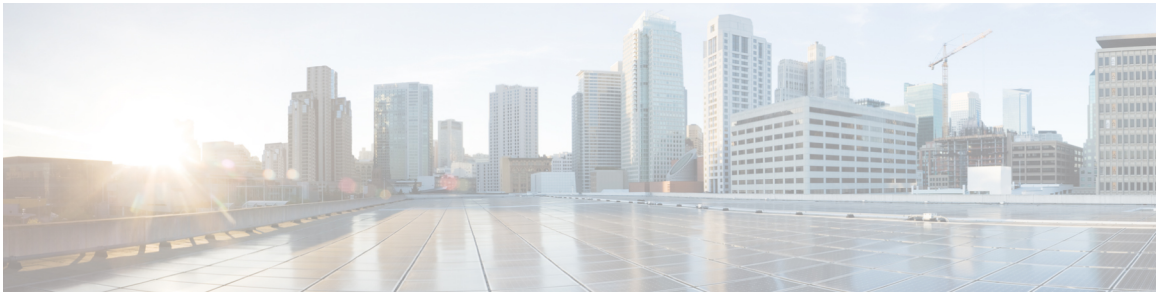
Cisco Ultra-Reliable Wireless Backhaul for Catalyst IW Access Points, Software Configuration Guide, Release 17.16.x

First Published: 2024-12-11

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883



CONTENTS

Preface

This preface describes this guide and provides information about the configuration of URWB on Cisco Catalyst Industrial Wireless access points, and related documentation.

It includes the following sections:

About this Guide

This guide details the configuration of the URWB mode of operation for the Cisco Catalyst IW9167E, IW9165E, and IW9165D access points. UWRB is supported as part of the Unified Industrial Wireless (UIW) software. UIW Release 17.16.1 introduces these new features:

- 4900-4990 MHz Frequency Support for US and Canada with License Enforcement
- Additional Country Codes Support
- Network Address Translation

Related Documentation

Documentation for the access point control and provisioning of wireless access points (CAPWAP) and workgroup bridge (WGB) modes of operation for the Catalyst IW9167 and IW9165 access points are available in the following URLs:

- Catalyst IW9167 Heavy Duty Access Point
- Catalyst IW9165E Rugged Access Point
- Catalyst IW9165D Heavy Duty Access Point

Communications, Services, and Additional Information

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.

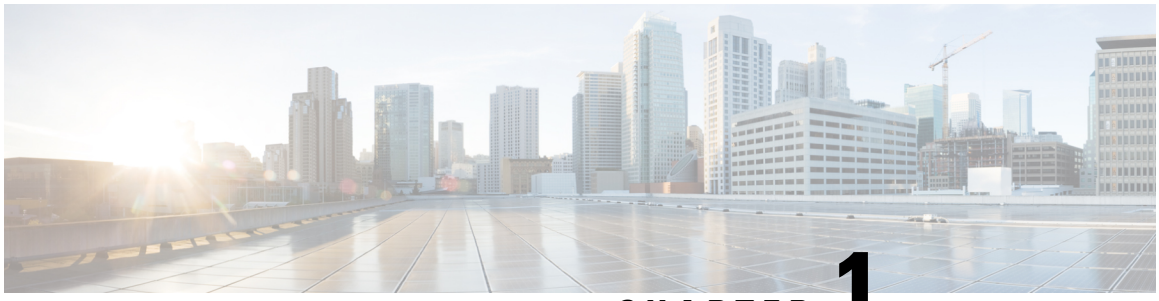
- To get the business impact you're looking for with the technologies that matter, visit Cisco Services.
- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions, and services, visit Cisco DevNet.
- To obtain general networking, training, and certification titles, visit Cisco Press.
- To find warranty information for a specific product or product family, access Cisco Warranty Finder.

Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a gateway to the Cisco bug-tracking system, which maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. The BST provides you with detailed defect information about your products and software.

Documentation Feedback

To provide feedback about Cisco technical documentation, use the feedback form available in the right pane of every online document.



CHAPTER 1

Overview of Cisco Catalyst IW9167E and IW9165 Access Points

Overview of Cisco Catalyst IW9167E and IW9165 Access Points

Overview of Cisco Catalyst IW9167E

The Catalyst IW9167E access point provides reliable wireless connectivity for mission-critical applications in a state-of-the art platform to deliver a network that is more reliable and secure, with higher throughput, more capacity, and less device interference. The Catalyst IW9167E is Cisco's first outdoor Wi-Fi 6E ready Access Point supporting tri-radio and tri-band (2.4/5/6 GHz bands). The Catalyst IW9167E can operate in Wi-Fi (control and provisioning of wireless access points (CAPWAP)) mode or Ultra-Reliable Wireless Backhaul (URWB) mode and URWB software on Catalyst IW9167E designed to support the Cisco style parser.

Overview of Cisco Catalyst IW9165

The Catalyst IW9165 supports up to a 3.6 Gbps PHY data rate with two 2x2 multiple input and multiple output (MIMO) and two ethernet ports (2.5 mGig and 1G). The Catalyst IW9165 uses URWB, which offers seamless handoffs, low latency, and high availability. The Catalyst IW9165 is designed to take advantage of the 6 GHz band expansion to deliver a network that is more reliable and secure, with higher throughput, more capacity, and less device interference. The Catalyst IW9165 has the option to switch images by just updating the software to operate the Catalyst IW9165 in workgroup bridge (WGB) or URWB mode without changing the hardware.

The Catalyst IW9165 series is available in two models:

- Catalyst IW9165E Rugged Access Point and Wireless Client
- Catalyst IW9165D Access Point

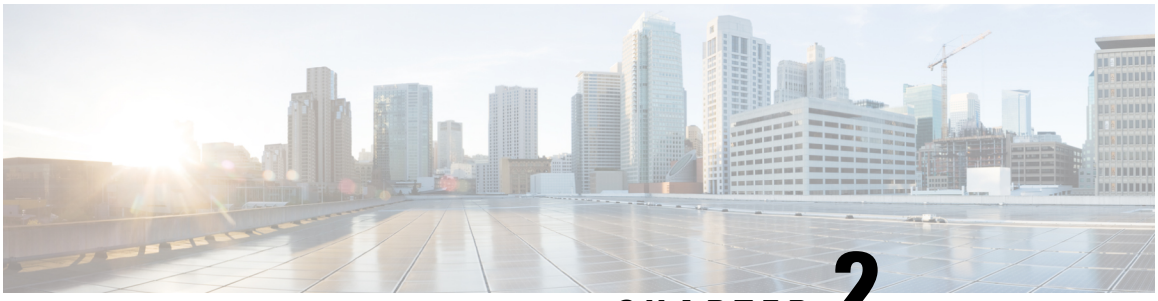
Cisco Catalyst IW9165E Rugged Access Point and Wireless Client

The Catalyst IW9165E supports a 2x2 Wi-Fi 6E design with external antennas, and it is designed to add ultra-reliable wireless connectivity to moving vehicles and machines. Low power consumption, rugged IP30 design and small form factor make the Catalyst IW9165E very simple to integrate into industrial assets.

From UIW Release 17.14.1, the Catalyst IW9165E supports the Dying Gasp functionality. Once the DC-IN power supply stops, the Dying Gasp functionality allows the device to preserve power for at least 100 ms. During this time, the device sends a message to other devices in the network indicating that it is about to shut down, and this avoids abrupt packet transmission failure. Catalyst IW9165E generates the Dying Gasp messages, and the Catalyst IW9165D, IW9165E, and IW9167E devices process these messages.

Cisco Catalyst IW9165D Access Point

The Catalyst IW9165D supports a 2x2 Wi-Fi 6E design with internal and external antennas, and it is designed to simplify wireless backhaul deployment. The Catalyst IW9165D is designed with heavy-duty IP67 and a built-in directional antenna that enables long-range, high-throughput connectivity when fiber is not an option, so that you can create a fixed wireless infrastructure (point-to-point, point-to-multipoint, and mesh) as well as backhaul traffic from mobile devices along wayside or trackside deployments. The external antenna ports let you quickly extend your network to new places when needed and choose the right antenna based on the use cases and deployment architectures.



CHAPTER 2

Initial Configuration of the Device in Provisioning Mode

Catalyst IW Access Points running in URWB mode support configuration from Cisco Industrial Wireless (IW) Service or using local management interfaces. An access point (AP) with no configuration defaults to provisioning mode, which allows the initial configuration to be sent to the access point from IW Service.

Note From UIW Release 17.16.1, IoT OD IW changes to IW Service.

Provisioning mode is a special mode where the AP attempts to request network configuration using dynamic host configuration protocol (DHCP) and connect to IW Service. If network connectivity exists, the AP connects to IW Service. If there is no network connectivity, the AP can be configured locally using the GUI or CLI, accessible using the console port or SSH.

Note Use these default credentials to log into either the GUI or CLI:

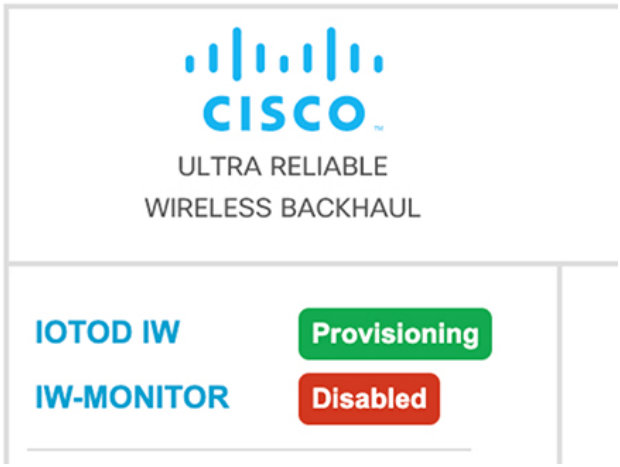
- Username: Cisco
- Password: Cisco

The DHCP server assigns a default gateway and domain name system (DNS) server. IW Service uses DNS geo-location to direct AP in the United States to the US cluster. Other locations are directed to the EU cluster. Ensure your IW Service organization is configured to the correct cluster.

DHCP is only used in provisioning mode. A static IP address must be assigned for normal operation. If DHCP is unavailable and configuration through IW Service is required, the IP address, subnet, default gateway, and DNS can be manually configured.

Note When the device is in provisioning mode, the AP attempts to get an IP address from a DHCP server. If the device fails to receive an IP address through DHCP, the AP reverts to a fallback IP address of 192.168.0.10/24.

- To verify if the device is in provisioning mode, go to the device configurator interface and the status of IW Service is shown as **Provisioning**:

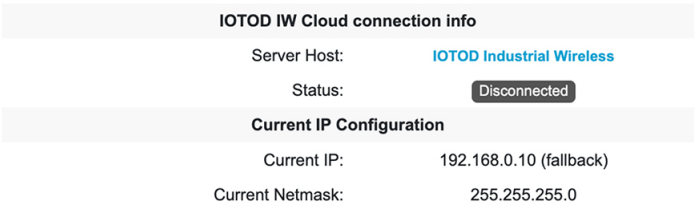


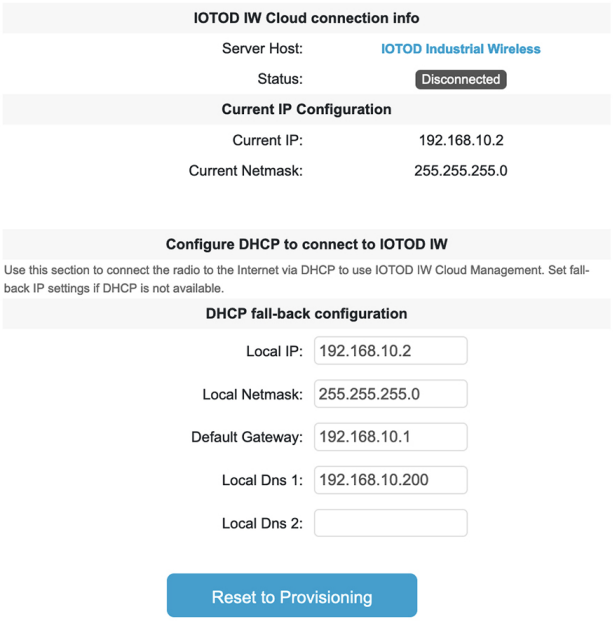
- To verify if the device is in provisioning mode, use the following show command:

```
Device#show iw-service status
  IW Service mode: Provisioning
  Status: Connected
```

- If the status of IW Service is shown as **Online** or **Offline**, choose either of the following options:
  - To configure a new device, revert the wireless device to provisioning mode and reset the device, see Resetting the Device to Factory Default Using GUI, on page 8.
  - To change the connection settings with current configuration, see Configuring General Settings, on page 11.

If the device is in provisioning mode, the device configurator interface is shown:

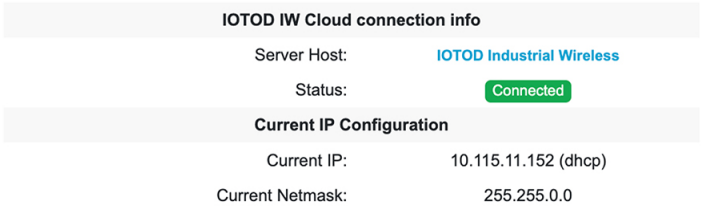




The device's status and LEDs blink continuously and LEDs repeat this cycle until the device either enters a fallback condition, or enters **Online**, or **Offline** mode. To know more about LED status, see LED Pattern for Catalyst IW9165, on page 146 or LED Pattern for Catalyst IW9167, on page 145.

Note DHCP is used only in provisioning mode. A static IP address must be assigned for normal operation.

Ensure that the device is connected to a network that supports DHCP. If the connection to IW Service is successful, the cloud connection info status is shown as **Connected**.



To configure the fallback address, use the following CLI command:

Note In the provisioning mode, the IP, netmask, default gateway, primary DNS, and secondary DNS configuration (IP command) are allowed.

```
Device# configure ip address ipv4 [ static IP address [ static netmask [ IP address of default gateway [ dns1 ip [ dns2 ip ] ] ] ] ]
```

For example:

```
Device# configure ip address ipv4 static 192.168.10.2 255.255.255.0 192.168.10.1
192.168.10.200 192.168.10.201
```

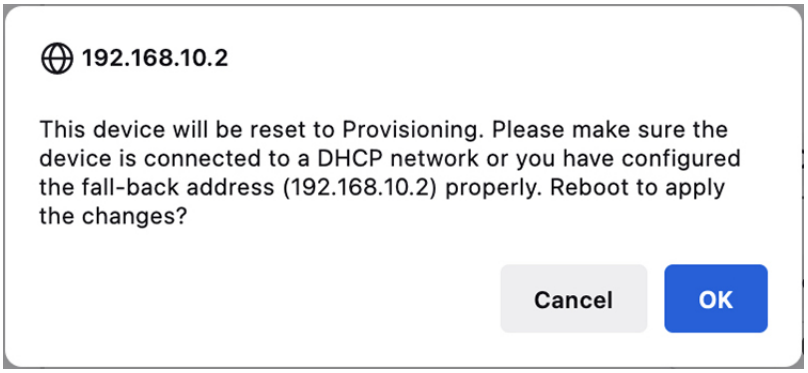
The device sets the fallback address (192.168.0.10 by default) or the configured IP address automatically if it does not receive an address from the DHCP server. If the device fails to connect to IW Service, verify the following to reach IW Service:

1. Check if the ethernet cable leading to the device is connected correctly.
2. Check if the local DNS server can fix the IP address of IW Service cloud server and if the address can be reached.
3. Check if access point uses an outbound HTTPS connection on tcp/443 for the following domains:
   - device.ciscoiot.com
   - us.ciscoiot.com
   - eu.ciscoiot.com
4. If IW Service is still offline, perform a local (offline) configuration using the device's configurator interface.

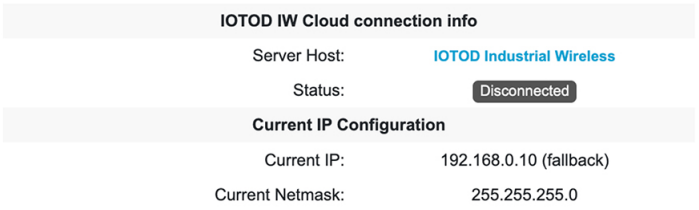
If the device fails to connect to the network in provisioning mode, follow these steps:

1. Enter alternative **Local IP**, **Local Netmask**, **Default Gateway**, **Local Dns 1**, and **Local Dns 2** values as needed, using IW Service image and click the **Save fallback IP**.

   A reboot confirmation pop-up appears:



2. Click **OK** or **Reset** to go back to IW Service and adjust the settings.
   - Once you click **OK**, the device reboots and remains in provisioning mode.
   - The device attempts to connect to the network using the new connection values.
3. If the device fails to connect to the network using the **DHCP** settings, **IoT OD IW Cloud connection Status** is shows as **Disconnected**.



4. To verify if the device is in provisioning mode and not connected to IW Service, use the following CLI command:

```
Device#show iw-service status
 IW Service mode: Provisioning
 Status: Disconnected
```

The following CLI example shows that the device is in provisioning mode and retrieved the IP address from the DHCP server:

```
Device#show ip
 IP:             192.168.0.10
 Network:        255.255.255.0
 Gateway:
 Nameservers:

 DHCP Address (PROVISIONING Mode):
 IP:             10.0.0.2
 Network:        255.255.255.0
 Gateway:        10.0.0.1
 Nameservers:    8.8.8.8

 Fallback Address (PROVISIONING Mode):
 IP:             169.254.201.72
 Network:        255.255.0.0
```

The following CLI example shows the device in provisioning mode fails to retrieve the IP address from the DHCP server and using the default fallback IP address 192.168.0.10:

```
Device#show ip
 IP:             192.168.0.10
 Network:        255.255.255.0
 Gateway:
 Nameservers:

 DHCP Address (PROVISIONING Mode):
 IP:             192.168.0.10
 Network:        255.255.255.0
 Gateway:
 Nameservers:    127.0.0.1

 Fallback Address (PROVISIONING Mode):
 IP:             169.254.201.72
 Network:        255.255.0.0
```


- Resetting the Device to Factory Default Using GUI, on page 8
- Rebooting the Device using GUI, on page 9
- Saving and Restoring the Device Settings, on page 10
- Configuring General Settings, on page 11
- Connecting to the Access Point Console Port, on page 12

Resetting the Device to Factory Default Using GUI

You can reset the device to factory default either by pressing a reset button for 30 seconds when power is supplied to the access point or through configurator interface. For more information about reset button, see Using the Reset Button.

Note A hard reset reverts all device configuration settings, including the device IP address and administrator password to factory defaults. Instead if you want to reboot the device, see Rebooting the Device using GUI, on page 9.

1. In the **MANAGEMENT SETTINGS**, click **reset factory default**.

2. Click **YES** in the confirmation pop-up window. To abort the factory reset, click **NO**.
3. If you have previously saved a configuration file for the device, you can restore the saved configuration settings to the device, see Saving and Restoring the Device Settings, on page 10.

Note Do not perform a hard reset unless the device requires reconfiguration using its factory configuration as the starting point. Hard reset resets the device's IP address, administrator password, and it disconnects the device from the network.

Resetting the Device to Factory Default Using CLI

To reset of the device configuration, use the following CLI command:

```
device#configure factory reset config
WARNING: "configure factory reset config" will clear config and reboot.
Do you want to proceed? (y/n)
```

Enter `y` in the CLI command to start the device reset process or alternatively enter `n` to abort the process.

To reset the device configuration and data wipe, use the following CLI command:

```
Device#configure factory reset default
WARNING: "configure factory reset default" will take minutes to perform DATA WIPE.
```

The following files are cleared as part of this process:

```
1) Config, Bak config files
2) Crashfiles
3) syslogs
4) Boot variables
5) Pktlogs
6) Manually created files
Do you want to proceed? (y/n)
```

Enter `y` in the CLI command to start the device reset of the configuration and data wipe or alternatively enter `n` to abort the process.

Rebooting the Device using GUI

To reboot the device's operating system, follow these steps:

1. In the **MANAGEMENT SETTINGS**, click **reboot**.

2. In the confirmation pop-up window, click **Yes**. To abort the reboot, click **No**.

Rebooting the Device using CLI

To perform reboot, use the following CLI command:

```
Device#reload
Proceed with reload command (cold)? [confirm]
```

Enter `confirm` in the CLI command to start the device reboot process.

Saving and Restoring the Device Settings

The **LOAD OR RESTORE SETTINGS** window allows you to perform the following tasks:

- Save the device's existing software configuration as a configuration (*.conf) file.
- Upload and apply a saved configuration file to the current device.

Note Device software configuration (*.conf) files are not interchangeable with IW Service configuration setup (*.iwconf) files.

Tip Saved configuration files are reused for all devices of the same type. These saved configuration files act as configuration backup files to speed up redeployment if you need to replace the damaged device with a new device of the same type.

To download the device's existing configuration settings to your computer, follow these steps:

1. In the **MANAGEMENT SETTINGS**, click **configuration settings**.

   The **LOAD OR RESTORE SETTINGS** window appears.

2. Click **Save** to download the device configuration (*.conf).

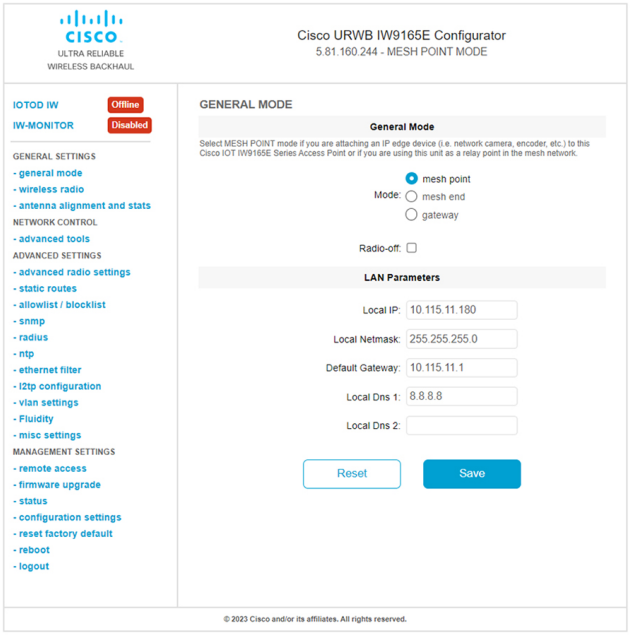
To upload a saved configuration file to the device, follow these steps:

1. Click **Browse** to upload the configuration (*.conf) file to the device.
2. Click **Restore** to apply the configuration settings to the device.

Configuring General Settings

To change the **General Mode** settings, follow these steps:

1. In the **GENERAL SETTINGS**, click **general mode**.



The **General Mode** has the operational mode controls. Devices capable of operating in a mesh radio network are shipped in **mesh point** mode.

Note When designing the required network layout, there must be at least one mesh end device. This device performs control and administrative functions, such as license management. This is necessary for correct network operation, even if the network consists of only two devices.

To change the device's operational mode, select any one of the following mode:

- **Gateway** - This mode is applicable for advanced Layer 3 mobility deployments, and it is not used in most networks.
- **Mesh Point** - This mode is applicable for the remaining access points in the network. These access points establish links to other access points with the same network passphrase configured as mesh end or mesh point using wireless links or wired links. In this scenario, the access point has Layer 2 visibility of other access points.

- **Mesh End** - This mode configures the access point to perform control and administrative network functions. There must be at least one mesh end in each network. This access point is typically installed in the most central point where the wireless and wired networks converge.

Configuring General Settings using CLI

To configure general settings, use the following CLI command:

```
Device#configure modeconfig mode
  gateway    layer 3 global gateway mode
  meshend    mesh end mode
  meshpoint  mesh point mode

Device#configure modeconfig mode meshend
  mpls       MPLS support
  radio-off  disable radio interfaces
```

Changing the LAN Parameters

The LAN parameters has entry controls for local address setting. Perform the following to change the LAN parameters:

1. Once the **General Mode** window is opened for the first time, the **Local IP** and **Local Netmask** LAN parameters are shown with factory-set default values.
2. If needed, enter the local primary DNS address in the **Dns 1** field, and enter the local secondary DNS address in the **Dns 2** field.
3. Click **Save** to save the LAN settings. To clear the settings, click **Reset**.

Configuring LAN Parameters using CLI

To configure LAN parameters, use the following CLI command:

Example:

```
device#configure ip address ipv4 static
192.168.10.2 255.255.255.0 192.168.10.1 192.168.10.200 192.168.10.201
```

Connecting to the Access Point Console Port

To configure the access point locally (without connecting to a wired LAN), connect the computer to the access point's console port using a DB-9 to RJ-45 serial cable and to open the CLI by connecting to the access point's console port, follow these steps:

1. Connect a nine-pin, female DB-9 to RJ-45 serial cable to the RJ-45 serial port on the access point and to the COM port on a computer.
2. Set up a terminal emulator to communicate with the access point. In the terminal emulator, use the following settings:

Parameter	Value
Baud rate	115200 bps
Data	Eight bits

Parameter	Value
Parity	No
Stop	One stop bit
Flow Control	No

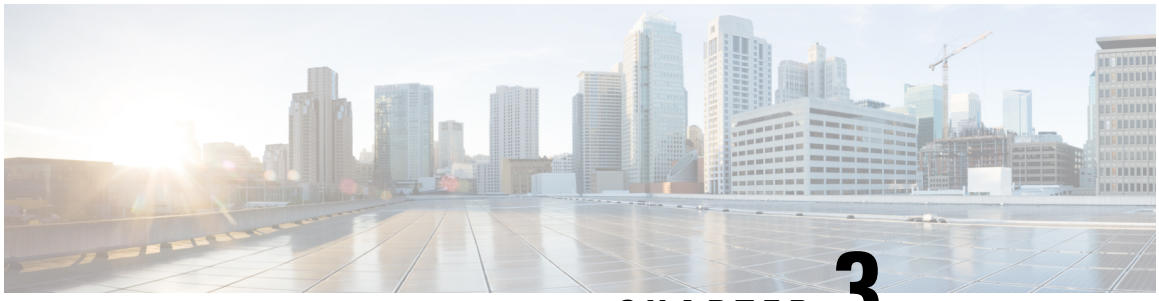
3. There are two available command-prompt modes: standard command prompt (>) and privileged command prompt (#). When logged in for the first time, it directs you to standard command prompt (>) mode to execute unprivileged commands.

   To access privileged command-prompt (#) mode, enter the enable command (abbreviated as en) and enter the enable password (the privilege mode login password is different from the standard login password).

   Use these default credentials to log in:

   - Username: Cisco
   - Password: Cisco

Note Once the initial configuration completes, ensure to remove the serial cable from the access point.



CHAPTER 3

IPv6 Support

Overview

From UIW Release 17.15.1, APs support IPv6 addresses. By default, the IPv6 service is disabled on the AP. You can enable and configure the IPv6 address on the AP using either the CLI or GUI.

IPv6 Address Types

You can configure the AP with the following IPv6 address types:

- Link-Local
- Unique-Local
- Global Unicast

Link-Local

Link-local addresses are used within the scope of a single link and cannot be routed. These addresses refer specifically, to a particular physical link and are used for addresses on a single link for purposes such as automatic address configuration and the neighbor discovery protocol. Link-local addresses can be used to reach the neighboring nodes attached to the same link.

Unique-Local

Unique local addresses can be routed within a private organization, but not through the public internet. It is not expected to be routable on the global Internet. However, it is routable inside a limited area, such as a site, and it may route between a limited set of sites.

Global Unicast

A global unicast address is a routable address in the IPv6 Internet, similar to the public IPv4 address space.

IPv6 Limitations on the AP

- The IPv6 support is limited only to host functionality.
- The Fluidity Layer 3 network does not support IPv6.

Enable or Disable IPv6 using CLI

By default, IPv6 support is disabled on the AP. When IPv6 is enabled, a link-local address is automatically assigned to the AP.

Use this command to enable or disable the IPv6 address on the AP.

```
Device#configure ipv6 {enable | disable}
```

Enable or Disable IPv6 RA Autoconfig using CLI

Use this command to enable or disable the IPv6 RA Autoconfig on the AP.

```
Device#configure ipv6 enable autoconfig-ra {enable | disable}
```

Note

- Enable: Enables the autoconfiguration from router advertisement.
- Disable: Disables the autoconfiguration from router advertisement.

Configure Static IPv6 Address with eui-64, Gateway, and DNS Server Address

Use this command to configure the static IPv6 address with eui-64, gateway, and DNS server address on the AP.

```
Device#configure ap address ipv6 static fc00::4236:5aff:xxxx:168/64 eui-64 fc00::1
2001:4860:4860::xxxx 2001:4860:4860::xxxx
```

Verify Static IPv6 Address with eui-64, Gateway, and DNS Server Address

To verify the static IPv6 address with eui-64, gateway, and DNS server address on the AP, use the following **show** command:

```
Device#show ipv6
IPv6: Enabled
Router Advertisment auto-configuration: Disabled
Static IPv6 config:
Address: fc00::4236:5aff:xxxx:168/64
Gateway: fc00::1
DNS1: 2001:4860:4860::xxxx
DNS2: 2001:4860:4860::xxxx
Currently assigned addresses:
fc00::4236:5aff:xxxx:168/64 global
fe80::4236:5aff:xxxx:168/64 link
```

Configure Static IPv6 Address without eui-64, Gateway, and DNS Server Address

Use this command to configure the static IPv6 address without eui-64, gateway, and DNS server address on the AP.

```
Device#configure ap address ipv6 static fc00::1234:5678:xxxx:def/64 fc00::1
2001:4860:4860::xxxx 2001:4860:4860::xxxx
```

Verify Static IPv6 Address without eui-64, Gateway, and DNS Server Address

To verify the static IPv6 address without eui-64, gateway, and DNS server address on the AP, use the following **show** command:

```
Device#show ipv6
IPv6: Enabled
Router Advertisment auto-configuration: Disabled
Static IPv6 config:
Address: fc00::1234:5678:xxxx:def/64
```

```
Gateway: fc00::1
DNS1: 2001:4860:4860::xxxx
DNS2: 2001:4860:4860::xxxx
Currently assigned addresses:
fc00::1234:5678:xxxx:def/64 global
fe80::4236:5aff:xxxx:168/64 link
```

Configure Static IPv6 Address with eui-64

Use this command to configure the static IPv6 address with eui-64 on the AP.

```
Device#configure ap address ipv6 static fc00::4236:5aff:xxxx:168/64 eui-64
```

Verify Static IPv6 Address with eui-64

To verify the static IPv6 address with eui-64 on the AP, use the following **show** command:

```
Device#show ipv6
IPv6: Enabled
Router Advertisment auto-configuration: Disabled
Static IPv6 config:
Address: fc00::4236:5aff:xxxx:168/64
Currently assigned addresses:
fc00::4236:5aff:xxxx:168/64 global
fe80::4236:5aff:xxxx:168/64 link
```

Configure Static IPv6 Address without eui-64

Use this command to configure the static IPv6 address without eui-64 on the AP.

```
Device#configure ap address ipv6 static fc00::1234:5678:xxxx:def
```

Verify Static IPv6 Address without eui-64

To verify the static IPv6 address without eui-64 on the AP, use the following **show** command:

```
Device#show ipv6
IPv6: Enabled
Router Advertisement auto-configuration: Disabled
Static IPv6 config:
Address: fc00::1234:5678:xxxx:def/128
Currently assigned addresses:
fc00::1234:5678:xxxx:def/128 global
fe80::4236:5aff:xxxx:168/64 link
```

Clear the IPv6 Gateway and DNS Servers Configuration

Use this command to clear the IPv6 gateway and DNS servers addresses configuration on the AP.

```
Device#configure ap address ipv6 static fc00::1234:5678:xxxx:def/64 :: :: ::
```

Verify the Cleared IPv6 Gateway and DNS Servers Configuration

To verify the cleared IPv6 gateway and DNS server addresses configuration on the AP, use the following **show** command:

```
Device#show ipv6
IPv6: Enabled
Router Advertisment auto-configuration: Disabled
Static IPv6 config:
Address: fc00::1234:5678:xxxx:def/64
Currently assigned addresses:
fc00::1234:5678:xxxx:def/64 global
fe80::4236:5aff:xxxx:168/64 link
```

Note While adapting services to work with IPv6, such as TFTP, you must consider that link-local IP addresses might require network interface specifications.

