



Cisco Catalyst IW9165E Rugged Access Point and Wireless Client Configuration Guide, Cisco IOS XE 17.17.x

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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



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CHAPTER 1

Introduction

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Overview of Cisco Catalyst IW9165E Access Point

The Cisco Catalyst IW9165E Rugged Access Point (AP) and Wireless Client (here after referred as the Catalyst IW9165E). This AP supports 2x2 Wi-Fi 6E design with external antennas. 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.

Cisco Unified Industrial Wireless Software Releases

- From Cisco Unified Industrial Wireless (UIW) Software Release 17.12.1, Catalyst IW9165E can operate in [Cisco Ultra-Reliable Wireless Backhaul \(CURWB\)](#) mode. It delivers high availability, low latency, and zero packet loss with seamless handoffs.
- From Cisco UIW Software Release 17.13.1, the Catalyst IW9165E can also operate as:
 - Wi-Fi client in Workgroup Bridge (WGB) mode; this allows it to connect to a Cisco AP infrastructure.
 - Wi-Fi client in Universal WGB (uWGB) mode; this allows it to connect to a third-party AP infrastructure.

Both modes help in bridging the wired clients behind the WGB to the infrastructure's AP.

- From Cisco UIW Software Release 17.14.1, the Catalyst IW9165E can operate in Lightweight AP (control and provisioning of wireless access points (CAPWAP)) mode, or Ultra-Reliable Wireless Backhaul (URWB) mode, or WGB mode.

The IW9165E allows you to change its operating mode to CAPWAP, WGB, or URWB by just updating the software, without changing the hardware.

CAPWAP modes

In CAPWAP mode, APs can operate in these modes:

- **Local mode:** This is the default mode for the AP. In this mode, the AP serves clients. In local mode, the AP creates two CAPWAP tunnels for the controller; one for the management and the other for data traffic. This configuration is called as central switching because the AP switches (bridges) the data traffic to the controller.
- **Flexconnect mode:** In this mode, the data traffic switches locally, and it is not sent to the controller. In this mode, the AP behaves like an autonomous AP, but the WLC manages the AP. Here, the AP continues to work, even after the controller connection lost.
- **Fabric mode:** In this mode, the AP has a VxLAN tunnel (Access-Tunnel) build to the fabric edge where the AP is attached. If the AP connects to an extended node (EN) or a policy extended node (PEN), the access tunnels connect the AP to the fabric edge where the EN or PEN links up. This VxLAN tunnel maintains network segmentation up to AP. The AP is responsible for inserting the SGT tag in the VxLAN tunnel to the fabric edge.
- **Sniffer mode:** In this mode, the AP starts sniffing the air on a given channel. It captures all the data packets from devices on that channel and sends them to a remote computer that uses programs like Airopeek or Wireshark to analyze the information. The AP tags the traffic with Security Group Tag (SGT) as it travels through the VxLAN tunnel to the fabric edge.



Note In this mode, ensure that both the server and the WLC are on the same VLAN; otherwise, an error message appears.

- **Monitor mode:** In this mode, the AP doesn't handle data traffic between clients and infrastructure. Instead, AP acts as a dedicated sensor for location-based services (LBS), rogue AP detection, and Intrusion Detection System (IDS). When the AP is in monitor mode, it actively monitors the airwaves and typically does not serve clients.
- **Site Survey mode:** In this mode, AP is used for configuring the RF parameters for site survey investigation. For information, see the [AP Survey Mode](#) section in the [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).

Unsupported Features

- 2.4 GHz radio, and
- Scan radio.

For more information about how to configure the AP on the WLC, see [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).

Determine image

Software images are stored under different folders on the same section on IW9165E.



Choose the software image accordingly as per the AP's mode:

- CAPWAP,
- URWB, or
- WGB/uWGB.

Table 1: IW9165E software images

IW9165E mode	Software image
CAPWAP	ap1g6b-k9w8-xxx.tar
URWB	UIW image ap1g6m-k9c1-xxx.tar
WGB or uWGB	

Use the **show version** command to determine the image running on IW9165E.

- If the output shows **Cisco AP Software, (ap1g6b)**; AP is running with the CAPWAP mode.

```
Cisco AP Software, (ap1g6b), C9165, RELEASE SOFTWARE
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2024 by Cisco Systems, Inc.
Compiled Tue Feb 20 23:04:29 GMT 2024
```
- If the output shows **Cisco AP Software (ap1g6m)**; AP is running with the URWB mode or WGB/uWGB.

```
Cisco AP Software, (ap1g6m), C9165, RELEASE SOFTWARE
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2024 by Cisco Systems, Inc.
Compiled Tue Feb 20 23:04:29 GMT 2024
```

Image conversion

To convert the IW9165E access point either from Wi-Fi mode (CAPWAP) or URWB mode or WGB mode, follow these steps:

1. Use the **configure boot mode urwb** command to convert from CAPWAP to URWB mode or from WGB/uWGB to URWB mode.

```
Device#configure boot mode urwb
```

2. Use the **configure boot mode capwap** command to convert from URWB to CAPWAP mode or from WGB/uWGB to CAPWAP mode.

```
Device#configure boot mode capwap
```

3. Use the **configure boot mode wgb** command to convert from CAPWAP to WGB/uWGB mode or from URWB to WGB/uWGB mode.

```
Device#configure boot mode wgb
```

**Note**

Once you perform these commands, the AP starts to reboot and the new configuration takes effect.

**Warning**

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

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
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.

Related documentation

To view all support information for the Cisco Catalyst IW9165 Rugged Series, see <https://www.cisco.com/content/en/us/support/wireless/catalyst-iw9165-rugged-series/series.html>.

In addition to the documentation available on the support page, you will need to refer to these guides:

- For information about IW9165E hardware, see [Cisco Catalyst IW9165E Rugged Access Point and Wireless Client Hardware Installation Guide](#).
- A full listing of the AP's features and specifications is provided in [Cisco Catalyst IW9165 Series Data Sheet](#).
- For information about Cisco URWB mode configuration, see the relevant documents at: <https://www.cisco.com/content/en/us/support/wireless/catalyst-iw9165-rugged-series/series.html>.
- For more information about the configuration on Cisco Catalyst 9800 Series Wireless Controllers, see [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).



CHAPTER 2

Workgroup Bridges

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Workgroup Bridge modes

WGB mode

WGB mode provides wireless connectivity to wired clients connected to the Ethernet port of the WGB.

Key characteristics

- It bridges the wired network to a wireless segment.
- It learns the MAC addresses of connected Ethernet-wired clients and shares these identifiers with the Wireless LAN Controller (WLC). This is done through an AP infrastructure using Internet Access Point Protocol (IAPP) messaging.
- It establishes a single wireless connection to the root AP, which treats the WGB as a wireless client.



Note This mode is ideal for environments requiring wireless connectivity for wired devices that lack native wireless capabilities.

Universal Workgroup Bridge mode

Universal Workgroup Bridge (uWGB) mode is a complementary category to the WGB mode, designed to act as a wireless bridge between wired clients and wireless infrastructure.

Key characteristics

- It supports both Cisco and non-Cisco wireless networks.
- It uses a wireless interface to connect with the AP, employing the radio MAC address for association.
- It ensures that wired clients connected to the uWGB can access wireless networks seamlessly.



Note This mode is especially useful in scenarios where interoperability with non-Cisco wireless infrastructure is required.

Comparison of key features of WGB and uWGB modes

This table outlines the differences between these two modes.

Feature	WGB mode	uWGB mode
Connectivity	Cisco wireless networks only	Cisco and non-Cisco wireless networks
Interface Usage	Learns MAC addresses using Ethernet ports	Uses radio MAC address for association
Use Case	Bridging wired clients to Cisco wireless networks	Bridging wired clients to any wireless network

Use case of WGB mode

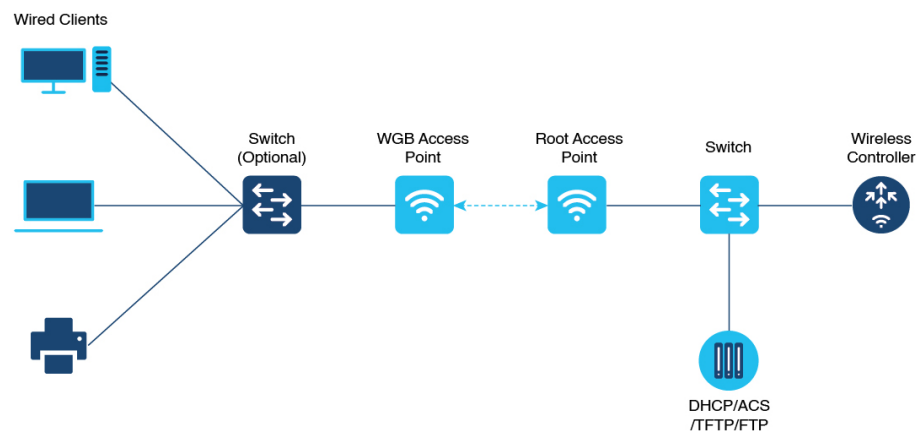
A factory floor uses wired devices such as sensors and PLCs, which lack built-in wireless connectivity. These devices connect to the WGB using Ethernet, and it bridges them to the wireless infrastructure through a single connection to the root AP.

Use case of uWGB mode

A retail store employs a point-of-sale (POS) system with wired devices that require connectivity to a wireless network. uWGB connects these devices to the store's wireless infrastructure, supporting both Cisco and non-Cisco wireless networks. The uWGB uses its wireless interface to associate with the AP, enabling seamless communication between the wired POS devices and the wireless network.

Use these modes to efficiently extend wireless capabilities to wired devices, enhancing both network scalability and flexibility.

Figure 1: WGB mode implementation



WGB and uWGB modes recommendations

WGB mode recommendations

- The WGB can associate only with Cisco lightweight access points (APs).
- In a Meraki wireless infrastructure using WPA1 security, the uWGB does not associate with any SSIDs.
- Speed and duplex settings are automatically negotiated based on the locally connected endpoint's capabilities. These settings cannot be manually configured on the AP's wired 0 and wired 1 interfaces.
- Spanning Tree Protocol (STP) and Per-VLAN Spanning Tree (PVST) packets must be used to detect and prevent loops in wired and wireless networks. The WGB transparently bridges STP packets between two wired segments. However, incorrect or inconsistent STP configuration can cause issues such as:
 - Blocking of the WGB's wireless link to the AP or WGB by connected switches.
 - Loss of connection between the WGB and the AP or between the AP and its controller.

- Wired clients being unable to obtain IP addresses due to blocked switch ports. To avoid these issues, disable STP on switches directly connected to the wireless network if you need to stop STP bridging by the WGB.
- During Layer 3 roaming, if a wired client connects to the WGB network after the WGB roams to a foreign controller, the wired client's IP address will only display on the anchor controller, not the foreign controller.
- Deauthenticating a WGB record from a controller clears all entries of wired clients connected to that WGB.
- Wired clients connected to a WGB do not support:
 - MAC filtering,
 - link tests,
 - idle timeout, and
 - web authentication.
- A WGB cannot associate with a WLAN configured with Adaptive 802.11r.

IPv6 and IPv4 Support

- The WGB supports IPv6 traffic exclusively for wired clients, even though IPv4 is enabled.
- IPv6 management for the WGB does not function properly, even if the WGB successfully associates with an uplink. IPv6 pings and SSH to the WGB management IPv6 address do not work.



Note Re-enable IPv6 on the WGB, even if it is already enabled and an IPv6 address has been assigned.

Channel bandwidth issue

If the infrastructure AP operates on a non-dynamic frequency selection (non-DFS) channel and changes its channel bandwidth, the WGB continues to use the original channel bandwidth.



Note Confirm that the WGB connects to the AP using the correct channel bandwidth.

uWGB mode recommendations

- TFTP and SFTP are not supported in uWGB mode. Perform software upgrades in WGB mode only. For more information, see [uWGB Image Upgrade](#).
- uWGB mode supports wired clients connected to the wired0 interface. Wired clients connected to the wired1 interface are not supported.
- You should configure an arbitrary non-routable IP address for uWGB. Using a static or dynamic IP address in the same range as the end device can result in unexpected behavior.
- From UIW Release 17.13.1, an AP in uWGB mode is managed using SSH. Image upgrade can be performed when no wired clients are connected to the AP.

- When a wired client is detected, the AP in uWGB mode remains in the same uWGB mode. You cannot upgrade the image of the AP.
- When a wired client is not detected, the AP in uWGB mode switches to WGB mode. You can manage as well as upgrade the image of the AP.

Guidelines to reset the login credentials

Credential requirements

- The username length must be between 1 and 32 characters.
- The password length must be between 8 and 120.
- The password must include:
 - at least one uppercase character
 - one lowercase character
 - one digit, and
 - one punctuation mark.
- The password can include:
 - alphanumeric characters, and
 - special characters (ASCII decimal code from 33 to 126).
- The password must exclude:
 - " (double quote)
 - ' (single quote), and
 - ? (question mark).
- The password cannot:
 - Contain three consecutive characters in sequence (ABC/ CBA).
 - Contain three consecutive identical characters (AAA).
 - Be the same as or the reverse of the username.
- The new password must contain at least four characters that are different from the current password.

Default example credentials:

- username: Cisco
- password: Cisco
- enable password: Cisco

Credentials example:

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

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

% First Login: Please Reset 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

% Credentials changed, please re-login

[*04/18/2023 23:53:44.8926] chpasswd: password for user changed
[*04/18/2023 23:53:44.9074]
[*04/18/2023 23:53:44.9074] Management user configuration saved successfully
[*04/18/2023 23:53:44.9074]

User Access Verification
Username: demouser
Password: DemoP@ssw0rd
APFC58.9A15.C808>enable
Password:DemoE^aP@ssw0rd
APFC58.9A15.C808#
```



Note

In the provided example, passwords are displayed in plain text for clarity. In real-world scenarios, passwords are masked with asterisks (*).

Configure WLAN policy profile and VLAN settings for WGB support

Before you begin

To enable WGB to join a wireless network, you must configure the WLAN and its associated policy profile on the controller. This ensures proper communication and connectivity between the WGB and the AP.

Procedure

Step 1 Use the **wlan profile-name** command to enter the WLAN configuration submode.

```
Device#wlan profile-name
```

Note

Here, *profile-name* refers to the name of the configured WLAN.

Step 2

Use the **ccx aironet-iesupport** command to configure the Cisco Client Extensions (CCX) option and enable support for Aironet Information Element (IE) on the WLAN.

```
Device#ccx aironet-iesupport
```

Note

This configuration is mandatory for the WGB to associate with the AP.

Configure WLAN policy profile for WGB

Before you begin

Follow this procedure to configure a WLAN policy profile and enable VLAN client support for a WGB on the AP. This ensures seamless client connectivity and proper VLAN assignment for WGBs in the network.

Procedure**Step 1**

Use the **wireless profile policy profile-policy** command to access the wireless policy configuration mode for the desired profile.

```
Device#wireless profile policy profile-policy
```

Step 2

Use the **vlan vlan-id** command to map the WLAN policy profile to the corresponding VLAN ID.

```
Device#vlan vlan-id
```

Step 3

Use the **wgb vlan** command to enable VLAN client support for the WGB.

```
Device#wgb vlan
```

Condition	Action or result
If the <code>profile-policy</code> does not exist	Create the wireless profile policy before proceeding with the configuration.
If the VLAN ID is not correctly assigned	Reassign the VLAN using the correct <code>vlan-id</code> to ensure proper connectivity.
If WGB VLAN support is not enabled	Execute the <code>wgb vlan</code> command to allow client support for WGBs.

What to do next**Note**

- Ensure that you have administrative access to the device before attempting this configuration.
- Verify that the VLAN ID you assign exists and is configured on the network infrastructure.

Upgrade the uWGB image

To upgrade the uWGB software image by converting it to WGB mode, performing the upgrade, and reverting it back to uWGB mode. The process requires using TFTP or SFTP protocols for the software download.

Before you begin

The uWGB mode does not support TFTP or SFTP protocols for image upgrades. Therefore, the device must first be converted to WGB mode to enable the image upgrade process.

Procedure

Step 1 Connect a TFTP or SFTP server to the wired 0 port of the uWGB.

Step 2 Use the **configure Dot11Radio slot_id disable** command to disable the radio interface.

```
Device#configure Dot11Radio slot_id disable
```

Step 3 Convert uWGB to WGB mode.

Use the **configure Dot11Radio slot_id mode wgb ssid-profile ssid_profile_name** command to reboot the device with the downloaded configuration.

```
Device#configure Dot11Radio slot_id mode wgb ssid-profile ssid_profile_name
```

This command will reboot with downloaded configs.
Are you sure you want continue? <confirm>

Note

Replace *ssid_profile_name* with any existing configured SSID profile.

Step 4 When the device reboots, assign a static IP address to the WGB.

Use the **configure ap address ipv4 static IPv4_address netmask Gateway_IPv4_address** command to assign a static IP address to the WGB.

```
Device#configure ap address ipv4 static 192.168.1.101 255.255.255.0 192.168.1.1
```

Step 5 Use the **pingserver_IP** command to view the ICMP ping results to the server.

```
Device#ping server_IP
```

Example:

```
Device#ping 192.168.1.20
Sending 5, 100-byte ICMP Echos to 192.168.1.20, timeout is 2 seconds
PING 192.168.1.20
```

```
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0.858/0.932/1.001 ms
```

Step 6 Use the **archive download/reload** <tftp | sftp | http>://server_ip/file_path command to upgrade the uWGB software.

```
Device#archive download/reload <tftp | sftp | http >://server_ip /file_path
```

Step 7 Use the **configure Dot11Radio slot_id mode uwgb wired_client_mac_addr ssid-profile ssid_profile_name** command to revert the device back to uWGB mode.

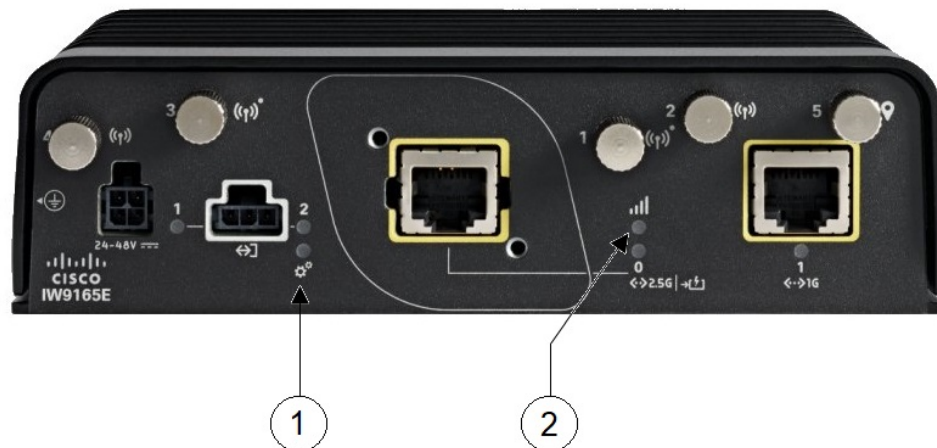
```
Device#configure Dot11Radio slot_id mode uwgb wired_client_mac_addr ssid-profile ssid_profile_name
```

LED pattern

There are two LEDs located at the front of AP panel:

- System status LED
- RSSI status LED

Figure 2: IW9165E LEDs



1	System status LED • Blinking Red: Indicates that the WGB is disassociated. • Solid green: Indicates that the WGB is associated with the parent AP.	2	RSSI status LED • Solid green: When the RSSI value is greater than or equal to -71 dBm. • Blinking green: When the RSSI value is between -81 dBm and -70 dBm. • Solid yellow: When the RSSI value is between -95 dBm and -81 dBm. • Off: For all other RSSI values.
---	--	---	---

Configure IP address

Configure IPv4 address

- Use the **configure ap address ipv4 dhcp** command to configure IPv4 address using DHCP.

```
Device#configure ap address ipv4 dhcp
```

- Use the **configure ap address ipv4 static ipv4_addr netmask gateway** command to configure the static IPv4 address. By doing so, you can manage the device using a wired interface without an uplink connection.

```
Device#configure ap address ipv4 static ipv4_addr netmask gateway
```

Verify current IP configuration

Use **show ip interface brief** command to view the current IP address configuration.

```
Device#show ip interface brief
```

Configure IPv6 address

Use the **configure ap address ipv6 static ipv6_addr prefixlen [gateway]** command to configure the static IPv6 address. This configuration allows you to manage the AP through a wired interface without uplink connection.

```
Device#configure ap address ipv6 static ipv6_addr prefixlen [gateway]
```

Enable IPv6 auto configuration

Use the **configure ap address ipv6 auto-config enable** command to enable the IPv6 auto configuration on the AP.

```
Device#configure ap address ipv6 auto-config enable
```



Note

- Use the **configure ap address ipv6 auto-config disable** command to disable the IPv6 auto configuration on the AP.
- Use the **configure ap address ipv6 auto-config enable** command to enable IPv6 SLAAC. Note that SLAAC does not apply to CoS of WGB. This command configures IPv6 address with DHCPv6 instead of SLAAC.

Configure IPv6 address using DHCP

Use the **configure ap address ipv6 dhcp** command to configure IPv6 address using DHCP.

```
Device#configure ap address ipv6 dhcp
```

Verify current IP configuration

Use the **show ipv6 interface brief** command to verify current IP address configuration.

```
Device#show ipv6 interface brief
```

WGB configuration

Perform these tasks for WGB configuration:

1. [Create an SSID profile](#).
2. [Configure the radio in WGB mode](#), and associate the SSID profile with the radio.
3. Turn on the radio.

WGB uplink supports various security methods, which includes:

- Open (unsecured)
- Pre-shared key (PSK), and
- Dot1x (LEAP, PEAP, FAST-EAP, and TLS).



Note Ensure that the below configuration order is followed when EAP-TLS security is desired on the WGB:

1. Configure the device username/password, NTP server, hostname, and valid IP address.
2. Create trustpoints and import the certificates using your preferred method.
3. (Optional) Configure the dot1x credentials.
4. Create the EAP profile and map the method, trustpoint name and dot1x credentials (optional).
5. Bind the EAP profile to the SSID profile.
6. Bind the SSID profile to the preferred radio.

Dot1x FAST-EAP configuration example

```
configure dot1x credential demo-cred username demouser1 password Dem0Pass!@
configure eap-profile demo-eap-profile dot1x-credential demo-cred
configure eap-profile demo-eap-profile method fast
configure ssid-profile demo-FAST ssid demo-fast authentication eap profile demo-eap-profile
key-management wpa2
configure dot11radio 1 mode wgb ssid-profile demo-FAST
configure dot11radio 1 enable
```

These sections provide detailed information on the WGB configuration procedure.

SSID configuration

Perform these tasks to configure SSID.

Create an SSID profile

Choose one of these authentication protocols to configure the SSID profile:

1. [Open authentication](#)
2. [PSK authentication](#)
 - PSK WPA2 authentication
 - PSK Dot11r authentication, and
 - PSK Dot11w authentication.
3. [Dot1x authentication](#)

Configure an SSID profile using open authentication

Use the **configure ssid-profile ssid-profile-name ssid radio-serv-name authentication open** command to configure an SSID profile using open authentication.

