists the associated arguments for a keyword.

Understanding Abbreviated Commands

You need to enter only enough characters for the switch to recognize the command as unique.

This example shows how to enter the **show configuration** privileged EXEC command in an abbreviated form:

```
Switch# show conf
```

No and Default Forms of Commands

Almost every configuration command also has a **no** form. In general, use the **no** form to disable a feature or function or reverse the action of a command. For example, the **no shutdown** interface configuration command reverses the shutdown of an interface. Use the command without the keyword **no** to reenable a disabled feature or to enable a feature that is disabled by default.

Configuration commands can also have a **default** form. The **default** form of a command returns the command setting to its default. Most commands are disabled by default, so the **default** form is the same as the **no** form. However, some commands are enabled by default and have variables set to certain default values. In these cases, the **default** command enables the command and sets variables to their default values.

CLI Error Messages

This table lists some error messages that you might encounter while using the CLI to configure your switch.

Table 2: Common CLI Error Messages

Error Message	Meaning	How to Get Help
`% Ambiguous command: "show con"`	You did not enter enough characters for your switch to recognize the command.	Reenter the command followed by a question mark (?) without any space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Incomplete command.`	You did not enter all of the keywords or values required by this command.	Reenter the command followed by a question mark (?) with a space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Invalid input detected at '^' marker.`	You entered the command incorrectly. The caret (^) marks the point of the error.	Enter a question mark (?) to display all of the commands that are available in this command mode. The possible keywords that you can enter with the command appear.

Configuration Logging

You can log and view changes to the switch configuration. You can use the Configuration Change Logging and Notification feature to track changes on a per-session and per-user basis. The logger tracks each configuration command that is applied, the user who entered the command, the time that the command was entered, and the parser return code for the command. This feature includes a mechanism for asynchronous notification to registered applications whenever the configuration changes. You can choose to have the notifications sent to the syslog.

Note Only CLI or HTTP changes are logged.

How to Use the CLI to Configure Features

Configuring the Command History

The software provides a history or record of commands that you have entered. The command history feature is particularly useful for recalling long or complex commands or entries, including access lists. You can customize this feature to suit your needs.

Changing the Command History Buffer Size

By default, the switch records ten command lines in its history buffer. You can alter this number for a current terminal session or for all sessions on a particular line. This procedure is optional.

SUMMARY STEPS

1. **terminal history** [**size** *number-of-lines*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal history** [**size** *number-of-lines*] **Example:** `Switch# terminal history size 200`	Changes the number of command lines that the switch records during the current terminal session in privileged EXEC mode. You can configure the size from 0 to 256.

Recalling Commands

To recall commands from the history buffer, perform one of the actions listed in this table. These actions are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

SUMMARY STEPS

1. **Ctrl-P** or use the **up arrow** key
2. **Ctrl-N** or use the **down arrow** key
3. **show history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**Ctrl-P** or use the **up arrow** key	Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Step 2	**Ctrl-N** or use the **down arrow** key	Returns to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the up arrow key. Repeat the key sequence to recall successively more recent commands.

	Command or Action	Purpose
Step 3	**show history** **Example:** `Switch# show history`	Lists the last several commands that you just entered in privileged EXEC mode. The number of commands that appear is controlled by the setting of the **terminal history** global configuration command and the **history** line configuration command.

Disabling the Command History Feature

The command history feature is automatically enabled. You can disable it for the current terminal session or for the command line. This procedure is optional.

SUMMARY STEPS

1. **terminal no history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal no history** **Example:** `Switch# terminal no history`	Disables the feature during the current terminal session in privileged EXEC mode.

Enabling and Disabling Editing Features

Although enhanced editing mode is automatically enabled, you can disable it and reenable it.

SUMMARY STEPS

1. **terminal editing**
2. **terminal no editing**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal editing** **Example:** `Switch# terminal editing`	Reenables the enhanced editing mode for the current terminal session in privileged EXEC mode.

	Command or Action	Purpose
Step 2	**terminal no editing** **Example:** `Switch# terminal no editing`	Disables the enhanced editing mode for the current terminal session in privileged EXEC mode.

Editing Commands Through Keystrokes

The keystrokes help you to edit the command lines. These keystrokes are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

Table 3: Editing Commands

Editing Commands	Description
Ctrl-B or use the **left arrow** key	Moves the cursor back one character.
Ctrl-F or use the **right arrow** key	Moves the cursor forward one character.
Ctrl-A	Moves the cursor to the beginning of the command line.
Ctrl-E	Moves the cursor to the end of the command line.
Esc B	Moves the cursor back one word.
Esc F	Moves the cursor forward one word.
Ctrl-T	Transposes the character to the left of the cursor with the character located at the cursor.
Delete or **Backspace** key	Erases the character to the left of the cursor.
Ctrl-D	Deletes the character at the cursor.
Ctrl-K	Deletes all characters from the cursor to the end of the command line.
Ctrl-U or **Ctrl-X**	Deletes all characters from the cursor to the beginning of the command line.
Ctrl-W	Deletes the word to the left of the cursor.

Esc D	Deletes from the cursor to the end of the word.
Esc C	Capitalizes at the cursor.
Esc L	Changes the word at the cursor to lowercase.
Esc U	Capitalizes letters from the cursor to the end of the word.
Ctrl-V or **Esc Q**	Designates a particular keystroke as an executable command, perhaps as a shortcut.
Return key	Scrolls down a line or screen on displays that are longer than the terminal screen can display. **Note** The More prompt is used for any output that has more lines than can be displayed on the terminal screen, including **show** command output. You can use the **Return** and **Space** bar keystrokes whenever you see the More prompt.
Space bar	Scrolls down one screen.
Ctrl-L or **Ctrl-R**	Redisplays the current command line if the switch suddenly sends a message to your screen.

Editing Command Lines That Wrap

You can use a wraparound feature for commands that extend beyond a single line on the screen. When the cursor reaches the right margin, the command line shifts ten spaces to the left. You cannot see the first ten characters of the line, but you can scroll back and check the syntax at the beginning of the command. The keystroke actions are optional.

To scroll back to the beginning of the command entry, press **Ctrl-B** or the left arrow key repeatedly. You can also press **Ctrl-A** to immediately move to the beginning of the line.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

The following example shows how to wrap a command line that extends beyond a single line on the screen.

SUMMARY STEPS

1. **access-list**
2. **Ctrl-A**
3. **Return** key

DETAILED STEPS

	Command or Action	Purpose

Step 1	**access-list**
	
	Example:
	`Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35`
	`Switch(config)# $ 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35 255.25`
	`Switch(config)# $t tcp 10.15.22.25 255.255.255.0 131.108.1.20 255.255.255.0 eq`
	`Switch(config)# $15.22.25 255.255.255.0 10.15.22.35 255.255.255.0 eq 45`
		Displays the global configuration command entry that extends beyond one line.
		
		When the cursor first reaches the end of the line, the line is shifted ten spaces to the left and redisplayed. The dollar sign ($) shows that the line has been scrolled to the left. Each time the cursor reaches the end of the line, the line is again shifted ten spaces to the left.

Step 2	**Ctrl-A** **Example:** `Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.2$`	Checks the complete syntax. The dollar sign ($) appears at the end of the line to show that the line has been scrolled to the right.
Step 3	**Return** key	Execute the commands. The software assumes that you have a terminal screen that is 80 columns wide. If you have a different width, use the **terminal width** privileged EXEC command to set the width of your terminal. Use line wrapping with the command history feature to recall and modify previous complex command entries.

Searching and Filtering Output of show and more Commands

You can search and filter the output for **show** and **more** commands. This is useful when you need to sort through large amounts of output or if you want to exclude output that you do not need to see. Using these commands is optional.

SUMMARY STEPS

1. {**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*

DETAILED STEPS

	Command or Action	Purpose
Step 1	{**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*	Searches and filters the output.

	Command or Action	Purpose

	Example:
	`Switch# show interfaces | include protocol`
	`Vlan1 is up, line protocol is up`
	`Vlan10 is up, line protocol is down`
	`GigabitEthernet1/0/1 is up, line protocol is down`
	`GigabitEthernet1/0/2 is up, line protocol is up`
		Expressions are case sensitive. For example, if you enter **| exclude output**, the lines that contain **output** are not displayed, but the lines that contain **output** appear.

Accessing the CLI on a Switch Stack

You can access the CLI through a console connection, through Telnet, a SSH, or by using the browser.

You manage the switch stack and the stack member interfaces through the . You cannot manage stack members on an individual switch basis. You can connect to the through the console port or the Ethernet management port of one or more stack members. Be careful with using multiple CLI sessions on the . Commands that you enter in one session are not displayed in the other sessions. Therefore, it is possible to lose track of the session from which you entered commands.

Note We recommend using one CLI session when managing the switch stack.

If you want to configure a specific stack member port, you must include the stack member number in the CLI command interface notation.

To debug the standby switch, use the **session standby ios** privileged EXEC command from the active switch to access the IOS console of the standby switch. To debug a specific stack member, use the **session switch** *stack-member-number* privileged EXEC command from the active switch to access the diagnostic shell of the stack member. For more information about these commands, see the switch command reference.

Accessing the CLI Through a Console Connection or Through Telnet

Before you can access the CLI, you must connect a terminal or a PC to the switch console or connect a PC to the Ethernet management port and then power on the switch, as described in the hardware installation guide that shipped with your switch.

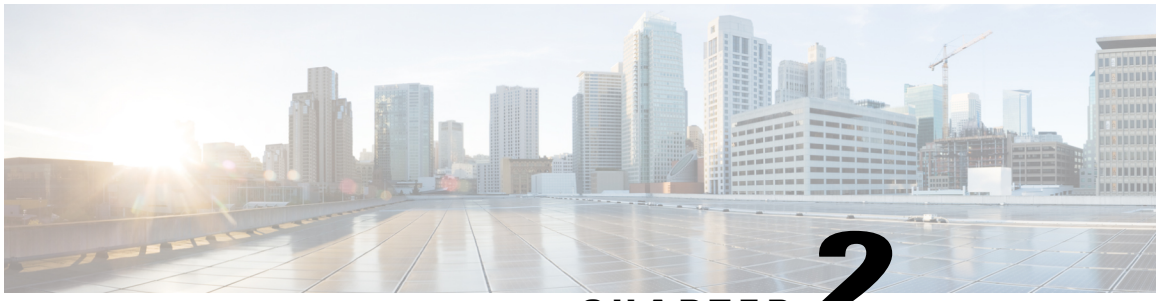
If your switch is already configured, you can access the CLI through a local console connection or through a remote Telnet session, but your switch must first be configured for this type of access.

You can use one of these methods to establish a connection with the switch:

- Connect the switch console port to a management station or dial-up modem, or connect the Ethernet management port to a PC. For information about connecting to the console or Ethernet management port, see the switch hardware installation guide.
- Use any Telnet TCP/IP or encrypted Secure Shell (SSH) package from a remote management station. The switch must have network connectivity with the Telnet or SSH client, and the switch must have an enable secret password configured.

- The switch supports up to 16 simultaneous Telnet sessions. Changes made by one Telnet user are reflected in all other Telnet sessions.
- The switch supports up to five simultaneous secure SSH sessions.

After you connect through the console port, through the Ethernet management port, through a Telnet session or through an SSH session, the user EXEC prompt appears on the management station.



CHAPTER 2

Using the Web Graphical User Interface

Prerequisites for Using the Web GUI

- The GUI must be used on a PC running Windows 7, Windows XP SP1 (or later releases), or Windows 2000 SP4 (or later releases).
- The switch GUI is compatible with Microsoft Internet Explorer version 10.x, Mozilla Firefox 20.x, or Google Chrome 26.x.

Information About Using The Web GUI

A web browser, or graphical user interface (GUI), is built into each switch.

You can use either the service port interface or the management interface to access the GUI. We recommend that you use the service-port interface. Click Help at the top of any page in the GUI to display online help. You might need to disable your browser's pop-up blocker to view the online help.

Web GUI Features

The switch web GUI supports the following:

The Configuration Wizard—After initial configuration of the IP address and the local username/password or auth via the authentication server (privilege 15 needed), the wizard provides a method to complete the initial

wireless configuration. Start the wizard through Configuration -> Wizard and follow the nine-step process to configure the following:

- Admin Users
- SNMP System Summary
- Management Port
- Wireless Management
- RF Mobility and Country code
- Mobility configuration
- WLANs
- 802.11 Configuration
- Set Time

The Monitor tab:

- Displays summary details of switch, clients, and access points.
- Displays all radio and AP join statistics.
- Displays air quality on access points.
- Displays list of all Cisco Discovery Protocol (CDP) neighbors on all interfaces and the CDP traffic information.
- Displays all rogue access points based on their classification-friendly, malicious, ad hoc, classified, and unclassified.

The Configuration tab:

- Enables you to configure the switch for all initial operation using the web Configuration Wizard. The wizard allows you to configure user details, management interface, and so on.
- Enables you to configure the system, internal DHCP server, management, and mobility management parameters.
- Enables you to configure the switch, WLAN, and radios.
- Enables you to configure and set security policies on your switch.
- Enables you to access the switch operating system software management commands.

The Administration tab enables you to configure system logs.

Connecting the Console Port of the Switch

Before You Begin

Before you can configure the switch for basic operations, you need to connect it to a PC that uses a VT-100 terminal emulation program (such as HyperTerminal, ProComm, Minicom, or Tip).

Step 1 Connect one end of a null-modem serial cable to the switch's RJ-45 console port and the other end to your PC's serial port.

Step 2 Plug the AC power cord into the switch and a grounded 100 to 240 VAC, 50/60-Hz electrical outlet. Turn on the power supply. The bootup script displays operating system software initialization (code download and power-on self-test verification) and basic configuration. If the switch passes the power-on self-test, the bootup script runs the configuration wizard, which prompts you for basic configuration input.

Step 3 Enter **yes**. Proceed with basic initial setup configuration parameters in the CLI setup wizard. Specify the IP address for the service port which is the gigabitethernet 0/0 interface.
After entering the configuration parameters in the configuration wizard, you can access the Web GUI. Now, the switch is configured with the IP address for service port.

Logging On to the Web GUI

Enter the switch IP address in your browser's address bar. For a secure connection, enter https://**ip-address**. For a less secure connection, enter http://**ip-address**.

Enabling Web and Secure Web Modes

Step 1 Choose **Configuration** > **Switch** > **Management** > **Protocol Management** > **HTTP-HTTPS**.

The **HTTP-HTTPS Configuration** page appears.

Step 2 To enable web mode, which allows users to access the switch GUI using "http://ip-address," choose Enabled from the HTTP Access drop-down list. Otherwise, choose Disabled. Web mode (HTTP) is not a secure connection.

Step 3 To enable secure web mode, which allows users to access the switch GUI using "https://ip-address," choose Enabled from the HTTPS Access drop-down list. Otherwise, choose Disabled. Secure web mode (HTTPS) is a secure connection.

Step 4 Choose to track the device in the IP Device Tracking check box.

Step 5 Choose to enable the trust point in the Enable check box.

Step 6 Choose the trustpoints from the Trustpoints drop-down list.

Step 7 Enter the amount of time, in seconds, before the web session times out due to inactivity in the HTTP Timeout-policy (1 to 600 sec) text box.
The valid range is from 1 to 600 seconds.

Step 8 Enter the server life time in the Server Life Time (1 to 86400 sec) text box.
The valid range is from1 to 86400 seconds.

Step 9 Enter the maximum number of connection requests that the server can accept in the Maximum number of Requests (1 to 86400) text box.
The valid range is from 1 to 86400 connections.

Step 10 Click **Apply**.

Step 11 Click **Save Configuration**.

Configuring the Switch Web GUI

The configuration wizard enables you to configure basic settings on the switch. You can run the wizard after you receive the switch from the factory or after the switch has been reset to factory defaults. The configuration wizard is available in both GUI and CLI formats.

Step 1 Connect your PC to the service port and configure an IPv4 address to use the same subnet as the switch. The switch is loaded with IOS XE image and the service port interface is configured as gigabitethernet 0/0.

Step 2 Start Internet Explorer 10 (or later), Firefox 2.0.0.11 (or later), or Google Chrome on your PC and enter the management interface IP address on the browser window. The management interface IP address is same as the gigabitethernet 0/0 (also known as service port interface). When you log in for the first time, you need to enter HTTP username and password. By default, the username is **admin** and the password is **cisco**.
You can use both HTTP and HTTPS when using the service port interface. HTTPS is enabled by default and HTTP can also be enabled.

When you log in for the first time, the **Accessing Cisco Switch <Model Number> <Hostname>** page appears.

Step 3 On the **Accessing Cisco Switch** page, click the **Wireless Web GUI** link to access switch web GUI **Home** page.

Step 4 Choose **Configuration** > **Wizard** to perform all steps that you need to configure the switch initially.
The **Admin Users** page appears.

Step 5 On the **Admin Users** page, enter the administrative username to be assigned to this switch in the User Name text box and the administrative password to be assigned to this switch in the Password and Confirm Password text boxes. Click **Next**.
The default username is **admin** and the default password is **cisco**. You can also create a new administrator user for the switch. You can enter up to 24 ASCII characters for username and password.

The **SNMP System Summary** page appears.

Step 6 On the **SNMP System Summary** page, enter the following SNMP system parameters for the switch, and click **Next**:

- Customer-definable switch location in the Location text box.
- Customer-definable contact details such as phone number with names in the Contact text box.
- Choose **enabled** to send SNMP notifications for various SNMP traps or **disabled** not to send SNMP notifications for various SNMP traps from the SNMP Global Trap drop-down list.
- Choose **enabled** to send system log messages or **disabled** not to send system log messages from the SNMP Logging drop-down list.

Note The SNMP trap server, must be reachable through the distribution ports (and not through the gigabitethernet0/0 service or management interface).

The **Management Port** page appears.

Step 7 In the **Management Port** page, enter the following parameters for the management port interface (gigabitethernet 0/0) and click **Next**.

- Interface IP address that you assigned for the service port in the IP Address text box.
- Network mask address of the management port interface in the Netmask text box.
- The IPv4 Dynamic Host Configuration Protocol (DHCP) address for the selected port in the IPv4 DHCP Server text box.

The **Wireless Management** page appears.

Step 8 In the **Wireless Management** page, enter the following wireless interface management details, and click **Next**.

- Choose the interface—VLAN, or Ten Gigabit Ethernet from the Select Interface drop-down list.
- VLAN tag identifier, or 0 for no VLAN tag in the VLAN id text box.
- IP address of wireless management interface where access points are connected in the IP Address text box.
- Network mask address of the wireless management interface in the Netmask text box.
- DHCP IPv4 IP address in the IPv4 DHCP Server text box.

When selecting VLAN as interface, you can specify the ports as –Trunk or Access ports from the selected list displayed in the Switch Port Configuration text box.

The **RF Mobility and Country Code** page appears.

Step 9 In the **RF Mobility and Country Code** page, enter the RF mobility domain name in the RF Mobility text box, choose current country code from the Country Code drop-down list, and click **Next**. From the GUI, you can select only one country code.

Note Before configuring RF grouping parameters and mobility configuration, ensure that you refer to the relevant conceptual content and then proceed with the configuration.

The **Mobility Configuration** page with mobility global configuration settings appears.

Step 10 In the **Mobility Configuration** page, view and enter the following mobility global configuration settings, and click **Next**.

- Choose **Mobility Controller** or **Mobility Agent** from the Mobility Role drop-down list:

- If Mobility Agent is chosen, enter the mobility controller IP address in the Mobility Controller IP Address text box and mobility controller IP address in the Mobility Controller Public IP Address text box.
- If Mobility Controller is chosen, then the mobility controller IP address and mobility controller public IP address are displayed in the respective text boxes.

- Displays mobility protocol port number in the Mobility Protocol Port text box.
- Displays the mobility switch peer group name in the Mobility Switch Peer Group Name text box.
- Displays whether DTLS is enabled in the DTLS Mode text box.

  DTLS is a standards-track Internet Engineering Task Force (IETF) protocol based on TLS.
- Displays mobility domain identifier for 802.11 radios in the Mobility Domain ID for 802.11 radios text box.
- The amount of time (in seconds) between each ping request sent to an peer switch in the Mobility Keepalive Interval (1-30)sec text box.

  Valid range is from 1 to 30 seconds, and the default value is 10 seconds.
- Number of times a ping request is sent to an peer switch before the peer is considered to be unreachable in the Mobility Keepalive Count (3-20) text box.

  The valid range is from 3 to 20, and the default value is 3.
- The DSCP value that you can set for the mobility switch in the Mobility Control Message DSCP Value (0-63) text box.

  The valid range is 0 to 63, and the default value is 0.
- Displays the number of mobility switch peer group member configured in the Switch Peer Group Members Configured text box.

The **WLANs** page appears.

Step 11 In the **WLANs** page, enter the following WLAN configuration parameters, and click **Next**.

- WLAN identifier in the WLAN ID text box.
- SSID of the WLAN that the client is associated with in the SSID text box.
- Name of the WLAN used by the client in the Profile Name text box.

The **802.11 Configuration** page appears.

Step 12 In the **802.11 Configuration** page, check either one or both 802.11a/n/ac and 802.11b/g/n check boxes to enable the 802.11 radios, and click **Next**.
The **Set Time** page appears.

Step 13 In the **Set Time** page, you can configure the time and date on the switch based on the following parameters, and click **Next**.

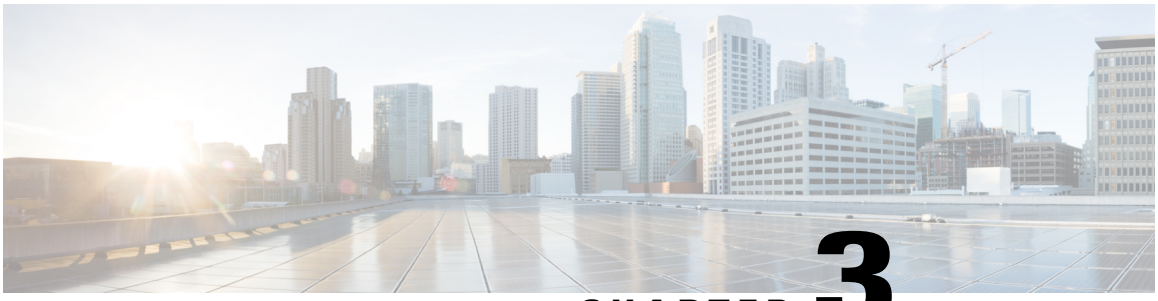
- Displays current timestamp on the switch in the Current Time text box.
- Choose either Manual or NTP from the Mode drop-down list.

  On using the NTP server, all access points connected to the switch, synchronizes its time based on the NTP server settings available.

- Choose date on the switch from the Year, Month, and Day drop-down list.
- Choose time from the Hours, Minutes, and Seconds drop-down list.
- Enter the time zone in the Zone text box and select the off setting required when compared to the current time configured on the switch from the Offset drop-down list.

The **Save Wizard** page appears.

Step 14 In the **Save Wizard** page, you can review the configuration settings performed on the switch using these steps, and if you wish to change any configuration value, click **Previous** and navigate to that page.
You can save the switch configuration created using the wizard only if a success message is displayed for all the wizards. If the **Save Wizard** page displays errors, you must recreate the wizard for initial configuration of the switch.



CHAPTER 3

Configuring MLD Snooping

This module contains details of configuring MLD snooping

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

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

Information About Configuring IPv6 MLD Snooping

You can use Multicast Listener Discovery (MLD) snooping to enable efficient distribution of IP Version 6 (IPv6) multicast data to clients and routers in a switched network on the switch. Unless otherwise noted, the term switch refers to a standalone switch and to a switch stack.

Note To use IPv6 on a Catalyst 2960-XR switch, you must configure the dual IPv4 and IPv6 Switch Database Management (SDM) template on the switch.

Note For complete syntax and usage information for the commands used in this chapter, see the command reference for this release or the Cisco IOS documentation referenced in the procedures.

Understanding MLD Snooping

In IP Version 4 (IPv4), Layer 2 switches can use Internet Group Management Protocol (IGMP) snooping to limit the flooding of multicast traffic by dynamically configuring Layer 2 interfaces so that multicast traffic is forwarded to only those interfaces associated with IP multicast devices. In IPv6, MLD snooping performs a similar function. With MLD snooping, IPv6 multicast data is selectively forwarded to a list of ports that want to receive the data, instead of being flooded to all ports in a VLAN. This list is constructed by snooping IPv6 multicast control packets.

MLD is a protocol used by IPv6 multicast routers to discover the presence of multicast listeners (nodes wishing to receive IPv6 multicast packets) on the links that are directly attached to the routers and to discover which multicast packets are of interest to neighboring nodes. MLD is derived from IGMP; MLD Version 1 (MLDv1) is equivalent to IGMPv2, and MLD Version 2 (MLDv2) is equivalent to IGMPv3. MLD is a subprotocol of Internet Control Message Protocol Version 6 (ICMPv6), and MLD messages are a subset of ICMPv6 messages, identified in IPv6 packets by a preceding Next Header value of 58.

The switch supports two versions of MLD snooping:

- MLDv1 snooping detects MLDv1 control packets and sets up traffic bridging based on IPv6 destination multicast addresses.
- MLDv2 basic snooping (MBSS) uses MLDv2 control packets to set up traffic forwarding based on IPv6 destination multicast addresses.

The switch can snoop on both MLDv1 and MLDv2 protocol packets and bridge IPv6 multicast data based on destination IPv6 multicast addresses.

Note The switch does not support MLDv2 enhanced snooping, which sets up IPv6 source and destination multicast address-based forwarding.

MLD snooping can be enabled or disabled globally or per VLAN. When MLD snooping is enabled, a per-VLAN IPv6 multicast address table is constructed in software and hardware. The switch then performs IPv6 multicast-address based bridging in hardware.

According to IPv6 multicast standards, the switch derives the MAC multicast address by performing a logical-OR of the four low-order octets of the switch MAC address with the MAC address of 33:33:00:00:00:00. For example, the IPv6 MAC address of FF02:DEAD:BEEF:1:3 maps to the Ethernet MAC address of 33:33:00:01:00:03.

A multicast packet is unmatched when the destination IPv6 address does not match the destination MAC address. The switch forwards the unmatched packet in hardware based the MAC address table. If the destination MAC address is not in the MAC address table, the switch floods the packet to all ports in the same VLAN as the receiving port.

MLD Messages

MLDv1 supports three types of messages:

- Listener Queries are the equivalent of IGMPv2 queries and are either General Queries or Multicast-Address-Specific Queries (MASQs).
- Multicast Listener Reports are the equivalent of IGMPv2 reports

- Multicast Listener Done messages are the equivalent of IGMPv2 leave messages.

MLDv2 supports MLDv2 queries and reports, as well as MLDv1 Report and Done messages.

Message timers and state transitions resulting from messages being sent or received are the same as those of IGMPv2 messages. MLD messages that do not have valid link-local IPv6 source addresses are ignored by MLD routers and switches.

MLD Queries

The switch sends out MLD queries, constructs an IPv6 multicast address database, and generates MLD group-specific and MLD group-and-source-specific queries in response to MLD Done messages. The switch also supports report suppression, report proxying, Immediate-Leave functionality, and static IPv6 multicast group address configuration.

When MLD snooping is disabled, all MLD queries are flooded in the ingress VLAN.

When MLD snooping is enabled, received MLD queries are flooded in the ingress VLAN, and a copy of the query is sent to the CPU for processing. From the received query, MLD snooping builds the IPv6 multicast address database. It detects multicast router ports, maintains timers, sets report response time, learns the querier IP source address for the VLAN, learns the querier port in the VLAN, and maintains multicast-address aging.

Note When the IPv6 multicast router is a Catalyst 6500 switch and you are using extended VLANs (in the range 1006 to 4094), IPv6 MLD snooping must be enabled on the extended VLAN on the Catalyst 6500 switch in order for the Catalyst 2960, 2960-S, 2960-C, or 2960-X switch to receive queries on the VLAN. For normal-range VLANs (1 to 1005), it is not necessary to enable IPv6 MLD snooping on the VLAN on the Catalyst 6500 switch.

When a group exists in the MLD snooping database, the switch responds to a group-specific query by sending an MLDv1 report. When the group is unknown, the group-specific query is flooded to the ingress VLAN.

When a host wants to leave a multicast group, it can send out an MLD Done message (equivalent to IGMP Leave message). When the switch receives an MLDv1 Done message, if Immediate- Leave is not enabled, the switch sends an MASQ to the port from which the message was received to determine if other devices connected to the port should remain in the multicast group.

Multicast Client Aging Robustness

You can configure port membership removal from addresses based on the number of queries. A port is removed from membership to an address only when there are no reports to the address on the port for the configured number of queries. The default number is 2.

Multicast Router Discovery

Like IGMP snooping, MLD snooping performs multicast router discovery, with these characteristics:

- Ports configured by a user never age out.
- Dynamic port learning results from MLDv1 snooping queries and IPv6 PIMv2 packets.
- If there are multiple routers on the same Layer 2 interface, MLD snooping tracks a single multicast router on the port (the router that most recently sent a router control packet).

- Dynamic multicast router port aging is based on a default timer of 5 minutes; the multicast router is deleted from the router port list if no control packet is received on the port for 5 minutes.
- IPv6 multicast router discovery only takes place when MLD snooping is enabled on the switch.
- Received IPv6 multicast router control packets are always flooded to the ingress VLAN, whether or not MLD snooping is enabled on the switch.
- After the discovery of the first IPv6 multicast router port, unknown IPv6 multicast data is forwarded only to the discovered router ports (before that time, all IPv6 multicast data is flooded to the ingress VLAN).

MLD Reports

The processing of MLDv1 join messages is essentially the same as with IGMPv2. When no IPv6 multicast routers are detected in a VLAN, reports are not processed or forwarded from the switch. When IPv6 multicast routers are detected and an MLDv1 report is received, an IPv6 multicast group address is entered in the VLAN MLD database. Then all IPv6 multicast traffic to the group within the VLAN is forwarded using this address. When MLD snooping is disabled, reports are flooded in the ingress VLAN.

When MLD snooping is enabled, MLD report suppression, called listener message suppression, is automatically enabled. With report suppression, the switch forwards the first MLDv1 report received by a group to IPv6 multicast routers; subsequent reports for the group are not sent to the routers. When MLD snooping is disabled, report suppression is disabled, and all MLDv1 reports are flooded to the ingress VLAN.

The switch also supports MLDv1 proxy reporting. When an MLDv1 MASQ is received, the switch responds with MLDv1 reports for the address on which the query arrived if the group exists in the switch on another port and if the port on which the query arrived is not the last member port for the address.

