CleanAir Configuration Guide, Cisco IOS XE Release 3E (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 IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

SAVE THESE INSTRUCTIONS

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:

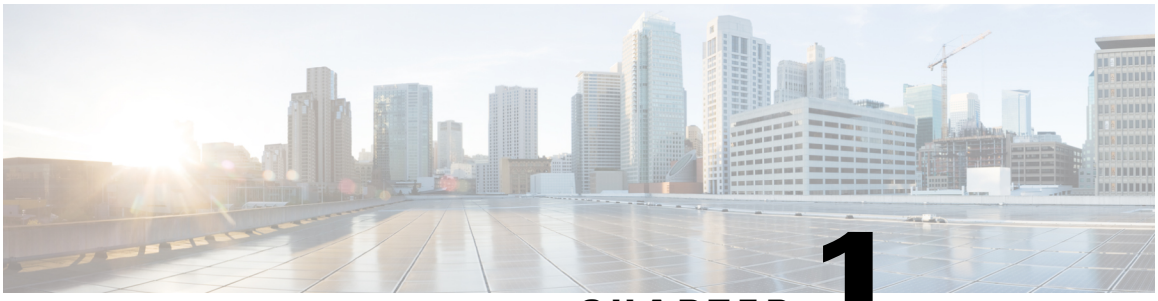
  https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

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/c/en/us/td/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

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)#`		Use this mode to configure parameters for the Ethernet ports.

Mode	Access Method	Prompt	Exit Method	About This Mode
			To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	
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.

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.
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.
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*
	
	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`
		Searches and filters the output.
		
		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.

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.

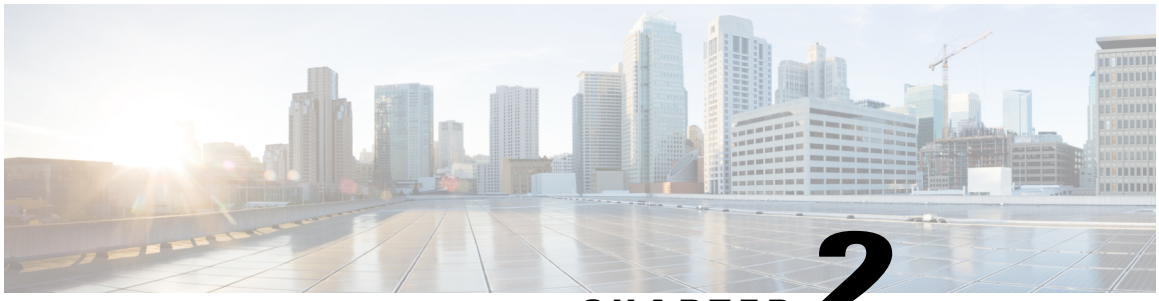
If your switch is already configured, you can access the CLI through a local console connection or through a remote Telnet session, but your switch must first be configured for this type of access.

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**.

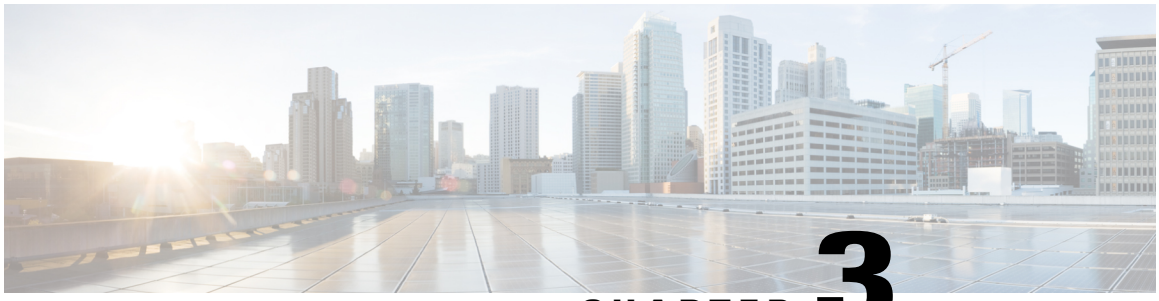
- Displays current timestamp on the switch in the Current Time text box.
- Choose either Manual or NTP from the Mode drop-down list.

  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 Cisco CleanAir

Finding Feature Information

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

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

Prerequisites for CleanAir

You can configure Cisco CleanAir only on CleanAir-enabled access points.

Only Cisco CleanAir-enabled access points using the following access point modes can perform Cisco CleanAir spectrum monitoring:

- Local—In this mode, each Cisco CleanAir-enabled access point radio provides air quality and interference detection reports for the current operating channel only.
- Monitor—When Cisco CleanAir is enabled in monitor mode, the access point provides air quality and interference detection reports for all monitored channels.

  The following options are available:

  - All— All channels
  - DCA—Channel selection governed by the DCA list
  - Country—All channel legal within a regulatory domain

  Note The access point does not participate in AQ HeatMap in Prime Infrastructure.

- SE-Connect—This mode enables a user to connect a Spectrum Expert application running on an external Microsoft Windows XP or Vista PC to a Cisco CleanAir-enabled access point in order to display and analyze detailed spectrum data. The Spectrum Expert application connects directly to the access point, bypassing the switch. An access point in SE-Connect mode does not provide any Wi-Fi, RF, or spectrum data to the switch. All CleanAir system functionality is suspended while the AP is in this mode, and no clients are served. This mode is intended for remote troubleshooting only. Up to three active Spectrum Expert connections are possible.

Related Topics

Enabling CleanAir for 2.4-GHz Band, on page 28
Configuring a CleanAir Alarm for 2.4-GHz Air-Quality and Devices, on page 29
Configuring Interference Reporting for 2.4-GHz Devices, on page 31
Enabling CleanAir for 5-GHz Band, on page 32
Configuring a CleanAir Alarm for 5-GHz Air-Quality and Devices, on page 33
Configuring Interference Reporting for 5-GHz devices, on page 34

Restrictions for CleanAir

- Access points in monitor mode do not transmit Wi-Fi traffic or 802.11 packets. They are excluded from radio resource management (RRM) planning and are not included in the neighbor access point list. IDR clustering depends on the switch's ability to detect neighboring in-network access points. Correlating interference device detections from multiple access points is limited between monitor-mode access points.
- Cisco recommends a ratio of 1 monitor mode access point for every 5 local mode access points, this may also vary based on the network design and expert guidance for best coverage.
- Spectrum Expert (Windows XP laptop client) and AP should be pingable, otherwise; it will not work.

Related Topics

Enabling CleanAir for 2.4-GHz Band, on page 28

Information About CleanAir

Cisco CleanAir is a spectrum intelligence solution designed to proactively manage the challenges of a shared wireless spectrum. All of the users of the shared spectrum can be seen (both native devices and foreign interferers). It also enables the network to act upon this information. For example, the interfering device can be manually removed or the system can automatically change the channel away from the interference.

A Cisco CleanAir system consists of CleanAir-enabled access points, wireless controller modules, mobility controllers, mobility anchors and next generation switches. The access points join the mobility controller directly or through the mobility anchor. They collect information about all devices that operate in the industrial, scientific, and medical (ISM) bands, identify and evaluate the information as a potential interference source, and forward it to the switch. The switch controls the access points, collects spectrum data, and forwards information to Cisco Prime Infrastructure (PI) or a Cisco Mobility Services Engine (MSE) upon request.

Any networking configurations can be performed only on the mobility controller, configurations cannot be performed in the MA mode. However, any radio level CleanAir configurations can be done using mobility anchor.