```
Device#configure ssid-profile ssid-profile-name ssid radio-serv-name authentication open
```

Configure an SSID profile using PSK authentication

Choose one of these authentication protocols to configure an SSID profile using PSK authentication:

- configure an SSID profile using PSK WPA2 authentication
- configure an SSID profile using PSK Dot11r authentication, and
- configure an SSID profile using PSK Dot11w authentication .

Configure an SSID profile using PSK WPA2 authentication

Use the **configure ssid-profile ssid-profile-name ssid SSID_name authentication psk preshared-key key-management wpa2** command to configure an SSID profile using PSK WPA2 authentication.

```
Device#configure ssid-profile ssid-profile-name ssid SSID_name authentication psk  
preshared-key key-management wpa2
```

Configure an SSID profile using PSK Dot11r authentication

Use the **configure ssid-profile ssid-profile-name ssid SSID_name authentication psk preshared-key key-management dot11r** command to configure an SSID profile using PSK Dot11r authentication.

```
Device#configure ssid-profile ssid-profile-name ssid SSID_name authentication psk  
preshared-key key-management dot11r
```

Configure an SSID profile using PSK Dot11w authentication

Use the **configure ssid-profile ssid-profile-name ssid SSID_name authentication psk preshared-key key-management dot11w** command to configure an SSID profile using PSK Dot11w authentication

```
Device#configure ssid-profile ssid-profile-name ssid SSID_name authentication psk  
preshared-key key-management dot11w
```

Configure an SSID profile using Dot1x authentication

Use the **configure ssid-profile ssid-profile-name ssid radio-serv-name authentication eap profile eap-profile-name key-management {dot11r | wpa2 | dot11w {optional | required}}** command to configure an SSID profile using Dot1x authentication.

```
Device#configure ssid-profile ssid-profile-name ssid radio-serv-name authentication eap
profile eap-profile-name key-management { dot11r | wpa2 | dot11w { optional | required}}
```

Configure an SSID profile using Dot1x EAP-PEAP authentication

Here is an example that shows the configuration of an SSID profile using Dot1x EAP-PEAP authentication:

```
Device#configure dot1x credential c1 username wgbusr password cisco123456
Device#configure eap-profile p1 dot1x-credential c1
Device#configure eap-profile p1 method peap
Device#configure ssid-profile iot-peap ssid iot-peap authentication eap profile p1
key-management wpa2
```

Configure radio interface for WGB

IW9165E does not have 2.4 GHz radio. You can configure only dot11radio 1 as uplink and operate in WGB mode.

Use the **configure dot11radio slot_id mode wgb ssid-profile ssid-profile-name** command to configure a radio interface to a WGB SSID profile.

```
Device#configure dot11radio 1 mode wgb ssid-profile ssid-profile-name
```

Enable radio interface for WGB

Use the **configure dot11radio slot_id enable** command to enable a radio interface.

```
Device#configure dot11radio 1 enable
```



Note Use the **configure dot11radio slot_id disable** command to disable a radio interface.

Configure a Dot1X credential

Use the **configure dot1x credential profile-name username name password pwd** command to configure Dot1x credential.

```
Device#configure dot1x credential profile-name username name password pwd
```

Verify WGB EAP Dot1x profile

Use the **show wgb eap dot1x credential profile** command to view the status of WGB EAP Dot1x profile.

```
Device#show wgb eap dot1x credential profile
```

Deauthenticate WGB wired client

Use the **clear wgb client {all |single mac-addr}** command to deauthenticate WGB wired client.

```
Device#clear wgb client {all |single mac-addr}
```

Configure an EAP profile

Perform these steps to configure an EAP profile:

1. Attach the Dot1x credential profile to the EAP profile.
2. Attach the EAP profile to the SSID profile.
3. Attach the SSID profile to the radio.

Procedure

Step 1 Use the **configure eap-profile** *profile-name* **method** { **fast** | **leap** | **peap** | **tls** } command to configure the EAP profile.

```
Device#configure eap-profile profile-name method { fast | leap | peap | tls}
```

Note

Choose an EAP profile method.

- fast
- peap, or
- tls.

Step 2 Use the **configure eap-profile** *profile-name* **trustpoint** { **default** | **name** *trustpoint-name* } command to attach the CA trustpoint for TLS. By default, the WGB uses the internal MIC certificate for authentication.

```
Device#configure eap-profile profile-name trustpoint { default | name trustpoint-name}
```

Step 3 Use the **configure eap-profile** *profile-name* **dot1x-credential** *profile-name* command to attach the dot1x-credential profile.

```
Device#configure eap-profile profile-name dot1x-credential profile-name
```

Step 4 [Optional] Use the **configure eap-profile** *profile-name* **delete** command to delete an EAP profile.

```
Device#configure eap-profile profile-name delete
```

Configure trustpoint manual enrollment for terminal

Procedure

Step 1 Use the **configure crypto pki trustpoint** *ca-server-name* **enrollment terminal** command to create a trustpoint in WGB.

```
Device#configure crypto pki trustpoint ca-server-name enrollment terminal
```

Step 2 Use the **configure crypto pki trustpoint** *ca-server-name* **authenticate** command to authenticate a trustpoint manually.

```
Device#configure crypto pki trustpoint ca-server-name authenticate
```

Enter the base 64 encoded CA certificate.

Enter **quit** to finish the certificate.

Note

If you use an intermediate certificate, import all the certificate chains in the trustpoint.

Example:

```
Device#configure crypto pki trustpoint demotp authenticate
```

Enter the base 64 encoded CA certificate.

....And end with the word "quit" on a line by itself....

```
-----BEGIN CERTIFICATE-----
[base64 encoded root CA certificate]
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
[base64 encoded intermediate CA certificate]
-----END CERTIFICATE-----
quit
```

- Step 3** Use the **configure crypto pki trustpoint *ca-server-name* key-size *key-length*** command to configure a private key size.

```
Device#configure crypto pki trustpoint ca-server-name key-size key-length
```

- Step 4** Use the **configure crypto pki trustpoint *ca-server-name* subject-name *name* [Optional] 2ltr-country-code *state-name* *locality* *org-name* *org-unit* *email*** command to configure the subject-name.

```
Device#configure crypto pki trustpoint ca-server-name subject-name name [Optional] 2ltr-country-code
state-name locality org-name org-unit email
```

- Step 5** Use the **configure crypto pki trustpoint *ca-server-name* enroll** command to generate a private key and certificate signing request (CSR).

```
Device#configure crypto pki trustpoint ca-server-name enroll
```

Create the digitally signed certificate using the CSR output in the CA server.

- Step 6** Use the **configure crypto pki trustpoint *ca-server-name* import certificate** command to import the signed certificate in WGB.

```
Device#configure crypto pki trustpoint ca-server-name import certificate
```

Enter the base 64 encoded CA certificate.

Enter **quit** to finish the certificate.

```
Device#quit
```

- Step 7** [Optional] Use the **configure crypto pki trustpoint *trustpoint-name* delete** command to delete a trustpoint.

```
Device#configure crypto pki trustpoint trustpoint-name delete
```

- Step 8** Use the **show crypto pki trustpoint** command to view the trustpoint summary.

```
Device#show crypto pki trustpoint
```

- Step 9** Use the **show crypto pki trustpoint *trustpoint-name* certificate** command to view the content of the certificates that are created for a trustpoint.

```
Device#show crypto pki trustpoint trustpoint-name certificate
```

Configure trustpoint auto-enrollment for WGB

Procedure

Step 1 Use the **configure crypto pki trustpoint** *ca-server-name* **enrollment url** *ca-server-url* command to enroll a trustpoint in the WGB using the server URL.

```
Device#configure crypto pki trustpoint ca-server-name enrollment url ca-server-url
```

Step 2 Use the **configure crypto pki trustpoint** *ca-server-name* **authenticate** command to authenticate a trustpoint.

```
Device#configure crypto pki trustpoint ca-server-name authenticate
```

This command fetches the CA certificate from CA server automatically.

Step 3 Use the **configure crypto pki trustpoint** *ca-server-name* **key-size** *key-length* command to configure a private key size.

```
Device#configure crypto pki trustpoint ca-server-name key-size key-length
```

Step 4 Use the **configure crypto pki trustpoint** *ca-server-name* **subject-name** *name* [Optional] *2ltr-country-code* *state-name* *locality* *org-name* *org-unit* *email* command to configure the subject-name.

```
Device#configure crypto pki trustpoint ca-server-name subject-name name [Optional] 2ltr-country-code state-name locality org-name org-unit email
```

Step 5 Use the **configure crypto pki trustpoint** *ca-server-name* **enroll** command to enroll the trustpoint.

```
Device#configure crypto pki trustpoint ca-server-name enroll
```

Request the digitally signed certificate from the CA server.

Step 6 Use the **configure crypto pki trustpoint** *ca-server-name* **auto-enroll enable** *renew-percentage* command to enable auto-enroll.

```
Device#configure crypto pki trustpoint ca-server-name auto-enroll enable renew-percentage
```

Note

Use the **configure crypto pki trustpoint** *ca-server-name* **auto-enroll disable** command to disable the auto-enroll.

Step 7 [Optional] Use the **configure crypto pki trustpoint** *trustpoint-name* **delete** command to delete a trustpoint.

```
Device#configure crypto pki trustpoint trustpoint-name delete
```

Step 8 Use the **show crypto pki trustpoint** command to view the trustpoint summary.

```
Device#show crypto pki trustpoint
```

Step 9 Use the **show crypto pki trustpoint** *trustpoint-name* **certificate** command to view the details of the certificate for a specific trustpoint.

```
Device#show crypto pki trustpoint trustpoint-name certificate
```

Step 10 Use the **show crypto pki timers** command to view the public key infrastructure (PKI) timer information.

show crypto pki timers

```
Device#show crypto pki timers
```

Configure manual certificate enrollment using TFTP server

Procedure

- Step 1** Specify the enrollment method.
- Use the **configure crypto pki trustpoint *ca-server-name* enrollment tftp *tftp-addr/file-name*** command to retrieve the CA and client certificate for a trustpoint.
- ```
Device#configure crypto pki trustpoint ca-server-name enrollment tftp tftp-addr/file-name
```
- Step 2** Use the **configure crypto pki trustpoint *ca-server-name* authenticate** command to authenticate a trustpoint manually.
- ```
Device#configure crypto pki trustpoint ca-server-name authenticate
```
- This retrieves and authenticates the CA certificate from the specified TFTP server. If the file specification is included, the WGB adds the extension **.ca** to the specified filename.
- Step 3** Use the **configure crypto pki trustpoint *ca-server-name* key-size *key-length*** command to configure a private key size.
- ```
Device#configure crypto pki trustpoint ca-server-name key-size key-length
```
- Step 4** Use the **configure crypto pki trustpoint *ca-server-name* subject-name *name* [Optional] *2ltr-country-code state-name locality org-name org-unit email*** command to configure the subject-name.
- ```
Device#configure crypto pki trustpoint ca-server-name subject-name name [Optional] 2ltr-country-code state-name locality org-name org-unit email
```
- Step 5** Use the **configure crypto pki trustpoint *ca-server-name* enroll** command to generate a private key and Certificate Signing Request (CSR).
- ```
Device#configure crypto pki trustpoint ca-server-name enroll
```
- This generates certificate request and sends the request to the TFTP server. The filename to be written is appended with the **.req** extension.
- Step 6** Use the **configure crypto pki trustpoint *ca-server-name* import certificate** command to import the signed certificate in WGB.
- ```
Device#configure crypto pki trustpoint ca-server-name import certificate
```
- The console terminal uses TFTP to import a certificate and the WGB tries to get the approved certificate from the TFTP. The filename to be written is appended with the **.crt** extension.
- Step 7** Use the **show crypto pki trustpoint** command to view the trustpoint summary.
- ```
Device#show crypto pki trustpoint
```
- Step 8** Use the **show crypto pki trustpoint *trustpoint-name* certificate** command to view the content of the certificates that are created for a trustpoint.
- ```
Device#show crypto pki trustpoint trustpoint-name certificate
```
-

Configure PKCS12 or PFX or P12 certificate enrollment for WGB mode using TFTP server

Procedure

Use **configure crypto pki trustpoint** *trustpoint_name* **import pkcs12 tftp** *tftp://IP_ADDRESS/path_to_certificate password certificate_password* command to import PKCS12 full certificate bundle for EAP-TLS authentication and private key.

```
Device#configure crypto pki trustpoint trustpoint1 import pkcs12 tftp tftp://1.2.3.4/cert.crt
```

Verify PKCS12 or PFX or P12 certificate enrollment for WGB mode

Procedure

Use the **show crypto pki trustpoint** command to verify the downloaded PKCS12 certificate.

Example:

```
Device#show crypto pki trustpoint
Crypto PKI trustpoints are:-
=====
Trustpoint name : example
Enrollment method : TFTP
  TFTP path : tftp://192.168.0.1/users/example/ca
CA-Cert file : /storage/wbridge_pki_cert/example/example_ca.pem
  Subject : C=US,ST=Unknown,L=Unknown,O=Cisco,OU=Wnbu,CN=ap.cisco.com
,emailAddress=wgb@cisco.com
  Key size : 2048
```

Configure WGB or uWGB timer

The CLI commands for timer configuration are same for both WGB and uWGB modes. Use these commands to configure timer:

- Use the **configure wgb association response timeout** *response-millisecs* command to configure the WGB association response timeout.

```
Device#configure wgb association response timeout response-millisecs
```

The default value is 100 milliseconds, and the valid range is between 100 and 5000 milliseconds.

- Use the **configure wgb authentication response timeout** *response-millisecs* command to configure the WGB authentication response timeout.

```
Device#configure wgb authentication response timeout response-millisecs
```

The default value is 100 milliseconds, and the valid range is between 100 and 5000 milliseconds.

- Use the **configure wgb eap timeout** *timeout-secs* command to configure the WGB EAP timeout.

```
Device#configure wgb eap timeout timeout-secs
```

The default value is 3 seconds, and the valid range is between 2 and 60 seconds.

- Use the **configure wgb bridge client timeout** *timeout-secs* command to configure the WGB bridge client response timeout.

```
Device#configure wgb bridge client timeout timeout-secs
```

The default timeout value is 300 seconds, and the valid range is between 10 and 1000000 seconds.

uWGB configuration

The uWGB mode can associate with third-party APs using uplink radio MAC address, thus the uWGB role supports only one wired client.

Most WGB configurations also apply to uWGB mode. The only difference is that you configure wired client's MAC address using this command:

Device#configure dot11 <slot_id> mode uwgb <uwgb_wired_client_mac_address> ssid-profile <ssid-profile>

Dot1x FAST-EAP configuration example:

```
Device#configure dot1x credential demo-cred username demouser1 password Dem0Pass!@
Device#configure eap-profile demo-eap-profile dot1x-credential demo-cred
Device#configure eap-profile demo-eap-profile method fastDevice#
Device#configure ssid-profile demo-FAST ssid demo-fast authentication eap profile
demo-eap-profile key-management wpa2
Device#configure dot11radio 1 mode uwgb fc58.220a.0704 ssid-profile demo-FAST
Device#configure dot11radio 1 enable
```

These sections provide detailed information about uWGB configuration:

- [SSID configuration](#)
- [Configure a dot1X credential](#)
- [Configure an EAP profile](#)
- [Configure trustpoint manual enrollment for terminal](#)
- [Configure trustpoint auto-enrollment for WGB](#)
- [Configure manual certificate enrollment using TFTP server](#)
- [Configure WGB or uWGB timer](#)

Conversion between WGB and uWGB modes

Conversion from WGB to uWGB mode

Use the **configure dot11radio <radio_slot_id> mode uwgb <WIRED_CLIENT_MAC> ssid-profile <SSID_PROFILE_NAME>** command to convert from WGB to uWGB mode.

```
Device#configure dot11radio <radio_slot_id> mode uwgb <WIRED_CLIENT_MAC> ssid-profile
<SSID_PROFILE_NAME>
```

Conversion from uWGB to WGB mode

Use the **configure dot11radio <radio_slot_id> mode wgb ssid-profile <SSID_PROFILE_NAME>** command to convert from uWGB to WGB mode. This conversion involves rebooting of the AP.

```
Device#configure dot11radio 1 mode wgb ssid-profile <SSID_PROFILE_NAME>
```

```
This command will reboot with downloaded configs.
Are you sure you want continue? [confirm]
```

Import and export WGB configuration

Export WGB configuration

You can upload the current configuration of an existing WGB to a server and then you can download it for newly deployed WGBs.

Use the **copy configuration upload <sftp|tftp:> ip-address [directory] [file-name]** command to upload the working configuration of an existing WGB to a server.

```
Device#copy configuration upload <sftp|tftp:> ip-address [directory] [file-name]
```

Import WGB configuration

Use the **copy configuration download <sftp|tftp:> ip-address [directory] [file-name]** command to download a sample configuration to all WGBs in the deployment.

```
Device#copy configuration download <sftp|tftp:> ip-address [directory] [file-name]
```



Note When you execute the **copy configuration download** command, the AP starts to reboot. The new configuration takes effect only after the reboot.

Verify the WGB and uWGB configuration

Use the **show run** command to check whether the AP is in WGB mode or uWGB mode.

- WGB:

```
Device#show run
AP Name           : APFC58.9A15.C808
AP Mode           : WorkGroupBridge
CDP State         : Enabled
Watchdog monitoring : Enabled
SSH State         : Disabled
AP Username       : admin
Session Timeout   : 300
```

```
Radio and WLAN-Profile mapping:-
=====
```

Radio ID	Radio Mode Authentication	SSID-Profile	SSID
1	WGB OPEN	myssid	demo

Radio configurations:-

```

=====
Radio Id      : NA
Admin state   : NA
Mode          : NA
Radio Id      : 1
Admin state   : DISABLED
Mode          : WGB
Dot11 type    : 11ax
Radio Id      : NA
Admin state   : NA
Mode          : NA
  
```

• uWGB:

```

Device#show run
AP Name       : APFC58.9A15.C808
AP Mode       : WorkGroupBridge
CDP State     : Enabled
Watchdog monitoring : Enabled
SSH State     : Disabled
AP Username   : admin
Session Timeout : 300
  
```

Radio and WLAN-Profile mapping:-

Radio ID	Radio Mode Authentication	SSID-Profile	SSID
1	UWGB OPEN	myssid	demo

Radio configurations:-

```

=====
Radio Id      : NA
Admin state   : NA
Mode          : NA
Radio Id      : 1
Admin state   : DISABLED
Mode          : UWGB
Uclient mac   : 0009.0001.0001
Current state  : WGB
UClient timeout : 0 Sec
Dot11 type    : 11ax
Radio Id      : NA
Admin state   : NA
Mode          : NA
  
```

Use the **show wgb dot11 associations** command to view the WGB and uWGB configuration.

• WGB:

```

Device#show wgb dot11 associations
Uplink Radio ID : 1
Uplink Radio MAC : 00:99:9A:15:B4:91
SSID Name : roam-m44-open
Parent AP Name : APFC58.9A15.C964
Parent AP MAC : 00:99:9A:15:DE:4C
Uplink State : CONNECTED
Auth Type : OPEN
Dot11 type : 11ax
Channel : 100
Bandwidth : 20 MHz
Current Datarate (Tx/Rx) : 86/86 Mbps
Max Datarate : 143 Mbps
RSSI : 53
IP : 192.168.1.101/24
Default Gateway : 192.168.1.1
IPV6 : ::/128
Assoc timeout : 100 Msec
Auth timeout : 100 Msec
Dhcp timeout : 60 Sec

```

- uWGB:

```

Device#show wgb dot11 associations
Uplink Radio ID : 1
Uplink Radio MAC : 00:09:00:01:00:01
SSID Name : roam-m44-open
Parent AP MAC : FC:58:9A:15:DE:4C
Uplink State : CONNECTED
Auth Type : OPEN
Uclient mac : 00:09:00:01:00:01
Current state : UWGB
Uclient timeout : 60 Sec
Dot11 type : 11ax
Channel : 36
Bandwidth : 20 MHz
Current Datarate (Tx/Rx) : 77/0 Mbps
Max Datarate : 143 Mbps
RSSI : 60
IP : 0.0.0.0
IPV6 : ::/128
Assoc timeout : 100 Msec
Auth timeout : 100 Msec
Dhcp timeout : 60 Sec

```

Syslog

Overview of syslog

Syslog is a common protocol; it sends event data logs to a central location for storing. However, Syslog currently supports only UDP mode. If you enable the debug command in WGB, it collects debug logs. All collected logs are sent to the syslog server are in the kernel facility and at the warning level.

Enable or disable WGB syslog

Use the **logging host enable** <server_ip> **UDP** command to enable WGB syslog.

```
Device#logging host enable <server_ip> UDP
```



Note Use the **logging host disable** <server_ip> **UDP** command to disable default WGB syslog.

Verify WGB syslog

Use the **show running-config** command to view current syslog configuration.

```
show running-config
```

Configure transmission rate with high throughput for WGB

When configuring WGB mode for moving deployments, you can manually configure the transmission rate limit using the high throughput (HT) modulation and coding scheme (MCS).

Example of WGB configuration with transmission rate of 802.11n HT m4. m5. rate:

Config dot11radio [1/2] 802.11ax disable

Config dot11radio [1/2] 802.11ac disable

Config dot11radio [1/2] speed ht-mcs m4. m5.



Note You can configure legacy rate using WGB.

Config dot11radio [1/2] speed legacy-rate basic-6.0 9.0 12.0 18.0 24.0

Both 802.11 management and control frames use legacy rates. The WGB's legacy rates should match or overlap with the AP's legacy rates; otherwise, the WGB association fails.

Use the **debug wgb dot11 rate** command to check WGB Tx MCS rate. Here is an example that shows the output of this command.

