



## Cisco CleanAir

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## Information About Cisco CleanAir

Cisco CleanAir is a solution designed to proactively manage the challenges of a shared wireless spectrum. It allows you to see all the users of a shared spectrum (both native devices and foreign interferers). It also enables the network to act upon this information. For example, you can manually remove the interfering device, or the system can automatically change the channel away from the interference. CleanAir provides spectrum management and Radio Frequency (RF) visibility.

A Cisco CleanAir system consists of CleanAir-enabled access points and Cisco Catalyst 9800 Series Wireless Controller . These access points collect information about all the 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 controller . The controller controls the access points and displays the interference devices.

For every device operating in the unlicensed band, Cisco CleanAir provides information about what it is, how it is impacting your wireless network, and what actions you or your network should take. It simplifies RF so that you do not have to be an RF expert.

Wireless LAN systems operate in unlicensed 2.4-GHz and 5-GHz ISM bands. Many devices, such as 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 802.11 radio communications, might 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 RF interference.

## Cisco CleanAir-Related Terms

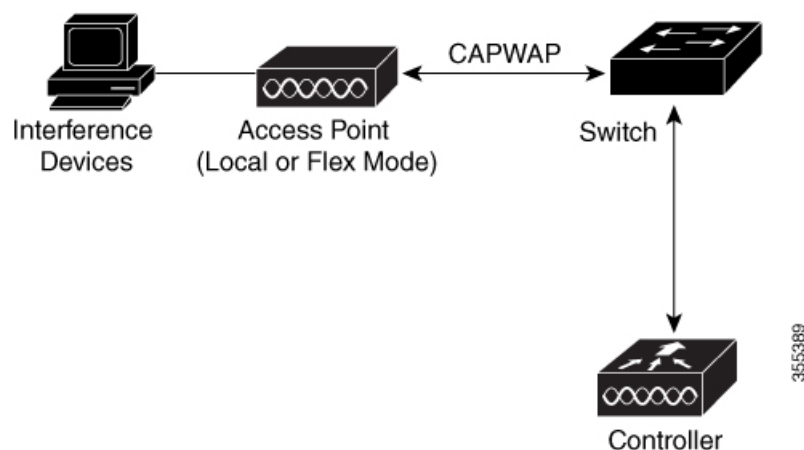
*Table 1: CleanAir-Related Terms*

Term	Description
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 total interference from all the identified sources represented by AQI and the 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	Event-Driven RRM. EDRRM allows an access point in distress to bypass normal RRM intervals and immediately change channels.
IDR	Interference Device Reports that an access point sends to the controller .
ISI	Interference Severity Index. The ISI is an indicator of the severity of the interference.
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.

## Cisco CleanAir Components

The basic Cisco CleanAir architecture consists of Cisco CleanAir-enabled APs and device.

*Figure 1: Cisco CleanAir Solution*



An access point equipped with Cisco CleanAir technology collects information about Wi-Fi interference sources and processes it. The access point collects and sends the Air Quality Report (AQR) and Interference Device Report (IDR) to the controller .

The controller controls and configures CleanAir-capable access points, and collects and processes spectrum data. The controller provides local user interfaces (GUI and CLI) to configure basic CleanAir features and services and display current spectrum information. The controller also detects, merges, and mitigates interference devices using RRM TPC and DCA For details, see Interference Device Merging.

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

- Configures Cisco CleanAir capabilities on the access point.
- Provides interfaces (GUI and CLI) 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 contain information about the total interference from all the identified sources represented by the Air Quality Index (AQI) and the summary for the most severe interference categories. The CleanAir system can also include unclassified interference information under per-interference type reports that enable you to take action in scenarios where interference because of unclassified interfering devices is more.
- Collects and processes IDRs from the access point and stores them in the interference device database.



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**Note** When Cisco CleanAir is disabled and Spectrum Intelligence (SI) is enabled in the controller, both CleanAir and Air Quality reporting are disabled. In spite of this, Air Quality is still populated for SI APs and viewed as disabled when **show ap dot11 5ghz/24ghz cleanair config** command is executed. This is an expected behavior as SI APs report Air Quality.

Here, Spectrum intelligence is a subset of CleanAir features. For more information on Spectrum Intelligence, see the *Spectrum Intelligence Deployment Guide*.

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## Interference Types that Cisco CleanAir can Detect

Cisco CleanAir access points can detect and report severity of the interference. Spectrum event-driven RRM is one such mitigation strategy.

