Cambium Networks™

SOFTWARE USER GUIDE

ePMP

Release 5.x.x

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About This Guide

This guide describes the planning, installation, configuration, and operation of the Cambium ePMP Series of point-to-multipoint and point-to-point wireless Ethernet systems. It is intended for use by the system designer, system installer, and system administrator.

For system configuration, monitoring, and fault finding, see:

- Using the Device Management Interface

For operation and troubleshooting, see:

- Operation and Troubleshooting

Precautionary statements

This section explains the precautionary statements used in this document.

Warning

Precautionary statements with the Warning tag precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:

⚠

> **Warning**
>
> Text and consequence for not following the instructions in the warning.

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 36 cm between the radiator and your body.

IC Interference Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs / récepteurs exempts de licence qui sont conformes au (x) RSS (s) exemptés de licence d'Innovation, Sciences et Développement économique Canada. L'opération est soumise aux deux conditions suivantes:

(1) Cet appareil ne doit pas provoquer d'interférences.

(2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

IMPORTANT NOTE

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

IC MPE distance: 20 cm

Warning

Devices shall not be used for control of or communications with unmanned aircraft systems.

Les appareils ne doivent pas être utilisés pour contrôler ou communiquer avec des systèmes d'aéronefs sans pilote.

Warning

Operation on oil platforms, automobiles, trains, maritime vessels and aircraft shall be prohibited.

L'exploitation sur les plates-formes pétrolières, les automobiles, les trains, les navires maritimes et les aéronefs est interdite.

Warning

The antenna height shall be determined by the installer or operator of the standard-power access point or fixed client device, or by automatic means. This information shall be stored internally in the device. Provision of accurate device information is mandatory.

La hauteur de l'antenne doit être déterminée par l'installateur ou l'opérateur du point d'accès à puissance standard ou de l'appareil client fixe, ou par des moyens automatiques. Ces informations doivent être stockées en interne dans l'appareil. La fourniture d'informations précises sur l'appareil est obligatoire.

Attention

Precautionary statements with the Attention tag precede instructions that are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. An attention statement has the following format:

Attention

Text and consequence for not following the instructions.

Note

Precautionary statements with the Note tag indicate the possibility of an undesirable situation or provide additional information to help the reader understand a topic or concept. A note has the following format:

Note

Text.

Compatibility Matrix

This Release 5.x.x is applicable to the following products:

- ePMP 4600
- ePMP 4500
- ePMP 4500L
- ePMP 4500C
- ePMP 4600L
- Force 4625
- Force 4525
- Force 4525L
- Force 4600C
- ePMP 3000x
- Force 300-xx

Backward Compatibility Matrix

A backward compatibility matrix for 5.x.x shows how newer software versions work with older hardware, software, or system components. It helps users determine which older systems are compatible with updates, ensuring smooth upgrades and minimizing potential issues.

Model	Software Version 4.x.x	Software Version 5.x.x
AC Platform		
Force 300-25	Supported	Supported
ePMP 3000	Supported	Supported
Force 300-16	Supported	Supported
ePMP 3000L	Supported	Supported
Force 300	Supported	Supported
Force 300-13	Supported	Supported
Force 300-19	Supported	Supported
Force 300-19R	Supported	Supported
ePMP Client MAXrP	Supported	Supported
Force 300-25	Supported	Supported
Force 300-25L	Supported	Supported
Force 300 CSML	Supported	Supported

Model	Software Version 4.x.x	Software Version 5.x.x
Force 300-13L	Supported	Supported
AX Platform		
ePMP 4600	-	Supported
ePMP 4500	-	Supported
ePMP 4500C	-	Supported
ePMP 4600L	-	Supported
ePMP 4500L	-	Supported
Force 425	-	Supported
Force 400C	-	Supported
Force 4600C	-	Supported
Force 4518	-	Supported
Force 4525	-	Supported
Force 4525L	-	Supported
Force 4625	-	Supported

MU-MIMO

The ePMP MU-MIMO AP is equipped either with a sector antenna array or a pseudo-omni antenna. Antenna diversity allows simultaneous DL transmissions for two subscriber modules for MU-MIMO. As such, the ePMP 4600 AP's DL throughput capacity is significantly increased versus the ePMP 1000/2000 APs.

This is a contrast to a traditional wireless system, where two subscribers cannot communicate on the same channel to the same AP at the same time without causing significant self-interference and degrading the overall wireless network performance.

