



# Managing Rogue Devices

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## Rogue Detection

### Rogue Devices

Rogue access points can disrupt wireless LAN operations by hijacking legitimate clients and using plain-text or other denial-of-service or man-in-the-middle attacks. That is, a hacker can use a rogue access point to capture sensitive information, such as usernames and passwords. The hacker can then transmit a series of Clear to Send (CTS) frames. This action mimics an access point, informing a particular client to transmit, and instructing all the other clients to wait, which results in legitimate clients being unable to access network resources. Wireless LAN service providers have a strong interest in banning rogue access points from the air space.

Because rogue access points are inexpensive and readily available, employees sometimes plug unauthorized rogue access points into existing LANs and build ad hoc wireless networks without their IT department's knowledge or consent. These rogue access points can be a serious breach of network security because they can be plugged into a network port behind the corporate firewall. Because employees generally do not enable any security settings on the rogue access point, it is easy for unauthorized users to use the access point to intercept network traffic and hijack client sessions. There is an increased chance of enterprise security breach when wireless users connect to access points in the enterprise network.

The following are some guidelines to manage rogue devices:

- The access points are designed to serve associated clients. These access points spend relatively less time performing off-channel scanning: about 50 milliseconds on each channel. If you want to detect a large number of rogue APs and clients with high sensitivity, a monitor mode access point must be used. Alternatively, you can reduce the scan intervals from 180 seconds to a lesser value, for example, 120 or 60 seconds, ensuring that the radio goes off-channel more frequently, which improves the chances of rogue detection. However, the access point continues to spend about 50 milliseconds on each channel.

- Rogue detection is disabled by default for OfficeExtend access points because these access points, which are deployed in a home environment, are likely to detect many rogue devices.
- Client card implementation might mitigate the effectiveness of containment. This normally happens when a client might quickly reconnect to the network after receiving a "de-association/de-authentication" frame, so it might still be able to pass some traffic. However, the browsing experience of the rogue client would be badly affected when it is contained.
- It is possible to classify and report rogue access points by using rogue states and user-defined classification rules that enable rogues to automatically move between states.
- Each controller limits the number of rogue containments to three and six per radio for access points in the monitor mode.
- When manual containment is performed using configuration, the rogue entry is retained even after the rogue entry expires.
- When a rogue entry expires, the managed access points are instructed to stop any active containment on it.
- To validate a Rogue Client against AAA, add the rogue client MAC to the AAA user-database with relevant delimiter, username, and password being the MAC address with relevant delimiter. The Access-Accept contains the Cisco-AV-pair with one of the following keywords:

**rogue-ap-state=state**




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**Note** Here, **state** can be of three types, namely: alert, threat, and contain.

For instance, **rogue-ap-state=threat**.

If Access-Accept has no AV-Pair rogue-ap-class or an invalid value of rogue-ap-class, such a rogue client state is set to either of the following:

- Contained, if the config is set to autocontain clients or untrusted AP.
- Threat

The Radius Access-Reject for rogue client AAA validation is ignored.

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- When Validate Rogue Clients Against AAA is enabled, the controller requests the AAA server for rogue client validation only once. As a result, if rogue client validation fails on the first attempt then the rogue client will not be detected as a threat any more. To avoid this, add the valid client entries in the authentication server before enabling Validate Rogue Clients Against AAA.

### Restrictions on Rogue Detection

- Rogue containment is not supported on DFS channels.

A rogue access point is moved to a contained state either automatically or manually. The controller selects the best available access point for containment and pushes the information to the access point. The access point stores the list of containments per radio. For auto containment, you can configure the controller to use only the monitor mode access point. The containment operation occurs in the following two ways:

- The container access point goes through the list of containments periodically and sends unicast containment frames. For rogue access point containment, the frames are sent only if a rogue client is associated.
- Whenever a contained rogue activity is detected, containment frames are transmitted.

Individual rogue containment involves sending a sequence of unicast disassociation and deauthentication frames.

From 17.7.1 release onwards, Beacon DS Attack and Beacon Wrong Channel signatures were introduced.

**Beacon DS Attack**—When managed and rogue APs use the same BSSID, the rogue APs are termed as impersonators. An attacker can add the Direct-Sequence parameter set information element with any channel number. If the added channel number is different from the channel number used by the managed AP, the attack is termed as Beacon DS Attack.