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 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. Spontaneous interference event is commonly used for CleanAir.



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

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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) which, 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.

Microwave Ovens, Outdoor Ethernet bridges are two classes of devices that qualify as persistent, since once detected, it is likely that these devices will continue to be a random problem and are not likely to move. For these types of devices we can tell RRM of the detection and Bias the affected channel so that RRM "remembers" that there is a high potential for client impacting interference for the Detecting AP on the detected channel. For more information, see [https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-3/b\\_RRM\\_White\\_Paper/b\\_RRM\\_White\\_Paper\\_chapter\\_0100.html?bookSearch=true#id\\_15217](https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-3/b_RRM_White_Paper/b_RRM_White_Paper_chapter_0100.html?bookSearch=true#id_15217).

CleanAir PDA devices include:

- Microwave Oven
- WiMax Fixed
- WiMax Mobile
- Motorola Canopy

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.

## 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 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.

## 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. An AP can only measure air quality and interference when the AP is not busy transmitting Wi-Fi frames. This implies that CleanAir detections will be drastically lower if the AP is having a high channel utilization.
- FlexConnect—When a FlexConnect access point is connected to the controller, its Cisco CleanAir functionality is identical to local mode.

- **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 channels are legal within a regulatory domain

## 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 device's ability to detect neighboring in-network access points. Correlating interference device detections from multiple access points is limited between monitor-mode access points.
- For 4800 AP slot 1 5 GHz is dedicated and cannot be individually moved to monitor mode. However, slot 0 is XOR and can be moved to monitor as well as 2.4/5 GHz. Slot 2 is dedicated monitor and will operate in 5GHz and in AP monitor mode, slot 2 will be disabled because a monitor radio is already available in both 2.4/5GHz. 3700 AP has dedicated 2.4GHz (slot0) and 5GHz (slot1).
- Do not connect access points in SE connect mode directly to any physical port on the controller.
- CleanAir is not supported wherein the channel width is 160 MHz.

## How to Configure CleanAir

### Enabling CleanAir for the 2.4-GHz Band (GUI)

#### Procedure

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|---------------|--|
| <b>Step 1</b> | Choose <b>Configuration &gt; Radio Configurations &gt; CleanAir</b>            |
| <b>Step 2</b> | On the <b>CleanAir</b> page, click the <b>me2.4 GHz Band &gt; General</b> tab. |
| <b>Step 3</b> | Check the <b>Enable CleanAir</b> checkbox.                                     |
| <b>Step 4</b> | Click <b>Apply</b> .   |
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## Enabling CleanAir for the 2.4-GHz Band (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> Device# <code>configure terminal</code>	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 24ghz cleanair</b>  <b>Example:</b> Device(config)# <code>ap dot11 24ghz cleanair</code> Device(config)# <code>no ap dot11 24ghz cleanair</code>	Enables the CleanAir feature on the 802.11b network. Run the <b>no</b> form of this command to disable CleanAir on the 802.11b network.
<b>Step 3</b>	<b>end</b>  <b>Example:</b> Device(config)# <code>end</code>	Returns to privileged EXEC mode. Alternatively, you can also press <b>Ctrl-Z</b> to exit global configuration mode.

## Configuring Interference Reporting for a 2.4-GHz Device (GUI)

### Procedure

- Step 1** Choose **Configuration > Radio Configurations > CleanAir**.
- Step 2** Click the **2.4 GHz Band** tab.
- Step 3** Choose the interference types and add them to the **Interference Types to detect** section.

The following interference types are available:

- BLE Beacon—Bluetooth low energy beacon
- Bluetooth Discovery
- Bluetooth Link
- Canopy
- Continuous Transmitter
- DECT-like Phone—Digital Enhanced Cordless Technology phone
- 802.11 FH—802.11 frequency hopping device
- WiFi Inverted—Device using spectrally inverted Wi-Fi signals
- Jammer
- Microwave Oven

- WiFi Invalid Channel—Device using nonstandard Wi-Fi channels
- TDD Transmitter
- Video Camera
- SuperAG—802.11 SuperAG device
- WiMax Mobile
- WiMax Fixed
- 802.15.4
- Microsoft Device
- SI\_FHSS