```
JWGB1#debug wgb dot11 rate
[*10/14/2023 03:16:08.6175]
[*10/14/2023 03:16:08.6175] 24:16:1B:F8:02:6E MAC Tx-Pkts Rx-Pkts Tx-Rate(Mbps) Rx-Rate(Mbps) RSSI Tx-Retries
JWGB1#[*10/14/2023 03:16:09.6179] 24:16:1B:F8:02:6E 332 330 3 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 0
[*10/14/2023 03:16:10.6183] 24:16:1B:F8:02:6E 327 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 25
[*10/14/2023 03:16:11.6187] 24:16:1B:F8:02:6E 327 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 18
[*10/14/2023 03:16:12.6190] 24:16:1B:F8:02:6E 330 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 13
[*10/14/2023 03:16:13.6194] 24:16:1B:F8:02:6E 333 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 21
[*10/14/2023 03:16:14.6198] 24:16:1B:F8:02:6E 331 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 16
[*10/14/2023 03:16:15.6202] 24:16:1B:F8:02:6E 328 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 24
[*10/14/2023 03:16:16.6206] 24:16:1B:F8:02:6E 330 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 21
[*10/14/2023 03:16:17.6210] 24:16:1B:F8:02:6E 332 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 22
[*10/14/2023 03:16:18.6214] 24:16:1B:F8:02:6E 327 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 22
[*10/14/2023 03:16:19.6218] 24:16:1B:F8:02:6E 333 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 18
[*10/14/2023 03:16:20.6221] 24:16:1B:F8:02:6E 330 2 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -71 17
[*10/14/2023 03:16:21.6258] 24:16:1B:F8:02:6E 328 3 HT-20,1SS,MCS5,(52) HT-20,1SS,MCS5,(52) -70 16
```

802.11v

Overview of 802.11v

802.11v is the wireless network management standard of the IEEE 802.11 family. It includes enhancements such as network-assisted roaming. This feature helps with load balancing and directs poorly connected clients to better APs.

Enhancement of roaming with 802.11v support

By adding 802.11v support to a WGB, WGB becomes capable of detecting an upcoming disconnection before it occurs. It then actively initiates a roam to select an appropriate AP from a list of neighboring APs. The WGB periodically checks for the latest neighbor APs to ensure optimal association during the next roam.

Basic service set transition request frame

The Basic Service Set (BSS) Transition Request frame includes channel information of neighboring APs. It helps in reducing roaming latency in environments with multiple channels by allowing scans of only those channels.

Disassociate the client on the AP using WLC

The WLC can disassociate a client based on factors such as load balance, RSSI value, and data rate on the AP side. This disassociation can be communicated to an 802.11v client. If the client does not re-associate with another AP within a configurable period, the disassociation occurs. You can enable the disassociation-imminent configuration on the WLC. This action activates the optional field within the BSS transition management request frame. For detailed information of 802.11v configuration on the WLC, see [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).

Use these commands to configure 802.11v support on WGB:

Enable 802.11v support on WGB

Use the **configure wgb mobile station interface dot11Radio <radio_slot_id> dot11v-bss-transition enable** command to enable 802.11v support on WGB. When you enable 802.11v support, WGB scans only the channels learned from neighbor list.

```
Device#configure wgb mobile station interface dot11Radio <radio_slot_id> dot11v-bss-transition enable
```



Note Use **configure wgb mobile station interface dot11Radio <radio_slot_id> dot11v-bss-transition disable** command to disable 802.11v support on WGB.

Configure BSS transition query interval

Use **configure wgb neighborlist-update-interval <1-900>** command to configure the time interval that WGB sends BSS transition query message to the parent AP.

```
Device# configure wgb neighborlist-update-interval <1-900>
```



Note The default value is 10 seconds and configure the time interval in seconds format.

Verify neighbor list

Use **show wgb dot11v bss-transition neighbour** command to check neighbor list received from associated AP.

```
Device#show wgb dot11v bss-transition neighbour
```

Verify channel list

Use **show wgb dot11v bss-transition channel** command to check channel list from dot11v neighbor, aux radio scanned, and residual channel scanned.

```
Device#show wgb dot11v bss-transition channel
```

Clear neighbor list

Use this command to clear neighbor list to provide error condition recovery.

```
Device#clear wgb dot11v bss-transition neighbor
```

Configure aux scanning

You can configure aux-scan mode as either scanning-only or handoff mode on WGB radio 2 (5 GHz) to improve roaming performance.

Overview of scanning-only mode

- The AP allows the radio to operate only for scanning purposes rather than providing client connectivity.
- The AP scans the wireless environment continuously to gather data on network performance, interference, rogue devices, and other critical metrics.

Scanning only mode

When slot 2 radio is configured as scanning only mode, slot 1 (5G) radio will always be picked as uplink. Slot 2 (5G) radio will keep scanning configured SSID based on the channel list. By default, the channel list contains all supported 5G channels (based on reg domain). The scanning list can be configured manually or learned by 802.11v.

When roaming is triggered, the algorithm looks for candidates from scanning table and skips scanning phase if the table is not empty. WGB then makes an association to that candidate AP.

Configure scanning only mode

Use the **configure dot11Radio 2 mode scan only** command to configure scanning only mode.

```
Device#configure dot11Radio 2 mode scan only
```

Manually configure the channel list

Use the **configure wgb mobile station interface dot11Radio 1 scan <channel> add** command to manually add the channel to the channel list.

```
Device#configure wgb mobile station interface dot11Radio 1 scan <channel> [add|delete]
```



Note Use the **configure wgb mobile station interface dot11Radio 1 scan <channel> delete** command to manually delete the channel from the channel list.

Configure scanning table timer

Use the **configure wgb scan radio 2 timeout1500** command to adjust the timer. By default, candidate AP entries in scanning table are automatically removed in 1200 ms.

```
Device#configure wgb scan radio 2 timeout 1500
```



Note

- Scanning AP expire time is from 1 to 5000.
- From the scanning table, the AP selects the candidate with the best RSSI value. However, sometimes the RSSI values might not be updated and it lead to roaming failures.

Verify scanning table

Use **show wgb scan** command to verify the scanning table.

```
Device#show wgb scan
Best AP expire time: 5000 ms

*****[ AP List ]*****
BSSID          RSSI    CHANNEL    Time
FC:58:9A:15:E2:4F    84      136      1531
FC:58:9A:15:DE:4F    37      136       41

*****[ Best AP ]*****
BSSID          RSSI    CHANNEL    Time
FC:58:9A:15:DE:4F    37      136       41
```

Aux-Scan Handoff mode

When you configure the radio 2 in the handoff mode, both radio 1 and radio 2 can serve as uplink connections. While one radio maintains the wireless uplink, and the other scans the channels. You can manually configure the scanning list, or it can be automatically learned using the 802.11v standard.

Radio roles

The radio 2 shares the same MAC address with the radio 1 and supports scanning, association, and data serving. Both radios can work either as **serving** or **scanning** role. After each roaming event, the roles and traffic automatically switch between radio 1 and radio 2.

Roaming of AP

When roaming is triggered, the system algorithm checks the scanning database for the best AP to establish a connection. WGB always uses the radio in the scanning role to complete the roaming association with the new AP. This configuration helps in improving the roaming interruption from 20 to 50 milliseconds.

Here is an example of aux-scan handoff radio mode configuration on IW9165E:

Slot 0 (2.4 G)	Slot 1 (5G)	Slot 2 (5G only)	Slot 3 (scanning radio)
N/A	WGB	Scan handoff	N/A

Here's a table that shows how long roaming interruptions last for different methods when using three different modes:

Roaming interruption time	Normal channel setting	Aux-Scan only	Aux-Scan Handoff
Scanning	$(40+20)*3=180$ ms	0-40 ms	0 ms
Association	30-80 ms	30-80 ms	20-50 ms
Total	~210 ms	70-120 ms	20-50 ms

Configure radio 2 as Aux-Scan Handoff mode

Use the **configure dot11Radio 2 mode scan handoff** command to configure the WGB slot2 radio to aux-scan mode:

```
Device#configure dot11Radio 2 mode scan handoff
```

Verify radio configuration

Use the **show run** command to view the radio configuration.

```
Device#show run
...
Radio Id                : 1
  Admin state            : ENABLED
  Mode                   : WGB
  Spatial Stream         : 1
  Guard Interval         : 800 ns
  Dot11 type             : 11n
  11v BSS-Neighbor       : Disabled
  A-MPDU priority        : 0x3f
  A-MPDU subframe number : 12
  RTS Protection         : 2347 (default)
  Rx-SOP Threshold       : AUTO
  Radio profile          : Default
  Encryption mode        : AES128
Radio Id                : 2
  Admin state            : ENABLED
  Mode                   : SCAN - Handoff
  Spatial Stream         : 1
  Guard Interval         : 800 ns
  Dot11 type             : 11n
  11v BSS-Neighbor       : Disabled
  A-MPDU priority        : 0x3f
  A-MPDU subframe number : 12
  RTS Protection         : 2347 (default)
```

```

Rx-SOP Threshold      : AUTO
Radio profile         : Default

```

Verify WGB scan

Use the **show wgb scan** command to view the current role of each radio and the results of aux scanning.

```

Device#show wgb scan
Best AP expire time: 2500 ms

Aux Scanning Radio Results (slot 2)
*****[ AP List ]*****
BSSID          RSSI    CHANNEL  Time
FC:58:9A:15:DE:4E    54      153      57
FC:58:9A:15:E2:4E    71      153      64

*****[ Best AP ]*****
BSSID          RSSI    CHANNEL  Time
FC:58:9A:15:DE:4E    54      153      57

Aux Serving Radio Results
*****[ AP List ]*****
BSSID          RSSI    CHANNEL  Time
FC:58:9A:15:DE:4E    58      153      57
FC:58:9A:15:E2:4E    75      153     133

*****[ Best AP ]*****
BSSID          RSSI    CHANNEL  Time
FC:58:9A:15:DE:4E    58      153      57

```

Optimized roaming with dual-radio WGB

From the Cisco IOS-XE 17.15.1 release, devices with dual-radio configurations have improved roaming efficiency. Roaming is triggered due to continuous missing beacon frames or maximum packet retries. The second radio allows the WGB to skip the scanning phase and directly check the scanning table for potential APs. This process reduces service downtime.

Trigger factors for roaming

Roaming is triggered in these events:

- Low RSSI: Measures the power level that a wireless device, such as an AP, receives from a signal. Use RSSI values to determine the quality of the wireless connection to troubleshoot and optimize wireless networks.
- Beacon miss-count: Indicates the number of consecutive beacon frames that a client device has missed from an AP in a wireless network.
- Maximum packet retries: Specifies the maximum number of times a data packet can be retransmitted if the client device does not send an acknowledgement.

Configure dual-radio

Here are the possible configurations for the IW9167E AP in a dual-radio setup:

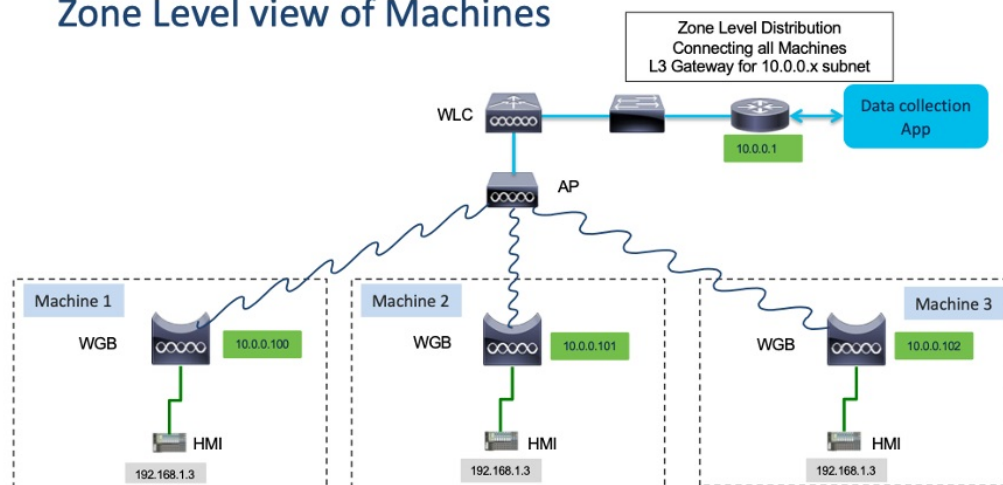
Dual-radio	AP
5 GHz radio 1 + radio 2 (scanning only mode)	IW9165E
5 GHz radio 1 + radio 2 (aux-scan handoff mode)	

Configuring Layer 2 NAT

One-to-one (1:1) Layer 2 NAT is a service that allows the assignment of a unique public IP address to an existing private IP address (end device), so that the end device can communicate with public network. Layer 2 NAT has two translation tables where private-to-public and public-to-private subnet translations can be defined.

In the industrial scenario where the same firmware is programmed to every HMI (customer machine, such as a Robot), firmware duplication across machines means IP address is reused across HMIs. This feature solves the problem of multiple end devices with the same duplicated IP addresses in the industrial network communicating with the public network.

Zone Level view of Machines



The following table provides the commands to configure Layer 2 NAT:

Table 2: Layer 2 NAT Configuration Commands

Command	Description
<code>#configure l2nat {enable disable}</code>	Enables or disables L2 NAT.
<code>#configure l2nat default-vlan <vlan_id></code>	Specifies the default vlan where all NAT rules will be applied. If <i>vlan_id</i> is not specified, all NAT rules will be applied to vlan 0.

Command	Description
#configure l2nat {add delete} inside from host <original_ip_addr> to <translated_ip_addr>	Adds or deletes a NAT rule which translates a private IP address to a public IP address. • <i>original_ip_addr</i>—Private IP address of the wired client connected to WGB Ethernet port. • <i>translated_ip_addr</i>—Public IP address that represents the wired client at public network.
#configure l2nat {add delete} outside from host <original_ip_addr> to <translated_ip_addr>	Adds or deletes a NAT rule which translates a public IP address to a private IP address. • <i>original_ip_addr</i>—Public IP address of an outside network host. • <i>translated_ip_addr</i>—Private IP address which represents the outside network host at private network.
#configure l2nat {add delete} inside from network <original_nw_prefix> to <translated_nw_prefix> <subnet_mask>	Adds or deletes a NAT rule which translates a private IP address subnet to a public IP address subnet. • <i>original_nw_prefix</i>—Private IP network prefix. • <i>translated_nw_prefix</i>—Public IP network prefix.
#configure l2nat {add delete} outside from network <original_nw_prefix> to <translated_nw_prefix> <subnet_mask>	Adds or deletes a NAT rule which translates a public IP address subnet to a private IP address subnet. • <i>original_nw_prefix</i>—Public IP network prefix. • <i>translated_nw_prefix</i>—Private IP network prefix.

The following table provides the show and debug commands to verify and troubleshoot your Layer 2 NAT configuration:

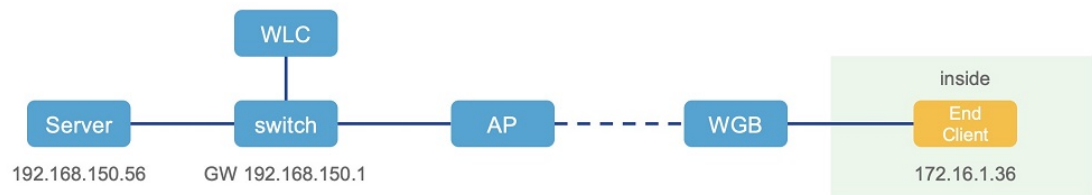
Table 3: Layer 2 NAT Show and Debug Commands

Command	Description
#show l2nat entry	Displays the Layer 2 NAT running entries.
#show l2nat config	Displays the Layer 2 NAT configuration details.
#show l2nat stats	Displays the Layer 2 NAT packet translation statistics.
#show l2nat rules	Displays the Layer 2 NAT rules from the configuration.
#clear l2nat statistics	Clears packet translation statistics.
#clear l2nat rule	Clears Layer 2 NAT rules.

Command	Description
<code>#clear l2nat config</code>	Clears Layer 2 NAT configuration.
<code>#debug l2nat</code>	Enables debugging of packet translation process.
<code>#debug l2nat all</code>	Prints out the NAT entry match result when a packet arrives. Caution This debug command may create overwhelming log print in console. Console may lose response because of this command, especially when Syslog service is enabled with a broadcast address.
<code>#undebug l2nat</code>	Disables debugging of packet translation process.

Configuration Example of Host IP Address Translation

In this scenario, the end client (172.16.1.36) connected to WGB needs to communicate with the server (192.168.150.56) connected to the gateway. Layer 2 NAT is configured to provide an address for the end client on the outside network (192.168.150.36) and an address for the server on the inside network (172.16.1.56).



The following table shows the configuration tasks for this scenario.

Command	Purpose
<code>#configure l2nat add inside from host 172.16.1.36 to 192.168.150.36</code> <code>#configure l2nat add outside from host 192.168.150.56 to 172.16.1.56</code>	Adds NAT rules to make inside client and outside server communicate with each other.
<code>#configure l2nat add inside from host 172.16.1.1 to 192.168.150.1</code> <code>#configure l2nat add inside from host 172.16.1.255 to 192.168.150.255</code>	Adds NAT for gateway and broadcast address.

The following show commands display your configuration.

- The following command displays the Layer 2 NAT configuration details. In the output, I2O means "inside to outside", and O2I means "outside to inside".

```

#show l2nat config
L2NAT Configuration are:
=====
Status: enabled
Default Vlan: 0

```

The Number of L2nat Rules: 4

Dir	Inside	Outside	Vlan
O2I	172.16.1.56	192.168.150.56	0
I2O	172.16.1.36	192.168.150.36	0
I2O	172.16.1.255	192.168.150.255	0
I2O	172.16.1.1	192.168.150.1	0

- The following command displays the Layer 2 NAT rules.

```
#show l2nat rule
```

Dir	Inside	Outside	Vlan
O2I	172.16.1.56	192.168.150.56	0
I2O	172.16.1.36	192.168.150.36	0
I2O	172.16.1.255	192.168.150.255	0
I2O	172.16.1.1	192.168.150.1	0

- The following command displays Layer 2 NAT running entries.

```
#show l2nat entry
```

Direction	Original	Substitute	Age	Reversed
inside-to-outside	172.16.1.36@0	192.168.150.36@0	-1	false
inside-to-outside	172.16.1.56@0	192.168.150.56@0	-1	true
inside-to-outside	172.16.1.1@0	192.168.150.1@0	-1	false
inside-to-outside	172.16.1.255@0	192.168.150.255@0	-1	false
outside-to-inside	192.168.150.36@0	172.16.1.36@0	-1	true
outside-to-inside	192.168.150.56@0	172.16.1.56@0	-1	false
outside-to-inside	192.168.150.1@0	172.16.1.1@0	-1	true
outside-to-inside	192.168.150.255@0	172.16.1.255@0	-1	true

- The following command displays the WGB wired clients over the bridge.

- Before Layer 2 NAT is enabled:

```
#show wgb bridge
```

```
***Client ip table entries***
```

mac	vap	port	vlan_id	seen_ip	confirm_ago	fast_brg
B8:AE:ED:7E:46:EB	0	wired0	0	172.16.1.36	0.360000	true
24:16:1B:F8:05:0F	0	wbridge1	0	0.0.0.0	3420.560000	true

- After Layer 2 NAT is enabled:

```
#show wgb bridge
```

```
***Client ip table entries***
```

mac	vap	port	vlan_id	seen_ip	confirm_ago	fast_brg
B8:AE:ED:7E:46:EB	0	wired0	0	192.168.150.36	0.440000	true
24:16:1B:F8:05:0F	0	wbridge1	0	0.0.0.0	3502.220000	true

If there are E2E traffic issues for wired client in NAT, restart the client register process by using the following command:

```
#clear wgb client single B8:AE:ED:7E:46:EB
```

- The following command displays the Layer 2 NAT packet translation statistics.

```
#show l2nat stats
```

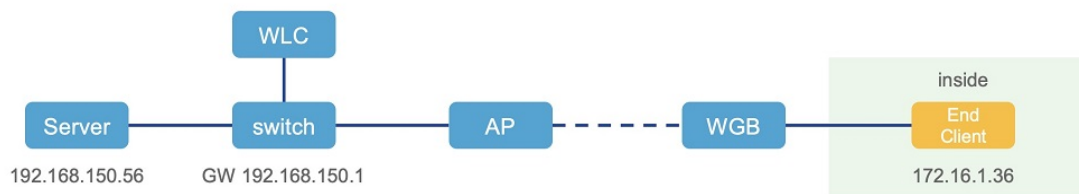
Direction	Original	Substitute	ARP	IP	ICMP	UDP	TCP
inside-to-outside	172.16.1.1@2660	192.168.150.1@2660	1	4	4	0	0
inside-to-outside	172.16.1.36@2660	192.168.150.36@2660	3	129	32	90	1
inside-to-outside	172.16.1.56@2660	192.168.150.56@2660	2	114	28	85	1
inside-to-outside	172.16.1.255@2660	192.168.150.255@2660	0	0	0	0	0
outside-to-inside	192.168.150.1@2660	172.16.1.1@2660	1	4	4	0	0
outside-to-inside	192.168.150.36@2660	172.16.1.36@2660	3	39	38	0	1
outside-to-inside	192.168.150.56@2660	172.16.1.56@2660	2	35	34	0	1
outside-to-inside	192.168.150.255@2660	172.16.1.255@2660	0	0	0	0	0

To reset statistics number, use the following command:

```
#clear l2nat stats
```

Configuration Example of Network Address Translation

In this scenario, Layer 2 NAT is configured to translate the inside addresses from 172.16.1.0 255.255.255.0 subnet to addresses in the 192.168.150.0 255.255.255.0 subnet. Only the network prefix will be replaced during the translation. The host bits of the IP address remain the same.



The following command is configured for this scenario:

```
#configure l2nat add inside from network 172.16.1.0 to 192.168.150.0 255.255.255.0
```

Configuring Native VLAN on Ethernet Ports

A typical deployment of WGB is that a single wired client connects directly to the WGB Ethernet port. As a result, wired client traffic must be on the same VLAN as the WGB (or WLC/AP/WGB) management VLAN. If you need the wired client traffic to be on a different VLAN other than the WGB management VLAN, you should configure native VLAN on the Ethernet port.



Note Configuring native VLAN ID per Ethernet port is not supported. Both Ethernet ports share the same native VLAN configuration.



Note When WGB broadcast tagging is enabled and a single wired passive client connects directly to the WGB Ethernet port, it may hit the issue that infrastructure DS side client fails to ping this WGB behind the passive client. The workaround is to configure the following additional commands: **configure wgb ethport native-vlan enable** and **configure wgb ethport native-vlan id X**, where X is the same VLAN as the WGB (or WLC/AP/WGB) management VLAN.

The following table provides the commands to configure native VLAN:

Table 4: Native VLAN Configuration Commands

Command	Description
#config wgb ethport native-vlan {enable disable} Example: #config wgb ethport native-vlan enable	Enables or disables native VLAN configuration.

Command	Description
#config wgb ethport native-vlan id <vlan-id> Example: #config wgb ethport native-vlan id 2735	Specifies native VLAN ID.

To verify your configuration, use the **show wgb ethport config** or **show running-config** command.

Low Latency Profile

IEEE 802.11 networks have a great role to play in supporting and deploying the Internet of Things (IoT) for the low latency and QoS requirement by applying the Enhanced Distributed Channel Access (EDCA), aggregated MAC protocol data unit (AMPDU), and aggregated or non-aggregated packet retry.

Enhanced Distributed Channel Access (EDCA) parameters are designed to provide preferential wireless channel access for voice, video, and other quality of service (QoS) traffic.

Configuring WGB optimized-video EDCA Profile

To configure optimized low latency profile for video use case, use the following command:

#configure dot11Radio <radio_slot_id> profile optimized-video {enable | disable}

Use the following command to verify the configuration:

```
WGB1#show controllers dot11Radio 1
EDCA profile: optimized-video
EDCA in use
=====
AC Type CwMin CwMax Aifs Txop ACM
AC_BE L 4 10 11 0 0
AC_BK L 6 10 11 0 0
AC_VI L 3 4 2 94 0
AC_VO L 2 3 1 47 0

Packet parameters in use
=====
wbridge1 A-MPDU Priority 0: Enabled
wbridge1 A-MPDU Priority 1: Enabled
wbridge1 A-MPDU Priority 2: Enabled
wbridge1 A-MPDU Priority 3: Enabled
wbridge1 A-MPDU Priority 4: Disabled
wbridge1 A-MPDU Priority 5: Disabled
wbridge1 A-MPDU Priority 6: Disabled
wbridge1 A-MPDU Priority 7: Disabled
wbridge1 A-MPDU subframe number: 3
wbridge1 Packet retries drop threshold: 16
```

Configuring WGB optimized-automation EDCA Profile

To configure optimized low latency profile for automation use case, use the following command:

#configure dot11Radio <radio_slot_id> profile optimized-automation {enable | disable}

Use the following command to verify the configuration:

```

WGB1#show controllers dot11Radio 1
EDCA profile: optimized-automation
EDCA in use
=====
AC Type CwMin CwMax Aifs Txop ACM
AC_BE L 7 10 12 0 0
AC_BK L 8 10 12 0 0
AC_VI L 7 7 3 0 0
AC_VO L 3 3 1 0 0

Packet parameters in use
=====
wbridge1 A-MPDU Priority 0: Enabled
wbridge1 A-MPDU Priority 1: Enabled
wbridge1 A-MPDU Priority 2: Enabled
wbridge1 A-MPDU Priority 3: Enabled
wbridge1 A-MPDU Priority 4: Disabled
wbridge1 A-MPDU Priority 5: Disabled
wbridge1 A-MPDU Priority 6: Disabled
wbridge1 A-MPDU Priority 7: Disabled
wbridge1 A-MPDU subframe number: 3
wbridge1 Packet retries drop threshold: 16

```

Configuring WGB customized-wmm EDCA profile

To configure customized Wi-Fi Multimedia (WMM) profile, use the following command:

```
#configure dot11Radio <radio_slot_id> profile customized-wmm {enable | disable}
```

To configure customized WMM profile parameters, use the following command:

```
#configure dot11Radio {0|1|2} wmm {be | vi | vo | bk} {cwmmin <cwmmin_num> | cwmax <cwmax_num> |
aifs <aifs_num> | txoplimit <txoplimit_num>}
```

Parameter descriptions:

- 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)
- aifs—Arbitration Inter-Frame Spacing, <1-15> in units of slot time
- cwmmin—Contention Window min, <0-15> 2^n-1 , in units of slot time
- cwmax—Contention Window max, <0-15> 2^n-1 , in units of slot time
- txoplimit—Transmission opportunity time, <0-255> integer number, in units of 32us

Configuring Low Latency Profile on WGB

Use the following command to configure low latency profile on WGB:

```
AP# configure dot11Radio <radio_slot_id> profile low-latency [ampdu <length>] [sifs-burst {enable |
disable}] [rts-cts {enable | disable}] [non-aggr <length>] [aggr <length>]
```

Use the following command to display iot-low-latency profile EDCA detailed parameters:

```
#show controllers dot11Radio 1 | beg EDCA
EDCA config
L: Local C:Cell A:Adaptive EDCA params
  AC   Type  CwMin  CwMax  Aifs  Txop  ACM
AC_BE  L      4      6     11    0     0
AC_BK  L      6     10    11    0     0
AC_VI  L      3      4      1    0     0
AC_VO  L      0      2      0    0     1
AC_BE  C      4     10    11    0     0
AC_BK  C      6     10    11    0     0
AC_VI  C      3      4      2   94    0
AC_VO  C      2      3      1   47    1
```

Configuring EDCA Parameters (Wireless Controller GUI)

Procedure

Step 1 Choose **Configuration > Radio Configurations > Parameters**. Using this page, you can configure global parameters for 6 GHz, 5 GHz, and 2.4 GHz radios.

Note

You cannot configure or modify parameters, if the radio network is enabled. Disable the network status on the **Configuration > Radio Configurations > Network** page before you proceed.

Step 2 In the **EDCA Parameters** section, choose an EDCA profile from the **EDCA Profile** drop-down list. Enhanced Distributed Channel Access (EDCA) parameters are designed to provide preferential wireless channel access for voice, video, and other quality-of-service (QoS) traffic.

[Configuration](#) > [Radio Configurations](#) > [Parameters](#)

6 GHz Band **5 GHz Band** 2.4 GHz Band

⚠ 5 GHz Network is operational. Configuring EDCA Profile, DFS Channel Switch Announcement will result in loss of connectivity of clients.

EDCA Parameters

EDCA Profile

iot-low-latency ▼
wmm-default
custom-voice
optimized-video-voice
optimized-voice
svp-voice
fastlane
iot-low-latency

Client Load Based Configuration

DFS (802.11h)

⚠ DTPC Support is enabled. Please do not change Power Constraints.

Step 3 Click **Apply**.

Configuring EDCA Parameters (Wireless Controller CLI)

Procedure

Step 1 Enters global configuration mode.

configure terminal

Example:

```
Device# configure terminal
```

Step 2 Disables the radio network.

ap dot11 {5ghz | 24ghz | 6ghz} shutdown

Example:

```
Device(config)# ap dot11 5ghz shutdown
```

Step 3 Enables iot-low-latency EDCA profile for the 5 GHz, 2.4 GHz, or 6 GHz network.

ap dot11 {5ghz | 24ghz | 6ghz} edca-parameters iot-low-latency

Example:

```
Device(config)# ap dot11 5ghz edca-parameters iot-low-latency
```

Step 4 Enables the radio network.

no ap dot11 {5ghz | 24ghz | 6ghz} shutdown

Example:

```
Device(config)# no ap dot11 5ghz shutdown
```

Step 5 Returns to privileged EXEC mode.

end

Example:

```
Device(config)# end
```

Step 6 Displays the current configuration.

show ap dot11 {5ghz | 24ghz | 6ghz} network

Example:

```
Device(config)# show ap dot11 5ghz network
EDCA profile type check           : iot-low-latency
```

Configuring A-MPDU

Aggregation is the process of grouping packet data frames together, rather than transmitting them separately. Two aggregation methods are available: Aggregated MAC Protocol Data Unit (A-MPDU) and Aggregated MAC Service Data Unit (A-MSDU).

The A-MPDU parameters define the size of an aggregated packet and define the proper spacing between aggregated packets so that the receive side WLAN station can decode the packet properly.

To configure profiled based A-MPDU under 2.4G, 5G and 6G radio, use the following commands:

```
WLC(config)# ap dot11 {5ghz | 24ghz | 6ghz} rf-profile <profile-name>
```

```
WLC(config-rf-profile)# [no] dot11n a-mpdu tx block-ack window-size <1-255>
```

Global configuration is a special profile which can also be configured by using the following command:

```
WLC(config)#[no] ap dot11 {5ghz | 24ghz | 6ghz} dot11n a-mpdu tx block-ack window-size <1-255>
```

To bind different RF profiles with the radio RF tag, use the following command:

```
WLC(config)# wireless tag rf <rf-tag-name>
```

```
WLC (config-wireless-rf-tag)# 5ghz-rf-policy <rf-profile-name>
```



Note RF profile level configured **a-mpdu tx block-ack window-size** value takes preference over globally configured value.

To display configured a-mpdu length value, use the following command:

```
# show controllers dot11Radio <radio_slot_id>
```

```
AP# show controllers dot11Radio 1
Radio Aggregation Config:
=====
```

```
TX A-MPDU Priority: 0x3f
TX A-MSDU Priority: 0x3f
TX A-MPDU Window: 0x7f
```

Configuring and Validating SNMP With WGB

Simple Network Management Protocol (SNMP) is an application-layer protocol that provides a message format for communication between SNMP managers and agents. SNMP provides a standardized framework and a common language that is used for monitoring and managing devices in a network.

WGBs provide network administrators with an SNMP interface, allowing them to poll various states and counters. This enables administrators to easily monitor the health of their WGBs in the field.

By default, SNMP is disabled.

The SNMP framework has the following components, which are as follows.

- **SNMP Manager** : The Simple Network Management Protocol (SNMP) manager is a system that controls and monitors the activities of network hosts using SNMP. The most common managing system is a network management system (NMS). The term NMS can be applied either to a dedicated device used for network management or to the applications used on such a device.

- **SNMP Agent:** The Simple Network Management Protocol (SNMP) agent is the software component within a managed device that maintains the data for the device and reports this data, as needed, to managing systems.
- **SNMP MIB:** An SNMP agent contains MIB variables, whose values the SNMP manager can request or change through Get or Set operations. A manager can get a value from an agent or store a value in that agent. The agent gathers data from the SNMP MIB, the repository for information about device parameters and network data. The agent can also respond to manager requests to get or set data.

The following illustration shows the SNMP process. SNMP agent receives a request from SNMP client, and it passes the request to the subagent. The subagent then returns a response to the SNMP agent and the agent creates an SNMP response packet and sends the response to the remote network management station that initiated the request.

Figure 3: SNMP Process



SNMP Versions

Cisco IOS software supports the following versions of SNMP:

- **SNMPv2c**—The community-string-based administrative framework for SNMPv2. SNMPv2c is an update of the protocol operations and data types of SNMPv2p (SNMPv2 classic), and uses the community-based security model of SNMPv1.
- **SNMPv3**—Version 3 of SNMP. SNMPv3 uses the following security features to provide secure access to devices:
 - **Message integrity**—Ensuring that a packet has not been tampered with in transit.
 - **Authentication**—Determining that the message is from a valid source.
 - **Encryption**—Scrambling the contents of a packet to prevent it from being learned by an unauthorized source.

Supported SNMP MIB File

The Management Information Base (MIB) is a database of the objects that can be managed on a device. The managed objects, or variables, can be set or read to provide information on the network devices and interfaces and are organized hierarchically. The MIB consists of collections of managed objects identified by object identifiers. MIBs are accessed using a network management protocol such as SNMP.

The MIB module provides network management information on IEEE 802.11 wireless device association management and data packet forwarding configuration and statistics.

An Object Identifier (OID) uniquely identifies a MIB object on a managed network device. The OID identifies the MIB object's location in the MIB hierarchy, and provides a means of accessing the MIB object in a network of managed devices.

Given below is a list of objects that are supported by the SNMP Management and Information Base (MIB): CISCO-DOT11-ASSOCIATION-MIB.

Table 5: Supported OIDs

OID Object Name	OID	OID Type	OID Description
cDot11ParentAddress	1.3.6.1.4.1.9.9.273.1.1.1	String	Provides the MAC address of the parent access point.
cDot11ActiveWirelessClients	1.3.6.1.4.1.9.9.273.1.1.2.1.1	Gauge	The device on this interface is currently associating with the number of wireless clients.
cDot11ActiveBridges	1.3.6.1.4.1.9.9.273.1.1.2.1.2	Gauge	The device on this interface is currently associating with the number of bridges.
cDot11ActiveRepeaters	1.3.6.1.4.1.9.9.273.1.1.2.1.3	Gauge	The device on the interface is currently associating with the number of repeaters.
cDot11AssStatsAssociated	1.3.6.1.4.1.9.9.273.1.1.3.1.1	Counter	When device restarts, the object counts the number of stations associated with the device on the interface.
cDot11AssStatsAuthenticated	1.3.6.1.4.1.9.9.273.1.1.3.1.2	Counter	When the device restarted, it currently counts the number of stations authenticated with the device on the interface.
cDot11AssStatsRoamedIn	1.3.6.1.4.1.9.9.273.1.1.3.1.3	Counter	When the device restarted, the object counts the number of stations roamed from another device to the device on the interface.

OID Object Name	OID	OID Type	OID Description
cDot11AssStatsRoamedAway	1.3.6.1.4.1.9.9.273.1.1.3.1.4	Counter	This object counts the number of stations roamed away from the device on the interface since device re-started.
cDot11AssStatsDeauthenticated	1.3.6.1.4.1.9.9.273.1.1.3.1.5	Counter	This object counts the number of stations deauthenticated with this device on the interface since device re-started
cDot11AssStatsDisassociated	1.3.6.1.4.1.9.9.273.1.1.3.1.6	Counter	This object counts the number of stations disassociated with this device on the interface since device re-started
cd11IfCipherMicFailClientAddress	1.3.6.1.4.1.9.9.273.1.1.4.1.1	String	This is MAC address of the client attached to the radio interface that caused the most recent MIC failure
cd11IfCipherTkipLocalMicFailures	1.3.6.1.4.1.9.9.273.1.1.4.1.2	Counter	When the device restarted, the object counts the number of MIC failures encountered on the radio interface.
cd11IfCipherTkipRemotMicFailures	1.3.6.1.4.1.9.9.273.1.1.4.1.3	Counter	When the device restarted, the object counts the number of MIC failures reported by clients on the radio interface.

OID Object Name	OID	OID Type	OID Description
cd11IfCipherTkipCounterMeasInvok	1.3.6.1.4.1.9.9.273.1.1.4.1.4	Counter	When the device restarted, the object counts the number of TKIP Counter Measures invoked on the interface.
cd11IfCipherCcmpReplaysDiscarded	1.3.6.1.4.1.9.9.273.1.1.4.1.5	Counter	When the device restarted, the object counts the number of received unicast fragments discarded by replay mechanism on the interface.
cd11IfCipherTkipReplaysDetected	1.3.6.1.4.1.9.9.273.1.1.4.1.6		When the device restarted, the object counts the number of TKIP replay errors detected on this interface.
cDot11ClientRoleClassType	1.3.6.1.4.1.9.9.273.1.2.1.1.3	Counter	The role classification of the client
cDot11ClientDevType	1.3.6.1.4.1.9.9.273.1.2.1.1.4	EnumVal	The device type of the client.
cDot11ClientRadioType	1.3.6.1.4.1.9.9.273.1.2.1.1.5	EnumVal	The radio classification of the client.
cDot11ClientWepEnabled	1.3.6.1.4.1.9.9.273.1.2.1.1.6	EnumVal	Whether WEP key mechanism is used for transmitting frames of data for the client
cDot11ClientWepKeyMixEnabled	1.3.6.1.4.1.9.9.273.1.2.1.1.7	EnumVal	Whether this client is using WEP key mixing
cDot11ClientMicEnabled	1.3.6.1.4.1.9.9.273.1.2.1.1.8	EnumVal	Whether the MIC is enabled for the client
cDot11ClientPowerSaveMode	1.3.6.1.4.1.9.9.273.1.2.1.1.9	EnumVal	The power management mode of the client.

OID Object Name	OID	OID Type	OID Description
cDot11ClientAid	1.3.6.1.4.1.99.273.1.2.1.1.10	Gauge	This is the association identification number of clients or multicast addresses associating with the device.
cDot11ClientDataRateSet	1.3.6.1.4.1.99.273.1.2.1.1.11	String	Is a set of data rates at which this client can transmit and receive data
cDot11ClientSoftwareVersion	1.3.6.1.4.1.99.273.1.2.1.1.12	String	Cisco IOS software version
cDot11ClientName	1.3.6.1.4.1.99.273.1.2.1.1.13	String	Cisco IOS device hostname
cDot11ClientAssociationState	1.3.6.1.4.1.99.273.1.2.1.1.14	EnumVal	The object indicates the state of the authentication and association process
cDot11ClientVlanId	1.3.6.1.4.1.99.273.1.2.1.1.17	Gauge	The VLAN which the wireless client is assigned to when it is successfully associated to the wireless station.
cDot11ClientSubIfIndex	1.3.6.1.4.1.99.273.1.2.1.1.18	Integer	This is the ifIndex of the sub-interface which this wireless client is assigned to when it is successfully associated to the wireless station.
cDot11ClientAuthenAlgorithm	1.3.6.1.4.1.99.273.1.2.1.1.19	EnumVal	The IEEE 802.1x authentication methods performed between the wireless station and this client during association

OID Object Name	OID	OID Type	OID Description
cDot11ClientDot1xAuthenAlgorithm	1.3.6.1.4.1.99.273.1.2.1.1.21	Octet String	The IEEE 802.1x authentication methods performed between the wireless client and the authentication server.
cDot11ClientUpTime	1.3.6.1.4.1.99.273.1.3.1.1.2	Gauge	The time in seconds that this client has been associated with this device
cDot11ClientSignalStrength	1.3.6.1.4.1.99.273.1.3.1.1.3	Integer	The device-dependent measure the signal strength of the most recently received packet from the client.
cDot11ClientSigQuality	1.3.6.1.4.1.99.273.1.3.1.1.4	Gauge	The device-dependent measure the signal quality of the most recently received packet from the client.
cDot11ClientPacketsReceived	1.3.6.1.4.1.99.273.1.3.1.1.6	Counter	The number of packets received from this client.
cDot11ClientBytesReceived	1.3.6.1.4.1.99.273.1.3.1.1.7	Counter	The number of bytes received from the client.
cDot11ClientPacketsSent	1.3.6.1.4.1.99.273.1.3.1.1.8	Counter	The number of packets sent to the client.
cDot11ClientBytesSent	1.3.6.1.4.1.99.273.1.3.1.1.9	Counter	The number of bytes sent to the client.
cDot11ClientMsduRetries	1.3.6.1.4.1.99.273.1.3.1.1.11	Counter	The counter increases when it successfully transmits an MSDU after one or more retransmissions.

OID Object Name	OID	OID Type	OID Description
cDot11ClientMsduFails	1.3.6.1.4.1.9.9.273.1.3.1.1.12	Counter	The counter increments when the client fails to transmit an MSDU successfully because the number of transmit attempts exceeds a certain limit.

Configuring SNMP from the WGB CLI

The following CLI commands are used for SNMP configuration.



Note

- SNMP CLI logic modified for SNMP configuration, all parameters of SNMP are required to be configured before enable SNMP feature by CLI: configure snmp enabled.
- All the related configurations of SNMP will be removed automatically when disable SNMP feature.

Procedure

Step 1 Enter the **SNMP v2c community ID** number (SNMP v2c only).

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

Step 2 Specify the **SNMP protocol version**.

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

Step 3 Specify the **SNMP v3 authentication** protocol (SNMP v3 only).

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

Step 4 Enter the **SNMP v3 username** (SNMP v3 only).

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

Step 5 Enter the **SNMP v3 user password** (SNMP v3 only).

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

Step 6 Specify the **SNMP v3 encryption protocol** (SNMP v3 only).

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

Note

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

Step 7 Enter the **SNMP v3 encryption passphrase** (SNMP v3 only).

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

Step 8 **Enable SNMP** functionality in WGB.

Device#**configure snmp enabled**

To configure **SNMP v2c**, repeat Step 1 through Step 2 and Step 8.

To configure **SNMP v3**, repeat Step 2 through Step 8.

Step 9 **Disable SNMP configuration.**

Device#**configure snmp disabled**

When SNMP is disabled, all related configuration is removed.

Example

Example of SNMP configuration.

- **CLI for configuring SNMP v2c:**

```
Device#configure snmp v2 community-id <length 1-64>
Device#configure snmp version v2c
Device#configure snmp enabled
```

- **CLI for configuring SNMP v3 (security level AuthPriv):**

```
Device#configure snmp auth-method <md5|sha>
Device#configure snmp v3 username <length 32>
Device#configure snmp v3 password <length 8-64>
Device#configure snmp secret <length 8-64>
Device#configure snmp encryption <aes|des>
Device#configure snmp version v3
Device#configure snmp enabled
```

- **CLI for configuring SNMP v3 (security level AuthNoPriv):**

```
Device#configure snmp auth-method <md5|sha>
Device#configure snmp v3 username <length 32>
Device#configure snmp v3 password <length 8-64>
Device#configure snmp encryption none
Device#configure snmp version v3
Device#configure snmp enabled
```

Verifying SNMP from WGB CLI

Use the following show command to verify the SNMP configuration.

- **Show output of SNMP version v3:**

```
Device# show snmp
SNMP: enabled
Version: v3
Community ID: test
Username: username
Password: password
```

```
Authentication method: SHA
Encryption: AES
Encryption Passphrase: passphrase
Engine ID: 0x8000000903c0f87fe5f314
```

- **Show output of SNMP version v2c:**