OFDM and channel bandwidth

ePMP transmits using Orthogonal Frequency Division Multiplexing (OFDM). This wideband signal consists of many equally spaced sub-carriers. Although each subcarrier is modulated at a low rate using conventional modulation schemes, the resultant data rate from all the sub-carriers is high.

The channel bandwidth of the OFDM signal is 20 MHz, 40 MHz, or 80 MHz, based on operator configuration. For 6 GHz, 160 MHz bandwidth is also supported.

Each channel is offset in center frequency from its neighboring channel by 5 MHz.

Using the Device Management Interface

This section describes all configuration and alignment tasks that are performed while deploying the ePMP system.

Perform the following tasks while configuring the ePMP devices:

- Preparing for configuration
- Connecting to the unit
- Using the web interface
- Using the installation wizard - Access Point
- Using the installation wizard - Subscriber Module
- Using the menu options

Preparing for configuration

This section describes the actions to be performed before proceeding with the unit configuration. It has the following topics:

- Safety precautions
- Regulatory compliance

Safety precautions

All national and local safety standards must be followed while configuring the units.

> **Warning**
>
> Ensure that personnel is not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in Compliance with safety standards, in particular, the minimum separation distances.

Observe the following guidelines:

- Never work in front of the antenna when the device is powered on.
- Always switch off the power supply before connecting or disconnecting the Ethernet cable from the module.

Regulatory compliance

All applicable radio regulations must be followed while configuring the units and aligning the antennas. For more information, refer to Compliance with safety standards section.

Connecting to the unit

To connect the unit to management PC, perform the following procedures:

- Configuring the management PC
- Connecting to the a PC and powering up

Configuring the management PC

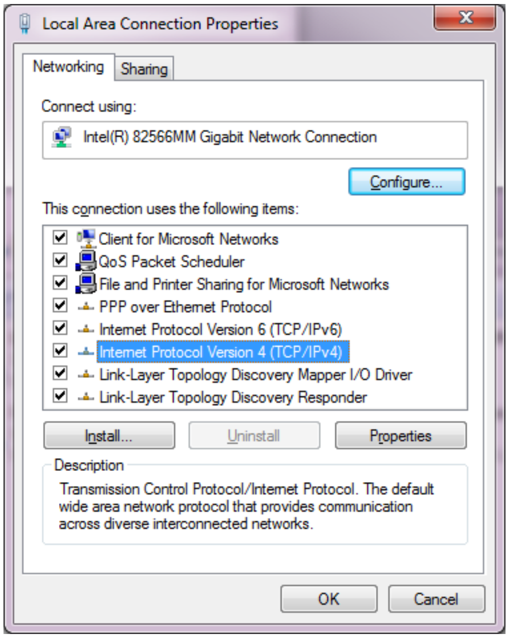
Perform the following steps to configure the local management PC to communicate with the ePMP module:

1. Select **Properties** for the Ethernet port.

   For Windows 7, navigate to **Control Panel > Network and Internet > Network Connections > Local Area Connection**.

2. Select the **Internet Protocol (TCP/IP)** option.

3. Click **Properties**.



Connect using:

Intel(R) 82566MM Gigabit Network Connection

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ QoS Packet Scheduler
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ PPP over Ethernet Protocol
- ☑ Internet Protocol Version 6 (TCP/IPv6)
- ☑ Internet Protocol Version 4 (TCP/IPv4)
- ☑ Link-Layer Topology Discovery Mapper I/O Driver
- ☑ Link-Layer Topology Discovery Responder

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

4. Enter an IP address that is valid for the 169.254.1.x network, avoiding 169.254.1.1. For example, 169.254.1.100.

5. Enter a subnet mask of **255.255.255.0**.

   Leave the default gateway blank.

6. Click **OK** and then click **Close**.

Connecting to a PC and powering up

Connect a management PC directly to the ePMP device to configure, align, and to power up the ePMP device. To connect the PC to the device, perform the following steps:

1. Verify that the device and power supply are connected correctly (the device Ethernet port is connected to the power supply Ethernet power port (**Gigabit Data+Power** or **10/100Mbit Data+Power**).

2. Connect the PC Ethernet port to the LAN (**Gigabit Data** or **10/100Mbit Data**) port of the power supply using a standard (not crossed) Ethernet cable.

3. Apply main or battery power to the power supply. The Green power LED must blink continuously.

Note

If the power and Ethernet LEDs do not blink continuously, refer to Testing hardware section to troubleshoot.

Using the web interface

This section describes the usage of ePMP web interfaces.