MLD Done Messages and Immediate-Leave

When the Immediate-Leave feature is enabled and a host sends an MLDv1 Done message (equivalent to an IGMP leave message), the port on which the Done message was received is immediately deleted from the group.You enable Immediate-Leave on VLANs and (as with IGMP snooping), you should only use the feature on VLANs where a single host is connected to the port. If the port was the last member of a group, the group is also deleted, and the leave information is forwarded to the detected IPv6 multicast routers.

When Immediate Leave is not enabled in a VLAN (which would be the case when there are multiple clients for a group on the same port) and a Done message is received on a port, an MASQ is generated on that port. The user can control when a port membership is removed for an existing address in terms of the number of MASQs. A port is removed from membership to an address when there are no MLDv1 reports to the address on the port for the configured number of queries.

The number of MASQs generated is configured by using the **ipv6 mld snooping last-listener-query count** global configuration command. The default number is 2.

The MASQ is sent to the IPv6 multicast address for which the Done message was sent. If there are no reports sent to the IPv6 multicast address specified in the MASQ during the switch maximum response time, the port on which the MASQ was sent is deleted from the IPv6 multicast address database. The maximum response time is the time configured by using the **ipv6 mld snooping last-listener-query-interval** global configuration command. If the deleted port is the last member of the multicast address, the multicast address is also deleted, and the switch sends the address leave information to all detected multicast routers.

When Immediate Leave is not enabled and a port receives an MLD Done message, the switch generates MASQs on the port and sends them to the IPv6 multicast address for which the Done message was sent. You

can optionally configure the number of MASQs that are sent and the length of time the switch waits for a response before deleting the port from the multicast group.

When you enable MLDv1 Immediate Leave, the switch immediately removes a port from a multicast group when it detects an MLD Done message on that port. You should only use the Immediate-Leave feature when there is a single receiver present on every port in the VLAN. When there are multiple clients for a multicast group on the same port, you should not enable Immediate-Leave in a VLAN.

Topology Change Notification Processing

When topology change notification (TCN) solicitation is enabled by using the **ipv6 mld snooping tcn query solicit** global configuration command, MLDv1 snooping sets the VLAN to flood all IPv6 multicast traffic with a configured number of MLDv1 queries before it begins sending multicast data only to selected ports. You set this value by using the **ipv6 mld snooping tcn flood query count** global configuration command. The default is to send two queries. The switch also generates MLDv1 global Done messages with valid link-local IPv6 source addresses when the switch becomes the STP root in the VLAN or when it is configured by the user. This is same as done in IGMP snooping.

MLD Snooping in Switch Stacks

The MLD IPv6 group address databases are maintained on all switches in the stack, regardless of which switch learns of an IPv6 multicast group. Report suppression and proxy reporting are done stack-wide. During the maximum response time, only one received report for a group is forwarded to the multicast routers, regardless of which switch the report arrives on.

The election of a new stack master does not affect the learning or bridging of IPv6 multicast data; bridging of IPv6 multicast data does not stop during a stack master re-election. When a new switch is added to the stack, it synchronizes the learned IPv6 multicast information from the stack master. Until the synchronization is complete, data ingress on the newly added switch is treated as unknown multicast data.

How to Configure IPv6 MLD Snooping

Default MLD Snooping Configuration

Table 4: Default MLD Snooping Configuration

Feature	Default Setting
MLD snooping (Global)	Disabled.
MLD snooping (per VLAN)	Enabled. MLD snooping must be globally enabled for VLAN MLD snooping to take place.
IPv6 Multicast addresses	None configured.
IPv6 Multicast router ports	None configured.
MLD snooping Immediate Leave	Disabled.

Feature	Default Setting
MLD snooping robustness variable	Global: 2; Per VLAN: 0. **Note** The VLAN value overrides the global setting. When the VLAN value is 0, the VLAN uses the global count.
Last listener query count	Global: 2; Per VLAN: 0. **Note** The VLAN value overrides the global setting. When the VLAN value is 0, the VLAN uses the global count.
Last listener query interval	Global: 1000 (1 second); VLAN: 0. **Note** The VLAN value overrides the global setting. When the VLAN value is 0, the VLAN uses the global interval.
TCN query solicit	Disabled.
TCN query count	2.
MLD listener suppression	Disabled.

MLD Snooping Configuration Guidelines

When configuring MLD snooping, consider these guidelines:

- You can configure MLD snooping characteristics at any time, but you must globally enable MLD snooping by using the **ipv6 mld snooping** global configuration command for the configuration to take effect.
- When the IPv6 multicast router is a Catalyst 6500 switch and you are using extended VLANs (in the range 1006 to 4094), IPv6 MLD snooping must be enabled on the extended VLAN on the Catalyst 6500 switch in order for the switch to receive queries on the VLAN. For normal-range VLANs (1 to 1005), it is not necessary to enable IPv6 MLD snooping on the VLAN on the Catalyst 6500 switch.
- MLD snooping and IGMP snooping act independently of each other. You can enable both features at the same time on the switch.
- The maximum number of multicast entries allowed on the switch or switch stack is determined by the configured SDM template.
-
- The maximum number of address entries allowed for the switch or switch stack is 4000.

Enabling or Disabling MLD Snooping on the Switch (CLI)

By default, IPv6 MLD snooping is globally disabled on the switch and enabled on all VLANs. When MLD snooping is globally disabled, it is also disabled on all VLANs. When you globally enable MLD snooping, the VLAN configuration overrides the global configuration. That is, MLD snooping is enabled only on VLAN interfaces in the default state (enabled).

You can enable and disable MLD snooping on a per-VLAN basis or for a range of VLANs, but if you globally disable MLD snooping, it is disabled in all VLANs. If global snooping is enabled, you can enable or disable VLAN snooping.

Beginning in privileged EXEC mode, follow these steps to globally enable MLD snooping on the switch:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 mld snooping** **Example:** `Switch(config)# ipv6 mld snooping`	Enables MLD snooping on the switch.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**copy running-config startup-config** **Example:** `Switch(config)# copy running-config startup-config`	(Optional) Save your entries in the configuration file.
Step 5	**reload** **Example:** `Switch(config)# reload`	Reload the operating system.

Enabling or Disabling MLD Snooping on a VLAN (CLI)

Beginning in privileged EXEC mode, follow these steps to enable MLD snooping on a VLAN.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 mld snooping** **Example:** `Switch(config)# ipv6 mld snooping`	Enables MLD snooping on the switch.
Step 3	**ipv6 mld snooping vlan** *vlan-id* **Example:** `Switch(config)# ipv6 mld snooping vlan 1`	Enables MLD snooping on the VLAN. The VLAN ID range is 1 to 1001 and 1006 to 4094. **Note** MLD snooping must be globally enabled for VLAN snooping to be enabled.
Step 4	**end** **Example:** `Switch(config)# ipv6 mld snooping vlan 1`	Returns to privileged EXEC mode.

Configuring a Static Multicast Group (CLI)

Hosts or Layer 2 ports normally join multicast groups dynamically, but you can also statically configure an IPv6 multicast address and member ports for a VLAN.

Beginning in privileged EXEC mode, follow these steps to add a Layer 2 port as a member of a multicast group:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode
Step 2	**ipv6 mld snooping vlan** *vlan-id* **static** *ipv6_multicast_address* **interface** *interface-id*	Configures a multicast group with a Layer 2 port as a member of a multicast group:

	Command or Action	Purpose
	Example: `Switch(config)# ipv6 mld snooping vlan 1 static FF12::3 interface gigabitethernet 0/1`	• *vlan-id* is the multicast group VLAN ID. The VLAN ID range is 1 to 1001 and 1006 to 4094. • *ipv6_multicast_address* is the 128-bit group IPv6 address. The address must be in the form specified in RFC 2373. • *interface-id* is the member port. It can be a physical interface or a port channel (1 to 48).
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

Step 4	Use one of the following:
	• **show ipv6 mld snooping address**
	• **show ipv6 mld snooping address vlan** *vlan-id*
	Example:
	`Switch# show ipv6 mld snooping address`
	or
	`Switch# show ipv6 mld snooping vlan 1`
		Verifies the static member port and the IPv6 address.

Configuring a Multicast Router Port (CLI)

Note Static connections to multicast routers are supported only on switch ports.

Beginning in privileged EXEC mode, follow these steps to add a multicast router port to a VLAN:

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**ipv6 mld snooping vlan** *vlan-id* **mrouter interface** *interface-id* **Example:** `Switch(config)# ipv6 mld snooping vlan 1 mrouter interface gigabitethernet 0/2`	Specifies the multicast router VLAN ID, and specify the interface to the multicast router. • The VLAN ID range is 1 to 1001 and 1006 to 4094. • The interface can be a physical interface or a port channel. The port-channel range is 1 to 48.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show ipv6 mld snooping mrouter** [**vlan** *vlan-id*] **Example:** `Switch# show ipv6 mld snooping mrouter vlan 1`	Verifies that IPv6 MLD snooping is enabled on the VLAN interface.

Enabling MLD Immediate Leave (CLI)

Beginning in privileged EXEC mode, follow these steps to enable MLDv1 Immediate Leave:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 mld snooping vlan** *vlan-id* **immediate-leave** **Example:** `Switch(config)# ipv6 mld snooping vlan 1 immediate-leave`	Enables MLD Immediate Leave on the VLAN interface.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 4	**show ipv6 mld snooping vlan** *vlan-id* **Example:** `Switch# show ipv6 mld snooping vlan 1`	Verifies that Immediate Leave is enabled on the VLAN interface.

Configuring MLD Snooping Queries (CLI)

Beginning in privileged EXEC mode, follow these steps to configure MLD snooping query characteristics for the switch or for a VLAN:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 mld snooping robustness-variable** *value* **Example:** `Switch(config)# ipv6 mld snooping robustness-variable 3`	(Optional) Sets the number of queries that are sent before switch will deletes a listener (port) that does not respond to a general query. The range is 1 to 3; the default is 2.
Step 3	**ipv6 mld snooping vlan** *vlan-id* **robustness-variable** *value* **Example:** `Switch(config)# ipv6 mld snooping vlan 1 robustness-variable 3`	(Optional) Sets the robustness variable on a VLAN basis, which determines the number of general queries that MLD snooping sends before aging out a multicast address when there is no MLD report response. The range is 1 to 3; the default is 0. When set to 0, the number used is the global robustness variable value.
Step 4	**ipv6 mld snooping last-listener-query-count** *count* **Example:** `Switch(config)# ipv6 mld snooping last-listener-query-count 7`	(Optional) Sets the number of MASQs that the switch sends before aging out an MLD client. The range is 1 to 7; the default is 2. The queries are sent 1 second apart.
Step 5	**ipv6 mld snooping vlan** *vlan-id* **last-listener-query-count** *count*	(Optional) Sets the last-listener query count on a VLAN basis. This value overrides the value configured globally. The range is 1 to 7; the default is 0. When set to 0, the global count value is used. Queries are sent 1 second apart.

	Command or Action	Purpose
	Example: `Switch(config)# ipv6 mld snooping vlan 1 last-listener-query-count 7`	
Step 6	**ipv6 mld snooping last-listener-query-interval** *interval* **Example:** `Switch(config)# ipv6 mld snooping last-listener-query-interval 2000`	(Optional) Sets the maximum response time that the switch waits after sending out a MASQ before deleting a port from the multicast group. The range is 100 to 32,768 thousands of a second. The default is 1000 (1 second).
Step 7	**ipv6 mld snooping vlan** *vlan-id* **last-listener-query-interval** *interval* **Example:** `Switch(config)# ipv6 mld snooping vlan 1 last-listener-query-interval 2000`	(Optional) Sets the last-listener query interval on a VLAN basis. This value overrides the value configured globally. The range is 0 to 32,768 thousands of a second. The default is 0. When set to 0, the global last-listener query interval is used.
Step 8	**ipv6 mld snooping tcn query solicit** **Example:** `Switch(config)# ipv6 mld snooping tcn query solicit`	(Optional) Enables topology change notification (TCN) solicitation, which means that VLANs flood all IPv6 multicast traffic for the configured number of queries before sending multicast data to only those ports requesting to receive it. The default is for TCN to be disabled.
Step 9	**ipv6 mld snooping tcn flood query count** *count* **Example:** `Switch(config)# ipv6 mld snooping tcn flood query count 5`	(Optional) When TCN is enabled, specifies the number of TCN queries to be sent. The range is from 1 to 10; the default is 2.
Step 10	**end**	Returns to privileged EXEC mode.
Step 11	**show ipv6 mld snooping querier** [**vlan** *vlan-id*] **Example:** `Switch(config)# show ipv6 mld snooping querier vlan 1`	(Optional) Verifies that the MLD snooping querier information for the switch or for the VLAN.

Disabling MLD Listener Message Suppression (CLI)

MLD snooping listener message suppression is enabled by default. When it is enabled, the switch forwards only one MLD report per multicast router query. When message suppression is disabled, multiple MLD reports could be forwarded to the multicast routers.

Beginning in privileged EXEC mode, follow these steps to disable MLD listener message suppression:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enter global configuration mode.
Step 2	**no ipv6 mld snooping listener-message-suppression** **Example:** `Switch(config)# no ipv6 mld snooping listener-message-suppression`	Disable MLD message suppression.
Step 3	**end** **Example:** `Switch(config)# end`	Return to privileged EXEC mode.
Step 4	**show ipv6 mld snooping** **Example:** `Switch# show ipv6 mld snooping`	Verify that IPv6 MLD snooping report suppression is disabled.

Displaying MLD Snooping Information

You can display MLD snooping information for dynamically learned and statically configured router ports and VLAN interfaces. You can also display IPv6 group address multicast entries for a VLAN configured for MLD snooping.

Table 5: Commands for Displaying MLD Snooping Information

Command	Purpose
show ipv6 mld snooping [**vlan** *vlan-id*]	Displays the MLD snooping configuration information for all VLANs on the switch or for a specified VLAN. (Optional) Enter **vlan** *vlan-id* to display information for a single VLAN. The VLAN ID range is 1 to 1001 and 1006 to 4094.

Command	Purpose
show ipv6 mld snooping mrouter [**vlan** *vlan-id*]	Displays information on dynamically learned and manually configured multicast router interfaces. When you enable MLD snooping, the switch automatically learns the interface to which a multicast router is connected. These are dynamically learned interfaces. (Optional) Enters **vlan** *vlan-id* to display information for a single VLAN. The VLAN ID range is 1 to 1001 and 1006 to 4094.
show ipv6 mld snooping querier [**vlan** *vlan-id*]	Displays information about the IPv6 address and incoming port for the most-recently received MLD query messages in the VLAN. (Optional) Enters **vlan** *vlan-id* to display information for a single VLAN.The VLAN ID range is 1 to 1001 and 1006 to 4094.
show ipv6 mld snooping address [**vlan** *vlan-id*] [**count** | **dynamic** | **user**]	Displays all IPv6 multicast address information or specific IPv6 multicast address information for the switch or a VLAN. • Enters **count** to show the group count on the switch or in a VLAN. • Enters **dynamic** to display MLD snooping learned group information for the switch or for a VLAN. • Entesr **user** to display MLD snooping user-configured group information for the switch or for a VLAN.
show ipv6 mld snooping address vlan *vlan-id* [*ipv6-multicast-address*]	Displays MLD snooping for the specified VLAN and IPv6 multicast address.

Configuration Examples for Configuring MLD Snooping

Configuring a Static Multicast Group: Example

This example shows how to statically configure an IPv6 multicast group:

```
Switch# configure terminal
Switch(config)# ipv6 mld snooping vlan 2 static FF12::3 interface gigabitethernet

          1/0/1
Switch(config)# end
```

Configuring a Multicast Router Port: Example

This example shows how to add a multicast router port to VLAN 200:

```
Switch# configure terminal
Switch(config)# ipv6 mld snooping vlan 200 mrouter interface gigabitethernet
          0/2
Switch(config)# exit
```

Enabling MLD Immediate Leave: Example

This example shows how to enable MLD Immediate Leave on VLAN 130:

```
Switch# configure terminal
Switch(config)# ipv6 mld snooping vlan 130 immediate-leave
Switch(config)# exit
```

Configuring MLD Snooping Queries: Example

This example shows how to set the MLD snooping global robustness variable to 3:

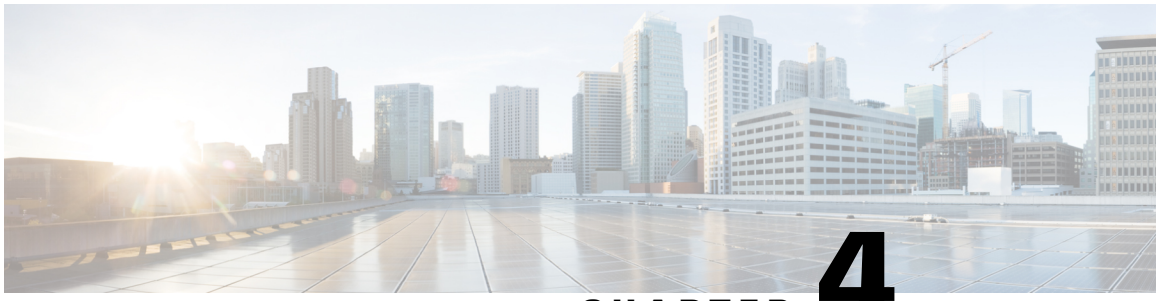
```
Switch# configure terminal
Switch(config)# ipv6 mld snooping robustness-variable 3
Switch(config)# exit
```

This example shows how to set the MLD snooping last-listener query count for a VLAN to 3:

```
Switch# configure terminal
Switch(config)# ipv6 mld snooping vlan 200 last-listener-query-count 3
Switch(config)# exit
```

This example shows how to set the MLD snooping last-listener query interval (maximum response time) to 2000 (2 seconds):

```
Switch# configure terminal
Switch(config)# ipv6 mld snooping last-listener-query-interval 2000
Switch(config)# exit
```



CHAPTER 4

Configuring IPv6 Unicast Routing

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

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

Information About Configuring IPv6 Unicast Routing

This chapter describes how to configure IPv6 unicast routing on the switch.

Note To use all IPv6 features in this chapter, the switch or stack master must be running the IP services feature set. Switches running the IP base feature set support IPv6 static routing, RIP for IPv6, and OSPF. Switches running the LAN base feature set support only IPv6 host functionality.

Understanding IPv6

IPv4 users can move to IPv6 and receive services such as end-to-end security, quality of service (QoS), and globally unique addresses. The IPv6 address space reduces the need for private addresses and Network Address Translation (NAT) processing by border routers at network edges.

For information about how Cisco Systems implements IPv6, go to:

http://www.cisco.com/en/US/products/ps6553/products_ios_technology_home.html

For information about IPv6 and other features in this chapter

- See the *Cisco IOS IPv6 Configuration Library*.
- Use the Search field on Cisco.com to locate the Cisco IOS software documentation. For example, if you want information about static routes, you can enter *Implementing Static Routes for IPv6* in the search field to learn about static routes.

IPv6 Addresses

The switch supports only IPv6 unicast addresses. It does not support site-local unicast addresses, or anycast addresses.

The IPv6 128-bit addresses are represented as a series of eight 16-bit hexadecimal fields separated by colons in the format: n:n:n:n:n:n:n:n. This is an example of an IPv6 address:

2031:0000:130F:0000:0000:09C0:080F:130B

For easier implementation, leading zeros in each field are optional. This is the same address without leading zeros:

2031:0:130F:0:0:9C0:80F:130B

You can also use two colons (::) to represent successive hexadecimal fields of zeros, but you can use this short version only once in each address:

2031:0:130F::09C0:080F:130B

For more information about IPv6 address formats, address types, and the IPv6 packet header, see the "Implementing IPv6 Addressing and Basic Connectivity" chapter of *Cisco IOS IPv6 Configuration Library* on Cisco.com.

In the "Information About Implementing Basic Connectivity for IPv6" chapter, these sections apply to the switch:

- IPv6 Address Formats
- IPv6 Address Type: Unicast
- IPv6 Address Type: Multicast
- IPv6 Address Output Display
- Simplified IPv6 Packet Header

Supported IPv6 Unicast Routing Features

The switch supports hop-by-hop extension header packets, which are routed in software.

The switch provides IPv6 routing capability over Routing Information Protocol (RIP) for IPv6, and Open Shortest Path First (OSPF) Version 3 Protocol. It supports up to 16 equal-cost routes and can simultaneously forward IPv4 and IPv6 frames at line rate.

128-Bit Wide Unicast Addresses

The switch supports aggregatable global unicast addresses and link-local unicast addresses. It does not support site-local unicast addresses.

- Aggregatable global unicast addresses are IPv6 addresses from the aggregatable global unicast prefix. The address structure enables strict aggregation of routing prefixes and limits the number of routing table entries in the global routing table. These addresses are used on links that are aggregated through organizations and eventually to the Internet service provider.

  These addresses are defined by a global routing prefix, a subnet ID, and an interface ID. Current global unicast address allocation uses the range of addresses that start with binary value 001 (2000::/3). Addresses with a prefix of 2000::/3(001) through E000::/3(111) must have 64-bit interface identifiers in the extended unique identifier (EUI)-64 format.

- Link local unicast addresses can be automatically configured on any interface by using the link-local prefix FE80::/10(1111 1110 10) and the interface identifier in the modified EUI format. Link-local addresses are used in the neighbor discovery protocol (NDP) and the stateless autoconfiguration process. Nodes on a local link use link-local addresses and do not require globally unique addresses to communicate. IPv6 routers do not forward packets with link-local source or destination addresses to other links.

For more information, see the section about IPv6 unicast addresses in the "Implementing IPv6 Addressing and Basic Connectivity" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

DNS for IPv6

IPv6 supports Domain Name System (DNS) record types in the DNS name-to-address and address-to-name lookup processes. The DNS AAAA resource record types support IPv6 addresses and are equivalent to an A address record in IPv4. The switch supports DNS resolution for IPv4 and IPv6.

Path MTU Discovery for IPv6 Unicast

The switch supports advertising the system maximum transmission unit (MTU) to IPv6 nodes and path MTU discovery. Path MTU discovery allows a host to dynamically discover and adjust to differences in the MTU size of every link along a given data path. In IPv6, if a link along the path is not large enough to accommodate the packet size, the source of the packet handles the fragmentation.

ICMPv6

The Internet Control Message Protocol (ICMP) in IPv6 generates error messages, such as ICMP destination unreachable messages, to report errors during processing and other diagnostic functions. In IPv6, ICMP packets are also used in the neighbor discovery protocol and path MTU discovery.

Neighbor Discovery

The switch supports NDP for IPv6, a protocol running on top of ICMPv6, and static neighbor entries for IPv6 stations that do not support NDP. The IPv6 neighbor discovery process uses ICMP messages and solicited-node multicast addresses to determine the link-layer address of a neighbor on the same network (local link), to verify the reachability of the neighbor, and to keep track of neighboring routers.

The switch supports ICMPv6 redirect for routes with mask lengths less than 64 bits. ICMP redirect is not supported for host routes or for summarized routes with mask lengths greater than 64 bits.

Neighbor discovery throttling ensures that the switch CPU is not unnecessarily burdened while it is in the process of obtaining the next hop forwarding information to route an IPv6 packet. The switch drops any additional IPv6 packets whose next hop is the same neighbor that the switch is actively trying to resolve. This drop avoids further load on the CPU.

Default Router Preference

The switch supports IPv6 default router preference (DRP), an extension in router advertisement messages. DRP improves the ability of a host to select an appropriate router, especially when the host is multihomed and the routers are on different links. The switch does not support the Route Information Option in RFC 4191.

An IPv6 host maintains a default router list from which it selects a router for traffic to offlink destinations. The selected router for a destination is then cached in the destination cache. NDP for IPv6 specifies that routers that are reachable or probably reachable are preferred over routers whose reachability is unknown or suspect. For reachable or probably reachable routers, NDP can either select the same router every time or cycle through the router list. By using DRP, you can configure an IPv6 host to prefer one router over another, provided both are reachable or probably reachable.

For more information about DRP for IPv6, see the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

IPv6 Stateless Autoconfiguration and Duplicate Address Detection

The switch uses stateless autoconfiguration to manage link, subnet, and site addressing changes, such as management of host and mobile IP addresses. A host autonomously configures its own link-local address, and booting nodes send router solicitations to request router advertisements for configuring interfaces.

For more information about autoconfiguration and duplicate address detection, see the “Implementing IPv6 Addressing and Basic Connectivity” chapter of *Cisco IOS IPv6 Configuration Library* on Cisco.com.

IPv6 Applications

The switch has IPv6 support for these applications:

- Ping, traceroute, Telnet, and TFTP
- Secure Shell (SSH) over an IPv6 transport
- HTTP server access over IPv6 transport
- DNS resolver for AAAA over IPv4 transport
- Cisco Discovery Protocol (CDP) support for IPv6 addresses

For more information about managing these applications, see the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

DHCP for IPv6 Address Assignment

DHCPv6 enables DHCP servers to pass configuration parameters, such as IPv6 network addresses, to IPv6 clients. The address assignment feature manages non-duplicate address assignment in the correct prefix based on the network where the host is connected. Assigned addresses can be from one or multiple prefix pools. Additional options, such as default domain and DNS name-server address, can be passed back to the client.

Address pools can be assigned for use on a specific interface, on multiple interfaces, or the server can automatically find the appropriate pool.

For more information and to configure these features, see the *Cisco IOS IPv6 Configuration Guide*.

This document describes only the DHCPv6 address assignment. For more information about configuring the DHCPv6 client, server, or relay agent functions, see the “Implementing DHCP for IPv6” chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Static Routes for IPv6

Static routes are manually configured and define an explicit route between two networking devices. Static routes are useful for smaller networks with only one path to an outside network or to provide security for certain types of traffic in a larger network.

For more information about static routes, see the “Implementing Static Routes for IPv6” chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

RIP for IPv6

Routing Information Protocol (RIP) for IPv6 is a distance-vector protocol that uses hop count as a routing metric. It includes support for IPv6 addresses and prefixes and the all-RIP-routers multicast group address FF02::9 as the destination address for RIP update messages.

For more information about RIP for IPv6, see the “Implementing RIP for IPv6” chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

OSPF for IPv6

The switch running the IP Base feature set supports Open Shortest Path First (OSPF) for IPv6, a link-state protocol for IP. For more information, see*Cisco IOS IPv6 Configuration Library* on Cisco.com.

HSRP for IPv6

Switches running the IPServices and IPBase feature set support the Hot Standby Router Protocol (HSRP) for IPv6. HSRP provides routing redundancy for routing IPv6 traffic not dependent on the availability of any single router. IPv6 hosts learn of available routers through IPv6 neighbor discovery router advertisement messages. These messages are multicast periodically or are solicited by hosts.

An HSRP IPv6 group has a virtual MAC address that is derived from the HSRP group number and a virtual IPv6 link-local address that is, by default, derived from the HSRP virtual MAC address. Periodic messages are sent for the HSRP virtual IPv6 link-local address when the HSRP group is active. These messages stop after a final one is sent when the group leaves the active state.

For more information about configuring HSRP for IPv6, see the "HSRP for IPv6" section.

For more information about configuring HSRP for IPv4, see the "Configuring HSRP" section.

EIGRP IPv6

Switches running the IP services feature set support the Enhanced Interior Gateway Routing Protocol (EIGRP) for IPv6. It is configured on the interfaces on which it runs and does not require a global IPv6 address.

Note Switches running the IP base feature set do not support any IPv6 EIGRP features, including IPv6 EIGRP stub routing.

Before running, an instance of EIGRP IPv6 requires an implicit or explicit router ID. An implicit router ID is derived from a local IPv4 address, so any IPv4 node always has an available router ID. However, EIGRP IPv6 might be running in a network with only IPv6 nodes and therefore might not have an available IPv4 router ID.

For more information about EIGRP for IPv6, see the "Implementing EIGRP for IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

SNMP and Syslog Over IPv6

To support both IPv4 and IPv6, IPv6 network management requires both IPv6 and IPv4 transports. Syslog over IPv6 supports address data types for these transports.

SNMP and syslog over IPv6 provide these features:

- Support for both IPv4 and IPv6
- IPv6 transport for SNMP and to modify the SNMP agent to support traps for an IPv6 host
- SNMP- and syslog-related MIBs to support IPv6 addressing
- Configuration of IPv6 hosts as trap receivers

For support over IPv6, SNMP modifies the existing IP transport mapping to simultaneously support IPv4 and IPv6. These SNMP actions support IPv6 transport management:

- Opens User Datagram Protocol (UDP) SNMP socket with default settings
- Provides a new transport mechanism called *SR_IPV6_TRANSPORT*
- Sends SNMP notifications over IPv6 transport
- Supports SNMP-named access lists for IPv6 transport
- Supports SNMP proxy forwarding using IPv6 transport
- Verifies SNMP Manager feature works with IPv6 transport

For information on SNMP over IPv6, including configuration procedures, see the "Managing Cisco IOS Applications over IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

For information about syslog over IPv6, including configuration procedures, see the "Implementing IPv6 Addressing and Basic Connectivity" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

HTTP(S) Over IPv6

The HTTP client sends requests to both IPv4 and IPv6 HTTP servers, which respond to requests from both IPv4 and IPv6 HTTP clients. URLs with literal IPv6 addresses must be specified in hexadecimal using 16-bit values between colons.

The accept socket call chooses an IPv4 or IPv6 address family. The accept socket is either an IPv4 or IPv6 socket. The listening socket continues to listen for both IPv4 and IPv6 signals that indicate a connection. The IPv6 listening socket is bound to an IPv6 wildcard address.

The underlying TCP/IP stack supports a dual-stack environment. HTTP relies on the TCP/IP stack and the sockets for processing network-layer interactions.

Basic network connectivity (**ping**) must exist between the client and the server hosts before HTTP connections can be made.

For more information, see the "Managing Cisco IOS Applications over IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Unsupported IPv6 Unicast Routing Features

The switch does not support these IPv6 features:

- IPv6 policy-based routing
- IPv6 virtual private network (VPN) routing and forwarding (VRF) table support
- Support for IPv6 routing protocols: multiprotocol Border Gateway Protocol (BGP) and Intermediate System-to-Intermediate System (IS-IS) routing
- IPv6 packets destined to site-local addresses
- Tunneling protocols, such as IPv4-to-IPv6 or IPv6-to-IPv4
- The switch as a tunnel endpoint supporting IPv4-to-IPv6 or IPv6-to-IPv4 tunneling protocols
- IPv6 unicast reverse-path forwarding
- IPv6 Web Cache Communication Protocol (WCCP)

IPv6 Feature Limitations

Because IPv6 is implemented in switch hardware, some limitations occur due to the IPv6 compressed addresses in the hardware memory. These hardware limitations result in some loss of functionality and limits some features.