For every device operating in the unlicensed band, Cisco CleanAir tells what it is, where it is, how it is impacting the wireless network, and what actions should be taken. It simplifies RF.

Wireless LAN systems operate in unlicensed 2.4-GHz and 5-GHz ISM bands. Many devices like microwave ovens, cordless phones, and Bluetooth devices also operate in these bands and can negatively affect the Wi-Fi operations.

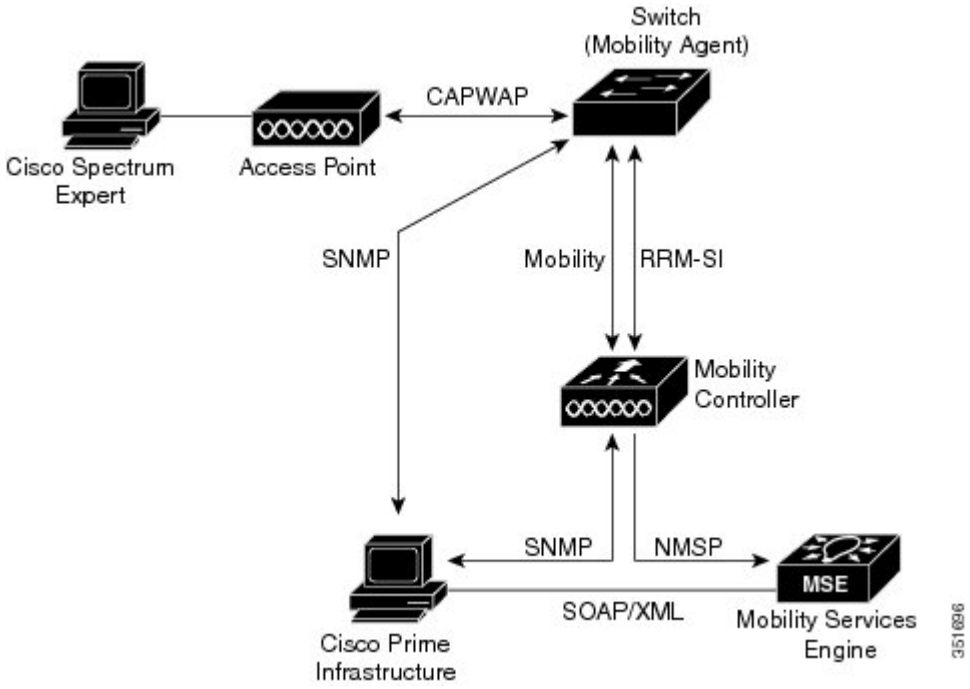
Some of the most advanced WLAN services, such as voice over wireless and IEEE 802.11n radio communications, could be significantly impaired by the interference caused by other legal users of the ISM bands. The integration of Cisco CleanAir functionality addresses this problem of radio frequency (RF) interference.

Cisco CleanAir Components

The basic Cisco CleanAir architecture consists of Cisco CleanAir-enabled APs and switch. Cisco Prime Infrastructure (PI), Mobility Services Engine (MSE) and Cisco Spectrum Expert are optional system

components. Cisco PI and MSE provide user interfaces for advanced spectrum capabilities such as historic charts, tracking interference devices, location services and impact analysis.

Figure 1: Cisco CleanAir Solution



An access point equipped with Cisco CleanAir technology collects information about non-Wi-Fi interference sources, processes it, and forwards it to the MA. The access point sends AQR and IDR reports to the controller.

The mobility controller (MC) controls and configures CleanAir-capable access points, collects and processes spectrum data, and provides it to the PI and/or the MSE. The MC provides local user interfaces (GUI and CLI) to configure basic CleanAir features and services and display current spectrum information. The MC also does detection, merging and mitigation of interference devices using RRM TPC and DCM. For details on Interference Device Merging, see Interference Device Merging, on page 27.

Cisco PI provides advanced user interfaces for CleanAir that include feature enabling and configuration, consolidated display information, historic AQ records and reporting engines. PI also shows charts of interference devices, AQ trends, and alerts.

Cisco MSE is required for location and historic tracking of interference devices, and provides coordination and consolidation of interference reports across multiple controllers. MSE also provides adaptive Wireless Intrusion Prevention System (WIPS) service that provides comprehensive over-the-air threat detection, location and mitigation. MSE also merges all the interference data.

To obtain detailed spectrum data that can be used to generate RF analysis plots similar to those provided by a spectrum analyzer, you can configure a Cisco CleanAir-enabled access point to connect directly to a Microsoft Windows XP or Vista PC running the Cisco Spectrum Expert application.

The switch performs the following tasks in a Cisco CleanAir system:

- Configures Cisco CleanAir capabilities on the access point.
- Provides interfaces (GUI, CLI, and SNMP) for configuring Cisco CleanAir features and retrieving data.

- Displays spectrum data.
- Collects and processes AQRs from the access point and stores them in the air quality database. AQRs contains information about the total interference from all identified sources represented by Air Quality Index (AQI) and summary for the most severe interference categories. The CleanAir system can also include unclassified interference information under per interference type reports which enable you to take action in cases where the interference due to unclassified interfering devices is frequent.
- Collects and processes Interference Device Reports (IDRs) from the access point and stores them in the interference device database.
- Forwards spectrum data to Prime Infrastructure and the MSE.

Terms Used in Cisco CleanAir

Table 4: CleanAir-related Terms

Term	Decription
AQI	Air Quality Index. The AQI is an indicator of air quality, based on the air pollutants. An AQI of 0 is bad and an AQI > 85 is good.
AQR	Air Quality Report. AQRs contain information about the total interference from all identified sources represented by AQI and summary of the most severe interference categories. AQRs are sent every 15 minutes to the Mobility Controller and every 30 seconds in the Rapid mode.
DC	Duty Cycle. Percentage of time that the channel is utilized by a device.
EDRRM	EDRRM Event Driven RRM. EDRRM allows an access point in distress to bypass normal RRM intervals and immediately change channels.
IDR	Interference Device Reports that the access point sends to the controller.
ISI	Interference Severity Index. The ISI is an indicator of the severity of the interference.
MA	Mobility Agent. An MA is either an access switch that has a wireless module running on it or an MC with an internal MA running on it. An MA is the wireless component that maintains client mobility state machine for a mobile client that is connected to an access point to the device that the MA is running on.
MC	Mobility Controller. An MC provides mobility management services for inter-peer group roaming events. The MC provides a central point of contact for management and sends the configuration to all the mobility agents under its sub-domain of their mobility configuration, peer group membership and list of members.
RSSI	Received Signal Strength Indicator. RSSI is a measurement of the power present in a received radio signal. It is the power at which an access point sees the interferer device.

Interference Types that Cisco CleanAir can Detect

Cisco CleanAir can detect interference, report on the location and severity of the interference, and recommend different mitigation strategies. Two such mitigation strategies are persistent device avoidance and spectrum event-driven RRM. New

Wi-Fi chip-based RF management systems share these characteristics:

- Any RF energy that cannot be identified as a Wi-Fi signal is reported as noise.
- Noise measurements that are used to assign a channel plan tend to be averaged over a period of time to avoid instability or rapid changes that can be disruptive to certain client devices.
- Averaging measurements reduces the resolution of the measurement. As such, a signal that disrupts clients might not look like it needs to be mitigated after averaging.
- All RF management systems available today are reactive in nature.