**Beacon Wrong Channel**—When managed and rogue APs use the same BSSID, the rogue APs are termed as AP impersonators. If an AP impersonator uses a channel number that is different from the one used by the managed AP with the same BSSID, the attack is termed as Beacon Wrong Channel. In such a case, the Direct-Sequence Information Element might not even be present in the Beacon frame.

## Information About Rogue Containment (Protected Management Frames (PMF) Enabled)

From Cisco IOS XE Amsterdam, 17.3.1 onwards, rogue devices that are enabled with 802.11w Protected Management Frames (PMF) are not contained. Instead, the rogue device is marked as *Contained Pending*, and a WSA alarm is raised to inform about the Contained Pending event. Because the device containment is not performed, access point (AP) resources are not consumed unnecessarily.



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**Note** This feature is supported only on the Wave 2 APs.

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Run the **show wireless wps rogue ap detailed** command to verify the device containment, when PMF is enabled on a rogue device.

## AP Impersonation Detection

The various methods to detect AP impersonation are:

- AP impersonation can be detected if a managed AP reports itself as Rogue. This method is always enabled and no configuration is required.
- AP impersonation detection is based on MFP.
- AP impersonation detection based on AP authentication.

Infrastructure MFP protects 802.11 session management functions by adding message integrity check (MIC) information elements, to the management frames sent by APs (and not those sent by clients), which are then validated by other APs in the network. If infrastructure MFP is enabled, the managed APs check if the MIC information elements are present and if MIC information elements are as expected. If either of these conditions is not fulfilled, the managed AP sends rogue AP reports with updated AP authentication failure counter.

The AP Authentication functionality allows you to detect AP impersonation. When you enable this functionality, the controller creates an AP domain secret and shares it with other APs in the same network. This allows the APs to authenticate each other.

An AP Authentication information element is attached to beacon and probe response frames. If the AP Authentication information element has an incorrect Signature field, or the timestamp is off, or if the AP Authentication information element is missing, then the AP that has detected such a condition increments the **AP authentication failure count** field. An impersonation alarm is raised after the **AP authentication failure count** field breaches its threshold. The rogue AP is classified as **Malicious** with state **Threat**.

Run the **show wireless wps rogue ap detail** command to see when the impersonation is detected due to authentication errors.

## Configuring Rogue Detection (GUI)

### Procedure

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- Step 1** Choose **Configuration > Tags & Profiles > AP Join**.
  - Step 2** Click the **AP Join Profile Name** to edit the AP join profile properties.
  - Step 3** In the **Edit AP Join Profile** window, click the **Rogue AP** tab.
  - Step 4** Check the **Rogue Detection** check box to enable rogue detection.
  - Step 5** In the **Rogue Detection Minimum RSSI** field, enter the RSSI value.
  - Step 6** In the **Rogue Detection Transient Interval** field, enter the interval in seconds.
  - Step 7** In the **Rogue Detection Report Interval** field, enter the report interval value in seconds.
  - Step 8** In the **Rogue Detection Client Number Threshold** field, enter the threshold for rogue client detection.
  - Step 9** Check the **Auto Containment on FlexConnect Standalone** check box to enable auto containment.
  - Step 10** Click **Update & Apply to Device**.
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## Configuring Rogue Detection (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 profile <i>profile-name</i> rogue detection min-transient-time <i>time in seconds</i></b>  <b>Example:</b> Device(config)# <b>ap profile profile1</b>  Device(config)# <b>rogue detection min-transient-time 120</b>	Specify the time interval at which rogues have to be consistently scanned for by APs after the first time the rogues are scanned.  Valid range for the time in sec parameter is 120 seconds to 1800 seconds, and the default value is 0.