Enable and Configure Static IPv6 using GUI

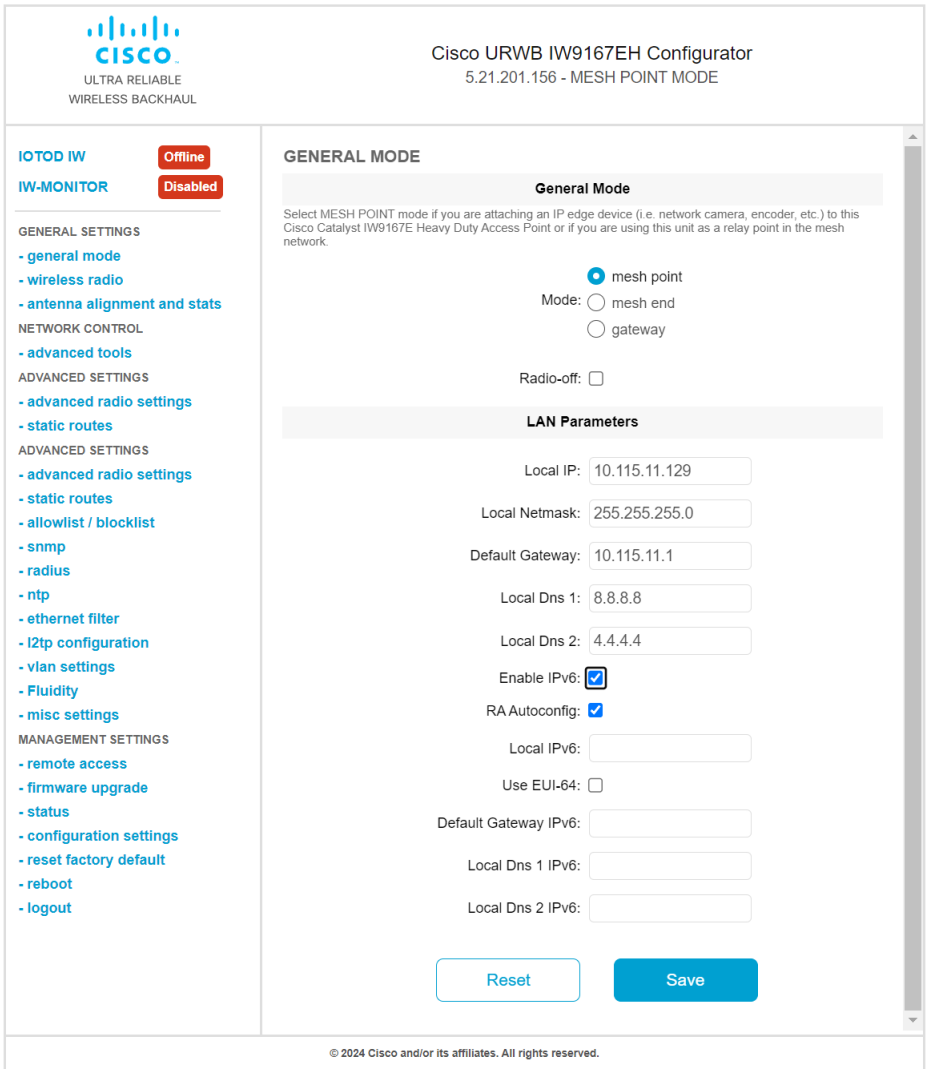
Procedure

Step 1 Launch the computer's web browser and enter the URL to open the configurator login page.

Step 2 Enter the username and password in the respective fields.

Step 3 Click **Login**.
Once you successfully log into the GUI, the URWB configurator displays.

Step 4 In the **GENERAL SETTINGS**, click **general mode** to open the **General Mode** window.



Note
In the GUI, the term "local" refers to the IPv4 or IPv6 addresses that are set up statically. Specifically, the **Local IPv6** accepts all type of IPv6 address, which allows for the static configuration of the device's IPv6 address.

Step 5 Check the **Enable IPv6** check box. The system automatically enables the **RA Autoconfig**.

Step 6 Enter IPv6 address in the **Local IPv6** field.

Step 7 (Optional) Check the **Use EUI-64** check box.

Note
IPv6 addresses differ with and without the eui-64 option.

Step 8 (Optional) Enter the gateway IP address in the **Default Gateway IPv6** field.

Step 9 (Optional) Enter the DNS server 1 IP address in the **Local Dns 1 IPv6** field.

Step 10 (Optional) Enter the DNS server 2 IP address in the **Local Dns 2 IPv6** field.

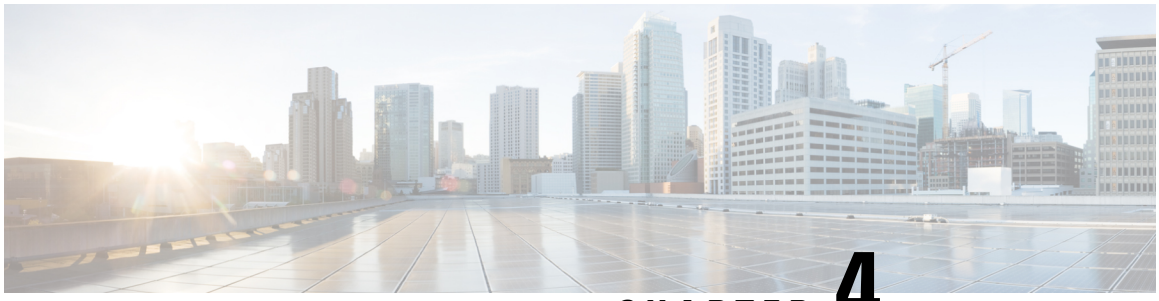
Step 11 Click **Save**.

Verify Static IPv6 using GUI

Procedure

Step 1 In the **MANAGEMENT SETTINGS**, click **status**.

Step 2 On the **STATUS** page, in the **DEVICE SETTINGS** section, you can view the IPv6 details.



CHAPTER 4

Configuring URWB Operation Mode

Configuring URWB Operation Mode

Catalyst Industrial Wireless access points support multiple wireless technologies, such as Catalyst Wi-Fi (AP), Cisco Ultra-Reliable Wireless Backhaul (URWB), and Workgroup Bridge (WGB). The modes supported vary by specific access point.

The access point OS supports two different software images: Catalyst Wi-Fi (AP) and Unified Industrial Wireless (UIW). Both URWB and WGB are part of the UIW software. The access point mode is determined at boot time based on the mode the access point is configured to operate in.

Determining from CLI

The access point OS supports two different software images: Catalyst Wi-Fi (AP) and UIW. Use the following show command to determine which software is running and look for the indicated platform code:

```
Device# show version
Cisco AP Software, (ap1g6j), C9167, RELEASE SOFTWARE
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2022 by Cisco Systems, Inc.
Compiled Thu Aug 18 01:01:29 PDT 2022
ROM: Bootstrap program is U-Boot boot loader
BOOTLDR: U-Boot boot loader Version 2022010100
APFC58. 9A16.E464 uptime is 1 days, 3 hours, 58 minutes
Last reload time : Wed Sep 7 11:17:00 UTC 2022
Last reload reason: reload command
```

If the show version displays `ap1g6a` or `ap1g6b`, it means that the access point OS is running. If the show version displays `ap1g6j` or `ap1g6m`, it means the UIW software is running.

To check if the access point is running in URWB mode, use the following CLI command:

```
Device#show iw-service status
```

If the command exists, then the access point is running in URWB mode, otherwise the access point is running in WGB mode.

Reset Button Settings

The following reset actions are performed in the URWB mode when the LED turns to blinking red (after the boot loader gets the reset signal). Ensure you to press the device's reset button before the device is powering on.

- If you press the reset button for < 20 seconds, it clears the existing configuration.
- If you press the reset button for > 20 seconds and < 60 seconds, it triggers the factory reset.
- If you press the reset button for > 60 seconds, it does not clear the configuration.

Configuring Image Conversion

To convert a Catalyst IW9167E access point either from Wi-Fi mode (CAPWAP AP) to URWB mode or from URWB mode to Wi-Fi mode (CAPWAP AP), follow these steps:

1. To convert from CAPWAP to URWB mode or from WGB/uWGB to URWB mode, use the following CLI command. The access point then reboots and starts up in URWB mode.

   configure boot mode urwb

2. To convert from URWB to CAPWAP mode or from WGB/uWGB to CAPWAP mode, use the following CLI command. The access point then reboots and starts up in CAPWAP mode.

   configure boot mode capwap

3. To convert from CAPWAP to WGB/uWGB mode or from URWB to WGB/uWGB mode, use the following CLI command:

   configure boot mode wgb

Note Image conversion performs a full factory reset which completely erases the configuration and data.

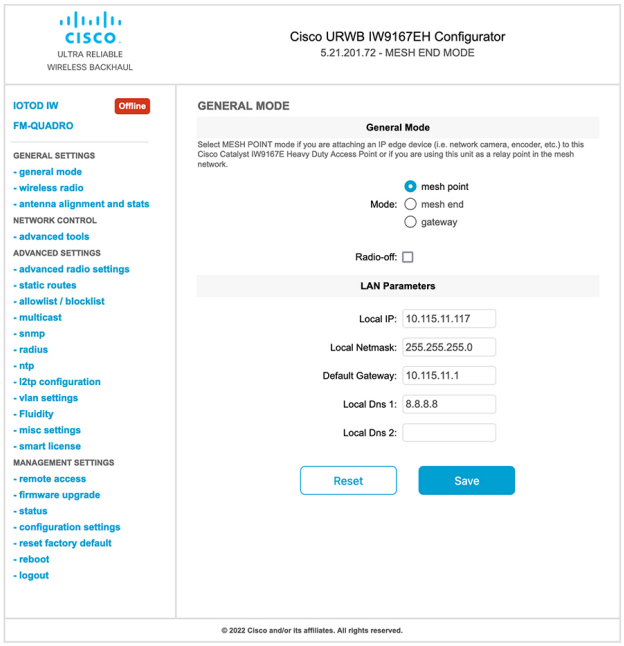
Instructions to Access the GUI

To access the Web UI (Web User Interface), use the following procedure:

1. To access a Web UI, open the web browser and enter the following URL: https://<IP address of unit>/

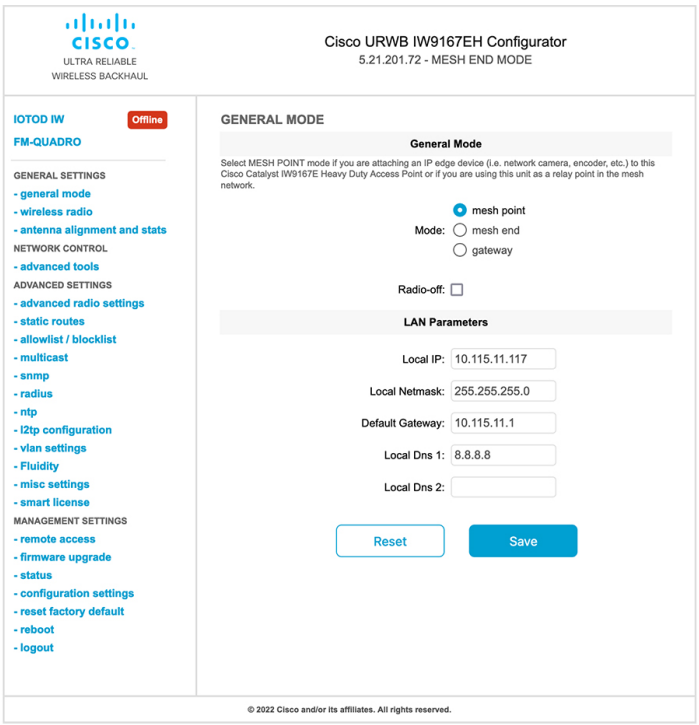
   The **IW9167E or IW9165 Configurator** window appears.

2. To access the configuration page, use the credentials as follows: **Username** and **Enable password**.
3. Once you successfully log into the GUI, the URWB configurator displays:



URWB Catalyst IW9167E Configuration from GUI

The following image shows the configuration of the Catalyst IW9167E configurator:



Committing CLI Configuration

To save the current or running configuration settings to local storage or memory, type `write` CLI command. The modified value is in the cache configuration file, once the `write` command is entered, re-boot the device to take effect of the current configuration. To make the configuration effective, use the following CLI commands:

```
Device# write
```

or

```
Device# wr
```

write or wr: commit the current configuration settings to memory.

```
Device# reload
```

reload: reload the device.

Example:

```
Device# write
!!! Please reboot to take effect
Device# reload
```

Proceed with reload? [confirm]

(enter to confirm)

Configuring IW Service Online and Offline Mode from CLI

IW Service is the cloud management portal, and the device is connected to the online cloud through the network. In offline mode the device is configured in local mode using CLI and GUI, and it is not connected to the cloud.

When the device is configured in offline mode, choose following options:

- Configure the device manually using CLI and GUI.
- Configure the device on IW Service cloud service and select the configuration file exported from IW Service and upload the configuration file using upload configuration button at the end of IW Service management page.

To activate or deactivate IW Service configuration capability, use the following CLI command:

```
Device#configure iw-service {offline | online}
```

Online - To set up IW Service mode to online. The device can be managed from IW Service cloud server (if it is connected to the network).

Offline - To set up IW Service mode to offline. The device is disconnected from IW Service and must be manually configured using the CLI, or offline configurator interface.

Configuring Password (after first login) using CLI

Once the device switches to offline mode (after the initial login), you need to set up new login credential. To configure login credentials using GUI or CLI, the login credentials should follow these criteria:

- The username length must be between 3 to 32 characters long.
- The password length must be between 8 to 32 characters long.
- The password must include the following:
  - At least one uppercase letter
  - At least one lowercase character,
  - At least one digit
  - At least one special character
- The password can contain alphanumeric characters and special characters (ASCII decimal code from 33 to 126), but the following special characters are not allowed:

  " [double quote]

  ' [single quote]

  ? [question mark]
- The password must not contain:
  - Three sequential characters or digits (ABC/ CBA)
  - The same three characters or digits consecutively (AAA) or (666)

- Same as the current or existing password
- Same as or the reverse of the username

Example:

Default credentials:

```
username: Cisco
password: Cisco
enable password: Cisco
```

To reset the credentials, use the following sample credentials:

```
username: demouser
password: DemoP@ssw0rd
enable password: DemoE^aP@ssw0rd
```

Example of configuring password using CLI:

```
Device#configure iw-service {offline}
Switching to IW Service  Offline mode...
Will switch from Provisioning Mode to IW Service  offline Mode, device need to reboot:Y/N?
Y
User access verification.
[Device rebooting...]

User Access Verification:
Username: Cisco
Password: Cisco
```

After first login, reset the credentials:

```
Current Password:Cisco
Current Enable Password:Cisco
New User Name:demouser
New Password:DemoP@ssw0rd
Confirm New Password:DemoP@ssw0rd
New Enable Password:DemoE^aP@ssw0rd
Confirm New Enable Password:DemoE^aP@ssw0rd
```

Once the credentials are changed, re-login:

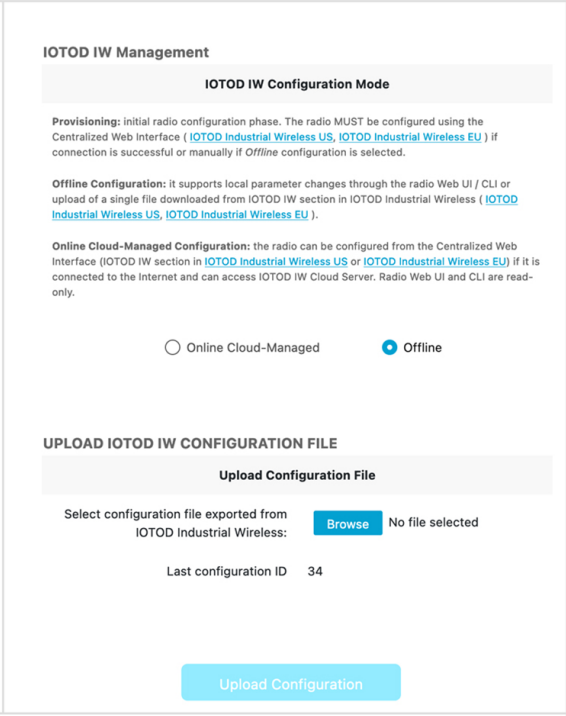
```
User access verification
Username: demouser
Password: DemoP@ssw0rd
Device> enable
```

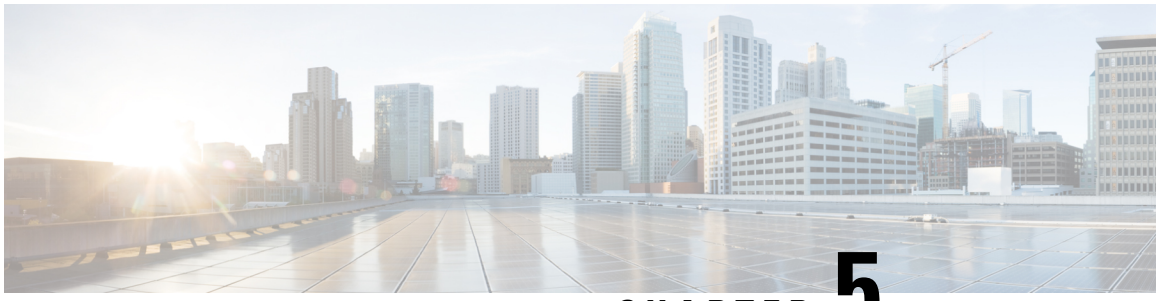
```
Password:DemoE^aP@ssw0rd

Device#
```

Note In the above example, all passwords are in plain text. This is for demo purposes (sample credential). In the real scenario, they are hidden behind asterisks (*).

Configure IW Service using GUI

This image shows the configuration of IW Service:





CHAPTER 5

Configuring URWB Radio Mode

Configuring URWB Radio Mode

The wireless interfaces are configured to operate in a specific mode, or you can disable it. Once you configure the Radio mode, the device starts working as a Fluidity or Fixed infrastructure.

The following table shows the configuration of Radio mode on the device:

Table 1: Radio Mode Configuration

Radio Role	Radio Mode	Description
Fixed Infrastructure	Fixed Fluidmax primary Fluidmax secondary	P2P mode (point to point) P2MP (point to multipoint) mode (Fluidmax) and P2MP P2MP mode (Fluidmax) and P2MP
Mobility AP	Fluidity	Mobility mode
Mobility Client	Fluidity	Mobility mode

Following table shows the Fluidity status and it is derived from operating mode of enabled radio interfaces:

Table 2: Operating Mode of Radio Interface

Radio 1 / Radio 2	Fixed Infrastructure	Fluidity
Fixed Infrastructure	Fluidity disabled	Fluidity enabled
Fluidity	Fluidity enabled	Fluidity enabled

Multiple and dual radio interfaces are possible based on the following table:

Table 3: Configuration of Multiple Radio interfaces

Radio 1 / Radio 2	Fixed Infrastructure / Mesh	Mobility AP	Mobility client
Fixed Infrastructure / Mesh	ME/MP relay, P2MP (mesh)	Yes, trailer use case (Mining trailer)	Supported but no specific use case
Mobility AP	Yes, trailer use case (Mining trailer)	Standard Fluidity (multiple clients on each radio)	Not supported, use V2V or Fixed + AP
Mobility client	Supported but no specific use case	Not supported, use V2V or Fixed + AP	Standard Fluidity (multiple clients on each radio)

Configuring Radio-off Mode from CLI

To configure Radio-off mode when both radios (Fluidity and fixed) are disabled, use the following CLI commands and procedure:

Note If you specify radio-off, the device disables all the wireless interfaces.

1. Set the device's current operating mode. Mode could be mesh end, mesh point or global gateway (L3).

   ```
   Device# configure modeconfig mode {meshpoint | meshend | gateway}
   ```

2. Set the device's selected Multi-Protocol Label Switching (MPLS) OSI layer and the possible value of layer is 2 (OSI Layer-2) or 3 (OSI Layer-3).

   ```
   Device# configure modeconfig mode {meshpoint | meshend | gateway}[layer {2|3}]
   ```

3. To set the radio-off mode.

   ```
   Device# configure modeconfig mode { meshpoint | meshend | gateway } [layer {2|3}] [
   radio-off {fluidity | fixed}]
   ```

4. To end the current configuration, use the following CLI command:

   ```
   Device# (configure modeconfig mode { meshpoint | meshend | gateway } [layer {2|3}] [
   radio-off {fluidity | fixed}])# end
   ```

```
Device# wr
```

Example:

```
Configure modeconfig mode meshend radio-off fluidity
Configure modeconfig mode meshend radio-off fixed
```

Configuring Radio Mode for URWB from CLI

To configure Radio mode for URWB, use the following CLI commands:

To select the operating function of the wireless interface, use these CLI commands. Device allows mixed Fluidity and fixed infrastructure combinations for different interfaces.

1. Configure the wireless with radio interface number <1 or 2>.

   ```
   Device# configure dot11Radio <interface>
   ```

2. Configure an operating mode for the specified interface.

   ```
   Device# configure dot11Radio <interface> mode {fixed|fluidity|fluidmax}
   ```

   Fluidity - This interface operates the device in Fluidity, either as a mobility infrastructure or as a vehice mode.

   Fixed - This interface operates in fixed infrastructure mode (no Fluidity).

   Fluidmax - This interface operates in Fluidmax P2MP mode. More parameters can be specified to configure the Fluidmax operating features, for example: Primary/Secondary role and cluster ID.

3. Set Fluidmax role for Fluidmax interface mode.

   ```
   Device# configure dot11Radio <interface>mode {fixed|fluidity|fluidmax} {primary |
   secondary}
   ```

   Primary - set Fluidmax role to primary

   Secondary - set Fluidmax role to secondary

4. To end the current configuration, use the following CLI command:

   ```
   Device (configure dot11Radio <interface>mode{fixed|fluidity|fluidmax}) # end
   Device# wr
   ```

Note When at least one interface is set to Fluidity mode, the device operates globally in Fluidity mode. If all interfaces are set to fixed, Fluidity is disabled.

Configuring AMPDU using CLI

To configure an Aggregated MAC Protocol Data Unit's (AMPDU) length and priority, use the following CLI commands:

```
Device# configure dot11radio <interface> ampdu length <length>
```

length: <0-255> integer number – microseconds

```
Device# configure dot11radio <interface> ampdu priority {enable | disable}
```

enable: enable ampdu tx priority

disable: disble ampdu tx priority

```
Device# configure dot11radio <interface> ampdu priority [enable]
```

0: ampdu tx priority for index 0

1: ampdu tx priority for index 1

2: ampdu tx priority for index 2

3: ampdu tx priority for index 3

4: ampdu tx priority for index 4

5: ampdu tx priority for index 5

6: ampdu tx priority for index 6

7: ampdu tx priority for index 7

all: ampdu tx priority for all indexes (index 0 to 7)

Configuring Frequency from CLI

To configure an operating frequency, use the following CLI command:

```
Device# configure dot11radio <interface> frequency <frequency>
```

frequency: <0-7125> operating frequency in MHz

Configuring Maximum Modulation Coding Scheme Index from CLI

To configure maximum modulation coding scheme (MCS) index, use the following CLI command:

```
Device# configure dot11radio <interface> mcs <maxmcs>
```

Set maximum MCS index in integer or string AUTO. For AUTO, the background process automatically configures the maxmcs.

Maxmcs values:

< 0-11 > Maximum mcs index 0 to 11.

Word AUTO

Note If High Efficiency mode is disabled, set the MCS index value ranging from zero to nine. If High Efficiency mode is enabled, set the MCS index value as 10 or 11.

Configuring Maximum Number of Spatial Streams Index from CLI

To configure maximum number of spatial streams (NSS) index, use the following CLI command:

```
Device# configure dot11radio <interface> spatial-stream <maxnss>
```

Set maximum spatial stream number in integer or string AUTO. For AUTO, the background process automatically configures the maxnss.

Maxnss values:

< 1-4 > Maximum nss index 1 to 4.

Word AUTO

Note Catalyst IW9165 supports up to two spatial streams and Catalyst IW9167 supports up to four spatial streams. The maximum number of spatial streams configured must be same or less than the number of antennas enabled.

Configuring Rx-SOP Threshold from CLI

To configure receiver start of packet (Rx-SOP) threshold, use the following CLI command:

```
Device# configure dot11radio <interface> rx-sop-threshold
```

<0 - 91> Enter rx-sop- threshold (0: AUTO, VALUE: -VALUE dBi).

Configuring RTS Mode from CLI

To disable ready to send (RTS) mode, use the following CLI command:

```
Device# configure dot11radio <interface> rts <disable>
```

Disable: Disables the RTS protection.

To enable RTS with threshold value, use the following CLI command:

```
Device# configure dot11radio <interface> rts enable <threshold>
```

Threshold: Threshold range <0 - 2346>.

Configuring WMM Mode from CLI

To configure wireless multimedia (WMM) mode, use the following CLI command:

```
Device# configure dot11radio <interface> wmm [bk|be|vi|vo]
```

[bk|be|vi|vo]: Represents the class-of-service (CoS) parameters.

be: Best-effort traffic queue (CS0 and CS3).

bk: Background traffic queue (CS1 and CS2).

vi: Video traffic queue (CS4 and CS5).

vo: Voice traffic queue (CS6 and CS7).

To clear wireless stats counters, use the following CLI command:

```
Device# configure dot11Radio <interface> wifistats <clear>
```

Clear: Clear wireless stats counters.

Configuring NTP from CLI

To configure the NTP server address, use the following CLI command:

```
Device# configure ntp server <string>
```

String - IP address or domain name.

Example:

```
Device# configure ntp server 192.168.216.201
```

To configure the NTP authentication, use the following CLI command:

```
Device# configure ntp authentication none
Device# configure ntp authentication md5 <password> <keyid>
Device# configure ntp authentication sha1 <password> <keyid>
```

none - disable the NTP authentication md5|sha1 - authentication method.

Example:

```
Device# configure ntp authentication md5 test1234 65535
```

Note Optional, the md5 password and keyid should match NTP server's md5 password and keyid.