```
Device# show snmp
SNMP: enabled
Version: v2c
Community ID: test
Username: username
Password: password
Authentication method: SHA
Encryption: AES
Encryption Passphrase: passphrase
Engine ID: 0x8000000903c0f87fe5f314
```

Support for QoS ACL Classification and Marking

Starting from Cisco Unified Industrial Wireless Software Release 17.14.1, WGB allows you to classify different packets from two wired ports and mark them to the different access control driver queues according to the user configuration.

In addition to TCP or UDP, WGB also supports ethertype-based and DSCP-based classification. To meet the jitter and latency requirement, the WGB must classify packets and assign them to different access control queues based on the field environment.

Overview

WGB allows you to create custom rules to map incoming packets from an Ethernet port to specific priority queues on the wireless side. WGB offers the functionality to map upstream data traffic based on either IEEE 802.1p (dot1p) or Differentiated Services Code Point (DSCP).

You can configure the rules based on Ethernet type (for example, Profinet), transport layer port numbers or port range, and DSCP. It ensures forwarding packets to the different access control queues on the wireless network, facilitating efficient QoS enforcement.

As incoming packets arrive at the Ethernet port, it directs them to a specific access control queue on the wireless side using a customized rule-based mapping.

The customized rule dictates the classification and assignment of packets to different access control queues based on predetermined criteria such as source/destination IP addresses, port numbers, or protocol types. Once defined, the rules identify critical services or traffic within the incoming packets. Matching these critical services using the defined rules enables mapping them to higher priority queues within the network infrastructure.

Using rule-based traffic classification and mapping on the WGB, you can effectively manage and prioritize network traffic to meet the specific demands of critical applications and services. This approach enables you to enforce QoS policies effectively within your network to maintain optimal network performance, minimizes latency for critical services, and enhances overall user experience.

Traffic Classification Based on QoS and ACL

Classification is the process of distinguishing one traffic from another by examining the fields in the packet. The device enables classification only when QoS is enabled.

During classification, the device performs a lookup and assigns a QoS label to the packet. The QoS label indicates all QoS actions to perform on the packet and identifies the queue from which the packet is sent.

Layer 2 ethernet frames use the Ethertype field to carry classification information. The ethertype field, typically 2 bytes in size, normally indicates the type of data encapsulated in the frames

Layer 3 IP packets carry the classification information in the type of service (ToS) field that has 8 bits. The ToS field carries either an IP precedence value or a Differentiated Services Code Point (DSCP) value. IP precedence values range 0–7. DSCP values range 0–63.

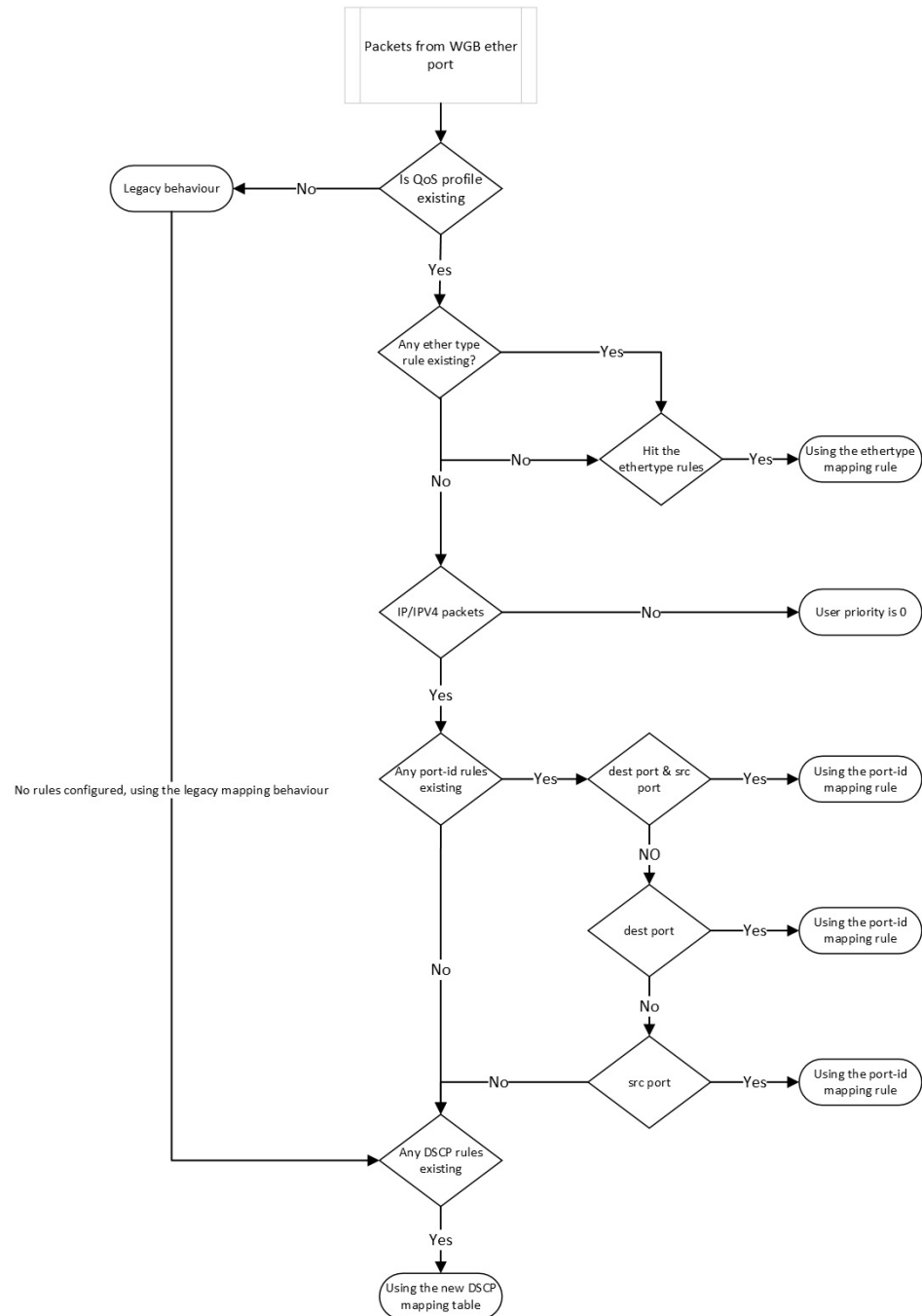
Layer 4 TCP segments or UDP datagrams carry the classification information in the source or destination port field. These port fields specify the port numbers associated with the sender and receiver of the data, enabling networking devices to classify traffic based on predetermined criteria.

The system assigns traffic to a specific service class based on ether type, DSCP, or UDP/TCP port (or port range), treating packets within the service class consistently. The WGB help to classify different packets from the two wired ports and map them to the different driver queues according to the user config.

The data plane statistics provide counts of how many times each rule hit by network traffic. These counters are essential for network administrators to analyse the effectiveness of their rules and policies, and optimize network performance.

The control plane is a part of a network architecture responsible for managing and configuring how data is forwarded through the network.

Figure 4: Flowchart of traffic flows from WGB ethernet port



When QoS is disabled, access points follows the legacy mapping behavior and perform the following:

1. Retrieve the Tag Control Information (TCI) priority from the VLAN element for the specified ethertype 0x8100.
2. For ethertype 0x8892 (profinet) QoS mapping, assigns the TCI priority as 6.

- For ethertype 0x0800 (IP) and 0x86DD (IPv6), the DSCP priority is set according to the default dscp2dot1p mapping table.

```

===== dscp mapping =====
Default dscp2dot1p Table Value:
[0]->0 [1]->0 [2]->0 [3]->0 [4]->0 [5]->0 [6]->0 [7]->0
[8]->1 [9]->1 [10]->1 [11]->1 [12]->1 [13]->1 [14]->1 [15]->1
[16]->2 [17]->2 [18]->2 [19]->2 [20]->2 [21]->2 [22]->2 [23]->2
[24]->3 [25]->3 [26]->3 [27]->3 [28]->3 [29]->3 [30]->3 [31]->3
[32]->4 [33]->4 [34]->4 [35]->4 [36]->4 [37]->4 [38]->4 [39]->4
[40]->5 [41]->5 [42]->5 [43]->5 [44]->5 [45]->5 [46]->5 [47]->5
[48]->6 [49]->6 [50]->6 [51]->6 [52]->6 [53]->6 [54]->6 [55]->6
[56]->7 [57]->7 [58]->7 [59]->7 [60]->7 [61]->7 [62]->7 [63]->7

```

When QoS is enabled, access points perform the following:

- The priority for an ethertype QoS mapping 0x8892 (profinet) is based on the configuration setting.
- For ethertype 0x0800 (IP) and 0x86DD (IPv6), the priority is based on mapping rules that consider port or DSCP.
 - Check the UDP/TCP port (or port range) rule.
 - Check the DSCP rule.
- Assigns the user priority value 0 to non-IPv4/IPv6 packets.
- If there is no rule configuration, the QoS profile follows the legacy mapping behavior.



Note if 802.1p priority exists, it overrides any customised rule.

Configuring Quality of Service Mapping Profile

The following commands allow users to define the different classification rules for configuring WGB QoS mapping.

Procedure

- Step 1** Enable the QoS mapping profile.

```
Device#config wgb qos-mapping <profile-name> enable
```

Example:

```
Device#configure wgb qos-mapping demo-profile enable
```

- Step 2** WGB QoS mapping profile rules based on **ethernet type**.

The below command is used to set the rules based on ethernet frame type.

- Add rules based on ethernet type.

```
Device#config wgb qos-mapping <profile-name> add ethtype hex <number> priority <0-7>
```

Example:

```
Device#configure wgb qos-mapping demo-profile add ethtype hex 8892 priority 5
```

If the command specifies a profile that does not exist, the command will create a new empty profile and then add mapping rule to it.

- Delete rules based on ethernet type

```
Device#config wgb qos-mapping <profile-name> delete ethtype hex <number>
```

Example:

```
Device#configure wgb qos-mapping demo-profile delete ethtype hex 8892
```

The command will issue a warning message if it specifies a profile that does not exist. Furthermore, if deleting the specified mapping rule leaves the profile empty, it will be automatically removed.

Step 3

Rules based on **port-id/range**.

The below command is used to set the rules based on L4 port id/range.

- Add rules based on port-id/range.

```
Device#config wgb qos-mapping <profile-name> add srcport <number> | <range <start-number>  
<end-number>> [dstport <number> | <range <start-number> <end-number>>] priority <0-7>
```

Example:

```
Device#configure wgb qos-mapping demo-profile add srcport range 5050 5070 dstport 8000 priority 3
```

If the command specifies a profile that does not exist, the command will create a new empty profile and then add mapping rule to it.

- Delete rules based on port-id/range.

```
Device#config wgb qos-mapping <profile-name> delete [srcport <number> | <range <start-number>  
<end-number>> [dstport <number> | <range <start-number> <end-number>>]]
```

Example:

```
Device#configure wgb qos-mapping demo-profile delete srcport range 5050 5070 dstport 8000
```

The command will issue a warning message if it specifies a profile that does not exist. Furthermore, if deleting the specified mapping rule leaves the profile empty, it will be automatically removed.

Step 4

Rules based on **DSCP**.

The below command is used to set the rules based on IPv4/IPv6 packet DSCP value.

- Add

```
Device#config wgb qos-mapping <profile-name> add dscp <number> priority <0-7>
```

Example:

```
Device#configure wgb qos-mapping demo-profile add dscp 63 priority 4
```

If the command specifies a profile that does not exist, the command will create a new empty profile and then add mapping rule to it.

- Delete

```
Device#config wgb qos-mapping <profile-name> delete dscp <number> priority <0-7>
```

Example:

```
Device#configure wgb qos-mapping demo-profile delete dscp 63
```

The command will issue a warning message if it specifies a profile that does not exist. Furthermore, if deleting the specified mapping rule leaves the profile empty, it will be automatically removed.

Note

After deleting the DSCP mapping rule, the rules are reset to the default values of the DSCP mapping.

Step 5 Disable the QoS mapping profile.

```
Device#config wgb qos-mapping <profile-name> disable
```

Example:

```
Device#configure wgb qos-mapping demo-profile disable
```

When disabled, the command clear the profile from the datapath and retain it in the WGB configuration file. If the specified profile does not exist, the command issue a warning message and will not create a new empty profile.

Step 6 Delete the QoS mapping profile.

```
Device#config wgb qos-mapping <profile-name> delete
```

Example:

```
Device#configure wgb qos-mapping demo-profile delete
```

When deleted, the profile is removed from data path and WGB configuration.

Verifying WGB Quality of Service Mapping

To verify the WGB QoS mapping configuration on the Control Plane, run the **show wgb qos-mapping**.

```
Device# show wgb qos-mapping
```

```
Number of QoS Mapping Profiles: 2
=====
Profile name : qos1
Profile status : active
Number of Rules: 8
Rules:
L4 srcport : 31000-31100, dstport : 6666-7777, priority : 7
L4 srcport : 23000, dstport : N/A, priority : 3
L4 srcport : N/A, dstport : 20000-20100, priority : 5
L4 srcport : N/A, dstport : 2222, priority : 2
L4 srcport : 12300-12500, dstport : N/A, priority : 6
IPv4/IPv6 dscp: 43, priority : 1
Ethernet type : 0x8892, priority : 0
L4 srcport : 8888, dstport : 9999, priority : 4

Profile name : qos2
Profile status : inactive
Number of Rules: 8
Rules:
L4 srcport : 31000-31100, dstport : 6666-7777, priority : 2
L4 srcport : 23000, dstport : N/A, priority : 6
L4 srcport : N/A, dstport : 20000-20100, priority : 4
L4 srcport : N/A, dstport : 2222, priority : 7
L4 srcport : 12300-12500, dstport : N/A, priority : 3
```

```
IPv4/IPv6 dscp: 43, priority : 0
Ethernet type : 0x8892, priority : 1
L4 srcport : 8888, dstport : 9999, priority : 5
```

To verify the WGB QoS mapping configuration on the Data Plane, run the **show datapath qos-mapping rule**.

```
Device# show datapath qos-mapping rule
```

```
Status: active
QoS Mapping entries
===== dscp mapping =====
Default dscp2dot1p Table Value:
[0]->0 [1]->0 [2]->0 [3]->0 [4]->0 [5]->0 [6]->0 [7]->0
[8]->1 [9]->1 [10]->1 [11]->1 [12]->1 [13]->1 [14]->1 [15]->1
[16]->2 [17]->2 [18]->2 [19]->2 [20]->2 [21]->2 [22]->2 [23]->2
[24]->3 [25]->3 [26]->3 [27]->3 [28]->3 [29]->3 [30]->3 [31]->3
[32]->4 [33]->4 [34]->4 [35]->4 [36]->4 [37]->4 [38]->4 [39]->4
[40]->5 [41]->5 [42]->5 [43]->5 [44]->5 [45]->5 [46]->5 [47]->5
[48]->6 [49]->6 [50]->6 [51]->6 [52]->6 [53]->6 [54]->6 [55]->6
[56]->7 [57]->7 [58]->7 [59]->7 [60]->7 [61]->7 [62]->7 [63]->7

active dscp2dot1p Table Value:
[0]->0 [1]->0 [2]->0 [3]->0 [4]->0 [5]->0 [6]->0 [7]->0
[8]->1 [9]->1 [10]->1 [11]->1 [12]->1 [13]->1 [14]->1 [15]->1
[16]->7 [17]->2 [18]->2 [19]->2 [20]->2 [21]->2 [22]->2 [23]->2
[24]->3 [25]->3 [26]->3 [27]->3 [28]->3 [29]->3 [30]->3 [31]->3
[32]->4 [33]->4 [34]->4 [35]->4 [36]->4 [37]->4 [38]->4 [39]->4
[40]->5 [41]->5 [42]->5 [43]->5 [44]->5 [45]->5 [46]->5 [47]->5
[48]->6 [49]->6 [50]->6 [51]->6 [52]->6 [53]->6 [54]->6 [55]->6
[56]->7 [57]->7 [58]->7 [59]->7 [60]->7 [61]->7 [62]->7 [63]->7
```

To verify the WGB QoS mapping statistics on Data Plane, run the **show datapath qos-mapping statistics** command.

```
Device# show datapath qos-mapping statistics
```

```
===== pkt stats per dscp-mapping rule =====
dscp up   pkt_cnt
16 7 0
```

To clear the WGB QoS mapping statistics on Data Plane, run the **clear datapath qos-mapping statistics** command.



Note The command clears packet count statistics per rule on data-plane.

Packet Capture: TCP Dump on WGB

TCP Dump on WGB

The TCP dump utility is a network packet analyzer commonly used for network monitoring and data acquisition. When applied to a WGB, the TCP dump can capture, display, and save the packets transmitted over the wired interfaces of the WGB.

TCP Dump on WGB chapter provides information on how to enable TCP dump through the WGB wired interface on the Catalyst IW9165E.

Purpose of TCP Dump Utility

TCP dump on a WGB monitors and troubleshoots network communications, ensuring the WGB relays frames correctly between the wired clients and the wireless networks.

Functions of TCP Dump Utility

- display captured packets in real time on the WGB terminal, and
- capture packets to storage.



Note The TCP dump utility does not support the simultaneous capture of packets to storage and printing them on the WGB terminal.

Packet Capture Modes

- Default: Displays captured packets with header in the real time on the WGB terminal
- Verbose: Parses and prints real-time packets on the WGB terminal, displaying the headers and prints the data of each packet, including its link-level header, in hexadecimal format.



Note Reformat the verbose output for text2pcap compatibility.

In default or verbose mode, the WGB terminal can print a maximum of 1000 packet entries.

- Capture: Captures packets to a file storage instead of printing them in real time. Use the **show pcap** command to view the captured internal wired packets.



Note Every round of Packet Capture (PCAP) clears the existing PCAP file.

Before any new PCAP session, transfer the current PCAP file to an external server to prevent it from being overwritten.

PCAP stops automatically when the PCAP file reaches a size of 100 MB.

Protocol Packet Capture Capabilities on WGB

You can capture packets from an AP either using a default or custom filter through the WGB wired port and then upload them to an external server.

The default filter captures three main protocol packets such as IP, TCP, or UDP.

A custom filter captures specific packets that are relevant for troubleshooting specific issues or monitoring certain types of network activity.

You can use different protocol filters to capture packets for debugging. For instance, include the given protocols in your filter expression:

- Transmission Control Protocol
- Internet Control Message Protocol (ICMP) and ICMPv6
- Profinet with IP proto 0x8892
- Address Resolution Protocol (ARP)
- Internet Group Management Protocol (IGMP)
- User Datagram Protocol
- Dynamic Host Configuration Protocol (DHCP) with port 67 or port 68 and DHCPv6 with port 546 or port 547
- Common Industrial Protocol (CIP) with TCP port 44818
- Domain Name System (DNS) with port 53
- Simple Network Management Protocol with port 161 or port 162.



Note The protocols listed represent only a portion of the PCAP capabilities.

Filter expressions for packet captures

The filter expression for a PCAP comprises at least one primitive. Primitives usually consist of qualifiers followed by an identifier. The identifier can be a name or a number.

There are three kinds of qualifiers.

- Type: Specifies the type of the identifier. The type can be a port, a host, a network, or a range of ports.
For example: **port 20**
- Dir: Specifies that the capture is for only packets with a given transfer direction.
For example: **src x.x.x.x and port ftp-data** or **dst x.x.x.x and port ftp**
- Proto: Limits the capture to a specific protocol.
For example: **tcp port 21**.

The filter expressions can be combined using the logical operators AND, OR, and NOT to create more specific and complex filters.



Note When constructing filter expressions, it is important to understand the order of operations and use parentheses to group expressions when necessary to ensure the correct interpretation.

Enable Wired Packet Capture on WGB

Procedure

Step 1 To enable PCAP, choose one of the options given here:

- a. PCAP using default filter:

```
Device#debug traffic wired [0|1] {ip|tcp|udp} [verbose|capture]
```

[0-1]: Specifies the wired interface number. If not selected, capture packets from all the wired interface.

This table lists examples of PCAP in default, verbose, and capture modes:

Mode	Example
Default: Captures IP protocol header packets.	<pre>Device#debug traffic wired 1 ip APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet) 1 08:35:50.529851 IP 209.165.200.213 > 209.165.200.1: ICMP echo request, id 13721, seq 1, length 64 2 08:35:50.534813 IP 209.165.200.1 > 209.165.200.213: ICMP echo reply, id 13721, seq 1, length 64</pre>
Verbose: Captures detailed information of the UDP protocol packets.	<pre>Device#debug traffic wired 1 udp verbose APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet) 1 08:25:59.696990 IP6 fe80::322c:712c:5787:f246.dhcpv6-client > ff02::1:2.dhcpv6-server: dhcp6 solicit 0x0000: 3333 0001 0002 fc58 9a16 e428 86dd 6001 0x0010: 7b92 006d 1101 fe80 0000 0000 0000 322c 0x0020: 712c 5787 f246 ff02 0000 0000 0000 0000 0x0030: 0000 0001 0002 0222 0223 006d 00a6 010c 0x0040: d064 0008 0002 ffff 0006 001e 0034 0011 0x0050: 0015 0016 0017 0018 001f 0038 0040 0043 0x0060: 0052 0053 005e 005f 0060 0001 000a 0003 0x0070: 0001 fc58 9a16 e428 0014 0000 0027 0013 0x0080: 0006 4150 4643 3538 0439 4131 3604 4534 0x0090: 3238 0000 0300 0c00 0000 0100 0000 0000 0x00a0: 0000 00</pre>
Capture: Writes TCP packet information to the PCAP file.	<pre>Device#debug traffic wired 1 tcp capture % Writing packets to "/pcap/APXXXX.XXXX.XXXX_capture.pcap0" APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet)</pre>

- b. PCAP using custom filter:

Note

Enable only one PCAP process at a time. Do not use unsupported characters like "`\$^&|\\><?; and ~ in the filter expressions.

```
Device#debug traffic wired [0|1] filter expression [verbose|capture]
```

This table lists examples of PCAP in default, verbose, and capture modes:

Mode	Example
Default: Captures IP protocol header packets.	<pre>Device#debug traffic wired 0 filter icmp APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet) 1 10:38:59.948729 IP 209.165.200.213 > 209.165.200.1: ICMP echo request, id 16204, seq 1, length 64 2 10:38:59.954308 IP 209.165.200.1 > 209.165.200.213: ICMP echo reply, id 16204, seq 1, length 64</pre>
Verbose: Captures detailed information of the UDP protocol packets.	<pre>Device#debug traffic wired 1 filter icmp verbose APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet) 17:13:30.706493 IP 209.165.200.213 > 209.165.200.1: ICMP echo request, id 986, seq 1, length 64 0x0000: fc58 9a17 afd4 f8e4 3b9d 7322 0800 4500 0x0010: 0054 57a0 4000 4001 889e c0a8 6cc8 c0a8 0x0020: 6c51 0800 940c 03da 0001 7f3d 5365 0000 0x0030: 0000 cea2 0000 0000 0000 1011 1213 1415 0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425 0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 0x0060: 3637 17:13:30.710567 IP 209.165.200.1 > 209.165.200.213: ICMP echo reply, id 986, seq 1, length 64 0x0000: f8e4 3b9d 7322 fc58 9a17 afd4 0800 4500 0x0010: 0054 9102 0000 4001 8f3c c0a8 6c51 c0a8 0x0020: 6cc8 0000 9c0c 03da 0001 7f3d 5365 0000 0x0030: 0000 cea2 0000 0000 0000 1011 1213 1415 0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425 0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 0x0060: 3637</pre>
Capture: Writes TCP packet information to the PCAP file.	<pre>Device#ddebug traffic wired 1 filter icmp capture % Writing packets to "/tmp/pcap/APXXXX.XXXX.XXXX_capture.pcap0" APXXXX.XXXX.XXXX#reading from file /dev/click_wired_log, link-type EN10MB (Ethernet)</pre>

For more information on filter expressions, see *TCP dump pcap-filter* documentation.

c. PCAP in multiple vlan using custom filter:

Note

Some custom filters miss traffic in non-native VLANs. For example, the custom filter command **#debug traffic wired 0 filter icmp** fails to capture downlink ICMP traffic in non-native VLANs.

To capture downlink traffic in non-native VLANs, you have two options:

- Include the VLAN in the filter expression to capture bidirectional traffic of the wired client in a non-native VLAN

```
Device#debug traffic wired 0 filter "icmp or (vlan and icmp)"
1 12:27:40.833815 IP 209.165.200.102 > 209.165.200.1: ICMP echo request, id 27279, seq 1,
length 64
2 12:27:40.841331 IP 209.165.200.1 > 209.165.200.102: ICMP echo reply, id 27279, seq 1, length
64
```

- To capture all IP traffic including native vlan and non-native vlan, use the default IP filter.