These are feature limitations.

- The switch cannot forward SNAP-encapsulated IPv6 packets in hardware. They are forwarded in software.
- The switch cannot apply QoS classification on source-routed IPv6 packets in hardware.

IPv6 and Switch Stacks

The switch supports IPv6 forwarding across the stack and IPv6 host functionality on the stack master. The stack master runs the IPv6 unicast routing protocols and computes the routing tables. They receive the tables and create hardware IPv6 routes for forwarding. The stack master also runs all IPv6 applications.

Note To route IPv6 packets in a stack, all switches in the stack should be running the IP Base feature set.

If a new switch becomes the stack master, it recomputes the IPv6 routing tables and distributes them to the member switches. While the new stack master is being elected and is resetting, the switch stack does not forward IPv6 packets. The stack MAC address changes, which also changes the IPv6 address. When you specify the stack IPv6 address with an extended unique identifier (EUI) by using the **ipv6 address** *ipv6-prefix/prefix length* **eui-64** interface configuration command, the address is based on the interface MAC address. See the Configuring IPv6 Addressing and Enabling IPv6 Routing (CLI), on page 45.

If you configure the persistent MAC address feature on the stack and the stack master changes, the stack MAC address does not change for approximately 4 minutes.

These are the functions of IPv6 stack master and members:

- Stack master:
  - runs IPv6 routing protocols
  - generates routing tables
  - distributes routing tables to stack members that use dCEFv6
  - runs IPv6 host functionality and IPv6 applications
- Stack member (must be running the IP services feature set):
  - receives CEFv6 routing tables from the stack master
  - programs the routes into hardware

Note IPv6 packets are routed in hardware across the stack if the packet does not have exceptions (IPv6Options) and the switches in the stack have not run out of hardware resources.

  - flushes the CEFv6 tables on master re-election

Default IPv6 Configuration

Table 6: Default IPv6 Configuration

Feature	Default Setting
SDM template	Advance desktop. Default is advanced template
IPv6 routing	Disabled globally and on all interfaces
CEFv6 or dCEFv6	**Note** When IPv6 routing is enabled, CEFv6 and dCEF6 are automatically enabled.
IPv6 addresses	None configured

Configuring IPv6 Addressing and Enabling IPv6 Routing (CLI)

This section describes how to assign IPv6 addresses to individual Layer 3 interfaces and to globally forward IPv6 traffic on the switch.

Before configuring IPv6 on the switch, consider these guidelines:

- Not all features discussed in this chapter are supported by the switch. See the Unsupported IPv6 Unicast Routing Features, on page 43.
-
- In the **ipv6 address** interface configuration command, you must enter the *ipv6-address* and *ipv6-prefix* variables with the address specified in hexadecimal using 16-bit values between colons. The *prefix-length* variable (preceded by a slash [/]) is a decimal value that shows how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address).

To forward IPv6 traffic on an interface, you must configure a global IPv6 address on that interface. Configuring an IPv6 address on an interface automatically configures a link-local address and activates IPv6 for the interface. The configured interface automatically joins these required multicast groups for that link:

- solicited-node multicast group FF02:0:0:0:0:1:ff00::/104 for each unicast address assigned to the interface (this address is used in the neighbor discovery process.)
- all-nodes link-local multicast group FF02::1
- all-routers link-local multicast group FF02::2

To remove an IPv6 address from an interface, use the **no ipv6 address** *ipv6-prefix/prefix length* **eui-64** or **no ipv6 address** *ipv6-address* **link-local** interface configuration command. To remove all manually configured IPv6 addresses from an interface, use the **no ipv6 address** interface configuration command without arguments. To disable IPv6 processing on an interface that has not been explicitly configured with an IPv6 address, use the **no ipv6 enable** interface configuration command. To globally disable IPv6 routing, use the **no ipv6 unicast-routing** global configuration command.

For more information about configuring IPv6 routing, see the "Implementing Addressing and Basic Connectivity for IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Beginning in privileged EXEC mode, follow these steps to assign an IPv6 address to a Layer 3 interface and enable IPv6 routing:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**sdm prefer dual-ipv4-and-ipv6** {**advanced** | **vlan**}	Selects an SDM template that supports IPv4 and IPv6.

	Command or Action	Purpose
	Example: `Switch(config)# sdm prefer dual-ipv4-and-ipv6 default`	• **advanced—**Sets the switch to the default template to balance system resources. • **vlan—**Maximizes VLAN configuration on the switch with no routing supported in hardware. **Note** Advanced is available at all license levels. VLAN template is available only in lanbase.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**reload** **Example:** `Switch# reload`	Reloads the operating system.
Step 5	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode after the switch reloads.
Step 6	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the Layer 3 interface to configure. The interface can be a physical interface, a switch virtual interface (SVI), or a Layer 3 EtherChannel.
Step 7	**no switchport** **Example:** `Switch(config-if)# no switchport`	Removes the interface from Layer 2 configuration mode (if it is a physical interface).
Step 8	Use one of the following: • **ipv6 address** *ipv6-prefix/prefix length* **eui-64** • **ipv6 address** *ipv6-address/prefix length* • **ipv6 address** *ipv6-address* **link-local** • **ipv6 enable** • **ipv6 address***WORD* • **ipv6 address***autoconfig*	• Specifies a global IPv6 address with an extended unique identifier (EUI) in the low-order 64 bits of the IPv6 address. Specify only the network prefix; the last 64 bits are automatically computed from the switch MAC address. This enables IPv6 processing on the interface. • Manually configures an IPv6 address on the interface. • Specifies a link-local address on the interface to be used instead of the link-local address that is automatically configured when IPv6 is enabled on the interface. This command enables IPv6 processing on the interface.

	Command or Action	Purpose

	• **ipv6 address***dhcp*
	
	Example:
	`Switch(config-if)# ipv6 address 2001:0DB8:c18:1::/64 eui 64`
	`Switch(config-if)# ipv6 address 2001:0DB8:c18:1::/64`
	`Switch(config-if)# ipv6 address 2001:0DB8:c18:1:: link-local`
	`Switch(config-if)# ipv6 enable`
		• Automatically configures an IPv6 link-local address on the interface, and enables the interface for IPv6 processing. The link-local address can only be used to communicate with nodes on the same link.

Step 9	**exit** **Example:** `Switch(config-if)# exit`	Returns to global configuration mode.
Step 10	**ip routing** **Example:** `Switch(config)# ip routing`	Enables IP routing on the switch.
Step 11	**ipv6 unicast-routing** **Example:** `Switch(config)# ipv6 unicast-routing`	Enables forwarding of IPv6 unicast data packets.
Step 12	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 13	**show ipv6 interface** *interface-id* **Example:** `Switch# show ipv6 interface gigabitethernet 1/0/1`	Verifies your entries.
Step 14	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring IPv4 and IPv6 Protocol Stacks (CLI)

Beginning in privileged EXEC mode, follow these steps to configure a Layer 3 interface to support both IPv4 and IPv6 and to enable IPv6 routing.

Note To disable IPv6 processing on an interface that has not been configured with an IPv6 address, use the **no ipv6 enable** interface configuration command.

SUMMARY STEPS

1. **configure terminal**
2. **ip routing**
3. **ipv6 unicast-routing**
4. **interface** *interface-id*
5. **no switchport**
6. **ip address** *ip-address mask* [**secondary**]
7. Use one of the following:
   - **ipv6 address** *ipv6-prefix/prefix length* **eui-64**
   - **ipv6 address** *ipv6-address/prefix length*
   - **ipv6 address** *ipv6-address* **link-local**
   - **ipv6 enable**
   - **ipv6 address***WORD*
   - **ipv6 address***autoconfig*
   - **ipv6 address***dhcp*
8. **end**
9. Use one of the following:
   - **show interface** *interface-id*
   - **show ip interface** *interface-id*
   - **show ipv6 interface** *interface-id*
10. **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	**ip routing** **Example:** `Switch(config)# ip routing`	Enables routing on the switch.
Step 3	**ipv6 unicast-routing** **Example:** `Switch(config)# ipv6 unicast-routing`	Enables forwarding of IPv6 data packets on the switch.
Step 4	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the Layer 3 interface to configure.
Step 5	**no switchport** **Example:** `Switch(config-if)# no switchport`	Removes the interface from Layer 2 configuration mode (if it is a physical interface).
Step 6	**ip address** *ip-address mask* [**secondary**] **Example:** `Switch(config-if)# ip address 10.1.2.3 255.255.255`	Specifies a primary or secondary IPv4 address for the interface.
Step 7	Use one of the following: • **ipv6 address** *ipv6-prefix/prefix length* **eui-64** • **ipv6 address** *ipv6-address/prefix length* • **ipv6 address** *ipv6-address* **link-local** • **ipv6 enable** • **ipv6 address***WORD*	• Specifies a global IPv6 address. Specify only the network prefix; the last 64 bits are automatically computed from the switch MAC address. • Specifies a link-local address on the interface to be used instead of the automatically configured link-local address when IPv6 is enabled on the interface. • Automatically configures an IPv6 link-local address on the interface, and enables the interface for IPv6

	Command or Action	Purpose
	• **ipv6 address***autoconfig* • **ipv6 address***dhcp*	processing. The link-local address can only be used to communicate with nodes on the same link. **Note** To remove all manually configured IPv6 addresses from an interface, use the **no ipv6 address** interface configuration command without arguments.
Step 8	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 9	Use one of the following: • **show interface** *interface-id* • **show ip interface** *interface-id* • **show ipv6 interface** *interface-id*	Verifies your entries.
Step 10	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Default Router Preference (CLI)

Router advertisement messages are sent with the default router preference (DRP) configured by the **ipv6 nd router-preference** interface configuration command. If no DRP is configured, RAs are sent with a medium preference.

A DRP is useful when two routers on a link might provide equivalent, but not equal-cost routing, and policy might dictate that hosts should prefer one of the routers.

For more information about configuring DRP for IPv6, see the "Implementing IPv6 Addresses and Basic Connectivity" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Beginning in privileged EXEC mode, follow these steps to configure a DRP for a router on an interface.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode and identifies the Layer 3 interface on which you want to specify the DRP.
Step 3	**ipv6 nd router-preference** {**high** | **medium** | **low**} **Example:** `Switch(config-if)# ipv6 nd router-preference medium`	Specifies a DRP for the router on the switch interface.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show ipv6 interface** **Example:** `Switch# show ipv6 interface`	Verifies the configuration.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring IPv6 ICMP Rate Limiting (CLI)

ICMP rate limiting is enabled by default with a default interval between error messages of 100 milliseconds and a bucket size (maximum number of tokens to be stored in a bucket) of 10.

Beginning in privileged EXEC mode, follow these steps to change the ICMP rate-limiting parameters:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 icmp error-interval** *interval* [*bucketsize*] **Example:** `Switch(config)# ipv6 icmp error-interval 50 20`	Configures the interval and bucket size for IPv6 ICMP error messages: • *interval*—The interval (in milliseconds) between tokens being added to the bucket. The range is from 0 to 2147483647 milliseconds. • *bucketsize*—(Optional) The maximum number of tokens stored in the bucket. The range is from 1 to 200.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show ipv6 interface** [*interface-id*] **Example:** `Switch# show ipv6 interface gigabitethernet 1/0/1`	Verifies your entries.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring CEF and dCEF for IPv6

Cisco Express Forwarding (CEF) is a Layer 3 IP switching technology to improve network performance. CEF implements an advanced IP look-up and forwarding algorithm to deliver maximum Layer 3 switching performance. It is less CPU-intensive than fast-switching route-caching, allowing more CPU processing power to be dedicated to packet forwarding. In a switch stack, the hardware uses distributed CEF (dCEF) in the stack. IPv4 CEF and dCEF are enabled by default. IPv6 CEF and dCEF are disabled by default, but automatically enabled when you configure IPv6 routing.

IPv6 CEF and dCEF are automatically disabled when IPv6 routing is unconfigured. IPv6 CEF and dCEF cannot disabled through configuration. You can verify the IPv6 state by entering the **show ipv6 cef** privileged EXEC command.

To route IPv6 unicast packets, you must first globally configure forwarding of IPv6 unicast packets by using the **ipv6 unicast-routing** global configuration command, and you must configure an IPv6 address and IPv6 processing on an interface by using the **ipv6 address** interface configuration command.

For more information about configuring CEF and dCEF, see *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Configuring Static Routing for IPv6 (CLI)

Before configuring a static IPv6 route, you must enable routing by using the **ip routing** global configuration command, enable the forwarding of IPv6 packets by using the **ipv6 unicast-routing** global configuration command, and enable IPv6 on at least one Layer 3 interface by configuring an IPv6 address on the interface.

For more information about configuring static IPv6 routing, see the "Implementing Static Routes for IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 route** *ipv6-prefix/prefix length* {*ipv6-address* | *interface-id* [*ipv6-address*]} [*administrative distance*] **Example:** `Switch(config)# ipv6 route 2001:0DB8::/32 gigabitethernet2/0/1 130`	Configures a static IPv6 route. • *ipv6-prefix*—The IPv6 network that is the destination of the static route. It can also be a hostname when static host routes are configured. • */prefix length*—The length of the IPv6 prefix. A decimal value that shows how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). A slash mark must precede the decimal value. • *ipv6-address*—The IPv6 address of the next hop that can be used to reach the specified network. The IPv6 address of the next hop need not be directly connected; recursion is done to find the IPv6 address of the directly connected next hop. The address must be in the form documented in RFC 2373, specified in hexadecimal using 16-bit values between colons. • *interface-id*—Specifies direct static routes from point-to-point and broadcast interfaces. With point-to-point interfaces, there is no need to specify the IPv6 address of the next hop. With broadcast interfaces, you should always specify the IPv6 address of the next hop, or ensure that the specified prefix is assigned to the link, specifying a link-local address as the next hop. You can optionally specify the IPv6 address of the next hop to which packets are sent.

	Command or Action	Purpose
		Note You must specify an *interface-id* when using a link-local address as the next hop (the link-local next hop must also be an adjacent router). • *administrative distance*—(Optional) An administrative distance. The range is 1 to 254; the default value is 1, which gives static routes precedence over any other type of route except connected routes. To configure a floating static route, use an administrative distance greater than that of the dynamic routing protocol.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

Step 4	Use one of the following:
	• **show ipv6 static** [*ipv6-address* | *ipv6-prefix/prefix length*] [**interface** *interface-id*] [**detail**]][**recursive**] [**detail**]
	• **show ipv6 route static** [*updated*]
	Example:
	`Switch# show ipv6 static 2001:0DB8::/32 interface gigabitethernet2/0/1`
	or
	`Switch# show ipv6 route static`
		Verifies your entries by displaying the contents of the IPv6 routing table.
		• **interface** *interface-id*—(Optional) Displays only those static routes with the specified interface as an egress interface.
		• **recursive**—(Optional) Displays only recursive static routes. The **recursive** keyword is mutually exclusive with the **interface** keyword, but it can be used with or without the IPv6 prefix included in the command syntax.
		• **detail**—(Optional) Displays this additional information:
		◦ For valid recursive routes, the output path set, and maximum resolution depth.
		◦ For invalid routes, the reason why the route is not valid.

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

Configuring RIP for IPv6 (CLI)

Before configuring the switch to run IPv6 RIP, you must enable routing by using the **ip routing** global configuration command, enable the forwarding of IPv6 packets by using the **ipv6 unicast-routing** global configuration command, and enable IPv6 on any Layer 3 interfaces on which IPv6 RIP is to be enabled.

For more information about configuring RIP routing for IPv6, see the "Implementing RIP for IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com,

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 router rip** *name* **Example:** `Switch(config)# ipv6 router rip cisco`	Configures an IPv6 RIP routing process, and enters router configuration mode for the process.
Step 3	**maximum-paths** *number-paths* **Example:** `Switch(config-router)# maximum-paths 6`	(Optional) Define the maximum number of equal-cost routes that IPv6 RIP can support. The range is from 1 to 32, and the default is 16 routes.
Step 4	**exit** **Example:** `Switch(config-router)# exit`	Returns to global configuration mode.
Step 5	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the Layer 3 interface to configure.
Step 6	**ipv6 rip** *name* **enable** **Example:** `Switch(config-if)# ipv6 rip cisco enable`	Enables the specified IPv6 RIP routing process on the interface.
Step 7	**ipv6 rip** *name* **default-information** {**only** | **originate**} **Example:** `Switch(config-if)# ipv6 rip cisco default-information only`	(Optional) Originates the IPv6 default route (::/0) into the RIP routing process updates sent from the specified interface. **Note** To avoid routing loops after the IPv6 default route (::/0) is originated from any interface, the routing process ignores all default routes received on any interface. • **only—**Select to originate the default route, but suppress all other routes in the updates sent on this interface.

	Command or Action	Purpose
		• **originate—**Select to originate the default route in addition to all other routes in the updates sent on this interface.
Step 8	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

Step 9	Use one of the following:
	• **show ipv6 rip** [*name*] [**interface***interface-id*] [**database**] [**next-hops**]
	• **show ipv6 rip**
	
	Example:
	`Switch# show ipv6 rip cisco interface gigabitethernet2/0/1`
	or
	`Switch# show ipv6 rip`
		• Displays information about current IPv6 RIP processes.
		• Displays the current contents of the IPv6 routing table.

Step 10	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring OSPF for IPv6 (CLI)

You can customize OSPF for IPv6 for your network. However, the defaults for OSPF in IPv6 are set to meet the requirements of most customers and features.

Follow these guidelines:

- Be careful when changing the defaults for IPv6 commands. Changing the defaults might adversely affect OSPF for the IPv6 network.
- Before you enable IPv6 OSPF on an interface, you must enable routing by using the **ip routing** global configuration command, enable the forwarding of IPv6 packets by using the **ipv6 unicast-routing** global configuration command, and enable IPv6 on Layer 3 interfaces on which you are enabling IPv6 OSPF.

For more information about configuring OSPF routing for IPv6, see the “Implementing OSPF for IPv6” chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 router ospf** *process-id* **Example:** `Switch(config)# ipv6 router ospf 21`	Enables OSPF router configuration mode for the process. The process ID is the number assigned administratively when enabling the OSPF for IPv6 routing process. It is locally assigned and can be a positive integer from 1 to 65535.
Step 3	**area** *area-id* **range** {*ipv6-prefix/prefix length*} [**advertise** | **not-advertise**] [**cost** *cost*] **Example:** `Switch(config)# area .3 range 2001:0DB8::/32 not-advertise`	(Optional) Consolidates and summarizes routes at an area boundary. • *area-id*—Identifier of the area about which routes are to be summarized. It can be specified as either a decimal value or as an IPv6 prefix. • *ipv6-prefix/prefix length*—The destination IPv6 network and a decimal value that shows how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). A slash mark (/) must precede the decimal value. • **advertise**—(Optional) Sets the address range status to advertise and generate a Type 3 summary link-state advertisement (LSA). • **not-advertise**—(Optional) Sets the address range status to DoNotAdvertise. The Type 3 summary LSA is suppressed, and component networks remain hidden from other networks. • **cost** *cost*—(Optional) Sets the metric or cost for this summary route, which is used during OSPF SPF calculation to determine the shortest paths to the destination. The value can be 0 to 16777215.
Step 4	**maximum paths** *number-paths* **Example:** `Switch(config)# maximum paths 16`	(Optional) Defines the maximum number of equal-cost routes to the same destination that IPv6 OSPF should enter in the routing table. The range is from 1 to 32, and the default is 16 paths.
Step 5	**exit** **Example:** `Switch(config-if)# exit`	Returns to global configuration mode.

	Command or Action	Purpose
Step 6	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the Layer 3 interface to configure.
Step 7	**ipv6 ospf** *process-id* **area** *area-id* [**instance** *instance-id*] **Example:** `Switch(config-if)# ipv6 ospf 21 area .3`	Enables OSPF for IPv6 on the interface. • **instance** *instance-id*—(Optional) Instance identifier.
Step 8	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

Step 9	Use one of the following:
	• **show ipv6 ospf** [*process-id*] [*area-id*] **interface** [*interface-id*]
	• **show ipv6 ospf** [*process-id*] [*area-id*]
	
	Example:
	`Switch# show ipv6 ospf 21 interface gigabitethernet2/0/1`
	or
	`Switch# show ipv6 ospf 21`
		• Displays information about OSPF interfaces.
		• Displays general information about OSPF routing processes.

Step 10	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring EIGRP for IPv6

Before configuring the switch to run IPv6 EIGRP, enable routing by entering the **ip routing global configuration** command, enable the forwarding of IPv6 packets by entering the **ipv6 unicast-routing global** configuration command, and enable IPv6 on any Layer 3 interfaces on which you want to enable IPv6 EIGRP.

To set an explicit router ID, use the **show ipv6 eigrp** command to see the configured router IDs, and then use the **router-id** command.

As with EIGRP IPv4, you can use EIGRPv6 to specify your EIGRP IPv6 interfaces and to select a subset of those as passive interfaces. Use the **passive-interface** command to make an interface passive, and then use the **no passive-interface** command on selected interfaces to make them active. EIGRP IPv6 does not need to be configured on a passive interface.

For more configuration procedures, see the "Implementing EIGRP for IPv6" chapter in the *Cisco IOS IPv6 Configuration Library* on Cisco.com.

Displaying IPv6

For complete syntax and usage information on these commands, see the Cisco IOS command reference publications.

Table 7: Commands for Monitoring IPv6

Command	Purpose
show ipv6 access-list	Displays a summary of access lists.
show ipv6 cef	Displays Cisco Express Forwarding for IPv6.
show ipv6 interface *interface-id*	Displays IPv6 interface status and configuration.
show ipv6 mtu	Displays IPv6 MTU per destination cache.
show ipv6 neighbors	Displays IPv6 neighbor cache entries.
show ipv6 ospf	Displays IPv6 OSPF information.
show ipv6 prefix-list	Displays a list of IPv6 prefix lists.
show ipv6 protocols	Displays IPv6 routing protocols on the switch.
show ipv6 rip	Displays IPv6 RIP routing protocol status.
show ipv6 route	Displays the IPv6 route table entries.
show ipv6 routers	Displays the local IPv6 routers.
show ipv6 static	Displays IPv6 static routes.
show ipv6 traffic	Displays IPv6 traffic statistics.

Table 8: Commands for Displaying EIGRP IPv6 Information

Command	Purpose
show ipv6 eigrp [*as-number*] *interface*	Displays information about interfaces configured for EIGRP IPv6.
show ipv6 eigrp [*as-number*] *neighbor*	Displays the neighbors discovered by EIGRP IPv6.
show ipv6 eigrp [*as-number*] *traffic*	Displays the number of EIGRP IPv6 packets sent and received.
show ipv6 eigrp topology [*as-number* | *ipv6-address*] [**active** | **all-links** | **detail-links** | **pending** | **summary** | **zero-successors**| **Base**]	Displays EIGRP entries in the IPv6 topology table.

Configuring DHCP for IPv6 Address Assignment

Default DHCPv6 Address Assignment Configuration

By default, no DHCPv6 features are configured on the switch.

DHCPv6 Address Assignment Configuration Guidelines

When configuring DHCPv6 address assignment, consider these guidelines:

- In the procedures, the specified interface must be one of these Layer 3 interfaces:
  - DHCPv6 IPv6 routing must be enabled on a Layer 3 interface.
  - SVI: a VLAN interface created by using the **interface vlan** *vlan_id* command.
  - EtherChannel port channel in Layer 3 mode: a port-channel logical interface created by using the **interface port-channel port-channel-number** command.
- The switch can act as a DHCPv6 client, server, or relay agent. The DHCPv6 client, server, and relay function are mutually exclusive on an interface.
- The DHCPv6 client, server, or relay agent runs only on the master switch. When there is a stack master re-election, the new master switch retains the DHCPv6 configuration. However, the local RAM copy of the DHCP server database lease information is not retained.

Enabling DHCPv6 Server Function (CLI)

Use the **no** form of the DHCP pool configuration mode commands to change the DHCPv6 pool characteristics. To disable the DHCPv6 server function on an interface, use the **no ipv6 dhcp server** interface configuration command.

Beginning in privileged EXEC mode, follow these steps to enable the DHCPv6 server function on an interface.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 dhcp pool** *poolname* **Example:** `Switch(config)# ipv6 dhcp pool 7`	Enters DHCP pool configuration mode, and define the name for the IPv6 DHCP pool. The pool name can be a symbolic string (such as Engineering) or an integer (such as 0).
Step 3	**address prefix** *IPv6-prefix* {**lifetime**} {*t1 t1* | **infinite**} **Example:** `Switch(config-dhcpv6)# address prefix 2001:1000::0/64 lifetime 3600`	(Optional) Specifies an address prefix for address assignment. This address must be in hexadecimal, using 16-bit values between colons. **lifetime** *t1 t1*—Specifies a time interval (in seconds) that an IPv6 address prefix remains in the valid state. The range is 5 to 4294967295 seconds. Specify **infinite** for no time interval.
Step 4	**link-address** *IPv6-prefix* **Example:** `Switch(config-dhcpv6)# link-address 2001:1002::0/64`	(Optional) Specifies a link-address IPv6 prefix. When an address on the incoming interface or a link-address in the packet matches the specified IPv6 prefix, the server uses the configuration information pool. This address must be in hexadecimal, using 16-bit values between colons.
Step 5	**vendor-specific** *vendor-id* **Example:** `Switch(config-dhcpv6)# vendor-specific 9`	(Optional) Enters vendor-specific configuration mode and specifies a vendor-specific identification number. This number is the vendor IANA Private Enterprise Number. The range is 1 to 4294967295.

	Command or Action	Purpose
Step 6	**suboption** *number* {**address** *IPv6-address* | **ascii** *ASCII-string* | **hex** *hex-string*} **Example:** `Switch(config-dhcpv6-vs)# suboption 1 address 1000:235D::`	(Optional) Enters a vendor-specific suboption number. The range is 1 to 65535. Enter an IPv6 address, ASCII text, or a hex string as defined by the suboption parameters.
Step 7	**exit** **Example:** `Switch(config-dhcpv6-vs)# exit`	Returns to DHCP pool configuration mode.
Step 8	**exit** **Example:** `Switch(config-dhcpv6)# exit`	Returns to global configuration mode.
Step 9	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the interface to configure.
Step 10	**ipv6 dhcp server** [*poolname* | **automatic**] [**rapid-commit**] [**preference** *value*] [**allow-hint**] **Example:** `Switch(config-if)# ipv6 dhcp server automatic`	Enables DHCPv6 server function on an interface. • *poolname*—(Optional) User-defined name for the IPv6 DHCP pool. The pool name can be a symbolic string (such as Engineering) or an integer (such as 0). • **automatic**—(Optional) Enables the system to automatically determine which pool to use when allocating addresses for a client. • **rapid-commit**—(Optional) Allows two-message exchange method. • **preference** *value*—(Optional) Configures the preference value carried in the preference option in the advertise message sent by the server. The range is from 0 to 255. The preference value default is 0. • **allow-hint**—(Optional) Specifies whether the server should consider client suggestions in the SOLICIT message. By default, the server ignores client hints.

	Command or Action	Purpose
Step 11	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

Step 12	Do one of the following:
	• **show ipv6 dhcp pool**
	• **show ipv6 dhcp interface**
	
	Example:
	`Switch# show ipv6 dhcp pool`
	or
	`Switch# show ipv6 dhcp interface`
		• Verifies DHCPv6 pool configuration.
		• Verifies that the DHCPv6 server function is enabled on an interface.

Step 13	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Enabling DHCPv6 Client Function (CLI)

This task explains how to enable the DHCPv6 client on an interface.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Enters interface configuration mode, and specifies the interface to configure.

	Command or Action	Purpose
Step 3	**ipv6 address dhcp** [**rapid-commit**] **Example:** `Switch(config-if)# ipv6 address dhcp rapid-commit`	Enables the interface to acquire an IPv6 address from the DHCPv6 server. **rapid-commit—**(Optional) Allow two-message exchange method for address assignment.
Step 4	**ipv6 dhcp client request** [**vendor-specific**] **Example:** `Switch(config-if)# ipv6 dhcp client request vendor-specific`	(Optional) Enables the interface to request the vendor-specific option.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 6	**show ipv6 dhcp interface** **Example:** `Switch# show ipv6 dhcp interface`	Verifies that the DHCPv6 client is enabled on an interface.