**Step 4** Click **Apply**.

## Configuring Interference Reporting for a 2.4-GHz Device (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 24ghz cleanair device {ble-beacon   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 }</b> <b>Example:</b> Device(config)# <b>ap dot11 24ghz cleanair device ble-beacon</b> Device(config)# <b>ap dot11 24ghz cleanair device bt-discovery</b> Device(config)# <b>ap dot11 24ghz cleanair device bt-link</b> Device(config)# <b>ap dot11 24ghz cleanair device canopy</b> Device(config)# <b>ap dot11 24ghz cleanair device cont-tx</b>	Configures the 2.4-GHz interference devices to report to the device. Run the <b>no</b> form of this command to disable the configuration. The following is a list of the keyword descriptions: <ul style="list-style-type: none"> <li>• <b>ble-beacon</b>—Bluetooth low energy beacon</li> <li>• <b>bt-discovery</b>—Bluetooth discovery</li> <li>• <b>bt-link</b>—Bluetooth link</li> <li>• <b>canopy</b>—Canopy device</li> <li>• <b>cont-tx</b>—Continuous transmitter</li> <li>• <b>dect-like</b>—Digital Enhanced Cordless Communication-like phone</li> <li>• <b>fh</b>—802.11-frequency hopping device</li> <li>• <b>inv</b>—Device using spectrally inverted Wi-Fi signals</li> </ul>

	Command or Action	Purpose
	<pre>Device(config)# ap dot11 24ghz cleanair device dect-like</pre> <pre>Device(config)# ap dot11 24ghz cleanair device fh</pre> <pre>Device(config)# ap dot11 24ghz cleanair device inv</pre> <pre>Device(config)# ap dot11 24ghz cleanair device jammer</pre> <pre>Device(config)# ap dot11 24ghz cleanair device mw-oven</pre> <pre>Device(config)# ap dot11 24ghz cleanair device nonstd</pre> <pre>Device(config)# ap dot11 24ghz cleanair device report</pre> <pre>Device(config)# ap dot11 24ghz cleanair device superag</pre> <pre>Device(config)# ap dot11 24ghz cleanair device tdd-tx</pre> <pre>Device(config)# ap dot11 24ghz cleanair device video</pre> <pre>Device(config)# ap dot11 24ghz cleanair device wimax-fixed</pre> <pre>Device(config)# ap dot11 24ghz cleanair device wimax-mobile</pre> <pre>Device(config)# ap dot11 24ghz cleanair device xbox</pre> <pre>Device(config)# ap dot11 24ghz cleanair device zigbee</pre> <pre>Device(config)# ap dot11 24ghz cleanair device alarm</pre>	<ul style="list-style-type: none"> <li>• <b>jammer</b>—Jammer</li> <li>• <b>mw-oven</b>—Microwave oven</li> <li>• <b>nonstd</b>—Device using nonstandard Wi-Fi channels</li> <li>• <b>report</b>—Interference device reporting</li> <li>• <b>superag</b>—802.11 SuperAG device</li> <li>• <b>tdd-tx</b>—TDD transmitter</li> <li>• <b>video</b>—Video camera</li> <li>• <b>wimax-fixed</b>—WiMax Fixed</li> <li>• <b>wimax-mobile</b>—WiMax Mobile</li> <li>• <b>microsoft xbox</b>—Microsoft Xbox device</li> <li>• <b>zigbee</b>—802.15.4 device</li> </ul>
<b>Step 3</b>	<pre>end</pre> <p><b>Example:</b></p> <pre>Device(config)# end</pre>	Returns to privileged EXEC mode. Alternatively, you can also press <b>Ctrl-Z</b> to exit global configuration mode.

## Enabling CleanAir for the 5-GHz Band (GUI)

### Procedure

**Step 1** Choose **Configuration > Radio Configurations > CleanAir**



- Step 2** On the **CleanAir** page, click the **me5 GHz Band > General** tab.
- Step 3** Check the **Enable CleanAir** checkbox.
- Step 4** Click **Apply**.

## Enabling CleanAir for the 5-GHz Band (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# <code>configure terminal</code>	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 5ghz cleanair</b> <b>Example:</b> Device(config)# <code>ap dot11 5ghz cleanair</code> Device(config)# <code>no ap dot11 5ghz cleanair</code>	Enables the CleanAir feature on a 802.11a network. Run the <b>no</b> form of this command to disable CleanAir on the 802.11a network.
<b>Step 3</b>	<b>end</b> <b>Example:</b> Device(config)# <code>end</code>	Returns to privileged EXEC mode. Alternatively, you can also press <b>Ctrl-Z</b> to exit global configuration mode.