	Command or Action	Purpose
		<p><b>Note</b></p> <p>This feature is applicable to all AP modes.</p> <p>Using the transient interval values, you can control the time interval at which APs should scan for rogues. APs can also filter the rogues based on their transient interval values.</p> <p>This feature has the following advantages:</p> <ul style="list-style-type: none"> <li>• Rogue reports from APs to the controller are shorter</li> <li>• Transient rogue entries are avoided in the controller</li> </ul> <p>Unnecessary memory allocation for transient rogues are avoided</p>
<b>Step 3</b>	<p><b>ap profile <i>profile-name</i> rogue detection containment {<b>auto-rate</b>   <b>flex-rate</b>}</b></p> <p><b>Example:</b></p> <pre>Device(config)# ap profile profile1 Device(config)# rogue detection containment flex-rate</pre>	Specifies the rogue containment options. The <b>auto-rate</b> option enables auto-rate for containment of rogues. The <b>flex-rate</b> option enables rogue containment of standalone flexconnect APs.
<b>Step 4</b>	<p><b>ap profile <i>profile-name</i> rogue detection enable</b></p> <p><b>Example:</b></p> <pre>Device(config)# ap profile profile1</pre>	Enables rogue detection on all APs.
<b>Step 5</b>	<p><b>ap profile <i>profile-name</i> rogue detection report-interval <i>time in seconds</i></b></p> <p><b>Example:</b></p> <pre>Device(config)# ap profile profile1 Device(config)# rogue detection report-interval 120</pre>	<p>Configures rogue report interval for monitor mode Cisco APs.</p> <p>The valid range for reporting the interval in seconds is 10 seconds to 300 seconds.</p>

## Configuring RSSI Deviation Notification Threshold for Rogue APs (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p>	Enters global configuration mode.

	Command or Action	Purpose
	Device# <code>configure terminal</code>	
<b>Step 2</b>	<b>wireless wps rogue ap notify-rssi-deviation</b> <b>Example:</b> Device(config)# <code>wireless wps rogue ap notify-rssi-deviation</code>	Configures RSSI deviation notification threshold for Rogue APs.
<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 Management Frame Protection (GUI)

### Procedure

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- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
  - Step 2** In the **Rogue Policy** tab, under the **MFP Configuration** section, check the **Global MFP State** check box and the **AP Impersonation Detection** check box to enable the global MFP state and the AP impersonation detection, respectively.
  - Step 3** In the **MFP Key Refresh Interval** field, specify the refresh interval in hours.
  - Step 4** Click **Apply**.
- 

## Configuring Management Frame Protection (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>wireless wps mfp</b> <b>Example:</b> Device(config)# <code>wireless wps mfp</code>	Configures a management frame protection.
<b>Step 3</b>	<b>wireless wps mfp {ap-impersonation   key-refresh-interval}</b> <b>Example:</b> Device(config)# <code>wireless wps mfp ap-impersonation</code>	Configures ap impersonation detection (or) MFP key refresh interval in hours.  key-refresh-interval—Refers to the MFP key refresh interval in hours. The valid range is from 1 to 24. Default value is 24.

	Command or Action	Purpose
	Device(config)# wireless wps mfp key-refresh-interval	
<b>Step 4</b>	<b>end</b> <b>Example:</b> Device(config)# end	Saves the configuration and exits configuration mode and returns to privileged EXEC mode.

## Enabling Access Point Authentication

### 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>wireless wps ap-authentication</b> <b>Example:</b> Device(config)# wireless wps ap-authentication	Configures the wireless WPS AP authentication.
<b>Step 3</b>	<b>wireless wps ap-authentication threshold threshold</b> <b>Example:</b> Device(config)# wireless wps ap-authentication threshold 100	Configures AP neighbor authentication and sets the threshold for AP authentication failures.
<b>Step 4</b>	<b>wlan wlan-name wlan-id SSID-name</b> <b>Example:</b> Device(config)# wlan wlan-demo 1 ssid-demo	Configures a WLAN.
<b>Step 5</b>	<b>ccx aironet-iesupport</b> <b>Example:</b> Device(config-wlan)# ccx aironet-iesupport	Enables support for Aironet Information Elements on this WLAN.
<b>Step 6</b>	<b>end</b> <b>Example:</b> Device# end	Returns to privileged EXEC mode.

## Verifying Management Frame Protection

To verify if the Management Frame Protection (MFP) feature is enabled or not, use the following command:

```

Device# show wireless wps summary
Client Exclusion Policy
  Excessive 802.11-association failures : unknown
  Excessive 802.11-authentication failures: unknown
  Excessive 802.1x-authentication      : unknown
  IP-theft                             : unknown
  Excessive Web authentication failure  : unknown
  Failed Qos Policy                    : unknown

Management Frame Protection
  Global Infrastructure MFP state : Enabled
  AP Impersonation detection     : Disabled
  Key refresh interval          : 15

```

To view the MFP details, use the following command:

```

Device# show wireless wps mfp summary
Management Frame Protection
  Global Infrastructure MFP state : Enabled
  AP Impersonation detection     : Disabled
  Key refresh interval          : 15

```

## Verifying Rogue Detection

This section describes the new command for rogue detection.