Cisco CleanAir is different and can positively identify not only the source of the noise but also its location and potential impact to a WLAN. Having this information allows you to consider the noise within the context of the network and make intelligent and, where possible, proactive decisions. For CleanAir, two types of interference events are common:

- Persistent interference
- Spontaneous interference

Persistent interference events are created by devices that are stationary in nature and have intermittent but largely repeatable patterns of interference. For example, consider the case of a microwave oven located in a break room. Such a device might be active for only 1 or 2 minutes at a time. When operating, however, it can be disruptive to the performance of the wireless network and associated clients. Using Cisco CleanAir, you can positively identify the device as a microwave oven rather than indiscriminate noise. You can also determine exactly which part of the band is affected by the device, and because you can locate it, you can understand which access points are most severely affected. You can then use this information to direct RRM in selecting a channel plan that avoids this source of interference for the access points within its range. Because this interference is not active for a large portion of the day, existing RF management applications might attempt to again change the channels of the affected access points. Persistent device avoidance is unique, however, in that it remains in effect as long as the source of interference is periodically detected to refresh the persistent status. The Cisco CleanAir system knows that the microwave oven exists and includes it in all future planning. If you move either the microwave oven or the surrounding access points, the algorithm updates RRM automatically.

Note Spectrum event-driven RRM can be triggered only by Cisco CleanAir-enabled access points in local mode.

Spontaneous interference is interference that appears suddenly on a network, perhaps jamming a channel or a range of channels completely. The Cisco CleanAir spectrum event-driven RRM feature allows you to set a threshold for air quality (AQ) that, if exceeded, triggers an immediate channel change for the affected access point. Most RF management systems can avoid interference, but this information takes time to propagate through the system. Cisco CleanAir relies on AQ measurements to continuously evaluate the spectrum and can trigger a move within 30 seconds. For example, if an access point detects interference from a video camera, it can recover by changing channels within 30 seconds of the camera becoming active. Cisco CleanAir also

identifies and locates the source of interference so that more permanent mitigation of the device can be performed at a later time.

In the case of Bluetooth devices, Cisco CleanAir-enabled access points can detect and report interference only if the devices are actively transmitting. Bluetooth devices have extensive power save modes. For example, interference can be detected when data or voice is being streamed between the connected devices.

Interference Device Merging

The Interference Devices (ID) messages are processed on a Mobility Controller (MC). The Mobility Anchor (MA) forwards the ID messages from APs and hence they are processed on the MC. The MC has visibility of the neighbor information across APs connected to different MAs.

ID merging logic requires AP neighbor information. Neighbor information is obtained from the RRM module. This api only gives neighbor information to the APs directly connected to MC.

Currently the AP neighbor list on MA is synced to MC once every 3 minutes; hence the AP neighbor list obtained by this api could be at most 3 mins old. This delay results in delay in merging of Devices as they are discovered. The subsequent periodic merge will pick up the updated neighbor information and merge is performed

Persistent Devices

Some interference devices such as outdoor bridges and Microwave Ovens only transmit when needed. These devices can cause significant interference to the local WLAN due to short duration and periodic operation remain largely undetected by normal RF management metrics. With CleanAir the RRM DCA algorithm can detect, measure, register and remember the impact and adjust the DCA algorithm. This minimizes the use of channels affected by the persistent devices in the channel plan local to the interference source. Cisco CleanAir detects and stores the persistent device information in the switch and this information is used to mitigate interfering channels.

Persistent Devices Detection

CleanAir-capable Monitor Mode access point collects information about persistent devices on all configured channels and store the information in controller. Local/Bridge mode AP detects interference devices on the serving channels only.

Persistent Device Avoidance

When a Persistent Device (PD) is detected in the CleanAir module, it is reported to the RRM module on the MA. This information is used in the channel selection by the subsequent EDRRM Event Driven RRM (ED-RRM) signal sent to the RRM module.

EDRRM and AQR Update Mode

EDRRM is a feature that allows an access point that is in distress to bypass normal RRM intervals and immediately change channels. A CleanAir access point always monitors AQ and reports the AQ every 15 minutes. AQ only reports classified interference devices. The key benefit of EDRRM is very fast action time. If an interfering device is operating on an active channel and causes enough AQ degradation to trigger an

EDRRM, then no clients will be able to use that channel or the access point. You must remove the access point from the channel. EDRRM is not enabled by default, you must first enable CleanAir and then enable EDRRM.

AQRs are only available on the MC. The mode configuration and timers are held in Radio Control Block (RCB) on MA (for APs connected to MA). There is no change to the current API available for EMS/NMS. No change is required for directly connected APs as RCB (spectrum config and timers) is available locally. For remote APs (APs connected to MA), three new control messages are added. These three messages are for enable, restart timer and disable rapid update mode for a given AP MAC address and slot.

Related Topics

Configuring EDRRM for CleanAir-Events, on page 36

CleanAir High Availability

CleanAir configuration (network and radio) is stateful during the switchover. On the MC, Embedded Instrumentation Core (EICORE) provides the sync on network configurations across active and standby nodes. The radio configurations are synced using the HA Infrastructre. The CleanAir configurations on MA are pulled from the MC upon joining. The network configuration is not stored in the EICORE on MA, hence it is synced using HA Infrastructure.

CleanAir Data (AQ and IDR) reports are not stateful, that is, the standby and active nodes are not synced. On switchover, the APs send the reports to the current active slot. The RRM Client (HA Infra Client) is used for CleanAir HA sync.

How to Configure CleanAir

Enabling CleanAir for 2.4-GHz Band

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz cleanair**
3. **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	**ap dot11 24ghz cleanair**
	
	Example:
	`Switch(config)#ap dot11 24ghz cleanair`
	`Switch(config)#no ap dot11 24ghz cleanair`
		Enables the CleanAir feature on 802.11b network. Add **no** in the command to disable CleanAir on the 802.11b network.

Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48

Configuring a CleanAir Alarm for 2.4-GHz Air-Quality and Devices

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz cleanair alarm air-quality threshold** *threshold_value*
3. **ap dot11 24ghz cleanair alarm device** {**bt-discovery** | **bt-link** | **canopy** | **cont-tx** | **dect-like** | **fh** | **inv** | **jammer** | **mw-oven** | **nonstd** | **report** | **superag** | **tdd-tx** | **video** | **wimax-fixed** | **wimax-mobile** | **xbox** | **zigbee** }
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 24ghz cleanair alarm air-quality threshold** *threshold_value* **Example:** `Switch(config)#ap dot11 24ghz cleanair alarm air-quality threshold 50`	Configures the alarm for the threshold value for air-quality for all the 2.4-GHz devices. Add the **no** form of this command to disable the alarm.