To configure a new password using a GUI or CLI, the password should match the following criteria:

- The password length range is from 8 to 20 characters.
- The following special characters are not allowed:
  - ' (apex)
  - " [double apex]
  - ` [backtick]
  - $ [dollar]
  - = [equal]
  - \ [backslash]
  - # [number sign]
  - whitespace

To enable or disable the NTP service, use the following CLI command:

```
Device# configure ntp { enable|disable }
```

To configure the NTP timezone, use the following CLI command:

```
Device# configure ntp timezone <string>
```

Example:

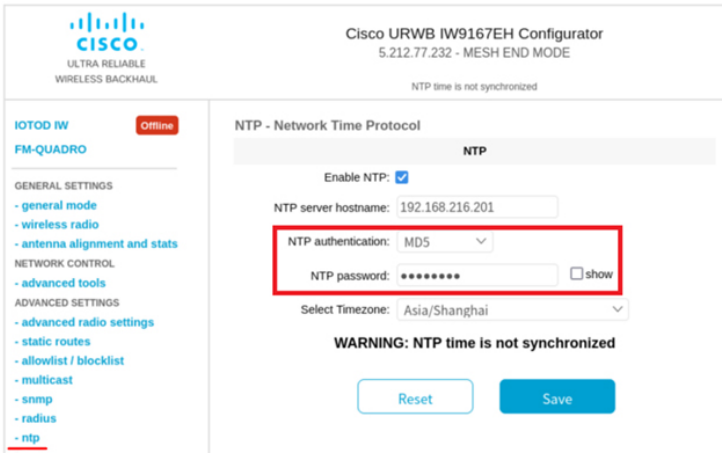
```
Device# configure ntp timezone Asia/Shanghai
```

To validate the NTP configuration and status, use the following show commands:

```
Device# show ntp config
NTP status: enabled
NTP server: 192.168.216.201
authentication: MD5
password: test123
keyid: 5
timezone: Asia/Shanghai

Device# #show ntp (Using this command to check if device can sync up time with NTP server)
Stratum Version Last Received  Delay    Offset  Jitter    NTP server
1          4      9sec ago    1.840ms -0.845ms 0.124ms 192.168.216.201
```

Configuring NTP from GUI

The following image shows the GUI of NTP:



Validating Radio Mode for URWB

To validate Radio mode, use the following show commands:

```
Device# show dot11Radio <interface> config
```

Example:

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fluidity
Frequency : 5785 MHz
```

```
Channel : 157
Channel width : 40 MHz
```

```
Device# show dot11Radio 2 config
Interface : enabled
Mode : fluidmax secondary
Frequency : 5180 MHz
Channel : 36
Channel width : 40 MHz
```

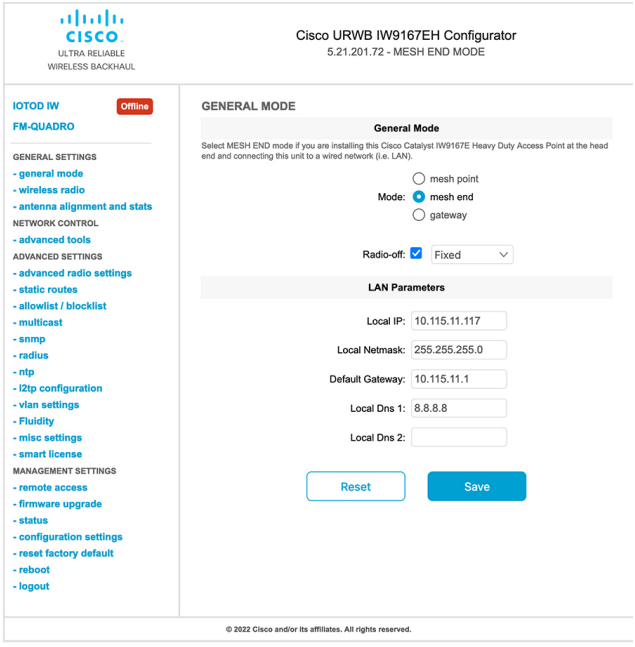
To change the Radio mode of vehicle access point (mobility client) to Fixed or Fluidmax, configure Fluidity role as infrastructure using CLI:

```
Device# configure fluidity id infrastructure
```

.

Configuring Radio-off Mode from GUI

To configure a Radio-off mode, choose fixed or Fluidity mode as shown in the following image. Select a **mesh end** mode if you are installing the Catalyst IW9167E access point at the head end and connecting this device to a wired network such as LAN.



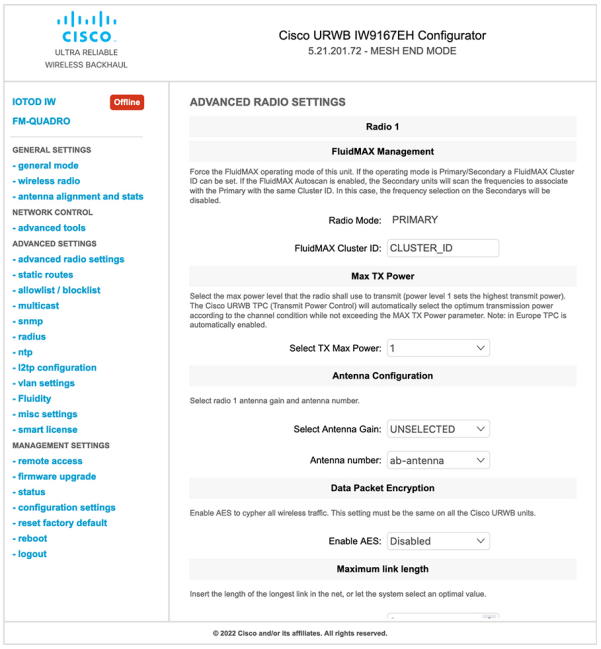
Configuring Radio Mode from GUI

To establish a wireless connection the operating frequency should be same between the devices.

To configure a Radio mode using GUI, follow these steps:

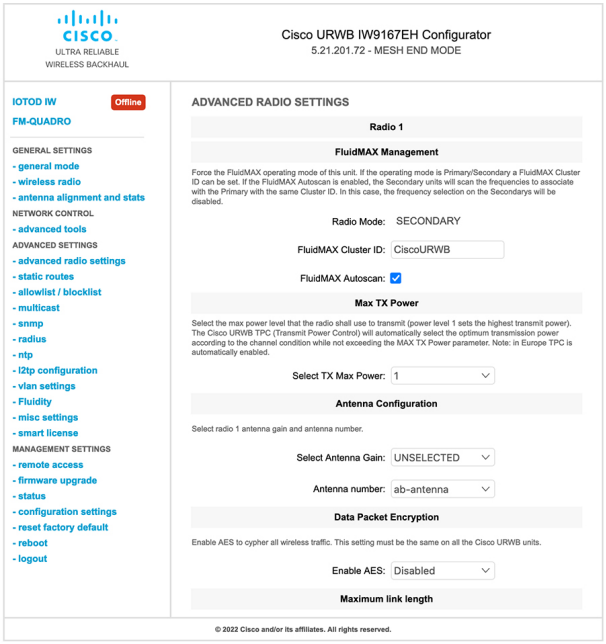
1. Set the operating mode for specified radio (Radio1 and Radio2) interface.

2. In the **WIRELESS RADIO** section, choose Radio 1 Role as **Fluidmax Primary** with FluidMAX Cluster ID. In this scenario, the frequency selection for the Primary is enabled and Secondary is disabled. In the **ADVANCED RADIO SETTINGS** window, go to **Max TX Power** section, and choose power level as 1 from the **Select TX Max Power** drop-down list and URWB transmission power control (TPC) automatically selects the optimum transmission power.



Note In Europe TPC is automatically enabled.

3. In the **WIRELESS RADIO** section, choose Radio 1 Role as **Fluidmax Secondary** with FluidMAX Cluster ID. In the **ADVANCED RADIO SETTINGS**, if you check the **FluidMAX Autoscan** check box, the secondary devices scan the frequencies to associate with the Primary with the same Cluster ID. In this case the frequency selection on the Secondary is in disable mode. In the **Max TX Power** section, and choose power level as 1 from the **Select TX Max Power** drop-down list and URWB TPC automatically selects the optimum transmission power.



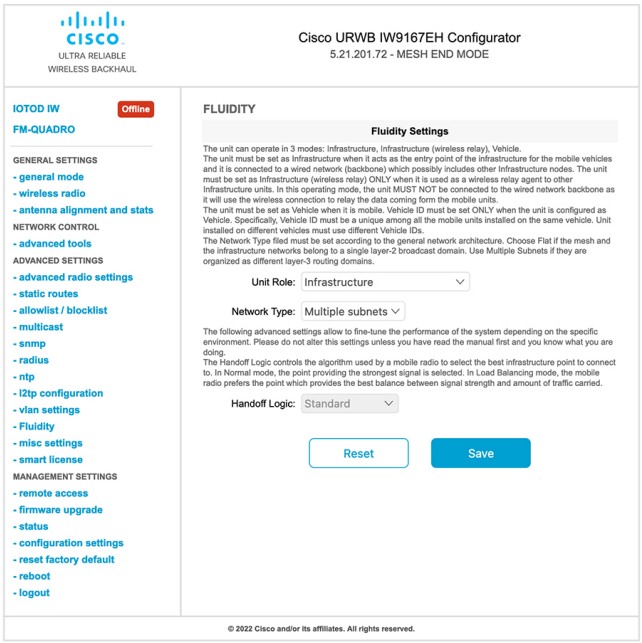
Note In Europe TPC is automatically enabled.

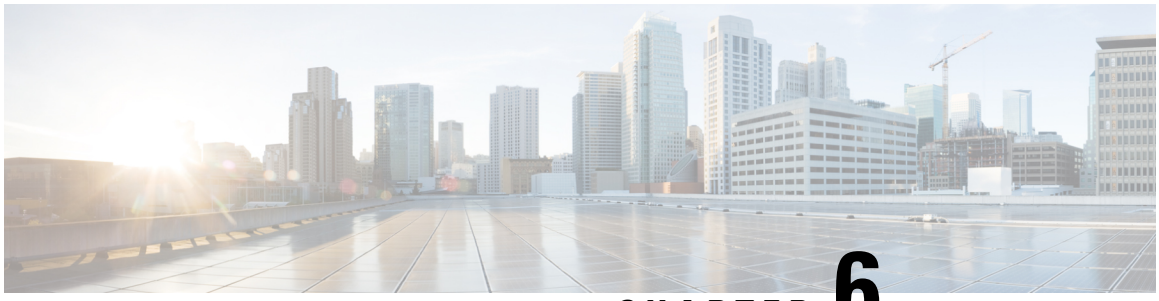
4. In the **Fluidity Settings** section, choose **Unit Role** as **Infrastructure** from the drop-down list, When the device acts as the entry point of the infrastructure for the mobile vehicles or choose unit role as **Infrastructure (wireless relay)** only when it used as a wireless relay agent to other infrastructure unit or choose unit role as a **Vehicle** when it is mobile.
5. Choose network type based on the to the general network architecture:
   a. Choose **Flat** mode from **Network Type** drop-down list, if the network belongs to single layer-2 broadcast domain.

      or

   b. Choose **Multiple subnets** if the network belongs to single layer-3 broadcast domain.


ULTRA RELIABLE
WIRELESS BACKHAUL
Cisco URWB IW9167EH Configurator
5.21.201.72 - MESH END MODE
IOTOD IW
Offline
FM-QUADRO
GENERAL SETTINGS
- general mode
- wireless radio
- antenna alignment and stats
NETWORK CONTROL
- advanced tools
ADVANCED SETTINGS
- advanced radio settings
- static routes
- allowlist / blocklist
- multicast
- snmp
- radius
- ntp
- l2tp configuration
- vlan settings
- Fluidity
- misc settings
- smart license
MANAGEMENT SETTINGS
- remote access
- firmware upgrade
- status
- configuration settings
- reset factory default
- reboot
- logout
WIRELESS RADIO
Wireless Settings
"Shared Passphrase" is an alphanumeric string or special characters excluding "[apex] "[double apex] `[backtick] $[dollar] =[equal] \[backslash] and whitespace (e.g. "mysecurecamnet") that indentifies your network. It MUST be the same for all the Cisco URWB units belonging to the same network.
Shared Passphrase: PASSWORD
In order to establish a wireless connection between Cisco URWB units, they need to be operating on the same frequency.
Radio 1 Settings
Role: Fluidity
Frequency (MHz): 5180
Channel Width (MHz): 80
Radio 2 Settings
Role: Disabled
Reset
Save
© 2022 Cisco and/or its affiliates. All rights reserved.


ULTRA RELIABLE
WIRELESS BACKHAUL
Cisco URWB IW9167EH Configurator
5.21.201.72 - MESH END MODE
IOTOD IW
Offline
FM-QUADRO
GENERAL SETTINGS
- general mode
- wireless radio
- antenna alignment and stats
NETWORK CONTROL
- advanced tools
ADVANCED SETTINGS
- advanced radio settings
- static routes
- allowlist / blocklist
- multicast
- snmp
- radius
- ntp
- l2tp configuration
- vlan settings
- Fluidity
- misc settings
- smart license
MANAGEMENT SETTINGS
- remote access
- firmware upgrade
- status
- configuration settings
- reset factory default
- reboot
- logout
FLUIDITY
Fluidity Settings
The unit can operate in 3 modes: Infrastructure, Infrastructure (wireless relay), Vehicle.
The unit must be set as Infrastructure when it acts as the entry point of the infrastructure for the mobile vehicles and it is connected to a wired network (backbone) which possibly includes other Infrastructure nodes. The unit must be set as Infrastructure (wireless relay) ONLY when it is used as a wireless relay agent to other Infrastructure units. In this operating mode, the unit MUST NOT be connected to the wired network backbone as it will use the wireless connection to relay the data coming form the mobile units.
The unit must be set as Vehicle when it is mobile. Vehicle ID must be set ONLY when the unit is configured as Vehicle. Specifically, Vehicle ID must be a unique among all the mobile units installed on the same vehicle. Unit installed on different vehicles must use different Vehicle IDs.
The Network Type filed must be set according to the general network architecture. Choose Flat if the mesh and the infrastructure networks belong to a single layer-2 broadcast domain. Use Multiple Subnets if they are organized as different layer-3 routing domains.
Unit Role: Infrastructure
Network Type: Multiple subnets
The following advanced settings allow to fine-tune the performance of the system depending on the specific environment. Please do not alter this settings unless you have read the manual first and you know what you are doing.
The Handoff Logic controls the algorithm used by a mobile radio to select the best infrastructure point to connect to. In Normal mode, the point providing the strongest signal is selected. In Load Balancing mode, the mobile radio prefers the point which provides the best balance between signal strength and amount of traffic carried.
Handoff Logic: Standard
Reset
Save
© 2022 Cisco and/or its affiliates. All rights reserved.



CHAPTER 6

IW Service Cluster

Overview

IW Service Cluster

Cisco Industrial Wireless is a cloud-based IoT services platform designed to monitor and manage IoT devices and networks. For more information about the IW Service, see Introduction to Industrial Wireless.

IW Service Cluster Before Release 17.15.1

Earlier than Cisco UIW Release 17.15.1, selecting the IW Service cluster for access was not an option. The default setting was auto, which redirected users to either the US or EU cluster based on the geolocation. For example, devices in the United States are redirected to the US cluster and devices outside the United States are redirected to the EU cluster.

IW Service Cluster in Release 17.15.1

From Cisco UIW Release 17.15.1, you can configure the IW Service cluster URL to Auto, EU, or US options.

Configure IW Service Cluster from CLI

Procedure

To configure the IW Service cluster in an AP, run the following command:

Device#**iw-cluster** {**auto** | **us** | **eu**}

Note
By default, the auto option is enabled.

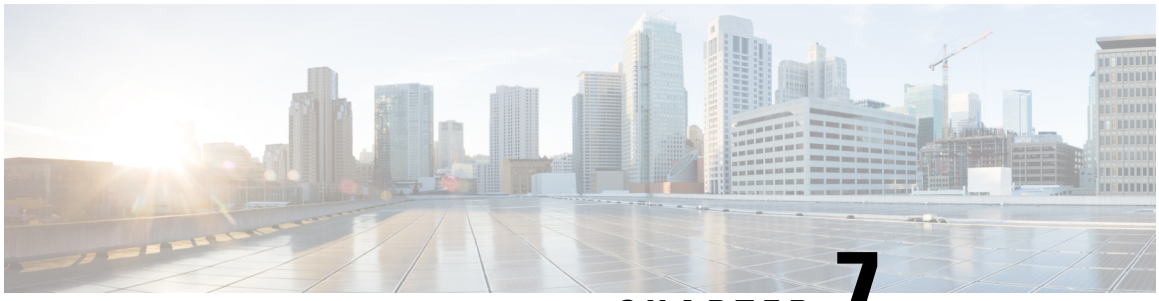
After you configure the AP with the required cluster, use the following URL to access the IW Service.

- For auto use: device.ciscoiot.com
- For the US, use: us.ciscoiot.com
- For the EU, use: eu.ciscoiot.com

Verify IW Service Cluster

To verify the IW Service cluster configuration, run the following command:

```
Device#show iw-service cluster configuration IW Service EU Cluster
```



CHAPTER 7

Configuring Radio Antenna Settings

Configuring Radio Antenna Settings

The Catalyst IW9167E supports eight external antennas with eight N-type female connectors to support multiple antenna options. The antenna ports 1, 4, and 5 can support self-identifying antennas (SIA). Radio 1 connects to ports 1 to 4, and Radio 2 connects to ports 5 to 8. For more information on antennas, see Antennas and Radios.

The Catalyst IW9165E supports four external antennas with Reverse-polarity SMA (RP-SMA) (f) connectors. Radio 1 connects to antenna ports 1 and 2, Radio 2 connects to antenna ports 3 and 4, and antenna ports 1 and 3 can support SIA antennas.

The Catalyst IW9165D has a built-in directional antenna and supports two external antennas with N-type (f) connectors. Radio 1 connects to the internal antenna. Radio 2 connects to antenna ports 1 and 3. Antenna port 3 can support SIA antenna.

The following sections describe the CLI commands to manage antenna port and gain on each antenna for different Radio mode:

Configuring Antenna Gain

To configure an antenna gain, use the following CLI command:

Set the maximum antenna gain value in integer or string UNSELECTED.

For UNSELECTED, the background process automatically configures the minimum supported antenna gain.

Note Once the SIA is connected, gain sets automatically without any input.

```
Device# configure dot11radio <interface> antenna gain <gain>
gain:
<1-19> antenna gain in dBi
WORD UNSELECTED
Device# write
```

Configuring Transmit and Receive Antennas

To configure a transmission chain, use the following CLI command:

Note Catalyst IW9165 does not support abcd-antenna mode.

```
Device# configure dot11radio <interface> antenna < A >
configure antenna chains (A) in use as follows
a-antenna - configure dot11 antenna a
ab-antenna - configure dot11 antenna ab
abcd-antenna - configure dot11 antenna abcd
Device# write
```

Configuring Transmission Power

To configure a transmission power, use the following CLI command:

Set the maximum transmission power level. For AUTO, the background process automatically configures the maximum allowed power level one.

Note Eight is the lowest power level and one is the highest power level.

```
Device# configure dot11radio <interface> txpower-level <level>
txpower level:
<1-8> tx power level value
WORD AUTO
Device# write
```

Validate URWB Individual Antenna RSSI Values

Cisco UIW Release 17.15.1 introduces the URWB Individual Antenna Received Signal Strength Indicator (RSSI) for the Catalyst IW9167E, IW9165E, and IW9165D access points. This feature allows you to view the RSSI value measured for each antenna separately. Multiple RSSI values enable you to monitor the signal strength received separately by each antenna on their radio interface.

For example, with the Catalyst IW9167E's four antennas per radio, you can now check the RSSI for each of the four antennas individually. This detailed information is valuable for troubleshooting and helps identify possible issues with individual antennas or cables. By examining the RSSI for each radio chain, you can determine if a specific antenna is malfunctioning or if its performance varies compared to the others.

Table 4: Radio Chain to Antenna Port Mapping

Access Point	Radio Interface	Radio Chain	Antenna Port
IW9167EH	1	[A,B,C,D]	[4, 3,2,1]
	2	[A,B,C,D]	[5,6,7,8]

Access Point	Radio Interface	Radio Chain	Antenna Port
IW9165E	1	[A,B]	[1,2]
	2	[A,B]	[3,4]
IW9165D	2	[A,B]	[1,3]

Procedure

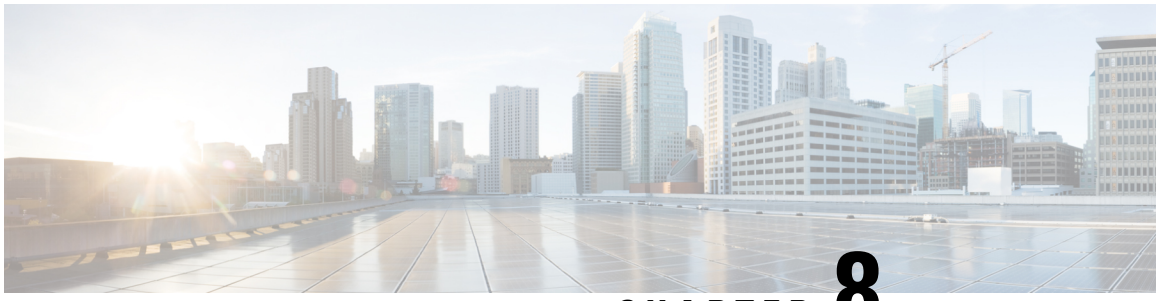
To validate the RSSI of individual antenna on an AP, use the following command:

```
Device#show dot11Radio <n> wifistats rssi
```

Replace <n> with the appropriate radio number

Example:

```
Device#show dot11Radio 1 wifistats rssi
FC:58:9A:15:E4:D2
       MeshID 5.21.201.204 via R1
       rssi [-70, -69, -70, -71]
FC:58:9A:15:B9:12
       MeshID 5.21.200.80 via R1
       rssi [-70, -69, -70, -71]
```



CHAPTER 8

Configuring Wired Interface

Enabling and Disabling Wired Interface

Configuring the wired interface is introduced from UIW Release 17.12.1 and this feature allows wire interfaces to be disabled. It is not possible to disable both wire interfaces at the same time. You can enable the wired interface using the CLI.

Enabling or disabling wired interface using CLI

To enable or disable specific wired interface, use the following CLI command:

```
Device# configure wired <0-1>
                disabled disable wired interface
                enabled enable wired interface
```

Example:

```
Device# configure wired 0 disabled
         Device# configure wired 1 enabled
         Device# write
         Device# reload
```

Error handling configuration

The following CLI command shows the error when both the interfaces are configured as disable mode:

```
Device # configure wired 0 disabled
         Device# configure wired 1 disabled
         ERROR: Interface wired0 is disabled, cannot disable both interfaces
```

Verifying enabling and disabling wired interface using CLI

To verify enable or disable state of wired interface, use the following show command:

```
Device# #show wired <0-1> config
```

Example:

```
Device# show wired 0 config
         WIRED0 status: enabled
```

```
Device# show wired 1 config
         WIRED1 status: disabled
```

Configuring Maximum Transmission Unit Settings

The maximum frame size that can be transported across the URWB network can be configured. This setting must be configured on every access point in the URWB network.

Configuring MTU setting using CLI

To change the MTU value for wired interfaces, use the following CLI command:

```
Device# configure wired mtu
         <1530-1600> Unsigned integer set wired mtu
```

Example:

```
Device# configure wired mtu 1600
```

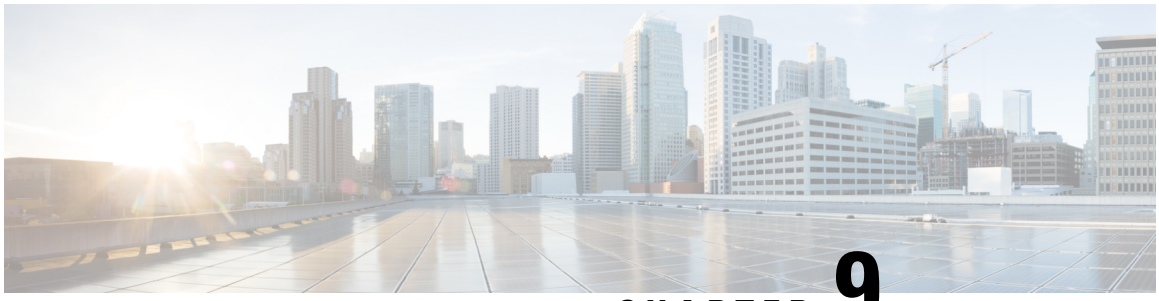
Verifying MTU setting using CLI

To verify the MTU value for wired interfaces, use the following show command:

```
Device# show wired mtu
```

Example:

```
Device# show wired mtu
         Configured MTU: 1600
```



CHAPTER 9

Enable or Disable SSH and Web UI Access

Enable SSH Access

Procedure

Step 1 To enable access to the SSH, use the following command:

```
Device# configure ssh enable
```

Step 2 To verify whether SSH is enabled, use the following command:

```
Device# show ssh

SSH: enabled
```

Disable SSH Access

Procedure

Step 1 To disable access to the SSH, use the following command:

```
Device# configure ssh disable
```

Step 2 To verify whether SSH is disabled, use the following command:

```
Device# show ssh

SSH: disabled
```

Enable Web UI Access

Procedure

Step 1 To enable Web UI access, use the following command:

```
Device# configure webui enable
```

Step 2 To verify whether web UI access is enabled, use the following command:

```
Device# show webui config

Web-UI: enabled
```

Disable Web UI Access

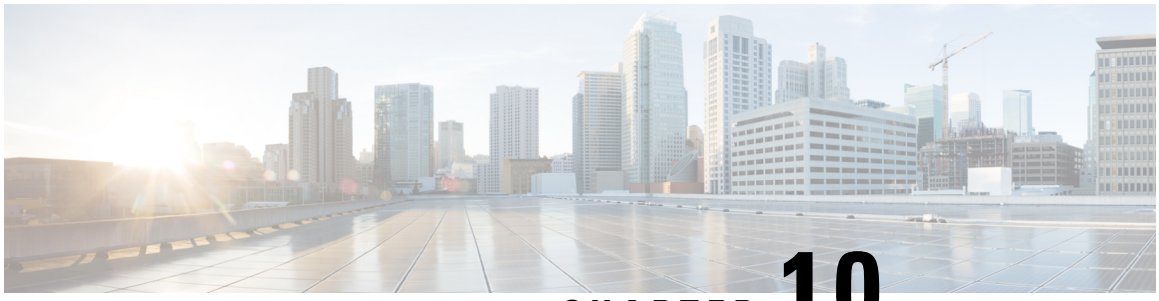
Procedure

Step 1 To disable Web UI access, use the following command:

```
Device# configure webui disable
```

Step 2 To verify whether web UI access is disabled, use the following command:

```
Device# show webui config

Web-UI: disabled
```



CHAPTER 10

Configure and validate radio channel and bandwidth

4900-4990 MHz frequency support for US and Canada with license enforcement

From UIW Release 17.16.1, the Cisco Catalyst IW9167E, IW9165D, and IW9165E APs introduces additional support 4.9 GHz frequency band in URWB mode for Canada (-A) and -B (United States) domains.

When operating in the 4.9 GHz frequency bands for -A and -B domains, devices use 10 MHz and 20 MHz channel bandwidths with 5 MHz channel spacing.

The 4.9 GHz frequency bands are available on both the radio slot 1 and slot 2 and is disabled by default.

Note The -A and -B domains do not support IEEE 802.11ax rates when operating in 4.9 GHz.

Table 5: 4.9 GHz Frequency Bands Supported for the 10 MHz and 20 MHz Channel Bandwidth

Channel	Channel bandwidth (10 MHz)	Channel bandwidth (20 MHz)
11	4945	NA
19	4985	NA

Channel	Channel bandwidth (10 MHz)	Channel bandwidth (20 MHz)
20	4950	4950
21	4955	4955
22	4960	4960
23	4965	4965
24	4970	4970
25	4975	4975
26	4980	4980

Enable 4900-4990 MHz frequency bands

The IW Service sends the 4.9 GHz frequency band enablement configuration to the AP.

Use this task to enable the 4.9 GHz frequency bands on the AP.

Procedure

Configure the 4.9 GHz frequency band enablement using IW Service online or offline deployment mode.

For more information on how to configure the 4.9 GHz band enablement from IW Service, see the Introduction to Industrial Wireless.

Configure operating channel from CLI

Note From UIW Release 17.15.1, the Cisco Catalyst IW9167E, IW9165D, and IW9165E AP supports 4.9 GHz frequency band in URWB mode for -Q domain (Japan).

When operating at 4.9 GHz frequency band, the device supports only 20 MHz channel bandwidth.

The -Q domain supports 802.11ax rates when operating in 4.9 GHz.

Table 6: Supported channels and frequencies for the 4.9 GHz band

Channel	Frequency (MHz)
184	4920
188	4940

Channel	Frequency (MHz)
192	4960
196	4980

To configure the operating channel, use these commands given here:

Procedure

Step 1 Configure the wireless device with radio interface number < 1 or 2 >.

```
Device# configure dot11Radio <interface>
```

Step 2 Set the operating channel id.

```
Device# configure dot11Radio [1|2] channel <1 to 256>
```

Step 3 Returns to privileged EXEC mode.

```
Device(configure dot11Radio [1|2] channel <1 to 256>)# end
```

Configure channel bandwidth from CLI

1. Configure the wireless device with radio interface number <1 or 2>.

   ```
   Device#configure dot11Radio <interface>
   ```

2. Set channel bandwidth in MHz.
   - Radio 1 supports 20, 40, and 80 MHz bandwidths.
   - Radio 2 supports 20, 40, 80, and 160 MHz bandwidths.

   ```
   Device#configure dot11Radio [1|2] band-width [20|40|80|160]
   ```

3. Returns to privileged EXEC mode.

   ```
   Device (configure dot11Radio [1|2] band-width [20|40|80|160])#end
   ```

Validating operating channel and bandwidth from CLI

To validate radio channel and bandwidth, use the following show command:

```
Device# show dot11Radio <interface> config
```

Example:

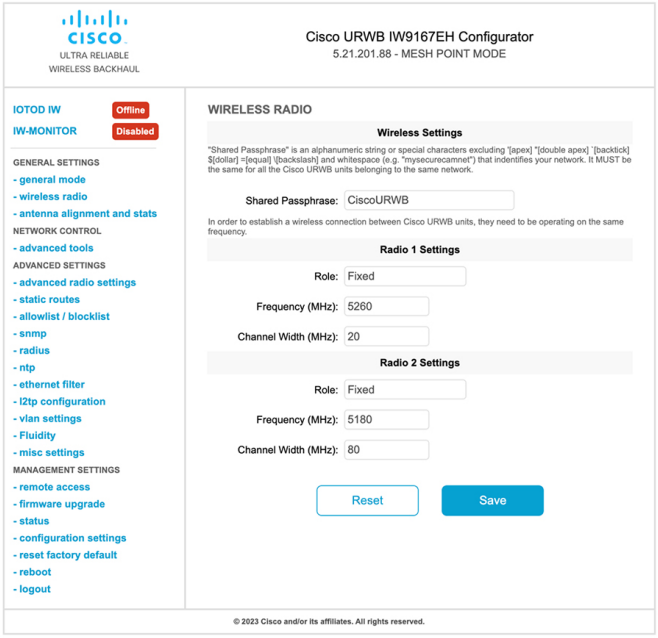
```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fluidmax secondary
Frequency : 5180 MHz
```