- Logging into the web interface

Logging into the web interface

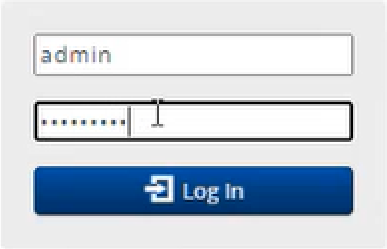
Perform the following procedure to login into the web interface as a system administrator.

Equipment and tools

- ePMP device connected to the power supply by Ethernet cable.
- PC is connected to the power supply by Ethernet cable.
- Power supply powered up.
- Minimum supported browser versions: Chrome v29, Firefox v24, Internet Explorer 10, Safari v5.

Procedure

1. Verify that the device and power supply are connected correctly (the device Ethernet port is connected to the power supply Ethernet power port (**Gigabit Data+Power** or **10/100Mbit Data+Power**).
2. Configure the host machine with an IP address in the 169.254.1.x subnet (excluding 169.254.1.1).
3. Configure the host machine with an IP address in the 169.254.1.x subnet (excluding 169.254.1.1).
4. Connect the power supply to power mains.
5. From the browser, navigate to the device's default IP address **169.254.1.1**.



admin

•••••••••

6. Log in with **admin** username and **admin** password.

Note

If **Device IP address Mode** is set to **DHCP** and the device is unable to retrieve IP address information via DHCP, the device management IP is set to 192.168.0.1 (AP Mode), 192.168.0.2 (SM mode), or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port at 169.254.1.1.

Attention

All the new ePMP devices contain default username and password configurations. It is recommended to change the password configurations immediately. These passwords is configured in the management UI section **Configuration > System > Account Management**.

Using the installation wizard – Access Point

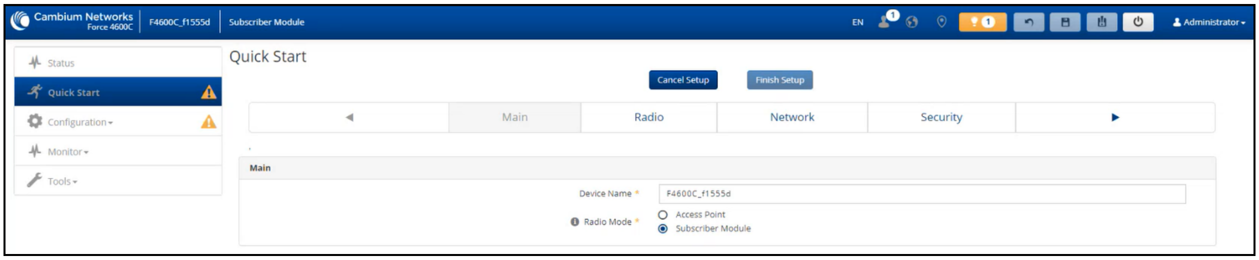
ePMP device provides a guided configuration mechanism for configuring key parameters for the link operation.

This setup can be accessed from the **Installation** page by clicking on the Start Setup button.

Click **Finish Setup** to commit the changes to the device.

Step 1: Main system parameters

Figure 1 shows the Main system parameters page.



Device Name * F4600C_f1555d

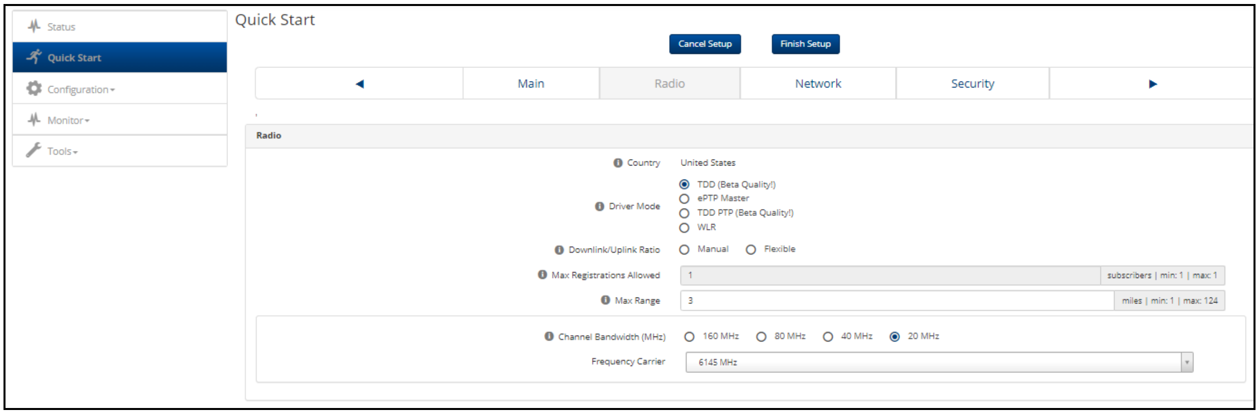
Radio Mode * ○ Access Point ● Subscriber Module