## Configuring Interference Reporting for a 5-GHz Device (GUI)

### Procedure

- Step 1** Choose **Configuration > Radio Configurations > CleanAir**.
- Step 2** Click the **5 GHz Band** tab.
- Step 3** Choose the interference types and add them to the **Interference Types to detect** section.

The following interference types are available:

- Canopy
- Continuous Transmitter
- DECT-like Phone—Digital Enhanced Cordless Technology phone
- 802.11 FH—802.11 frequency hopping device
- WiFi Inverted—Device using spectrally inverted Wi-Fi signals
- Jammer
- WiFi Invalid Channel—Device using nonstandard Wi-Fi channels

- SuperAG—802.11 SuperAG device
- TDD Transmitter
- WiMax Mobile
- WiMax Fixed
- Video Camera

**Step 4** Click **Apply**.

## Configuring Interference Reporting for a 5-GHz Device (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 5ghz cleanair device {canopy   cont-tx   dect-like   inv   jammer   nonstd   report   superag   tdd-tx   video   wimax-fixed   wimax-mobile}</b>  <b>Example:</b>  Device(config)# <b>ap dot11 5ghz cleanair device canopy</b>  Device(config)# <b>ap dot11 5ghz cleanair device cont-tx</b>  Device(config)# <b>ap dot11 5ghz cleanair device dect-like</b>  Device(config)# <b>ap dot11 5ghz cleanair device inv</b>  Device(config)# <b>ap dot11 5ghz cleanair device jammer</b>  Device(config)# <b>ap dot11 5ghz cleanair device nonstd</b>  Device(config)# <b>ap dot11 5ghz cleanair device report</b>  Device(config)# <b>ap dot11 5ghz cleanair device superag</b>	Configures a 5-GHz interference device to report to the device. Run the <b>no</b> form of this command to disable interference device reporting.  The following is a list of the keyword descriptions: <ul style="list-style-type: none"> <li>• <b>canopy</b>—Canopy device</li> <li>• <b>cont-tx</b>—Continuous transmitter</li> <li>• <b>dect-like</b>—Digital Enhanced Cordless Communication-like phone</li> <li>• <b>fh</b>—802.11-frequency hopping device</li> <li>• <b>inv</b>—Device using spectrally-inverted Wi-Fi signals</li> <li>• <b>jammer</b>—Jammer</li> <li>• <b>nonstd</b>—Device using nonstandard Wi-Fi channels</li> <li>• <b>superag</b>—802.11 SuperAG device</li> <li>• <b>tdd-tx</b>—TDD transmitter</li> <li>• <b>video</b>—Video camera</li> <li>• <b>wimax-fixed</b>—WiMax fixed</li> </ul>

	Command or Action	Purpose
	<pre>Device(config)#ap dot11 5ghz cleanair device tdd-tx  Device(config)#ap dot11 5ghz cleanair device video  Device(config)#ap dot11 5ghz cleanair device wimax-fixed  Device(config)#ap dot11 5ghz cleanair device wimax-mobile  Device(config)#ap dot11 5ghz cleanair device si_fhss  Device(config)#ap dot11 5ghz cleanair device alarm</pre>	<ul style="list-style-type: none"> <li>• <b>wimax-mobile</b>—WiMax mobile</li> </ul>
<b>Step 3</b>	<pre>end  Example: Device(config)# end</pre>	Returns to privileged EXEC mode. Alternatively, you can also press <b>Ctrl-Z</b> to exit global configuration mode.