The following command can be used to verify rogue detection on the device.

**Table 1: Verifying Adhoc Rogues Information**

Command	Purpose
<b>show wireless wps rogue adhoc detailed</b> <i>mac_address</i>	Displays the detailed information for an Adhoc rogue.
<b>show wireless wps rogue adhoc summary</b>	Displays a list of all Adhoc rogues.

**Table 2: Verifying Rogue AP Information**

Command	Purpose
<b>show wireless wps rogue ap clients</b> <i>mac_address</i>	Displays the list of all rogue clients associated with a rogue.
<b>show wireless wps rogue ap custom summary</b>	Displays the custom rogue AP information.
<b>show wireless wps rogue ap detailed</b> <i>mac_address</i>	Displays the detailed information for a rogue AP.
<b>show wireless wps rogue ap friendly summary</b>	Displays the friendly rogue AP information.
<b>show wireless wps rogue ap list</b> <i>mac_address</i>	Displays the list of rogue APs detected by a given AP.
<b>show wireless wps rogue ap malicious summary</b>	Displays the malicious rogue AP information.
<b>show wireless wps rogue ap summary</b>	Displays a list of all Rogue APs.
<b>show wireless wps rogue ap unclassified summary</b>	Displays the unclassified rogue AP information.



**Table 3: Verifying Rogue Auto-Containment Information**

Command	Purpose
<code>show wireless wps rogue auto-contain</code>	Displays the rogue auto-containment information.

**Table 4: Verifying Classification Rule Information**

Command	Purpose
<code>show wireless wps rogue rule detailed <i>rule_name</i></code>	Displays the detailed information for a classification rule.
<code>show wireless wps rogue rule summary</code>	Displays the list of all rogue rules.

**Table 5: Verifying Rogue Statistics**

Command	Purpose
<code>show wireless wps rogue stats</code>	Displays the rogue statistics.

**Table 6: Verifying Rogue Client Information**

Command	Purpose
<code>show wireless wps rogue client detailed <i>mac_address</i></code>	Displays detailed information for a Rogue client.
<code>show wireless wps rogue client summary</code>	Displays a list of all the Rogue clients.

**Table 7: Verifying Rogue Ignore List**

Command	Purpose
<code>show wireless wps rogue ignore-list</code>	Displays the rogue ignore list.

## Examples: Rogue Detection Configuration

This example shows how to configure the minimum RSSI that a detected rogue AP needs to be at, to have an entry created in the device:

```
Device# wireless wps rogue ap notify-min-rssi 100
```

This example shows how to configure the classification interval:

```
Device# configure terminal
Device(config)#
Device(config)#
Device(config)# end
Device# show wireless wps rogue client /show wireless wps rogue ap summary
```

## Configuring Rogue Policies (GUI)

### Procedure

- 
- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
- Step 2** In the **Rogue Policies** tab, use the **Rogue Detection Security Level** drop-down to select the security level.
- Step 3** In the **Expiration timeout for Rogue APs (seconds)** field, enter the timeout value.
- Step 4** Select the **Validate Rogue Clients against AAA** check box to validate rogue clients against AAA server.
- Step 5** Select the **Validate Rogue APs against AAA** check box to validate rogue access points against AAA server.
- Step 6** In the **Rogue Polling Interval (seconds)** field, enter the interval to poll the AAA server for rogue information.
- Step 7** Select the **Detect and Report Adhoc Networks** check box to enable detection of rogue adhoc networks.
- Step 8** In the **Rogue Detection Client Number Threshold** field, enter the threshold to generate SNMP trap.
- Step 9** In the **Auto Contain** section, enter the following details.
- Step 10** Use the **Auto Containment Level** drop-down to select the level.
- Step 11** Select the **Auto Containment only for Monitor Mode APs** check box to limit the auto-containment only to monitor mode APs.
- Step 12** Select the **Rogue on Wire** check box to limit the auto-containment only to rogue APs on wire.
- Step 13** Select the **Using our SSID** check box to limit the auto-containment only to rogue APs using one of the SSID configured on the controller.
- Step 14** Select the **Adhoc Rogue AP** check box to limit the auto-containment only to adhoc rogue APs.
- Step 15** Click **Apply**.
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## Configuring Rogue Policies (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>wireless wps rogue ap timeout <i>number of seconds</i></b>  <b>Example:</b> Device(config)# <code>wireless wps rogue ap timeout 250</code>	Configures the expiration time for rogue entries, in seconds. Valid range for the time in seconds 240 seconds to 3600 seconds.
<b>Step 3</b>	<b>wireless wps rogue client notify-min-rssi <i>RSSI threshold</i></b>  <b>Example:</b>	Configures the minimum RSSI notification threshold for rogue clients. Valid range for the RSSI threshold in dB is -128 - dB to -70 dB.