Figure 1: *Quick Start page*

Attribute	Description
Main	
Device Name	The configured identifier used in NMS such as cnMaestro.
Radio Mode	**Access Point**: Select if the radio is an access point. **Subscriber Module**: Select if the radio is a subscriber module.

Step 2: Radio parameters

Figure 2 shows the Radio parameters page.



Country United States

Driver Mode ● TDD (Beta Quality!) ○ ePTP Master ○ TDD PTP (Beta Quality!) ○ WLR

Downlink/Uplink Ratio ○ Manual ○ Flexible

Max Registrations Allowed 1 subscribers | min: 1 | max: 1

Max Range 3 miles | min: 1 | max: 124

Channel Bandwidth (MHz) ○ 160 MHz ○ 80 MHz ○ 40 MHz ● 20 MHz

Frequency Carrier 6145 MHz

Figure 2: *Radio parameters page*

Attribute	Description
Radio	
Country	Defines the country code that is used by the device. The country code of the Subscriber Module follows the country code of the associated AP unless it is an FCC SKU in which case the country code is the United States or Canada. Country code defines the regulatory rules in use for the device.
Driver Mode	**TDD**: The device is operating in point-to-multipoint (PMP) mode using TDD scheduling. The AP can GPS synchronize in this mode. **ePTP Master**: The AP is operating as a Master in point-to-point mode. The AP does not support GPS Synchronization in this mode but can provide significantly lower latency than other modes. QoS (MIR and traffic priority) capability and Link Quality/Capacity indicators are not available in this mode. **TDD PTP**: The AP is operating in point-to-point (PTP) mode using TDD scheduling. The AP can GPS synchronize in this mode.
Downlink/Uplink Ratio	The schedule of downlink traffic to uplink traffic on the radio link. The three options, **75/25**, **50/50,** and **30/70**, allow the radio to operate in a fixed ratio on every frame. In other words, this ratio represents the amount of the total radio link's aggregate throughput that will be used for downlink resources, and the amount of the total radio link's aggregate throughput that will be used for uplink resources.
Max Range	This parameter represents the cell coverage radius. Subscriber Modules outside the configured radius does not able to connect. It is recommended to configure Max Range to match the actual physical distance of the farthest subscriber.
Channel Bandwidth	Configure the channel size used by the radio for RF transmission.
Frequency Carrier	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the **Country** parameter. Ensure that a thorough spectrum analysis is completed before configuring this parameter.

Testing the hardware

This section describes the procedure to test the hardware when it fails while starting or during operation.

Before start testing the hardware, verify that all the outdoor cables which connects the device to equipment inside the building, are of the supported type, as defined in Ethernet cabling.

Power LED is OFF

Meaning: Either the power supply is not receiving power from the AC/DC outlet, or there is a wiring fault in the unit.

Action: Remove the device cable from the PSU and observe the effect on the power LED. If the power LED does not illuminate, confirm that the main power supply is working, for example, check the plug. If the power supply is working, report a suspected power supply fault to Cambium Networks.

Checking the power supply LED

When the power supply is connected to the main power supply, the expected LED behavior is:

- The power LED illuminates continuously in Green color.

If the expected LED operation does not occur, or if a fault is suspected in the hardware, check the LED states and choose the correct test procedure.

- Power LED is OFF
- Ethernet LED is OFF

Ethernet LED is OFF

Meaning: There is no Ethernet traffic between the device and the power supply.

Action: The fault may be in the LAN or device cable:

- Remove the LAN cable from the power supply, examine it, and confirm it is not faulty.
- If the PC connection is working, remove the AP/SM cable from the power supply, examine it, and check that the wiring to pins 1, 2 and 3, 6 are correct and not crossed.

Test Ethernet packet errors reported by the device

Login to the device and click **Monitor** > **Performance**. Click **Reset System Counters** at the bottom of the page and wait until LAN RX - Total Packet Counter has reached 1 million. If the counter does not increment or increments too slowly, because for example the ePMP system is newly installed and there is no offered Ethernet traffic, then exit this procedure and consider using the Test ping packet loss procedure.