```
Device#debug traffic wired 0 ip
1 12:27:40.833815 IP 209.165.200.102 > 209.165.200.1: ICMP echo request, id 27279, seq 1,
length 64
2 12:27:40.841331 IP 209.165.200.1 > 209.165.200.102: ICMP echo reply, id 27279, seq 1, length
64
```

To disable wired PCAP, see [Disable Wired Packet Capture on WGB](#).

Step 2 To upload the packets to an external server, use the command given here:

Note

Before uploading the packets, complete the PCAP process and save the packets to file.

Use TFTP, SFTP, or SCP server to upload the PCAP file to an external server.

Device#**copy pcap APxxxx.xxxx.xxxx_capture.pcap0 <tftp|sftp>://A.B.C.D[/dir]/[filename]**

copy pcap APxxxx.xxxx.xxxx_capture.pcap0 scp://username@A.B.C.D[:port]/dir/[filename]

Example:

```
Device#copy pcap APXXXX.XXXX.XXXX_capture.pcap0 scp://iot@209.165.200.213:/capture/wgb_sniffer.pcap
copy ""/pcap/APXXXX.XXXX.XXXX_capture.pcap0"" to
"scp://iot@209.165.200.213:/capture/wgb_dhcp_sniffer_0_46_29.pcap" (Y/N)Y
iot@209.165.200.213 password:
APXXXX.XXXX.XXXX_capture.pcap0          0%      0      0.0KB/s   --:--  ETA
APXXXX.XXXX.XXXX_capture.pcap0          100% 2530   916.5KB/s   00:00
```

Disable Wired Packet Capture on WGB

Procedure

To disable PCAP, use the command given here:

a. Default filter:

Device#**no debug traffic wired** [0-3] {**ip** | **tcp** | **udp**} [**verbose** | **capture**]

b. Custom filter:

Device#**no debug traffic wired** [0-3] *filter expression* [**verbose** | **capture**]

Note

Use either the **no debug** or **undebug all** command to terminate the capture process.

Verify Wired Packet Capture on WGB

- To verify the debug status, use the **show debug** command.

```
Device#show debug
traffic:
  wired tcp debugging is enabled
```

- To view the captured internal wired packets stored in the file, use the **show pcap** command.



Note After capturing packets to the file, use the **show pcap** command to view them.

```
Device#show pcap
reading from file /pcap/APXXXX.XXXX.XXXX_capture.pcap0, link-type EN10MB (Ethernet)
 1  00:00:00.000000 IP 0.0.0.0 > 224.0.0.1: igmp query v2
 2  09:41:48.903670 IP 209.165.200.189 > 209.165.200.1: ICMP echo request, id 29920, seq
    1, length 64
 3  09:41:48.908927 IP 209.165.200.1 > 209.165.200.189: ICMP echo reply, id 29920, seq
    1, length 64
 4  09:41:49.904914 IP 209.165.200.102 > 209.165.200.1: ICMP echo request, id 29920, seq
    2, length 64
 5  09:41:49.909009 IP 209.165.200.1 > 209.165.200.102: ICMP echo reply, id 29920, seq
    2, length 64
```

- To filter and view the basic content of captured packets sequentially, run the **show pcap [filter expression]** command.

```
Device#show pcap filter "src 209.165.200.189"
reading from file /pcap/APXXXX.XXXX.XXXX_capture.pcap0, link-type EN10MB (Ethernet)
 1  09:41:48.903670 IP 209.165.200.189 > 209.165.200.1: ICMP echo request, id 29920,
    seq 1, length 64
 2  09:41:48.908927 IP 209.165.200.1 > 209.165.200.189: ICMP echo reply, id 29920, seq
    1, length 64
```

- To filter and view the detailed content of a specific packet, run the **show pcap [filter expression][detail no]** command.

```
Device#show pcap filter "src 209.165.200.189" detail 2
2024-04-25 09:41:49.904914
000000 18 59 f5 96 af 74 00 50 56 85 8a 0a 08 00 45 00
000010 00 54 14 6c 40 00 40 01 b7 9d 64 16 53 72 64 16
000020 53 01 08 00 70 81 74 e0 00 02 d4 3e 2b 66 00 00
000030 00 00 50 24 04 00 00 00 00 00 10 11 12 13 14 15
000040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25
000050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35
000060 36 37
```

Port Address Translation on WGB

Port Address Translation

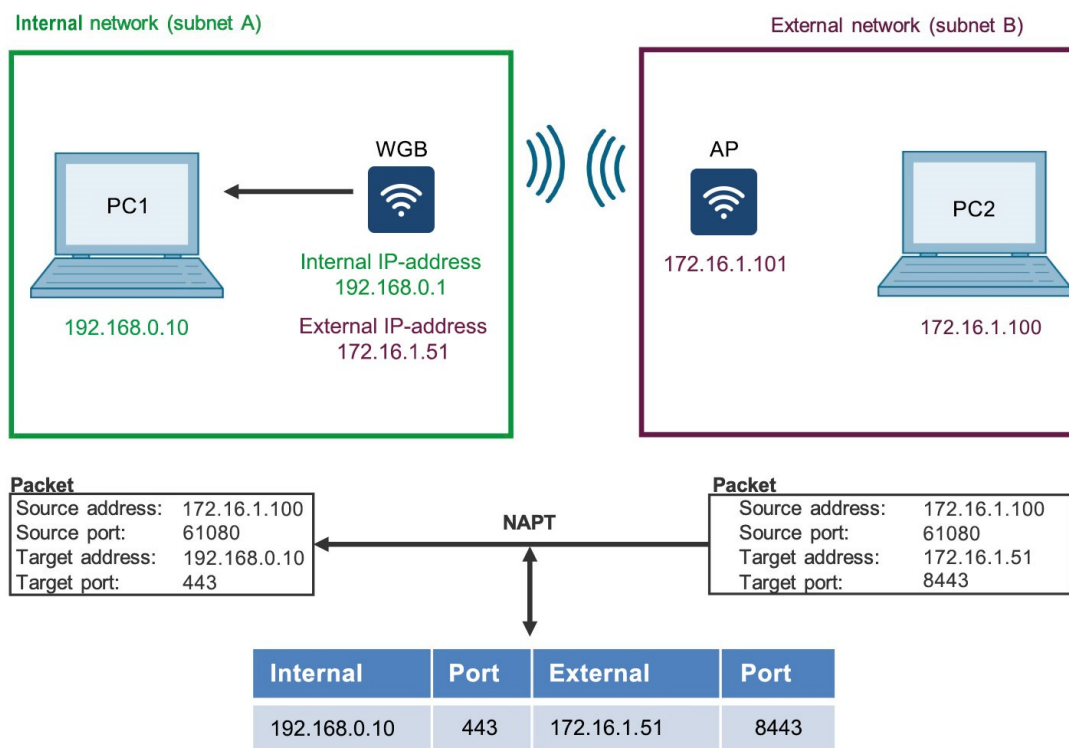
From UIW Release 17.16.1, Port Address Translation (PAT) is supported on the IW9165E WGB APs of each Automated Guided Vehicle (AGV).

PAT, also known as Network Address and Port Translation (NAPT), translates multiple internal wired client private IP addresses and port numbers to unique public IP address and port numbers before sending the packets to the external network.

A private or internal IP address is used only in an internal network, whereas a public or external IP address is used on the Internet and is globally unique.

NAPT mapping is based on the IP address and the port number. With NAPT, packets from multiple internal hosts are mapped to the same external IP address with different port numbers.

Client devices within the internal local subnet can reuse the same IP addresses across different AGVs.



Profinet clients on the AGV must be configured with a unique IP address belonging to the global subnet.

NAPT configuration supports upstream and downstream data flow. For more information, see [Upstream and downstream data flow](#), on page 68.

Supported protocol

NAPT supports TCP or UDP to communicate between devices on the internal and external network.

Limitation

The limitations of NAPT on WGB are:

- The WGB NAPT feature does not support NAT for incoming packets with an 802.1Q VLAN tag behind the device.
- The WGB NAPT feature does not support multicast traffic for WGB NAT inside wired client.
- The WGB NAPT feature supports FTP traffic in active mode. For passive mode FTP traffic, the WGB PAT feature supports only when the FTP server is located within the NAT inside.
- The WGB NAPT feature supports the TFTP protocol only when the TFTP server resides inside the NAT.
- The WGB NAPT feature does not support Application Layer Gateway (ALG).

NAPT rule and mapping table

NAPT rule

The WGB creates the default mapping rule based on the configured IP addresses, and it translates traffic flow triggered by internal client devices.

The default mapping rule consists of <inside-IP-address, inside-tcp-or-udp-port>, <outside-ip-address, predefined port range>, and <protocol>, where the protocol can be either UDP or TCP.



Note The configuration supports a maximum of 256 IP NAT rules.

NAPT mapping table

The WGB creates and manages the mapping table based on the traffic and NAPT rules.

NAPT uses entries that include the source IP address, source port number, protocol type, destination IP address, and destination port number (TCP or UDP) to translate addresses and filter packets to index the NAPT mapping table.



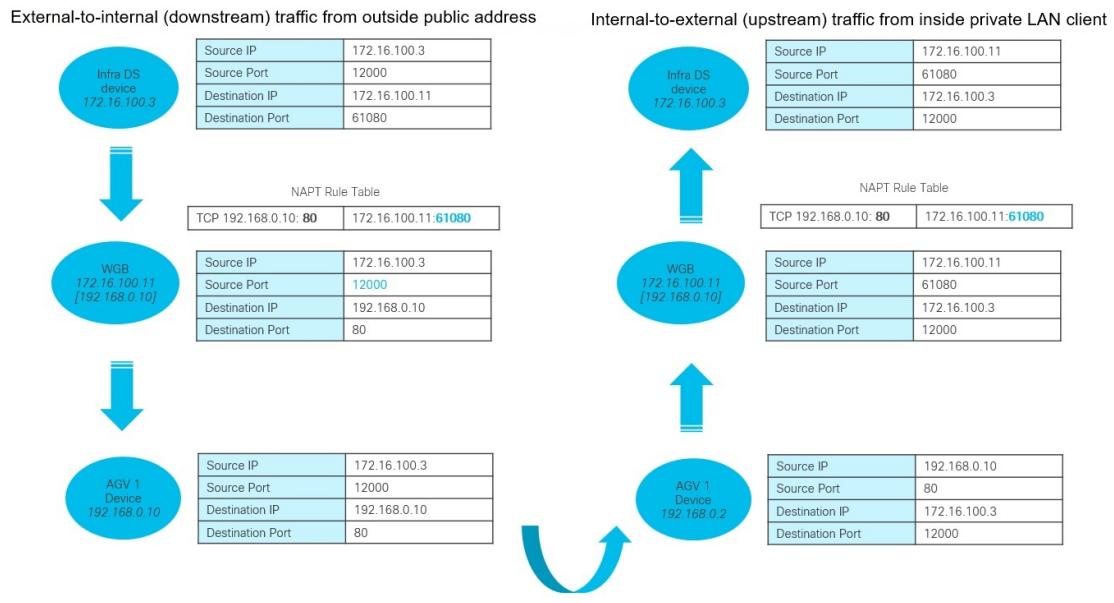
Note The maximum number of mapping entries in NAPT translation table is 4096.

Table 6: NAPT Mapping Table

Protocol	Internal Local IP Address and Port	WGB Global IP Address	External Global IP Address and Port
TCP	192.168.0.10: 80	172.16.100.11	172.16.100.11: 61080

Upstream and downstream data flow

Figure 5: Upstream and downstream data flow Using NAT



Upstream data flow using SNAT

Upstream data flow refers to the flow of packets from the internal networks to the external networks. The WGB acts as a gateway between the internal and external networks.

The WGB translates all outgoing packets from the internal network to the external network using Source Network Address Translation (SNAT).

The SNAT for upstream traffic translates the source IP address and port numbers of the packets passing through the WGB replacing it with the WGB's IP address. This ensures that internal IP addresses are not exposed to the external network.

Downstream data flow using NAT

Downstream data flow refers to the flow of data from the external network to the AGV's internal network. The WGB acts as a gateway between the external and internal networks.

When the WGB receives packets with the external IP address and port number, WGB checks the mapping table to match the destination IP address and the port number of the incoming packet.

WGB then translates and forwards packets to the internal network according to the destination IP address and port number.

Configure NAT on WGB

To configure NAT on the WGB, use the given commands.

Follow Step 1 through Step 3 to configure upstream data flow using SNAT.

Follow Step 4 and Step 5 to configure downstream data flow using NAPT.

Procedure

-
- Step 1** Use the **configure ip nat enable** command to enable NAPT on WGB.
- ```
Device#configure ip nat enable
```
- Note**  
Use the **configure ip nat disable** command to disable the NAPT on WGB.
- Step 2** Use the **configure ip nat address add ip** *inside-ip-address* **netmask** *netmask* command to configure inside IPv4 address and netmask on WGB.
- ```
Device#configure ip nat address add ip 192.168.0.1 netmask 255.255.255.0
```
- Step 3** (Optional) Use the **configure ip nat inside port range** *min-port-number* *max-port-number* command to configure SNAT port range on the WGB for upstream data flow.
- ```
Device#configure ip nat inside port range 32000 33000
```
- Inside port valid range is from 1 to 65535.
- The default range for inside port is from 30000 to 59999.
- Note**  
Ensure that the SNAT port range and the NAPT port range do not overlap.
- Step 4** Use the **configure ip nat outside port range** *min-port-number* *max-port-number* command to configure NAPT port range on WGB for downstream data flow.
- ```
Device#configure ip nat outside port range 34000 62000
```
- Outside port number valid ranges is from 1025 to 65535.
- Note**
When creating a NAPT rule, do not use the reserved port numbers 1233, 1234, and 20000 for outside ports.
Ensure that the NAPT port range and the SNAT port range do not overlap.
- Step 5** Use the **configure ip nat rule add inside ip** *inside-ip-address* **port** *inside-port-number* **outside port** *outside-port-number* **protocol** { **tcp** | **udp** } command to configure the NAPT mapping rule for downstream data flow.
- ```
Device#configure ip nat rule add inside ip 192.168.0.10 port 80 outside port 61080 protocol tcp
```
- inside-ip-address* is the internal wired client network IP address.
- inside-port-number* is the internal wired client network TCP or UDP port number.
- The configuration supports the downstream data flow.
- Note**  
Ensure that the outside port number is within the port range specified in Step 4.
-

## Delete NAPT mapping rule

Use this task to delete the NAPT mapping rule on the WGB.

### Procedure

---

Delete the configuration using the given commands as required.

- Use the **configure ip nat rule delete inside ip** *inside- ip-address* **port** *inside-port-number* **outside port** *outside-port-number* **protocol** { **tcp** | **udp** } command to delete the NAPT mapping rule.

```
Device#configure ip nat rule delete inside ip 192.168.1.10 port 80 outside port 61080 protocol tcp
```

- Use the **configure ip nat entry delete** *rule-id* command to delete the NAPT mapping rule as per the rule-id.

```
Device#configure ip nat entry del 0
```

#### Note

Use the **show ip nat configuration** command to view the rule-id.

- Use the **configure ip nat entry delete** *all* command to delete all the NAPT mapping rules on the WGB.

```
Device#configure ip nat entry delete all
```

---

## Delete NAPT IP address

Use this task to delete NAPT IP address on the WGB.



---

**Note** To remove all the NAPT configuration, you should also delete the IP address and interface.

---

### Procedure

---

Delete the NAPT IP address on the WGB using the given commands as required.

- Use the **configure ip nat address delete** command to delete the gateway IPv4 address for the internal wired client on the uWGB.

```
Device#configure ip nat address delete
```

- Use the **configure interface nat-outside address delete** command to delete the external IPv4 address on the uWGB.

```
Device#configure interface nat-outside address delete
```

---

## Verify NAPT on WGB

### Verify NAPT configuration

Use the **show ip nat configuration** command to print the current NAPT configuration on WGB.

```
Device#show ip nat configuration
IP NAT Configuration are:
=====
Status: enabled
inside interface ip/netmask: 192.168.0.1/255.255.255.0
SNAT port range: 10000 - 20000
NAPT port range: 61000 - 65535
The number of ip nat rules: 1
Id Outside_port Inside_ip Inside_port Protocol
0 61080 192.168.0.10 80 tcp
```

### Verify NAPT entry

Use the **show ip nat translations** command to print the current NAPT translation entries from the NAPT rule table.

```
Device#show ip nat translations
UDP:
 src_ip port dst_ip port => src_ip port dst_ip port direction
 expiry_time
(192.168.0.10, 41278, 172.16.1.51, 22000) => (172.16.1.101, 30004, 172.16.1.51, 22000)
[forward] exp: 290
(172.16.1.51, 22000, 172.16.1.101, 61080) => (172.16.1.51, 22000, 192.168.0.10, 41278)
[reverse] exp: 290
=====
TCP:
 src_ip port dst_ip port => src_ip port dst_ip port direction
 expiry_time
(192.168.0.10, 80, 172.16.100.3, 443) => (172.16.100.11, 30000, 172.16.100.3, 443) [forward]
exp: 138
(172.16.100.3, 443, 172.16.100.11, 30000) => (172.16.100.3, 443, 192.168.0.10, 80) [reverse]
exp: 138
```

In the output, forward refers to the log details of the WGB processed data packets, which include details such as source, destination and any translation performed.

Reverse refers to the log details of the return traffic based on the original packets forwarded by the WGB. It ensures the response from the destination correctly reaches back to the source by reversing the direction of the original traffic.

## Port Address Translation on uWGB

### Port Address Translation

From UIW Release 17.16.1, Port Address Translation (PAT) is supported on the IW9165E uWGB of each Automated Guided Vehicle (AGV).

PAT, also known as Network Address and Port Translation (NAPT), translates multiple internal wired client private IP addresses and port numbers to unique public IP address and port numbers before sending the packets to the external network.

A private or internal IP address is used only in an internal network, whereas a public or external IP address is used on the Internet and is globally unique.

NAPT mapping is based on the IP address and the port number. With NAPT, packets from multiple internal hosts are mapped to the same external IP address with different port numbers.

Client devices within the internal local subnet can reuse the same IP addresses across different AGVs.

#### Precondition

In a NAPT deployment, AGV devices in the internal local subnet have pre-configured IP address.

#### Supported protocol

NAPT supports TCP or UDP to communicate between devices on the internal and external network.

#### Limitation of NAPT

The NAPT limitations are:

- The NAPT does not support Access Control Lists (ACLs).
- The NAPT supports only one private LAN as the NAPT inside network.

## NAPT rule and mapping table

#### NAPT rule

The uWGB creates the default mapping rule based on the configured IP addresses, and it translates traffic flow triggered by internal client devices.

Configure a NAPT mapping rule to manage translation for traffic coming from external hosts.

The default mapping rule consists of <inside-IP-address, inside-tcp-or-udp-port>, <outside-ip-address, predefined port range>, and <protocol>, where the protocol can be either UDP or TCP.

#### NAPT mapping table

The uWGB creates and manages the mapping table based on the traffic and NAPT rules.

NAPT uses flow identifiers such as source address, source port, destination address, destination port, and IP protocol (TCP or UDP) to index the NAPT mapping table.



---

**Note** The maximum number of mapping entries in NAPT translation table is 4096, and these entries automatically appear in pairs.

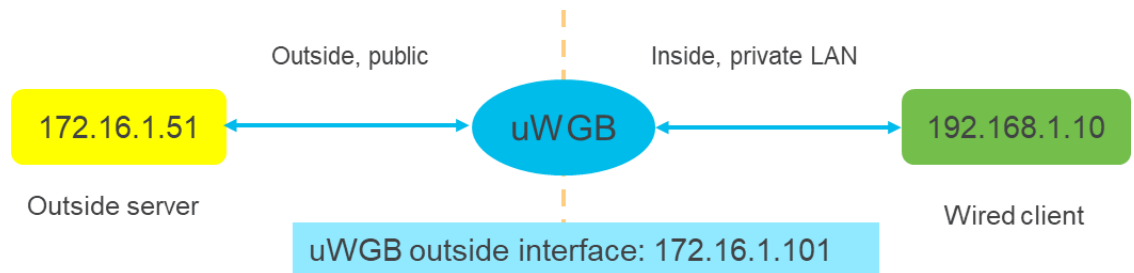
---

Table 7: NAPT Mapping Table

| Protocol | Inside Local IP Address and Port | uWGB Global IP Address | Outside Global IP Address and Port |
|----------|----------------------------------|------------------------|------------------------------------|
| TCP      | 192.168.1.10: 80                 | 172.16.1.101           | 172.16.1.101: 61080                |

## Upstream and downstream data flow

Figure 6: Upstream and downstream Data Flow Using NAPT



### Upstream data flow using SNAT

Upstream data flow refers to the flow of packets from the internal networks to the external networks. The uWGB acts as a gateway between the internal and external networks. The uWGB translates all outgoing packets from the internal network to the external network using Source Network Address Translation (SNAT).

The SNAT translates the source IP address of the packets passing through the uWGB replacing it with the uWGB client IP address. This ensures that internal IP address are not exposed to the external network.

### Downstream data flow using NAPT

Downstream data flow refers to the flow of data from the external network to the AGV's internal network. The uWGB acts as a gateway between the external and internal networks.

When the uWGB receives the packets with the external IP address and port, uWGB checks the mapping table to match the destination IP address and the destination TCP or UDP port of the incoming packet.

If the rule matches, uWGB translates the destination IP address and port numbers according to the matched entry in the table and forwards the packets to the internal network.

## Configure NAPT on uWGB

To configure NAPT on the uWGB, use the given commands.

Follow Step 1 through Step 4 to configure support for upstream data flow using SNAT.

Follow Step 5 and Step 6 to configure support for downstream data flow using NAPT.

## Procedure

**Step 1** Use the **config ip nat enable** command to enable NAPT on the uWGB.

```
Device#config ip nat enable
```

**Note**

Use the **configure ip nat disable** command to disable the NAPT on the uWGB.

**Step 2** (Optional) Use the **configure ip nat inside port range** *min-port-number max-port-number* command to configure SNAT port range on the uWGB for upstream data flow.

```
Device#configure ip nat inside port range 32000 33000
```

Inside port valid range is from 1025 to 65535.

The default range for inside port is from 30000 to 59999.

The SNAT port range is the source port that the uWGB uses when sending traffic from internal network to the external network.

**Note**

Ensure that the SNAT port range and the NAPT port range do not overlap.

**Step 3** Use the **config ip nat address add ip** *inside-ip-address netmask netmask* command to configure the gateway IPv4 address for the internal wired client on the uWGB.

```
Device#config ip nat address add ip 192.168.1.1 netmask 255.255.255.0
```

**Step 4** Use the **configure interface nat-outside address ipv4 static** *static-ip-address static-netmask gateway-ip-address* command to configure external IPv4 address on the uWGB.

```
Device#configure interface nat-outside address ipv4 static 172.16.1.101 255.255.255.0 172.16.1.1
```

*static-ip-address* is the uWGB own public address

*gateway-ip-address* is the uWGB external IP address.

The outside port number is automatically generated for upstream data flow.

The configuration supports the internal-to-external traffic flow.

**Step 5** Use the **configure ip nat outside port range** *min-port-number max-port-number* command to configure NAPT port range on the uWGB to receive traffic from the external network to the internal network.

```
Device#configure ip nat outside port range 34000 62000
```

Outside port valid range is from 1025 to 65535.

**Note**

Ensure that the NAPT port range and the SNAT port range do not overlap.

**Step 6** Use the **config ip nat rule add inside ip** *inside-ip-address port inside-port-number outside port outside-port-number protocol { tcp | udp }* command to configure the NAPT mapping rule for downstream data flow.