	Command or Action	Purpose
	Device(config)# <b>wireless wps rogue client notify-min-rssi -128</b>	
<b>Step 4</b>	<b>wireless wps rogue client notify-min-deviation <i>RSSI threshold</i></b> <b>Example:</b> Device(config)# <b>wireless wps rogue client notify-min-deviation 4</b>	Configures the RSSI deviation notification threshold for rogue clients. Valid range for the RSSI threshold in dB is 0 dB to 10 dB.
<b>Step 5</b>	<b>wireless wps rogue ap aaa polling-interval <i>AP AAA Interval</i></b> <b>Example:</b> Device(config)# <b>wireless wps rogue ap aaa polling-interval 120</b>	Configures rogue AP AAA validation interval. The valid range for the AP AAA interval in seconds is 60 seconds to 86400 seconds.
<b>Step 6</b>	<b>wireless wps rogue adhoc</b> <b>Example:</b> Device(config)# <b>wireless wps rogue adhoc</b>	Enables detecting and reporting adhoc rogue (IBSS).
<b>Step 7</b>	<b>wireless wps rogue client client-threshold <i>threshold</i></b> <b>Example:</b> Device(config)# <b>wireless wps rogue client client-threshold 100</b>	Configures the rogue client per a rogue AP SNMP trap threshold. The valid range for the threshold is 0 to 256.

## Rogue Location Discovery Protocol (RLDP)

### Rogue Location Discovery Protocol

Rogue Location Discovery Protocol (RLDP) is an active approach, which is used when rogue AP has no authentication (Open Authentication) configured. This mode, which is disabled by default, instructs an active AP to move to the rogue channel and connect to the rogue as a client. During this time, the active AP sends de-authentication messages to all connected clients and then shuts down the radio interface. Then, it associates to the rogue AP as a client. The AP then tries to obtain an IP address from the rogue AP and forwards a User Datagram Protocol (UDP) packet (port 6352) that contains the local AP and rogue connection information to the controller through the rogue AP. If the controller receives this packet, the alarm is set to notify the network administrator that a rogue AP was discovered on the wired network with the RLDP feature. RLDP has 100 % accuracy in rogue AP detection. It detects Open APs and NAT APs.

Following are some guidelines to manage RLDP:

- Rogue Location Discovery Protocol (RLDP) detects rogue access points that are configured for open authentication.
- RLDP detects rogue access points that use a broadcast Basic Service Set Identifier (BSSID), that is, the access point broadcasts its Service Set Identifier in beacons.

- RLDP detects only those rogue access points that are on the same network. If an access list in the network prevents the sending of RLDP traffic from the rogue access point to the embedded wireless controller, RLDP does not work.
- RLDP does not work on 5-GHz Dynamic Frequency Selection (DFS) channels.
- If RLDP is enabled on mesh APs, and the APs perform RLDP tasks, the mesh APs are dissociated from the embedded wireless controller. The workaround is to disable RLDP on mesh APs.
- If RLDP is enabled on non-monitor APs, client connectivity outages occur when RLDP is in process.

The following steps describe the functioning of RLDP:

1. Identify the closest Unified AP to the rogue using signal strength values.
2. The AP then connects to the rogue as a WLAN client, attempting three associations before timing out.
3. If association is successful, the AP then uses DHCP to obtain an IP address.
4. If an IP address was obtained, the AP (acting as a WLAN client) sends a UDP packet to each of the embedded wireless controller's IP addresses.
5. If the embedded wireless controller receives even one of the RLDP packets from the client, that rogue is marked as on-wire.