```
Channel : 36
Channel width : 40 MHz

Device# show dot11Radio 2 config
Interface : enabled
Mode : fluidity
Frequency : 5785 MHz
Channel : 157
Channel width : 40 MHz
```

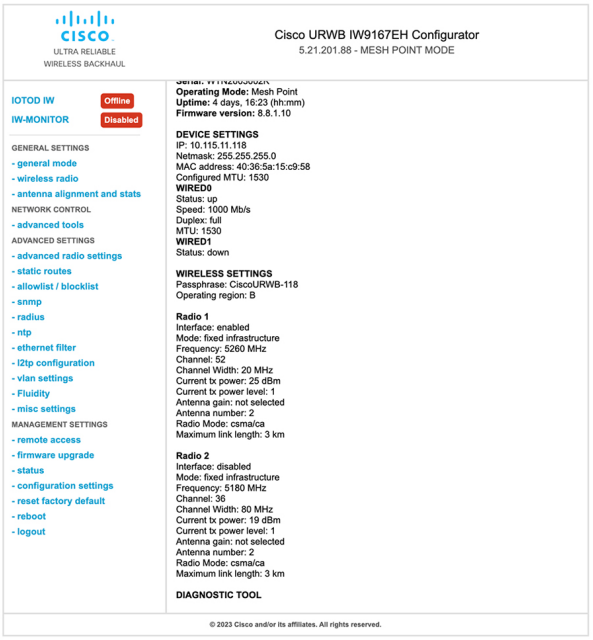
Configure radio channel and bandwidth from GUI

To configure Radio channel and bandwidth using GUI, set the operating channel ID, Radio mode as Fluidity or fixed infrastructure and set the Radio frequency range and bandwidth.

Following image shows the configuration of Radio channel and bandwidth:



Following image shows the status of Radio channel and bandwidth configuration and specific information of each wireless interface.



Configure VLAN settings

Default VLAN configuration parameters for the access point are:

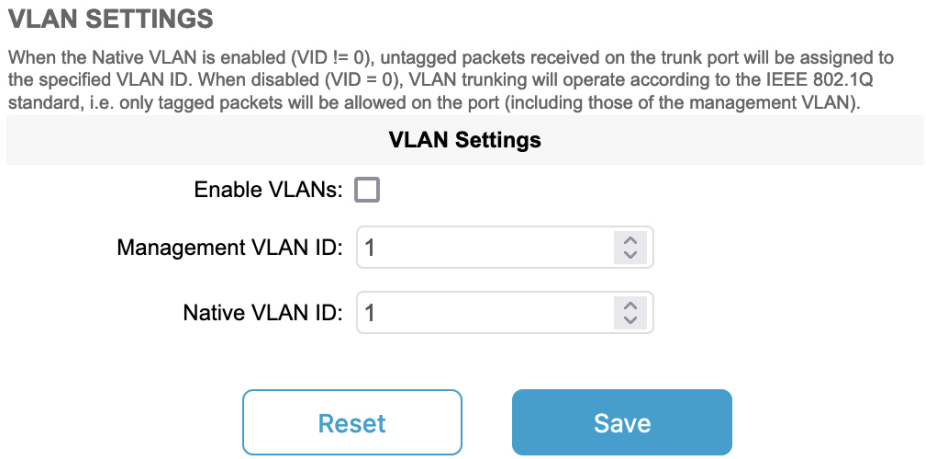
Parameter	Default value
Management VLAN ID (MVID)	1
Native VLAN ID (NVID)	1

To connect the access point to a VLAN that is part of the local wireless network, follow these steps:

Procedure

Step 1 In the **ADVANCED SETTINGS**, click **vlan settings**.

The **VLAN SETTINGS** window appears.



Step 2 Check the **Enable VLANs** checkbox to connect the access point to a VLAN that is part of the local wireless network.

Step 3 Enter the management identification number of the VLAN in the **Management VLAN ID** field. For detailed info about vlan settings and packet management, see Rules for packet management.

Note
The same **Management VLAN ID** must be used on all the access points that are part of the same mesh network.

Step 4 Enter the native identification number of the VLAN in the **Native VLAN ID** field.

Step 5 Click **Save**.

Rules for packet management

Traffic management

The incoming data packets are classified based on the following parameter values:

Access port rules management for incoming packets with an access point in smart mode	
Untagged packet	If native VLAN is ON, then the packet is allowed (tagged with NVID) If native VLAN is OFF, then the packet is dropped
Tagged packet (any VID without any check)	Packet allowed with original tag

Access port rules management for outgoing packets with an access point in smart mode	
Packets from the access points (for example: IW Service interface)	Packet tagged with MVID
Signaling traffic	Packet tagged with MVID
Tagged with valid VID (1–4094), but not with NVID	Packet allowed (tagged)

Access port rules management for outgoing packets with an access point in smart mode	
Tagged with null VID (0) or NVID	Packet allowed (untagged)

Note The packets transmitted through the Cisco VIC SFP+ interface is always tagged with a VLAN header. The interface transmits outgoing packets are classified as untagged with an IEEE 802.1p header with a VLAN ID tag of 0.

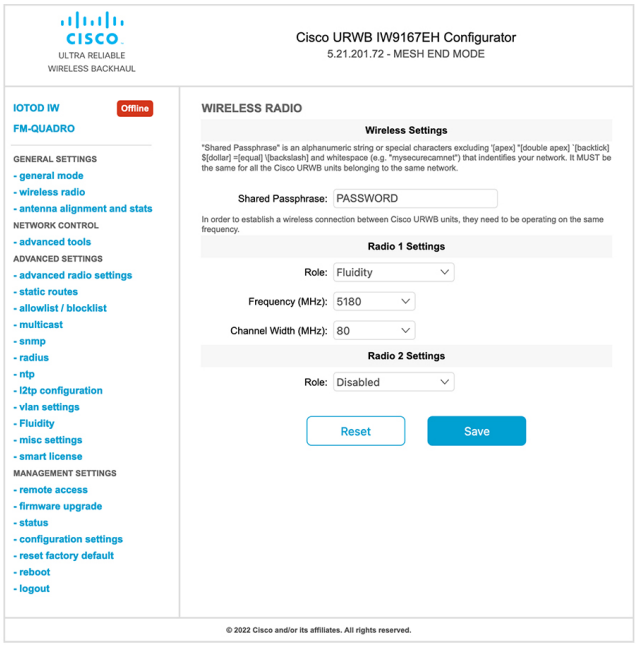
Configure fluidity using GUI

To configure a Fluidity mode using GUI, follow these scenarios:

1. In the **GENERAL SETTINGS**, click **wireless radio**.

   The **WIRELESS RADIO** window appears.

2. Choose Radio mode as **Fluidity** from the **Role** drop-down list.



Once you choose Radio role as **Fluidity**, go to **Fluidity** settings. To go to Fluidity, follow these steps:

1. In the **ADVACED SETTINGS**, click **Fluidity**.

   The **FLUIDITY** window appears.

2. In the **Fluidity Settings**, choose **Unit Role** from the drop-down list. Make device role as any one of following mode:

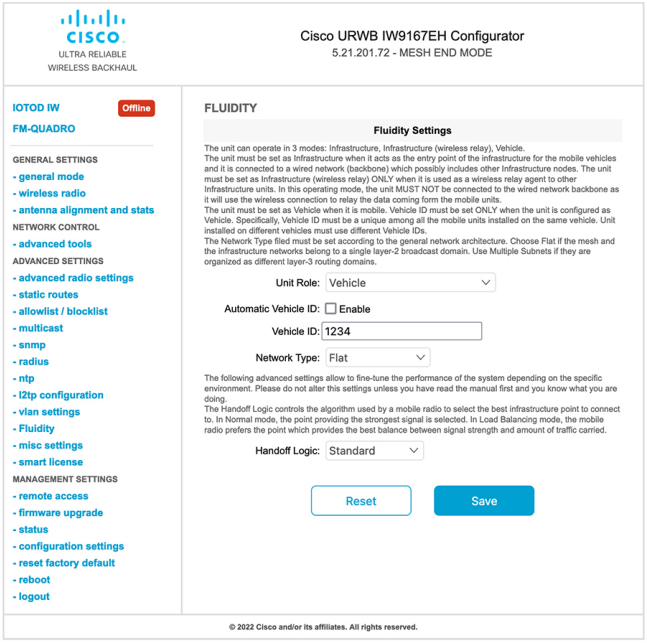
   - Infrastructure
   - Infrastructure (wireless relay)

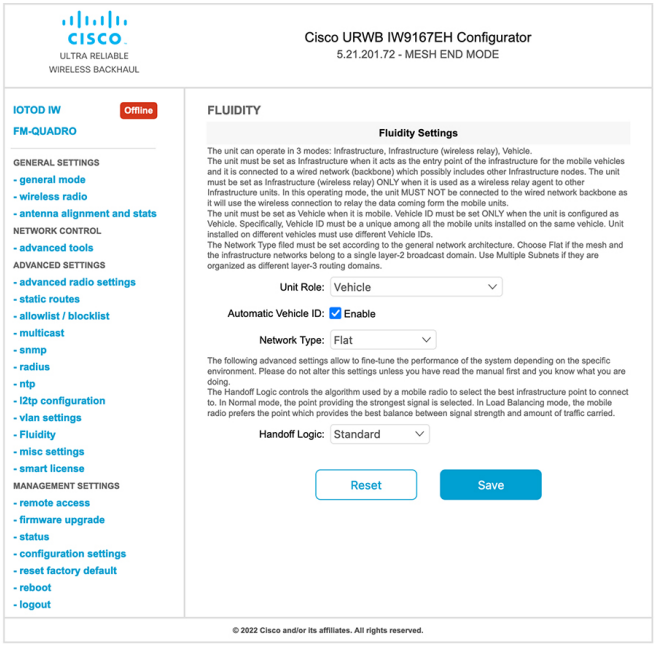
- Vehicle

Note

- Vehicle ID must be unique among all the mobile devices installed on the same vehicle.
- If the device installed on different vehicles must use different Vehicles IDs'.

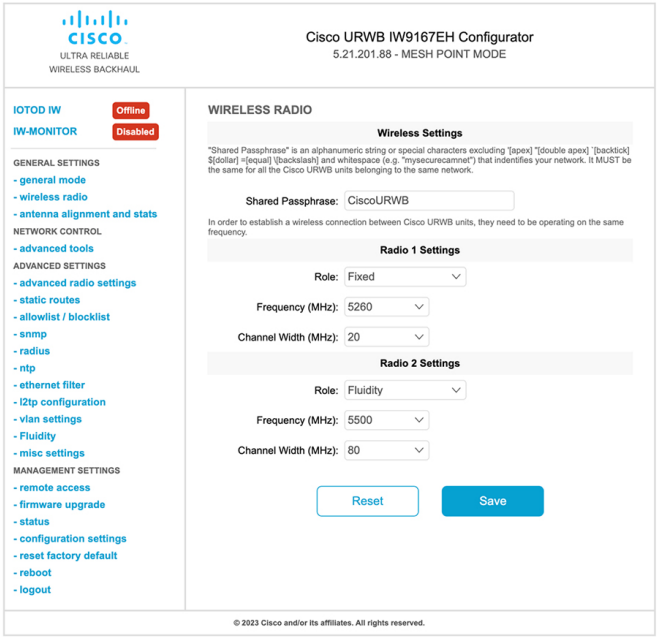
3. Check the **Automatic Vehicle ID** check box to automatically set Vehicle ID for mobile units.

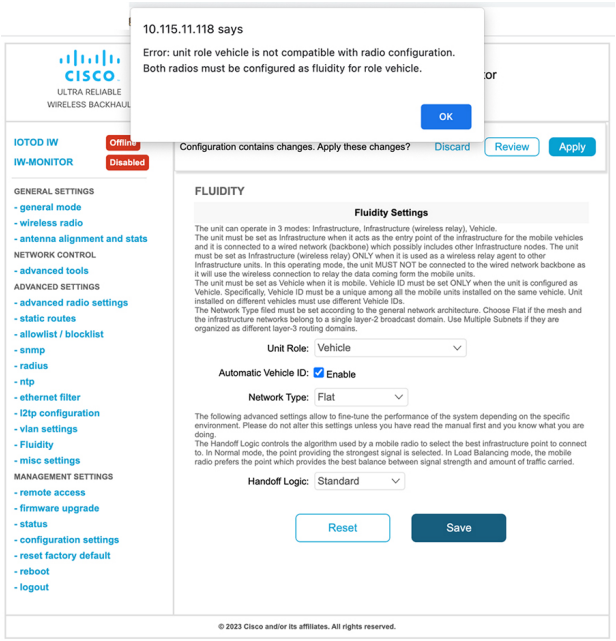




Following Fluidity configuration shows wireless interface device role configured as infrastructure mode:

The following image shows, both radios must be configured as Fluidity for role Vehicle. if one wireless interface is configured in fixed mode and the other one is configured in Fluidity mode then unit role Vehicle cannot be selected.





Configure fluidity using CLI

To enable Fluidity, use the following CLI commands:

Note At least one radio interface should be in Fluidity mode.

```
Device# configure dot11Radio <interface> mode fluidity
```

Example to enable Fluidity for radio 1:

```
configure dot11Radio 1 mode fluidity
```

If the desired Fluidity role is Vehicle both radios should be in Fluidity mode:

```
configure dot11Radio 1 mode fluidity
configure dot11Radio 2 mode fluidity
```

Configuring fluidity role using CLI

To configure Fluidity role (infra or client), use the following CLI commands:

1. Configure the Fluidity role (infrastructure or mobile).

   ```
   Device# configure fluidity id
   ```

2. Configure Fluidity id mode.

   ```
   Device# configure fluidity id {mode}
   Mode is one of the following values
   vehicle-auto - vehicle mode with automatic vehicle ID selection
   vehicle ID - (alphanumeric) vehicle mode with manual ID.
   infrastructure - infrastructure mode
   wireless-relay - wireless infrastructure with no ethernet connection to the backhaul
   ```

3. To end this configuration, use the following CLI command:

   ```
   Device (configure fluidity id {mode}) # end
   ```

   ```
   Device# wr
   ```

   Example:

   ```
   Device# configure fluidity id [vehicle-auto | infrastructure | vehicle-id |
   wireless-relay]
   ```

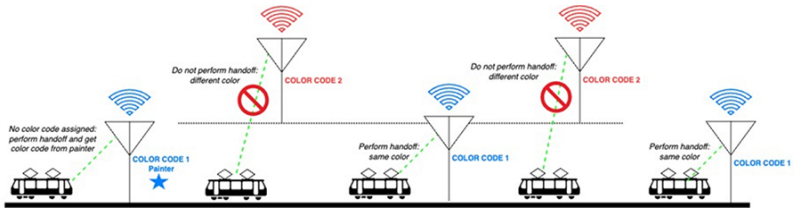
Configure fluidity coloring

Fluidity Coloring is introduced from UIW Release 17.12.1. It enables wayside or outside devices (Fluidity infrastructure devices) to be given specific color codes to enhance or drive the handoff process, and with the standard configuration handoff decision is made based on received signal strength indication (RSSI).

Typical use case: When a train is travelling on one side of the track in one direction (metro line with single tunnel for both track directions) and does not need to connect to the access point located on the opposite side of the tunnel, so mark the access point on each side with a different color to prevent occasional handovers to infrastructure devices on the opposite track.

Fluidity coloring logic

The following image explains the Fluidity coloring logic and painter is a key role for wayside or outside device (Fluidity infrastructure device):



The process of Fluidity coloring as follows:

- Based on the color code, painter notifies the Fluidity vehicle device which Fluidity infrastructure devices are suitable for the handoff.
- The Fluidity vehicle device ignores the color settings and continues to use the standard handoff mechanism (based on RSSI level) until it detects a painter.
- Once the Fluidity vehicle device completes the handoff on a Fluidity infrastructure device with the painter configuration, it starts considering only Fluidity infrastructure devices with the same color code or other painters Fluidity infrastructure devices.
- Multiple Fluidity infrastructure devices acting as painters are allowed.

The following table explains the Fluidity color role and its corresponding options:

Table 7: Fluidity Coloring Role

Fluidity Coloring Role	Options
Wayside painter (Fluidity infrastructure device)	Only one color code can be assigned to a Fluidity infrastructure device configured as a painter
Wayside standard (Fluidity infrastructure device)	A non-painter Fluidity infrastructure device can be configured with multiple color codes
Fluidity vehicle	Only one color can be assigned to Fluidity vehicle device

Configure fluidity coloring using CLI

To configure a Fluidity color mode, use the following CLI commands:

```
Device# configure fluidity color mode
                Disabled: disable coloring
                Enabled: enable coloring
```

```
Device# configure fluidity color value
WORD quoted list of colors from 1 to 7 or "p X" for painter (for example: "1 2 6","4", "p
1"). "clear" to reset
```

Example (painter):

```
Device# configure fluidity color mode enabled
Device# configure fluidity color value "p 1"
Device# write
Device# reload
```

Example (non-painter):

```
Device# configure fluidity color mode enabled
Device# configure fluidity color value "3 4 5"
```

```
Device# write
Devie# reload
```

Example (clear):

```
Device# configure fluidity color value clear
```

Verify fluidity coloring using CLI

To verify a Fluidity color mode, use the following show commands:

```
Device# #show fluidity config
```

Example (painter):

```
Device# show fluidity config
                ...
                Color: enabled, current: p 1
                ...
```

Example (non-painter):

```
Device# show fluidity config
                ...
                Color: enabled, current: 3 4 5
                ...
```

Example (clear):

```
Device# show fluidity config
                ...
                Color: enabled, current: 0
                ...
```

Configure fluidity coloring RSSI threshold

The Fluidity vehicle device temporarily ignore the Fluidity coloring settings if there is a coverage hole and the current RSSI is less than the configured RSSI threshold. In this case, the Fluidity vehicle device retain it's Fluidity coloring settings and ignores them until it receives a handoff from a Fluidity infrastructure device that has the current color code. The Fluidity vehicle device resets its Fluidity coloring settings to the default value (no color) after four consecutive handoffs on a Fluidity infrastructure device with color codes differs from the present value.

Configure fluidity coloring RSSI threshold using CLI

```
Device# configure fluidity color rssi-threshold
         <0-96> COLOR_RSSI_THRESHOLD
```

Example:

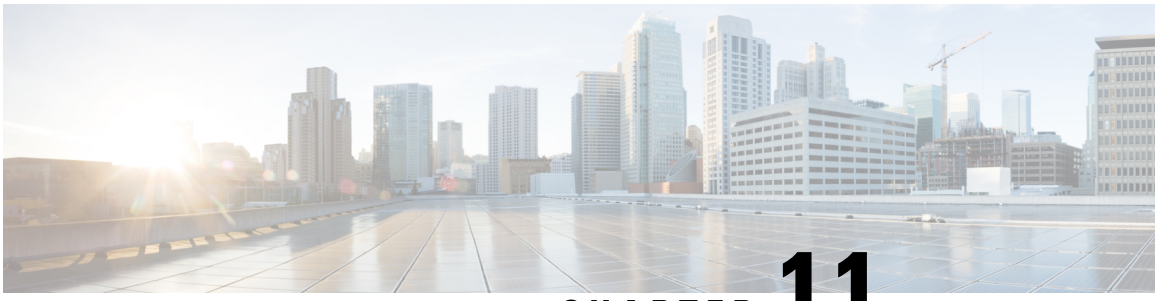
```
Device# configure fluidity color rssi-threshold 55
```

Verify fluidity coloring RSSI threshold using CLI

```
Device# show fluidity config
```

Example:

```
Device# show fluidity config
                ...
                Color: enabled, current: 0
                Color min RSSI threshold: 55
```



CHAPTER 11

Configuring and Validating High Efficiency (802.11 ax)

Configuring and Validating High Efficiency

When High Efficiency (HE) is enabled, it is backward compatible with 802.11ac. To enable or disable 802.11ax HE, the following list is supported:

- URWB HE supports 20,40, and 80 MHz bandwidth for slot 1
- URWB HE supports 20,40,80, and 160 MHz bandwidth for slot 2
- URWB HE default setting is disabled
- HE negotiation is only supported between the devices with HE enabled

To enable HE mode, use the following CLI command:

```
Device# configure dot11Radio [1|2] high-efficiency enable
```

To configure maxmcs as 11, use the following CLI command:

```
Device# configure dot11Radio [1|2] mcs maxmcs 11 <mcs index in integer or string>
```

Note The default maxmcs is Nine.

To disable HE mode, use the following CLI command:

```
Device# configure dot11Radio [1|2] high-efficiency disable
default maxmcs is 9.
```

To validate HE mode, use the following show command:

```
Device# show dot11Radio 1 config
Maximum tx mcs : 9
High-Efficiency : Enabled
Maximum tx nss : 2
RTS Protection : disabled
guard-interval : 800ns
```

```
Device# show dot11Radio 2 config
Maximum tx mcs : 9
High-Efficiency : Enabled
Maximum tx nss : 2
RTS Protection : disabled
guard-interval : 800ns
```

```
Device# show eng-stats
```

WLAN1 Rx:

```
FC:58:9A:16F8:52 rate 1201 MCS 11/2 HE80/G1(800ns) ssn 48 rssi-48 received
```

WLAN1 Tx:

```
FC:58:9A:16F8:52 rate 1201 MCS 11/2 HE80/G1(800ns) sent 195612 failed 0
```

WLAN2 Rx:

```
FC:58:9A:16F8:13 rate 1201 MCS 11/2 HE80/G1(800ns) ssn 50 rssi-46 received
```

WLAN2 Tx:

```
FC:58:9A:16F8:13 rate 864 MCS 11/2 HE80/G1(800ns) sent 390797 failed 1
```

Configuring Global Gateway from GUI

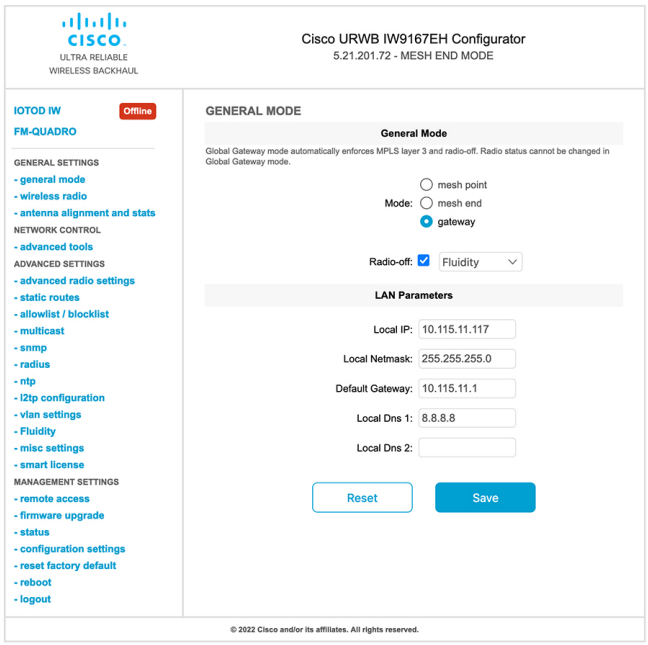
Global gateway mode automatically enforces the MPLS Layer 3. In this mode, Radio-off and Radio status cannot be changed.

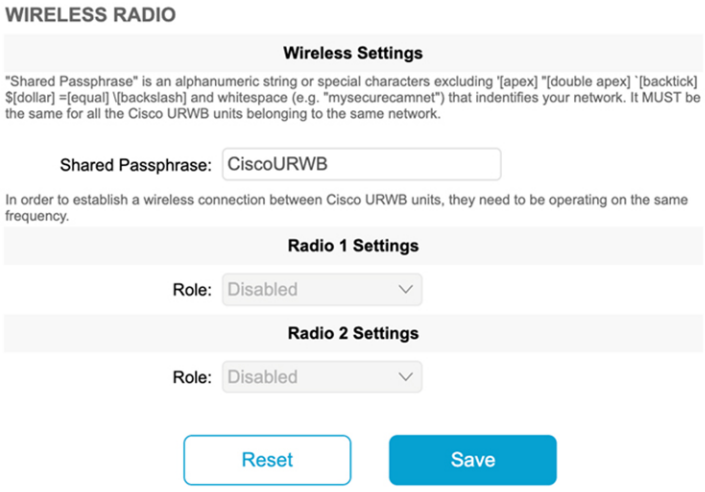
1. In the **GENERAL SETTINGS**, click **general mode**.

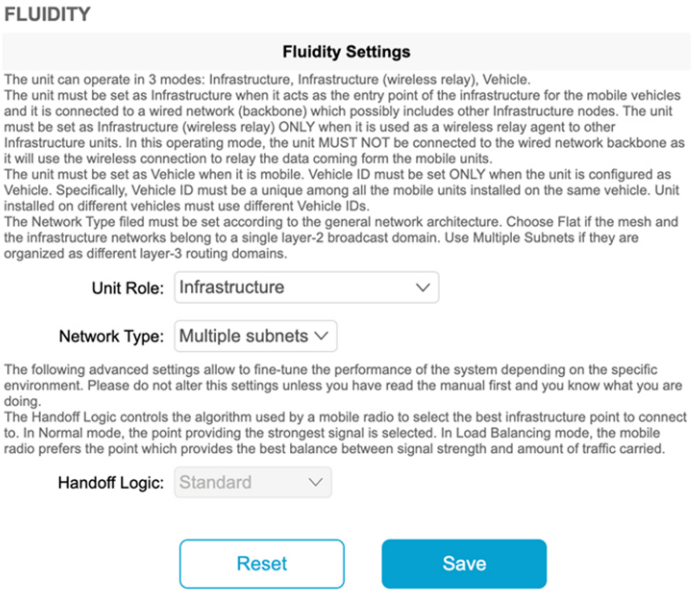
   The **GENERAL MODE** window appears.

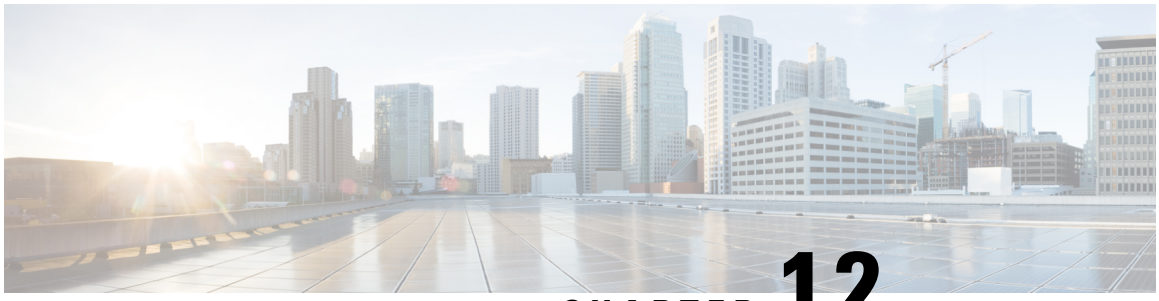
2. Click **gateway** from **Mode**.

Following images shows the GUI configuration of global gateway mode:


Cisco URWB IW9167EH Configurator
5.21.201.72 - MESH END MODE
ULTRA RELIABLE WIRELESS BACKHAUL
IOTOD IW
Offline
FM-QUADRO
GENERAL SETTINGS
- general mode
- wireless radio
- antenna alignment and stats
NETWORK CONTROL
- advanced tools
ADVANCED SETTINGS
- advanced radio settings
- static routes
- allowlist / blocklist
- multicast
- snmp
- radius
- ntp
- l2tp configuration
- vlan settings
- Fluidity
- misc settings
- smart license
MANAGEMENT SETTINGS
- remote access
- firmware upgrade
- status
- configuration settings
- reset factory default
- reboot
- logout
GENERAL MODE
General Mode
Global Gateway mode automatically enforces MPLS layer 3 and radio-off. Radio status cannot be changed in Global Gateway mode.
Mode: mesh point
mesh end
gateway
Radio-off: Fluidity
LAN Parameters
Local IP: 10.115.11.117
Local Netmask: 255.255.255.0
Default Gateway: 10.115.11.1
Local Dns 1: 8.8.8.8
Local Dns 2:
Reset
Save
© 2022 Cisco and/or its affiliates. All rights reserved.


WIRELESS RADIO
Wireless Settings
"Shared Passphrase" is an alphanumeric string or special characters excluding '[apex] "[double apex] `[backtick] $[dollar] =[equal] \[backslash] and whitespace (e.g. "mysecurecamnet") that indentifies your network. It MUST be the same for all the Cisco URWB units belonging to the same network.
Shared Passphrase: CiscoURWB
In order to establish a wireless connection between Cisco URWB units, they need to be operating on the same frequency.
Radio 1 Settings
Role: Disabled
Radio 2 Settings
Role: Disabled
Reset
Save


FLUIDITY
Fluidity Settings
The unit can operate in 3 modes: Infrastructure, Infrastructure (wireless relay), Vehicle.
The unit must be set as Infrastructure when it acts as the entry point of the infrastructure for the mobile vehicles and it is connected to a wired network (backbone) which possibly includes other Infrastructure nodes. The unit must be set as Infrastructure (wireless relay) ONLY when it is used as a wireless relay agent to other Infrastructure units. In this operating mode, the unit MUST NOT be connected to the wired network backbone as it will use the wireless connection to relay the data coming form the mobile units.
The unit must be set as Vehicle when it is mobile. Vehicle ID must be set ONLY when the unit is configured as Vehicle. Specifically, Vehicle ID must be a unique among all the mobile units installed on the same vehicle. Unit installed on different vehicles must use different Vehicle IDs.
The Network Type filed must be set according to the general network architecture. Choose Flat if the mesh and the infrastructure networks belong to a single layer-2 broadcast domain. Use Multiple Subnets if they are organized as different layer-3 routing domains.
Unit Role:
Infrastructure
Network Type:
Multiple subnets
The following advanced settings allow to fine-tune the performance of the system depending on the specific environment. Please do not alter this settings unless you have read the manual first and you know what you are doing.
The Handoff Logic controls the algorithm used by a mobile radio to select the best infrastructure point to connect to. In Normal mode, the point providing the strongest signal is selected. In Load Balancing mode, the mobile radio prefers the point which provides the best balance between signal strength and amount of traffic carried.
Handoff Logic:
Standard
Reset
Save



CHAPTER 12

Configuring Guard Interval for HE (High Efficiency)

Configuring Guard Interval for HE (High Efficiency)

Longer guard intervals improve link reliability for long range outdoor deployments and the feature like guard interval supports URWB stacks.

To configure a guard interval, use the following CLI command:

```
Device# configure dot11Radio [interface] guard-interval [gi]
```

gi - Guard interval values are:

1600 - To configure 1600 ns guard interval (supported only in HE mode)

3200 - To configure 3200 ns guard interval (supported only in HE mode)

400 - To configure 400 ns guard interval (supported in HT and VHT modes)

800 - To configure 800 ns guard interval (default guard interval mode and disable mode in HT, VHT, and HE)

Example:

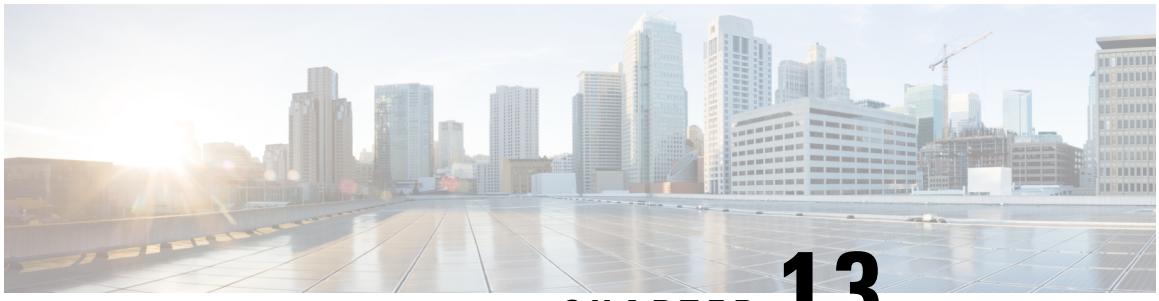
```
Device# configure dot11Radio 1 high-efficiency enable

Device# configure dot11Radio 1 guard-interval 1600

Device# configure dot11Radio 1 guard-interval 3200

Device# wr
```

To validate a guard interval, use the following show commands:

```
Device# show dot11Radio 1 config
Maximum tx mcs: 9
High-efficiency : enabled
Maximum tx nss : 2
RTS protection : disabled
guard-interval : 1600 ns

Device# show dot11Radio 2 config
Maximum tx mcs: 9
High-efficiency : enabled
```

Configuring Guard Interval for HE (High Efficiency)

```
Maximum tx nss : 2
RTS protection : disabled
guard-interval : 3200 ns
```



CHAPTER 13

Configuring and Validating SNMP

Configuring and Validating SNMP

Simple network management protocol (SNMP) applications are used in URWB software for network management functionalities.

The SNMP client sends a request to the SNMP agent. The SNMP agent passes the request to the subagent. The subagent responds to the SNMP agent. The SNMP agent creates an SNMP response packet and sends it to the remote network management station that initiates the request.

Figure 1: SNMP Process

Configuring SNMP from CLI

To configure SNMP, use the following CLI commands:

Note

- SNMP CLI logic modified for SNMP configuration, before enabling the SNMP feature using CLI, you must configure all SNMP parameters.
- Disabling the SNMP feature automatically removes all related configurations.

To enable or disable SNMP functionality, use the following CLI command:

```
Device#configure snmp [enable | disable]
```

To specify the SNMP protocol version, use the following CLI command:

```
Device#configure snmp version {v2c | v3}
```

To specify the SNMP v2c community ID number (SNMP v2c only), use the following CLI command:

```
Device#configure snmp v2c community-id <length 1-64>
```

To specify the SNMP v3 username (SNMP v3 only), use the following CLI command:

```
Device#configure snmp v3 username <length 32>
```

To specify the SNMP v3 user password (SNMP v3 only), use the following CLI command:

```
Device#configure snmp v3 password <length 8-64>
```

To specify the SNMP v3 authentication protocol (SNMP v3 only), use the following CLI command:

```
Device#configure snmp auth-method <md5|sha>
```

To specify the SNMP v3 encryption protocol (SNMP v3 only), use the following CLI command:

```
Device#configure snmp encryption {des | aes | none}
```

Possible encryption values are des or aes. Alternatively, enter none if a v3 encryption protocol is not needed.

To specify the SNMP v3 encryption passphrase (SNMP v3 only), use the following CLI command:

```
Device#configure snmp secret <length 8-64>
```

To specify the SNMP periodic trap settings, use the following CLI command:

```
Device#configure snmp periodic-trap {enable | disable}
```

To specify the notification trap period for periodic SNMP traps, use the following CLI command:

```
Device#configure snmp trap-period <1-2147483647>
```

Notification value trap period measured in minutes.

To enable or disable SNMP event traps, use the following CLI command:

```
Device#configure snmp event-trap {enable | disable}
```

To specify the SNMP NMS hostname or IP address, use the following CLI command:

```
Device#configure snmp nms-hostname {hostname |Ip Address}
```

To disable SNMP configuration, use the following CLI command:

```
Device#configure snmp disabled
```

Once you disable SNMP, it clears all the sensitive information including credentials. You have to re-specify all the valid values again to enable SNMP.

Example of SNMP configuration:

CLI for SNMP v2:

```
Device#configure snmp v2 community-id <length 1-64>
Device#configure snmp nms-hostname hostname/Ip Address
Device#configure snmp trap-period <1-2147483647>
Device#configure snmp periodic-trap enable/disable
Device#configure snmp event-trap enable/disable
Device#configure snmp version v2c
Device#configure snmp enabled
```

CLI for SNMP v3:

```
Device #configure snmp nms-hostname hostname/Ip Address
Device#configure snmp trap-period <1-2147483647>
Device#configure snmp v3 username <length 32>
Device#configure snmp v3 password <length 8-64>
Device#configure snmp auth-method <md5|sha>
Device#configure snmp encryption <aes|des|none>
Device#configure snmp secret <length 8-64>
Device#configure snmp periodic-trap enable/disable
Device#configure snmp event-trap enable/disable
Device#configure snmp version v3
Device#configure snmp enabled
```

Validating SNMP from CLI

To validate the SNMP, use the following show command:

```
Device# show snmp
SNMP: enabled
Version: v3
Username: username
Password: password
Authentication method: SHA
Encryption: AES
Encryption Passphrase: passphrase
Engine ID: 0x8000000903c0f87fe5f314
Periodic Trap: enabled
Notification Period (minutes): 5
Event Trap: enabled
NMS hostname: 192.168.116.11
Device# show snmp
SNMP: enabled
Version: v2c
Community ID: test
Periodic Trap: enabled
Notification Period (minutes): 5
Event Trap: enabled
NMS hostname: 192.168.116.11
Device# show system status snmpd
Service Status
Service Name : snmpd
Loaded : loaded
Active : active (running)
Main ProcessID : 6437
Running Since : Mon 2022-09-19 14:45:27 UTC; 3h 34min ago
Service Restart : 0
```

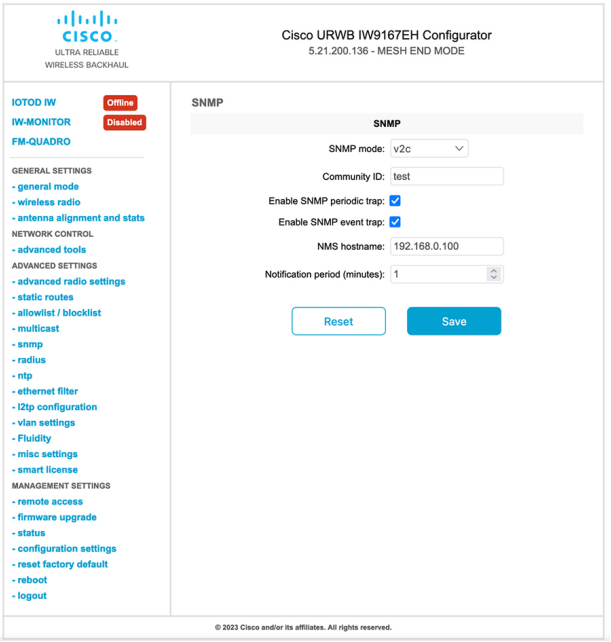
Configuring SNMP Version v2c using GUI

By default, the access points are shipped from the factory with SNMP in disabled mode.

To change the access point's SNMP mode to version **v2c** and configure the access point, follow these steps:

Procedure

Step 1 Choose the version **v2c** from the **SNMP mode** drop-down list.
The **SNMP** window appears.



Step 2 Enter the community identity value in the **Community ID** field.

Important
The same community identity value must be set for all the access points in the network.

Step 3 Check the **Enable SNMP event trap** check box to enable SNMP event traps for significant system-related events, and then enter the network management station (NMS) host name in the **NMS hostname** field.

Important
The NMS host to which traps are sent must have an SNMP agent that is configured to collect SNMP v2c traps.

Step 4 Check the **Enable SNMP periodic trap** check box to enable periodic SNMP traps to send SNMP traps at defined periodic intervals and then enter the host name of NMS in the **NMS hostname** field. Enter the notification period (minutes) in the **Notification period**.

Step 5 Click **Save**.

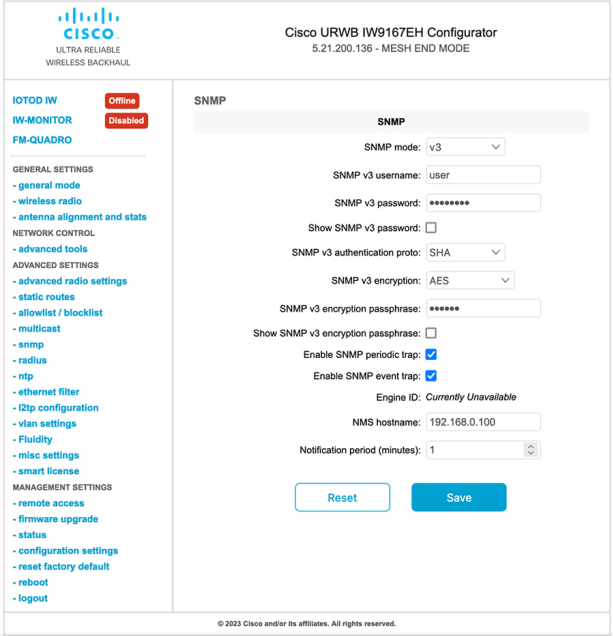
Configuring SNMP Version v3 using GUI

By default, the access points are shipped from the factory with SNMP in disabled mode.

To change the access point's SNMP mode to version **v3** and then configure the access point, follow these steps:

Procedure

Step 1 Choose the version **v3** from the **SNMP mode** drop-down list.
The **SNMP** window appears.



Step 2 Enter the SNMP v3 username in the **SNMP v3 username** field.

Note
The same SNMP v3 username must be set for all the access points in the network.

Step 3 To change the current SNMP v3 password, enter the new password in the **SNMP v3 password** field.

Step 4 Choose the authentication type from the **SNMP v3 authentication proto** drop-down list. The available options are:

- **MD5**
- **SHA**

Important
The same SNMP authentication protocol must be set for all the access points in the network.

Step 5 Choose the appropriate encryption protocol from the **SNMP v3 encryption** drop-down list. The available options are:

- **No Encryption**
- **DES** (Data Encryption Standard)
- **AES** (Advanced Encryption Standard)

Note
The same encryption protocol must be set for all the access points in the network.

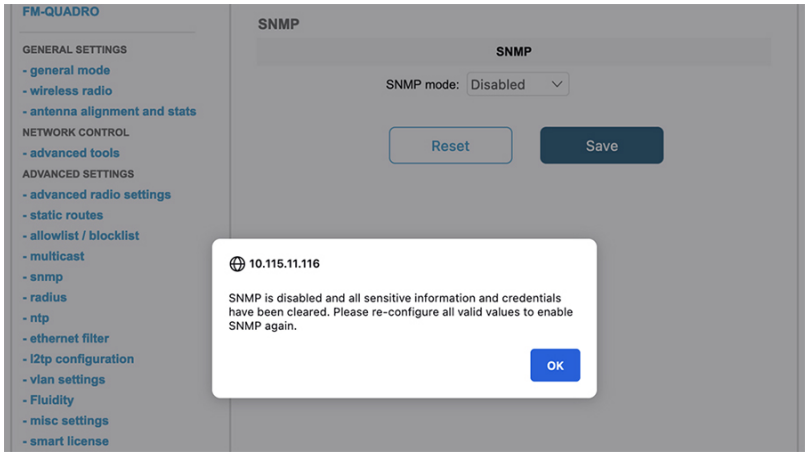
Step 6 To change the encryption passphrase, enter a new passphrase in the **SNMP v3 encryption passphrase** field.

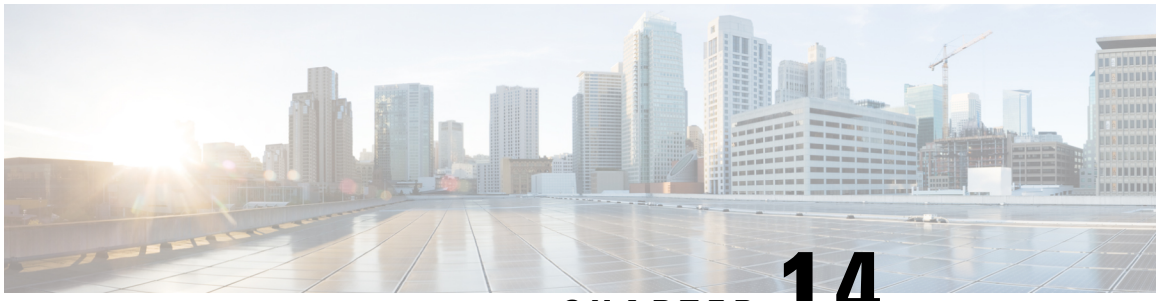
Step 7 Check the **Enable SNMP periodic trap** check box to enable the periodic SNMP traps to send SNMP traps at defined periodic intervals and then enter the host name of NMS in the **NMS hostname** field. Enter the notification period (minutes) in the **Notification period**.

Step 8 Check the **Enable SNMP event trap** check box to enable the SNMP event traps for significant system-related events and then enter the host name of NMS in the **NMS hostname** field.

Note
The NMS host to which traps are sent must have an SNMP agent configured to collect v3 traps.

Step 9 Click **Save**.
If you disable the SNMP, the following pop-up appears:





CHAPTER 14

Multicast

Overview of multicast

AP supports multicast forwarding for Layer 2 and Layer 3 networks. You can configure multicast using either GUI or CLI. Multicast is a method of communication where data is sent from one source to multiple destinations simultaneously. Multicast transmissions can be point-to-multipoint or multipoint-to multipoint.

Note

- By default, only the multicast IP addresses specified below are forwarded across the URWB network.
- Multicast configuration is required only on mesh end devices.
- The multicast reserved IP address range is 224.0.0.0 to 239.255.255.255.

Reserved IP address range for multicast protocols

By default, multicast is enabled for these protocols within the specified IP address ranges:

Protocol	Reserved multicast IP address range
Universal plug and play (UPnP)	239.255.255.250
Open Shortest Path First (OSPF)	224.0.0.5 and 224.0.0.6
Internet Group Management Protocol (IGMP)	N/A

Advantages of multicast configuration

- It reduces the amount of bandwidth used by sending a single stream of data from one source to multiple destinations.

- It supports many devices without significantly increasing network load.
- It optimizes network performance for applications that require real-time data distribution.
- It maintains consistent quality by reducing the number of duplicate streams, helping to maintain consistent Quality of Service (QoS) for all recipient APs.

Configure multicast using GUI

Before you begin

- You can configure multicast only on the mesh end device.
- Ensure that you have a valid multicast group, netmask, and destination IP addresses.
- Ensure that you have a supported mesh end device to configure multicast.

Procedure

Step 1 Launch your computer's web browser and enter the URL to open the configurator login page.

Step 2 Enter your username and password in the respective **Username** and **Enable Password** fields.

Step 3 Click **Login**.
Once you have successfully logged into the GUI, the URWB configurator displays.

Step 4 In the **ADVANCED SETTINGS**, click **multicast** to open the **MULTICAST** window.

Step 5 In the **Add a new multicast route** section, enter these details:

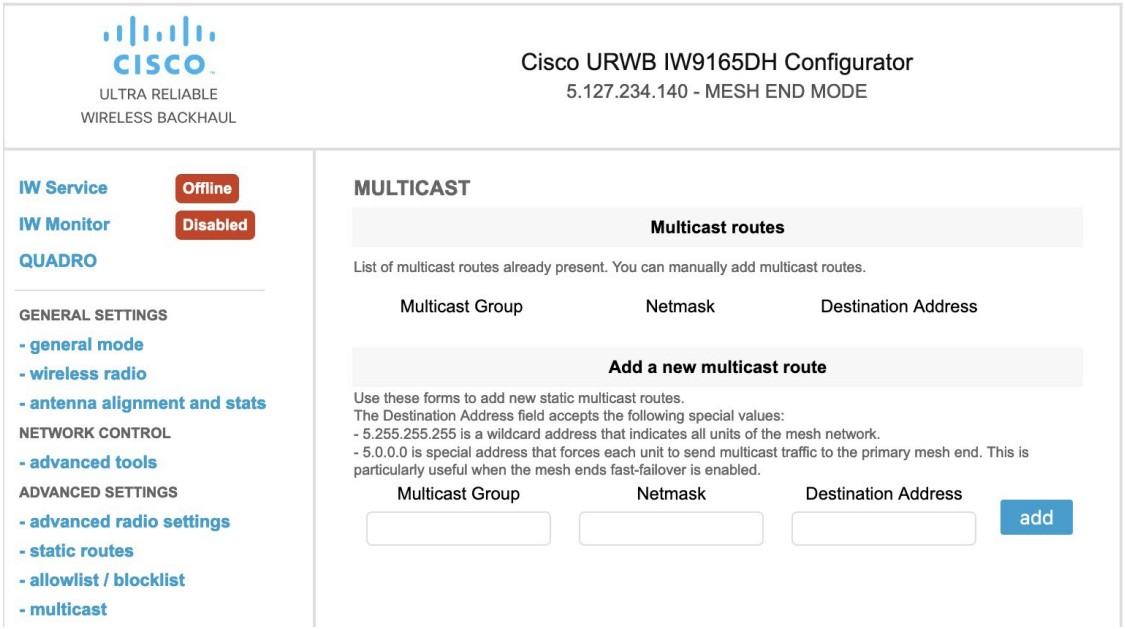
- Multicast IP address in the **Multicast Group** field.
- Netmask IP address in the **Netmask** field.
- Destination IP address in the **Destination Address** field.

Note
The **Destination Address** field accepts the following special values:

- 5.255.255.255 IP address in the **Destination Address** field: sends the data to all the mesh point devices over the mesh network. This is applicable only for the downstream data flow.
- 5.0.0.0 IP address in the **Destination Address** field: sends the data to the current primary mesh end device. This is useful, especially when the mesh end's fast failover is enabled. This is applicable only for the upstream data flow.

Tip
The netmask field allows you to specify block of multicast addresses. When you specify multiple multicast groups, the multicast IP address should reflect the network address for the group.

Step 6 Click **add**.
Once you have successfully added a rule, the new multicast route appears in the **Multicast routes** section.



Step 7 Click **Apply** to update the configuration.
AP reboots to apply the changes.

Configure multicast using CLI

Use the **configure multicast group add** *multicast-IP-address Netmask destination-IP-address* command to add the destination IP address.

Example:

```
Device#configure multicast group add 224.5.5.5 255.255.255.255 5.255.255.255
```

Note This configuration takes effect only after the reboot.

In Layer 3 mode, configure multicast rules on all mesh end devices and the global gateway. Use these different multicast IP addresses for upstream and downstream traffic:

- 224.5.5.5/5.0.0.0: sends the data to the current primary mesh end device. This is useful, especially when the mesh end's fast failover is enabled. This is applicable only for the upstream data flow.
- 224.5.5.6/5.255.255.255: sends the data to all the mesh point devices over the mesh network. This is applicable only for the downstream data flow.

Delete multicast using CLI

Use the **configure multicast group delete** *multicast IP-address Netmask meshID IP-address* command to delete the meshID IP address from the multicast group.

Example:

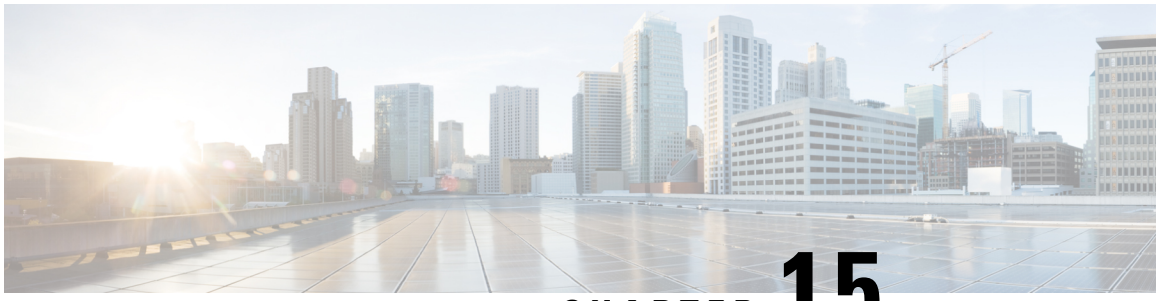
```
Device#configure multicast group delete 224.5.5.5 255.255.255.255 5.255.255.255
```

Note This configuration takes effect only after the reboot.

Verify multicast configuration using CLI

Use the **show multicast configuration** command to view the status of multicast configuration.

```
Device#show multicast configuration
Multicast Group 224.5.5.5/255.255.255.255
Destination Address 5.255.255.255
```



CHAPTER 15

Configuring and Validating Key Controller (Wireless Security)

Configuring and Validating Key Controller (Wireless Security)

To support wireless security to standard Wi-Fi Protected Access (WPA) protocols, a key rotation strategy is implemented for Catalyst IW9167E. The key controller protocol is a packet exchange between two devices, in which different stages of the process correspond to different states of each device. The algorithm flow is controlled by a set of timers scheduled periodically to generate new Pairwise Transient Key/Group Transient Key for packet encryption. The more frequently keys are updated, the lesser amount of information is leaked in the event of an attack.

Configuring Key Controller from CLI

To configure a key controller, use the following CLI commands:

1. To enable Advanced Encryption Standard (AES) on Radio, use the following CLI command:

   ```
   Device# configure dot11Radio <interface> crypto aes enable
   ```

2. To enable key controller, use the following CLI command:

   ```
   Device #configure dot11Radio <interface> crypto key-control enable
   ```

3. To enable key rotation, use the following CLI command:

   ```
   Device# configure dot11Radio <interface> crypto key-control key-rotation enable
   ```

4. To set key rotation timer, use the following CLI command:

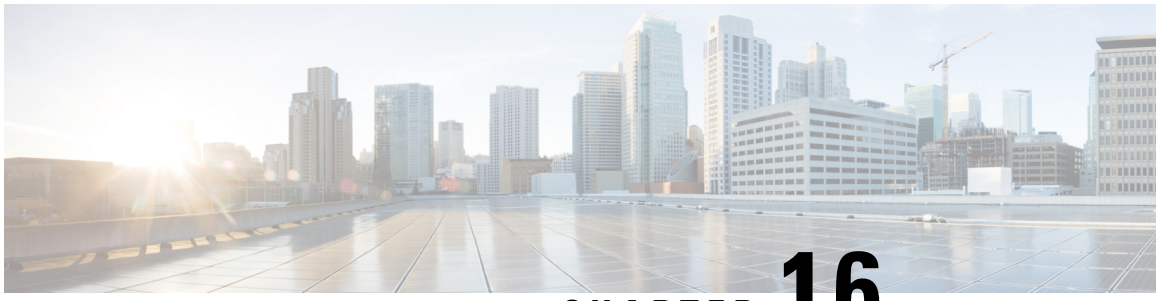
   ```
   Device# configure dot11Radio <interface> crypto key-control key-rotation 3600
   ```

Note By default, AES mode is disabled. Configuration should be same on all devices.

Validating Key Controller from CLI

To validate a key controller, use the following show command:

```
Device# show dot11Radio X crypto
AES encryption: enabled
AES key-control: enabled
Key rotation: enabled
Key rotation timeout: 3600(second)
```



CHAPTER 16

FIPS Certification

FIPS Certification

The Federal Information Processing Standard (FIPS) mode ensures that the SSH and GUI functionalities are in compliance with FIPS140-3 security standards from NIST. When FIPS is enabled, the AP ensures that the configuration is compliant with FIPS requirements.

Note FIPS certification does not support SNMP.

Enable or Disable FIPS Mode using CLI

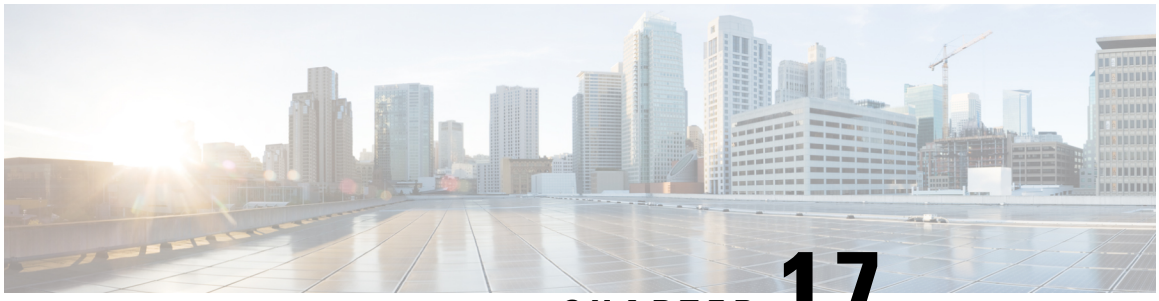
Use this command to enable or disable FIPS mode on AP.

```
Device#configure fips {enable|disable}
```

Verify FIPS Mode using CLI

Use this command to verify FIPS mode on the AP.

```
Device#show fips
FIPS: enabled
```



CHAPTER 17

Fixed domains and country codes (ROW)

Configure and Verify Country Code using CLI

To configure country code for the Rest of the World (ROW) domain, use the following CLI command:

```
Device# configure countrycode [countrycode]
```

Example:

```
Configure countrycode GB
```

The above CLI reports an error if the configured country code is not included in the ROW and the wireless interface does not work correctly if the country code is not configured.

Note Reboot the device before configuring other wireless parameters such as frequency, channel width, and after configuring country code. Setting the country code is only applicable for access points with the ROW domain, such as IW9167EH-ROW.

To verify status of country code, use the following show command:

```
Device# show version | in Product
Product/Model Number: IW9167EH-ROW
```

To verify status of ROW country code, use the following show command:

```
Device# show dot11Radio <interface> config
```

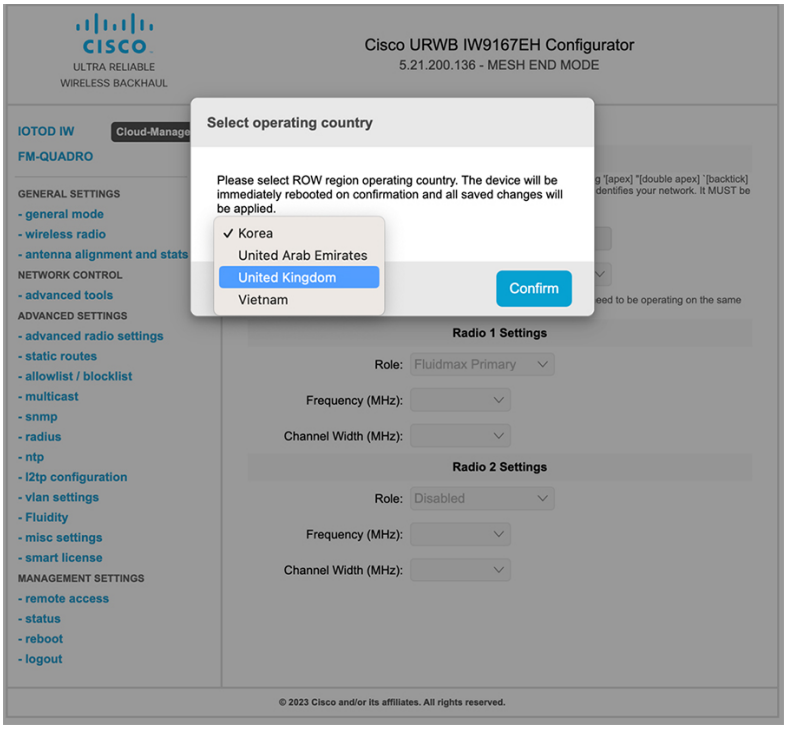
Example:

```
Device# show dot11Radio 1 config
…….
DFS region : GB
DFS radar role : auto
Radar Detected : 0
Indoor deployment: disable
```

Configure country code using GUI

Wireless interfaces fail to work if country code is not configured. To configure the country code:

1. In the **GENERAL SETTINGS**, click **wireless radio**.
2. For ROW domain, if the country code is not selected, the following pop-up appears:



3. To select a country code, click the pop-up in the above image then it redirects to the **Wireless Settings** section. In the **Wireless Settings** section, choose country from the drop-down list.

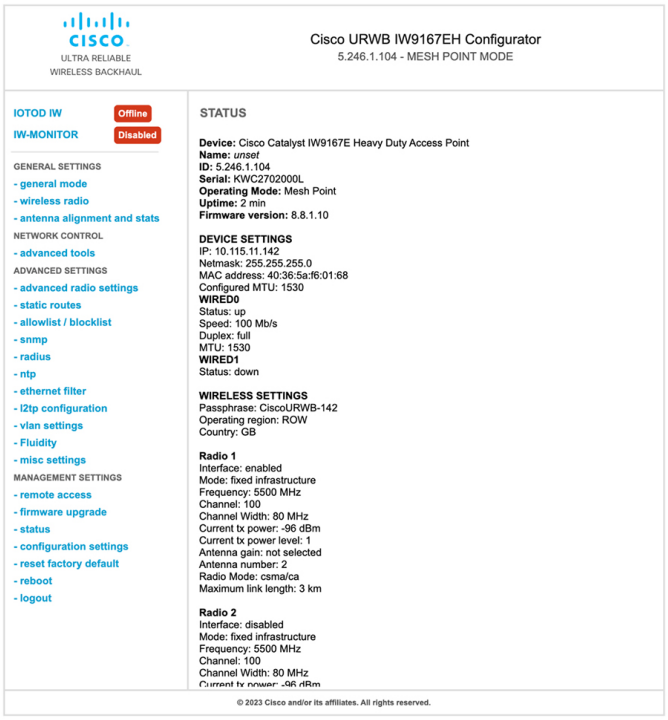
   A confirmation pop-up appears.

4. Click **Confirm**.

   A reboot confirmation screen appears.

5. Click **Yes**.
6. In the **MANAGEMENT SETTINGS**, click **status**.

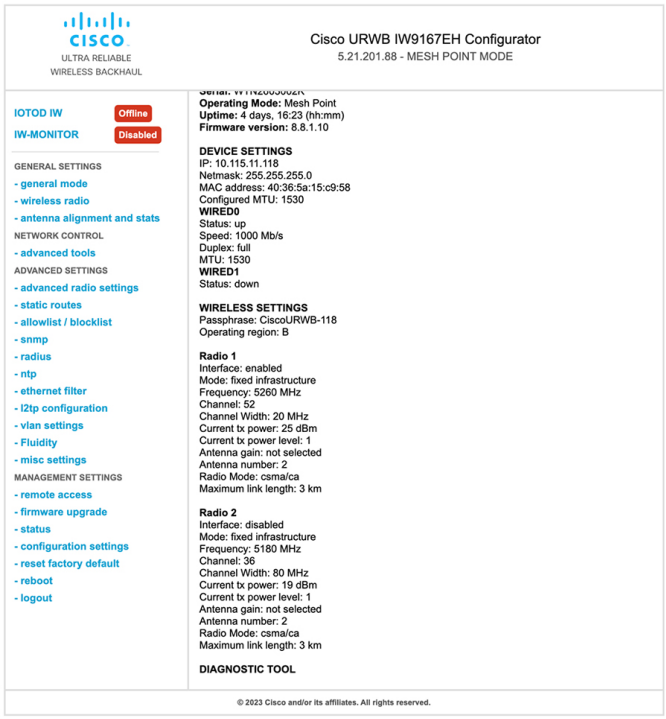
   In the **STATUS** page, check the details of operating region and country for confirmation.



7. To establish a wireless connection between devices, set the same operating frequency in radio devices.

Note **Shared Passphrase** must be same for all the devices belonging to the same network.

Following image shows the configuration of country code using GUI:



Support fixed domains and country codes (ROW)

The ROW reg domain simplifies the domain management of the manufacturing process for all the country codes that do not have a specific domain mapped. The fixed domain and country code support for the Catalyst IW9167E, IW9165E, and IW9165D access points are described in this section.

You are responsible for ensuring APs approval for use in your country. To verify approval and to identify the regulatory domain associated with a particular country. For more information, see Cisco Product Approval Status.

Catalyst IW9167E supported fixed domains

Domain	Indoor Deployment Support
A	No
B	N/A
E	Yes
F	No
Q	No
Z	No

Note Outdoor and indoor frequencies are same for the B domain.

Catalyst IW9167E supported country codes (ROW)

Domain ROW Country Code	Indoor Deployment Support	Support Version
VN (Vietnam)	N/A	17.11.1
GB (Great Britain)	Yes	17.11.1
KR (Korea)	No	17.12.1
IN (India)	No	17.12.1
PE (Peru)	No	17.12.1
PH (Philippines)	No	17.12.1
ZA (South Africa)	No	17.13.1
AR (Argentina)	No	17.13.1
HK (Hong Kong)	No	17.13.1

Domain ROW Country Code	Indoor Deployment Support	Support Version
PK (Pakistan)	No	17.13.1
UY (Uruguay)	No	17.13.1
CO (Colombia)	No	17.13.1
BR (Brazil)	No	17.13.1
CN (China)	No	17.13.1
EC (Ecuador)	No	17.13.1
IQ (Iraq)	No	17.13.1
SG (Singapore)	No	17.13.1
SA (Saudi Arabia)	No	17.13.1
QA (Qatar)	No	17.13.1
MX (Mexico)	No	17.13.1
TH (Thailand)	No	17.13.1
CL (Chile)	No	17.13.1
TW (Taiwan, Republic of China)	No	17.13.1
AE (United Arab Emirates)	No	17.13.1
EG (Egypt)	No	17.15.1
MY (Malaysia)	No	17.15.1
MN (Mongolia)	No	17.15.1
DZ (Algeria)	No	17.16.1
BS (Bahamas)	No	17.16.1
CR (Costa Rica)	No	17.16.1
NG (Nigeria)	No	17.16.1
PA (Panama)	No	17.16.1

Note You can select only the listed country codes using CLI or GUI.

For ROW domain, select the country code for the device to work.

IS (Iceland) and MC (Monaco) are supported using -E domain.

Catalyst IW9165E Supported Fixed Domains

Domain	Indoor Deployment Support
A	Yes
B	N/A
E	Yes
Z	Yes
Q	Yes
F	Yes

Note Outdoor and indoor frequencies are same for B domain.

Catalyst IW9165E supported country codes (ROW)

Domain ROW Country Code	Indoor Deployment Support	Support Version
GB (Great Britain)	Yes	17.12.1
ZA (South Africa)	Yes	17.13.1
IN (India)	Yes	17.13.1
KR (Korea)	Yes	17.13.1
PE (Peru)	Yes	17.13.1
AE (UAE)	Yes	17.13.1
MX (Mexico)	Yes	17.13.1
BR (Brazil)	Yes	17.13.1
CL (Chile)	Yes	17.13.1
SA (Saudi Arabia)	Yes	17.13.1
PH (Philippines)	Yes	17.13.1
QA (Qatar)	Yes	17.13.1
SG (Singapore)	Yes	17.13.1
LK (Sri Lanka)	Yes	17.13.1
TH (Thailand)	Yes	17.13.1

Domain ROW Country Code	Indoor Deployment Support	Support Version
VN (Vietnam)	Yes	17.13.1
TW (Taiwan, Republic of China)	Yes	17.14.1
EG (Egypt)	Yes	17.15.1
MY (Malaysia)	Yes	17.15.1
AR (Argentina)	Yes	17.15.1
CN (China)	Yes	17.15.1
CO (Colombia)	Yes	17.15.1
EC (Ecuador)	Yes	17.15.1
HK (Hong Kong)	Yes	17.15.1
DZ (Algeria)	No	17.16.1
BH (Bahrain)	No	17.16.1
CR (Costa Rica)	No	17.16.1
IQ (Iraq)	No	17.16.1
MN (Mongolia)	No	17.16.1
PK (Pakistan)	No	17.16.1
PA (Panama)	No	17.16.1

Note You can select only the listed country codes using CLI or GUI.

For ROW domain, select the country code for the device to work.

Catalyst IW9165D supported fixed domains

Domain	Indoor Deployment Support
A	No
B	N/A
E	Yes
Z	No
Q	No

Domain	Indoor Deployment Support
F	No

Note Outdoor and indoor frequencies are same for the B domain.

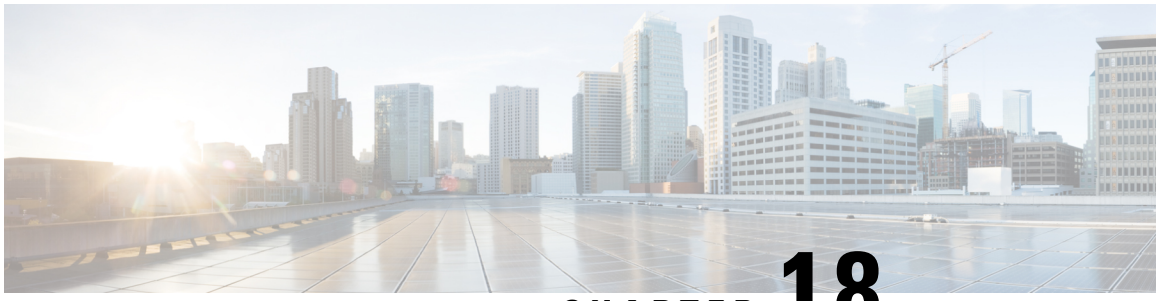
Catalyst IW9165DH supported country codes (ROW)

Domain ROW Country Code	Indoor Deployment Support	Support Version
GB (Great Britain)	Yes	17.12.1
ZA (South Africa)	No	17.13.1
IN (India)	No	17.13.1
KR (Korea)	No	17.13.1
PE (Peru)	No	17.13.1
AE (UAE)	No	17.13.1
MX (Mexico)	No	17.13.1
BR (Brazil)	No	17.13.1
CL (Chile)	No	17.13.1
SA (Saudi Arabia)	No	17.13.1
PH (Philippines)	No	17.13.1
QA (Qatar)	No	17.13.1
SG (Singapore)	No	17.13.1
LK (Sri Lanka)	No	17.13.1
TH (Thailand)	No	17.13.1
VN (Vietnam)	No	17.13.1
TW (Taiwan, Republic of China)	No	17.14.1
EG (Egypt)	No	17.15.1
MY (Malaysia)	No	17.15.1
AR (Argentina)	No	17.15.1
CN (China)	No	17.15.1

Domain ROW Country Code	Indoor Deployment Support	Support Version
CO (Colombia)	No	17.15.1
EC (Ecuador)	No	17.15.1
HK (Hong Kong)	No	17.15.1
DZ (Algeria)	No	17.16.1
CR (Costa Rica)	No	17.16.1
IQ (Iraq)	No	17.16.1
MN (Mongolia)	No	17.16.1
PK (Pakistan)	No	17.16.1
PA (Panama)	No	17.16.1

Note You can select only the listed country codes using CLI or GUI.

For ROW domain, select the country code for the device to work.

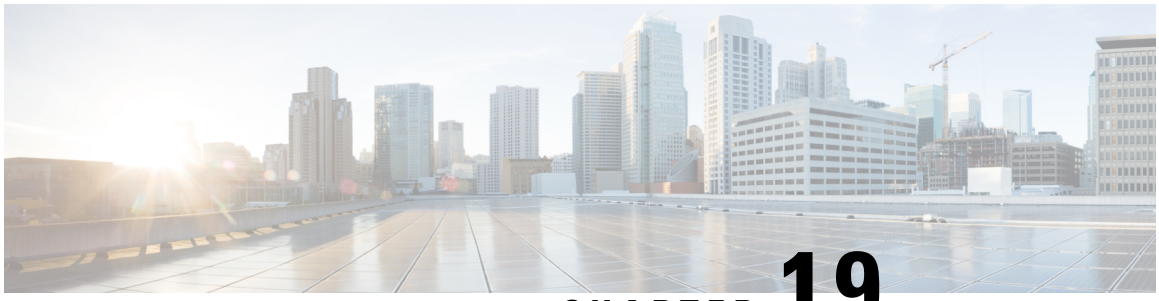


CHAPTER 18

Smart Licensing

Smart Licensing Support

The Smart Licensing chapter is replaced by a new standalone guide called Smart Licensing on the Cisco Ultra-Reliable Wireless Backhaul for Catalyst IW Access Points. This guide contains updated information related Smart licensing for access point running in URWB mode.



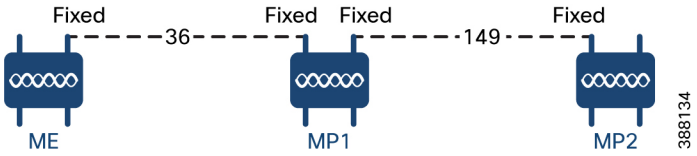
CHAPTER 19

Configuring and Validating of Point-to-Point Relay Topology

Configuring and Validating of Point-to-Point Relay Topology

The following image shows two radio interfaces on a single device (MP1) to implement a point-to-point relay topology:

Figure 2: point to point relay topology



To configure point-to-point relay topology, follow these scenarios:

1. Configure Mesh End (ME), MP1 on channel 36 and MP2 on the default channel 149.
2. Continue from step 1 configuration.
3. Enable the second slot interface on Mesh Point (MP2) again and wait 30 seconds to implement the point-to-point relay topology for two radio interfaces on a single device.

Configuring Point to Point Relay Topology from CLI

To configure a point-to-point relay topology, use the following CLI commands:

1. Configure the wireless device with radio interface number <1 or 2>.

   ```
   Device# configure dot11Radio <interface>
   ```

2. Set wireless interface admin state to enable or disable mode.

```
Device# configure dot11Radio <interface> > {enable | disable}
```

3. Configure an operating mode for the specified interface (fixed or Fluidity or Fluidmax).

```
Device# configure dot11Radio <interface> > [enable | disable] mode { fluidity | fixed |
 fluidmax }
```

4. Set the operating channel for the specified interface and the operating channel id valid range is between 1 to 256.

```
Device# configure dot11Radio <interface> > [enable | disable] mode [fluidity | fixed |
fluidmax] channel <channel id>
```

5. To end this configuration, use the following CLI command:

```
Device (configure dot11Radio <interface> > {enable | disable} mode {fluidity | fixed |
fluidmax} channel <channel id>) #end
```

Example:

```
Device#configure dot11Radio <2> {enable | disable} mode {fluidity} channel <36>
```

Example for point-to-point relay topology configuration:

Mesh End (ME) Configuration

```
Device#configure dot11Radio 2 enable
Device#configure dot11Radio 2 mode fixed
Device#configure dot11Radio 2 channel 36
```

Mesh Point (MP1) Configuration

```
Device#configure fluidity id infrastructure
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fixed
Device#configure dot11Radio 1 channel 36
Device#configure dot11Radio 2 enable
Device#configure dot11Radio 2 mode fixed
Device#configure dot11Radio 2 channel 149
```

MP2 Configuration

```
Device#configure fluidity id infrastructure
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fixed
Device#configure dot11Radio 1 channel 149
```

Validating Point to Point Relay Topology from CLI

To validate point-to-point relay topology configuration, use the following show commands:

```
Device# show dot11Radio <interface> config
```

Mesh End (ME) Statistics

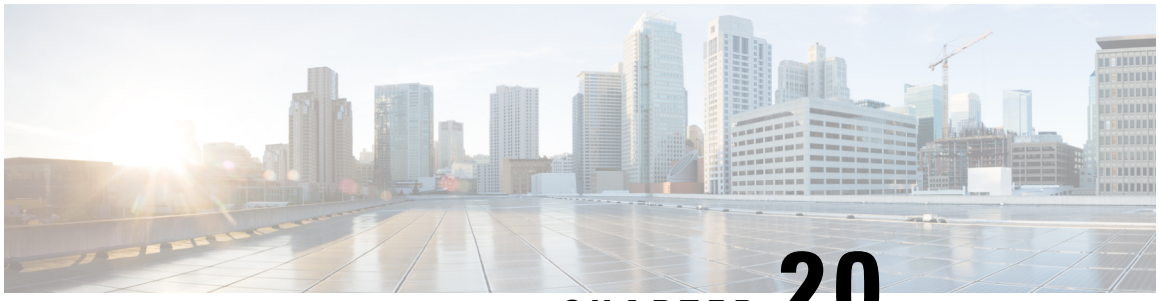
```
Device#show dot11Radio 2 config
Interface : enabled
Mode : fixed infrastructure
Frequency : 5180 MHz
Channel : 36
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
```

Mesh Point (MP1) Statistics

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fixed infrastructure
Frequency : 5180 MHz
Channel : 36
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
Device# show dot11Radio 2 config
Interface : enabled
Mode : fixed infrastructure
Frequency : 5745 MHz
Channel : 149
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
```

MP2 Statistics

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fixed infrastructure
Frequency : 5745 MHz
Channel : 149
……
Passphrase : Cisco
AES encryption : enabled
```



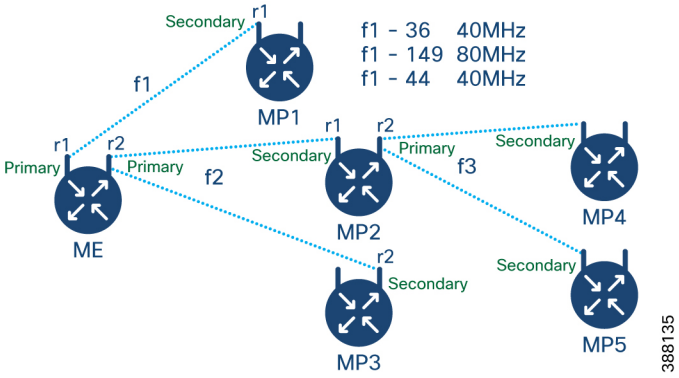
CHAPTER 20

Configure and Validate Fluidmax Topology

Configure and Validate Fluidmax (point to multipoint) Topology

For fixed infrastructure, any wireless interface can be configured to operate in Fluidmax mode to implement point-to-multipoint connections. Each interface uses an independent set of Fluidmax parameters, allowing for great flexibility in the network topologies that can be implemented. As an example, the below image explains two cascaded point-to-multipoint clusters where the ME (Mesh End) node uses both radios in Fluidmax Primary mode to serve several secondary clients (MP1 (Mesh Point), MP2, and MP3) on two different frequencies. For MP2, the first radio operates in Fluidmax secondary mode to connect to the ME, while the second interface is configured as Fluidmax Primary to serve more downstream clients (MP4 and MP5).

Figure 3: Two cascaded Fluidmax Topology



Configure Point to Multipoint Topology from CLI

Use these commands to configure a Fluidmax (point-to-multipoint) topology.

```
Device#configure dot11Radio <interface>
```

Interface - <0-3> dot11Radio interface number

```
Device#configure dot11Radio <interface> {enable | disable}
```

Enable or disable - Set wireless interface admin state to enable or disable at runtime

```
Device#configure dot11Radio <interface> mode {fluidity | fixed | fluidmax } { primary |
secondary }
```

Mode - Operating mode for the specified interface (Fluidity or Fixed or Fluidmax)

Primary | secondary - Fluidmax role for the device, either primary or secondary

```
Device#configure dot11Radio <interface> channel <channel id>
```

Channel - Set the operating channel id <1 – 256>

```
Device#configure dot11Radio <interface> band-width <channel bandwidth>
```

Bandwidth - channel bandwidth in MHz and currently supported values are 20, 40, 80, and 160.

```
Device#wr
```

Example of point to multipoint (Fluidmax) topology configuration:

ME (Mesh End) Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax primary
Device#configure dot11Radio 1 channel 36
Device#configure dot11Radio 1 band-width 40
Device#configure dot11Radio 2 enable
Device#configure dot11Radio 2 mode fluidmax primary
Device#configure dot11Radio 2 channel 149
Device#configure dot11Radio 2 band-width 80
```

MP1 (Mesh point) Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax secondary
Device#configure dot11Radio 1 channel 36
Device#configure dot11Radio 1 band-width 40
```

MP2 Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax secondary
Device#configure dot11Radio 1 channel 149
Device#configure dot11Radio 1 band-width 80
Device#configure dot11Radio 2 enable
Device#configure dot11Radio 2 mode fluidmax primary
Device#configure dot11Radio 2 channel 44
Device#configure dot11Radio 2 band-width 40
```

MP3 Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax secondary
Device#configure dot11Radio 1 channel 149
Device#configure dot11Radio 1 band-width 80
```

MP4 Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax secondary
Device#configure dot11Radio 1 channel 44
Device#configure dot11Radio 1 band-width 40
```

MP5 Configuration

```
Device#configure dot11Radio 1 enable
Device#configure dot11Radio 1 mode fluidmax secondary
Device#configure dot11Radio 1 channel 44
Device#configure dot11Radio 1 band-width 40
```

Cluster ID: This is an ID assigned to an interface when it is set in Fluidmax mode. This ID should be the same for primary and backup primary nodes. It helps in identifying and grouping devices that belong to the same cluster.

Tower ID: This is used to enable or disable the Fluidmax Tower ID for a specified interface.

Note Tower ID is used in configurations where there is a Gateway + Mesh Point (MP) – MP with the same tower ID.

Use these commands to configure the interface, cluster id, and tower id in Fluidmax mode.

```
Fluidmax - Set the interface in Fluidmax mode.
Primary | Secondary - Fluidmax role for the device, either primary or secondary.
Device# configure dot11Radio [1|2] mode fluidmax cluster id fluidmesh
Cluster id - Set Fluidmax Cluster ID assigned to the interface.
Device# configure dot11Radio [1|2] mode fluidmax tower [enable|disable]
Tower – Enable or disable Fluidmax Tower ID for specified interface.
```

Validate Point to Multipoint Topology using CLI

Use this command to validate the point-to-multipoint (Fluidmax) topology configuration.

```
Device# show dot11Radio <interface> config
```

Example:

ME (Mesh End) radio2

```
Device# show dot11Radio 2 config
Interface : enabled
Mode : fluidmax primary
Frequency : 5745 MHz
Channel : 149
…….
Fluidmax Configuration
Tower ID : disabled
Cluster ID : fluidmesh
Automatic scan : enabled
Automatic scan threshold : disabled
```

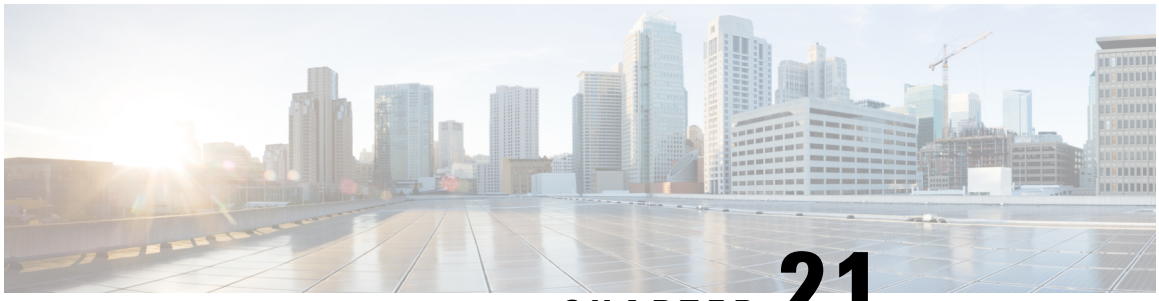
MP2 (Mesh Point)

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fluidmax secondary
Frequency : 5745 MHz
Channel : 149
…….
Fluidmax Configuration
Tower ID : disabled
Cluster ID : fluidmesh
Automatic scan : enabled
Automatic scan threshold : disabled
Device# show dot11Radio 2 config
Interface : enabled
Mode : fluidmax primary
Frequency : 5220 MHz
Channel : 44
Channel width : 40
…….
```

```
Fluidmax Configuration
Tower ID : 100
Cluster ID : fluidmesh
Automatic scan : enabled
Automatic scan threshold : disabled
```

MP4 radio1

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fluidmax secondary
Frequency : 5220 MHz
Channel : 44
Fluidmax Configuration
Tower ID : disabled
Cluster ID : fluidmesh
Automatic scan : enabled
Automatic scan threshold : disabled
```



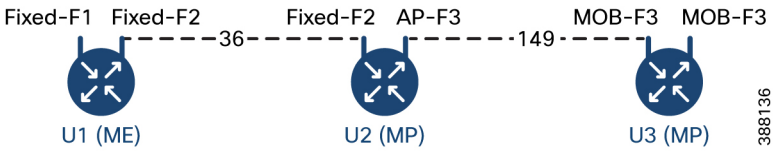
CHAPTER 21

Configuring and Validating Mixed Mode (Fixed infrastructure + Fluidity) Topology

Configuring and Validating Mixed Mode (Fixed Infrastructure + Fluidity) Topology

The mixed mode configuration provides flexibility of configuration on multi-radio device with different frequencies. From the image, U2 is configured with one radio as fixed infrastructure and the second radio as a Fluidity access point to accept vehicle connections simultaneously. Both radio interfaces on U1 configured as fixed infrastructure when U3 has both radio interfaces configured as Fluidity. The wireless interface can also operate in Fluidmax mode without any restriction of the P2MP (Point-to-MultiPoint) role (Primary or Secondary) if fixed infrastructure role is suitable.

Figure 4: Mixed Mode Topologies



Configuring Mixed Mode Topology from CLI

To configure a mixed mode topology, use the following CLI command:

```
Device# configure fluidity id {vehicle-auto | vehicle ID | infrastructure | wireless- relay}
```

Fluidity id – Configure Fluidity role for the device

Vehicle-auto - Vehicle mode with automatic vehicle ID selection

Vehicle ID (alphanumeric) - Vehicle mode with manual ID

Infrastructure - Configure Infrastructure mode for the device

Wireless-relay - Wireless infrastructure with no ethernet connection to the backhaul

```
Device# configure dot11Radio <interface>
```

Interface - <0-3> dot11Radio interface number

```
Device# configure dot11Radio <interface> {enable | disable}
```

Enable or disable - Set wireless interface admin state to enable or disable at runtime

```
Device# configure dot11Radio <interface> mode {fluidity | fixed | fluidmax}
```

Mode - Operating mode for the specified interface (Fluidity or fixed or Fluidmax)

```
Device# configure dot11Radio <interface> channel <channel id>
```

Channel - Set the operating channel id <1 – 256>

```
Device# wr
```

Example:

U1 Configuration

```
Device# configure dot11Radio 2 enable
Device# configure dot11Radio 2 mode fixed
Device# configure dot11Radio 2 channel 36
```

U2 Configuration

```
Device# configure dot11Radio 1 enable
Device# configure dot11Radio 1 mode fixed
Device# configure dot11Radio 1 channel 36
Device# configure dot11Radio 2 enable
Device# configure dot11Radio 2 mode fluidity
Device# configure dot11Radio 2 channel 149
Device# configure fluidity id infrastructure
```

U3 Configuration

```
Device# configure fluidity id vehicle-auto
Device# configure dot11Radio 1 enable
Device# configure dot11Radio 1 mode fluidity
Device# configure dot11Radio 1 channel 149
```

Validating Mixed Mode Topology from CLI

To validate a mixed mode topology, use the following show commands:

```
Device# show dot11Radio <interface>config
```

U1 Statistics:

```
Device# show dot11Radio 2 config
Interface : enabled
Mode : fixed infrastructure
Frequency : 5180 MHz
Channel : 36
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
```

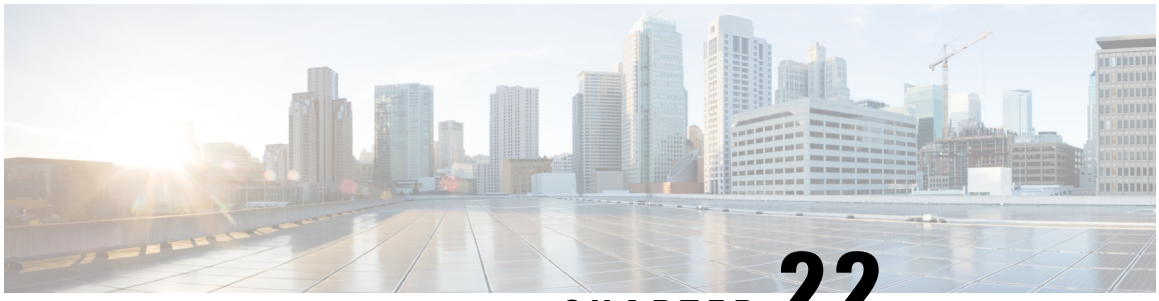
U2 Statistics:

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fixed infrastructure
```

```
Frequency : 5180 MHz
Channel : 36
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
Device# show dot11Radio 2 config
Interface : enabled
Mode : fluidity
Frequency : 5745 MHz
Channel : 149
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
```

U3 Statistics:

```
Device# show dot11Radio 1 config
Interface : enabled
Mode : fluidity
Frequency : 5745 MHz
Channel : 149
……
Passphrase : Cisco
AES encryption : enabled
AES key-control : enabled
```



CHAPTER 22

Configure and Validate Fast Failover

Overview of Fast Failover

Fast failover is a specific type of failover configuration, where the system monitors server health and can quickly switch over when needed.

Fast Failover mechanism:

- Provides hardware redundancy and carrier-grade availability within URWB-based networks.
- In case of hardware failure, Fast Failover allows network to recover again within:
  - less than 30 seconds (varies as per network size) when Fluidmax is used.
  - less than 500 milliseconds when Fluidity is used.

Note Fast Failover is included in all the Network Licenses

Configure and Validate Fast Failover

Note Configure and validate fast failover is applicable for both the Fluidmax and Fluidity modes.

Before you configure the fast failover, use the following pre-conditions:

1. Ensure that both the primary and the backup primary node should have same configuration. This includes the same channel's parameters: frequency, channel width, and mode. If Fluidmax is enabled, ensure that the Cluster ID is the same for both nodes.

2. Enable fast failover on all devices in the network.

Note Fluidmax Fast failover is supported only on MP to MP or ME to ME with Ethernet backhaul.

Configure Fast Failover from CLI

Use this command to configure fast failover.

```
Device# configure modeconfig mode meshpoint
```

Modeconfig – Configure current operating mode of device. Mode could be mesh end(ME), mesh point(MP), or global gateway (L3).

```
Device# configure mpls fastfail status [enable | disable]
```

Mpls - Configure mpls data frame packets for specified device.

Fastfail - Configure the fast failover feature status (enable or disable).

```
Device# configure mpls fastfail timeout <0 – 65535>
```

Fastfail timeout - Set the fast failover timeout for device failure detection.

Use this command to set the preempt delay.

```
Device# configure mpls preempt-delay <0- 65535>
```

By default the preemption delay time is 70 seconds. During this period, the primary device actively gathers updates from the secondary device. This allows it to fully understand the network's current preemption delay status.

Note Radio interface setting must be same on both ME point to Multi point primaries.

Validate Fast Failover from CLI

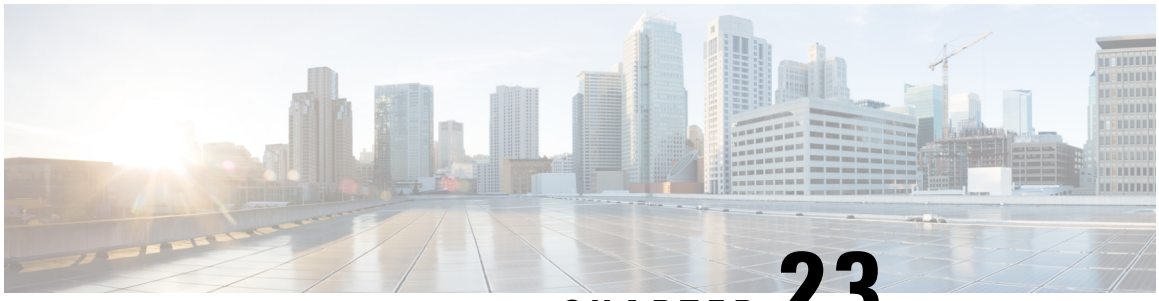
Use this command to validate fast failover.

```
Device# show mpls config
Device# show dot11Radio <interface> fluidmax (check Fluidmax Primary ID and working state)
```

Example:

```
Device# show mpls config
layer 2
unicast-fllod
arp-unicast:
reduce-broadcast:
cluster ID
MPLS fast failover: enabled
Node failover timeout: 100 ms
……
MPLS tunnels:
```

```
Idp_id 381877266 debug 0 auto_pw 1
Local_gw 5.21.201.116 global_gw 0.0.0.0 pwlist {}
```



CHAPTER 23

Configuring Indoor Deployment

Configuring Indoor Deployment

The Catalyst IW9167E and IW9165 support enabling and disabling of indoor deployment using CLI.

Note Before you enable the indoor deployment setting, ensure that the Catalyst IW9167E or IW9165 is set to indoor mode. As you can use the outdoor mode for indoors, but whereas the indoor mode is not suitable for outdoor because 5150–5350 MHz channels are indoor-related countries.

By default, the devices are set to outdoor mode.

To enable indoor deployment, use the following CLI command:

```
Device# configure wireless indoor-deployment enable
```

To disable indoor deployment, use the following CLI command:

```
Device# configure wireless indoor-deployment disable
```

To verify E indoor deployment, use the following show command:

For enabled indoor deployment

```
Device# show Dot11Radio {1|2} config
DFS region : E
DFS radar role : auto
Radar detected : 0
Indoor deployment : enable
```

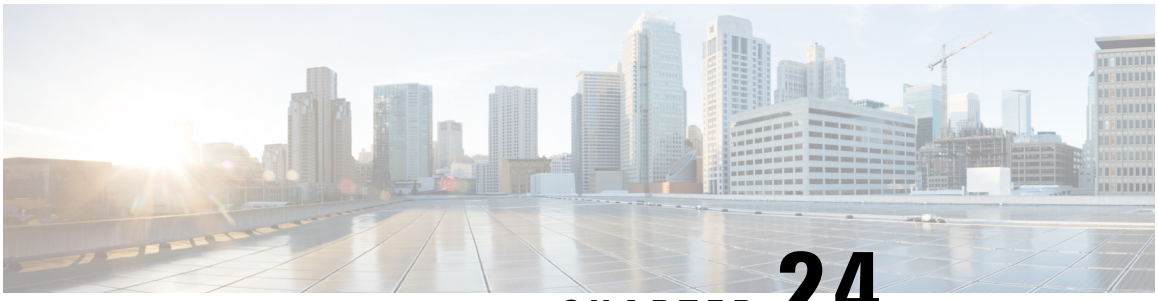
```
Device# show controllers Dot11Radio {1|2}
Radio info summary:
====================
Radio : 5.0 GHz
Carrier set : (-Ei) GB
Base radio MAC : FC:58:9A:15:B7:C0
Supported channels:
36 40 44 48 52 56 60 64 100 104 108 112 116 120 124 128 132 136 140
```

For disabled indoor deployment

```
Device# show Dot11Radio {1|2} config
DFS region : E
```

```
DFS radar role : auto
Radar detected : 0
Indoor deployment : disable
```

```
Device# show controllers Dot11Radio {1|2}
Radio info summary:
====================
Radio : 5.0 GHz
Carrier set : (-E) GB
Base radio MAC : FC:58:9A:15:B7:C0
Supported channels:
100 104 108 112 116 120 124 128 132 136 140
```



CHAPTER 24

Configuring Layer 2 Mesh Transparency

Configuring Layer 2 Mesh Transparency

Layer 2 mesh transparency feature allows you to select the ether type for a specific protocol. To forward the ether-types, use CLI or GUI to enable or disable the network. The following list of reserved ether-types cannot be configured:

Table 8: List of reserved ether-types

Ether-type (range)	Forwardable	Additional information
0x0000 – 0x05FF	User-configurable	Ethernet-I frames. STP and CDP are subject to other configuration options
0x0800	Yes	IPv4
0x0806	Yes	ARP (IPv4)
0x0900 – 0x09FF	No	URWB signaling protocols
0x8100	Yes	IEEE 802.1Q VLAN encapsulation
0x8847 – 0x8848	No	MPLS
0xFFFF	No	IANA reserved

The following functionalities are supported using the URWB data plane mesh network when used in MPLS Layer 2 mode.

- The Layer 2 mesh transparency feature forwards non-IPv4 Layer 2 protocols across the URWB network by selectively filtering which ether-types are permitted.
- Ether-types present in URWB network are detected and reported automatically.
- Ability to add and remove ether-types from the allowlist.

- Ability to configure full transparency (enable all Layer 2 protocols) in a convenient manner.
- Both CLI and GUI are supported.

Configuring and Verifying Layer-2 Protocols Forwarding Using CLI

To configure a Layer 2 protocol forwarding, use the following CLI command:

To add an ethernet type to allowlist, use the following CLI command:

```
Device# configure mpls ether-filter allow-list add

<0x0-0xffff> ether-type value
         all allow all ether-types
```

Example:

```
Device# configure mpls ether-filter allow-list add 0x86DD

Device# show mpls config
        ...
        Ethernet Filter allow-list: 0x8892 0x8204 0x86dd, ethernet-I block
        ...
```

To delete an ethernet type from allowlist, use the following CLI command:

```
Device# configure mpls ether-filter allow-list delete
         <0x0-0xffff> ether-type value
```

Example:

```
Device# configure mpls ether-filter allow-list delete 0x86DD

Device# show mpls config
        ...
        Ethernet Filter allow-list: 0x8892 0x8204, ethernet-I block
        ...
```

To clear all ethernet types from allowlist, use the following CLI command:

```
Device# configure mpls ether-filter allow-list clear
```

Example:

```
Device# show mpls config
                ...
                Ethernet Filter allow-list: 0x8892 0x8204 0x86dd, ethernet-I block
                ...
        Device# configure mpls ether-filter allow-list clear
        Device# write
        Device# reload

        Device# show mpls config
        ...
        Ethernet Filter allow-list: none, ethernet-I block
        ...
```

To add all ethernet types to allowlist, use the following CLI command:

```
Device# configure mpls ether-filter allow-list add all
```

Example:

```
Device# configure mpls ether-filter allow-list add all

        Device# show mpls config
        ...
        Ethernet Filter allow-list: all, ethernet-I block
```

Note The **all** keyword is used to set the ether filter in all-pass mode (fill allowlist with single entry 0x0000).

To clear list of detected ether-types, use the following CLI command:

```
Device# configure mpls ether-filter table clear
```

Example:

```
Device# show mpls ether-filter
                Ether-type Direction Description
                0x8899      INGRESS    ---
                0x86DD      INGRESS    IPv6
        Device# configure mpls ether-filter table clear
                Cisco-81.160.136#show mpls ether-filter
                Ether-type Direction Description
                0x8899      INGRESS    ---
```

Note The detection process works in background after clearing the detected ethernet types.

To configure Ethernet – I protocol, use the following CLI command:

```
Device# configure mpls ether-filter ethernet-I forward
```

Example:

```
Device# configure mpls ether-filter ethernet-I forward

Deive# show mpls config
        ...
        Ethernet Filter allow-list: 0x88F8 0x891D, ethernet-I forward
        ...