	Command or Action	Purpose
Step 3	**ap dot11 24ghz cleanair alarm device** {**bt-discovery** | **bt-link** | **canopy** | **cont-tx** | **dect-like** | **fh** | **inv** | **jammer** | **mw-oven** | **nonstd** | **report** | **superag** | **tdd-tx** | **video** | **wimax-fixed** | **wimax-mobile** | **xbox** | **zigbee** } **Example:** `Switch(config)#ap dot11 24ghz cleanair alarm device canopy`	Configures the alarm for the 2.4-GHz devices. Add the **no** form command to disable the alarm. • **bt-discovery—**Bluetooth Discovery. • **bt-link—**Bluetooth Link. • **canopy—**Canopy devices. • **cont-tx—**Continuous Transmitter. • **dect-like—**Digital Enhanced Cordless Communication (DECT)-like phone. • **fh—**802.11 frequency hopping devices. • **inv—**Devices using spectrally inverted WiFi signals. • **jammer—**Jammer. • **mw-oven—**Microwave oven. • **nonstd—**Devices using non standard Wi-Fi channels. • **report—**Interference device reporting. • **superag—**802.11 SuperAG devices. • **tdd-tx—**TDD Transmitter. • **video—**Video cameras. • **wimax-fixed—**WiMax Fixed. • **wimax-mobile—**WiMax Mobile. • **xbox—**Xbox. • **zigbee—**802.15.4 devices.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48

Configuring Interference Reporting for 2.4-GHz Devices

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz cleanair device**{**bt-discovery | bt-link | canopy | cont-tx | dect-like | fh | inv | jammer | mw-oven | nonstd | report | superag | tdd-tx | video | wimax-fixed | wimax-mobile | xbox | zigbee** }
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 24ghz cleanair device**{**bt-discovery	bt-link	canopy	cont-tx	dect-like	fh	inv	jammer	mw-oven	nonstd	report	superag	tdd-tx	video	wimax-fixed	wimax-mobile	xbox	zigbee** } **Example:** `Switch(config)# ap dot11 24ghz cleanair device bt-discovery` `Switch(config)# ap dot11 24ghz cleanair device bt-link` `Switch(config)# ap dot11 24ghz cleanair device canopy` `Switch(config)# ap dot11 24ghz cleanair device cont-tx` `Switch(config)# ap dot11 24ghz cleanair device dect-like` `Switch(config)# ap dot11 24ghz cleanair device fh` `Switch(config)# ap dot11 24ghz cleanair device inv` `Switch(config)# ap dot11 24ghz cleanair device jammer` `Switch(config)# ap dot11 24ghz cleanair device mw-oven` `Switch(config)# ap dot11 24ghz cleanair device nonstd` `Switch(config)# ap dot11 24ghz cleanair device report` `Switch(config)# ap dot11 24ghz cleanair device superag` `Switch(config)# ap dot11 24ghz cleanair device tdd-tx` `Switch(config)# ap dot11 24ghz cleanair device video` `Switch(config)# ap dot11 24ghz cleanair device wimax-fixed` `Switch(config)# ap dot11 24ghz cleanair device`	Configures the 2.4 GHz interference devices to report to the switch. Use the **no** form of this command to disable the configuration. • **bt-discovery—**Bluetooth Discovery • **bt-link—**Bluetooth Link • **canopy—**Canopy devices • **cont-tx**- Continuous Transmitter • **dect-like**- Digital Enhanced Cordless Communication (DECT) like phone • **fh**- 802.11 frequency hopping devices • **inv**- Devices using spectrally inverted WiFi signals • **jammer**- Jammer • **mw-oven**- Microwave Oven • **nonstd**- Devices using non-standard WiFi channels • **report**- no description • **superag**- 802.11 SuperAG devices • **tdd-tx**- TDD Transmitter • **video**- Video cameras • **wimax-fixed**- WiMax Fixed • **wimax-mobile**- WiMax Mobile • **xbox**- Xbox

	Command or Action	Purpose

	wimax-mobile
	`Switch(config)# ap dot11 24ghz cleanair device xbox`
	`Switch(config)# ap dot11 24ghz cleanair device zigbee`
		• **zigbee**- 802.15.4 devices

Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48
Monitoring the Interference Devices (GUI), on page 46

Enabling CleanAir for 5-GHz Band

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 5ghz cleanair**
3. **end**

DETAILED STEPS

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

Step 2	**ap dot11 5ghz cleanair**
	Example:
	`Switch(config)#ap dot11 5ghz cleanair`
	`Switch(config)#no ap dot11 5ghz cleanair`
		Enables the CleanAir feature on 802.11a network. Add **no** in the command to disable CleanAir on the 802.11a network.

Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48

Configuring a CleanAir Alarm for 5-GHz Air-Quality and Devices

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 5ghz cleanair alarm air-quality threshold** *threshold_value*
3. **ap dot11 5ghz cleanair alarm device**{**canopy** | **cont-tx** | **dect-like** | **inv** | **jammer** | **nonstd** | **radar** | **report** | **superag** | **tdd-tx** | **video** | **wimax-fixed** | **wimax-mobile**}
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 5ghz cleanair alarm air-quality threshold** *threshold_value* **Example:** `Switch(config)#ap dot11 5ghz cleanair alarm air-quality threshold 50`	Configures the alarm for the threshold value for air-quality for all the 5-GHz devices. Add the **No** form of the command to disable the alarm.
Step 3	**ap dot11 5ghz cleanair alarm device**{**canopy**	**cont-tx**	**dect-like**	**inv**	**jammer**	**nonstd**	**radar**	**report**	**superag**	**tdd-tx**	**video**	**wimax-fixed**	**wimax-mobile**} **Example:** `Switch(config)#ap dot11 5ghz cleanair alarm device`	Configures the alarm for the 5-GHz devices. Add the **no** form of the command to disable the alarm. • **canopy—**Canopy devices. • **cont-tx—**Continuous Transmitter. • **dect-like—**Digital Enhanced Cordless Communication (DECT) like phone. • **fh—**802.11 frequency hopping devices. • **inv—**Devices using spectrally inverted WiFi signals. • **jammer—**Jammer. • **nonstd—**Devices using non-standard WiFi channels.

	Command or Action	Purpose
		• **radar—**Radars. • **report—**Interference device reporting. • **superag—**802.11 SuperAG devices. • **tdd-tx—**TDD Transmitter. • **video—**Video cameras. • **wimax-fixed—**WiMax Fixed. • **wimax-mobile—**WiMax Mobile.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48

Configuring Interference Reporting for 5-GHz devices

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 5ghz cleanair device**{**canopy** | **cont-tx** | **dect-like** | **inv** | **jammer** | **nonstd** | **radar** | **report** | **superag** | **tdd-tx** | **video** | **wimax-fixed** | **wimax-mobile**}
3. **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	**ap dot11 5ghz cleanair device {canopy | cont-tx | dect-like | inv | jammer | nonstd | radar | report | superag | tdd-tx | video | wimax-fixed | wimax-mobile}**
	
	Example:
	
	`Switch(config)#ap dot11 5ghz cleanair device canopy`
	`Switch(config)#ap dot11 5ghz cleanair device cont-tx`
	`Switch(config)#ap dot11 5ghz cleanair device dect-like`
	`Switch(config)#ap dot11 5ghz cleanair device inv`
	`Switch(config)#ap dot11 5ghz cleanair device jammer`
	`Switch(config)#ap dot11 5ghz cleanair device nonstd`
	`Switch(config)#ap dot11 5ghz cleanair device radar`
	`Switch(config)#ap dot11 5ghz cleanair device report`
	`Switch(config)#ap dot11 5ghz cleanair device superag`
	`Switch(config)#ap dot11 5ghz cleanair device tdd-tx`
	`Switch(config)#ap dot11 5ghz cleanair device video`
	`Switch(config)#ap dot11 5ghz cleanair device wimax-fixed`
	`Switch(config)#ap dot11 5ghz cleanair device wimax-mobile`
		Configures the 5-GHz interference devices to report to the switch. Add the **no** form of the command to disable interference device reporting.
		