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**Note** The RLDP packets are unable to reach the embedded wireless controller if filtering rules are placed between the embedded wireless controller's network and the network where the rogue device is located.

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The embedded wireless controller continuously monitors all the nearby access points and automatically discovers and collects information on rogue access points and clients. When the embedded wireless controller discovers a rogue access point, it uses the Rogue Location Discovery Protocol (RLDP), if RLDP is enabled, to determine if the rogue is attached to your network.

Embedded Wireless Controller initiates RLDP on rogue devices that have open . If RLDP uses FlexConnect or local mode access points, then clients are disconnected for that moment. After the RLDP cycle, the clients are reconnected to the access points. As and when rogue access points are seen , the RLDP process is initiated.

You can configure the embedded wireless controller to use RLDP on all the access points or only on the access points configured for the monitor (listen-only) mode. The latter option facilitates automated rogue access point detection in a crowded radio frequency (RF) space, allowing monitoring without creating unnecessary interference and without affecting the regular data access point functionality. If you configure the embedded wireless controller to use RLDP on all the access points, the embedded wireless controller always chooses the monitor access point for RLDP operation if a monitor access point and a local (data) access point are both nearby. If RLDP determines that the rogue is on your network, you can choose to contain the detected rogue either manually or automatically.

RLDP detects on wire presence of the rogue access points that are configured with open authentication only once, which is the default retry configuration. Retries can be configured using the .

You can initiate or trigger RLDP from embedded wireless controller in three ways:

1. Enter the RLDP initiation command manually from the embedded wireless controller CLI.
2. Schedule RLDP from the embedded wireless controller CLI.

3. Auto RLDP. You can configure auto RLDP on embedded wireless controller either from embedded wireless controller CLI or GUI but keep in mind the following guidelines:
  - The auto RLDP option can be configured only when the rogue detection security level is set to custom.
  - Either auto RLDP or schedule of RLDP can be enabled at a time.

#### Restrictions for RLDP

- RLDP only works with open rogue APs broadcasting their SSID with authentication and encryption disabled.
- RLDP requires that the Managed AP acting as a client is able to obtain an IP address via DHCP on the rogue network.
- Manual RLDP can be used to attempt an RLDP trace on a rogue multiple number of times.
- During RLDP process, the AP is unable to serve clients. This negatively impacts performance and connectivity for local mode APs. To avoid this case, RLDP can be selectively enabled for Monitor Mode AP only.
- RLDP does not attempt to connect to a rogue AP operating in a 5GHz DFS channel.
- RLDP is supported only on Cisco IOS APs.

## Configuring RLDP for Generating Alarms (GUI)

### Procedure

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- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
  - Step 2** In the **RLDP** tab, use the **Rogue Location Discovery Protocol** drop-down to select one of the following options:
    - a) **Disable**: Disables RLDP on all the access points. **Disable** is the default option.
    - b) **All APs**: Enables RLDP on all APs.
    - c) **Monitor Mode APs**: Enables RLDP only on APs in the monitor mode.

**Note** The **Schedule RLDP** check box is enabled only if the **Disable** option is selected. The Schedule RLDP check box remains disabled when you select the **All APs** option or the **Monitor Mode APs** option.
  - Step 3** In the **Retry Count** field, specify the number of retries that should be attempted. The range allowed is between 1 and 5.
  - Step 4** Click **Apply**.
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## Configuring an RLDP for Generating Alarms (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>wireless wps rogue ap rldp alarm-only</b> <b>&lt;monitor-ap-only&gt;</b>  <b>Example:</b> Device(config)# <code>wireless wps rogue ap rldp alarm-only</code>  Device(config)# <code>wireless wps rogue ap rldp alarm-only monitor-ap-only</code>	Enables RLDP to generate alarms. In this method, the RLDP is always enabled.  The <b>monitor-ap-only</b> keyword is optional.  The command with just the <b>alarm-only</b> keyword enables RLDP without any restriction on the AP mode.  The command with <b>alarm-only</b> <b>&lt;monitor-ap-only&gt;</b> keyword enables RLDP in monitor mode access points only.
<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 a Schedule for RLDP (GUI)