Check the **LAN RX - Error Packet Counter** statistic. The test has passed if this is less than 10.

Test Ethernet packet errors reported by managed switch or router

If the device is connected to a managed Ethernet switch or router, it may be possible to monitor the error rate of Ethernet packets. Refer to *ePMP User Guide* of the managed network equipment. The test has passed if the rate of packet errors reported by the managed Ethernet switch or router is less than ten in one million packets.

Test ping packet loss

Using a computer, it is possible to generate and monitor packets lost between the power supply and the AP/SM. This can be achieved by executing the Command Prompt application which is supplied as standard with Windows and Mac operating systems.

> **Attention**
>
> This procedure disrupts network traffic carried by the device under test.

1. Ensure that the IP address of the computer is configured appropriately for connection to the device under test, and does not conflict with other devices connected to the network.
2. If the power supply is connected to an Ethernet switch or router then connect the computer to a spare port, if available.
3. If it is not possible to connect the computer to a spare port of an Ethernet switch or router, then the power supply must be disconnected from the network in order to execute this test:
    - Disconnect the power supply from the network.
    - Connect the computer directly to the LAN port of the power supply.

4. On the computer, open the Command Prompt application.

5. Send 1000 ping packets of length 1500 bytes. The process takes 1000 seconds, which is approximately 17 minutes.

   If the computer is running a Windows operating system, this is achieved by typing (for an IPv6 address, use the **ping6** command):

   ```
   ping -n 1000 -l 1500 <ipaddress>
   ```

   where <ipaddress> is the IP address of the AP or SM under test.

   If the computer is running a MAC operating system, this is achieved by typing:

   ```
   ping -c 1000 -s 1492 <ipaddress>
   ```

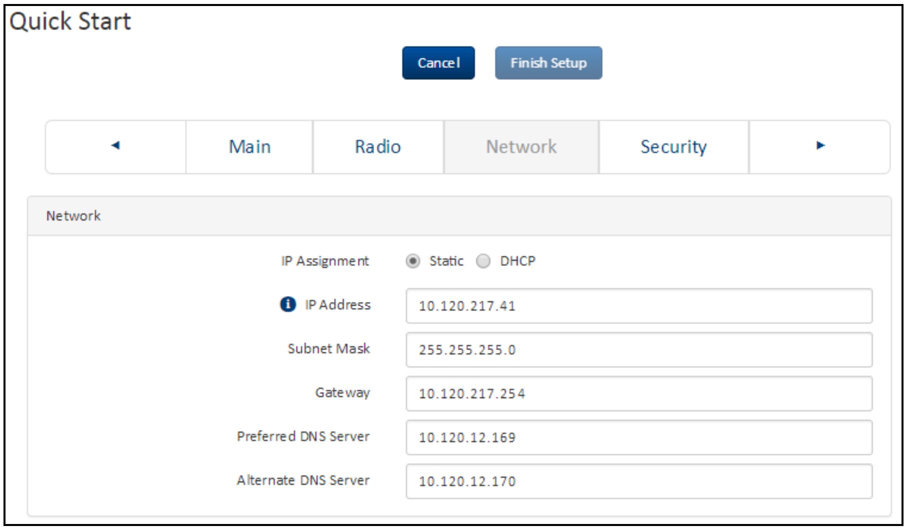
   where <ipaddress> is the IP address of the AP/SM under test.

6. Record the number of ping packets are lost. This is reported by Command Prompt on completion of the test.

   The test has passed if the number of lost packets is less than 2.

Step 3: Network parameters

Figure 3 shows the Network parameters page.