## Configuring Event Driven RRM for a CleanAir Event (GUI)

### Procedure

- Step 1** Choose **Configuration > Radio Configurations > RRM**. The **Radio Resource Management** page is displayed.
- Step 2** Click the **DCA** tab.
- Step 3** In the **Event Driven RRM** section, check the **EDRRM** check box to run RRM when CleanAir-enabled AP detects a significant level of interference.
- Step 4** Configure the **Sensitivity Threshold** level at which RRM has to be invoked from the following options:
- **Low**: Represents a decreased sensitivity to changes in the environment and its value is set at 35.
  - **Medium**: Represents medium sensitivity to changes in the environment at its value is set at 50.
  - **High**: Represents increased sensitivity to changes in the environment at its value is set at 60.
  - **Custom**: If you choose this option, you must specify a custom value in the **Custom Threshold** box.
- Step 5** To configure rogue duty cycle, check the **Rogue Contribution** check box and then specify the **Rogue Duty-Cycle** in terms of percentage. The default value of rogue duty cycle is 80 percent.
- Note** Rogue Contribution is a new component included in ED-RRM functionality. Rogue Contribution allows ED-RRM to trigger based on identified Rogue Channel Utilization, which is completely separate from CleanAir metrics. Rogue Duty Cycle comes from normal off channel RRM metrics, and invokes a channel change based on neighboring rogue interference. Because this comes from RRM metrics and not CleanAir, the timing - assuming normal 180 second off channel intervals - would be within 3 minutes or 180 seconds worst case. It is configured separately from CleanAir ED-RRM and is disabled by default. This allows the AP to become reactive to Wi-Fi interference that is not coming from own network and is measured at each individual AP.

**Step 6** Save the configuration.

## Configuring EDRRM for a CleanAir Event (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# <code>configure terminal</code>	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 {24ghz   5ghz} rrm channel cleanair-event</b> <b>Example:</b> Device(config)# <code>ap dot11 24ghz rrm channel cleanair-event</code> Device(config)# <code>no ap dot11 24ghz rrm channel cleanair-event</code>	Enables EDRRM CleanAir event. Run the <b>no</b> form of this command to disable EDRRM.
<b>Step 3</b>	<b>ap dot11 {24ghz   5ghz} rrm channel cleanair-event [sensitivity {custom   high   low   medium}]</b> <b>Example:</b> Device(config)# <code>ap dot11 24ghz rrm channel cleanair-event sensitivity high</code>	Configures the EDRRM sensitivity of the CleanAir event. The following is a list of the keyword descriptions: <ul style="list-style-type: none"> <li>• <b>Custom</b>—Specifies custom sensitivity to non-Wi-Fi interference as indicated by the AQ value.</li> <li>• <b>High</b>—Specifies the most sensitivity to non-Wi-Fi interference as indicated by the AQ value.</li> <li>• <b>Low</b>—Specifies the least sensitivity to non-Wi-Fi interference as indicated by the AQ value.</li> <li>• <b>Medium</b>—Specifies medium sensitivity to non-Wi-Fi interference as indicated by the AQ value.</li> </ul>
<b>Step 4</b>	<b>end</b> <b>Example:</b> Device(config)# <code>end</code>	Returns to privileged EXEC mode. Alternatively, you can also press <b>Ctrl-Z</b> to exit global configuration mode.

# CleanAir Pro Scanning

## Feature History for CleanAir Pro Scanning

This table provides release and related information about the feature explained in this section.

This feature is also available in all the releases subsequent to the one in which they are introduced in, unless noted otherwise.

*Table 2: Feature History for CleanAir Pro Scanning*

Release	Feature	Feature Information
Cisco IOS XE Cupertino 17.9.1	CleanAir Pro Scanning	The CleanAir Pro Scanning feature monitors and reports the different categories of non-Wi-Fi interference in the 2.4-GHz and 5-GHz bands.

## Information About CleanAir Pro Scanning

CleanAir Pro Scanning monitors and provides reports on the different categories of non-Wi-Fi interference, for the 2.4-GHz band and the 5-GHz band. The CleanAir Pro Scanning feature reports the type of interferer, the severity of the interference, and the impacted channels, to the controller, through the Interference Device Reports (IDRs). The air quality (AQ) metric report for each Dynamic Channel Assignment (DCA) channel, contains all the detected non-Wi-Fi interferers and the severity of each interferer.




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**Note** The CleanAir Pro Scanning feature is applicable only for APs with CleanAir Pro-supported radios.

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The controller maintains a database of the active interferers reported from each AP. The controller merges interferers across APs if the same interferer is observed across APs. The controller tracks the air quality for each channel and uses the air quality metric report in the channel selection for each AP.

CleanAir Pro Scanning scans channels in slots or bands that are currently enabled on an AP. Channel enablement under DCA is applicable only if you selected the **dca** keyword under the **ap dot11 rrm monitor channel-list** command. The **country** keyword monitors the regulatory channels, and the **all** keyword monitors all channels (everything that the radio can scan, regardless of regulatory constraints).