Device# configure mpls ether-filter ethernet-I block
```

Example:

```
Device# configure mpls ether-filter ethernet-I block

         Device# show mpls config
         ...
         Ethernet Filter allow-list: 0x88F8 0x891D, ethernet-I block
```

To verify list of allowed ether-types, use the following show command:

```
Device# show mpls config
```

Example:

```
Device# show mpls config
                ...
                Ethernet Filter allow-list: 0x8892 0x8204 0x86dd, ethernet-I block
                ...
```

To verify list of detected ether-types, use the following show command:

```
Device# show mpls ether-filter table
```

Example:

```
Device# show mpls ether-filter table
                Ether-type   Direction   Description
                0x8899        INGRESS       ---
                0x86DD        INGRESS       IPv6
```

Configuring Layer-2 Protocol Forwarding using GUI

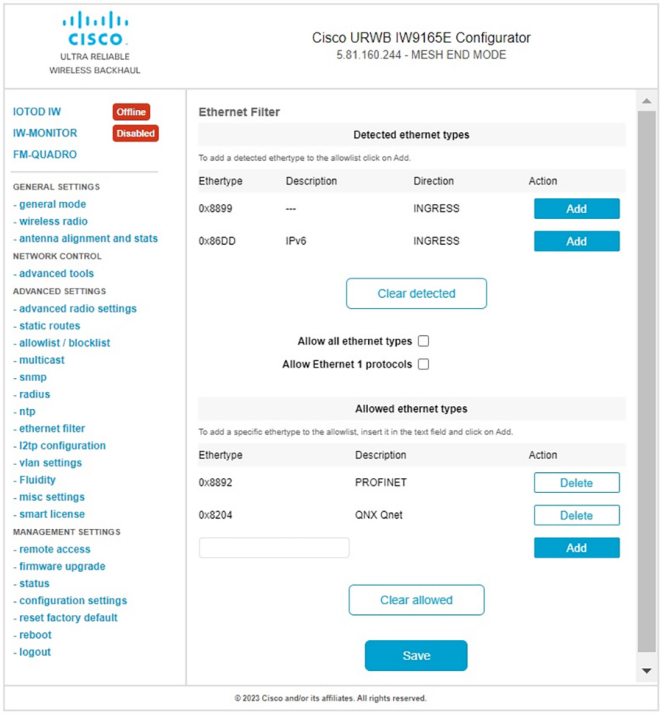
To add specific and detected ether types to the allowlist, follow these steps:

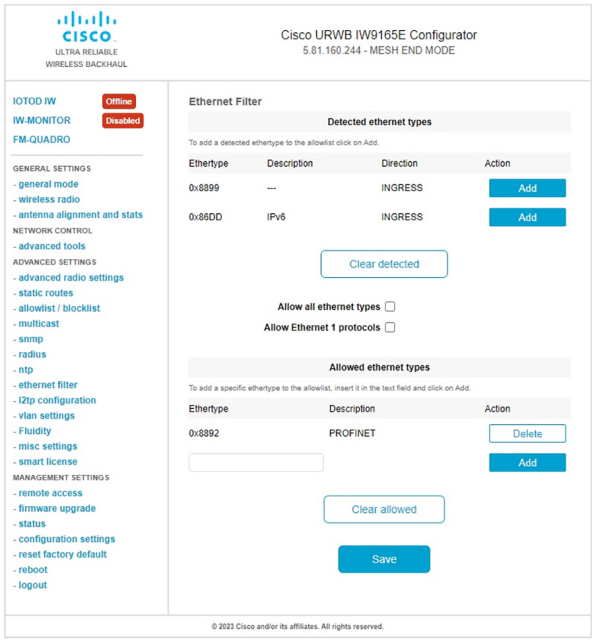
1. In the **ADVANCED SETTINGS**, click **ethernet filter**.

   The **Ethernet Filter** window appears.

2. Click **Add** to add an ether types to the allowlist in the **Detected ethernet types** section.
3. Once it is added, you can see the added ether types reflected in the **Allowed Ethernet type** section.
4. In the **Allowed ethernet types** section, to add a specific ether type to the allowlist, enter the **Ethertype** name in the text box and click **Add**.

The following images show the specific and detected ether types added to the allowlist:





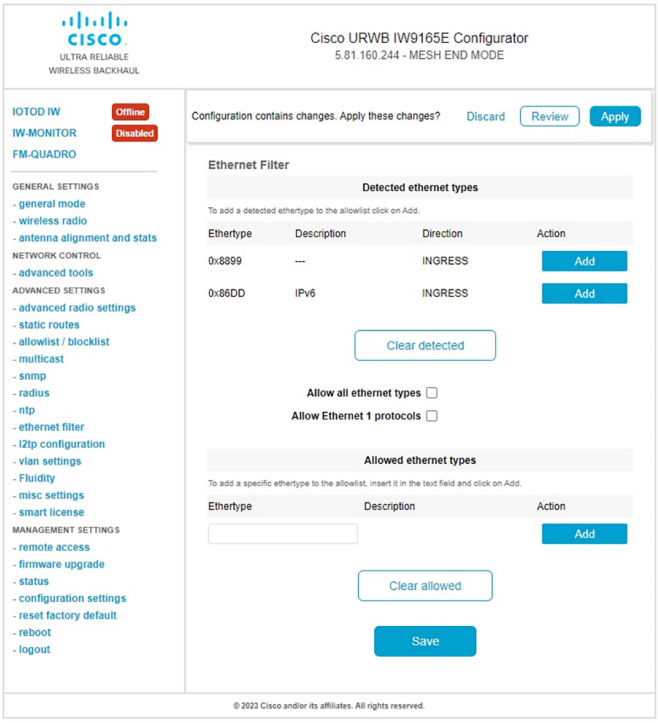
To clear all allowed ethernet types from the allowlist, follow these steps:

1. In the **ADVANCED SETTINGS**, click **ethernet filter**.

   The **Ethernet Filter** window appears.

2. Click **Clear allowed** in the **Allowed ethernet types** section to clear all the ethernet types from the allowlist.
3. Once you click **Clear allowed**, you can see all ethernet types cleared from allowlist.

The following image shows all allowed ethernet types cleared from the allowlist:



To clear all detected ethernet types from the allowlist, follow these steps:

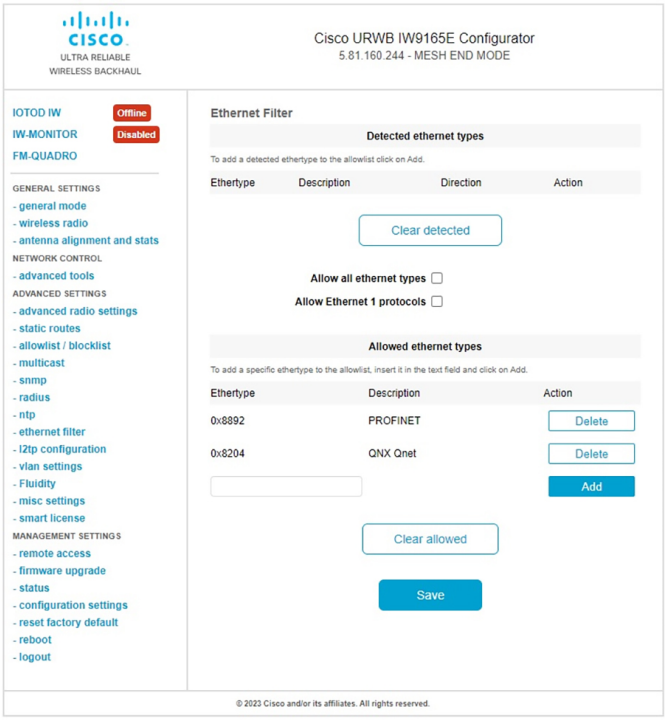
1. In the **ADVANCED SETTINGS**, click **ethernet filter**.

   The **Ethernet Filter** window appears.

2. Click **Clear detected** in the **Detected ethernet types** section to clear the detected ethernet types from allowlist.

3. Once you click **Clear detected**, you can see ethernet types cleared in the **Detected ethernet types** section.

The following image shows all detected ethernet types cleared from the allowlist:



To add or allow all ethernet types to the allowlist, follow these steps:

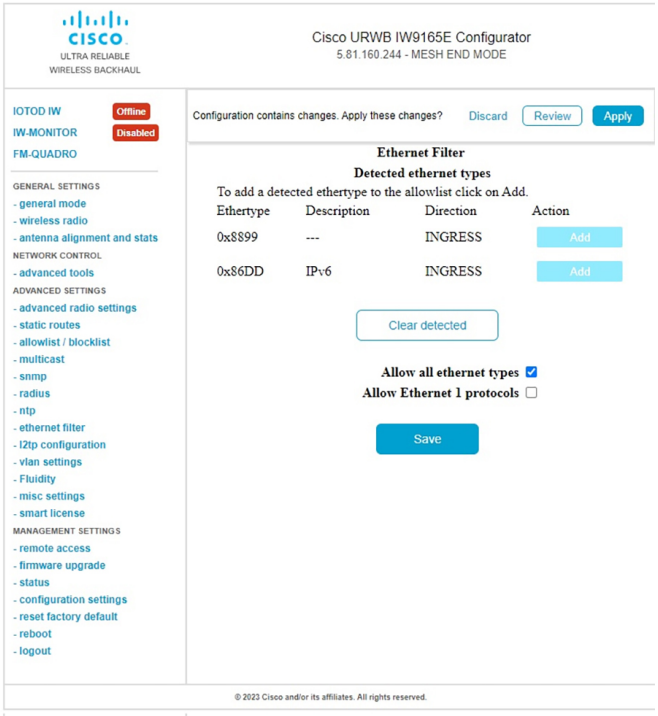
1. In the **ADVANCED SETTINGS**, click **ethernet filter**.

   The **Ethernet Filter** window appears.

2. Check the **Allow all ethernet types** check box in the **Ethernet Filter** section to allow all ethernet type to allowlist.

3. Click **Save** and then **Apply** to change the configuration.

The following image shows adding of all ethernet types to the allowlist:



To configure an ethernet 1 protocol, follow these steps:

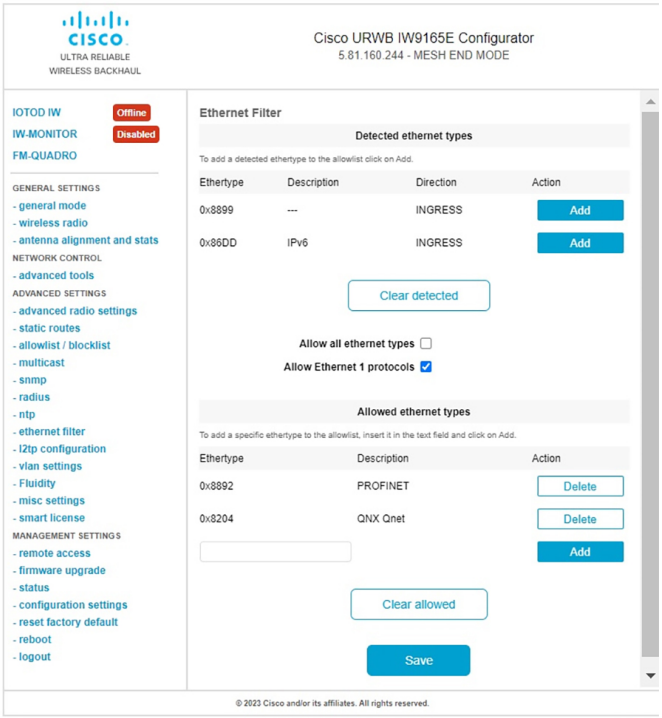
1. In the **ADVANCED SETTINGS**, click **ethernet filter**.

   The **Ethernet Filter** window appears.

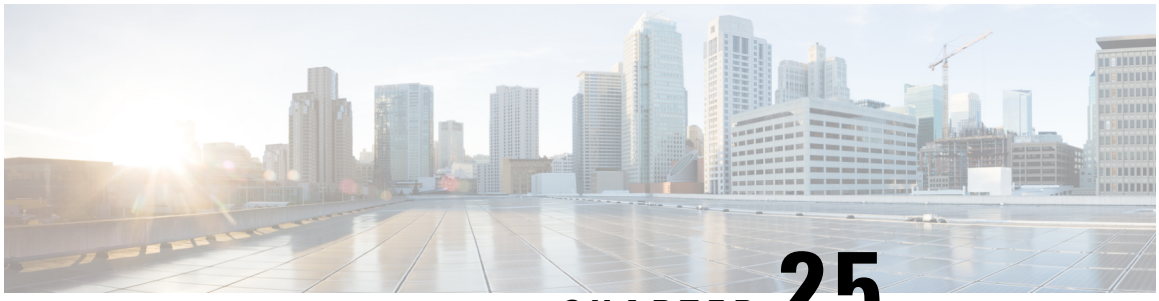
2. Check the **Allow Ethernet 1 protocols** check box in the **Ethernet Filter** section to enable ethernet 1 protocol mode.

3. Click **Save** and then **Apply** to change the configuration.

The following image shows the configuration of allowing an ethernet 1 protocol:


Cisco URWB IW9165E Configurator
5.81.160.244 - MESH END MODE
ULTRA RELIABLE WIRELESS BACKHAUL
IOTOD IW
Offline
IW-MONITOR
Disabled
FM-QUADRO
GENERAL SETTINGS
- general mode
- wireless radio
- antenna alignment and stats
NETWORK CONTROL
- advanced tools
ADVANCED SETTINGS
- advanced radio settings
- static routes
- allowlist / blocklist
- multicast
- snmp
- radius
- ntp
- ethernet filter
- l2tp configuration
- vlan settings
- Fluidity
- misc settings
- smart license
MANAGEMENT SETTINGS
- remote access
- firmware upgrade
- status
- configuration settings
- reset factory default
- reboot
- logout
Ethernet Filter
Detected ethernet types
To add a detected ethertype to the allowlist click on Add.
Ethertype
Description
Direction
Action
0x8899

INGRESS
Add
0x86DD
IPv6
INGRESS
Add
Clear detected
Allow all ethernet types
Allow Ethernet 1 protocols
Allowed ethernet types
To add a specific ethertype to the allowlist, insert it in the text field and click on Add.
Ethertype
Description
Action
0x8892
PROFINET
Delete
0x8204
QNX Qnet
Delete
Add
Clear allowed
Save
© 2023 Cisco and/or its affiliates. All rights reserved.



CHAPTER 25

Configuring Multipath Operation

Overview of MPO

Fast-moving mobile systems expect high-speed connectivity onboard, which implies reliable wireless ground-to-vehicle communication without any interruptions. However, the dynamic nature of the network, the environmental radio frequency conditions and roaming under the various Wi-Fi standards lead to packet losses. Multipath Operation (MPO) enhances reliability by sending duplicate copies of packets across multiple wireless paths. This patented technology duplicates your high priority traffic up to 4x and it reduces hardware failures to increase availability, reduce latency, and lower the effects of interference.

MPO introduce an approach to establish multiple label switched paths (LSPs) between a mobile system and the backend infrastructure of a wireless network. The multiple LSPs enables high priority packets to be sent through redundant paths to reduce packet loss.

Working Functionality of MPO

By default, an MPLS establishes a single tunnel using a single wireless link between the vehicle and infrastructure for data transmission. You can set up four MPLS tunnels to send MPO-protected traffic when you use two radio interfaces on two vehicle radios. When configuring MPO to utilize multiple links for protected traffic, it creates an MPLS tunnel over each available wireless link. Each wireless link replicates MPO-protected traffic. Even if one wireless link fails, the other links replicate the traffic. As of UIW Release 17.14.1, Fast Failover is supported with MPO.

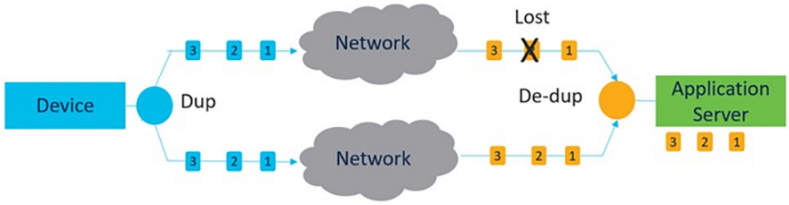
MPO Packet Duplication and Deduplication

For MPO, a duplicate packet is sent through several wireless channels (to various access points). This helps to ensure reliability, and the spatial diversity of the receiving access points greatly increases the chances of

at least one of the copies to be received correctly. Deduplication is another aspect of MPO to remove any duplicates of a packet that are received along the different wireless paths.

As a result, the delivered packets currently have sequence numbers assigned to them, thereby allowing the deduplication algorithm to eliminate copies of any packets that it has already received.

The process of Duplication and Deduplication as shown:



Duplication and Deduplication algorithm performs the following:

- Address packet loss and asymmetric high/variable delay paths.
- Remove additional packet delays created by buffering.
- Remove duplicate and out of sequence packets.
- Improve CPU, resource, and memory efficiency.

Configuring MPO Features Using CLI

To configure the MPO features, use the following CLI commands:

```
Device# configure fluidity mpo
```

cos - Configure class-of-service (CoS) of traffic to protect with MPO redundancy (only one CoS at a time) and the valid cos range is from zero to seven and the default value is six.

path - Configure max number of simultaneous redundant path established by only mobile devices. Maximum path link valid range is from one to four and the default value is one.

rssi - Configure min RSSI threshold for a wireless link to be eligible as a redundant path(dB) (mobile devices only). Minimum rssi value valid range is from 0 to 96 and the default value is 20.

telemetry – Configure enable/disable specific MPO telemetry. Telemetry value one of the following: enabled: M=1 or disabled: M=0 (default).

```
Device# configure fluidity mpo status
```

disabled: Disable MPO duplication/deduplication.

rx-only: Set mpo status as rx-only. Deduplicate incoming MPLS traffic and do not duplicate outgoing traffic.

enabled: Enable MPO. Duplicate outgoing traffic and de-duplicate incoming MPLS traffic.

Example:

```
Device# configure fluidity mpo cos C ( C value from 0 to 7 (default 6))
Device# configure fluidity mpo path max N ( N value from 1 to 4 ( default 1))
Device# configure fluidity mpo rssi min R ( R value from 0 to 96 ( default 20))
Device# configure fluidity mpo telemetry T (T can be one of: enabled: M=1
                                            Disabled: M=0 (default))
Device# configure fluidity mpo status S ( S can be one of:
```

```
                                                enabled: E=1 F=1
                                                rx-only: E=1 F=0
                                                disabled: E=0 F=1 (default))
```

The following example shows the UDP Telemetry stream with MPO counters:

```
Device# configure fluidity mpo telemetry <enabled | disabled>
Device# configure telemetry server 192.168.0.200
Device# configure telemetry export enable
Device# configure fluidity mpo telemetry enabled
```

To verify an MPO configuration parameter, use the following show command:

```
Device# show fluidity mpo config
```

Example:

```
Device# show fluidity mpo config
                Status: enabled
                Path max links: 2
                RSSI min: 20
                CoS: 6
```

Verifying MPO Features using CLI (MPO Monitoring)

The output of the **show mpls config** command:

```
Device# show mpls config
                  5.42.42.43:
                  path_id : 0
                  ilm : 136000
                  nhlfe : 16:
                  lbr : 5.42.42.42
                  age : 6.980000028 { 5.42.42.42 5.42.42.43 }

                  path_id : 1
                  ilm : 136001
                  nhlfe : 18:
                  lbr : 5.42.42.42
                  age : 6.970000026 { 5.42.42.42 5.42.42.43 }
```

The output of the **show fluidity mpo statistics** command:

```
Device# show fluidity mpo statistics (on Mesh End)
           table-size 2:

            MAC address : 40:36:5A:15:C8:50        8C:89:A5:83:EB:71
            Tx-1        : 0                        208
            Tx-2        : 0                        208
            Rx-Accept-1 : 178                      0
            Rx-Accept-2 : 30                       0
            Rx-Drop-1   : 30                       0
            Rx-Drop-2   : 178                      0
            Lost-1-only : 0                        0
            Lost        : 0                        0

Device# show fluidity mpo statistics (on Mobile Primary unit)
           table-size 2:

           MAC address : 40:36:5A:15:C8:50        8C:89:A5:83:EB:71
           Tx-1        : 208                      0
           Tx-2        : 208                      0
           Rx-Accept-1 : 0                        182
           Rx-Accept-2 : 0                        26
```

```
Rx-Drop-1   : 0                         26
Rx-Drop-2   : 0                         182
Lost-1-only : 0                         0
Lost        : 0                         0
```

MAC address: Source L2 address of the external network device which is sending packets.

Tx-1 and Tx-2: Shows the total count of packets that are eligible for duplication.

Rx-Accept-1 and Rx-Accept-2: These counters represent, respectively, the number of packets received and dropped in the de-duplication process either on the primary path or secondary paths.

Lost-1-only: Number of packets received and accepted in the de- duplication process on the secondary paths but not on the primary path.

Lost: The cumulative number of packets lost on both primary path and secondary paths.

The output of the `show fluidity network` command:

```
Device# show fluidity network (on Mesh End and Mobile Primary)

                    unit 5.21.201.60  infrastructure meshend primary
                    vehicles 4  total_mobiles 5
                    infrastructure 1  backbone 0  meshend 5.21.201.60

                    Vehicle ID : + 85313616
                    Path : 0
                    Infrastr.ID : 5.21.201.60
                    Via : R1
                    Mobile ID : 5.21.200.80
                    Via : R2
                    H/O seq : 5710
                    H/O age : 36.597
                    #M: 2
                    Primary ID : 5.21.200.80
                    Secondary IDs : 5.21.201.204

                    Vehicle ID : + 85313616
                    Path : 1
                    Infrastr.ID : 5.21.201.60
                    Via : R2
                    Mobile ID : 5.21.201.204
                    Via : R2
                    H/O seq : 5711
                    H/O age : 5.909
                    #M: 2
                    Primary ID : 5.21.200.80
                    Secondary IDs : 5.21.201.204
```

Note Intermediate nodes (MP and mobile secondaries) have only a subset of paths.

MPO path ID 0: primary path, others: redundant paths.

The output of the **`show eng-stats`** command:

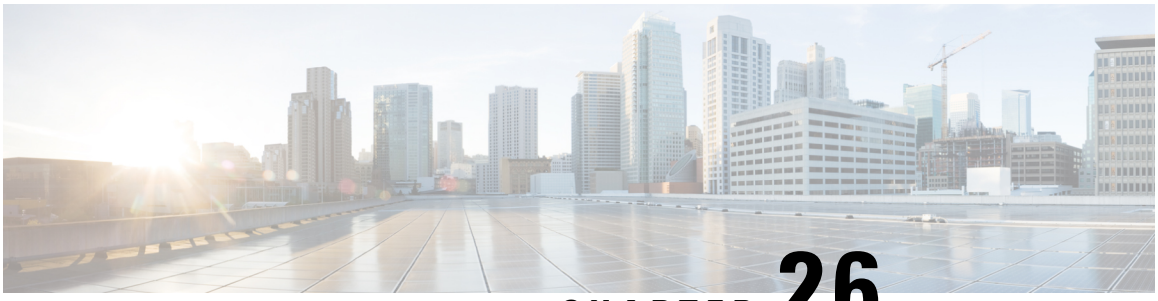
```
Device# show eng-stats (on mobile primary unit)
....
Fluidity role : primary
vehicle id : 0
static  : 3.21.201.60 [FC:58:9A:15:C7:D2]
```

```
mobile  : 4.21.200.80 [FC:58:9A:15:B9:13]
snr : 42
rssi : -54
dop : 40
chan : 132/40
handoff: 21.518258794
time : 2
Current:
ho_seq: 7  pending: false  age: 21.518303221  primary: 5.21.200.80
[0] - <3.21.201.60 - 4.21.200.80> status SUCCESS seq 6 id 0 age 59.469266332 rssi 42
[1] - <4.21.201.60 - 4.21.201.204> status SUCCESS seq 7 id 1 age 21.518317752 rssi 41
last primary: <3.21.201.60 - 4.21.200.80>
free ids: 7 6 5 4 3 2
current missing path mask: 1111110

HO Table
static  : 3.21.201.60 [FC:58:9A:15:C7:D2]
mobile  : 4.21.200.80 [FC:58:9A:15:B9:13]
rssi : 42
dop : 40
chan : 132/40
updated : 74
skip : 0

static  : 4.21.201.60 [FC:58:9A:15:C7:D3]
mobile  :  4.21.201.204 [FC:58:9A:15:E4:D3]
rssi : 41
dop : 40
chan : 100/40
updated : 18
skip : 0
rssi_delta : 6 3
threshold : 35
```

MPO Limitations

If MPO is enabled, the following handoff features are not available:

- Pole Ban and Pole Proximity
- Coloring
- Load balancing



CHAPTER 26

Configuring URWB Telemetry Protocol

Configuring URWB Telemetry Protocol

The URWB Telemetry Protocol is introduced from UIW Release 17.12.1 and it allows for custom external monitoring of real-time wireless performance. Third-party and custom applications can use this data. Pre-defined structured UDP packets sent at regular intervals contain various network metrics.

Each access point exports data for its radios. This data can be interpreted live by the receiving application or captured and processed later.

For more information about the protocol format, contact Cisco Support to request URWB Telemetry Protocol reference document.

The telemetry UDP packet contains the following information:

- Signal strength of packet
- Packet throughput and migration rate
- Number of transmission and retransmission
- Modulation rate
- Details of packet loss
- Operating frequency of each radio
- Information about the events that recording the network

Configuration of URWB Telemetry Protocol using CLI

By default, the telemetry data is disabled. To generate the telemetry packet, use the following CLI command:

To set the IP address and UDP port of the receiver, use the following CLI command (multicast addresses are supported):

```
Device# configure telemetry server <dest IP [port]>
```

To enable or disable the URWB Telemetry Protocol transmission to the configured receiver, use the following CLI command (multicast addresses are supported):

```
Device# configure telemetry server <dest IP [port]>
```

To enable or disable raw UDP telemetry transmission to the configured server, use the following CLI command:

```
Device# configure telemetry export [ enable | disable ]
```

Example:

```
Device# configure telemetry export enable
Device# configure telemetry server 10.115.11.56 1234
Device# write
Device# reload
```

Note

- Ensure the IP address is configured before you execute the **export enable** CLI command. If not, the command rejects with an error please configure the telemetry server IP first.
- The IP server is simultaneously set to 0.0.0.0 (the port value is unchanged) when you execute the **export disable** CLI command.

To verify telemetry configuration, use the following show command:

```
Device# show telemetry config
Telemetry export: enabled, current (live): disabled
Telemetry server: 10.115.11.56 1234, current (live): 0.0.0.0 30000
```

Live Configuration of URWB Telemetry Protocol using CLI

```
Device# configure telemetry live
Export : enable/disable telemetry export
Server : set telemetry server IP address (and port)
```

Note Server configuration is mandatory before you enable the live telemetry export.

Example:

```
Device# configure telemetry live export enable
Error: please configure the telemetry server IP first
```

Example (telemetry export after server configuration):

```
Device# configure telemetry live server 10.115.11.56 1234
Device# configure telemetry live export enable
Device# show telemetry config
Telemetry export: enabled, current (live): enabled
Telemetry server: 10.115.11.56 1234, current (live): 10.115.11.56 1234
```

Note The command immediately affects the current configuration when the live modifier is specified. Only the configuration file is changed if the live modifier is not used.

Configuration of GNSS Telemetry Protocol using CLI

To enable GNSS telemetry, use the following CLI command:

```
Device# configure gnss telemetry enable
```

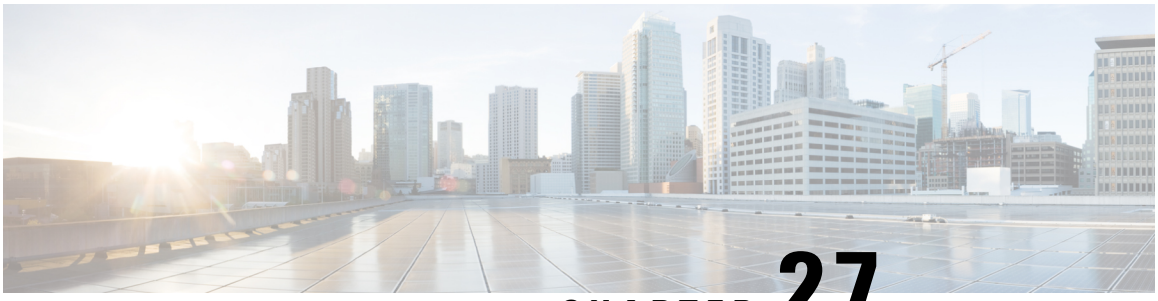
To disable GNSS telemetry, use the following CLI command:

```
Device# configure gnss telemetry disable
```

To show GNSS telemetry, use the following CLI command:

```
Device# show gnss telemetry
```

Configuring URWB Telemetry Protocol



CHAPTER 27

Configuring IW Monitor Management

Configuring IW Monitor Management

The UIW Release 17.12.1 introduces support for IW Monitor. It is a standalone on-premise monitoring application supporting the following features:

Table 9: IW Monitor features support from UIW Release 17.12.1 onwards.

Feature	Description
IW Monitor log for RADIUS (Remote Authentication Dial-In User Service)	Radius authentication attempts by mobile units are logged to IW Monitor
IW Monitor log CLI SSH access	SSH connections attempts are logged to IW Monitor
IW Monitor log GUI access	GUI logins are logged to IW Monitor
IW Monitor log ethernet link change	Physical link changes of LAN ports are buffered and logged to IW Monitor
IW Monitor log configuration change	Changes applied to the unit configuration through CLI or GUI are logged to Monitor

The on-premises IW Monitor supports the following primary capabilities:

- Dashboard to monitor network status
- Topology view of the network
- Real time and history charts for wireless Key Performance Indicators (KPIS)
- Real time performance monitoring
- Process the telemetry data sent by IW devices
- Network events logging

UIW Release 17.12.1 provides following support for IW Monitor dashboard:

- Attach and detach functions.
- Telemetry protocol support.
- CLI and GUI management.

Detaching IW Monitor Management using CLI

IW Monitor doesn't require any configuration, and access points are added to the IW Monitor. Use the following CLI to detach the device from the IW Monitor server and troubleshoot the connection.