Quick Start

Network

IP Assignment ● Static ○ DHCP

IP Address 10.120.217.41

Subnet Mask 255.255.255.0

Gateway 10.120.217.254

Preferred DNS Server 10.120.12.169

Alternate DNS Server 10.120.12.170

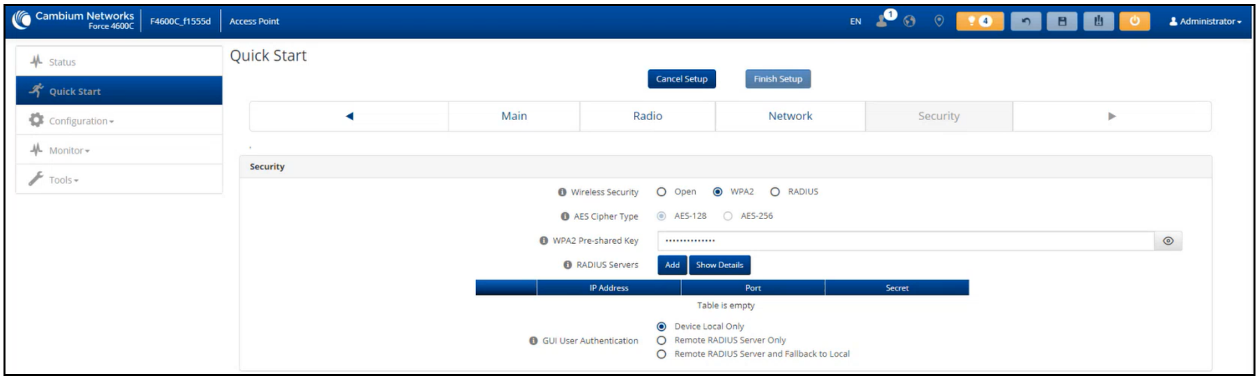
Figure 3: *Network parameters page*

Attribute	Description
Network	
IP Assignment	**Static:** Device management IP addressing is configured manually in fields **IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server**. **DHCP:** Device management IP addressing (**IP address, Subnet Mask, Gateway, and DNS Server**) is assigned via a network DHCP server, and parameters **IP Address, Subnet Mask, Gateway, Preferred DNS Server,** and **Alternate DNS Server** are not configurable.
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Attribute	Description
	If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (AP) or 192.168.0.2 (SM).
Subnet Mask	Defines the address range of the connected IP network. For example, if the **IP Address** is configured to **192.168.2.1** and **Subnet Mask** is configured to **255.255.255.0**, the device will belong to subnet **192.168.2.X**.
Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.

Step 4: Security parameters

Figure 4 shows the Security parameters page.



Security

Wireless Security ○ Open ● WPA2 ○ RADIUS

AES Cipher Type ● AES-128 ○ AES-256

WPA2 Pre-shared Key ••••••••••••••

RADIUS Servers

	IP Address	Port	Secret

Table is empty

GUI User Authentication
● Device Local Only
○ Remote RADIUS Server Only
○ Remote RADIUS Server and Fallback to Local

Figure 4: *Security parameters page*

Attribute	Description
Network	
Wireless Security	**Open:** All Subscriber Module devices requesting network entry are allowed registration. **WPA2:** The WPA2 mechanism provides AES radio link encryption and Subscriber Module network entry authentication. When enabled, the Subscriber Module must register using the Authentication Pre-shared Key configured on the AP and Subscriber Module. **RADIUS**: Enables Subscriber Module authentication through a pre-configured Radius server.
AES Cipher Type	**AES-128:** A symmetric encryption algorithm that uses a 128-bit key to convert plain text into Cipher. **AES-256:** A symmetric encryption algorithm that uses a 256-bit key to convert plain text into Cipher.
WPA2 Pre-shared Key	Configure this key on the AP, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.
RADIUS Servers	Up to three RADIUS servers can be configured on the device with the following attributes:

Attribute	Description
	IP Address: IP Address of the RADIUS server on the network. **Port:** The RADIUS server port. The default is 1812. **Secret:** Secret key that is used to communicate with the RADIUS server.
GUI User Authentication	This parameter applies to both the AP and its registered SMs. **Device Local Only:** The device GUI authentication is local to the device using one of the accounts configured under **Configuration > System > Account Management**. **Remote RADIUS Server Only:** The device GUI authentication is performed using a RADIUS server. **Remote RADIUS Server and Fallback to Local:** The device GUI authentication is performed using a RADIUS server. Upon failure of authentication through a RADIUS server, the authentication falls back to one of the local accounts configured under **Configuration > System > Account Management**.

Using the installation wizard – Subscriber Module

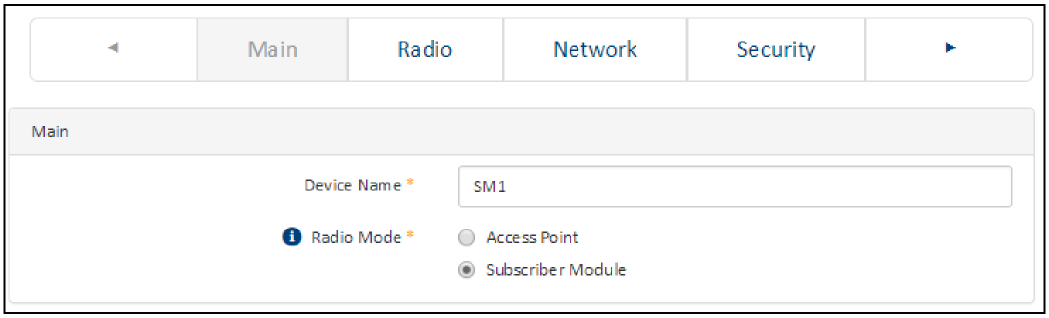
The ePMP device features the guided configuration mechanism for configuring key parameters for link operation.