Configuration Examples for IPv6 Unicast Routing

Configuring IPv6 Addressing and Enabling IPv6 Routing: Example

This example shows how to enable IPv6 with both a link-local address and a global address based on the IPv6 prefix 2001:0DB8:c18:1::/64. The EUI-64 interface ID is used in the low-order 64 bits of both addresses. Output from the **show ipv6 interface** EXEC command is included to show how the interface ID (20B:46FF:FE2F:D940) is appended to the link-local prefix FE80::/64 of the interface.

```
Switch(config)# ipv6 unicast-routing
Switch(config)# interface gigabitethernet1/0/11
Switch(config-if)# no switchport
Switch(config-if)# ipv6 address 2001:0DB8:c18:1::/64 eui 64
Switch(config-if)# end
Switch# show ipv6 interface gigabitethernet1/0/11
GigabitEthernet1/0/11 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::20B:46FF:FE2F:D940
  Global unicast address(es):
  2001:0DB8:c18:1:20B:46FF:FE2F:D940, subnet is 2001:0DB8:c18:1::/64 [EUI]
  Joined group address(es):
    FF02::1
```

```
    FF02::2
    FF02::1:FF2F:D940
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
  ICMP redirects are enabled
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND advertised reachable time is 0 milliseconds
  ND advertised retransmit interval is 0 milliseconds
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
  Hosts use stateless autoconfig for addresses.
```

Configuring Default Router Preference: Example

This example shows how to configure a DRP of *high* for the router on an interface.

```
Switch# configure terminal
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# ipv6 nd router-preference high
Switch(config-if)# end
```

Configuring IPv4 and IPv6 Protocol Stacks: Example

This example shows how to enable IPv4 and IPv6 routing on an interface.

```
Switch(config)# ip routing
Switch(config)# ipv6 unicast-routing
Switch(config)# interface fastethernet1/0/11
Switch(config-if)# no switchport
Switch(config-if)# ip address 192.168.99.1 255.255.255.0
Switch(config-if)# ipv6 address 2001:0DB8:c18:1::/64 eui 64
Switch(config-if)# end
```

Enabling DHCPv6 Server Function: Example

This example shows how to configure a pool called *engineering* with an IPv6 address prefix:

```
Switch# configure terminal
Switch(config)# ipv6 dhcp pool engineering
Switch(config-dhcpv6)#address prefix 2001:1000::0/64
Switch(config-dhcpv6)# end
```

This example shows how to configure a pool called *testgroup* with three link-addresses and an IPv6 address prefix:

```
Switch# configure terminal
Switch(config)# ipv6 dhcp pool testgroup
Switch(config-dhcpv6)# link-address 2001:1001::0/64
Switch(config-dhcpv6)# link-address 2001:1002::0/64
Switch(config-dhcpv6)# link-address 2001:2000::0/48
Switch(config-dhcpv6)# address prefix 2001:1003::0/64
Switch(config-dhcpv6)# end
```

This example shows how to configure a pool called *350* with vendor-specific options:

```
Switch# configure terminal
Switch(config)# ipv6 dhcp pool 350
Switch(config-dhcpv6)# address prefix 2001:1005::0/48
Switch(config-dhcpv6)# vendor-specific 9
Switch(config-dhcpv6-vs)# suboption 1 address 1000:235D::1
Switch(config-dhcpv6-vs)# suboption 2 ascii "IP-Phone"
Switch(config-dhcpv6-vs)# end
```

Enabling DHCPv6 Client Function: Example

This example shows how to acquire an IPv6 address and to enable the rapid-commit option:

```
Switch(config)# interface gigabitethernet2/0/1
Switch(config-if)# ipv6 address dhcp rapid-commit
```

Configuring IPv6 ICMP Rate Limiting: Example

This example shows how to configure an IPv6 ICMP error message interval of 50 milliseconds and a bucket size of 20 tokens.

```
Switch(config)#ipv6 icmp error-interval 50 20
```

Configuring Static Routing for IPv6: Example

This example shows how to configure a floating static route to an interface with an administrative distance of 130:

```
Switch(config)# ipv6 route 2001:0DB8::/32 gigabitethernet2/0/1 130
```

Configuring RIP for IPv6: Example

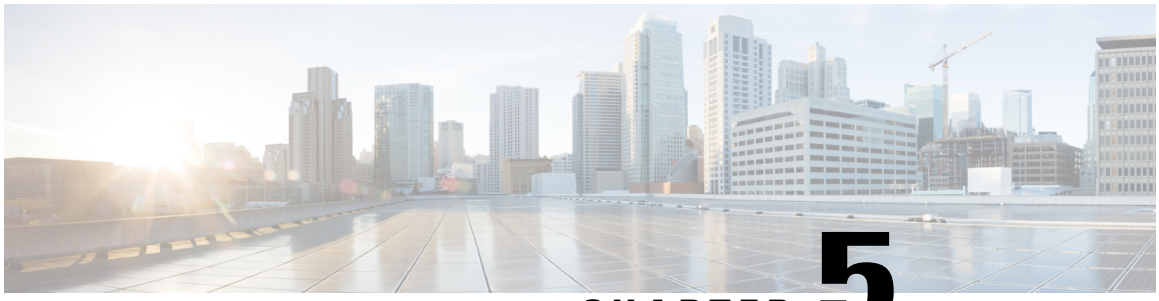
This example shows how to enable the RIP routing process *cisco* with a maximum of eight equal-cost routes and to enable it on an interface:

```
Switch(config)# ipv6 router rip cisco
Switch(config-router)# maximum-paths 8
Switch(config)# exit
Switch(config)# interface gigabitethernet2/0/11
Switch(config-if)# ipv6 rip cisco enable
```

Displaying IPv6: Example

This is an example of the output from the **show ipv6 interface** privileged EXEC command:

```
Switch# show ipv6 interface
Vlan1 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::20B:46FF:FE2F:D940
  Global unicast address(es):
    3FFE:C000:0:1:20B:46FF:FE2F:D940, subnet is 3FFE:C000:0:1::/64 [EUI]
  Joined group address(es):
    FF02::1
    FF02::2
    FF02::1:FF2F:D940
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
  ICMP redirects are enabled
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND advertised reachable time is 0 milliseconds
  ND advertised retransmit interval is 0 milliseconds
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
<output truncated>
```



CHAPTER 5

Configuring IPv6 Client IP Address Learning

Prerequisites for IPv6 Client Address Learning

Before configuring IPv6 client address learning, configure the wireless clients to support IPv6.

Related Topics

Configuring RA Guard Policy (CLI), on page 76

Information About IPv6 Client Address Learning

Client Address Learning is configured on switch to learn the wireless client's IPv4 and IPv6 address and clients transition state maintained by the switch on an association, re-association, de-authentication and timeout.

There are three ways for IPv6 client to acquire IPv6 addresses:

- Stateless Address Auto-Configuration (SLACC)
- Stateful DHCPv6
- Static Configuration

For all of these methods, the IPv6 client always sends neighbor solicitation DAD (Duplicate Address Detection) request to ensure there is no duplicate IP address on the network. The switch snoops the client's NDP and DHCPv6 packets to learn about its client IP addresses.

SLAAC Address Assignment

The most common method for IPv6 client address assignment is Stateless Address Auto-Configuration (SLAAC). SLAAC provides simple plug-and-play connectivity where clients self-assign an address based on the IPv6 prefix. This process is achieved

Stateless Address Auto-Configuration (SLAAC) is configured as follows:

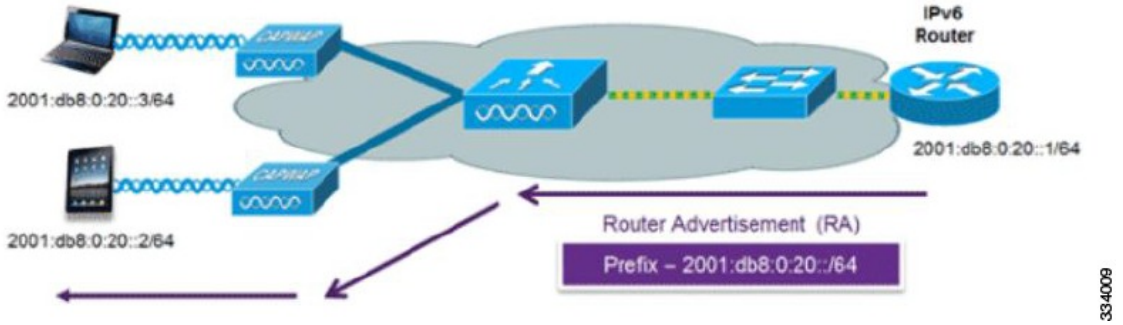
- Host sends a router solicitation message.
- Hosts waits for a Router Advertisement message.
- Hosts take the first 64 bits of the IPv6 prefix from the Router Advertisement message and combines it with the 64 bit EUI-64 address (in the case of ethernet, this is created from the MAC Address) to create a global unicast message. The host also uses the source IP address, in the IP header, of the Router Advertisement message, as its default gateway.
- Duplicate Address Detection is performed by IPv6 clients in order to ensure that random addresses that are picked do not collide with other clients.
- The choice of algorithm is up to the client and is often configurable.

The last 64 bits of the IP v6 address can be learned based on the following 2 algorithms:

- EUI-64 which is based on the MAC address of the interface, or

- Private addresses that are randomly generated.

Figure 1: SLAAC Address Assignment



The following Cisco IOS configuration commands from a Cisco-capable IPv6 router are used to enable SLAAC addressing and router advertisements:

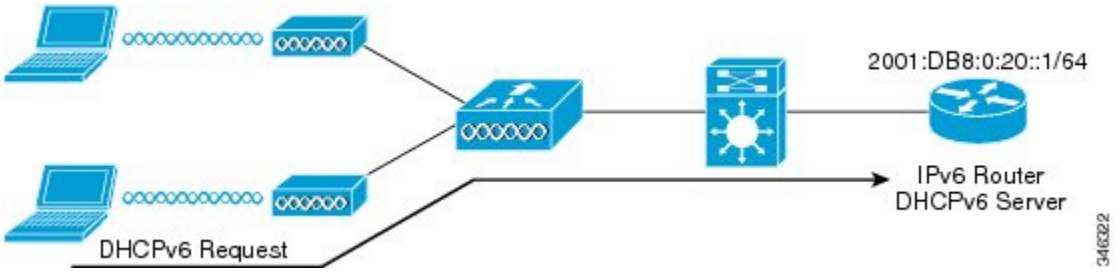
```
ipv6 unicast-routing
interface Vlan20
description IPv6-SLAAC
ip address 192.168.20.1 255.255.255.0
ipv6 address FE80:DB8:0:20::1 linklocal
ipv6 address 2001:DB8:0:20::1/64
ipv6 enable
end
```

Related Topics

Configuring IPv6 Snooping (CLI), on page 80
Configuring DHCP Pool (CLI), on page 84
Configuring Stateless Auto Address Configuration Without DHCP (CLI), on page 85
Configuring Stateless Auto Address Configuration With DHCP (CLI), on page 87
Configuring Stateful DHCP Locally (CLI), on page 88
Configuring Stateful DHCP Externally (CLI), on page 90

Stateful DHCPv6 Address Assignment

Figure 2: Stateful DHCPv6 Address Assignment



The use of DHCPv6 is not required for IPv6 client connectivity if SLAAC is already deployed. There are two modes of operation for DHCPv6 called Stateless and Stateful.

The DHCPv6 Stateless mode is used to provide clients with additional network information that is not available in the router advertisement, but not an IPv6 address as this is already provided by SLAAC. This information can include the DNS domain name, DNS server(s), and other DHCP vendor-specific options. This interface configuration is for a Cisco IOS IPv6 router implementing stateless DHCPv6 with SLAAC enabled:

```
ipv6 unicast-routing
ipv6 dhcp pool IPV6_DHCPPOOL
address prefix 2001:db8:5:10::/64
domain-name cisco.com
dns-server 2001:db8:6:6::1
interface Vlan20
description IPv6-DHCP-Stateless
ip address 192.168.20.1 255.255.255.0
ipv6 nd other-config-flag
ipv6 dhcp server IPV6_DHCPPOOL
ipv6 address 2001:DB8:0:20::1/64
end
```

The DHCPv6 Stateful option, also known as managed mode, operates similarly to DHCPv4 in that it assigns unique addresses to each client instead of the client generating the last 64 bits of the address as in SLAAC. This interface configuration is for a Cisco IOS IPv6 router implementing stateful DHCPv6 on a local Switch:

```
ipv6 unicast-routing
ipv6 dhcp pool IPV6_DHCPPOOL
address prefix 2001:db8:5:10::/64
domain-name cisco.com
dns-server 2001:db8:6:6::1
interface Vlan20
description IPv6-DHCP-Stateful
ip address 192.168.20.1 255.255.255.0
ipv6 address 2001:DB8:0:20::1/64
ipv6 nd prefix 2001:DB8:0:20::/64 no-advertise
ipv6 nd managed-config-flag
ipv6 nd other-config-flag
ipv6 dhcp server IPV6_DHCPPOOL
end
```

This interface configuration is for a Cisco IOS IPv6 router implementing stateful DHCPv6 on an external DHCP server:

```
ipv6 unicast-routing
domain-name cisco.com
dns-server 2001:db8:6:6::1
interface Vlan20
description IPv6-DHCP-Stateful
ip address 192.168.20.1 255.255.255.0
ipv6 address 2001:DB8:0:20::1/64
ipv6 nd prefix 2001:DB8:0:20::/64 no-advertise
ipv6 nd managed-config-flag
ipv6 nd other-config-flag
ipv6 dhcp_relay destination 2001:DB8:0:20::2
end
```

Related Topics

Configuring IPv6 Snooping (CLI), on page 80
Configuring DHCP Pool (CLI), on page 84
Configuring Stateless Auto Address Configuration Without DHCP (CLI), on page 85
Configuring Stateless Auto Address Configuration With DHCP (CLI), on page 87
Configuring Stateful DHCP Locally (CLI), on page 88
Configuring Stateful DHCP Externally (CLI), on page 90

Static IP Address Assignment

Statically configured address on a client.

Router Solicitation

A Router Solicitation message is issued by a host controller to facilitate local routers to transmit Router Advertisement from which it can obtain information about local routing or perform Stateless Auto-configuration. Router Advertisements are transmitted periodically and the host prompts with an immediate Router Advertisement using a Router Solicitation such as - when it boots or following a restart operation.

Related Topics

Configuring IPv6 ND Suppress Policy (CLI), on page 81

Router Advertisement

A Router Advertisement message is issued periodically by a router or in response to a Router Solicitation message from a host. The information contained in these messages is used by hosts to perform Stateless Auto-configuration and to modify its routing table.

Related Topics

Configuring IPv6 ND Suppress Policy (CLI), on page 81

Neighbor Discovery

IPv6 Neighbor Discovery is a set of messages and processes that determine relationships between neighboring nodes. Neighbor Discovery replaces ARP, ICMP Router Discovery, and ICMP Redirect used in IPv4.

IPv6 Neighbor Discovery inspection analyzes neighbor discovery messages in order to build a trusted binding table database, and IPv6 neighbor discovery packets that do not comply are dropped. The neighbor binding table in the switch tracks each IPv6 address and its associated MAC address. Clients are expired from the table according to Neighbor Binding timers.

Related Topics

Configuring IPv6 ND Suppress Policy (CLI), on page 81

Neighbor Discovery Suppression

The IPv6 addresses of wireless clients are cached by the switch. When the switch receives an NS multicast looking for an IPv6 address, and if the target address is known to the switch and belongs to one of its clients, the switch will reply with an NA message on behalf of the client. The result of this process generates the equivalent of the Address Resolution Protocol (ARP) table of IPv4 but is more efficient - uses generally fewer messages.

Note The switch acts like proxy and respond with NA, only when the **ipv6 nd suppress** command is configured

If the switch does not have the IPv6 address of a wireless client, the switch will not respond with NA and forward the NS packet to the wireless side. To resolve this, an NS Multicast Forwarding knob is provided. If this knob is enabled, the switch gets the NS packet for the IPv6 address that it does not have (cache miss) and forwards it to the wireless side. This packet reaches the intended wireless client and the client replies with NA.

This cache miss scenario occurs rarely, and only very few clients which do not implement complete IPv6 stack may not advertise their IPv6 address during NDP.

Related Topics

Configuring IPv6 ND Suppress Policy (CLI), on page 81

RA Guard

IPv6 clients configure IPv6 addresses and populate their router tables based on IPv6 router advertisement (RA) packets. The RA guard feature is similar to the RA guard feature of wired networks. RA guard increases the security of the IPv6 network by dropping the unwanted or rogue RA packets that come from wireless clients. If this feature is not configured, malicious IPv6 wireless clients announce themselves as the router for the network often with high priority, which would take higher precedence over legitimate IPv6 routers.

RA-Guard also examines the incoming RA's and decides whether to switch or block them based solely on information found in the message or in the switch configuration. The information available in the frames received is useful for RA validation:

- Port on which the frame is received
- IPv6 source address
- Prefix list

The following configuration information created on the switch is available to RA-Guard to validate against the information found in the received RA frame:

- Trusted/Untrusted ports for receiving RA-guard messages
- Trusted/Untrusted IPv6 source addresses of RA-sender
- Trusted/Untrusted Prefix list and Prefix ranges
- Router Preference

RA guard occurs at the switch. You can configure the switch to drop RA messages at the switch. All IPv6 RA messages are dropped, which protects other wireless clients and upstream wired network from malicious IPv6 clients.

```
//Create a policy for RA Guard//
ipv6 nd raguard policy raguard-router
trusted-port
device-role router
//Applying the RA Guard Policy on port/interface//
interface tengigabitethernet1/0/1 (Katana)
interface gigabitethernet1/0/1 (Edison)

ipv6 nd raguard attach-policy raguard-router
```

Related Topics

Configuring RA Guard Policy (CLI), on page 76
Applying RA Guard Policy (CLI), on page 77
Configuring RA Throttle Policy (CLI), on page 78
Applying RA Throttle Policy on VLAN (CLI), on page 79

RA Throttling

RA throttling allows the controller to enforce limits to RA packets headed toward the wireless network. By enabling RA throttling, routers that send many RA packets can be trimmed to a minimum frequency that will still maintain an IPv6 client connectivity. If a client sends an RS packet, an RA is sent back to the client. This RA is allowed through the controller and unicasted to the client. This process ensures that the new clients or roaming clients are not affected by the RA throttling.

Related Topics

Configuring RA Guard Policy (CLI), on page 76
Applying RA Guard Policy (CLI), on page 77
Configuring RA Throttle Policy (CLI), on page 78
Applying RA Throttle Policy on VLAN (CLI), on page 79

Configuring IPv6 Unicast (CLI)

IPv6 unicasting must always be enabled on the switch and the controller. IPv6 unicast routing is disabled.

Before You Begin

To enable the forwarding of IPv6 unicast datagrams, use the **ipv6 unicast-routing** command in global configuration mode. To disable the forwarding of IPv6 unicast datagrams, use the **no** form of this command.

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 unicast routing**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**ipv6 unicast routing** **Example:** `Switch (config)# ipv6 unicast routing`	enable the forwarding of IPv6 unicast datagrams

Configuring RA Guard Policy (CLI)

Configure RA Guard policy on the switch to add IPv6 client addresses and populate the router table based on IPv6 router advertisement packets.

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 nd raguard policy** raguard-router
3. **trustedport**
4. **device-role router**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ipv6 nd raguard policy** raguard-router **Example:** `Switch(config)# ipv6 nd raguard policy raguard-router`	Defines the RA guard policy name and enters RA guard policy configuration mode.
Step 3	**trustedport** **Example:** `Switch(config-ra-guard)# trustedport`	(Optional) Specifies that this policy is being applied to trusted ports.
Step 4	**device-role router** **Example:** `Switch(config-ra-guard)# device-role router`	Specifies the role of the device attached to the port.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Switch(config-ra-guard)# exit`	Exits RA guard policy configuration mode and returns to global configuration mode.

Related Topics

Prerequisites for IPv6 Client Address Learning, on page 69
RA Guard, on page 74
RA Throttling, on page 75
Applying RA Guard Policy (CLI), on page 77
Configuring RA Throttle Policy (CLI), on page 78
Applying RA Throttle Policy on VLAN (CLI), on page 79

Applying RA Guard Policy (CLI)

Applying the RA Guard policy on the switch will block all the untrusted RA's.

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **interface tengigabitethernet** 1/0/1
3. **ipv6 nd raguard attach-policy** raguard-router
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface tengigabitethernet** 1/0/1 **Example:** `Switch (config)# interface tengigabitethernet 1/0/1`	Specifies an interface type and number, and places the device in interface configuration mode.

	Command or Action	Purpose
Step 3	**ipv6 nd raguard attach-policy** raguard-router **Example:** `Switch(config-if)# ipv6 nd raguard attach-policy raguard-router`	Applies the IPv6 RA Guard feature to a specified interface.
Step 4	**exit** **Example:** `Switch(config-if)# exit`	Exits interface configuration mode.

Related Topics

Configuring RA Guard Policy (CLI), on page 76
RA Guard, on page 74
RA Throttling, on page 75
Configuring RA Throttle Policy (CLI), on page 78
Applying RA Throttle Policy on VLAN (CLI), on page 79

Configuring RA Throttle Policy (CLI)

Configure RA Throttle policy to allow the enforce the limits

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 nd ra-throttler policy** ra-throttler1
3. **throttleperiod**500
4. **max-through**10
5. **allow-atleast** 5 **at-most** 10

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**ipv6 nd ra-throttler policy** ra-throttler1 **Example:** `Switch(config)# ipv6 nd ra-throttler policy ra-throttler1`	Define the router advertisement (RA) throttler policy name and enter IPv6 RA throttle policy configuration mode.
Step 3	**throttleperiod**500 **Example:** `Switch(config-nd-ra-throttle)# throttleperiod 500`	Configures the throttle period in an IPv6 RA throttler policy.
Step 4	**max-through**10 **Example:** `Switch(config-nd-ra-throttle)# max-through 500`	Limits multicast RAs per VLAN per throttle period.
Step 5	**allow-atleast** 5 **at-most** 10 **Example:** `Switch(config-nd-ra-throttle)# allow-atleast 5 at-most 10`	Limits the number of multicast RAs per device per throttle period in an RA throttler policy.

Related Topics

Configuring RA Guard Policy (CLI), on page 76
Applying RA Guard Policy (CLI), on page 77
RA Guard, on page 74
RA Throttling, on page 75
Applying RA Throttle Policy on VLAN (CLI), on page 79

Applying RA Throttle Policy on VLAN (CLI)

Applying the RA Throttle policy on a VLAN. By enabling RA throttling, routers that send many RA packets can be trimmed to a minimum frequency that will still maintain an IPv6 client connectivity.

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **vlan configuration** 1
3. **ipv6 nd ra throttler attach-policy** ra-throttler1

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vlan configuration** 1 **Example:** `Switch(config)# vlan configuration 1`	Configures a VLAN or a collection of VLANs and enters VLAN configuration mode.
Step 3	**ipv6 nd ra throttler attach-policy** ra-throttler1 **Example:** `Switch(config-vlan)# ipv6 nd ra throttler attach-policy ra-throttler1`	Attaches an IPv6 RA throttler policy to a VLAN or a collection of VLANs.

Related Topics

Configuring RA Guard Policy (CLI), on page 76
Applying RA Guard Policy (CLI), on page 77
Configuring RA Throttle Policy (CLI), on page 78
RA Guard, on page 74
RA Throttling, on page 75

Configuring IPv6 Snooping (CLI)

IPv6 snooping must always be enabled on the switch and the controller.

Before You Begin

Enable IPv6 on the client machine.

SUMMARY STEPS

1. **vlan configuration 1**
2. **ipv6 snooping**
3. **ipv6 nd suppress**
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**vlan configuration 1** **Example:** `Switch(config)# vlan configuration 1`	Enters Vlan configuration mode.
Step 2	**ipv6 snooping** **Example:** `Switch(config-vlan)# ipv6 snooping`	Enables IPv6 snooping on the Vlan.
Step 3	**ipv6 nd suppress** **Example:** `Switch(config-vlan-config)# ipv6 nd suppress`	Enables the IPv6 ND suppress on the Vlan.
Step 4	**exit** **Example:** `Switch(config-vlan-config)# exit`	Saves the configuration and comes out of the Vlan configuration mode.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Configuring IPv6 ND Suppress Policy (CLI)

The IPv6 neighbor discovery (ND) multicast suppress feature stops as many ND multicast neighbor solicit (NS) messages as possible by dropping them (and responding to solicitations on behalf of the targets) or converting them into unicast traffic. This feature runs on a layer 2 switch or a wireless controller and is used to reduce the amount of control traffic necessary for proper link operations.

When an address is inserted into the binding table, an address resolution request sent to a multicast address is intercepted, and the device either responds on behalf of the address owner or, at layer 2, converts the request into a unicast message and forwards it to its destination.

Before You Begin

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 nd suppress policy**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Switch(config)# enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 3	**ipv6 nd suppress policy** **Example:** `Switch (config)# ipv6 nd suppress policy`	Defines the ND suppress policy name and enters ND suppress policy configuration mode.

Related Topics

Router Solicitation, on page 73
Router Advertisement, on page 73
Neighbor Discovery, on page 73
Neighbor Discovery Suppression, on page 73

Configuring IPv6 Snooping on VLAN/PortChannel

Neighbor Discover (ND) suppress can be enabled or disabled on either the VLAN or a switchport.

Before You Begin

SUMMARY STEPS

1. **vlan config901**
2. **ipv6 nd suppress**
3. **end**
4. **interface gi1/0/1**
5. **ipv6 nd suppress**
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**vlan config901** **Example:** `Switch(config)# vlan config901`	Creates a VLAN and enter the VLAN configuration mode
Step 2	**ipv6 nd suppress** **Example:** `Switch(config-vlan)# ipv6 nd suppress`	Applies the IPv6 nd suppress on VLAN.
Step 3	**end** **Example:** `Switch(config-vlan)# end`	Exits vlan configuration mode and enters the global configuration mode.
Step 4	**interface gi1/0/1** **Example:** `Switch (config)# interface gi1/0/1`	Creates a gigabitethernet port interface.
Step 5	**ipv6 nd suppress** **Example:** `Switch(config-vlan)# ipv6 nd suppress`	Applies the IPv6 nd suppress on the interface.
Step 6	**end** **Example:** `Switch(config-vlan)# end`	Exits vlan configuration mode and enters the global configuration mode.

Configuring IPv6 on Switch (CLI)

Use this configuration example to configure IPv6 on an interface.

Before You Begin

Enable IPv6 on the client and IPv6 support on the wired infrastructure.

SUMMARY STEPS

1. **interface vlan** 1
2. **ip address** fe80::1 link-local
3. **ipv6 enable**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface vlan** 1 **Example:** `Switch(config)# interface vlan 1`	Creates a interface and enters interface configuration mode.

Step 2	**ip address** fe80::1 link-local
	
	Example:
	`Switch(config-if)# ip address 198.51.100.1 255.255.255.0`
	
	`Switch(config-if)# ipv6 address fe80::1 link-local`
	`Switch(config-if)# ipv6 address 2001:DB8:0:1:FFFF:1234::5/64`
	`Switch(config-if)# ipv6 address 2001:DB8:0:0:E000::F/64`
		Configures IPv6 address on the interface using the link-local option.

Step 3	**ipv6 enable** **Example:** `Switch(config)# ipv6 enable`	(Optional) Enables IPv6 on the interface.
Step 4	**end** **Example:** `Switch(config)# end`	Exits from the interface mode.

Configuring DHCP Pool (CLI)

SUMMARY STEPS

1. **ipv6 dhcp pool** Vlan21
2. **address prefix** 2001:DB8:0:1:FFFF:1234::/64 **lifetime** 300 10
3. **dns-server** 2001:100:0:1::1
4. **domain-name** example.com
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ipv6 dhcp pool** Vlan21 **Example:** `Switch(config)# ipv6 dhcp pool vlan1`	Enters the configuration mode and configures the IPv6 DHCP pool on the Vlan.

	Command or Action	Purpose
Step 2	**address prefix** 2001:DB8:0:1:FFFF:1234::/64 **lifetime** 300 10 **Example:** `Switch(config-dhcpv6)# address prefix 2001:DB8:0:1:FFFF:1234::/64 lifetime 300 10`	Enters the configuration-dhcp mode and configures the address pool and its lifetime on a Vlan.
Step 3	**dns-server** 2001:100:0:1::1 **Example:** `Switch(config-dhcpv6)# dns-server 2001:20:21::1`	Configures the DNS servers for the DHCP pool.
Step 4	**domain-name** example.com **Example:** `Switch(config-dhcpv6)# domain-name example.com`	Configures the domain name to complete unqualified host names.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Configuring Stateless Auto Address Configuration Without DHCP (CLI)

SUMMARY STEPS

1. **interface vlan** 1
2. **ip address** fe80::1 link-local
3. **ipv6 enable**
4. **no ipv6 nd managed-config-flag**
5. **no ipv6 nd other-config-flag**
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface vlan** 1 **Example:** `Switch(config)# interface vlan 1`	Creates a interface and enters interface configuration mode.

Step 2	**ip address** fe80::1 link-local
	
	Example:
	`Switch(config-if)# ip address 198.51.100.1 255.255.255.0`
	`Switch(config-if)# ipv6 address fe80::1 link-local`
	`Switch(config-if)# ipv6 address 2001:DB8:0:1:FFFF:1234::5/64`
	`Switch(config-if)# ipv6 address 2001:DB8:0:0:E000::F/64`
		Configures IPv6 address on the interface using the link-local option.

Step 3	**ipv6 enable** **Example:** `Switch(config)# ipv6 enable`	(Optional) Enables IPv6 on the interface.

Step 4	**no ipv6 nd managed-config-flag**
	
	Example:
	`Switch(config)#interface vlan 1`
	`Switch(config-if)# no ipv6 nd managed-config-flag`
		Ensures the attached hosts do not use stateful autoconfiguration to obtain addresses.

Step 5	**no ipv6 nd other-config-flag** **Example:** `Switch(config-if)# no ipv6 nd other-config-flag`	Ensures the attached hosts do not use stateful autoconfiguration to obtain non-address options from DHCP (domain etc).
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Configuring Stateless Auto Address Configuration With DHCP (CLI)

SUMMARY STEPS

1. **interface vlan** 1
2. **ip address** fe80::1 link-local
3. **ipv6 enable**
4. **no ipv6 nd managed-config-flag**
5. **ipv6 nd other-config-flag**
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface vlan** 1 **Example:** `Switch(config)# interface vlan 1`	Creates a interface and enters interface configuration mode.

Step 2	**ip address** fe80::1 link-local
	
	Example:
	`Switch(config-if)# ip address 198.51.100.1 255.255.255.0`
	`Switch(config-if)# ipv6 address fe80::1 link-local`
	
	`Switch(config-if)# ipv6 address 2001:DB8:0:1:FFFF:1234::5/64`
	`Switch(config-if)# ipv6 address 2001:DB8:0:0:E000::F/64`
		Configures IPv6 address on the interface using the link-local option.

Step 3	**ipv6 enable** **Example:** `Switch(config)# ipv6 enable`	(Optional) Enables IPv6 on the interface.

Step 4	**no ipv6 nd managed-config-flag**
	
	Example:
	`Switch(config)#interface vlan 1`
	`Switch(config-if)# no ipv6 nd managed-config-flag`
		Ensures the attached hosts do not use stateful autoconfiguration to obtain addresses.

Step 5	**ipv6 nd other-config-flag** **Example:** `Switch(config-if)# no ipv6 nd other-config-flag`	Ensures the attached hosts do not use stateful autoconfiguration to obtain non-address options from DHCP (domain etc).