### Interference Device Reports (IDR)

Each AP detects non-Wi-Fi interferers, the duty cycle, Received Signal Strength Indicator (RSSI) in dBm, and a calculated metric known as Severity. These details are sent to the controller through the Interference Device Report (IDR) messages. The IDR event types, such as UP, UPDT, and DOWN, inform the controller about when each interferer was first detected (UP), when the interferer was updated (UPDT), and when it is no longer seen (DOWN). The controller keeps a list of these interferers along with key information, including the channels that are impacted by the interferer on a per-AP basis.

In an AP, interferers are merged with those that are detected on the same channel, same RSSI, and same device signature. This merge occurs on a controller across APs reporting the same type of interferer.

### Air Quality Index Reports

The Air Quality (AQ) metric is calculated for each AP, and is the inverse of the cumulative severity metrics. AQ starts at 100 (good) and is decremented by each reported interference source severity metric. For example, if three Bluetooth devices are reported by an AP, each with a severity of two, this will result in the overall cell AQ of 94 ( $2 \times 3 \text{ BT} = 6$ ,  $100 - 6 = \text{AQ of } 94$ ).



**Note** Cisco IOS XE Cupertino 17.9.1 supports 6-GHz only for spectral analysis on Cisco Catalyst Center. IDR and AQ are not supported for the 6-GHz band in Cisco IOS XE Cupertino 17.9.1.

## Enabling CleanAir Pro Scanning (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 2</b>	<b>ap dot11 6ghz cleanair</b> <b>Example:</b> Device(config)# ap dot11 6ghz cleanair	Configures the CleanAir features for the 6-GHz radios.
<b>Step 3</b>	<b>ap dot11 {24ghz   5ghz} cleanair</b> <b>Example:</b> Device(config)# ap dot11 24ghz cleanair	Configures the CleanAir features for the 2.4-GHz or 5-GHz radios.
<b>Step 4</b>	<b>ap dot11 {24ghz   5ghz} cleanair alarm air-quality</b> <b>Example:</b> Device(config)# ap dot11 24ghz cleanair alarm air-quality	Configures CleanAir alarm for air quality in the 2.4-GHz or 5-GHz radios.
<b>Step 5</b>	<b>ap dot11 {24ghz   5ghz} cleanair alarm air-quality threshold <i>threshold-value</i></b> <b>Example:</b> Device(config)# ap dot11 24ghz cleanair alarm air-quality threshold 25	Configures the air quality threshold value of CleanAir alarm in the 2.4-GHz or 5-GHz radios. The valid range is between 1 and 100.
<b>Step 6</b>	<b>ap dot11 {24ghz   5ghz} cleanair alarm device cont-tx</b> <b>Example:</b> Device(config)# ap dot11 24ghz cleanair alarm device cont-tx	Configures the continuous transmitter as the interference device CleanAir alarm in the 2.4-GHz or 5-GHz radios.

	Command or Action	Purpose
<b>Step 7</b>	<b>ap dot11 {24ghz   5ghz} cleanair alarm unclassified</b>  <b>Example:</b> Device(config)# ap dot11 24ghz cleanair alarm unclassified	Configures the air quality alarm on exceeding unclassified category severity.
<b>Step 8</b>	<b>ap dot11 {24ghz   5ghz} cleanair alarm unclassified threshold <i>threshold-value</i></b>  <b>Example:</b> Device(config)# ap dot11 24ghz cleanair alarm unclassified threshold 15	Configures the air quality alarm on exceeding unclassified category severity threshold. The valid range is between 1 and 100.
<b>Step 9</b>	<b>ap dot11 {24ghz   5ghz} cleanair device cont-tx</b>  <b>Example:</b> Device(config)# ap dot11 24ghz cleanair device cont-tx	Configure continuous transmitter as the CleanAir interference device type.