		• **canopy—**Canopy devices
		• **cont-tx—**Continuous Transmitter
		• **dect-like—**Digital Enhanced Cordless Communication (DECT) like phone
		• **fh—**802.11 frequency hopping devices
		• **inv—**Devices using spectrally inverted WiFi signals
		• **jammer—**Jammer
		• **nonstd—**Devices using non-standard WiFi channels
		• **radar—**Radars
		• **report—**Interference device reporting
		• **superag—**802.11 SuperAG devices
		• **tdd-tx—**TDD Transmitter
		• **video—**Video cameras
		• **wimax-fixed—**WiMax Fixed
		• **wimax-mobile—**WiMax Mobile

Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

Prerequisites for CleanAir, on page 21
Restrictions for CleanAir, on page 22
CleanAir FAQs, on page 48
Monitoring the Interference Devices (GUI), on page 46

Configuring EDRRM for CleanAir-Events

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11** {**24ghz** | **5ghz**} **rrm channel cleanair-event**
3. **ap dot11** {**24ghz** | **5ghz**} **rrm channel cleanair-event** [**sensitivity** {**high** | **low** | **medium**}]
4. **end**

DETAILED STEPS

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

Step 2	**ap dot11** {**24ghz**	**5ghz**} **rrm channel cleanair-event**
		
		Example:
		`Switch(config)#ap dot11 24ghz rrm channel cleanair-event`
		`Switch(config)#no ap dot11 24ghz rrm channel cleanair-event`
			Enables EDRRM cleanair-event. Add the **no** form of the command to disable EDRRM.

Step 3	**ap dot11** {**24ghz**	**5ghz**} **rrm channel cleanair-event** [**sensitivity** {**high**	**low**	**medium**}] **Example:** `Switch(config)#ap dot11 24ghz rrm channel cleanair-event sensitivity high`	Configures the EDRRM sensitivity of cleanair-event. • **High—**Specifies the most sensitivity to non Wi–Fi interference as indicated by the air quality (AQ) value. • **Low—**Specifies the least sensitivity to non Wi–Fi interference as indicated by the AQ value. • **Medium—**Specifies medium sensitivity to non Wi–Fi interference as indicated by the AQ value.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Related Topics

EDRRM and AQR Update Mode, on page 27

Configuring Persistent Device Avoidance

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11** {**24ghz** | **5ghz**} **rrm channel device**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11** {**24ghz**	**5ghz**} **rrm channel device** **Example:** `Switch(config)#ap dot11 24ghz rrm channel device`	Enables the persistent non Wi–Fi device avoidance in the 802.11 channel assignment. Add the **no** form of the command to disable the persistent device avoidance.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Cisco CleanAir using the Controller GUI

Configuring Cisco CleanAir on the Cisco Wireless LAN Controller (GUI)

Step 1 Choose **Configuration > Wireless** > **802.11a/n or 802.11b/g/n > CleanAir** to open the **802.11a (or 802.11b) > CleanAir** page.

Step 2 Select the **CleanAir** check box to enable Cisco CleanAir functionality on the 802.11a/n or 802.11b/g/n network, or unselect it to prevent the switch from detecting spectrum interference. By default, the Cisco CleanAir is disabled.

Step 3 Select the **Report Interferers** check box to enable the Cisco CleanAir system to report any detected sources of interference, or unselect it to prevent the switch from reporting interferers. The default value is selected.

Note Device Security alarms, Event Driven RRM, and the Persistence Device Avoidance algorithm do not work if Report Interferers are disabled.

Step 4 Select the **Persistent Device Propagation** check box to enable propagation of information about persistent devices that can be detected by CleanAir. Persistent device propagation enables you to propagate information about persistent devices to the neighboring access points connected to the same switch. Persistent interferers are present at the location and interfere with the WLAN operations even if they are not detectable at all times.

Step 5 Ensure that any sources of interference that need to be detected and reported by the Cisco CleanAir system appear in the Interferences to Detect box and any that do not need to be detected appear in the Interferences to Ignore box. Use the > and < buttons to move interference sources between these two boxes. By default, all interference sources are detected. The sources of interference that you can choose depend on the type of radio, 802.11a/n/ac or 802.11b/g/n, and are as follows:

- **802.11 FH—**A 802.11 FH device
- **802.15.4—**A 802.15.4 or ZigBee device
- **Continuous Transmitter—**A continuous transmitter
- **Bluetooth Discovery—**A Bluetooth device
- **DECT-like Phone—**A digital enhanced cordless communication (DECT)-compatible phone
- **Microsoft—**A Microsoft device
- **SuperAG—**A 802.11a/g SuperAG device
- **Microwave Phone—**A microwave phone
- **Jammer—**A jamming device
- **Canopy—**A canopy bridge device
- **TDD Transmitter—**A time division duplex (TDD) transmitter device
- **Video Camera—**An analog video camera
- **WiFi Invalid Channel—**A WiFi invalid channel
- **WiFi Inverted—**A device using spectrally inverted Wi-Fi signals (I and Q signals of the RF signal are inverted)
- **WiMAX Fixed—**A WiMAX fixed device (802.11a/n only)
- **WiMAX Mobile—**A WiMAX mobile device (802.11a/n only)

Note Access points that are associated to the switch send interference reports only for the interferers that appear in the Interferences to Detect box. This functionality allows you to filter out interferers that you do not want as well as any that may be flooding the network and causing performance problems for the switch or Prime Infrastructure. Filtering allows the system to resume normal performance levels.

Step 6 Configure Cisco CleanAir alarms as follows:

a) Select the **Enable AQI (Air Quality Index) Trap** check box to enable the triggering of air quality alarms, or unselect the box to disable this feature. The default value is selected.

b) If you selected the **Enable AQI Trap** check box in *Step a*, enter a value between 1 and 100 (inclusive) in the AQI Alarm Threshold text box to specify the threshold at which you want the air quality alarm to be triggered. When the air quality falls below the threshold level, the alarm is triggered. A value of 1 represents the worst air quality, and 100 represents the best. The default value is 35.

c) Enter the AQI threshold in the **AQI Alarm Threshold** text box. An alarm is generated when the air quality reaches a threshold value. The default is 35. The range is from 1 and 100.

d) Select the **Enable Interference For Security Alarm** check box to trigger interferer alarms when the switch detects specified device types, or unselect it to disable this feature. The default value is selected

e) Make sure that any sources of interference that need to trigger interferer alarms appear in the **Trap on These Types** box and any that do not need to trigger interferer alarms appear in the **Do Not Trap on These Types** box. Use the **>** and **<** buttons to move interference sources between these two boxes. By default, all interference sources trigger interferer alarms.
For example, if you want the switch to send an alarm when it detects a jamming device, select the **Enable Interference For Security Alarm** check box and move the jamming device to the **Trap on These Types** box.

Step 7 Click **Apply**.

Step 8 Trigger spectrum event-driven radio resource management (RRM) to run when a Cisco CleanAir-enabled access point detects a significant level of interference as follows:

a) Look at the **EDRRM** field to see the current status of spectrum event-driven RRM and, if enabled, the Sensitivity Threshold field to see the threshold level at which event-driven RRM is invoked.

b) If you want to change the current status of event-driven RRM or the sensitivity level, go to the **802.11a (or 802.11b) > RRM > Dynamic Channel Assignment (DCA)** page.

c) Select the **EDRRM** check box to trigger RRM to run when an access point detects a certain level of interference, or unselect it to disable this feature. The default value is selected.

d) If you selected the **EDRRM** check box in *Step c*, choose **Low**, **Medium**, **High** , or **Custom** from the Sensitivity Threshold drop-down list to specify the threshold at which you want RRM to be triggered. When the interference for the access point rises above the threshold level, RRM initiates a local dynamic channel assignment (DCA) run and changes the channel of the affected access point radio if possible to improve network performance. EDRRM prevents the access point from returning to the original channel for three hours after the event.
High—Represents an increased sensitivity to changes in the environment.