	Command or Action	Purpose
Step 6	**end** **Example:** `Switch(config)# end`	Exits from the interface mode.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Configuring Stateful DHCP Locally (CLI)

This interface configuration is for a Cisco IOS IPv6 router implementing stateful DHCPv6 on a local Switch

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 unicast-routing**
3. **ipv6 dhcp pool** IPv6_DHCPPOOL
4. **address prefix** 2001:DB8:0:1:FFFF:1234::/64
5. **dns-server** 2001:100:0:1::1
6. **domain-name** example.com
7. **exit**
8. **interface** vlan1
9. **description IPv6-DHCP-Stateful**
10. **ipv6 address** 2001:DB8:0:20::1/64
11. **ip address** 192.168.20.1 255.255.255.0
12. **ipv6 nd prefix** 2001:db8::/64 **no-advertise**
13. **ipv6 nd managed-config-flag**
14. **ipv6 nd other-config-flag**
15. **ipv6 dhcp server** IPv6_DHCPPOOL

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ipv6 unicast-routing** **Example:** `Switch(config)# ipv6 unicast-routing`	Configures IPv6 for unicasting.
Step 3	**ipv6 dhcp pool** IPv6_DHCPPOOL **Example:** `Switch (config)# ipv6 dhcp pool IPv6_DHCPPOOL`	Enters the configuration mode and configures the IPv6 DHCP pool on the VLAN.
Step 4	**address prefix** 2001:DB8:0:1:FFFF:1234::/64 **Example:** `Switch (config-dhcpv6)# address prefix 2001:DB8:0:1:FFFF:1234::/64`	Specifies the address range to provide in the pool.
Step 5	**dns-server** 2001:100:0:1::1 **Example:** `Switch (config-dhcpv6)# dns-server 2001:100:0:1::1`	Provides the DNS server option to DHCP clients.
Step 6	**domain-name** example.com **Example:** `Switch (config-dhcpv6)# domain-name example.com`	Provides the domain name option to DHCP clients.
Step 7	**exit** **Example:** `Switch (config-dhcpv6)# exit`	Returns to the previous mode.
Step 8	**interface** vlan1 **Example:** `Switch (config)# interface vlan 1`	Enters the interface mode to configure the stateful DHCP.
Step 9	**description IPv6-DHCP-Stateful** **Example:** `Switch (config-if)# description IPv6-DHCP-Stateful`	Enter description for the stateful IPv6 DHCP.
Step 10	**ipv6 address** 2001:DB8:0:20::1/64 **Example:** `Switch (config-if)# ipv6 address 2001:DB8:0:20::1/64`	Enters the IPv6 address for the stateful IPv6 DHCP.

	Command or Action	Purpose
Step 11	**ip address** 192.168.20.1 255.255.255.0 **Example:** `Switch (config-if)# ip address 192.168.20.1 255.255.255.0`	Enters the IPv6 address for the stateful IPv6 DHCP.
Step 12	**ipv6 nd prefix** 2001:db8::/64 **no-advertise** **Example:** `Switch (config-if)# ipv6 nd prefix 2001:db8::/64 no-advertise`	Configures the IPv6 routing prefix advertisement that must not be advertised.
Step 13	**ipv6 nd managed-config-flag** **Example:** `Switch (config-if)# ipv6 nd managed-config-flag`	Configures IPv6 interfaces neighbor discovery to allow the hosts to uses DHCP for address configuration.
Step 14	**ipv6 nd other-config-flag** **Example:** `Switch (config-if)# ipv6 nd other-config-flag`	Configures IPv6 interfaces neighbor discovery to allow the hosts to uses DHCP for non-address configuration.
Step 15	**ipv6 dhcp server** IPv6_DHCPPOOL **Example:** `Switch (config-if)# ipv6 dhcp server IPv6_DHCPPOOL`	Configures the DHCP server on the interface.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Configuring Stateful DHCP Externally (CLI)

This interface configuration is for a Cisco IOS IPv6 router implementing stateful DHCPv6 on an external DHCP server.

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 unicast-routing**
3. **dns-server** 2001:100:0:1::1
4. **domain-name** example.com
5. **exit**
6. **interface** vlan1
7. **description IPv6-DHCP-Stateful**
8. **ipv6 address** 2001:DB8:0:20::1/64
9. **ip address** 192.168.20.1 255.255.255.0
10. **ipv6 nd prefix** 2001:db8::/64 **no-advertise**
11. **ipv6 nd managed-config-flag**
12. **ipv6 nd other-config-flag**
13. **ipv6 dhcp_relaydestination** 2001:DB8:0:20::2

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ipv6 unicast-routing** **Example:** `Switch(config)# ipv6 unicast-routing`	Configures the IPv6 for unicasting.
Step 3	**dns-server** 2001:100:0:1::1 **Example:** `Switch (config-dhcpv6)# dns-server 2001:100:0:1::1`	Provides the DNS server option to DHCP clients.
Step 4	**domain-name** example.com **Example:** `Switch (config-dhcpv6)# domain-name example.com`	Provides the domain name option to DHCP clients.
Step 5	**exit** **Example:** `Switch (config-dhcpv6)# exit`	Returns to the previous mode.

	Command or Action	Purpose
Step 6	**interface** vlan1 **Example:** `Switch (config)# interface vlan 1`	Enters the interface mode to configure the stateful DHCP.
Step 7	**description IPv6-DHCP-Stateful** **Example:** `Switch (config-if)# description IPv6-DHCP-Stateful`	Enter description for the stateful IPv6 DHCP.
Step 8	**ipv6 address** 2001:DB8:0:20::1/64 **Example:** `Switch (config-if)# ipv6 address 2001:DB8:0:20::1/64`	Enters the IPv6 address for the stateful IPv6 DHCP.
Step 9	**ip address** 192.168.20.1 255.255.255.0 **Example:** `Switch (config-if)# ip address 192.168.20.1 255.255.255.0`	Enters the IPv6 address for the stateful IPv6 DHCP.
Step 10	**ipv6 nd prefix** 2001:db8::/64 **no-advertise** **Example:** `Switch (config-if)# ipv6 nd prefix 2001:db8::/64 no-advertise`	Configures the IPv6 routing prefix advertisement that must not be advertised.
Step 11	**ipv6 nd managed-config-flag** **Example:** `Switch (config-if)# ipv6 nd managed-config-flag`	Configures IPv6 interfaces neighbor discovery to allow the hosts to uses DHCP for address configuration.
Step 12	**ipv6 nd other-config-flag** **Example:** `Switch (config-if)# ipv6 nd other-config-flag`	Configures IPv6 interfaces neighbor discovery to allow the hosts to uses DHCP for non-address configuration.
Step 13	**ipv6 dhcp_relaydestination** 2001:DB8:0:20::2 **Example:** `Switch (config-if)# ipv6 dhcp_relay destination 2001:DB8:0:20::2`	Configures the DHCP server on the interface.

Related Topics

SLAAC Address Assignment, on page 70
Stateful DHCPv6 Address Assignment, on page 71

Monitoring IPv6 Clients (GUI)

To view the IPv6 clients associated with the Switch

Before You Begin

Select **Monitor** > **Clients**
The Clients page is displayed. The Clients page contains the following details:

- Client MAC Address— Displays the MAC address of the client.
- AP Name— Displays the access point name to which the client is connected to.
- WLAN— Displays the WLAN associated with the client.
- State— Displays the client authentication.
- Protocol— Displays the protocol used.

To view the client related general details, click the **Client MAC Address** parameter in the Clients page. The **Client > Detail** page displays IPv6 addresses of the client under the **General** tab.

Verifying IPv6 Address Learning Configuration

This example displays the output of the **show ipv6 dhcp pool** command. This command displays the IPv6 service configuration on the switch. The vlan 21 configured pool detail displays 6 clients that are currently using addresses from the pool.

SUMMARY STEPS

1. **show ipv6 dhcp pool**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show ipv6 dhcp pool**
	
	Example:
	`Switchshow ipv6 dhcp pool`
	`DHCPv6 pool: vlan21`
	`Address allocation prefix: 2001:DB8:0:1:FFFF:1234::/64 valid 86400 preferred 86400 (6 in use, 0 conflicts)`
	`DNS server: 2001:100:0:1::1`
	`Domain name: example.com`
	`Active clients: 6`
		Displays the IPv6 service configuration on the switch.

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
IP command reference	*IP Command Reference (Catalyst 3650 Switches)*

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

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

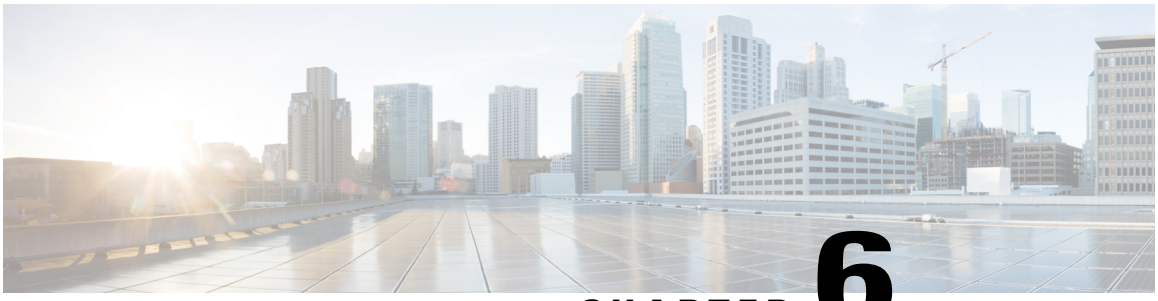
Technical Assistance

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 Information for IPv6 Client Address Learning

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 Client Address Learning Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 6

Configuring IPv6 WLAN Security

Prerequisites for IPv6 WLAN Security

A client VLAN must be mapped to the WLAN configured on the switch

Restrictions for IPv6 WLAN Security

RADIUS Server Support

- If multiple RADIUS servers are configured for redundancy, the user database must be identical in all the servers for the backup to work properly.

Radius ACS Support

- You must configure RADIUS on both your Cisco Secure Access Control Server (ACS) and your switch
- RADIUS is supported on Cisco Secure ACS version 3.2 and later releases.

Information About IPv6 WLAN Security

Information About RADIUS

Remote Authentication Dial-In User Service (RADIUS) is a client/server protocol that provides centralized security for users attempting to gain management access to a network. It serves as a back-end database similar to Local EAP and provides authentication and accounting services.

- Authentication—The process of verifying users when they attempt to log into the switch

  Users must enter a valid username and password for the switch to authenticate users to the RADIUS server. If multiple databases are configured, then specify the sequence in which the backend database must be tried.

- Accounting— The process of recording user actions and changes.

  Whenever a user successfully executes an action, the RADIUS accounting server logs the changed attributes, the user ID of the person who made the change, the remote host where the user is logged in, the date and time when the command was executed, the authorization level of the user, and a description of the action performed and the values provided. If the RADIUS accounting server is unreachable, the users can continue their sessions uninterrupted.

User Datagram Protocol— RADIUS uses User Datagram Protocol (UDP) for its transport. It maintains a database and listens on UDP port 1812 for incoming authentication requests and UDP port 1813 for incoming accounting requests. The switch, which requires access control, acts as the client and requests AAA services from the server. The traffic between the switch and the server is encrypted by an algorithm defined in the protocol and a shared secret key configured on both devices.

Configures multiple RADIUS accounting and authentication servers. For example, you can have one central RADIUS authentication server but several RADIUS accounting servers in different regions. If you configure multiple servers of the same type and the first one fails or becomes unreachable, the controller automatically tries the second one, then the third one if necessary, and so on.

When RADIUS method is configured for the WLAN, the switch will use the RADIUS method configured for the WLAN. When the WLAN is configured to use local EAP, the RADIUS method configured on the WLAN points to Local. The WLAN must also be configured with the name of the local EAP profile to use.

If no RADIUS method is configured in the WLAN, the switch will use the default RADIUS method defined in global mode.

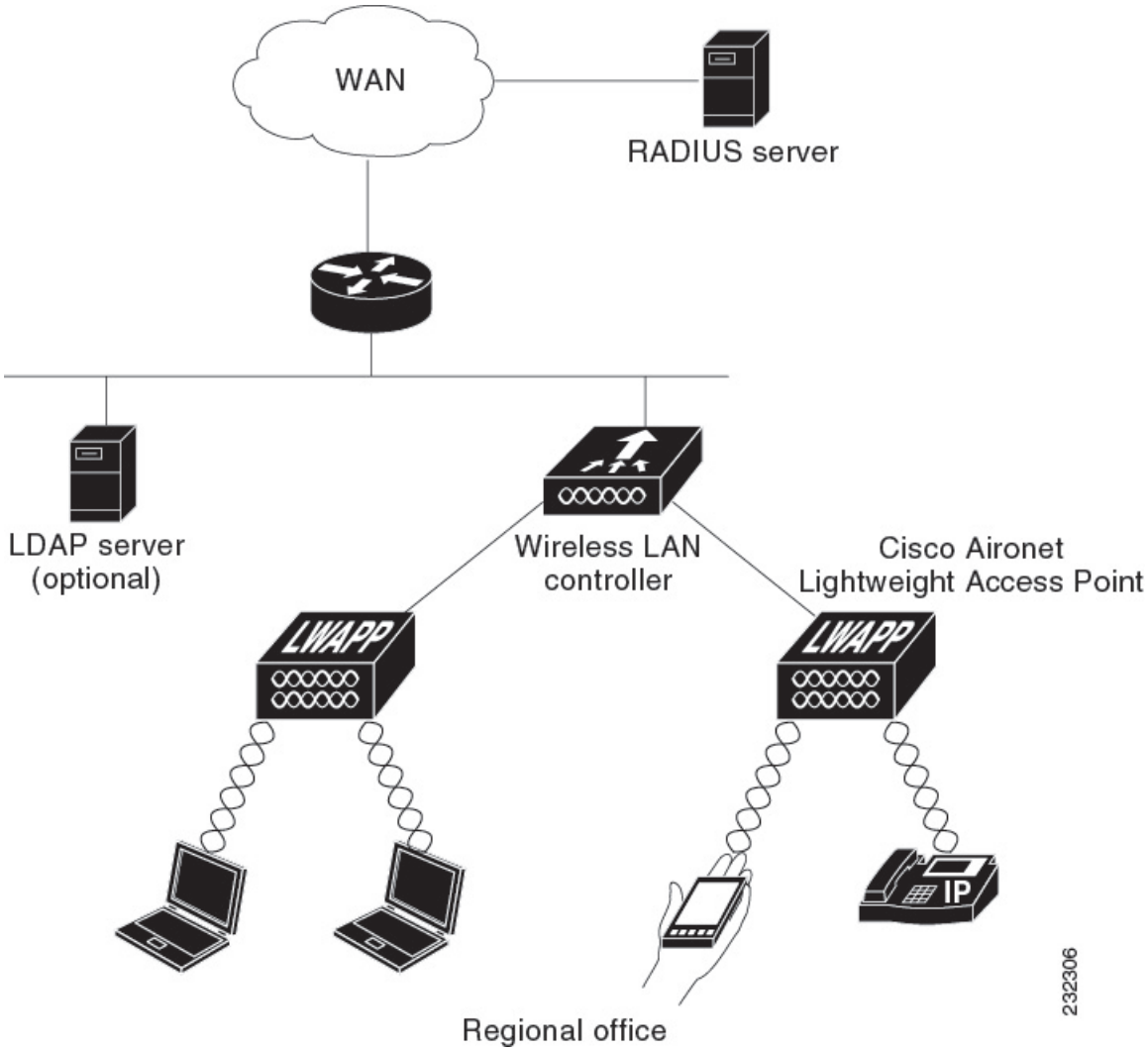
Information About Local EAP

Local EAP is an authentication method that allows users and wireless clients to be authenticated locally. It is designed for use in remote offices that maintain connectivity to wireless clients when the back-end system is disrupted or the external authentication server goes down. When you enable local EAP, the switch serves as the authentication server and the local user database, which removes dependence on an external authentication server. Local EAP retrieves user credentials from the local user database or the LDAP back-end database to authenticate users. Local EAP supports LEAP, EAP-FAST, EAP-TLS, PEAPv0/MSCHAPv2, and PEAPv1/GTC authentication between the controller and wireless clients.

Note The LDAP back-end database supports these local EAP methods: EAP-TLS, EAP-FAST/GTC, and PEAPv1/GTC. LEAP, EAP-FAST/MSCHAPv2, and PEAPv0. MSCHAPv2 is supported only if the LDAP server is set up to return a clear-text password.

Note Switch support Local EAP authentication against external LDAP databases such as Microsoft Active Directory and Novell's eDirectory. For more information about configuring the controller for Local EAP authentication against Novell's eDirectory, see the Configure Unified Wireless Network for Authentication Against Novell's eDirectory Database whitepaper.

Figure 3: Local EAP Example



Related Topics

Creating a Local User, on page 100
Creating an Client VLAN and Interface, on page 101
Configuring a EAP Profile, on page 102
Creating a Client VLAN, on page 115
Creating 802.1x WLAN Using an External RADIUS Server, on page 117

How to Configure IPv6 WLAN Security

Configuring Local Authentication

Creating a Local User

SUMMARY STEPS

1. **configure terminal**
2. **username** aaa_test
3. **password 0** aaa_test
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**username** aaa_test **Example:** `Switch(config)# username aaa_test`	Creates a username.
Step 3	**password 0** aaa_test **Example:** `Switch(config)# username aaa_test password 0 aaa_test`	Assigns a password for the username.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch# configure terminal
Switch(config)# username aaa_test password 0 aaa_test
Switch(config)# end
```

Related Topics

Information About IPv6 WLAN Security, on page 98

Creating an Client VLAN and Interface

SUMMARY STEPS

1. **configure terminal**
2. **vlan**
3. **exit**
4. **interface vlan** vlan_ID
5. **ip address**
6. **ipv6 address**
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**vlan** **Example:** `Switch(config)# vlan 137`	Creates a VLAN.
Step 3	**exit** **Example:** `Switch (config-vlan)# exit`	Exits VLAN configuration mode.
Step 4	**interface vlan** vlan_ID **Example:** `Switch (config)# interface vlan 137`	Associates the VLAN to an interface.
Step 5	**ip address** **Example:** `Switch(config-if)# ip address 10.7.137.10 255.255.255.0`	Assigns an IP address to the VLAN interface.

	Command or Action	Purpose
Step 6	**ipv6 address** **Example:** `Switch(config-if)#ipv6 address 2001:db8::20:1/64`	Assigns an IPv6 address to the VLAN interface.
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch# configure terminal
Switch(config)# vlan 137
Switch(config-vlan)#exit
Switch(config)#interface vlan 137
Switch(config-if)#ip address 10.7.137.10 255.255.255.0
Switch(config-if)#ipv6 address 2001:db8::20:1/64
Switch(config-if)#end
```

Related Topics

Information About IPv6 WLAN Security, on page 98

Configuring a EAP Profile

SUMMARY STEPS

1. **eap profile** name
2. **method leap**
3. **method tls**
4. **method peap**
5. **method mschapv2**
6. **method md5**
7. **method gtc**
8. **method fast profile** my-fast
9. **description** my_local**eap profile**
10. **exit**
11. **eap method fast profile**myFast
12. **authority-id** [identity|information]
13. **local-key 0** key-name
14. **pac-password 0** password
15. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**eap profile** name **Example:** `Switch(config)# eap profile wcm_eap_prof`	Creates a EAP profile.
Step 2	**method leap** **Example:** `Switch(config-eap-profile)# method leap`	Configures EAP-LEAP method on the profile.
Step 3	**method tls** **Example:** `Switch(config-eap-profile)# method tls`	Configures EAP-TLS method on the profile.
Step 4	**method peap** **Example:** `Switch(config-eap-profile)# method peap`	Configures PEAP method on the profile.
Step 5	**method mschapv2** **Example:** `Switch(config-eap-profile)# method mschapv2`	Configures EAP-MSCHAPV2 method on the profile.
Step 6	**method md5** **Example:** `Switch(config-eap-profile)# method md5`	Configures EAP-MD5 method on the profile.
Step 7	**method gtc** **Example:** `Switch(config-eap-profile)# method gtc`	Configures EAP-GTC method on the profile.

Step 8	**method fast profile** my-fast
	
	Example:
	`Switch(config-eap-profile)# eap method fast profile my-fast`
	`Switch (config-eap-profile)#description my_local eap profile`
		Creates a EAP profile named my-fast.

Step 9	**description** my_local**eap profile** **Example:** `Switch (config-eap-profile)#description my_local eap profile`	Provides a description for the local profile.
Step 10	**exit** **Example:** `Switch (config-eap-profile)# exit`	Exits the eap-profile configuration mode.

	Command or Action	Purpose
Step 11	**eap method fast profile**myFast **Example:** `Switch (config)# eap method fast profile myFast`	Configures the EAP method profile.

Step 12	**authority-id** [identity|information]
	
	Example:
	`Switch(config-eap-method-profile)# authority-id identity my_identity`
	`Switch(config-eap-method-profile)#authority-id information my_information`
		Configure the authority ID and information for the EAP method profile.

Step 13	**local-key 0** key-name **Example:** `Switch(config-eap-method-profile)# local-key 0 test`	Configures the local server key.
Step 14	**pac-password 0** password **Example:** `Switch(config-eap-method-profile)# pac-password 0 test`	Configures the PAC password for manual PAC provisioning.
Step 15	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch(config)#eap profile wcm_eap_prof
Switch(config-eap-profile)#method leap
Switch(config-eap-profile)#method tls
Switch(config-eap-profile)#method peap
Switch(config-eap-profile)#method mschapv2
Switch(config-eap-profile)#method md5
Switch(config-eap-profile)#method gtc
Switch(config-eap-profile)#eap method fast profile my-fast
Switch (config-eap-profile)#description my_local eap profile
Switch(config-eap-profile)# exit
Switch (config)# eap method fast profile myFast
Switch(config-eap-method-profile)#authority-id identity my_identity
Switch(config-eap-method-profile)#authority-id information my_information
Switch(config-eap-method-profile)#local-key 0 test
Switch(config-eap-method-profile)#pac-password 0 test
Switch(config-eap-method-profile)# end
```

Related Topics

Information About IPv6 WLAN Security, on page 98

Creating a Local Authentication Model

SUMMARY STEPS

1. **aaa** new-model
2. **authentication dot1x default local**
3. **dot1x** method_list **local**
4. **aaa authentication dot1x** dot1x_name **local**
5. **aaa authorization credential-download** name **local**
6. **aaa local authentication** auth-name **authorization** authorization-name
7. **session ID**
8. **dot1x system-auth-control**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**aaa** new-model **Example:** `Switch(config)# aaa new-model`	Creates a AAA authentication model.
Step 2	**authentication dot1x default local** **Example:** `Switch(config)# aaa authentication dot1x default local`	Implies that the dot1x must use the default local RADIUS when no other method is found.
Step 3	**dot1x** method_list **local** **Example:** `Switch(config)# aaa authentication dot1x wcm_local local`	Assigns the local authentication for wcm_local method list.
Step 4	**aaa authentication dot1x** dot1x_name **local** **Example:** `Switch(config)# aaa authentication dot1x aaa_auth local`	Configures the local authentication for the dot1x method.
Step 5	**aaa authorization credential-download** name **local** **Example:** `Switch(config)# aaa authorization credential-download wcm_author local`	Configures local database to download EAP credentials from Local/RADIUS/LDAP.
Step 6	**aaa local authentication** auth-name **authorization** authorization-name **Example:** `Switch(config)# aaa local authentication wcm_local authorization wcm_author`	Selects local authentication and authorization.

	Command or Action	Purpose
Step 7	**session ID** **Example:** `Switch(config)# aaa session-id common`	Configures a session ID for AAA.
Step 8	**dot1x system-auth-control** **Example:** `Switch(config)# dot1x system-auth-control`	Enables dot.1x system authentication control.

```
Switch(config)# aaa new-model
Switch(config)# aaa authentication dot1x default local
Switch(config)# aaa authentication dot1x wcm-local local
Switch(config)# aaa authentication dot1x aaa_auth local
Switch(config)# aaa authorization credential-download wcm_author local
Switch(config)# aaa local authentication wcm_local authorization wcm_author
Switch(config)# aaa session-id common
Switch(config)# dot1x system-auth-control
```

Creating a Client WLAN

Note This example uses 802.1x with dynamic WEP. You can use any other security mechanism supported by the wireless client and configurable on the switch

SUMMARY STEPS

1. **configure terminal**
2. **wlan** wlan name **<identifier>** SSID
3. **broadcast-ssid**
4. **no security wpa**
5. **security dot1x**
6. **security** dot1x authentication-list *wcm-local*
7. **local-auth** wcm_eap_prof
8. **client vlan** *137*
9. **no shutdown**
10. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**wlan** wlan name **<identifier>** SSID **Example:** `Switch(config)# wlan wlanProfileName 1 ngwcSSID`	Creates a WLAN.
Step 3	**broadcast-ssid** **Example:** `Switch(config-wlan)# broadcast-ssid`	Configures to broadcast the SSID on a WLAN.
Step 4	**no security wpa** **Example:** `Switch(config-wlan)# no security wpa`	Disables the wpa for WLAN to enable 802.1x.
Step 5	**security dot1x** **Example:** `Switch(config-wlan)# security dot1x`	Configures the 802.1x encryption security for the WLAN.
Step 6	**security** dot1x authentication-list *wcm-local* **Example:** `Switch(config-wlan)# security dot1x authentication-list wcm-local`	Configures the server group mapping to the WLAN for dot1x authentication.
Step 7	**local-auth** wcm_eap_prof **Example:** `Switch (config-wlan)# local-auth wcm_eap_profile`	Configures the eap profile on the WLAN for local authentication.
Step 8	**client vlan** *137* **Example:** `Switch(config-wlan)# client vlan 137`	Associates the VLAN to a WLAN.
Step 9	**no shutdown** **Example:** `Switch(config-wlan)# no shutdown`	Enables the WLAN.
Step 10	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch# config terminal
Switch(config)#wlan wlanProfileName 1 ngwcSSID
Switch(config-wlan)#broadcast-ssid
Switch(config-wlan)#no security wpa
Switch(config-wlan)#security dot1x
Switch(config-wlan)#security dot1x authentication-list wcm-local
Switch (config-wlan)# local-auth wcm_eap_prof
Switch(config-wlan)#client vlan 137
Switch(config-wlan)#no shutdown
Switch(config-wlan)#end
Switch#
```

Related Topics

Creating Client VLAN for WPA2+AES, on page 109

Configuring Local Authentication with WPA2+AES

SUMMARY STEPS

1. **configure terminal**
2. **aaa** new model
3. **dot1x system-auth-control**
4. **aaa authentication dot1x default local**
5. **aaa local authorization credential-download default local**
6. **aaa local authentication default authorization default**
7. **eap profile** wcm_eap_profile
8. **method leap**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**aaa** new model **Example:** `Switch(config)# aaa new-model`	Creates a AAA authentication model.
Step 3	**dot1x system-auth-control** **Example:** `Switch(config)# dot1x system-auth-control`	Enables dot1x system authentication control.

	Command or Action	Purpose
Step 4	**aaa authentication dot1x default local** **Example:** `Switch(config)# aaa authentication dot1x default local`	Configures the local authentication for the default dot1x method.
Step 5	**aaa local authorization credential-download default local** **Example:** `Switch(config)# aaa authorization credential-download default local`	Configures default database to download EAP credentials from local server.
Step 6	**aaa local authentication default authorization default** **Example:** `Switch(config)# aaa local authentication default authorization default`	Selects the default local authentication and authorization.
Step 7	**eap profile** wcm_eap_profile **Example:** `Switch(config)#eap profile wcm_eap_profile`	Creates an EAP profile.
Step 8	**method leap** **Example:** `Switch(config)# method leap`	Configures EAP-LEAP method on the profile.
Step 9	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch# configure terminal
Switch(config)# aaa new-model
Switch(config)# dot1x system-auth-control
Switch(config)# aaa authentication dot1x default local
Switch(config)# aaa authorization credential-download default local
Switch(config)# aaa local authentication default authorization default
Switch(config)#eap profile wcm_eap_profile
Switch(config)# method leap
Switch(config)# end
```

Creating Client VLAN for WPA2+AES

Create a VLAN for the WPA2+AES type of local authentication. This VLAN is later mapped to a WLAN.

SUMMARY STEPS

1. **configure terminal**
2. **vlan** vlan_ID
3. **exit**
4. **interface** vlan vlan_ID
5. **ip address**
6. **ipv6 address**
7. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**vlan** vlan_ID **Example:** `Switch (config)# vlan 105`	Creates a VLAN.
Step 3	**exit** **Example:** `Switch (config-vlan)# exit`	Exits from the VLAN mode.
Step 4	**interface** vlan vlan_ID **Example:** `Switch(config)# interface vlan 105`	Associates the VLAN to the interface.
Step 5	**ip address** **Example:** `Switch(config-if)# ip address 10.8.105.10 255.255.255.0`	Assigns IP address to the VLAN interface.
Step 6	**ipv6 address** **Example:** `Switch(config-if)#ipv6 address 2001:db8::10:1/64`	Assigns IPv6 address to the VLAN interface.
Step 7	**exit** **Example:** `Switch (config-if)# exit`	Exits from the interface mode.

```
Switch# configure terminal
Switch(config)# vlan105
Switch (config-vlan)# exit
Switch (config)# interface vlan 105
Switch(config-if)#ip address 10.8.105.10 255.255.255.0
Switch(config-if)#ipv6 address 2001:db8::10:1/64
Switch(config-if)#exit
Switch(config)#
```

Related Topics

Creating a Client WLAN , on page 106

Creating WLAN for WPA2+AES

Create a WLAN and map it to the client VLAN created for WPA2+AES.

SUMMARY STEPS

1. **configure terminal**
2. **wlan** wpas2-aes-wlan 1 wpas2-aes-wlan
3. **client vlan** 105
4. **local-auth** wcm_eap_profile
5. **security dot1x authentication-list default**
6. **no shutdown**
7. **end**

DETAILED STEPS

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

Step 2	**wlan** wpas2-aes-wlan 1 wpas2-aes-wlan
	
	Example:
	`Switch(config)#wlan wpa2-aes-wlan 1 wpa2-aes-wlan`
	`Switch(config-wlan)#`
		Creates a WLAN.

Step 3	**client vlan** 105
	
	Example:
	`Switch(config-wlan)#client vlan 105`
	`Switch(config-wlan)#`
		Maps the WLAN to the client VLAN.

	Command or Action	Purpose
Step 4	**local-auth** wcm_eap_profile **Example:** `Switch(config-wlan)#local-auth wcm_eap_profile`	Creates and sets the EAP profile on the WLAN.
Step 5	**security dot1x authentication-list default** **Example:** `Switch(config-wlan)#security dot1x authentication-list default`	Uses the default dot1x authentication list.

Step 6	**no shutdown**
	
	Example:
	`Switch(config-wlan)#no shutdown`
	`Switch(config-wlan)#`
		Enables the WLAN.

Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch# configure terminal
Switch(config)#wlan wpa2-aes-wlan 1 wpa2-aes-wlan
Switch(config-wlan)#client vlan 105
Switch(config-wlan)#local-auth wcm_eap_profile
Switch(config-wlan)#security dot1x authentication-list default
Switch(config-wlan)#no shutdown
Switch(config-wlan)# exit
```

Configuring External RADIUS Server

Configuring RADIUS Authentication Server Host

SUMMARY STEPS

1. **configure terminal**
2. **radius server One**
3. **address ipv4** address **auth-port**auth_port_number **acct-port** acct_port_number
4. **address ipv6** address **auth-port**auth_port_number **acct-port** acct_port_number
5. **key** 0cisco
6.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**radius server One** **Example:** `Switch (config)# radius server One`	Creates a radius server.
Step 3	**address ipv4** address **auth-port**auth_port_number **acct-port** acct_port_number **Example:** `Switch (config-radius-server)# address ipv4 10.10.10.10 auth-port 1812 acct-port 1813`	Configures the IPv4 address for the radius server.
Step 4	**address ipv6** address **auth-port**auth_port_number **acct-port** acct_port_number **Example:** `Switch (config-radius-server)# address ipv6 2001:db8::25:2 auth-port 1812 acct-port 1813`	Configures the IPv6 address for the radius server.
Step 5	**key** 0cisco **Example:** `Switch (config-radius-server)# key 0 cisco`	**exit**
Step 6	 **Example:** `Switch (config-radius-server)# exit`	Exits from the radius server mode.

```
Switch# configure terminal
Switch (config)# radius server One
Switch (config-radius-server)# address ipv4 10.10.10.10 auth-port 1812 acct-port 1813
Switch (config-radius-server)# address ipv6 2001:db8::25:2 auth-port 1812 acct-port 1813
Switch (config-radius-server)# key 0 cisco
Switch (config-radius-server)#exit
```

Related Topics

Configuring RADIUS Authentication Server Group , on page 114

Configuring RADIUS Authentication Server Group

SUMMARY STEPS

1. **configure terminal**
2. **aaa new-model**
3. **aaa group server radius** wcm_rad
4. **server** <ip address>**auth-port**1812**acct-port**1813
5. **aaa authentication dot1x** method_list **group** wcm_rad
6. **dot1x system-auth-control**
7. **aaa session-idcommon**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**aaa new-model** **Example:** `Switch(config)#aaa new-model`	Creates a AAA authentication model.