### Procedure

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- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
- Step 2** In the **RLDP** tab, choose the following options from the **Rogue Location Discovery Protocol** drop-down list:
- **Disable (default)**: Disables RLDP on all the access points.
- Step 3** In the **Retry Count** field, specify the number of retries that should be attempted. Provide a valid range between 1 to 5.
- Step 4** Check the **Schedule RLDP** check box and then specify the days, start time, and end time for the process to take place.
- Step 5** Click **Apply**.
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## Configuring a Schedule for RLDP (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>wireless wps rogue ap rldp schedule day day start start-time end end-time</b> <b>Example:</b> Device(config)# <code>wireless wps rogue ap rldp schedule day Monday start 10:10:01 end 12:00:00</code>	Enables RLDP based on a scheduled day, start time, and end time.  Here, <i>day</i> is the day when the RLDP scheduling can be done. The values are Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday.  <i>start-time</i> is the start time for scheduling RLDP for the day. You need to enter start time in <b>HH:MM:SS</b> format.  <i>end-time</i> is the end time for scheduling RLDP for the day. You need to enter end time in <b>HH:MM:SS</b> format.
<b>Step 3</b>	<b>wireless wps rogue ap rldp schedule</b> <b>Example:</b> Device(config)# <code>wireless wps rogue ap rldp schedule</code>	Enables the schedule.
<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.

## Configuring an RLDP for Auto-Contain (GUI)

### Procedure

- 
- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
- Step 2** In the **Rogue Policies** tab, under the **Auto Contain** section, check the **Rogue on Wire** checkbox.
- Step 3** Click **Apply**.
-

## Configuring an RLDP for Auto-Contain (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>wireless wps rogue ap rldp auto-contain [monitor-ap-only]</b>  <b>Example:</b> Device(config)# <code>wireless wps rogue ap rldp auto-contain</code>  Device(config)# <code>wireless wps rogue ap rldp auto-contain monitor-ap-only</code>	Enables RLDP to perform auto-contain. In this method, the RLDP is always enabled.  The <b>monitor-ap-only</b> keyword is optional.  The command with just the <b>auto-contain</b> keyword enables RLDP without any restriction on the AP mode.  The command with <b>auto-contain &lt;monitor-ap-only&gt;</b> keyword enables RLDP in monitor mode access points only.
<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 RLDP Retry Times on Rogue Access Points (GUI)

### Procedure

- 
- Step 1** Choose **Configuration > Security > Wireless Protection Policies**.
  - Step 2** On the **Wireless Protection Policies** page, click the **RLDP** tab.
  - Step 3** Enter the RLDP retry attempt value for rogue access points in the **Retry Count** field.  
The valid range is between 1 and 5.
  - Step 4** Save the configuration.
-



## Configuring RLDP Retry Times on Rogue Access Points (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>wireless wps rogue ap rldp retries</b> <i>num-entries</i>  <b>Example:</b> Device(config)# <code>wireless wps rogue ap rldp retries 2</code>	Enables RLDP retry times on rogue access points.  Here, <i>num-entries</i> is the number of RLDP retry times for each of the rogue access points.  The valid range is 1 to 5.
<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.

## Verifying Rogue AP RLDP

The following commands can be used to verify rogue AP RLDP:

**Table 8: Verifying Rogue AP Information**

Command	Purpose
<b>show wireless wps rogue ap rldp detailed</b> <i>mac_address</i>	Displays the RLDP details for a rogue AP.
<b>show wireless wps rogue ap rldp in progress</b>	Displays the list of in-progress RLDP.
<b>show wireless wps rogue ap rldp summary</b>	Displays the summary of RLDP scheduling information.

## Rogue Detection Security Level

The rogue detection security level configuration allows you to set rogue detection parameters.

The available security levels are:

- Critical: Basic rogue detection for highly sensitive deployments.
- High: Basic rogue detection for medium-scale deployments.
- Low: Basic rogue detection for small-scale deployments.
- Custom: Default security-level, where all detection parameters are configurable.