Custom—Allows you to set a threshold value in the Custom Sensitivity Threshold field. The default sensitivity is 35.

Low—Represents a decreased sensitivity to changes in the environment.

The EDRRM AQ threshold value for low sensitivity is 35, medium sensitivity is 50, and high sensitivity is 60.

e) Click **Apply**.

Step 9 Click **Save Configuration**.

Configuring Cisco CleanAir on an Access Point (GUI)

Step 1 Choose **Configuration > Wireless** > **Access Points > Radios > 802.11a/n or 802.11b/g/n** to open the 802.11a/n (or 802.11b/g/n) Radios page.

Step 2 Select the check box adjacent to the desired access point and click **Configure**. The 802.11a/n (or 802.11b/g/n) Radios page appears.
The **CleanAir Capable** field shows whether this access point can support CleanAir functionality. If it can, go to the next step to enable or disable CleanAir for this access point. If the access point cannot support CleanAir functionality, you cannot enable CleanAir for this access point.

Note By default, the Cisco CleanAir functionality is enabled on the radios.

Step 3 Enable Cisco CleanAir functionality for this access point by choosing **Enable** from the CleanAir Admin Status drop-down list. To disable CleanAir functionality for this access point, choose **Disable**. The default value is Enable. This setting overrides the global CleanAir configuration for this access point.

Step 4 Click **Apply**.

Step 5 Click **Save Configuration**.

Configuring Cisco Spectrum Expert

Configuring Spectrum Expert (GUI)

Before You Begin

- Spectrum Expert (Windows XP laptop client) and access point should be pingable, otherwise; it will not work.
- Prior to establishing a connection between the Spectrum Expert console and the access point, make sure that IP address routing is properly configured and the network spectrum interface (NSI) ports are open in any intervening firewalls.
- The access point must be a TCP server listening on ports 37540 for 2.4 GHz and 37550 for 5 GHz frequencies. These ports must be opened for the spectrum expert application to connect to the access point using the NSI protocol.
- You can view the NSI key from the switch CLI by using the **show ap name** *ap_name* **config dot11** {**24ghz** | **5ghz**} command.

Step 1 Ensure that Cisco CleanAir functionality is enabled for the access point that will be connected to the Spectrum Expert console.

Note The SE-Connect mode is set for the entire access point, not just a single radio. However, the Spectrum Expert console connects to a single radio at a time.

Step 2 Choose **Configuration** > **Wireless** > **Access Points** > **All APs** to open the All APs page.

Step 3 Click the name of the desired access point to open the All APs > Details page.

Step 4 Choose **SE-Connect** from the AP Mode drop-down list. This mode is available only for access points that are capable of supporting Cisco CleanAir functionality. For the SE-Connect mode to appear as an available option, the access point must have at least one spectrum-capable radio in the Enable state.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **OK** when prompted to reboot the access point.

Step 7 On the Windows PC, access the Cisco Software Center from this URL: http://www.cisco.com/cisco/software/navigator.html

Step 8 Click **Product > Wireless > Cisco Spectrum Intelligence** > **Cisco Spectrum Expert** > **Cisco Spectrum Expert Wi-Fi**, and then download the Spectrum Expert 4.1.11 executable (*.exe) file.

Step 9 Run the Spectrum Expert application on the PC.

Step 10 When the Connect to Sensor dialog box appears, enter the IP address of the access point, choose the access point radio, and enter the 16-byte network spectrum interface (NSI) key to authenticate. The Spectrum Expert application opens a TCP/IP connection directly to the access point using the NSI protocol.
When an access point in SE-Connect mode joins a switch, it sends a Spectrum Capabilities notification message, and the switch responds with a Spectrum Configuration Request. The request contains the 16-byte random NSI key generated by the switch for NSI authentication. The switch generates one key per access point, which the access point stores until it is rebooted.

Note You can establish up to three Spectrum Expert console connections per access point radio.

Step 11 Verify that the Spectrum Expert console is connected to the access point by selecting the Slave Remote Sensor text box in the bottom right corner of the Spectrum Expert application. If the two devices are connected, the IP address of the access point appears in this text box.

Step 12 Use the Spectrum Expert application to view and analyze spectrum data from the access point.

Configuring Spectrum Expert (CLI)

Before You Begin

- Spectrum Expert (Windows XP laptop client) and access point should be pingable, otherwise; it will not work.
- Prior to establishing a connection between the Spectrum Expert console and the access point, make sure that IP address routing is properly configured and the network spectrum interface (NSI) ports are open in any intervening firewalls.
- The access point must be a TCP server listening on ports 37540 for 2.4-GHz and 37550 for 5-GHz frequencies. These ports must be opened for the spectrum expert application to connect to the access point using the NSI protocol.
- You can view the NSI key from the switch CLI by using the **show ap name** *ap_name* **config dot11** {**24ghz** | **5ghz**} command.

Step 1 To configure the access point for SE-Connect mode, enter this command:
ap name *ap_name* **mode se-connect**

Example:
```
Switch#ap name Cisco_AP3500 mode se-connect
```

Step 2 When prompted to reboot the access point, enter **Y**.

Step 3 To view the NSI key for the access point, enter this command:
show ap name *ap_name* **config dot11** {**24ghz** | **5ghz**}

Example:

```
Switch#show ap name Cisco_AP3500 config dot11 24ghz

<snippet>
CleanAir Management Information
    CleanAir Capable                          : Yes
    CleanAir Management Admin State           : Enabled
    CleanAir Management Operation State       : Up
    CleanAir NSI Key                          : 274F1F9B1A5206683FAF57D87BFFBC9B
    CleanAir Sensor State                     : Configured

<snippet>
```

What to Do Next

On the Windows PC, download Cisco Spectrum Expert:

- Access the Cisco Software Center from this URL: http://www.cisco.com/cisco/software/navigator.html
- Click **Product > Wireless > Cisco Spectrum Intelligence** > **Cisco Spectrum Expert** > **Cisco Spectrum Expert Wi-Fi**, and then download the Spectrum Expert 4.1.11 executable (*.exe) file.
- Run the Spectrum Expert application on the PC.
- When the Connect to Sensor dialog box appears, enter the IP address of the access point, choose the access point radio, and enter the 16-byte network spectrum interface (NSI) key to authenticate. The Spectrum Expert application opens a TCP/IP connection directly to the access point using the NSI protocol.

  When an access point in SE-Connect mode joins a switch, it sends a Spectrum Capabilities notification message, and the switch responds with a Spectrum Configuration Request. The request contains the 16-byte random NSI key generated by the switch for use in NSI authentication. The switch generates one key per access point, which the access point stores until it is rebooted.

  Note You can establish up to three Spectrum Expert console connections per access point radio.

- Verify that the Spectrum Expert console is connected to the access point by selecting the Slave Remote Sensor text box in the bottom right corner of the Spectrum Expert application. If the two devices are connected, the IP address of the access point appears in this text box.
- Use the Spectrum Expert application to view and analyze spectrum data from the access point.