Step 3	**aaa group server radius** wcm_rad
	
	Example:
	`Switch(config)# aaa group server radius wcm_rad`
	`Switch(config-sg-radius)#`
		Creates an radius server-group.

Step 4	**server** <ip address>**auth-port**1812**acct-port**1813
	
	Example:
	`Switch(config-sg-radius)# server One auth-port 1812 acct-port 1813`
	`Switch(config-sg-radius)# server Two auth-port 1812 acct-port 1813`
	`Switch(config-sg-radius)# server Three auth-port 1812 acct-port 1813`
		Adds servers to the radius group created in Step 3. Configures the UDP port for RADIUS accounting server and authentication server.

Step 5	**aaa authentication dot1x** method_list **group** wcm_rad **Example:** `Switch(config)# aaa authentication dot1x method_list group wcm_rad`	Maps the method list to the radius group.
Step 6	**dot1x system-auth-control** **Example:** `Switch(config)# dot1x system-auth-control`	Enables the system authorization control for the radius group.

	Command or Action	Purpose
Step 7	**aaa session-idcommon** **Example:** `Switch(config)# aaa session-id common`	Ensures that all session IDs information sent out, from the radius group, for a given call are identical.

```
Switch# configure terminal
Switch(config)# aaa new-model
Switch(config)# aaa group server radius wcm_rad
Switch(config-sg-radius)# server One auth-port 1812 acct-port 1813
Switch(config-sg-radius)# server Two auth-port 1812 acct-port 1813
Switch(config-sg-radius)# server Three auth-port 1812 acct-port 1813
Switch(config)# aaa authentication dot1x method_list group wcm_rad
Switch(config)# dot1x system-auth-control
Switch(config)# aaa session-id common
Switch(config)#
```

Related Topics

Configuring RADIUS Authentication Server Host , on page 112

Creating a Client VLAN

SUMMARY STEPS

1. **configure terminal**
2. **vlan** 137
3. **exit**
4. **interface vlan** 137
5. **ip address** 10.7.137.10 255.255.255.0
6. **ipv6 address** 2001:db8::30:1/64
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**vlan** 137 **Example:** `Switch(config)# vlan 137`	Creates a VLAN and associate it to the interface.

	Command or Action	Purpose
Step 3	**exit** **Example:** `Switch (config-vlan)# exit`	Exits from the VLAN mode.
Step 4	**interface vlan** 137 **Example:** `Switch (config)# interface vlan 137`	Assigns a VLAN to an interface.
Step 5	**ip address** 10.7.137.10 255.255.255.0 **Example:** `Switch(config-if)# ip address 10.7.137.10 255.255.255.0`	Assigns an IPv4 address to the VLAN interface.
Step 6	**ipv6 address** 2001:db8::30:1/64 **Example:** `Switch(config-if)# ipv6 address 2001:db8::30:1/64`	Assigns an IPv6 address to the VLAN interface.
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch# configure terminal
Switch(config)# vlan137
Switch(config-vlan)# exit
Switch(config)# interface vlan137
Switch(config-if)# ip address 10.7.137.10 255.255.255.0
Switch(config-if)# ipv6 address 2001:db8::30:1/64
Switch(config-if)# end
```

Related Topics

Information About IPv6 WLAN Security, on page 98
Creating 802.1x WLAN Using an External RADIUS Server, on page 117

Creating 802.1x WLAN Using an External RADIUS Server

SUMMARY STEPS

1. **configure terminal**
2. **wlan** ngwc-1x**<ssid>**ngwc-1x
3. **broadcast-ssid**
4. **no security wpa**
5. **security dot1x**
6. **security dot1x authentication-list** wcm-rad
7. **client vlan** 137
8. **no shutdown**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global command mode.
Step 2	**wlan** ngwc-1x**<ssid>**ngwc-1x **Example:** `Switch(config)# wlan ngwc_8021x 2 ngwc_8021x`	Creates a new WLAN for 802.1x authentication.
Step 3	**broadcast-ssid** **Example:** `Switch(config-wlan)# broadcast-ssid`	Configures to broadcast the SSID on WLAN.
Step 4	**no security wpa** **Example:** `Switch(config-wlan)# no security wpa`	Disables the WPA for WLAN to enable 802.1x.
Step 5	**security dot1x** **Example:** `Switch(config-wlan)# security dot1x`	Configures the 802.1x encryption security for the WLAN.
Step 6	**security dot1x authentication-list** wcm-rad **Example:** `Switch(config-wlan)# security dot1x authentication-list wcm-rad`	Configures the server group mapping to the WLAN for dot1x authentication.

	Command or Action	Purpose
Step 7	**client vlan** 137 **Example:** `Switch(config-wlan)# client vlan 137`	Associates the VLAN to a WLAN.
Step 8	**no shutdown** **Example:** `Switch(config-wlan)# no shutdown`	Enables the WLAN.
Step 9	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit the global configuration mode.

```
Switch# configure terminal
Switch(config)#wlan ngwc_8021x 2 ngwc_8021x
Switch(config-wlan)# broadcast-ssid
Switch(config-wlan)# no security wpa
Switch(config-wlan)# security dot1x
Switch(config-wlan)# security dot1x authentication-list wcm-rad
Switch(config-wlan)# client vlan 137
Switch(config-wlan)# no shutdown
Switch(config-wlan)# end
```

Related Topics

Creating a Client VLAN, on page 115
Information About IPv6 WLAN Security, on page 98

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
WLAN command reference	*WLAN Command Reference, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)*
WLAN configuration	*WLAN Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)*

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

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

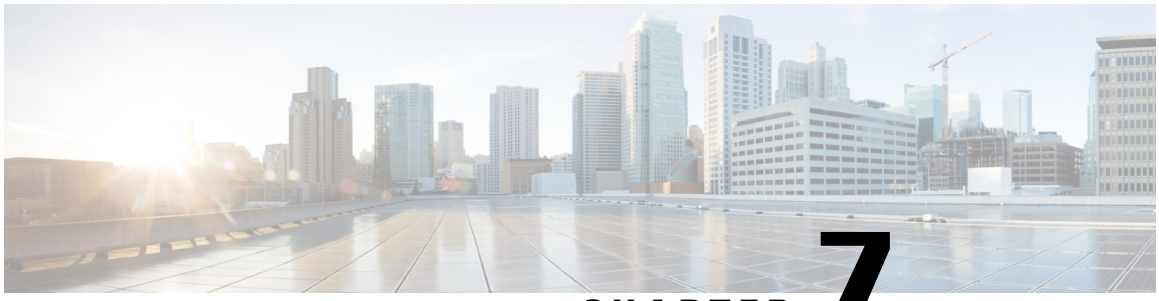
Technical Assistance

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 Information for IPv6 WLAN Security

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 WLAN Security Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 7

Configuring IPv6 ACL

Prerequisites for IPv6 ACL

You can filter IP Version 6 (IPv6) traffic by creating IPv6 access control lists (ACLs) and applying them to interfaces similarly to the way that you create and apply IP Version 4 (IPv4) named ACLs. You can also create and apply input router ACLs to filter Layer 3 management traffic when the switch is running the IP base feature set.

Related Topics

Creating IPv6 ACL, on page 125

Restrictions for IPv6 ACL

With IPv4, you can configure standard and extended numbered IP ACLs, named IP ACLs, and MAC ACLs. IPv6 supports only named ACLs.

The switch supports most of the Cisco IOS-supported IPv6 ACLs with some exceptions:

- The switch does not support matching on these keywords: **flowlabel**, **routing header**, and **undetermined-transport**.

- The switch does not support reflexive ACLs (the **reflect** keyword).
- The switch does not apply MAC-based ACLs on IPv6 frames.
- When configuring an ACL, there is no restriction on keywords entered in the ACL, regardless of whether or not they are supported on the platform. When you apply the ACL to an interface that requires hardware forwarding (physical ports or SVIs), the switch checks to determine whether or not the ACL can be supported on the interface. If not, attaching the ACL is rejected.
- If an ACL is applied to an interface and you attempt to add an access control entry (ACE) with an unsupported keyword, the switch does not allow the ACE to be added to the ACL that is currently attached to the interface

Information About IPv6 ACL

An access control list (ACL) is a set of rules used to limit access to a particular interface (for example, if you want to restrict a wireless client from pinging the management interface of the controller). ACLs are configured on the switchnd applied to the management interface, the AP-manager interface, any of the dynamic interfaces, or a WLAN to control data traffic to and from wireless clients or to the controller central processing unit (CPU) to control all traffic destined for the CPU.

You can also create a preauthentication ACL for web authentication. Such an ACL is used to allow certain types of traffic before authentication is complete.

IPv6 ACLs support the same options as IPv4 ACLs including source, destination, source and destination ports.

Note You can enable only IPv4 traffic in your network by blocking IPv6 traffic. That is, you can configure an IPv6 ACL to deny all IPv6 traffic and apply it on specific or all WLANs.

Understanding IPv6 ACLs

A switch supports two types of IPv6 ACLs:

- IPv6 router ACLs are supported on outbound or inbound traffic on Layer 3 interfaces, which can be routed ports, switch virtual interfaces (SVIs), or Layer 3 EtherChannels. IPv6 router ACLs apply only to IPv6 packets that are routed.
- IPv6 port ACLs are supported on inbound traffic on Layer 2 interfaces only. IPv6 port ACLs are applied to all IPv6 packets entering the interface.

A switch running the IP base feature set supports only input router IPv6 ACLs. It does not support port ACLs or output IPv6 router ACLs.

Note If you configure unsupported IPv6 ACLs, an error message appears and the configuration does not take affect.

The switch does not support VLAN ACLs (VLAN maps) for IPv6 traffic.

You can apply both IPv4 and IPv6 ACLs to an interface. As with IPv4 ACLs, IPv6 port ACLs take precedence over router ACLs:

- When an input router ACL and input port ACL exist in an SVI, packets received on ports to which a port ACL is applied are filtered by the port ACL. Routed IP packets received on other ports are filtered by the router ACL. Other packets are not filtered.
- When an output router ACL and input port ACL exist in an SVI, packets received on the ports to which a port ACL is applied are filtered by the port ACL. Outgoing routed IPv6 packets are filtered by the router ACL. Other packets are not filtered.

Note If any port ACL (IPv4, IPv6, or MAC) is applied to an interface, that port ACL is used to filter packets, and any router ACLs attached to the SVI of the port VLAN are ignored.

Related Topics

Creating IPv6 ACL, on page 125
Applying an IPv6 to an Interface, on page 129
Creating WLAN IPv6 ACL, on page 131
Displaying IPv6 ACLs, on page 131

Types of ACL

Per User IPv6 ACL

For the per-user ACL, the full access control entries (ACE) as the text strings are configured on the ACS.

The ACE is not configured on the Controller. The ACE is sent to the switch in the `ACCESS-Accept` attribute and applies it directly for the client. When a wireless client roams into an foreign switch, the ACEs are sent to the foreign switch as an AAA attribute in the mobility Handoff message.

Filter ID IPv6 ACL

For the filter-Id ACL, the full ACEs and the `acl name(filter-id)` is configured on the switch and only the `filter-id` is configured on the ACS. The `filter-id` is sent to the switch in the ACCESS-Accept attribute, and the switch looks up the filter-id for the ACEs, and then applies the ACEs to the client. When the client L2 roams to the foreign switch, only the filter-id is sent to the foreign switch in the mobility Handoff message. The foreign switch has to configure the filter-id and ACEs beforehand.

Downloadable IPv6 ACL

For the downloadable ACL(dACL), the full ACEs and the `dacl` name are all configured on the ACS only.

Note The controller does not configure any ACL.

The ACS sends the `dacl` name to the switch in its `ACCESS-Accept` attribute, which takes the `dacl` name and sends the `dACL` name back to the ACS, for the ACEs, using the `access-request` attribute.

The ACS responds to the corresponding ACEs of the switch in the `access-accept` attribute. When the wireless client roams to an foreign switch, only the `dacl` name is sent to the foreign switch in the mobility Handoff message. The foreign switch contacts the ACS server with the `dacl` name to retrieve the ACEs.

IPv6 ACLs and Switch Stacks

The stack master supports IPv6 ACLs in hardware and distributes the IPv6 ACLs to the stack members.

Note For full IPv6 functionality in a switch stack, all stack members must be running the IP services feature set.

If a new switch takes over as stack master, it distributes the ACL configuration to all stack members. The member switches sync up the configuration distributed by the new stack master and flush out entries that member switches sync up the configuration distributed by the new stack master and flush out entries that are not required.

When an ACL is modified, attached to, or detached from an interface, the stack master distributes the change to all stack members.

Configuring IPv6 ACLs

To filter IPv6 traffic, you perform these steps:

Before You Begin

Before configuring IPv6 ACLs, you must select one of the dual IPv4 and IPv6 SDM templates.

SUMMARY STEPS

1. Create an IPv6 ACL, and enter IPv6 access list configuration mode.
2. Configure the IPv6 ACL to block (deny) or pass (permit) traffic.
3. Apply the IPv6 ACL to the interface where the traffic needs to be filtered.
4. Apply the IPv6 ACL to an interface. For router ACLs, you must also configure an IPv6 address on the Layer 3 interface to which the ACL is applied.

DETAILED STEPS

	Command or Action	Purpose
Step 1	Create an IPv6 ACL, and enter IPv6 access list configuration mode.	
Step 2	Configure the IPv6 ACL to block (deny) or pass (permit) traffic.	
Step 3	Apply the IPv6 ACL to the interface where the traffic needs to be filtered.	

	Command or Action	Purpose
Step 4	Apply the IPv6 ACL to an interface. For router ACLs, you must also configure an IPv6 address on the Layer 3 interface to which the ACL is applied.	

Default IPv6 ACL Configuration

There are no IPv6 ACLs configured or applied.

Interaction with Other Features and Switches

- If an IPv6 router ACL is configured to deny a packet, the packet is not routed. A copy of the packet is sent to the Internet Control Message Protocol (ICMP) queue to generate an ICMP unreachable message for the frame.
- If a bridged frame is to be dropped due to a port ACL, the frame is not bridged.
- You can create both IPv4 and IPv6 ACLs on a switch or switch stack, and you can apply both IPv4 and IPv6 ACLs to the same interface. Each ACL must have a unique name; an error message appears if you try to use a name that is already configured.

  You use different commands to create IPv4 and IPv6 ACLs and to attach IPv4 or IPv6 ACLs to the same Layer 2 or Layer 3 interface. If you use the wrong command to attach an ACL (for example, an IPv4 command to attach an IPv6 ACL), you receive an error message.

- You cannot use MAC ACLs to filter IPv6 frames. MAC ACLs can only filter non-IP frames.
- If the hardware memory is full, for any additional configured ACLs, packets are dropped to the CPU, and the ACLs are applied in software. When the hardware is full a message is printed to the console indicating the ACL has been unloaded and the packets will be dropped on the interface.

Note Only packets of the same type as the ACL that could not be added (ipv4, ipv6, MAC) will be dropped on the interface.

How To Configure an IPv6 ACL

Creating IPv6 ACL

Beginning in privileged EXEC mode, follow these steps to create an IPv6 ACL:

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 access-list** *acl_name*
3. **{deny|permit} protocol**
4. **{deny|permit} tcp**
5. **{deny|permit} udp**
6. **{deny|permit} icmp**
7. **end**
8. **show ipv6 access-list**
9. **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	**ipv6 access-list** *acl_name* **Example:** `ipv6 access-list access-list-name`	Use a name to define an IPv6 access list and enter IPv6 access-list configuration mode.
Step 3	**{deny|permit} protocol** **Example:** `{deny | permit} protocol {source-ipv6-prefix/prefix-length | any | host source-ipv6-address} [operator [port-number]]{destination-ipv6-prefix/prefix-length | any |host destination-ipv6-address} [operator [port-number]][dscp value] [fragments][log] [log-input] [routing][sequence value] [time-range name]`	Enter deny or permit to specify whether to deny or permit the packet if conditions are matched. These are the conditions: • For protocol, enter the name or number of an Internet protocol: ahp, esp, icmp, ipv6, pcp, stcp, tcp, or udp, or an integer in the range 0 to 255 representing an IPv6 protocol number. • The source-ipv6-prefix/prefix-length or destination-ipv6-prefix/ prefix-length is the source or destination IPv6 network or class of networks for which to set deny or permit conditions, specified in hexadecimal and using 16-bit values between colons (see RFC 2373). • Enter any as an abbreviation for the IPv6 prefix ::/0. • For host source-ipv6-address or destination-ipv6-address, enter the source or destination IPv6 host address for which to set deny or permit conditions, specified in hexadecimal using 16-bit values between colons. • (Optional) For operator, specify an operand that compares the source or destination ports of the specified protocol. Operands are lt (less than), gt (greater than), eq (equal), neq (not equal), and range.

	Command or Action	Purpose
		If the operator follows the source-ipv6-prefix/prefix-length argument, it must match the source port. If the operator follows the destination-ipv6- prefix/prefix-length argument, it must match the destination port. • (Optional) The port-number is a decimal number from 0 to 65535 or the name of a TCP or UDP port. You can use TCP port names only when filtering TCP. You can use UDP port names only when filtering UDP. • (Optional) Enter dscp value to match a differentiated services code point value against the traffic class value in the Traffic Class field of each IPv6 packet header. The acceptable range is from 0 to 63. • (Optional) Enter fragments to check noninitial fragments. This keyword is visible only if the protocol is ipv6. • (Optional) Enter log to cause an logging message to be sent to the console about the packet that matches the entry. Enter log-input to include the input interface in the log entry. Logging is supported only for router ACLs. • (Optional) Enter routing to specify that IPv6 packets be routed. • (Optional) Enter sequence value to specify the sequence number for the access list statement. The acceptable range is from 1 to 4294967295 • (Optional) Enter time-range name to specify the time range that applies to the deny or permit statement.
Step 4	**{deny|permit} tcp** **Example:** `{deny | permit} tcp {source-ipv6-prefix/prefix-length	any	hostsource-ipv6-address} [operator [port-number]]{destination-ipv6-prefix/prefix-length	any |hostdestination-ipv6-address} [operator [port-number]][ack] [dscp value][established] [fin] [log][log-input] [neq {port |protocol}] [psh] [range{port	protocol}] [rst][routing] [sequence value] [syn] [time-range name][urg]`	(Optional) Define a TCP access list and the access conditions. Enter tcp for Transmission Control Protocol. The parameters are the same as those described in Step 3, with these additional optional parameters: • ack—Acknowledgment bit set. • established—An established connection. A match occurs if the TCP datagram has the ACK or RST bits set. • fin—Finished bit set; no more data from sender. • neq {port | protocol}—Matches only packets that are not on a given port number. • psh—Push function bit set. • range {port | protocol}—Matches only packets in the port number range. • rst—Reset bit set.

	Command or Action	Purpose
		• syn—Synchronize bit set. • urg—Urgent pointer bit set.

Step 5	**{deny|permit} udp**
	
	Example:
	`{deny | permit} udp {source-ipv6-prefix/prefix-length | any | hostsource-ipv6-address} [operator [port-number]]{destination-ipv6-prefix/prefix-length | any | hostdestination-ipv6-address} [operator [port-number]][dscp value] [log][log-input]`
	
	`[neq {port |protocol}] [range {port |protocol}] [routing][sequence value][time-range name]`
		(Optional) Define a UDP access list and the access conditions.
		
		Enter udp for the User Datagram Protocol. The UDP parameters are the same as those described for TCP, except that the operator [port]] port number or name must be a UDP port number or name, and the established parameter is not valid for UDP.

Step 6	**{deny|permit} icmp** **Example:** `{deny | permit} icmp {source-ipv6-prefix/prefix-length | any | hostsource-ipv6-address} [operator [port-number]] {destination-ipv6-prefix/prefix-length | any | hostdestination-ipv6-address} [operator [port-number]][icmp-type [icmp-code] |icmp-message] [dscpvalue] [log] [log-input] [routing] [sequence value][time-range name]`	(Optional) Define an ICMP access list and the access conditions. Enter icmp for Internet Control Message Protocol. The ICMP parameters are the same as those described for most IP protocols in Step 3a, with the addition of the ICMP message type and code parameters. These optional keywords have these meanings: • icmp-type—Enter to filter by ICMP message type, a number from 0 to 255. • icmp-code—Enter to filter ICMP packets that are filtered by the ICMP message code type, a number from 0 to 255. • icmp-message—Enter to filter ICMP packets by the ICMP message type name or the ICMP message type and code name. To see a list of ICMP message type names and code names, use the ? key or see command reference for this release.
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 8	**show ipv6 access-list** **Example:** `show ipv6 access-list`	Verify the access list configuration.
Step 9	**copy running-config startup-config** **Example:** `copy running-config startup-config`	(Optional) Save your entries in the configuration file.

Related Topics

Prerequisites for IPv6 ACL, on page 121
Understanding IPv6 ACLs, on page 122
Applying an IPv6 to an Interface, on page 129
Creating WLAN IPv6 ACL, on page 131
Displaying IPv6 ACLs, on page 131

Applying an IPv6 to an Interface

This section describes how to apply IPv6 ACLs to network interfaces. You can apply an IPv6 ACL to outbound or inbound traffic on layer 2 and Layer 3 interfaces. You can apply IPv6 ACLs only to inbound management traffic on Layer 3 interfaces.

Beginning in privileged EXEC mode, follow these steps to control access to an interface:

SUMMARY STEPS

1. **configure terminal**
2. **interface** interface_id
3. **no switchport**
4. **ipv6 address** *ipv6_address*
5. **ipv6 traffic-filter** *acl_name*
6. **end**
7. **show running-config interface tenGigabitEthernet 1/0/3**
8. **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	**interface** interface_id **Example:** `Switch# interface interface-id`	Identifies a Layer 2 interface (for port ACLs) or Layer 3 Switch Virtual interface (for router ACLs) on which to apply an access list, and enters interface configuration mode.
Step 3	**no switchport** **Example:** `Switch# no switchport`	Changes the interface from Layer 2 mode (the default) to Layer 3 mode (only if applying a router ACL).

	Command or Action	Purpose
Step 4	**ipv6 address** *ipv6_address* **Example:** `Switch# ipv6 address ipv6-address`	Configures an IPv6 address on a Layer 3 interface (for router ACLs). **Note** This command is not required on Layer 2 interfaces or if the interface has already been configured with an explicit IPv6 address.
Step 5	**ipv6 traffic-filter** *acl_name* **Example:** `Switch# ipv6 traffic-filter access-list-name {in | out}`	Applies the access list to incoming or outgoing traffic on the interface.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Step 7	**show running-config interface tenGigabitEthernet 1/0/3**
	
	Example:
	`Switch# show running-config interface tenGigabitEthernet 1/0/3`
	`.....`
	`.....`
	`Building configuration .....`
	`.....`
	`Current configuration : 98 bytes`
	`!`
	`interface TenGigabitEthernet1/0/3`
	` switchport mode trunk`
	` ipv6 traffic-filter MyFilter out`
	`end`
		Shows the configuration summary.

Step 8	**copy running-config startup-config** **Example:** `copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Creating IPv6 ACL, on page 125
Understanding IPv6 ACLs, on page 122
Creating WLAN IPv6 ACL, on page 131
Displaying IPv6 ACLs, on page 131

Creating WLAN IPv6 ACL

SUMMARY STEPS

1. **ipv6 traffic-filter acl** *acl_name*
2. **ipv6 traffic-filter acl web**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ipv6 traffic-filter acl** *acl_name* **Example:** `Switch(config-wlan)# ipv6 traffic-filter acl <acl_name>`	Creates a named WLAN ACL.
Step 2	**ipv6 traffic-filter acl web** **Example:** `Switch(config-wlan)# ipv6 traffic-filter acl web <acl_name-preauth>`	Creates a pre-authentication for WLAN ACL.

```
Switch(config-wlan)# ipv6 traffic-filter acl <acl_name>
Switch(config-wlan)#ipv6 traffic-filter acl web <acl_name-preauth>
```

Related Topics

Creating IPv6 ACL, on page 125
Applying an IPv6 to an Interface, on page 129
Understanding IPv6 ACLs, on page 122
Displaying IPv6 ACLs, on page 131

Verifying IPv6 ACL

Displaying IPv6 ACLs

You can display information about all configured access lists, all IPv6 access lists, or a specific access list by using one or more of the privileged EXEC commands.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show access-list** **Example:** `Switch# show access-lists`	Displays all access lists configured on the switch
Step 2	**show ipv6 access-list** *acl_name* **Example:** `Switch# show ipv6 access-list [access-list-name]`	Displays all configured IPv6 access list or the access list specified by name.

Related Topics

Creating IPv6 ACL, on page 125
Applying an IPv6 to an Interface, on page 129
Creating WLAN IPv6 ACL, on page 131
Understanding IPv6 ACLs, on page 122

Configuration Examples for IPv6 ACL

Example: Creating IPv6 ACL

This example configures the IPv6 access list named CISCO. The first deny entry in the list denies all packets that have a destination TCP port number greater than 5000. The second deny entry denies packets that have a source UDP port number less than 5000. The second deny also logs all matches to the console. The first permit entry in the list permits all ICMP packets. The second permit entry in the list permits all other traffic. The second permit entry is necessary because an implicit deny -all condition is at the end of each IPv6 access list.

Note Logging is supported only on Layer 3 interfaces.

```
Switch(config)# ipv6 access-list CISCO
Switch(config-ipv6-acl)# deny tcp any any gt 5000
Switch (config-ipv6-acl)# deny ::/0 lt 5000 ::/0 log
Switch(config-ipv6-acl)# permit icmp any any
Switch(config-ipv6-acl)# permit any any
```

Example: Applying IPv6 ACLs

This example shows how to apply the access list Cisco to outbound traffic on a Layer 3 interface.

```
Switch(config-if)# no switchport
Switch(config-if)# ipv6 address 2001::/64 eui-64
Switch(config-if)# ipv6 traffic-filter CISCO out
```

Example: Displaying IPv6 ACLs

This is an example of the output from the **show access-lists** privileged EXEC command. The output shows all access lists that are configured on the switch or switch stack.

```
Switch #show access-lists
Extended IP access list hello
10 permit ip any any
IPv6 access list ipv6
permit ipv6 any any sequence 10
```

This is an example of the output from the show ipv6 access-lists privileged EXEC command. The output shows only IPv6 access lists configured on the switch or switch stack.