```
Device#config ip nat rule add inside ip 192.168.1.10 port 80 outside port 61080 protocol tcp
```

**Note**

When creating a NAPT rule, do not use the reserved port numbers 1233, 1234, and 20000 for outside ports.

*inside-ip-address* is the internal wired client network IP address.

*inside-port-number* is the internal wired client network port number.

The configuration supports the downstream data flow.

---

## Delete NAPT mapping rule

Follow this procedure to delete the NAPT mapping rule on the uWGB.

### Procedure

---

Delete the configuration using the given commands as required.

- Use the **config ip nat rule delete inside ip *inside-ip-address* port *inside-port-number* outside port *outside-port-number* protocol { tcp | udp }** command to delete the NAPT mapping rule.

```
Device#config ip nat rule delete inside ip 192.168.1.10 port 80 outside port 61080 protocol tcp
```

- Use the **configure ip nat entry delete *rule-id*** command to delete the NAPT mapping rule as per the rule-id.

```
Device#configure ip nat entry del 0
```

#### Note

Use the **show ip nat configuration** command to view the rule-id.

- Use the **configure ip nat entry delete all** command to delete all the NAPT mapping rules on the uWGB.

```
Device#configure ip nat entry delete all
```

---

## Delete NAPT IP address

Follow this procedure to delete NAPT function IP address on the uWGB.



#### Note

To completely remove the NAPT configuration, ensure to delete the IP address and the interface.

---

### Procedure

---

Delete the necessary IP address of the NAPT function using the given commands as required.

- Use the **config ip nat address delete** command to delete the internal IPv4 address.

```
Device#Device#config ip nat address delete
```

- Use the **configure interface nat-outside address delete** command to delete the external IPv4 address.

```
Device#configure interface nat-outside address delete
```

## Manage uWGB in NAPT deployment

Follow this procedure to manage uWGB in a NAPT deployment.

### Before you begin

Ensure that all uWGB wired clients are in the private LAN.

### Procedure

- Step 1** Use the **configure dot11Radio 1 mode uwgb mac\_address ssid\_profile test\_ssid** command to configure radio mode to uWGB.

```
Device#configure dot11Radio 1 mode uwgb FC:58:9A:17:0D:52 ssid-profile testssid
```

You can choose any unique MAC addresss, or use the optional method given below to calculate a unique MAC address.

#### Note

Ensure MAC address does not conflict with existing devices on the network to prevent connectivity issue.

(Optional) To calculate the unique MAC address, add the offset 0x12 to the base MAC address.

Formula: base MAC address + offset = unique MAC address

#### Note

Ensure that the offset value is at least 0x12.

Example: FC:58:9A:17:0D:40 + 0x12 = FC:58:9A:17:0D:52

Use the **show controllers dot11Radio 1** command to find the base MAC address.

```
Device#show controllers dot11Radio 1
wifil Link encap:Ethernet HWaddr FC:58:9A:17:0D:40
 UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
 RX packets:9109 errors:70 dropped:59043 overruns:0 frame:0
 TX packets:27920 errors:13 dropped:0 overruns:0 carrier:0
 collisions:0 txqueuelen:2699
 RX bytes:913806 (892.3 KiB) TX bytes:5399794 (5.1 MiB)
```

- Step 2** Use the **show wgb dot11 associations** command to verify the uWGB is in the WGB state.

```
Device#show wgb dot11 associations
Uplink Radio ID : 1
Uplink Radio MAC : FC:58:9A:17:0D:52
SSID Name : SSID_NAME
Connected Duration : 56 hours, 37 minutes, 11 seconds
Parent AP MAC : B0:B8:67:3D:5E:D6
Uplink State : CONNECTED
Auth Type : PSK
Key management Type : WPA2
Uclient mac : FC:58:9A:17:0D:52
Current state : WGB
Uclient timeout : 60 Sec
```

```

Dot11 type : 11ac
Channel : 157
Bandwidth : 20 MHz
Current Datarate (Tx/Rx) : 156/144 Mbps
Max Datarate : 156 Mbps
RSSI : 35
IP : 172.16.1.101/24
Default Gateway : 172.16.1.1
IPv6 : ::/128
Assoc timeout : 100 Msec
Auth timeout : 100 Msec
Dhcp timeout : 60 Sec'

```

**Step 3** Configure NAPT for uWGB wired client end-to-end traffic flow.

## Verify NAPT on uWGB

### Verify NAPT configuration

Use the **show ip nat configuration** command to print the current NAPT configuration on uWGB.

```
Device#show ip nat configuration
```

```

IP NAT Configuration are:
=====
Status: enabled
inside interface ip/netmask: 192.168.1.1/255.255.255.0
SNAT port range: 30000 - 59999
NAPT port range: 60000 - 65000
outside proxy ip/netmask/gateway: 172.16.1.101/255.255.255.0/172.16.1.1
The number of ip nat rules: 2
Id Outside_port Inside_ip Inside_port Protocol
0 61001 192.168.1.10 20001 udp
1 61002 192.168.1.10 20002 tcp

```

### Verify NAPT entry

Use the **show ip nat translations** command to print the current NAPT translation entries from the NAPT rule table.

```
Device#show ip nat translations
```

```

ICMP:
 src_ip dst_ip port => src_ip dst_ip port direction
expiry_time
(172.16.1.1, 172.16.1.101, 30257) => (172.16.1.1, 192.168.1.10, 267) [reverse] exp: 272
(192.168.1.10, 172.16.1.1, 11) => (172.16.1.101, 172.16.1.1, 30001) [forward] exp: 272
=====
UDP:
 src_ip port dst_ip port => src_ip port dst_ip port direction
expiry_time
(192.168.1.10, 20000, 172.16.1.51, 35200) => (172.16.1.101, 61001, 172.16.1.51, 35200)
[reverse] exp: 214
(192.168.1.10, 51184, 172.16.1.51, 22000) => (172.16.1.101, 30001, 172.16.1.51, 22000)
[forward] exp: 161
(172.16.1.51, 35200, 172.16.1.101, 61001) => (172.16.1.51, 35200, 192.168.1.10, 20000)
[forward] exp: 214
(172.16.1.51, 22000, 172.16.1.101, 30001) => (172.16.1.51, 22000, 192.168.1.10, 51184)
[reverse] exp: 161
=====

```

```

TCP:
 src_ip port dst_ip port => src_ip port dst_ip port direction
 expiry_time
(192.168.1.10, 44155, 172.16.1.51, 23000) => (172.16.1.101, 30002, 172.16.1.51, 23000)
[forward] exp: 238
(172.16.1.51, 23000, 172.16.1.101, 30002) => (172.16.1.51, 23000, 192.168.1.10, 44155)
[reverse] exp: 238
=====

```

In the output, forward means an entry from an actual traffic stream that uWGB processes and forwards. It logs the details of the packets translated and sent through the uWGB.

Reverse means an entry by reversing the direction of an existing forward. It records the expected return path or response for the traffic originally forwarded.

# AAA User Authentication Support

## Information About AAA User Authentication Support

This chapter provides information on how to use AAA to control the use of network resources (via authentication) and define permissible actions (via authorization). From Release 17.15.1, AAA-based user management and authentication are supported on IW9165E WGB.

The AAA server assigns a privilege level from 0-15 to clients using an Authorization-Reply message. Only levels 1 (view user) and 15 (management user) are currently supported, with levels 2-14 reserved. Privilege levels 0 and 2-14 must not be used when adding users to the AAA server. If a user is added without a privilege level, WGB will assign the lowest privilege level to that user.

Features of AAA-based user management and authentication are as follows:

- Provides multiple-user support
- Stores usernames and passwords on the AAA server
- Utilizes AAA for user authentication
- Supports differentiated user privileges
- Restricts CLI access based on user privileges



**Note** Similar to a Cisco Router or Switch, the Workgroup Bridge (WGB) can also create and store usernames and passwords locally.

## Configuring AAA Server

### Before you begin

- You can add a secondary AAA server (RADIUS or TACACS+) before adding a primary AAA server. Once the primary AAA server is added, clients connect to the primary AAA server.

- When both primary and secondary RADIUS servers are configured, the WGB attempts to connect with the primary RADIUS server three times before switching to the secondary RADIUS server.
- For the TACACS+ server, the connection attempt is done only once with the primary TACACS+ server. If the primary TACACS+ server fails to respond, the secondary TACACS+ server is used.

**Note**

The WGB AAA RADIUS server configuration command is officially supported starting from the 17.15.1 release.

When you downgrade the image from the 17.15.1 release or later to the 17.14.1 release or earlier, or upgrade from the 17.14.1 release or earlier to the 17.15.1 release or later, the originally configured RADIUS server port is reset to zero. You need to reconfigure the RADIUS server port again.

**Procedure****Step 1**

Configure a AAA server (RADIUS or TACACS+) using the following command:

```
Device# config {radius | tacplus} authentication {primary | secondary} address {ipv4 | ipv6} ip-address port
port-number secret secret-string
```

**Note**

Do not use unsupported characters like vertical bar (|), semicolon (;), dollar sign (\$), less than (<), greater than (>), ampersand (&), caret (^), grave accent (`), backslash (\), carriage return (r), and double quotation marks (") in secret-string parameters.

**Step 2**

(Optional) To remove a AAA server (RADIUS or TACACS+), use the following command:

```
Device# config {radius | tacplus} authentication {primary | secondary} delete
```

## Enable or Disable RADIUS Authentication for Login User

**Procedure****Step 1**

Run the following command to enable AAA RADIUS authentication for the login user:

```
Device# config ap management aaa radius enable
```

**Step 2**

(Optional) Run the following command to disable AAA RADIUS authentication for the login user:

```
Device# config ap management aaa radius disable
```

# Enable or Disable TACACS+ Authentication for Login User

## Before you begin

### Procedure

- 
- Step 1** Run the following command to enable AAA TACACS+ authentication for the login user:  
Device# **config ap management aaa tacplus enable**
- Step 2** (Optional) Run the following command to disable AAA TACACS+ authentication for the login user:  
Device# **config ap management aaa tacplus disable**
- 

## Verify the AAA Authentication Configuration

To verify the AAA server (RADIUS or TACACS+) configuration, use the **show running-configuration** command.

The following is a sample output when AAA RADIUS authentication is enabled:

```
Device# show running-config

AAA server configuration:-
=====
Status: Enabled
AAA server type : radius
Primary RADIUS IP address : 192.0.2.0
Primary RADIUS port : 1812
.
.
.
```

The following is a sample output when AAA tacplus authentication is enabled:

```
Device# show running-config

AAA server configuration:-
=====
Status: Enabled
AAA server type : tacplus
Primary TACPLUS IP address : 192.0.2.0
Primary TACPLUS port : 49
.
.
.
```

## Radio Statistics Commands

To help troubleshooting radio connection issues, use the following commands:

- **#debug wgb dot11 rate**

**#debug wgb dot11 rate**

```

[*03/13/2023 18:00:08.7814]
Tx-Rate (Mbps) Rx-Rate (Mbps) RSSI SNR Tx-Retrieves
[*03/13/2023 18:00:08.7814] FC:58:9A:17:C2:51 0 0 0
HE-20,2SS,MCS6,GI0.8 (154) HE-20,3SS,MCS4,GI0.8 (154) -30 62 0
[*03/13/2023 18:00:09.7818] FC:58:9A:17:C2:51 0 0 0
HE-20,2SS,MCS6,GI0.8 (154) HE-20,3SS,MCS4,GI0.8 (154) -30 62 0

```

In this example, FC:58:9A:17:C2:51 is the parent AP radio MAC.

- **#show interfaces dot11Radio <slot-id> statistics**

**#show interfaces dot11Radio 1 statistics**

Dot11Radio Statistics:

DOT11 Statistics (Cumulative Total/Last 5 Seconds):

| RECEIVER          |                | TRANSMITTER       |               |
|-------------------|----------------|-------------------|---------------|
| Host Rx K Bytes:  | 965570/0       | Host Tx K Bytes:  | 1611903/0     |
| Unicasts Rx:      | 379274/0       | Unicasts Tx:      | 2688665/0     |
| Broadcasts Rx:    | 3166311/0      | Broadcasts Tx:    | 0/0           |
| Beacons Rx:       | 722130099/1631 | Beacons Tx:       | 367240960/784 |
| Probes Rx:        | 588627347/2224 | Probes Tx:        | 78934926/80   |
| Multicasts Rx:    | 3231513/0      | Multicasts Tx:    | 53355/0       |
| Mgmt Packets Rx:  | 764747086/1769 | Mgmt Packets Tx:  | 446292853/864 |
| Ctrl Frames Rx:   | 7316214/5      | Ctrl Frames Tx:   | 0/0           |
| RTS received:     | 0/0            | RTS transmitted:  | 0/0           |
| Duplicate frames: | 0/0            | CTS not received: | 0/0           |
| MIC errors:       | 0/0            | WEP errors:       | 2279546/0     |
| FCS errors:       | 0/0            | Retries:          | 896973/0      |
| Key Index errors: | 0/0            | Tx Failures:      | 8871/0        |
|                   |                | Tx Drops:         | 0/0           |

Rate Statistics for Radio::

[Legacy]:

6 Mbps:

|             |          |             |         |
|-------------|----------|-------------|---------|
| Rx Packets: | 159053/0 | Tx Packets: | 88650/0 |
|             |          | Tx Retries: | 2382/0  |

9 Mbps:

|             |      |             |      |
|-------------|------|-------------|------|
| Rx Packets: | 43/0 | Tx Packets: | 23/0 |
|             |      | Tx Retries: | 71/0 |

12 Mbps:

|             |     |             |       |
|-------------|-----|-------------|-------|
| Rx Packets: | 1/0 | Tx Packets: | 119/0 |
|             |     | Tx Retries: | 185/0 |

18 Mbps:

|             |     |             |       |
|-------------|-----|-------------|-------|
| Rx Packets: | 0/0 | Tx Packets: | 5/0   |
|             |     | Tx Retries: | 134/0 |

24 Mbps:

|             |       |             |         |
|-------------|-------|-------------|---------|
| Rx Packets: | 235/0 | Tx Packets: | 20993/0 |
|             |       | Tx Retries: | 5048/0  |

36 Mbps:

|             |     |             |       |
|-------------|-----|-------------|-------|
| Rx Packets: | 0/0 | Tx Packets: | 781/0 |
|             |     | Tx Retries: | 227/0 |

54 Mbps:

|             |       |             |        |
|-------------|-------|-------------|--------|
| Rx Packets: | 133/0 | Tx Packets: | 9347/0 |
|             |       | Tx Retries: | 1792/0 |

[SU]:

M0:

|             |     |             |     |
|-------------|-----|-------------|-----|
| Rx Packets: | 7/0 | Tx Packets: | 0/0 |
|             |     | Tx Retries: | 6/0 |

M1:

|             |        |             |         |
|-------------|--------|-------------|---------|
| Rx Packets: | 1615/0 | Tx Packets: | 35035/0 |
|             |        | Tx Retries: | 3751/0  |

M2:

|             |         |             |          |
|-------------|---------|-------------|----------|
| Rx Packets: | 15277/0 | Tx Packets: | 133738/0 |
|             |         | Tx Retries: | 22654/0  |

```

M3:
 Rx Packets: 10232/0 Tx Packets: 1580/0
 Tx Retries: 21271/0

M4:
 Rx Packets: 218143/0 Tx Packets: 190408/0
 Tx Retries: 36444/0

M5:
 Rx Packets: 399283/0 Tx Packets: 542491/0
 Tx Retries: 164048/0

M6:
 Rx Packets: 3136519/0 Tx Packets: 821537/0
 Tx Retries: 329003/0

M7:
 Rx Packets: 1171128/0 Tx Packets: 303414/0
 Tx Retries: 154014/0

```

```

Beacons missed: 0-30s 31-60s 61-90s 90s+
 2 0 0 0

```

#### • #show wgb dot11 uplink latency

```

AP4C42.1E51.A050#show wgb dot11 uplink latency
Latency Group Total Packets Total Latency Excellent(0-8) Very Good(8-16) Good (16-32
ms) Medium (32-64ms) Poor (64-256 ms) Very Poor (256+ ms)
 AC_BK 0 0 0 0 0
0 AC_BE 7 1840 4243793 1809 10
14 AC_VI 0 0 0 0 0
0 AC_VO 0 24 54134 24 0
0

```

#### • #show wgb dot11 uplink

```

AP4C42.1E51.A050#show wgb dot11 uplink

HE Rates: 1SS:M0-11 2SS:M0-11
Additional info for client 8C:84:42:92:FF:CF
RSSI: -24
PS : Legacy (Awake)
Tx Rate: 278730 Kbps
Rx Rate: 410220 Kbps
VHT_TXMAP: 65530
CCX Ver: 5
Rx Key-Index Errs: 0
 mac intf TxData TxUC TxBytes TxFail TxDcrd TxCumRetries MultiRetries
MaxRetriesFail RxData RxBytes RxErr TxRt (Mbps) RxRt (Mbps)
LER PER stats_ago
8C:84:42:92:FF:CF wbridge1 1341 1341 184032 0 0 543 96
0 317 33523 0 HE-40,2SS,MCS6,GIO.8 (309) HE-40,2SS,MCS9,GIO.8
(458) 27272 0 1.370000
Per TID packet statistics for client 8C:84:42:92:FF:CF
Priority Rx Pkts Tx Pkts Rx(last 5 s) Tx (last 5 s)
0 35 1314 0 8
1 0 0 0 0
2 0 0 0 0
3 0 0 0 0
4 0 0 0 0
5 0 0 0 0
6 182 24 1 0
7 3 3 0 0

Rate Statistics:

```

| Rate-Index | Rx-Pkts | Tx-Pkts | Tx-Retries |
|------------|---------|---------|------------|
| 0          | 99      | 3       | 0          |
| 4          | 1       | 1       | 9          |
| 5          | 21      | 39      | 35         |
| 6          | 31      | 185     | 64         |
| 7          | 26      | 124     | 68         |
| 8          | 28      | 293     | 82         |
| 9          | 77      | 401     | 151        |
| 10         | 32      | 140     | 97         |
| 11         | 2       | 156     | 37         |

## Event Logging

For WGB field deployment, event logging will collect useful information (such as WGB state change and packets rx/tx) to analyze and provide log history to present context of problem, especially in roaming cases.

You can configure WGB trace filter for all management packet types, including probe, auth, assoc, eap, dhcp, icmp, and arp. To enable or disable WGB trace, use the following command:

```
#config wgb event trace {enable|disable}
```

Four kinds of event types are supported:

- **Basic event:** covers most WGB basic level info message
- **Detail event:** covers basic event and additional debug level message
- **Trace event:** recording wgb trace event if enabled
- **All event:** bundle trace event and detail event

The log format is `[timestamp] module:level <event log string>`.

When abnormal situations happen, the eventlog messages can be dumped manually to memory by using the following show command which also displays WGB logging:

```
#show wgb event [basic|detail|trace|all]
```

The following example shows the output of **show wgb event all**:

```
APC0F8.7FE5.F3C0#show wgb event all
[*08/16/2023 08:18:25.167578] UP_EVT:4 R1 IFC:58:9A:17:B3:E7] parent_rssi: -42 threshold:
-70
[*08/16/2023 08:18:25.329223] UP_EVT:4 R1 State CONNECTED to SCAN_START
[*08/16/2023 08:18:25.329539] UP_EVT:4 R1 State SCAN_START to STOPPED
[*08/16/2023 08:18:25.330002] UP_DRV:1 R1 WGB UPLINK mode stopped
[*08/16/2023 08:18:25.629405] UP_DRV:1 R1 Delete client FC:58:9A:17:B3:E7
[*08/16/2023 08:18:25.736718] UP_CFG:8 R1 configured for standard: 7
[*08/16/2023 08:18:25.989936] UP_CFG:4 R1 band 1 current power level: 1
[*08/16/2023 08:18:25.996692] UP_CFG:4 R1 band 1 set tx power level: 1
[*08/16/2023 08:18:26.003904] UP_DRV:1 R1 WGB uplink mode started
[*08/16/2023 08:18:26.872086] UP_EVT:4 Reset aux scan
[*08/16/2023 08:18:26.872096] UP_EVT:4 Pause aux scan on slot 2
[*08/16/2023 08:18:26.872100] SC_MST:4 R2 reset uplink scan state to idle
[*08/16/2023 08:18:26.872104] UP_EVT:4 Aux bring down vap - scan
[*08/16/2023 08:18:26.872123] UP_EVT:4 Aux bring up vap - serv
[*08/16/2023 08:18:26.872514] UP_EVT:4 R1 State STOPPED to SCAN_START
[*08/16/2023 08:18:26.872709] SC_MST:4 R1 Uplink Scan Started.
[*08/16/2023 08:18:26.884054] UP_EVT:8 R1 CH event 149
```



**Note** It might take a long time to display the **show wgb event** command output in console. Using **ctrl+c** to interrupt the printing will not affect log dump to memory.

The following clear command erases WGB events in memory:

```
#clear wgb event [basic|detail|trace|all]
```

To save all event logs to WGB flash, use the following command:

```
#copy event-logging flash
```

The package file consists of four separate log files for different log levels.

You can also save event log to a remote server by using the following command:

```
#copy event-logging upload <tftp|sftp|scp>: //A.B.C.D [/dir] [/filename.tar.gz]
```

The following example saves event log to a TFTP server:

```
APC0F8.7FE5.F3C0#copy event-logging upload
tftp://192.168.100.100/tftpuser/evtlog-2023-05-31_11:45:49.tar.gz
Starting upload of WGB config
tftp://192.168.100.100/tftpuser/evtlog-2023-05-31_11:45:49.tar.gz ...
It may take a few seconds. If longer, please cancel command, check network and try again.
100.0%
Config upload completed.
```



**Note** While the **copy event-logging upload <tftp|sftp|scp>: //A.B.C.D [/dir] [/filename.tar.gz]** command remains supported. Starting from UIW Release 17.17.1, we recommend using the below transfer commands to obtain more comprehensive diagnostic information.

Use the below task to configure remote server and protocol type (TFTP or SFTP) on the WGB to collect and transfer event logs.

- Use the **transfer upload mode {ftp|tftp}** command to select the protocol for log transfer.

```
Device#transfer upload mode sftp
```

- If using SFTP, use the **transfer upload username username password password** to configure the username and password.

```
Device#transfer upload username Cisco password Cisco123
```

- Use the **transfer upload server-ip remote-server-ip** to configure the remote server IP address.

```
Device#transfer upload server-ip 192.168.71.11
```

- (Optional) Use the **transfer upload server-ip remote-server-ip path remote-server-path** to configure the remote server path.

```
Device#transfer upload server-ip 192.168.71.11 path /upload/wgb
```



**Note** The above static configurations are persistent and will remain effective even after a device reload.

- Use the **transfer upload start** command to collect event logs and transfer them to the remote server.