This setup is accessed on the **Installation** page by clicking on the **Start Setup** Start Setup button.

Click **Finish Setup** to commit the changes to the device.

Step 1: Main system parameters

Figure 5 shows the Main system parameters page.



Main

Device Name * SM1

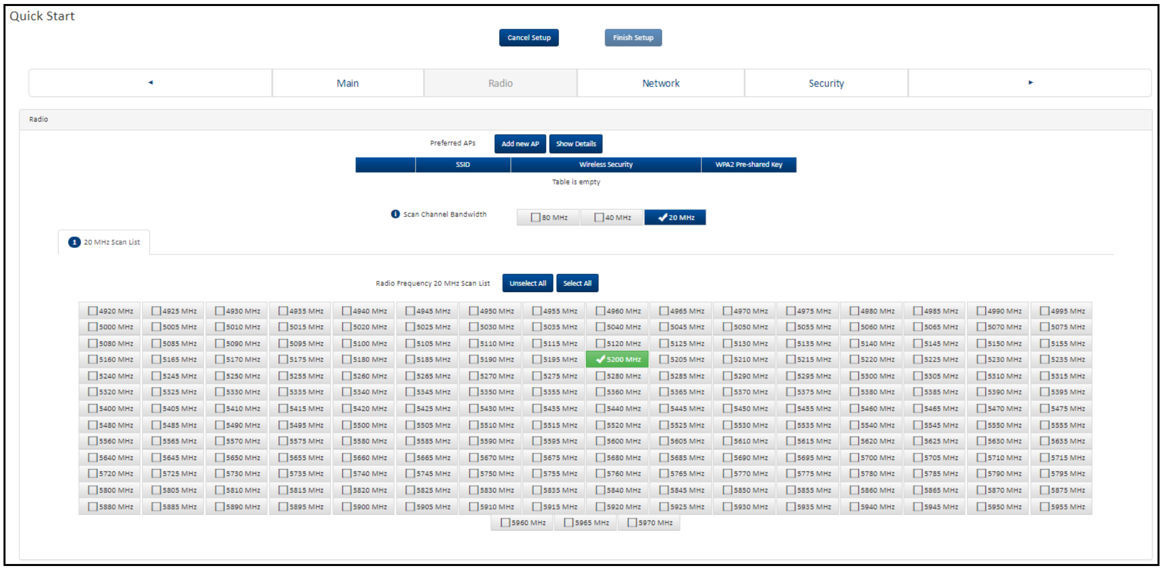
Radio Mode * ○ Access Point ● Subscriber Module

Figure 5: *Main system parameters page*

Attribute	Description
Main	
Device Name	The configured identifier used in NMS such as cnMaestro.
Radio Mode	This parameter controls the function of the device - All ePMP devices are configured to operate as an **Access Point** (AP) or **a Subscriber Module** (SM).

Step 2: Radio parameters

Figure 6 shows the Radio parameters page.