```
Switch# show ipv6 access-list
IPv6 access list inbound
permit tcp any any eq bgp (8 matches) sequence 10
permit tcp any any eq telnet (15 matches) sequence 20
permit udp any any sequence 30

IPv6 access list outbound
deny udp any any sequence 10
deny tcp any any eq telnet sequence 20
```

Example: Configuring RA Throttling and NS Suppression

This task describes how to create an RA throttle policy in order to help the power-saving wireless clients from being disturbed by frequent unsolicited periodic RA's. The unsolicited multicast RA is throttled by the controller.

Before You Begin

Enable IPv6 on the client machine.

SUMMARY STEPS

1. **configure terminal**
2. **ipv6 nd ra-throttler policy** Mythrottle
3. **throttle-period** 20
4. **max-through** 5
5. **allow at-least** 3 **at-most** 5
6. **switch (config)# vlan configuration 100**
7. **ipv6 nd suppress**
8. **ipv6 nd ra-th attach-policy** attach-policy_name
9. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**ipv6 nd ra-throttler policy** Mythrottle **Example:** `Switch (config)# ipv6 nd ra-throttler policy Mythrottle`	Creates a RA throttler policy called Mythrottle.
Step 3	**throttle-period** 20 **Example:** `Switch (config-nd-ra-throttle)# throttle-period 20`	Determines the time interval segment during which throttling applies.
Step 4	**max-through** 5 **Example:** `Switch (config-nd-ra-throttle)# max-through 5`	Determines how many initial RA's are allowed.
Step 5	**allow at-least** 3 **at-most** 5 **Example:** `Switch (config-nd-ra-throttle)# allow at-least 3 at-most 5`	Determines how many RA's are allowed after the initial RAs have been transmitted, until the end of the interval segment.
Step 6	**switch (config)# vlan configuration 100** **Example:** `Switch (config)# vlan configuration 100`	Creates a per vlan configuration.
Step 7	**ipv6 nd suppress** **Example:** `Switch (config)# ipv6 nd suppress`	Disables the neighbor discovery on the Vlan.
Step 8	**ipv6 nd ra-th attach-policy** attach-policy_name **Example:** `Switch (config)# ipv6 nd ra-throttle attach-policy attach-policy_name`	Enables the router advertisement throttling.
Step 9	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Example: Configuring RA Guard Policy

SUMMARY STEPS

1. **ipv6 nd raguard policy** MyPloicy
2. **trusted-port**
3. **device-role router**
4. **interface tenGigabitEthernet** 1/0/1
5. **ipv6 nd raguard attach-policy**MyPolicy
6. **vlan configuration** 19-21,23
7. **ipv6 nd suppress**
8. **ipv6 snooping**
9. **ipv6 nd raguard attach-policy** MyPolicy
10. **ipv6 nd ra-throttler attach-policy** Mythrottle

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ipv6 nd raguard policy** MyPloicy **Example:** `Switch (config)# ipv6 nd raguard policy MyPolicy`	
Step 2	**trusted-port** **Example:** `Switch (config-nd-raguard)# trusted-port`	Configures the trusted port for the policy created above.

Step 3	**device-role router**
	
	Example:
	`Switch (config-nd-raguard)# device-role [host|monitor|router|switch]`
	`Switch (config-nd-raguard)# device-role router`
		Defines the trusted device that can send RAs to the trusted port created above.

Step 4	**interface tenGigabitEthernet** 1/0/1 **Example:** `Switch (config)# interface tenGigabitEthernet 1/0/1`	Configures the interface to the trusted device.
Step 5	**ipv6 nd raguard attach-policy**MyPolicy **Example:** `Switch (config-if)# ipv6 nd raguard attach-policy Mypolicy`	Configures and attaches the policy to trust the RA's received from the port.

	Command or Action	Purpose
Step 6	**vlan configuration** 19-21,23 **Example:** `Switch (config)# vlan configuration 19-21,23`	Configures the wireless client vlans.
Step 7	**ipv6 nd suppress** **Example:** `Switch (config-vlan-config)# ipv6 nd suppress`	Suppresses the ND messages over wireless.
Step 8	**ipv6 snooping** **Example:** `Switch (config-vlan-config)# ipv6 snooping`	Captures IPv6 traffic.
Step 9	**ipv6 nd raguard attach-policy** MyPolicy **Example:** `Switch (config-vlan-config)# ipv6 nd raguard attach-policy Mypolicy`	Attaches the RA Guard policy to the wireless client vlans.
Step 10	**ipv6 nd ra-throttler attach-policy** Mythrottle **Example:** `Switch (config-vlan-config)#ipv6 nd ra-throttler attach-policy Mythrottle`	Attaches the RA throttling policy to the wireless client vlans.

Example: Configuring IPv6 Neighbor Binding

SUMMARY STEPS

1. **ipv6 neighbor binding** [vlan]19 2001:db8::25:4 **interface tenGigabitEthernet** 1/0/3 aaa.bbb.ccc

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ipv6 neighbor binding** [vlan]19 2001:db8::25:4 **interface tenGigabitEthernet** 1/0/3 aaa.bbb.ccc **Example:** `Switch (config)# ipv6 neighbor binding vlan 19 2001:db8::25:4 interface tenGigabitEthernet 1/0/3 aaa.bbb.ccc`	Sets and validates the neighbor 2001:db8::25: 4 only valid when transmitting on VLAN 19 through interface te1/0/3 with the source mac-address as aaa.bbb.ccc.

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
ACL configuration	*Security Configuration Guide (Catalyst 3650 Switches)*

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

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

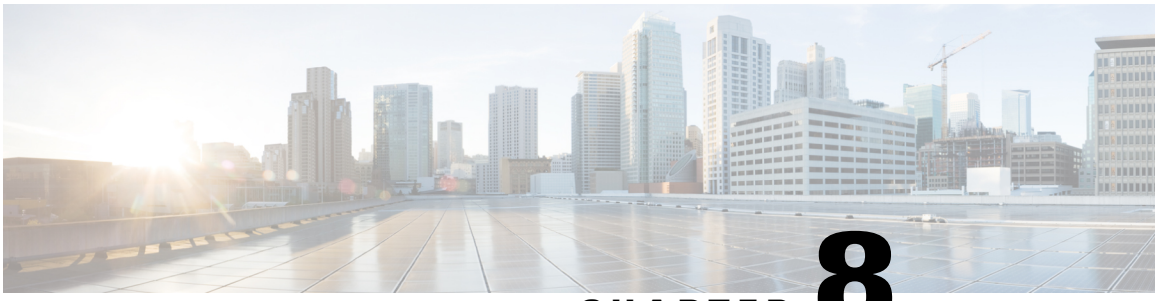
Technical Assistance

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 Information for IPv6 ACLs

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 ACL Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 8

Configuring IPv6 Web Authentication

Prerequisites for IPv6 Web Authentication

The following configurations must be in place before you start with IPv6 Web Authentication:

- IPv6 Device Tracking.
- IPv6 DHCP Snooping.
- Disable security of type 802.1x on the wlan.
- Each WLAN must have a vlan associated to it.
- Change the default wlan setting from **shutdown** to **no shutdown**.

Related Topics

Enabling Security on the WLAN, on page 142

Restrictions for IPv6 Web Authentication

The following restrictions are implied when using IPv6 web authentication:

Related Topics

Enabling Security on the WLAN, on page 142

Information About IPv6 Web Authentication

Web authentication is a Layer 3 security feature and the switch disallows IP traffic (except DHCP and DNS -related packets) from a particular client until it supplies a valid username and password. It is a simple authentication method without the need for a supplicant or client utility. Web authentication is typically used by customers who deploy a guest-access network. Traffic from both, HTTP and HTTPS, page is allowed to display the login page.

Note Web authentication does not provide data encryption and is typically used as simple guest access for either a hot spot or campus atmosphere, where connectivity is always a factor.

A WLAN is configured as **security webauth** for web based authentication. The switch supports the following types of web based authentication:

- Web Authentication – The client enters the credentials in a web page which is then validated by the Wlan controller.
- Web Consent – The Wlan controller presents a policy page with Accept/Deny buttons. Click Accept button to access the network.

A Wlan is typically configured for open authentication, that is without Layer 2 authentication, when web-based authentication mechanism is used.

Web Authentication Process

The following events occur when a WLAN is configured for web authentication:

- The user opens a web browser and enters a URL address, for example, *http://www.example.com*. The client sends out a DNS request for this URL to get the IP address for the destination. The switch bypasses the DNS request to the DNS server, which in turn responds with a DNS reply that contains the IP address of the destination *www.example.com*. This, in turn, is forwarded to the wireless clients.
- The client then tries to open a TCP connection with the destination IP address. It sends out a TCP SYN packet destined to the IP address of *www.example.com*.
- The switch has rules configured for the client and cannot act as a proxy for *www.example.com*. It sends back a TCP SYN-ACK packet to the client with source as the IP address of *www.example.com*. The client sends back a TCP ACK packet in order to complete the three-way TCP handshake and the TCP connection is fully established.
- The client sends an HTTP GET packet destined to *www.example.com*. The switch intercepts this packet and sends it for redirection handling. The HTTP application gateway prepares an HTML body and sends it back as the reply to the HTTP GET requested by the client. This HTML makes the client go to the default web-page of the switch, for example, *http://<Virtual-Server-IP>/login.html*.
- The client closes the TCP connection with the IP address, for example, *www.example.com*.
- If the client wants to go to virtual IP, the client tries to open a TCP connection with the virtual IP address of the switch. It sends a TCP SYN packet for virtual IP to the switch.
- The switch responds back with a TCP SYN-ACK and the client sends back a TCP ACK to the switch in order to complete the handshake.

- The client sends an HTTP GET for */login.html* destined to virtual IP in order to request for the login page.
- This request is allowed to the web server of the switch, and the server responds with the default login page. The client receives the login page in the browser window where the user can log in.

Related Topics

Disabling WPA, on page 141
Enabling Security on the WLAN, on page 142
Enabling a Parameter Map on the WLAN, on page 143
Enabling Authentication List on WLAN, on page 143
Configuring a Global WebAuth WLAN Parameter Map, on page 144
Configuring the WLAN, on page 145
Enabling IPv6 in Global Configuration Mode, on page 146
Verifying the Parameter Map, on page 147
Verifying Authentication List, on page 147

How to Configure IPv6 Web Authentication

Disabling WPA

Before You Begin

Disable 802.1x. A typical web authentication does not use Layer 2 security. Use this configuration to remove Layer 2 security.

SUMMARY STEPS

1. **configure terminal**
2. **wlan** test1 2 test1
3. **no security** wpa

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**wlan** test1 2 test1 **Example:** `Switch(config)# wlan test1 2 test1`	Creates a WLAN and assign an SSID to it.

	Command or Action	Purpose
Step 3	**no security** wpa **Example:** `Switch(config-wlan)# no security wpa`	Disables the WPA support for Wlan.

What to Do Next

Enable the following:

- Security Web Authentication.
- Parameter Local.
- Authentication List.

Related Topics

Web Authentication Process, on page 140

Enabling Security on the WLAN

SUMMARY STEPS

1. **parameter-map type web-auth global**
2. **virtual-ip ipv4** 192.0.2.1
3. **virtual-ip ipv6** 2001:db8::24:2

DETAILED STEPS

	Command or Action	Purpose
Step 1	**parameter-map type web-auth global** **Example:** `Switch(config)# parameter-map type web-auth global`	Applies the parameter map to all the web-auth wlans.
Step 2	**virtual-ip ipv4** 192.0.2.1 **Example:** `Switch(config-params-parameter-map)# virtual-ip ipv4 192.0.2.1`	Defines the virtual gateway IPv4 address.
Step 3	**virtual-ip ipv6** 2001:db8::24:2 **Example:** `Switch(config-params-parameter-map)# virtual-ip ipv6 2001:db8::24:2`	Defines the virtual gateway IPv6 address.

Related Topics

Prerequisites for IPv6 Web Authentication, on page 139
Restrictions for IPv6 Web Authentication, on page 139
Web Authentication Process, on page 140

Enabling a Parameter Map on the WLAN

SUMMARY STEPS

1. **security web-auth parameter-map** <mapname>

DETAILED STEPS

	Command or Action	Purpose
Step 1	**security web-auth parameter-map** <mapname> **Example:** `Switch(config-wlan)# security web-auth parameter-map webparalocal`	Enables web authentication for the wlan and creates a parameter map.

Related Topics

Web Authentication Process, on page 140

Enabling Authentication List on WLAN

SUMMARY STEPS

1. **security web-auth authentication-list** webauthlistlocal

DETAILED STEPS

	Command or Action	Purpose
Step 1	**security web-auth authentication-list** webauthlistlocal **Example:** `Switch(config-wlan)# security web-auth`	Enables web authentication for the wlan and creates a local web authentication list.

Related Topics

Web Authentication Process, on page 140

Configuring a Global WebAuth WLAN Parameter Map

Use this example to configure a global web auth WLAN and add a parameter map to it.

SUMMARY STEPS

1. **parameter-map type webauth global**
2. **virtual-ip ipv6** 2001:db8:4::1
3. **ratelimit init-state-sessions** 120
4. **max-https-conns** 70

DETAILED STEPS

	Command or Action	Purpose
Step 1	**parameter-map type webauth global** **Example:** `Switch (config)# parameter-map type webauth global`	Configures a global webauth and adds a parameter map to it.
Step 2	**virtual-ip ipv6** 2001:db8:4::1 **Example:** `Switch (config-params-parameter-map)# virtual-ip ipv6 2001:db8:4::1`	Defines a virtual gateway IP address that appears to the wireless clients for authentication.
Step 3	**ratelimit init-state-sessions** 120 **Example:** `Switch (config-params-parameter-map)# ratelimit init-state-sessions 120`	Sets the global ratelimit to limit the bandwidth that the web clients can use on the switch to avoid over-flooding attacks.
Step 4	**max-https-conns** 70 **Example:** `Switch (config-params-parameter-map)# max-http-conns 70`	Sets the maximum number of attempted http connections on the switch to avoid over-flooding atatcks.

Related Topics

Web Authentication Process, on page 140
Configuring the WLAN, on page 145

Configuring the WLAN

Before You Begin

- The WLAN must have a Vlan associated with it. By default, a new Wlan is always associated with Vlan 1, which can be changed as per the configuration requirements.
- Configure and enable the WLAN to *no shutdown*. By default, the Wlan is configured with the *shutdown* parameter and is disabled.

SUMMARY STEPS

1. **wlan** *1*
2. **client vlan** *interface ID*
3. **security web-auth authentication list** webauthlistlocal
4. **security web-auth parameter-map** global
5. **no security wpa**
6. **no shutdown**
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**wlan** *1* **Example:** `Switch(config-wlan)# wlan 1 name vicweb ssid vicweb`	Creates a wlan and assign an SSID to it.
Step 2	**client vlan** *interface ID* **Example:** `Switch(config-wlan)# client vlan VLAN0136`	Assigns the client to vlan interface.
Step 3	**security web-auth authentication list** webauthlistlocal **Example:** `Switch(config-wlan)# security web-auth authentication-list webauthlistlocal`	Configures web authentication for the wlan.
Step 4	**security web-auth parameter-map** global **Example:** `Switch(config-wlan)# security web-auth parameter-map global`	Configures the parameter map on the wlan.
Step 5	**no security wpa** **Example:** `Switch(config-wlan)# no security wpa`	Configures the security policy for a wlan. This enables the wlan.

	Command or Action	Purpose
Step 6	**no shutdown** **Example:** `Switch(config-wlan)# no shutdown`	Configures and enables the Wlan.
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Configuring a Global WebAuth WLAN Parameter Map, on page 144
Web Authentication Process, on page 140
Enabling IPv6 in Global Configuration Mode, on page 146

Enabling IPv6 in Global Configuration Mode

Enable IPv6 in global configuration for web authentication.

SUMMARY STEPS

1. **configure terminal**
2. **web-auth global**
3. **virtual IPv6**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**web-auth global** **Example:** `Switch(config)# parameter-map type webauth global`	Globally configures the parameter map type as web authentication.
Step 3	**virtual IPv6** **Example:** `Switch(config-params-parameter-map)# virtual-ip ipv6`	Selects IPv6 as the virtaul IP for web authentication. **Note** You can also select IPv4 as the preferred IP for web authentication.

Related Topics

Configuring the WLAN, on page 145
Web Authentication Process, on page 140
Verifying the Parameter Map, on page 147

Verifying IPv6 Web Authentication

Verifying the Parameter Map

Use the **show running configuration** command to verify the parameter map configured for Wlan.

SUMMARY STEPS

1. **show running config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show running config** **Example:** `Switchshow running config`	Displays the entire running configuration for the switch. Grep for parameter map to view the result.

```
wlan alpha 2 alpha
 no security wpa
 no security wpa akm dot1x
 no security wpa wpa2
 no security wpa wpa2 ciphers aes
 security web-auth
 security web-auth authentication-list webauthlistlocal
 security web-auth parameter-map webparalocal
```

Related Topics

Enabling IPv6 in Global Configuration Mode, on page 146
Web Authentication Process, on page 140
Verifying Authentication List, on page 147

Verifying Authentication List

Use the **show running configuration** command to verify the authentication list configured for the Wlan.

SUMMARY STEPS

1. **show running configuration**
2. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show running configuration** **Example:** `Switch#show running-config`	Displays the Wlan configuration. `Switch# show running-config`
Step 2	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch#show running-config
 ..................................
 ..................................
 ..................................
 wlan alpha 2 alpha
 no security wpa
 no security wpa akm dot1x
 no security wpa wpa2
 no security wpa wpa2 ciphers aes
 security web-auth
 security web-auth authentication-list webauthlistlocal
 security web-auth parameter-map webparalocal
 ..................................
 ..................................
 ..................................
```

Related Topics

Verifying the Parameter Map, on page 147
Web Authentication Process, on page 140

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
Web Authentication configuration	*Security Configuration Guide (Catalyst 3650 Switches)*

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

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

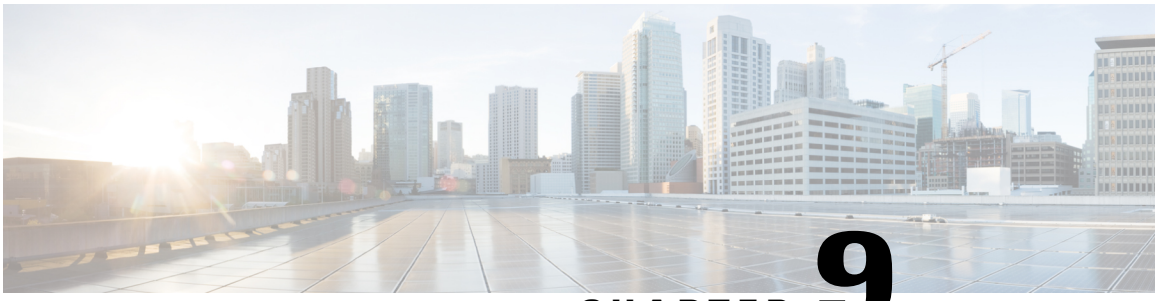
Technical Assistance

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 Information for IPv6 Web Authentication

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 Web Authentication Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 9

Configuring IPv6 Client Mobility

Prerequisites for IPv6 Client Mobility

To enable wireless IPv6 client connectivity, the underlying wired network must support IPv6 routing and an address assignment mechanism such as SLAAC or DHCPv6. The switch must have L2 adjacency to the IPv6 router, and the VLAN needs to be tagged when the packets enter the switch. APs do not require connectivity on an IPv6 network, as all traffic is encapsulated inside the IPv4 CAPWAP tunnel between the AP and switch.

Restrictions For IPv6 Client Mobility

- When using the IPv6 Client Mobility, clients must support IPv6 with either static stateless auto configuration (such as Windows XP clients) or stateful DHCPv6 IP addressing (such as Windows 7 clients).

- To allow smooth operation of stateful DHCPv6 IP addressing, you must have a switch or router that supports the DHCP for IPv6 feature (such as the switch) that is configured to act like a DHCPv6 server, or you need a dedicated server such as a Windows 2008 server with a built-in DHCPv6 server. Cisco Catalyst 3850 switch and Cisco Catalyst 5700 switch can act as (internal) a DHCPv6 server.

Note To load the SDM IPv6 template in the Cisco Catalyst 3850 switch, enter the **sdm prefer dual-ipv4** and **v6** default command and then reset the switch.

Information About IPv6 Client Mobility

The Switch supports IPv6 mobility for IPv6-only or dual-stack nodes. The IPv6 Client Mobility is divided into:

- Link Layer and
- Network Layer

The link layer is handled by the 802.11 protocol which enables the client to roam to any AP in the same BSS (basic service set) identified by the same SSID without losing the link layer connectivity.

However, link layer mobility is not enough to make wireless client Layer 3 applications continue to work seamlessly while roaming. Cisco IOSd's wireless mobility module uses mobility tunneling to retain seamless connectivity for the client's Layer 3 PoP (point of presence) when the client roams across different subnets on different switches.

IPv6 is the next-generation network layer Internet protocol intended to replace IPv4 in the TCP/IP suite of protocols. This new version increases the internet global address space to accommodate users and applications that require unique global IP addresses. IPv6 incorporates 128-bit source and destination addresses, which provide significantly more addresses than the 32-bit IPv4 addresses.

To support IPv6 clients across controllers, ICMPv6 messages must be dealt with specially to ensure the IPv6 client remains on the same Layer 3 network. The switch keep track of IPv6 clients by intercepting the ICMPv6 messages to provide seamless mobility and protect the network from network attacks. The NDP (neighbor discovery packets) packets are converted from multicast to unicast and delivered individually per client. This unique solution ensures that Neighbor Discovery and Router Advertisement packets are not leaked across Vlans. Clients can receive specific Neighbor Discovery and Router Advertisement packets ensuring correct IPv6 addressing and avoids unnecessary multicast traffic.

The configuration for IPv6 mobility is the same as IPv4 mobility and requires no separate software on the client side to achieve seamless roaming. The switch must be part of the same mobility group. Both IPv4 and IPv6 client mobility are enabled by default.

IPv6 client mobility is used for the following:

- Retaining the client IPv6 multiple addresses in Layer-2 and Layer-3 roaming.
- IPv6 Neighbor Discovery Prootcol (NDP) packet management.
- Client IPv6 addresses learning.

Using Router Advertisment

The Neighbor Discovery Protocol(NDP) operates in the link-layer and is responsible for the discovery of other nodes on the link. It determines the link-layer addresses of other nodes, finds the available routers, and maintains reachability information about the paths to other active neighbor nodes.

Router Advertisement (RA) is one of the IPv6 Neighbor Discovery Protocol (NDP) packets that is used by the hosts to discover available routers, acquire the network prefix to generate the IPv6 addresses, link MTU, and so on. The routers send RA on a regular basis, or in response to hosts Router Solicitation messages.

IPv6 wireless client mobility manages the IPv6 RA packet . The converged access switch forwards the link-local all-nodes multicast RA packets to the local and roaming wireless nodes mapped on same VLAN the RA was received on.

Figure 1 illustrates the link-local all-nodes mcast RA forwarding issue in the wireless node mobility.

Figure 4: Roaming Client Receiving Invalid RA from Router 2

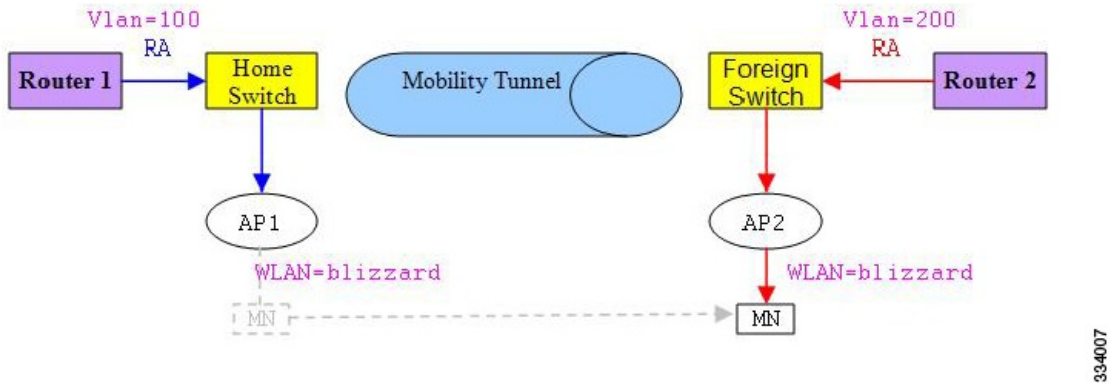
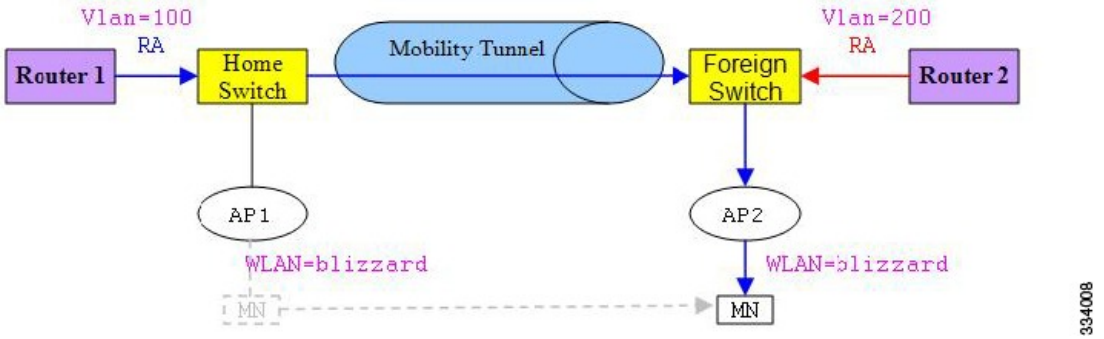


Figure 2 illustrates how a roaming client “MN” receives RA from VLAN 200 in a foreign switch and how it acquires an new IP address and breaks into L3 mobility's point of presence.

Figure 5: Roaming Client Receives Valid RA from Router 1



Related Topics

Verifying IPv6 Client Mobility, on page 155
Monitoring IPv6 Client Mobility, on page 156

RA Throttling and NS suppression

To safeguard the power-saving wireless clients form being disturbed by frequent unsolicited periodic RAs, the controller can throttle the unsolicited multicast RA.

Related Topics

Verifying IPv6 Client Mobility, on page 155
Monitoring IPv6 Client Mobility, on page 156

IPv6 Address Learning

There are three ways for IPv6 client to acquire IPv6 addresses:

- Stateless Address Auto-Configuration (SLAAC)
- Stateful DHCPv6
- Static configuration

For these methods, the IPv6 client always sends NS DAD (duplicate address detection) to ensure that there is no duplicated IP address on the network. The switch snoops the clients NDP and DHCPv6 packets to learn about its client IP addresses and then updates the controllers database. The database then informs the controller for the clients new IP address.

Related Topics

Verifying IPv6 Client Mobility, on page 155
Monitoring IPv6 Client Mobility, on page 156

Handling Multiple IP Addresses

In the case when the new IP address is received after RUN state, whether an addition or removal, the controller updates the new IP addresses on its local database for display purposes. Essentially, the IPv6 uses the existing or same PEM state machine code flow as in IPv4. When the IP addresses are requested by external entities, for example, from Prime Infrastructure, the controller will include all the available IP addresses, IPv4 and IPv6, in the API/SPI interface to the external entities.

An IPv6 client can acquire multiple IP addresses from stack for different purposes. For example, a link-local address for link local traffic, and a routable unique local or global address.

When the client is in the DHCP request state and the controller receives the first IP address notification from the database for either an IPv4 or IPv6 address, the PEM moves the client into the RUN state.

When a new IP address is received after the RUN state, either for addition or removal, the controller updates the new IP addresses on its local database for display purposes.

When the IP addresses are requested by external entities, for example, from Prime Infrastructure, the controller provides the available IP addresses, both IPv4 and IPv6, to the external entities.

Related Topics

Verifying IPv6 Client Mobility, on page 155

Monitoring IPv6 Client Mobility, on page 156

IPv6 Configuration

The switch supports IPv6 client as seamlessly as the IPv4 clients. The administrator must manually configure the Vlans to enable the IPV6, IPv6's snooping and throttling functionality. This will enable the NDP packets to throttle between the switch and its various clients

Related Topics

Verifying IPv6 Client Mobility, on page 155
Monitoring IPv6 Client Mobility, on page 156

High Availability

The switch will sync with the wireless clients when the clients IP address is hard to learn. When a switchover happens, the IPv6 neighbor binding table is synced to standby state. However, the wireless client will itself disassociate and reassociate to a new active state once the switchover is complete and the neighbor binding table is updated with latest information for that client.

If, during the reassociation, the client moves to another AP then the original entry in the binding table is marked as down for sometime and will be aged-out.

For the new entries joining the switch from another AP, the new IP address is learned and notified to the controller's database.

Note This feature is available only for the Cisco Catalyst 3850 Switch.

Related Topics

Verifying IPv6 Client Mobility, on page 155
Monitoring IPv6 Client Mobility, on page 156

Verifying IPv6 Client Mobility

The commands listed in the Table 1 applies to the IPv6 client mobility.

Table 9: Commands for Verifying IPv6 Client Mobility on Cisco 5760 WLC

Command	Description
debug mobility ipv6	Enables all the wireless client IPv6 mobility debugs.
debug **client** **mac-address** (mac-addr)	Displays wireless client debugging. Enter a MAC address for debugging information.

Related Topics

Using Router Advertisment, on page 152
RA Throttling and NS suppression, on page 154
IPv6 Address Learning, on page 154
Handling Multiple IP Addresses, on page 154
IPv6 Configuration, on page 155
Monitoring IPv6 Client Mobility, on page 156
High Availability, on page 155

Monitoring IPv6 Client Mobility

The commands in Table 2 are used to monitor IPv6 Client mobility on the switch.

Table 10: Monitoring IPv6 Client Mobility Commands

Commands	Description
show wireless client summary	Displays the wireless specific configuration of active clients.
show wireless client mac-address (mac-addr)	Displays the wireless specific configuration of active clients based on their MAC address.

Related Topics

Verifying IPv6 Client Mobility, on page 155
Using Router Advertisment, on page 152
RA Throttling and NS suppression, on page 154
IPv6 Address Learning, on page 154
Handling Multiple IP Addresses, on page 154
IPv6 Configuration, on page 155
High Availability, on page 155

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
Mobility configuration	*Mobility Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)*

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

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

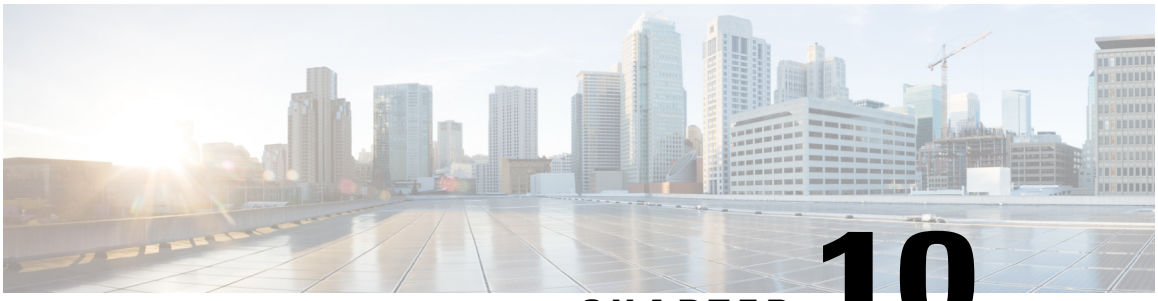
Technical Assistance

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 Information For IPv6 Client Mobility

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 Client Mobility Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 10

Configuring IPv6 Mobility

Pre-requisites for IPv6 Mobility

The mobility and its related infrastructure must be configured and ready for use.

Information About IPv6 Mobility

Mobility, or roaming, is a wireless LAN client's ability to maintain its association seamlessly from one access point to another securely and with as little latency as possible. This section explains how mobility works whenswitch are included in a wireless network.

When a wireless client associates and authenticates to an access point, the access point's switch places an entry for that client in its client database. This entry includes the client's MAC and IP addresses, security context and associations, quality of service (QoS) contexts, the WLAN, and the associated access point. The switch uses this information to forward frames and manage traffic to and from the wireless client.

When the wireless client moves its association from one access point to another, the switch simply updates the client database with the newly associated access point. If necessary, new security context and associations are established as well. The process becomes more complicated, however, when a client roams from an access point joined to one switch to an access point joined to a different switch. It also varies based on whether theswitch are operating on the same subnet.

Inter Controller Roaming

When the client associates to an access point joined to a new switch, the new switch exchanges mobility messages with the original switch, and the client database entry is moved to the new switch if sticky anchoring is disabled.

Related Topics

Monitoring IPv6 Mobility, on page 160

Intra Subnet Roaming with Sticky Anchoring, and Inter Subnet Roaming

Inter-subnet roaming is similar to inter-controller roaming in that the switch exchange mobility messages on the client roam. However, instead of moving the client database entry to the new switch, the original switch marks the client with an "Anchor" entry in its own client database. The database entry is copied to the new switch client database and marked with a "Foreign" entry in the new switch. The roam remains transparent to the wireless client, and the client maintains its original IP address.