```
Device#transfer upload start
```

Once the remote server is configured, the device collects and transfers the following data:

- The device collects core files for troubleshooting purposes.
- It gathers syslog files to monitor system events and activities.
- The WGB or uWGB running configuration is retrieved for configuration backup.
- Radio reset history is recorded to identify potential connectivity issues.
- Event logging data is transferred to track system performance and incidents.





## CHAPTER 3

# Control and Provisioning of Wireless Access Points

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- [Configuring Indoor Deployment, on page 91](#)
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## Overview

CAPWAP is an IEEE standard protocol that enables a wireless LAN controller to manage multiple APs and Wireless LAN Controllers (WLCs) to exchange control and data plane information over a secure communication tunnel.

CAPWAP only operates in Layer 3 and requires IP addresses to be present on both the APs and WLC. CAPWAP establishes tunnels on the UDP ports 5246 and 5247 for IPv4 and IPv6 respectively. It adds extra security with Datagram Transport Layer Security (DTLS) encryption.

DTLS serves as a protocol ensuring security between the AP and WLC, facilitating encrypted communication to prevent eavesdropping or tampering in potential man-in-the-middle attacks.

By default, DTLS secures the control channel for CAPWAP, encrypting all CAPWAP management and control traffic between the AP and WLC.

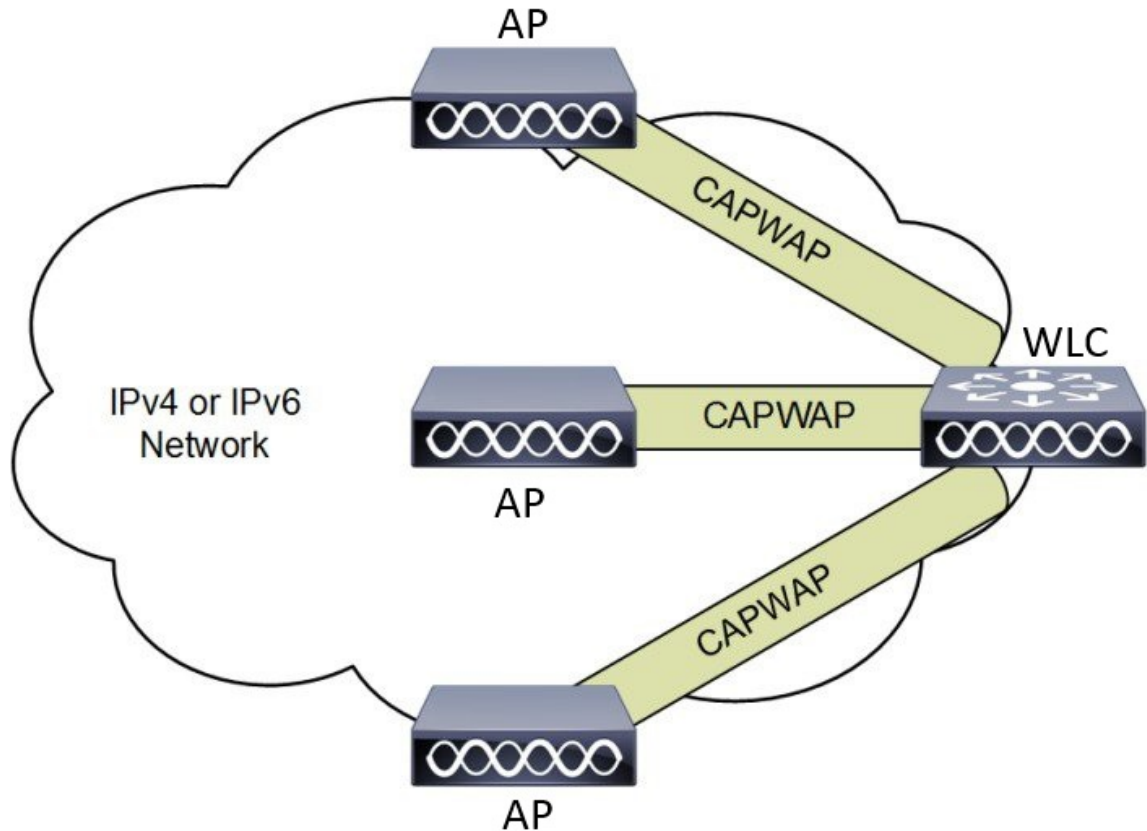
The data channel remains disabled by default, leaving client data moving between an AP and WLC unencrypted. Enabling CAPWAP data encryption is discretionary, and it necessitates the installation of a DTLS license on the WLC before activation on an AP.

If an AP does not support DTLS data encryption, DTLS is enabled only for the control plane, and a DTLS session for the data plane is not established

If an AP supports Data DTLS, it enables data DTLS after receiving the new configuration from the controller. The AP performs a DTLS handshake on port 5247 and after successfully establishing the DTLS session. All the data traffic (from the AP to the controller and the controller to the AP) is encrypted.

CAPWAP allows administrators to manage the entire wireless network from a central location. The IW9165E use the Internet Engineering Task Force (IETF) standard CAPWAP to communicate between the controller and other AP on the network.

*Figure 7: CAPWAP APs connected to a WLC*



## Provisioning certificate on Lightweight Access Point

The below stages describe Certificate Provisioning on a Lightweight Access Point (LAP):

1. **Certificate Request:** The LAP sends a certificate request to the controller to get a signed X.509 certificate.
2. **CA Proxy:** The controller acts as a CA proxy to facilitate the signing of the certificate request by the CA.
3. **Certificate Installation and Reboot:** Both the LSC CA and the LAP device certificates are installed in the LAP, and the system reboots automatically.
4. **JOIN Request:** After the reboot, the LAP sends the LSC device certificate to the controller as part of the JOIN request.
5. **JOIN Response and Validation:** The controller sends the new device certificate and validates the inbound LAP certificate with the new CA root certificate as part of the JOIN response.

### What's next

#### What to do next

Use LSC provisioning functionality to configure, authorize, and manage certificate enrollment with the existing PKI infrastructure for the controller and AP.

## Understanding CAPWAP Connectivity On AP

When CAPWAP is enabled, the first function is to initiate a discovery phase. Wireless APs search for a controller by sending discovery request messages. Upon receiving a discovery request, the controller replies with a discovery response. At this point, the two devices establish a secure connection using the Datagram Transport Layer Security (DTLS) protocol to exchange CAPWAP control and data messages.

By using CAPWAP discovery mechanisms, then AP sends a CAPWAP join request to the controller. The controller sends a CAPWAP join response to the AP that allows the AP to join the controller. When the AP joins the wireless controller, the wireless controller manages its configuration, firmware, control transactions, and data transactions.

The CAPWAP has two channels, namely control and data. The AP uses the control channel to send configuration messages, download images and client keys, or receive the context. The control channel has a single window in the current implementation. The APs must acknowledge every message sent from the controller in a single window. The APs does not transmit the next control packet until it acknowledges the earlier one.

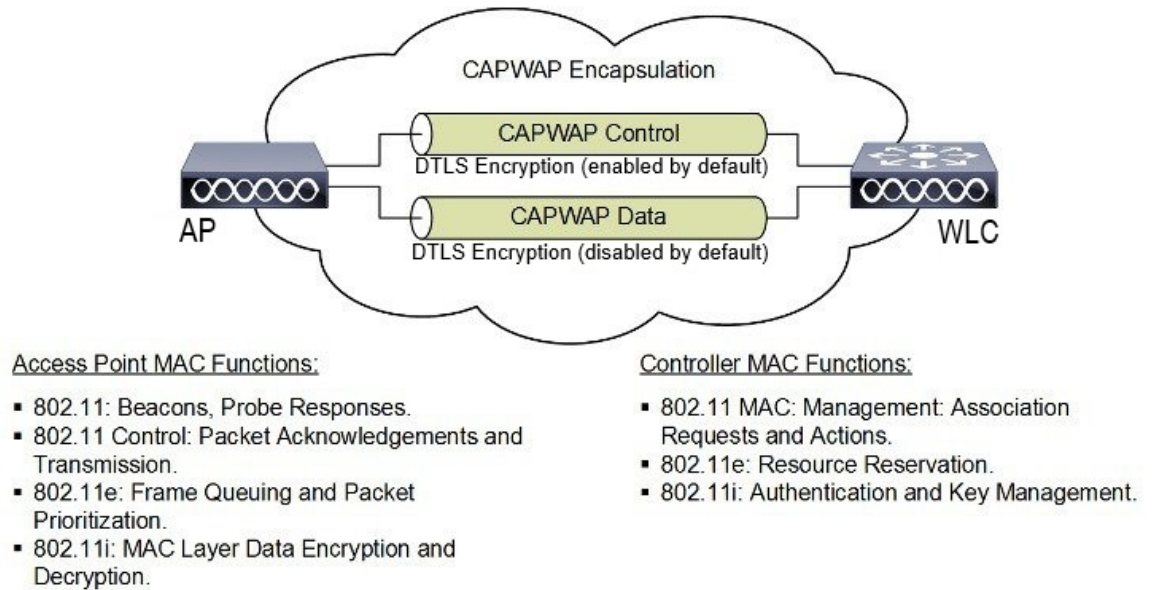
CAPWAP data channel facilitates the encapsulation and tunneling of user data traffic between APs and WLCs. This provide centralized management of user data flow, enabling the WLC to enforce policies, apply Quality of Service (QoS), and ensure security measures consistently across the wireless network. The user data is encapsulated within CAPWAP frames, allowing it to be transported between the APs and WLCs.

According to IETF, CAPWAP supports two modes of operation:

- **Split Media Access Control (MAC):** A key component of CAPWAP is the concept of a split MAC, where part of the 802.11 protocol operation is managed by the CAPWAP AP, while the remaining parts are managed by the WLC.

In split MAC mode, the CAPWAP protocol encapsulates all Layer 2 wireless data and management frames, which are then exchanged between the WLC and AP.

Figure 8: Split MAC Architecture



- **Local MAC:** Local MAC mode enables data frames to be locally bridged or tunneled as Ethernet frames.

Local MAC where all the wireless MAC functions are performed at the AP. The complete 802.11 MAC functions, including management and control frame processing, are resident on the APs.

In either mode, the AP processes Layer 2 wireless management frames locally and then forwards them to the controller.

## Reset Button Settings

The following reset actions are performed in the IW9165E 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.

- Keep the button pressed for < 20 seconds for full reset.
- Keep the button pressed for > 20 seconds and < 60 seconds for full factory reset (clear fips flag).

## Ethernet Port Usage On CAPWAP Mode

The Catalyst IW9165E supports up to a 3.6 Gbps PHY data rate with two 2x2 multiple input and multiple output (MIMO) and two ethernet ports (2.5G mGig and 1G).

Catalyst IW9165E have below internal port mapping rules:

- Wired0 – One mGig (2.5 Gbps) ethernet ports with 802.3af, 802.3at, 802.3bt PoE support.



**Note** The wired0 port is used as CAPWAP uplink port in the AP local/Flexconnect mode.

- Wired1 – 1Gig ethernet Lan Port.



**Note** Starting from 17.14.1 release, RLAN feature is not supported in the wired1 port.

## Configuring Indoor Deployment

The IW9165E supports indoor and outdoor deployment for the regulatory domain -B (USA), -E (EU), -A (Canada), -Z (Australia, New Zealand).

By default, AP deployment mode is indoor.

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

**Table 8: Radio 6G power mode support table**

| AP Deployment Mode | 6G Deployment Mode | Low Power Indoor support | Standard Power support |
|--------------------|--------------------|--------------------------|------------------------|
| Indoor AP          | Outdoor            | No                       | Yes                    |



**Note** Outdoor mode can be used indoors, but indoor mode cannot be used outdoors because 5150–5350 MHz channels are indoor-only in -E countries.

For more information about Configuring AP Deployment Mode on the Wireless Controller, See [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).

The command triggers an AP reboot. After AP registers to the wireless controller after rebooting, you need to assign corresponding country code to the AP.

## Verifying Indoor Deployment

To verify whether the indoor deployment is enabled or not on the WLC.

Run the **#show ap name <AP\_Name> config general | inc Indoor** command.

- When indoor mode is enabled, the show command provides the following output:

```
#show ap name <AP_Name> config general | inc Indoor
AP Indoor Mode : Enabled
```

- When indoor mode is disabled, the show command provides the following output:

```
#show ap name <AP_Name> config general | inc Indoor
AP Indoor Mode : Disabled
```

To check the status of the indoor deployment on AP, run the **show controllers Dot11Radio [1|2]** command.

- When indoor mode is enabled, the show command provides the following output:

```

Device#show controllers Dot11Radio [1|2]
...
Radio Info Summary:
=====
Radio: 5.0GHz
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

```




---

**Note** In the command output, "-Ei" indicates the indoor mode is enabled

---

- When indoor mode is disabled, the show command provides the following output:

```

Device#show controllers Dot11Radio [1|2]
...
Radio Info Summary:
=====
Radio: 5.0GHz
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

```




---

**Note** In the command output, "-E" indicates that indoor mode is disabled.

---

The CLI output also shows the supported channels.

## AP Radio Slot

Starting from Cisco Unified Industrial Wireless Software Release 17.14.1, Cisco Catalyst IW9165E now has one dedicated 2x2 5GHz Wi-Fi radio and Dual Band (XOR) radio serving for 5 GHz and 6 GHz 2x2 radios bands.

The Catalyst IW9165E has the option to switch between 5G and 6G band. To switch between 5G and 6G band use the following CLI command.

```
ap name <ap-name> dot11 dual-band band 6ghz/5ghz
```




---

**Note** By default, admin state is disabled.

Slot 2 XOR radio is fixed to 5G.

---

Table 9: AP Wi-Fi radio architecture modes

| Mode    | 5 GHz<br>Slot 1             | 5/6 GHz<br>Slot 2             |
|---------|-----------------------------|-------------------------------|
| 5G + 5G | 5GHz 2x2:2SS (20/40/80 MHz) | 5G 2x2:2SS (20/40/80/160 MHz) |
| 5G + 6G | 5GHz 2x2:2SS (20/40/80 MHz) | 6G 2x2:2SS (20/40/80/160 MHz) |

## Supporting Fixed Domains and Country Codes

The ROW regulatory 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 IW9165E access points are described in this section.

### Supported Fixed Domains

| Domain | Country Codes                 |
|--------|-------------------------------|
| A      | CA (Canada)                   |
| B      | US (United States of America) |

| Domain | Country Codes |
|--------|---------------|
| E      |               |

| Domain | Country Codes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | <ul style="list-style-type: none"> <li>• AT (Austria)</li> <li>• AT (Austria)</li> <li>• BE (Belgium)</li> <li>• BG (Bulgaria)</li> <li>• HR (Croatia)</li> <li>• CY (Cyprus)</li> <li>• CZ (Czech Republic)</li> <li>• DK (Denmark)</li> <li>• EE (Estonia)</li> <li>• FI (Finland)</li> <li>• FR (France)</li> <li>• DE (Germany)</li> <li>• GR (Greece)</li> <li>• HU Hungary)</li> <li>• IS (Iceland)</li> <li>• IE (Ireland)</li> <li>• IT (Italy)</li> <li>• LV (Latvia)</li> <li>• LI (Liechtenstein)</li> <li>• LT (Lithuania)</li> <li>• LU (Luxembourg)</li> <li>• MT (Malta)</li> <li>• NL (Netherlands)</li> <li>• NO (Norway)</li> <li>• PL (Poland)</li> <li>• PT (Portugal)</li> <li>• RO (Romania)</li> <li>• SK (Slovak Republic)</li> <li>• SI (Slovenia)</li> <li>• ES (Spain)</li> <li>• SE (Sweden), and</li> </ul> |

| Domain | Country Codes                                                                                       |
|--------|-----------------------------------------------------------------------------------------------------|
|        | <ul style="list-style-type: none"> <li>• CH (Switzerland).</li> </ul>                               |
| F      | ID (Indonesia)                                                                                      |
| Q      | JP (Japan)                                                                                          |
| Z      | <ul style="list-style-type: none"> <li>• AU (Australia) and</li> <li>• NZ (New Zealand).</li> </ul> |

#### Catalyst IW9165 Supported Country Codes (ROW)

| Domain | Country Codes                                                                                                                                                  |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ROW    | <ul style="list-style-type: none"> <li>• CL (Chile)</li> <li>• KR (Korea, Republic of)</li> <li>• GB (United Kingdom), and</li> <li>• VN (Vietnam).</li> </ul> |

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](#).

## Configuring Radio Antenna Settings

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

The IW9165E is compatible with Self Identifiable Antenna (SIA) antennas for the 6G band. Antenna ports 1 and 3 can support SIA antennas. For more information on antennas, see the [Cisco Catalyst IW9165E Rugged Access Point and Wireless Client Hardware Installation Guide](#).



**Note** A power cycle is mandatory after the first installation of the SIA antenna.  
SIA supports antenna IW-ANT-OMV-2567-N and IW-ANT-OMH-2567-N only.

**Table 10: Antenna Gain (dBm)**

| 5 GHz Slot 1     | 5 GHz Slot 2     | 6 GHz Slot 2 |
|------------------|------------------|--------------|
| 3 4 7 8 10 13 15 | 3 4 7 8 10 13 15 | 7            |

The following sections describe CLI commands to verify the SIA test.

To verify the SIA status on the controller, run **show ap config slots <AP>** command.

```
Device#show ap config slot ap_name
```

```

show ap config slots AP2CF8.9B1C.CE78
Cisco AP Name : AP4C42.1E51.A144
Attributes for Slot 2
SIA Status : Present(RPTNC)
SIA Product ID : IW-ANT-OMV-2567-N

```

## AFC Support for 6G Standard Power Mode

The Cisco Catalyst IW9165E supports the Automated Frequency Coordination (AFC) 6 GHz Standard Power mode. A standard power AP joins the system. Before enabling standard power, the AP must get the available frequencies and the power in each frequency range from the AFC system.

The AFC system computes the available frequencies and maximum allowable power based on the information provided by the regulatory body (FCC for the United States). The response is sent back to controller, which may assign a standard power channel to the AP based on the allowed channel list returned by the AFC system.

Standard Power AP coordinate through an AFC service. The AFC accesses information and, along with the AP's geographical location and antenna characteristics, creates a topographical propagation map modeling the AP's interference radius. This map allows you to assign maximum transmission power and coordinate/configure the channel settings to avoid interference.

**Table 11: Radio 6 GHz power mode support**

| AP Deployment Mode | 6G Deployment Mode | Low-power Indoor Support | Standard Power Support |
|--------------------|--------------------|--------------------------|------------------------|
| Indoor AP          | Outdoor            | No                       | Yes                    |

The transmission power is limited to a maximum of 36 dB Effective Isotropic Radiated Power (EIRP), and APs must be coordinated through an AFC service. These APs are allowed to operate in the UNII-5 (5.925-6.425 GHz) and UNII-7 (6.525-7.125 GHz) in the -B (U.S) domain.

**Table 12: 6 GHz Target Power**

| Max Conducted per Path Power (SP/AFC) |        | Antenna Gain | Tx x Rx Chains | Max EIRP (SP/AFC) |
|---------------------------------------|--------|--------------|----------------|-------------------|
| 20-80Mhz                              | 160Mhz |              |                |                   |
| 17 dBm                                | 17 dBm | 7 dBi        | 2x2            | 27 dBm            |

## Verifying AFC Status on AP

To verify the AFC request and response data on AP, run the **show rrm afc** command.

```

Device#show rrm afc
Location Type: 1
Deployment Type: 2
Height: 129
Uncertainty: 5
Height Type: 0
Request Status: 5

```

```
Request Status Timestamp: 2023-08-31T06:20:17Z
Request Id Sent: 5546388983266789933
Ellipse 1: longitude: -121.935066 latitude: 37.512830 major axis: 43 minor axis:
 9 orientation: 36.818100
AFC Response Request ID: 5546388983266789933
AFC Response Ruleset ID: US_47_CFR_PART_15_SUBPART_E
```

To verify the current operating power mode, run the **show controllers dot11Radio 2 | i Radio** command.

```
Device#show controllers dot11Radio 2 | i Radio
Dot11Radio2 Link encap:Ethernet HWaddr 24:16:1B:F8:06:C0
Radio Info Summary:
Radio: 6.0GHz (SP)
```

## GNSS Support

Global Navigation Satellite System (GNSS) is supported on IW9165E. The AP tracks GPS information for devices deployed in the outdoor environment and sends the GNSS information to the wireless controller.

Use the following command to display the GNSS information on the AP:

```
ap# show gnss info
```

Use the following commands to display the GPS location of the AP:

```
controller# show ap geolocation summary
controller# show ap name <Cisco AP> geolocation detail
```

## Information About Antenna Disconnection Detection

Having multiple antennas on the transmitter and receiver of an access point (AP) results in better performance and reliability. Multiple antennas improve reception through the selection of the stronger signal or a combination of individual signals at the receiver. Therefore, detection of an impaired antenna or physical breakage of an antenna is critical to the reliability of APs.

The Antenna Disconnection Detection feature is based on the signal strength delta across the antennas on the receiver. If the delta is more than the defined limit for a specific duration, the antenna is considered to have issues.

For every detection time period that you configure, the AP sends an Inter-Access Point Protocol (IAPP) message that carries the antenna condition. This message is sent only once when the issue is detected and is displayed in the controller trap messages, SNMP traps, and controller debug logs.

### Configuration Workflow

1. Configure APs.
2. Configure an AP profile.
3. Enable the feature in AP profile.
4. Configure feature parameters.
5. Verify the configuration.

For more information about Configuring Antenna Disconnection Detection on the Wireless Controller, See [Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide](#).

## Verifying Antenna Disconnection Detection

To verify the Antenna Disconnection Detection feature configuration on an AP, use the following command:

```
9800-Controller#sh ap name AP4C42.1E51.A144 config general
```

```
Cisco AP Name : AP4C42.1E51.A144
=====

Cisco AP Identifier : 8c84.4292.f840
Country Code : Multiple Countries : US,CN,GB,HK,DE,IN,CZ,NZ
Regulatory Domain Allowed by Country : 802.11bg:-ACE^ 802.11a:-ABCDEHNSZ^
802.11 6GHz:-BEZ^
Radio Authority IDs : None
AP Country Code : CZ - Czech Republic
AP Regulatory Domain
 802.11bg : -E
 802.11a : -E
MAC Address : 8c84.4292.f840
IP Address Configuration : DHCP
IP Address : 9.9.33.3
IP Netmask : 255.255.255.0
Gateway IP Address : 9.9.33.1
Fallback IP Address Being Used :
Domain :
Name Server :
CAPWAP Path MTU : 1485
Capwap Active Window Size : 1
```

To verify the Antenna Disconnection Detection feature configuration on an AP profile, use the following command:

```
9800-Controller#show ap profile name ap-profile detailed
```

```
AP Profile Name: ap-profile
.
.
.
AP broken antenna detection:
 Status : ENABLED
 RSSI threshold : 40
 Weak RSSI : -80
 Detection Time : 120
```

## Troubleshooting

The document provides use cases to understand the reason for the Control and Provisioning of Wireless Access Points (CAPWAP)/Lightweight Access Point Protocol (LWAPP) tunnel break between Access Points (APs) and the Wireless Controller. For more information, see [Troubleshoot Access Point Disassociation from Controller](#)



**Note** There could be some changes in the software or hardware that can cause commands to stop working, the syntax to change, or GUIs and CLIs to look different from one release to another.

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The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

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