```
Device# configure monitor
         detach : detach MONITOR action
```

Example:

```
Device# configure monitor detach
```

Verifying IW Monitor Management using CLI

To verify the IW Monitor management, use the following show command:

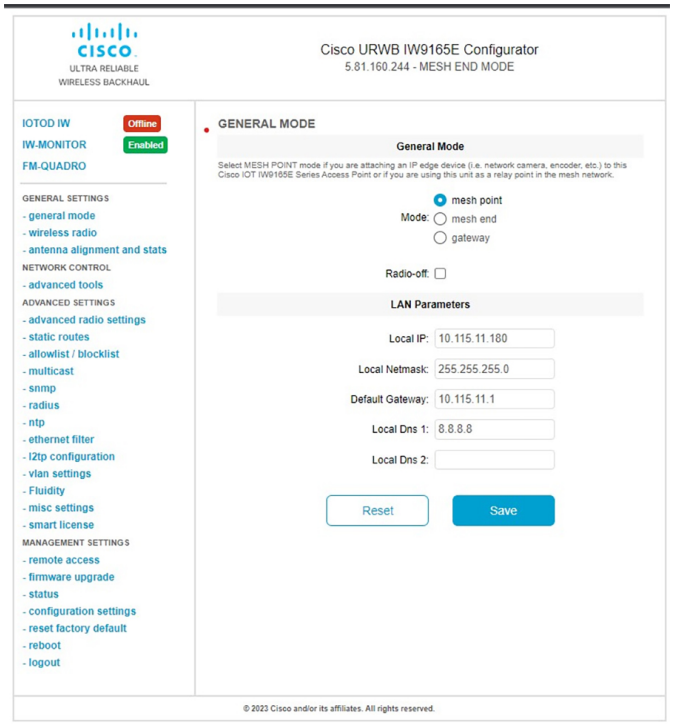
```
Device# show monitor
```

Example:

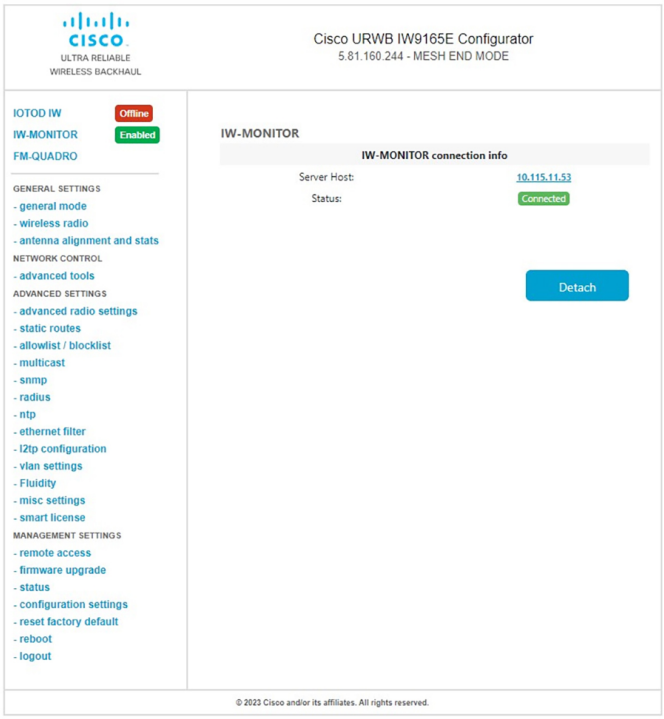
```
Device# show monitor
IW MONITOR: enabled
Status: Connected
```

Configuring IW Monitor Management using GUI

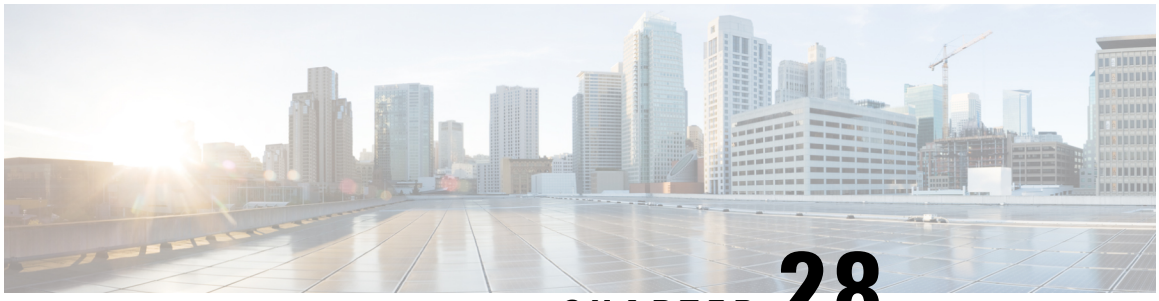
The following image shows the **IW MONITOR** is enabled in the **Cisco URWB IW9165E or IW9167E Configurator** window:



Once **IW-MONITOR** option is enabled, **IW-MONITOR connection info** appears as follows:



Configuring IW Monitor Management



CHAPTER 28

Upgrading the Device using TFTP

To upgrade the device using trivial file transfer protocol (TFTP), follow these conditions:

- The device must be connected to the network.
- The device must be configured to communicate with the local TFTP server.
- The target device image must be uploaded to the root directory of the local TFTP server.

Device Upgrade using TFTP

The TFTP device upgrade feature enables you to perform an automatic device upgrade or a direct device upgrade. In an automatic device upgrade, the device periodically checks for the availability of new device using the manifest file and initiates the upgrading process. In a direct device upgrade, the device retrieves the specified device image from the TFTP server and initiates the upgrading process. You can choose either of the following methods:

Automatic Device Upgrade using TFTP

Before you begin

This method enables the device to connect to the local TFTP server at user-determined intervals to check for the availability of new device image. The device detects the device image file and performs the upgrade.

Procedure

Step 1 Create *device.manifest* file and upload to the same TFTP server root directory where the device image is stored.

Step 2 Before enabling the TFTP automatic upgrade, configure the TFTP server and time interval.

Note
The time interval must be specified in the hours format.

Caution
Do not disconnect or reboot the device until the device download completes. Based on the image file size, the device upgrade may take some time.

Configuring Manifest File on the TFTP Server

At first, the device retrieves the manifest file from the TFTP server. Based on the information in the manifest file, the device then retrieves the device image from the TFTP server. Once the conditions are satisfied, the device initiates the device upgrade process.

Manifest File Format

The manifest file must be hosted on the TFTP server. It contains information related to the device image intended for the device upgrade. The manifest file holds the following information:

- Device image filename
- MD5 checksum of the device image file
- Device image version

The manifest file name must be specified based on the IW device model:

Device Type	Manifest File Name
IW9167EH	IW9167EH.manifest
IW9165E	IW9165E.manifest
IW9165DH	IW9165DH.manifest

Example format of manifest file:
`image_name=ap1g6m-k9c1-tar.202307110910`
`image_md5=376e15acd4e82a49a81d42add904f5b0`
`image_version=8.8.1.101`

Direct Device Upgrade using TFTP

The device obtains the specified device image from the TFTP server. To start the direct device upgrade process, use the following CLI commands:

Purpose	Command or Action
To configure the TFTP server with IP address	`Device#configure tftp server A.B.C.D` A.B.C.D: IP address of the TFTP server
To configure the TFTP upgrade image	`Device#configure tftp upgrade <image file>` Configure TFTP upgrade image <image file bin>

The device immediately starts the upgrade process.

Caution Do not disconnect or reboot the device until the device download completes. Based on the image file size, the device upgrade may take some time.

TFTP Device Upgrade using CLI

Purpose	Command or Action
To perform a device upgrade using the TFTP server	`Device#configure tftp server A.B.C.D` A.B.C.D: IP address of the tftp server
To disable automatic TFTP device upgrade	`Device#configure tftp upgrade automatic disable`
To enable automatic TFTP device upgrade	`Device#configure tftp upgrade automatic enable`
To check immediately for the manifest file without waiting for the check period	`Device#configure tftp upgrade check now`
To check TFTP device upgrade periodically	`Device#configure tftp upgrade check period 3` **Note** The check period must be specified in the hours format.
To check TFTP configuration	`Device#show tftp config`

Example of show TFTP configuration:

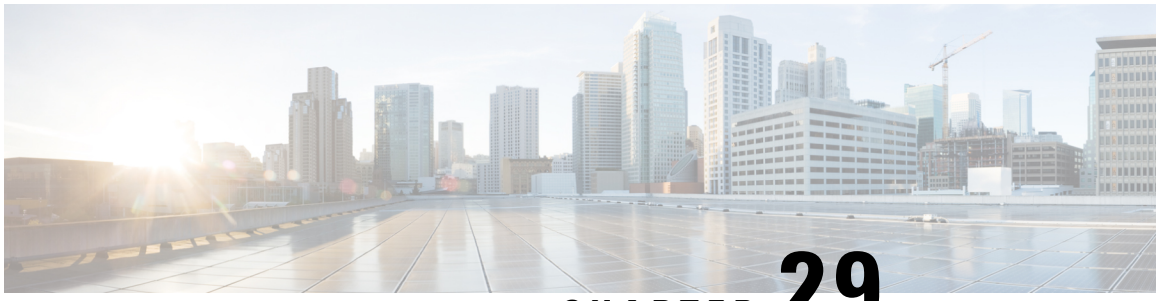
```
Device#show tftp config
Automatic TFTP Upgrade settings:
Status: enabled
Server: A.B.C.D
Check period (hours): 3
```

Example of automatic TFTP upgrade:

```
Device#configure tftp server A.B.C.D
Device#configure tftp upgrade check period 3
Device#write
Device#configure tftp upgrade automatic enable
Device#write
Device#reload
```

The device upgrade procedure fails to start:

- If the MD5 checksum reported in the manifest file does not match the MD5 checksum calculated on the device image file (*image_name*).
- If the device image version reported in the manifest file matches the current device version running on the device.



CHAPTER 29

LED Pattern for Catalysts IW9167 and IW9165

LED Pattern for Catalyst IW9167

The Catalyst IW9167E follows the below LED pattern during booting process (Blinking green) during a normal booting process:

Table 10: Definition of Booting LED Pattern

Events	LED State
Boot loader status sequence: DRAM memory test in progress DRAM memory test OK Board initialization in progress Initialization FLASH file system FLASH memory test OK Initializing Ethernet Ethernet OK Starting AP OS Initialization Successful	Blinking green
When you press the reset button for less than 20 seconds	Blinking red
When you press the reset button for more than 20 seconds	Solid red

Events	LED State
When reset button is released Or When you press the reset button for more than 60 seconds	Blinking green

Once the access point boots up, the Catalyst IW9167E follows these below LED patterns:

Table 11: Definition of URWB OS LED Pattern

AP State	LED State
General warning: Insufficient inline power	Cycling through red, green, and amber
Provisioning mode: Fallback	Blinking amber
Provisioning mode: DHCP	Amber
SNR(Signal to Noise Ratio) Excellent (>=25 dB)	Blinking green
SNR Good (15<=X<25 dB)	Fade-in green
SNR Bad (10<=X<15 dB)	Fade-in amber
SNR Unbearable (<10 dB)	Fade-in red

LED Pattern for Catalyst IW9165

The Catalyst IW9165E has tri-color red, green, and blue LED. The Catalyst IW9165D has red, green, and amber LED with three brightness levels. The access point is flexible with brightness levels. The controller CLI or GUI controls the brightness with eight different settings.

System LED's in the URWB stack have following patterns to indicate URWB states:

Table 12: LED pattern for URWB states

AP State	LED State
Fallback	Blinking amber or blue
DHCP	Amber or blue

RSSI LED

The Catalyst IW9165 supports a bi-color green and amber LED to show the RF Receive Signal Strength Indicator (RSSI). The RSSI LED does not have different brightness level.

Table 13: RSSI LEDs

Yellow LED	Green LED	Description
Blink	Off	RSSI < - 86 dBm
On	Off	RSSI is - 86 to - 81 dBm
Off	Blink	RSSI is - 81 to - 71 dBm
Off	On	RSSI > - 71 dBm

The following table shows the LED functionalities for the Catalyst IW9165E:

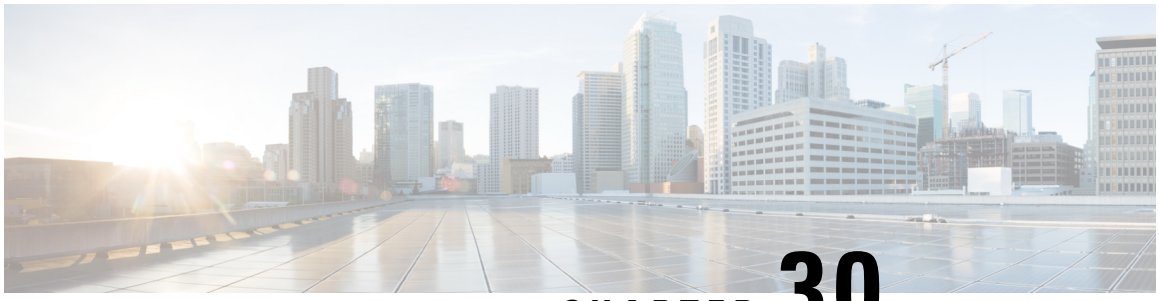
Table 14: URWB LED function for the Catalyst IW9165E

LED Function Label	Color/State	Description (Default = off)
System Status	Tricolor RGB	Indicates varies system status
RSSI	Yellow or Green	RSSI < - 86 dBm: yellow - 86 dBm =< RSSI =< - 81 dBM: blinking green RSSI > - 81 dBm: green
WAN GE	Green	Port is up with link
	Blinking Green	Link with activity
	Off	No link or port is Off
LAN GE	Green	Port is up with link
	Blinking Green	Link with activity
	Off	No link or port is Off
Digital IO 1-2	Yellow	Active as digital input or output
	Off	Inactive as digital input or output

The following table shows the LED functionalities for the Catalyst IW9165D:

Table 15: URWB LED function for the Catalyst IW9165D

LED Function Label	Color/State	Description (Default = off)
System Status	Tricolor RGA	Indicates varies system status
RSSI	Yellow or Green	RSSI < - 86 dBm: yellow - 86 dBm =< RSSI =< - 81 dBM: blinking green RSSI > - 81 dBm: green



CHAPTER 30

Configure and Verify Roaming Parameters

Packet Retries Limitation

Starting from UIW Release 17.15.1, you can set the limit for the packet retransmissions of unicast packets. This includes both aggregate and non-aggregate packets.

Note The maximum retry limit for packet retransmission is 32.

Configure Maximum Retry Limit for Packet Retransmissions using CLI

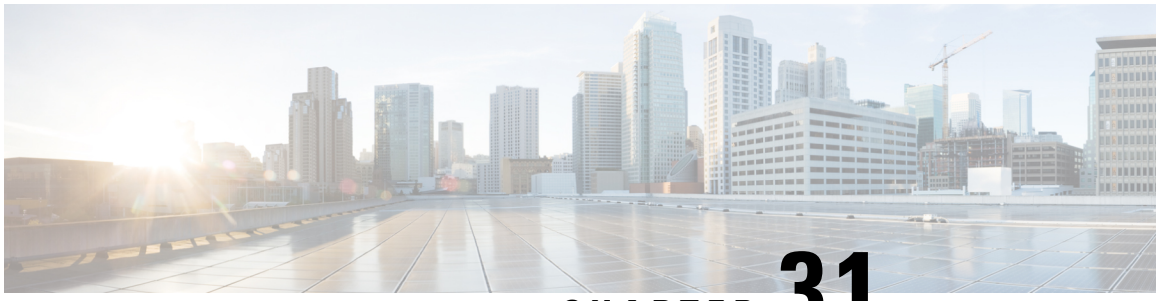
Use this command to configure maximum retry limit for packet retransmissions on the AP.

```
Device#configure dot11Radio <N> packet retries <retry-count>
```

Verify Maximum Retry Limit for Packet Retransmissions using CLI

```
Device#show dot11Radio 1 config
.
.
.
DFS region:             Q
DFS radar role:         auto
Radar detected:         0
Indoor deployment:      disable
```

```
Rx-SOP Threshold:       0 dBm(AUTO)
Max packet retries:     32
```



CHAPTER 31

Network Address Translation

Overview of network address translation

From UIW Release 17.16.1, AP supports the Network Address Translation (NAT) feature. This feature ensures smooth and efficient roaming for Automated Guided Vehicles (AGVs) by using a single public IP address for AGVs to access the outside network. It assigns port numbers to each application on the AGV, managing data flow for both downstream and upstream directions.

Note NAT is supported only in the Layer 2 mode of the AP.

This feature supports the following functionalities:

- NAT with Port Translation (NAPT)
- Source NAT (SNAT)

NAT with Port Translation (NAPT) for downstream traffic manages and routes incoming data packets to the correct inside device. It uses an address table to find a specific application's inside private IP address and port number to forward the packet. For more information, see Downstream data flow using NAPT for AGVs.

Source NAT (SNAT) for upstream traffic modifies the source IP address and port numbers of the outgoing packets from inside network devices before sending them to an external network. For more information, see Upstream data flow using SNAT for AGVs.

Advantage of NAT

A common IP address scheme for on-board vehicle systems reduces the complexity of uniquely identifying all vehicle equipment and facilitates access from external systems.

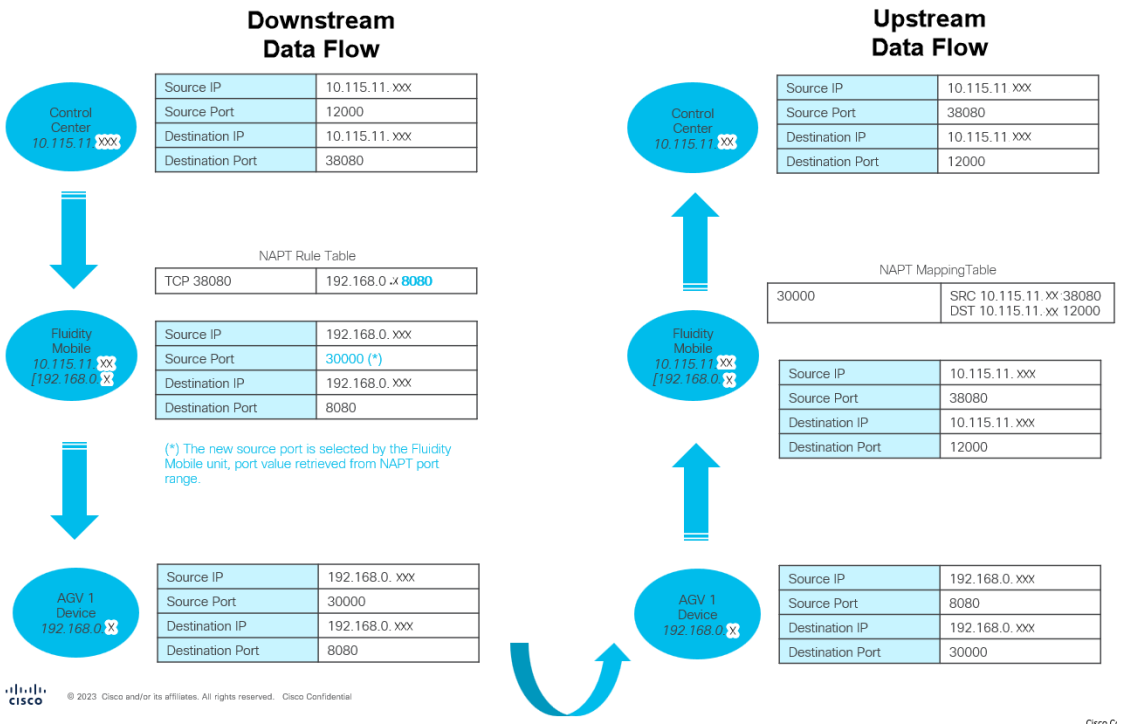
Downstream data flow using NAPT for AGVs

Downstream refers to the flow of data from the outside network to the AGV's inside network. The AP acts as a gateway between the outside and inside networks. When an AP receives a packet from the outside network, NAPT uses the address table to find the inside private IP address and port number of a specific application to forward the packet.

By using NAPT:

- Devices from the outside network can connect to services on the AGVs' inside network.
- APs in the AGVs' inside network can direct data flow to specific ports.

Figure 5: Example of Downstream Data Flow using NAPT:



Assign port numbers using NAPT for AGVs

NAPT assigns different port numbers to various services on an AGV. This ensures that responses from the outside network is sent to the correct service on the AGV.

Reserved outside port numbers for NAPT configuration

Protocol / Port Number	Service	Notes
TCP and UDP	—	Port numbers from 1 to 1023 are not allowed on both TCP and UDP protocols.
UDP/1812-1813	RADIUS	—
UDP/6600 UDP/6610	Industrial Wireless Monitor	On-Premises UDP and ping
UDP/<telemetry port>	Industrial Wireless Telemetry	• Port number configured for Industrial Wireless Telemetry protocol varies. • The default value configured for Telemetry is 30000.

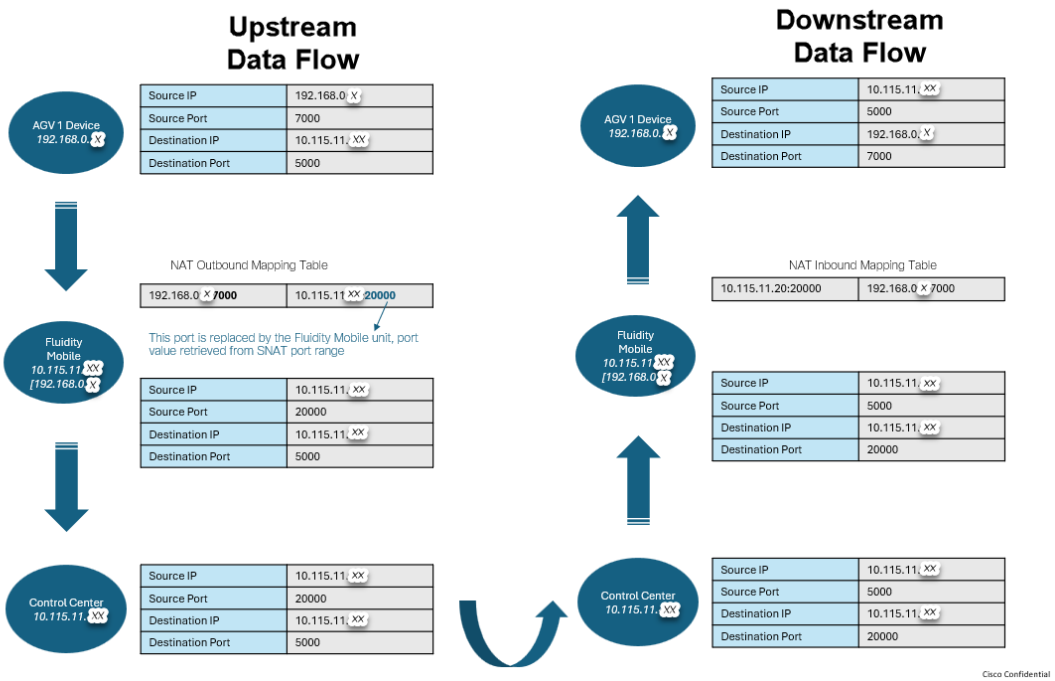
NAPT rule on AP

A NAPT rule sends data flow to specific ports on inside hosts. A typical NAPT rule consists of `<Protocol, Global Destination Port, Translated Local Destination IP, Translated Local Destination Port>`, where the protocol can be either UDP or TCP.

Upstream data flow using SNAT for AGVs

Upstream refers to the flow of data from the inside network to the outside network. The AP serves as a gateway between the inside and outside networks. When the AP sends a packet from the inside network to the outside network, SNAT changes the source IP address and source port in the outgoing packets to match the public IP and port.

Figure 6: Example of Upstream Data Flow using SNAT:



Configure NAPT using CLI

Perform this task to configure NAPT functionality to enable downstream data flow on the AP.

Procedure

Step 1 Use the **configure ip nat enable** command to enable the NAT rules on the AP.

```
Device#configure ip nat enable
```

Note
Use the **configure ip nat disable** command to disable the NAT configuration on the AP.

Step 2 Use the **configure ip nat inside ipv4** *ipv4-address netmask* command to configure inside IPv4 address on the NAT.

```
Device#configure ip nat inside ipv4 192.168.70.2 255.255.255.0
```

Step 3 Use the **configure ip nat inside port range** *left-limit-port-number right-limit-port-number* command to configure inside port range on the NAT.

```
Device#configure ip nat inside port range 32000 33000
```

Inside port valid range is from 30000 to 35000. This range should not overlap the SNAT range.

Step 4 Use the **configure ip nat entry add proto** {**TCP** | **UDP**} **outside port** *outside-port-number* **inside ipv4** *inside-ipv4-address* **port** *inside-port-number* command to configure protocol, outside port value, inside IPv4 address, and inside port value on the NAT.

```
Device#configure ip nat entry add proto TCP outside port 38080 inside ipv4 192.168.0.2 port
8080
```

Step 5 Use the **write** and **reload** command to save the current configuration.

```
Device#write
```

```
Device#reload
```

NAPT configuration example

```
Device#configure ip nat enable
Device#configure ip nat inside ipv4 192.168.0.1 255.255.255.0
Device#configure ip nat inside port range 32000 33000
Device#configure ip nat entry add proto TCP outside port 38080 inside ipv4 192.168.0.2 port
 8080
Device#write
Device#reload
```

Configure SNAT using CLI

Perform this task to configure SNAT functionality to enable upstream data flow on the AP.

Procedure

Step 1 Use the **configure ip nat enable** command to enable the NAT rules on the AP.

```
Device#configure ip nat enable
```

Note
Use the configure **ip nat disable** command to disable the NAT configuration on the AP.

Step 2 Use the **configure ip nat inside ipv4** *ipv4-address netmask* command to configure inside IPv4 address on the NAT.

```
Device#configure ip nat inside ipv4 192.168.70.2 255.255.255.0
```

Step 3 Use the **configure ip nat outside port range** *left-limit-port-number right-limit-port-number* command to configure outside port range on the NAT.

```
Device#configure ip nat outside port range 22000 23000
```

Outside port valid range is from 20000 to 25000. This range should not overlap the NAPT range.

Step 4 Use the **write** and **reload** command to save the current configuration.

```
Device#write
```

```
Device#reload
```

SNAT configuration example

```
Device#configure ip nat enable
Device#configure ip nat inside ipv4 192.168.0.1 255.255.255.0
Device#configure ip nat outside port range 22000 23000
Device#write
Device#reload
```

Delete NAT rule using CLI

Use the **configure ip nat entry del** command to delete the specific NAT rule on the AP.

```
Device#configure ip nat entry del 0
```

Delete all NAT rules using CLI

Use the **configure ip nat entry del all** command to delete all the NAT rules on the AP.

```
Device#configure ip nat entry del all
```

Verify NAT configuration using CLI

Use the **show ip nat config** command to see the status of NAT configuration.

```
device#show ip nat config
NAT: enabled
IP: 192.168.1.144
Netmask: 255.255.255.0
NAPT port range: 30000-35000
SNAT port range: 22000-23000
TCP timeout: 300
UDP timeout: 300
NAT max rules: 100
```

Verify NAT translations using CLI

Use the **show ip nat translations** command to see all the NAT translations.

```
Device#show ip nat translations

NAT: enabled

Port NAT Translations
---------------------

TCP Translations
```

```
(192.168.50.4, 4000, 192.168.50.1, 34200) => (10.115.11.157, 4443, 10.115.11.250, 51010)
(10.115.11.250, 51010, 10.115.11.157, 4443) => (192.168.50.1, 34200, 192.168.50.4, 4000)

UDP Translations
None

Source NAT Translations
----------------------
TCP Translations
(192.168.50.4, 51178, 10.115.11.250, 4000) => (10.115.11.157, 20292, 10.115.11.250, 4000)
(10.115.11.250, 4000, 10.115.11.157, 20292) => (10.115.11.250, 4000, 192.168.50.4, 51178)
UDP Translations
(10.115.11.250, 3000, 10.115.11.157, 22068) => (10.115.11.250, 3000, 192.168.50.4, 38318)
(192.168.50.4, 38318, 10.115.11.250, 3000) => (10.115.11.157, 22068, 10.115.11.250, 3000)
```