In inter-subnet roaming, WLANs on both anchor and foreign switch need to have the same network access privileges and no source-based routing or source-based firewalls in place. Otherwise, the clients may have network connectivity issues after the handoff.

For more information on configuring mobility see, the Cisco 5700 Wireless LAN Controller Mobility Configuration Guide, Cisco IOS XE, Release 3.2SE.

Related Topics

Monitoring IPv6 Mobility, on page 160

How to Configure IPv6 Mobility

Monitoring IPv6 Mobility

This chapter displays the mobility related IPv6 configuration. To see the mobility related configurations refer to the Cisco 5700 Wireless LAN Controller Mobility Configuration Guide, Cisco IOS XE 3.2SE.

SUMMARY STEPS

1. **show ipv6 neighbors binding mac** C0C1.C06B.C4E2

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ipv6 neighbors binding mac** C0C1.C06B.C4E2 **Example:** `Switch# show ipv6 neighbors binding mac C0C1.C06B.C4E2`	Displays the IPv6 related mobility configurations.

```
Switch# show ipv6 neighbors binding mac C0C1.C06B.C4E2
Binding Table has 45 entries, 37 dynamic (limit 100)
Codes: L - Local, S - Static, ND - Neighbor Discovery, DH - DHCP, PKT - Other Packet, API
- API created
Preflevel flags (prlvl):
0001:MAC and LLA match     0002:Orig trunk            0004:Orig access
0008:Orig trusted trunk    0010:Orig trusted access   0020:DHCP assigned
0040:Cga authenticated     0080:Cert authenticated    0100:Statically assigned

    IPv6 address                            Link-Layer addr Interface vlan prlvl  age
state    Time left
L   FE80:20:25::16                          2037.064C.BA71  Vl25        25  0100 3137mn
REACHABLE
L   FE80:20:24::16                          2037.064C.BA41  Vl24        24  0100 3137mn
REACHABLE
L   FE80:20:23::16                          2037.064C.BA44  Vl23        23  0100 3137mn
REACHABLE
ND  FE80:20:23::13                          2037.0653.6BC4  Te1/0/1     23  0005   85s
REACHABLE  223 s try 0
ND  FE80:20:22::17                          2037.064D.06F6  Te1/0/1     22  0005    3mn
REACHABLE  92 s try 0
L   FE80:20:22::16                          2037.064C.BA76  Vl22        22  0100 3137mn
REACHABLE
ND  FE80:20:22::13                          2037.0653.6BF6  Te1/0/1     22  0005  165s
REACHABLE  136 s try 0
ND  FE80:20:22::12                          2037.064C.94F6  Te1/0/1     22  0005   23s
REACHABLE  281 s try 0
ND  FE80:20:22::2                           0022.550E.8FC3  Te1/0/1     22  0005   18s
REACHABLE  295 s try 0
ND  FE80:20:21::17                          2037.064D.06E8  Te1/0/1     21  0005    4mn
REACHABLE  60 s try 0
L   FE80:20:21::16                          2037.064C.BA68  Vl21        21  0100 3137mn
REACHABLE
ND  FE80:20:21::13                          2037.0653.6BE8  Te1/0/1     21  0005   57s
REACHABLE  252 s try 0
ND  FE80:20:21::12                          2037.064C.94E8  Te1/0/1     21  0005    4s
REACHABLE  297 s
ND  FE80:20:21::2                           0022.550E.8FC2  Te1/0/1     21  0005    2s
REACHABLE  307 s try 0
ND  FE80::F866:8BE0:12E4:39CF               C0C1.C06B.C4E2  Ca4         21  0005    3mn
REACHABLE  89 s try 0
ND  FE80::6D0A:DB33:D69E:91C7               0050.B606.A6CE  Te1/0/1     22  0005  135s
REACHABLE  171 s try 0
ND  FE80::985:8189:9937:BB05                8CA9.8295.09CC  Ca0         21  0005   15s
REACHABLE  287 s
ND  FE80::20:24:13                          2037.0653.6BC1  Te1/0/1     24  0005  155s
REACHABLE  145 s try 0
L   2001:20:23::16                          2037.064C.BA44  Vl23        23  0100 3137mn
REACHABLE
DH  2001:20:22:0:C96C:AF29:5DDC:2689        0050.B606.A6CE  Te1/0/1     22  0024   19s
REACHABLE  286 s try 0(16574
DH  2001:20:22:0:A46B:90B2:F0DB:F952        0050.B606.A6CE  Te1/0/1     22  0024 2339mn
STALE      32401 s
DH  2001:20:22:0:7DFD:14EC:B1E4:1172        0050.B606.A6CE  Te1/0/1     22  0024 2339mn
STALE      24394 s
DH  2001:20:22:0:7CB3:D6DD:FD6A:50F         0050.B606.A6CE  Te1/0/1     22  0024 2333mn
STALE      29195 s
DH  2001:20:22:0:6D32:AF24:FDE1:2504        0050.B606.A6CE  Te1/0/1     22  0024  509mn
STALE      118821 s
DH  2001:20:22:0:5106:5AD:FE98:A2F0         0050.B606.A6CE  Te1/0/1     22  0024 2328mn
STALE      31362 s
ND  2001:20:22::201:13                      0050.B606.A6CE  Te1/0/1     22  0005   49s
REACHABLE  264 s try 0
L   2001:20:22::16                          2037.064C.BA76  Vl22        22  0100 3137mn
REACHABLE
ND  2001:20:22::13                          2037.0653.6BF6  Te1/0/1     22  0005  175s
REACHABLE  131 s try 0
ND  2001:20:22::2                           0022.550E.8FC3  Te1/0/1     22  0005   28s
```

```
REACHABLE  274 s try 0
ND  2001:20:21:0:F866:8BE0:12E4:39CF        C0C1.C06B.C4E2  Ca4         21  0005    4mn
REACHABLE  21 s try 0
ND  2001:20:21:0:C085:9D4C:4521:B777        0021.CC73.AA17  Te1/0/1     21  0005   11s
REACHABLE  290 s try 0
ND  2001:20:21:0:6233:4BFF:FE1A:744C        6033.4B1A.744C  Ca4         21  0005    3mn
REACHABLE  108 s try 0
ND  2001:20:21:0:447E:745D:2F48:1C68        8CA9.8295.09CC  Ca0         21  0005   34s
REACHABLE  276 s
ND  2001:20:21:0:3920:DDE8:B29:AD51         C0C1.C06B.C4E2  Ca4         21  0005    3mn
REACHABLE  87 s try 0
ND  2001:20:21:0:1016:A333:FAD5:6E66        0021.CC73.AA17  Te1/0/1     21  0005    4mn
REACHABLE  18 s try 0
ND  2001:20:21:0:C42:E317:BA9B:EB17         6033.4B1A.744C  Ca4         21  0005    4mn
REACHABLE  61 s try 0
ND  2001:20:21:0:985:8189:9937:BB05         8CA9.8295.09CC  Ca0         21  0005  135s
REACHABLE  173 s try 0
ND  2001:20:21::201:20                      0021.CC73.AA17  Te1/0/1     21  0005    4mn
REACHABLE  43 s try 0
ND  2001:20:21::17                          2037.064D.06E8  Te1/0/1     21  0005    4mn
REACHABLE  50 s try 0
L   2001:20:21::16                          2037.064C.BA68  Vl21        21  0100 3137mn
REACHABLE
ND  2001:20:21::13                          2037.0653.6BE8  Te1/0/1     21  0005   67s
REACHABLE  237 s try 0
ND  2001:20:21::12                          2037.064C.94E8  Te1/0/1     21  0005    5mn
REACHABLE  512 ms try 0
ND  2001:20:21::2                           0022.550E.8FC2  Te1/0/1     21  0005   12s
REACHABLE  294 s try 0
```

Related Topics

Inter Controller Roaming, on page 160
Intra Subnet Roaming with Sticky Anchoring, and Inter Subnet Roaming, on page 160

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
Mobility configurations	*Mobility Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)*

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

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

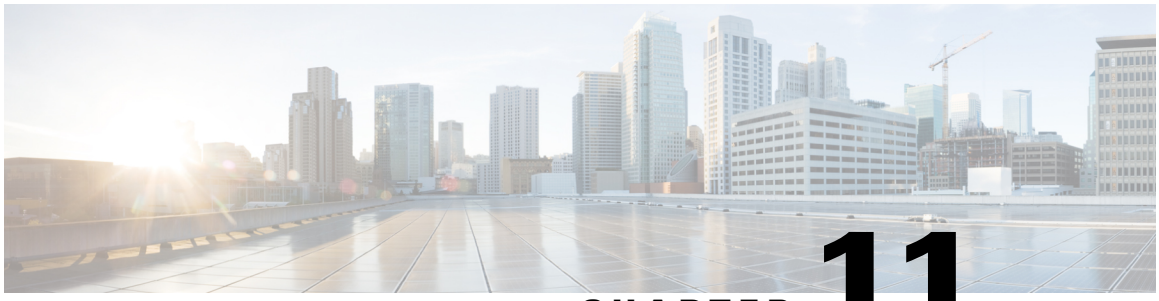
Technical Assistance

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 Information for IPv6 Mobility

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 Mobility Functionality	Cisco IOS XE 3.3SE	This feature was introduced.



CHAPTER 11

Configuring IPv6 NetFlow

Prerequisites For IPv6 Netflow

The networking device must be running a Cisco IOSd release that supports Cisco IOS Flexible NetFlow.

IPv6 Traffic

- One of the following must be enabled on your router and on any interfaces on which you want to enable Flexible NetFlow:
  - Cisco Express Forwarding IPv6 or
  - Distributed Cisco Express Forwarding IPv6.

Restrictions For IPv6 Netflow

The following restrictions apply to IPv6 Netflow configurations:

- Locally generated traffic (traffic that is generated by the router, Cisco WLC 5760, on which the Flexible NetFlow Output Accounting feature is configured) is not counted as flow traffic for the Output Flexible NetFlow Accounting feature.

- The Flexible NetFlow Output Accounting feature counts CEF-switched packets only. Process switched transit packets are not counted.

Information About IPv6 Netflow

NetFlow is a monitoring feature used on customer applications for network monitoring, user monitoring and profiling, network planning, security analysis, billing and accounting, and data warehousing and mining. You can use Flexible NetFlow on uplink ports to monitor user-defined flows, collect flow statistics, and perform per-flow policing. It collects and exports flow statistics to a collector device.

Note Flexible NetFlow is supported only on the Catalyst 3750-X and 3560-X switch running the IP base or IP services feature set and equipped with the network services module. It is not supported on switches running the NPE or the LAN base image.

Note Not all of the Flexible NetFlow commands in the command reference are available on the switch. Unsupported commands are either not visible or generate an error message if entered.

Understanding Flexible Netflow

With Flexible NetFlow, traffic is processed and packets are classified into flows. New flows are inserted in the NetFlow table, and statistics are automatically updated. You must configure both ingress and egress NetFlow monitoring. The network services module supports one monitor per interface per direction.

Flexible NetFlow consists of the following components:

- Records— These are combinations of key and non-key fields assigned to monitor Flexible NetFlow monitors to define the cache used to store data.
- Flow monitors— These are applied to interfaces to perform network traffic monitoring. A flow monitor includes a user-defined record, an optional flow exporter, and a cache that is automatically created when the monitor is applied to the first interface. The switch supports normal caches that age out according to settings.
- Flow exporters— These export the data in the flow monitor cache to a remote system, such as a server running NetFlow collector.
- Flow samplers— These reduce the load that Flexible NetFlow puts on the networking device to monitor traffic by limiting the number of packets that are analyzed.

You can configure unidirectional flow (destination or source-address based flows), and flow aging. The following features are supported on the network services module:

- Configuring collection statistics for Layer 2-switched (non-routing) traffic, Layer 3 (CAPWAP) IPv4 and IPv6 traffic, and Layer 4 TCP, IGMP, and ICMP traffic.
- NetFlow counting, maintenance, troubleshooting (debugging commands).

- NetFlow analysis is performed on traffic crossing the physical interfaces on the network services module. The switch processes egress (outbound) traffic after forwarding decisions are performed. Locally switched or routed traffic is forced through service module ports by configuring private VLANs or protected ports.

The following NetFlow characteristics are not supported:

- Netflow-5 protocol
- Predefined flow records
- ISL
- Policy-based NetFlow
- Cisco TrustSec monitoring

Though other modules that can be installed in the switch have 1-Gigabit and 10-Gigabit uplink interfaces, NetFlow is supported only on the network services module.

IPv6 Netflow

Flexible Netflow (FNF) allows the user to define a flow record (a particular set of key, non-key, counter and time-stamp fields of interest) that is optimal for a particular application by selecting the fields from a big collection of pre-defined fields, using CLI configuration commands.

The collection of the pre-defined fields includes the following fields:

- Data-link layer (L2) header fields
- IPv6 header fields
- Transport layer (L4) header fields
- Application layer (L5) header fields
- Routing attributes (generic, IPv4, IPv6)
- Interface fields
- Counter fields
- Timestamp fields

Related Topics

Configuring a Customized Flow Record , on page 168
Configuring the Flow Exporters , on page 170
Configuring a Customized Flow Monitor, on page 174
Applying a Flow Monitor to an Interface, on page 176
Configuring and Enabling Flow Sampling , on page 178

How To Configure IPv6 Netflow

Configuring a Customized Flow Record

You can match the following fields for the flow record:

- IPv4 or IPv6 destination address
- Datalink fields, to identify Layer 2 source and destination address and VLAN for traffic entering or leaving the interfaces, providing the MAC address of the directly connected host. Class of Service (CoS) and Ethertype datalink header fields are also available.
- Transport field source and destination ports, to identify the type of application: ICMP, IGMP, or TCP traffic.

You can collect the following fields for the flow record:

- The total number of bytes, flows or packets sent by the exporter (exporter) or the number of bytes or packets in a 64-bit counter (long). The timestamp based on system uptime from the time the first packet was sent or from the time the most recent (last) packet was seen.
- The SNMP index of the input or output interface. The interface for traffic entering or leaving the service module is based on the switch forwarding cache. This field is typically used in conjunction with datalink, IPv4, and IPv6 addresses, and provides the actual first-hop interface for directly connected hosts.
    - A value of 0 means that interface information is not available in the cache.
    - Some NetFlow collectors require this information in the flow record.

The following steps configure the customized flow record:

SUMMARY STEPS

1. **configure terminal**
2. **flow record** recordname
3. **description** description
4. **match** {ipv4 | ipv6} {destination | hop-limit | protocol | source | traffic-class| version} **address**
5. **match datalink** [dot1q | ethertype | mac | vlan]
6. **match transport** [destination-port | icmp | source-port]
7. **match interface** [input |output]
8. **match flow direction**
9. **collect counter** {bytes [layer2 | long] | packets [long]}
10. **collect timestamp absolute** [first | last]
11. **collect interface** [input | output]
12. **collect transport tcp flags** {ack | cwr | ece | fin | psh | rst | syn | urg}
13. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**flow record** recordname **Example:** `Switch(config)# flow record TestRecordName`	Creates a flow record and enters Flexible NetFlow flow record configuration mode. This command can also modify an existing flow record.
Step 3	**description** description **Example:** `Switch(config-flow-record)# description SampleNetflowDescription`	(Optional) Creates a description for the flow record.
Step 4	**match**{ipv4 | ipv6}{destination | hop-limit | protocol | source | traffic-class| version} **address** **Example:** `Switch(config-flow-record)# match ipv6 destination address`	Configures key ipv4 and ipv6 fields for the flow record.
Step 5	**match datalink** [dot1q | ethertype | mac | vlan] **Example:** `Switch(config-flow-record)# match datalink [dot1q | ethertype | mac | vlan]`	Configures key datalink (layer 2) fields for the flow record.
Step 6	**match transport** [destination-port | icmp | source-port] **Example:** `Switch(config-flow-record)# match transport [destination-port | icmp | source-port]`	Configures key transport layer fields for the flow record.
Step 7	**match interface** [input |output] **Example:** `Switch(config-flow-record)# match interface input`	Configures key interface fields for the flow record.
Step 8	**match flow direction** **Example:** `Switch(config-flow-record)# match flow direction`	Configures key flow identity fields for the flow record.
Step 9	**collect counter** {bytes [layer2 | long] | packets [long]} **Example:** `Switch(config-flow-record)#collect counter bytes layer2 long`	Configures the counter key field for the flow record.

	Command or Action	Purpose
Step 10	**collect timestamp absolute** [first | last] **Example:** `Switch(config-flow-record)# collect timestamp absolute [first | last ]`	Configures the timestamp key field for the flow record.
Step 11	**collect interface** [input | output] **Example:** `Switch(config-flow-record)# collect interface [input | output]`	Configures the interface key field for the flow record.
Step 12	**collect transport tcp flags** {ack | cwr | ece | fin | psh | rst | syn | urg} **Example:** `Switch(config-flow-record)# collect transport tcp flags ack`	Configures transports tcp flag fields for the flow record.
Step 13	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch(config)# flow record
Switch(config-flow-record)# description record to monitor network traffic
Switch(config-flow-record)# match ipv6 destination address
Switch(config-flow-record)# match datalink [dot1q | ethertype | mac | vlan]
Switch(config-flow-record)# match transport [destination-port | icmp |igmp | source-port]
Switch(config-flow-record)# match interface input
Switch(config-flow-record)# match flow direction
Switch(config-flow-record)#collect counter bytes layer2 long
Switch(config-flow-record)# collect timestamp absolute first
Switch(config-flow-record)# collect interface [input | output]
Switch(config-flow-record)# collect transport tcp flags ack
Switch(config-flow-record)# end
```

Related Topics

IPv6 Netflow, on page 167
Configuring the Flow Exporters , on page 170
Configuring a Customized Flow Monitor, on page 174
Applying a Flow Monitor to an Interface, on page 176
Configuring and Enabling Flow Sampling , on page 178

Configuring the Flow Exporters

The following steps are used to configure the NetFlow exporter.

Note The optional export-protocol flow exporter configuration command specifies the NetFlow export protocol used by the exporter. The switch supports only netflow-v9. Though visible in the CLI help, netflow-5 is not supported.

SUMMARY STEPS

1. **configure terminal**
2. **flow exporter** exporter-name
3. **description** description
4. **destination** {hostname | ip-address} **vrf** vrf-name
5. **dscp** <0-63>
6. **source** interface-id
7. **option** {exporter-stats | interface-table | sampler-table} **timeout** seconds]
8. **export-protocolnetflow-v9**
9. **template data timeout** seconds
10. **transport udp** udp-port
11. **ttl** seconds
12. **end**

DETAILED STEPS

	Command or Action
Step 1	**configure terminal** **Example:** `Switch# configure terminal`
Step 2	**flow exporter** exporter-name **Example:** `Switch(config)# flow exporter TestNetFlowExporterName`
Step 3	**description** description **Example:** `Switch(config-flow-exporter)# description SampleNetFlowExporterDescription`

	Command or Action

Step 4 **destination** {hostname | ip-address} **vrf** vrf-name

Example:
```
Switch(config-flow-exporter)# destination 198.51.100.120 vrf SampleVrfName
```

Step 5 **dscp** <0-63>

Example:
```
Switch(config-flow-exporter)# dscp 23
```

Step 6 **source** interface-id

Example:
```
Switch(config-flow-exporter)# source {
Auto-Template|Capwap|GigabitEthernet|GroupVI|InternalInterface|Loopback|Null|Port-channel|TenGigabitEthernet|Tunne
```

Step 7 **option** {exporter-stats | interface-table | sampler-table} **timeout** seconds]

Example:
```
Switch(config-flow-exporter)# option exporter-stats timeout 600
```

	Command or Action
Step 8	**export-protocolnetflow-v9** **Example:** `Switch(config-flow-exporter)# export-protocol netflow-v9`

Step 9	**template data timeout** seconds
	
	Example:
	`Switch(config-flow-exporter)# template data timeout 600`
	`Switch(config-flow-exporter)#`

Step 10	**transport udp** udp-port **Example:** `Switch(config-flow-exporter)# transport udp 67`
Step 11	**ttl** seconds **Example:** `Switch(config-flow-exporter)# ttl 100`
Step 12	**end** **Example:** `Switch(config)# end`

	Command or Action

```
Switch(config)# flow exporter QoS-Collector
Switch(config-flow-exporter)# description QoS Collector Bldg 19
Switch(config-flow-exporter)# destination 172.20.244.28
Switch(config-flow-exporter)# source vlan 1
Switch(config-flow-exporter)# dscp 3
Switch(config-flow-exporter)# transport udp 2055
Switch(config-flow-exporter)# end
```

What to Do Next

Configuring a Customized Flow Monitor.

Related Topics

Configuring a Customized Flow Record , on page 168
IPv6 Netflow, on page 167
Configuring a Customized Flow Monitor, on page 174
Applying a Flow Monitor to an Interface, on page 176
Configuring and Enabling Flow Sampling , on page 178

Configuring a Customized Flow Monitor

The following steps are used to configure a NetFlow monitor.

SUMMARY STEPS

1. **configure terminal**
2. **flow monitor** monitor -name
3. **description** description
4. **record** {TestNetflowRecordName|TestRecord}
5. **cache** {timeout [active| inactive|update] (seconds) | type (normal)}
6. **cache** {timeout [active| inactive|update] (seconds) | type (normal)}
7. **exporter** TestNetFlowExporterName
8. **cache** {timeout [active| inactive|update] (seconds) | type (normal)}
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**flow monitor** monitor -name **Example:** `Switch(config)# flow monitor SampleMonitorName`	Creates a flow monitor and enters Flexible NetFlow flow monitor configuration mode. You can also use this command to modify an existing flow monitor.
Step 3	**description** description **Example:** `Switch(config-flow-monitor)# Description SampleNetFlowMonitorName`	(Optional) Configures a description for the flow monitor.
Step 4	**record** {TestNetflowRecordName|TestRecord} **Example:** `Switch(config-flow-monitor)#record TestNetflowRecordName`	Specifies the record for the flow monitor.
Step 5	**cache** {timeout [active| inactive|update] (seconds) | type (normal)} **Example:** `Switch(config-flow-monitor)# cache type normal`	(Optional) Modifies the flow monitor cache parameters such as timeout values, number of cache entries, and the cache type. • **timeout active** *seconds*—Configures the active flow timeout. This defines the granularity of the traffic analysis. The range is from 1 to 604800 seconds. The default is 1800. Typical values are 60 or 300 seconds. See the Configuring Data Export for Cisco IOS Flexible NetFlow with Flow Exporters document for recommended values. • **type normal**—Configures normal flow removal from the flow cache. **Note** Although visible in the command line help, the entries keyword and inactive and update timeouts are not supported.
Step 6	**cache** {timeout [active| inactive|update] (seconds) | type (normal)} **Example:** `Switch(config-flow-monitor)# cache type normal`	Repeat step 5 to configure additional cache parameters for the flow monitor.
Step 7	**exporter** TestNetFlowExporterName **Example:** `Switch(config-flow-monitor)# exporter TestNetFlowExporterName`	(Optional) Specifies the name of an exporter that was created previously.

	Command or Action	Purpose
Step 8	**cache** {timeout [active| inactive|update] (seconds) | type (normal)} **Example:** `Switch(config-flow-monitor)# cache type normal`	Repeat step 5 to configure additional cache parameters for the flow monitor.
Step 9	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch(config)# flow monitor FLOW-MONITOR-1
Switch(config-flow-monitor)# Used for ipv6 traffic analysis
Switch(config-flow-monitor)# record FLOW-RECORD-1
Switch(config-flow-monitor)# cache timeout active 300
Switch(config-flow-monitor)# cache type normal
Switch(config-flow-monitor)# exporter EXPORTER-1
Switch(config-flow-monitor)# exit
```

What to Do Next

Apply a flow monitor to an interface

Related Topics

Configuring a Customized Flow Record , on page 168
Configuring the Flow Exporters , on page 170
IPv6 Netflow, on page 167
Applying a Flow Monitor to an Interface, on page 176
Configuring and Enabling Flow Sampling , on page 178

Applying a Flow Monitor to an Interface

The following are used to configure a NetFlow monitor to an interface.

SUMMARY STEPS

1. **configure terminal**
2. **interface** interface-id
3. **wlan** ssid
4. [ip | ipv6 | datalink] **flow monitor** monitor -name **sampler** [sampler | input | output]
5. **exit**
6. Repeat steps 2 and 3
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**interface** interface-id **Example:** `Switch(config)# interface tengigabitEthernet 1/0/1`	Identifies an interface and enters interface configuration mode. Flexible Net Flow is supported only on the service module 1-Gigabit or 10-Gigabit Ethernet interfaces. **Note** You cannot attach a NetFlow monitor to a port channel interface. If both service module interfaces are part of an EtherChannel, you should attach the monitor to both physical interfaces.
Step 3	**wlan** ssid **Example:** `Switch (config)# wlan test 1 test`	Configures the flow monitor on WLAN.
Step 4	[ip | ipv6 | datalink] **flow monitor** monitor -name **sampler** [sampler | input | output] **Example:** `Switch(config-if)# ipv6 flow monitor SampleMonitorName input`	Activates a previously created flow monitor by assigning it to the interface to analyze incoming or outgoing traffic. • ip—Enters record matching IPv4 IP addresses. • ipv6—Enters record matching IPv6 IP addresses. **Note** This keyword is visible only when the dual IPv4 and IPv6 Switch Database Management (SDM) template is configured on the switch. • input—Applies the flow monitor on input traffic. • output—Applies the flow monitor on output traffic. • sampler—(Optional) Applies the flow monitor sampler.

Step 5	**exit**
	
	Example:
	`Switch(config-if)# exit`
	`Switch(config)#`
		Returns to global configuration mode.

Step 6	Repeat steps 2 and 3 **Example:**	Configures additional cache parameters for the flow monitor.
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch(config)# interface tengigabitethernet 1/0/1
Switch(config-if)# ip flow monitor FLOW-MONITOR-1 input
```

```
Switch(config-if)# ip flow monitor FLOW-MONITOR-2 output
Switch(config-if)# end
```

Related Topics

Configuring a Customized Flow Record , on page 168
Configuring the Flow Exporters , on page 170
Configuring a Customized Flow Monitor, on page 174
IPv6 Netflow, on page 167
Configuring and Enabling Flow Sampling , on page 178

Configuring and Enabling Flow Sampling

The following steps are used to configure and enable flow sampling.

SUMMARY STEPS

1. **configure terminal**
2. **sampler** sampler -name
3. **description** description
4. **mode** {deterministic|random} (<1-1>)**out-of** <2-1024>
5. **end**
6. **interface** interface-id
7. **wlan** ssid
8. {ip | ipv6 | datalink] **flow monitor** monitor-name **sampler** sampler-name {input | output}
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**sampler** sampler -name **Example:** `Switch(config)# sampler SampleNameForSAMPLER`	Creates a flow monitor and enters Flexible NetFlow sampler configuration mode. You can also use this command to modify an existing sampler.
Step 3	**description** description **Example:** `Switch(config-sampler)#description SamplerName_1`	(Optional) Configures a description for the sampler.
Step 4	**mode** {deterministic|random} (<1-1>)**out-of** <2-1024>	Specifies the mode and window size from which to select packets. The window size range is from 2 to 1024.

	Command or Action	Purpose
	Example: `Switch(config-sampler)#mode random 1 out-of 2`	**Note** Although visible in the CLI help, the mode deterministic keyword is not supported.
Step 5	**end** **Example:** `Switch(config-sampler)# end`	Returns to global configuration mode.
Step 6	**interface** interface-id **Example:** `Switch(config)# interface tengigabitethernet 1/0/1`	Identifies an interface and enters interface configuration mode.
Step 7	**wlan** ssid **Example:** `Switch(config)# wlan test 1 test`	Configures to apply flow sampler on WLAN.
Step 8	{ip | ipv6 | datalink] **flow monitor** monitor-name **sampler** sampler-name {input | output} **Example:** `Switch(config-if)# ip flow monitor FLOW-MONITOR-1 sampler SAMPLE-1 input`	Activates a previously created IPv4 or IPv6 flow monitor by assigning it to the interface to analyze traffic.
Step 9	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

```
Switch(config)# sampler SAMPLER-1
Switch(config-sampler)# description Sample at 50
Switch(config-sampler)# mode random 1 out-of 2
Switch(config-sampler)# exit
Switch(config)# interface tengigabitethernet 1/0/1
Switch(config)# wlan test 1 test
Switch(config-if)# ip flow monitor FLOW-MONITOR-1 sampler SAMPLE-1 input
```

What to Do Next

How to configure netflow v9 for IPv6.

Related Topics

Configuring a Customized Flow Record , on page 168
Configuring the Flow Exporters , on page 170
Configuring a Customized Flow Monitor, on page 174
Applying a Flow Monitor to an Interface, on page 176
IPv6 Netflow, on page 167

Verifying IPv6 Netflow

This section describes the Netflow related **show** commands for IPv6. The following commands can be used to verify Netflow on the switch.

Command	Purpose
show flow record	Displays the status of the flow records.
show flow ssid <ssid_name>	Displays SSID interface information.
show flow monitor {monitor name} {cache|provisioning|statistics}	Displays the flow monitor information.
show flow exporter exporter-name	Displays the status of a flow exporter.
show flow monitor monitor -name	Displays the current status of a flow monitor.
show flow interface interface-id	Verifies that the Flexible NetFlow is configured on the interface.
show flow monitor monitor -name cache format [csv | record | table}	Displays data in the flow monitor cache.
show sampler sampler -name	Displays the current status of a flow sampler.

Monitoring IPv6 Netflow

This section describes the Netflow commands for IPv6.The following commands can be used to monitor Netflow on the switch.

Command	Purpose
show running-config flow record	Displays the configured flow records.
show running-config flow exporter exporter-name	Verifies the configured flow exporter.
show running-config flow monitor monitor -name	Verifies the flow monitor configuration.

Additional References

Related Documents

Related Topic	Document Title
IPv6 command reference	*IPv6 Command Reference (Catalyst 3650 Switches)*
Flexible NetFlow command reference	*Cisco Flexible NetFlow Command Reference (Catalyst 3650 Switches)*
Flexible NetFlow configuration	*Cisco Flexible NetFlow Configuration Guide (Catalyst 3650 Switches)*

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

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 Information for IPv6 NetFlow

This table lists the features in this module and provides links to specific configuration information:

Feature	Release	Modification
IPv6 NetFlow Functionality	Cisco IOS XE 3.3SE	This feature was introduced.

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