## Monitoring CleanAir Pro Statistics (GUI)

### Procedure

- 
- Step 1** Choose **Monitoring > Wireless > CleanAir Statistics**. The **CleanAir Statistics** window is displayed.
  - Step 2** Click the **5 GHz Band** tab or the **2.4 GHz Band** tab. The **CleanAir Interference Devices** tab is selected by default. You can monitor and detect the cluster IDs, the interferer type, severity, the affected channels, and so on, for the listed APs.
  - Step 3** Click the listed devices under the **CleanAir Interference Devices** tab to view the **CleanAir Interference Charts** that displays the **AQ Graph** and the **Interference Power**.
  - Step 4** Click the **Air Quality** tab to monitor the channel, the average and minimum AQ, number of interferers, the time at which the interference was detected, and the spectrum AP type.
  - Step 5** Click the **Worst Air Quality Report** tab to view the AQ report, with details of the AP that reported the worst AQ, the radio channel number with the worst-reported air quality, the minimum and the average AQ index, the interference device count, and the spectrum AP type.
- 

## Verifying CleanAir Pro Scanning Details

To view the CleanAir Air Quality (AQ) data, run the following command:

```
Device# show ap dot11 {24ghz | 5ghz} cleanair air-quality summary
```

To view the CleanAir Air Quality (AQ) worst data, run the following command:

```
Device# show ap dot11 {24ghz | 5ghz} cleanair air-quality worst
```

To view the CleanAir device cluster information, run the following command:

```
Device# show ap dot11 {24ghz | 5ghz} cleanair device cluster cluster-id
```

To view the CleanAir interferers of a device type, run the following command:

```
Device# show ap dot11 {24ghz | 5ghz} cleanair device type
```

To view the CleanAir configuration for a specific AP, run the following commands:

```
Device# show ap name ap-name dot11 {24ghz | 5ghz} cleanair air-quality
```

```
Device# show ap name ap-name dot11 {24ghz | 5ghz} cleanair device
```

## Verifying CleanAir Parameters

You can verify CleanAir parameters using the following commands:

**Table 3: Commands for verifying CleanAir**

Command Name	Description
show ap dot11 24ghz cleanair device type all	Displays all the CleanAir interferers for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type ble-beacon	Displays all the Bluetooth BLE beacons for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type bt-discovery	Displays CleanAir interferers of type BT Discovery for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type bt-link	Displays CleanAir interferers of type BT Link for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type canopy	Displays CleanAir interferers of type Canopy for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type cont-tx	Displays CleanAir interferers of type Continuous transmitter for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type dect-like	Displays CleanAir interferers of type DECT Like for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type fh	Displays CleanAir interferers of type 802.11FH for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type inv	Displays CleanAir interferers of type Wi-Fi Inverted for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type jammer	Displays CleanAir interferers of type Jammer for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type mw-oven	Displays CleanAir interferers of type MW Oven for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type nonstd	Displays CleanAir interferers of type Wi-Fi inverted channel for the 2.4-GHz band.



Command Name	Description
show ap dot11 24ghz cleanair device type superag	Displays CleanAir interferers of type SuperAG for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type tdd-tx	Displays CleanAir interferers of type TDD Transmit for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type video	Displays CleanAir interferers of type Video Camera for the 2.4-GHz band.
show ap dot11 24ghz cleanair device type wimax-fixed	Displays CleanAir interferers of type WiMax Fixed for the 2.4-GHz band.

## Monitoring 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 stop detecting the device temporarily. This device is then correctly marked as down. Such a device is correctly removed from the spectrum database. In cases when all the interferer detections for a specific device 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 for longer and they are remerged into a single record upon detection. This process smoothens the user records and accurately represents the device history.




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**Note** The following is a prerequisite for monitoring the interference devices:  
You can configure Cisco CleanAir only on CleanAir-enabled access points.

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## Configuration Examples for CleanAir

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

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

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:

```
Device#configure terminal
Device(config)#ap dot11 24ghz rrm channel cleanair-event
```

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

This example shows how to enable an access point in the monitor mode:

```
Device#ap name <ap-name> mode monitor
```

## CleanAir FAQs

- Q.** Multiple access points detect the same interference device. However, the device shows them as separate clusters or different suspected devices clustered together. Why does this happen?
- A.** Access points must be RF neighbors for the device to consider merging the devices that are detected by these access points. An access point takes time to establish neighbor relationships. A few minutes after the device reboots or after there is a change in the RF group, and similar events, clustering will not be very accurate.
- Q.** How do I view neighbor access points?
- A.** To view neighbor access points, use the **show ap ap\_name auto-rf dot11 {24ghz | 5ghz}** command.

This example shows how to display the neighbor access points:

```
Device#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 AP debug commands available for CleanAir?
- A.** The AP debug commands for CleanAir are:
- **debug cleanair {bringup | event | logdebug | low | major | nsi | offchan}**
  - **debug rrm {neighbor | off-channel | reports}**