Monitoring CleanAir Parameters

You can monitor CleanAir parameters using the following commands:

Table 5: Commands for Monitoring CleanAir

Commands	Description
show ap dot11 24ghz cleanair air-quality summary	Displays CleanAir Air Quality (AQ) data for 2.4-GHz band
show ap dot11 24ghz cleanair air-quality worst	Displays CleanAir Air Quality (AQ) worst data for 2.4-GHz band
show ap dot11 24ghz cleanair config	Displays CleanAir Configuration for 2.4-GHz band
show ap dot11 24ghz cleanair device type all	Displays all CleanAir Interferers for 2.4-GHz band
show ap dot11 24ghz cleanair device type bt-discovery	Displays CleanAir Interferers of type BT Discovery for 2.4-GHz band
show ap dot11 24ghz cleanair device type bt-link	Displays CleanAir Interferers of type BT Link for 2.4-GHz band
show ap dot11 24ghz cleanair device type canopy	Displays CleanAir Interferers of type Canopy for 2.4-GHz band
show ap dot11 24ghz cleanair device type cont-tx	Displays CleanAir Interferers of type Continuous transmitter for 2.4-GHz band
show ap dot11 24ghz cleanair device type dect-like	Displays CleanAir Interferers of type DECT Like for 2.4-GHz band
show ap dot11 24ghz cleanair device type fh	Displays CleanAir Interferers of type 802.11FH for 2.4-GHz band
show ap dot11 24ghz cleanair device type inv	Displays CleanAir Interferers of type WiFi Inverted for 2.4-GHz band
show ap dot11 24ghz cleanair device type jammer	Displays CleanAir Interferers of type Jammer for 2.4-GHz band
show ap dot11 24ghz cleanair device type mw-oven	Displays CleanAir Interferers of type MW Oven for 2.4-GHz band
show ap dot11 24ghz cleanair device type nonstd	Displays CleanAir Interferers of type WiFi Inv. Ch for 2.4-GHz band
show ap dot11 24ghz cleanair device type persistent	Displays CleanAir Interferers of type Persistent for 2.4-GHz band
show ap dot11 24ghz cleanair device type superag	Displays CleanAir Interferers of type SuperAG for 2.4-GHz band

Commands	Description
show ap dot11 24ghz cleanair device type tdd-tx	Displays CleanAir Interferers of type TDD Transmit for 2.4-GHz band
show ap dot11 24ghz cleanair device type video	Displays CleanAir Interferers of type Video Camera for 2.4-GHz band
show ap dot11 24ghz cleanair device type wimax-fixed	Displays CleanAir Interferers of type WiMax Fixed for 2.4-GHz band
show ap dot11 24ghz cleanair device type wimax-mobile	Displays CleanAir Interferers of type WiMax Mobile for 2.4-GHz band
show ap dot11 24ghz cleanair device type xbox	Displays CleanAir Interferers of type Xbox for 2.4-GHz band
show ap dot11 24ghz cleanair device type zigbee	Displays CleanAir Interferers of type zigbee for 2.4-GHz band
show ap dot11 5ghz cleanair air-quality summary	Displays CleanAir Air Quality (AQ) data for 5-GHz band
show ap dot11 5ghz cleanair air-quality worst	Displays CleanAir Air Quality (AQ) worst data for 5-GHz band
show ap dot11 5ghz cleanair config	Displays CleanAir Configuration for 5-GHz band
show ap dot11 5ghz cleanair device type all	Displays all CleanAir Interferers for 5-GHz band
show ap dot11 5ghz cleanair device type canopy	Displays CleanAir Interferers of type Canopy for 5-GHz band
show ap dot11 5ghz cleanair device type cont-tx	Displays CleanAir Interferers of type Continuous TX for 5-GHz band
show ap dot11 5ghz cleanair device type dect-like	Displays CleanAir Interferers of type DECT Like for 5-GHz band
show ap dot11 5ghz cleanair device type inv	Displays CleanAir Interferers of type WiFi Inverted for 5-GHz band
show ap dot11 5ghz cleanair device type jammer	Displays CleanAir Interferers of type Jammer for 5-GHz band
show ap dot11 5ghz cleanair device type nonstd	Displays CleanAir Interferers of type WiFi Inv. Ch for 5-GHz band
show ap dot11 5ghz cleanair device type persistent	Displays CleanAir Interferers of type Persistent for 5-GHz band

Commands	Description
show ap dot11 5ghz cleanair device type superag	Displays CleanAir Interferers of type SuperAG for 5-GHz band
show ap dot11 5ghz cleanair device type tdd-tx	Displays CleanAir Interferers of type TDD Transmit for 5-GHz band
show ap dot11 5ghz cleanair device type video	Displays CleanAir Interferers of type Video Camera for 5-GHz band
show ap dot11 5ghz cleanair device type wimax-fixed	Displays CleanAir Interferers of type WiMax Fixed for 5-GHz band
show ap dot11 5ghz cleanair device type wimax-mobile	Displays CleanAir Interferers of type WiMax Mobile for 5-GHz band

You can also check the CleanAir status of the access points using the switch GUI:

Choose **Monitor** > **Wireless** > **Access Points** > **802.11 a/n/ac**or **802.11 b/g/n**.
The **Radios** page is displayed showing a list of access points that are associated with the switch. You can see the CleanAir Admin and CleanAir Status.

The Cisco CleanAir status is one of the following:

- **UP—**The spectrum sensor for the access point radio is currently operational (error code 0).
- **DOWN—**The spectrum sensor for the access point radio is currently not operational because an error has occurred. The most likely reason for the error is that the access point radio is disabled (error code 8). To correct this error, enable the radio.
- **ERROR—**The spectrum sensor for the access point radio has crashed (error code 128), making CleanAir monitoring nonoperational for this radio. If this error occurs, reboot the access point. If the error continues to appear, you might want to disable Cisco CleanAir functionality on the radio.
- **N/A—**This access point radio is not capable of supporting Cisco CleanAir functionality.

Monitoring the Interference Devices

When a CleanAir-enabled access point detects interference devices, detections of the same device from multiple sensors are merged together to create clusters. Each cluster is given a unique ID. Some devices conserve power by limiting the transmit time until actually needed which results in the spectrum sensor to temporarily stop detecting the device. This device is then correctly marked as down. A down device is correctly removed from the spectrum database. In cases when all the interferer detections for a specific devices are reported, the cluster ID is kept alive for an extended period of time to prevent possible device detection bouncing. If the

same device is detected again, it is merged with the original cluster ID and the device detection history is preserved.

For example, some bluetooth headsets operate on battery power. These devices employ methods to reduce power consumption, such as turning off the transmitter when not actually needed. Such devices can appear to come and go from the classification. To manage these devices, CleanAir keeps the cluster IDs longer and they are remerged into a single record upon detection. This process smoothens the user records and accurately represents the device history.

Monitoring the Interference Devices (GUI)

Before You Begin

You can configure Cisco CleanAir only on CleanAir-enabled access points.

Step 1 Choose **Monitor > Interferers > Cisco CleanAir > 802.11a/n or 802.11b/g/n > Interference Devices** to open the Cisco APs > Interference Devices page.
This page shows the following information:

- **AP Name—**The name of the access point where the interference device is detected.
- **Interferer Type—**Type of the interferer.
- **Affected Channel—**Channel that the device affects.
- **Severity—**Severity index of the interfering device.
- **Duty Cycle (%)—**Proportion of time during which the interfering device was active.
- **RSSI—**Receive signal strength indicator (RSSI) of the access point.
- **DevID—**Device identification number that uniquely identified the interfering device.
- **ClusterID—**Cluster identification number that uniquely identifies the type of the devices.

Step 2 Click the **Filter** icon or choose the **Quick Filter** option from the Show drop-down list to display the information about interference devices based on a particular criteria.