**Note** When in Critical, High or Low, some rogue parameters are fixed and cannot be configured.

The following table shows parameter details for the three predefined levels:

**Table 9: Rogue Detection: Predefined Levels**

Parameter	Critical	High	Low
Cleanup Timer	3600	1200	240
AAA Validate Clients	Disabled	Disabled	Disabled
Adhoc Reporting	Enabled	Enabled	Enabled
Monitor-Mode Report Interval	10 seconds	30 seconds	60 seconds
Minimum RSSI	-128 dBm	-80 dBm	-80 dBm
Transient Interval	600 seconds	300 seconds	120 seconds
Auto Contain Works only on Monitor Mode APs.	Disabled	Disabled	Disabled
Auto Contain Level	1	1	1
Auto Contain Same-SSID	Disabled	Disabled	Disabled
Auto Contain Valid Clients on Rogue AP	Disabled	Disabled	Disabled
Auto Contain Adhoc	Disabled	Disabled	Disabled
Containment Auto-Rate	Enabled	Enabled	Enabled
Validate Clients with CMX	Enabled	Enabled	Enabled
Containment FlexConnect	Enabled	Enabled	Enabled
RLDP	Monitor-AP if RLDP scheduling is disabled.	Monitor-AP if RLDP scheduling is disabled	Disabled
Auto Contain RLDP	Disabled	Disabled	Disabled

## Setting Rogue Detection Security-level

Follow the procedure given below to set the rogue detection security-level:

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# configure terminal	Enters the global configuration mode.
<b>Step 2</b>	<b>wireless wps rogue security-level custom</b> <b>Example:</b> Device(config)# wireless wps rogue security-level custom	Configures rogue detection security level as custom.
<b>Step 3</b>	<b>wireless wps rogue security-level low</b> <b>Example:</b> Device(config)# wireless wps rogue security-level low	Configures rogue detection security level for basic rogue detection setup for small-scale deployments.
<b>Step 4</b>	<b>wireless wps rogue security-level high</b> <b>Example:</b> Device(config)# wireless wps rogue security-level high	Configures rogue detection security level for rogue detection setup for medium-scale deployments.
<b>Step 5</b>	<b>wireless wps rogue security-level critical</b> <b>Example:</b> Device(config)# wireless wps rogue security-level critical	Configures rogue detection security level for rogue detection setup for highly sensitive deployments.

## Wireless Service Assurance Rogue Events

Wireless Service Assurance (WSA) rogue events, supported in Release 16.12.x and later releases, consist of telemetry notifications for a subset of SNMP traps. WSA rogue events replicate the same information that is part of the corresponding SNMP trap.

For all the exported events, the following details are provided to the wireless service assurance (WSA) infrastructure:

- MAC address of the rogue AP
- Details of the managed AP and the radio that detected the rogue AP with strongest RSSI
- Event-specific data such as SSID, channel for potential honeypot event, and MAC address of the impersonating AP for impersonation event

The WSA rogue events feature can scale up to four times the maximum number of supported APs and half of the maximum number of supported clients.

The WSA rogue events feature is supported on Cisco DNA Center and other third-party infrastructure.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 2</b>	<b>network-assurance enable</b> <b>Example:</b> Device# network-assurance enable	Enables wireless service assurance.
<b>Step 3</b>	<b>wireless wps rogue network-assurance enable</b> <b>Example:</b> Device# wireless wps rogue network-assurance enable	Enables wireless service assurance for rogue devices. This ensures that the WSA rogue events are sent to the event queue.

## Monitoring Wireless Service Assurance Rogue Events

**Procedure**

- **show wireless wps rogue stats**

**Example:**

```
Device# show wireless wps rogue stats
```

```
WSA Events
Total WSA Events Triggered      : 9
  ROGUE_POTENTIAL_HONEYPOT_DETECTED : 2
  ROGUE_POTENTIAL_HONEYPOT_CLEARED  : 3
  ROGUE_AP_IMPERSONATION_DETECTED   : 4
Total WSA Events Enqueued      : 6
  ROGUE_POTENTIAL_HONEYPOT_DETECTED : 1
  ROGUE_POTENTIAL_HONEYPOT_CLEARED  : 2
  ROGUE_AP_IMPERSONATION_DETECTED   : 3
```

In this example, nine events have been triggered, but only six of them have been enqueued. This is because three events were triggered before the WSA rogue feature was enabled.

- **show wireless wps rogue stats internal**

```
show wireless wps rogue ap detailed rogue-ap-mac-addr
```

These commands show information related to WSA events into the event history.