Related Topics

Configuring Interference Reporting for 2.4-GHz Devices, on page 31
Configuring Interference Reporting for 5-GHz devices, on page 34

Monitoring the Worst Air Quality of Radio Bands (GUI)

Choose **Monitor** > **Cisco CleanAir** > **Worst Air-Quality** to open the Air Quality Report page.

This page shows the air quality of both the 802.11a/n and 802.11b/g/n radio bands. This page displays the following information:

- **AP Name—**Name of the access point that reported the worst air quality for the 802.11 radio band.
- **Channel Number—**Radio channel with the worst reported air quality.
- **Minimum Air Quality Index—**Minimum air quality for this radio channel. The range is from 1 to 100. An air quality index (AQI) value of 100 is the best, and 1 is the worst.
- **Average Air Quality Index—**Average air quality for this radio channel. The range is from 1 to 100. An air quality index (AQI) value of 100 is the best, and 1 is the worst.
- **Interference Device Count—**Number of interferers detected by the radios on the 802.11 radio band.

Configuration Examples for Configuring CleanAir

Enabling CleanAir on 2.4-GHz Band and an Access Point: Example

This example shows how to enable CleanAir on the 2.4-GHz band and an access point operating in the channel:

```
Switch#configure terminal
Switch(config)#ap dot11 24ghz cleanair
Switch(config)#exit
Switch#ap name TAP1 dot11 24ghz cleanair
Switch#end
```

Configuring a CleanAir Alarm for 2.4-GHz Air-Quality and Devices: Example

This example shows how to configure a CleanAir Alarm for 2.4-GHz Air-Quality threshold of 50 dBm and an Xbox device:

```
Switch#configure terminal
Switch(config)#ap dot11 24ghz cleanair alarm air-quality threshold 50
Switch(config)#ap dot11 24ghz cleanair alarm device xbox
Switch(config)#end
```

Configuring Interference Reporting for 5-GHz Devices: Example

This example shows how to configure interference reporting for 5-GHz devices:

```
Switch#configure terminal
Switch(config)#ap dot11 5ghz cleanair alarm device xbox
Switch(config)#end
```

Configuring EDRRM for CleanAir-Events: Example

This example shows how to enable an EDRRM cleanair-event in the 2.4-GHz band and configure high sensitivity to non Wi–Fi interference:

```
Switch#configure terminal
Switch(config)#ap dot11 24ghz rrm channel cleanair-event
Switch(config)#ap dot11 24ghz rrm channel cleanair-event sensitivity high
Switch(config)#end
```

Configuring Persistent Device Avoidance: Example

This example shows how to enable persistent non Wi–Fi device avoidance in the 2.4-GHz band:

```
Switch#configure terminal
Switch(config)#ap dot11 24ghz rrm channel device
Switch(config)#end
```

Configuring an Access Point for SE-Connect Mode: Example

This example shows how to configure an access point in the SE-Connect mode:

```
Switch#ap name Cisco_AP3500 mode se-connect
```

CleanAir FAQs

Q. How do I check if my MC is up?

A. To check if the MC is up, use the command: **show wireless mobility summary**.

This example shows how to display the mobility summary:

```
Switch#show wireless mobility summary

Mobility Controller Summary:
Mobility Role                                 : Mobility Controller
Mobility Protocol Port                        : 16666
Mobility Group Name                           : MG-AK
Mobility Oracle                               : Disabled
Mobility Oracle IP Address                    : 0.0.0.0
DTLS Mode                                     : Enabled
Mobility Domain ID for 802.11r                : 0x39b2
Mobility Keepalive Interval                   : 10
Mobility Keepalive Count                      : 3
Mobility Control Message DSCP Value           : 48
Mobility Domain Member Count                  : 2
Link Status is Control Link Status : Data Link Status
Controllers configured in the Mobility Domain:
IP              Public IP        Group Name       Multicast IP     Link Status
------------------------------------------------------------------------------
9.6.136.10      -                MG-AK            0.0.0.0          UP   : UP
```

Q. Multiple access points detect the same interference device, however, the switch shows them as separate clusters or different suspected devices clustered together. Why does this happen?

A. Access points must be RF neighbors for the switch to consider the merging of devices that are detected by these access points. The access point takes time to establish neighbor relationships. A few minutes after the switch reboots or a change in the RF group and similar events, clustering will not be very accurate.

Q. Can I merge two monitor mode access points using a switch?

A. No, you cannot merge two monitor mode access points using a switch. You can merge the monitor mode access points only using MSE.

Q. How do I view neighbor access points?

A. To view neighbor access points, use the command: **show ap** *ap_name* **auto-rf dot11** {**24ghz** | **5ghz**}

This example shows how to display the neighbor access points:

```
Switch#show ap name AS-5508-5-AP3 auto-rf dot11 24ghz

<snippet>
Nearby APs
  AP 0C85.259E.C350 slot 0                          :  -12 dBm on   1 (10.10.0.5)
  AP 0C85.25AB.CCA0 slot 0                          :  -24 dBm on   6 (10.10.0.5)
  AP 0C85.25C7.B7A0 slot 0                          :  -26 dBm on  11 (10.10.0.5)
  AP 0C85.25DE.2C10 slot 0                          :  -24 dBm on   6 (10.10.0.5)
  AP 0C85.25DE.C8E0 slot 0                          :  -14 dBm on  11 (10.10.0.5)
  AP 0C85.25DF.3280 slot 0                          :  -31 dBm on   6 (10.10.0.5)
  AP 0CD9.96BA.5600 slot 0                          :  -44 dBm on   6 (10.0.0.2)
  AP 24B6.5734.C570 slot 0                          :  -48 dBm on  11 (10.0.0.2)
<snippet>
```

Q. What are the debug commands available for CleanAir?

A. The debug commands for CleanAir are:

debug cleanair {**all** | **error** | **event** | **internal-event** | **nmsp** | **packet**}

debug rrm {**all** | **channel** | **detail** | **error** | **group** | **ha** | **manager** | **message** | **packet** | **power** | **prealarm** | **profile** | **radar** | **rf-change** | **scale** | **spectrum**}

Q. Why are CleanAir Alarms not generated for interferer devices?

A. Verify that the access points are CleanAir-capable and CleanAir is enabled both on the access point and the switch.

Q. Can the Cisco Catalyst 3850 and 3650 Series Switches function as a Mobility Agent (MA)?

A. Yes, the Cisco Catalyst 3850 and 3650 Series Switches can function as an MA.

Q. Are CleanAir configurations available on the MA?

A. From Release 3.3 SE, CleanAir configurations are available on the MA. You can use the following two CleanAir commands on the MA:

- **show ap dot11 5ghz cleanair config**
- **show ap dot11 24ghz cleanair config**

Related Topics

Enabling CleanAir for 2.4-GHz Band, on page 28
Configuring a CleanAir Alarm for 2.4-GHz Air-Quality and Devices, on page 29
Configuring Interference Reporting for 2.4-GHz Devices, on page 31
Enabling CleanAir for 5-GHz Band, on page 32
Configuring a CleanAir Alarm for 5-GHz Air-Quality and Devices, on page 33
Configuring Interference Reporting for 5-GHz devices, on page 34

Additional References

Related Documents

Related Topic	Document Title
CleanAir commands and their details	*CleanAir Command Reference, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)*
High Availability configurations	*High Availability Configuration Guide, Cisco IOS XE Release 3SE (Cisco 5700 Series Wireless Controllers)*
High Availability commands and their details	*High Availability Command Reference, Cisco IOS XE Release 3SE (Cisco 5700 Series Wireless Controllers)*

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

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