Quick Start

Radio

Preferred APs

	SSID	Wireless Security	WPA2 Pre-shared Key

Table is empty

Scan Channel Bandwidth □ 80 MHz □ 40 MHz ✓ 20 MHz

Radio Frequency 20 MHz Scan List

□ 4920 MHz	□ 4925 MHz	□ 4930 MHz	□ 4935 MHz	□ 4940 MHz	□ 4945 MHz	□ 4950 MHz	□ 4955 MHz	□ 4960 MHz	□ 4965 MHz	□ 4970 MHz	□ 4975 MHz	□ 4980 MHz	□ 4985 MHz	□ 4990 MHz	□ 4995 MHz
□ 5000 MHz	□ 5005 MHz	□ 5010 MHz	□ 5015 MHz	□ 5020 MHz	□ 5025 MHz	□ 5030 MHz	□ 5035 MHz	□ 5040 MHz	□ 5045 MHz	□ 5050 MHz	□ 5055 MHz	□ 5060 MHz	□ 5065 MHz	□ 5070 MHz	□ 5075 MHz
□ 5080 MHz	□ 5085 MHz	□ 5090 MHz	□ 5095 MHz	□ 5100 MHz	□ 5105 MHz	□ 5110 MHz	□ 5115 MHz	□ 5120 MHz	□ 5125 MHz	□ 5130 MHz	□ 5135 MHz	□ 5140 MHz	□ 5145 MHz	□ 5150 MHz	□ 5155 MHz
□ 5160 MHz	□ 5165 MHz	□ 5170 MHz	□ 5175 MHz	□ 5180 MHz	□ 5185 MHz	□ 5190 MHz	□ 5195 MHz	✓ 5200 MHz	□ 5205 MHz	□ 5210 MHz	□ 5215 MHz	□ 5220 MHz	□ 5225 MHz	□ 5230 MHz	□ 5235 MHz
□ 5240 MHz	□ 5245 MHz	□ 5250 MHz	□ 5255 MHz	□ 5260 MHz	□ 5265 MHz	□ 5270 MHz	□ 5275 MHz	□ 5280 MHz	□ 5285 MHz	□ 5290 MHz	□ 5295 MHz	□ 5300 MHz	□ 5305 MHz	□ 5310 MHz	□ 5315 MHz
□ 5320 MHz	□ 5325 MHz	□ 5330 MHz	□ 5335 MHz	□ 5340 MHz	□ 5345 MHz	□ 5350 MHz	□ 5355 MHz	□ 5360 MHz	□ 5365 MHz	□ 5370 MHz	□ 5375 MHz	□ 5380 MHz	□ 5385 MHz	□ 5390 MHz	□ 5395 MHz
□ 5400 MHz	□ 5405 MHz	□ 5410 MHz	□ 5415 MHz	□ 5420 MHz	□ 5425 MHz	□ 5430 MHz	□ 5435 MHz	□ 5440 MHz	□ 5445 MHz	□ 5450 MHz	□ 5455 MHz	□ 5460 MHz	□ 5465 MHz	□ 5470 MHz	□ 5475 MHz
□ 5480 MHz	□ 5485 MHz	□ 5490 MHz	□ 5495 MHz	□ 5500 MHz	□ 5505 MHz	□ 5510 MHz	□ 5515 MHz	□ 5520 MHz	□ 5525 MHz	□ 5530 MHz	□ 5535 MHz	□ 5540 MHz	□ 5545 MHz	□ 5550 MHz	□ 5555 MHz
□ 5560 MHz	□ 5565 MHz	□ 5570 MHz	□ 5575 MHz	□ 5580 MHz	□ 5585 MHz	□ 5590 MHz	□ 5595 MHz	□ 5600 MHz	□ 5605 MHz	□ 5610 MHz	□ 5615 MHz	□ 5620 MHz	□ 5625 MHz	□ 5630 MHz	□ 5635 MHz
□ 5640 MHz	□ 5645 MHz	□ 5650 MHz	□ 5655 MHz	□ 5660 MHz	□ 5665 MHz	□ 5670 MHz	□ 5675 MHz	□ 5680 MHz	□ 5685 MHz	□ 5690 MHz	□ 5695 MHz	□ 5700 MHz	□ 5705 MHz	□ 5710 MHz	□ 5715 MHz
□ 5720 MHz	□ 5725 MHz	□ 5730 MHz	□ 5735 MHz	□ 5740 MHz	□ 5745 MHz	□ 5750 MHz	□ 5755 MHz	□ 5760 MHz	□ 5765 MHz	□ 5770 MHz	□ 5775 MHz	□ 5780 MHz	□ 5785 MHz	□ 5790 MHz	□ 5795 MHz
□ 5800 MHz	□ 5805 MHz	□ 5810 MHz	□ 5815 MHz	□ 5820 MHz	□ 5825 MHz	□ 5830 MHz	□ 5835 MHz	□ 5840 MHz	□ 5845 MHz	□ 5850 MHz	□ 5855 MHz	□ 5860 MHz	□ 5865 MHz	□ 5870 MHz	□ 5875 MHz
□ 5880 MHz	□ 5885 MHz	□ 5890 MHz	□ 5895 MHz	□ 5900 MHz	□ 5905 MHz	□ 5910 MHz	□ 5915 MHz	□ 5920 MHz	□ 5925 MHz	□ 5930 MHz	□ 5935 MHz	□ 5940 MHz	□ 5945 MHz	□ 5950 MHz	□ 5955 MHz

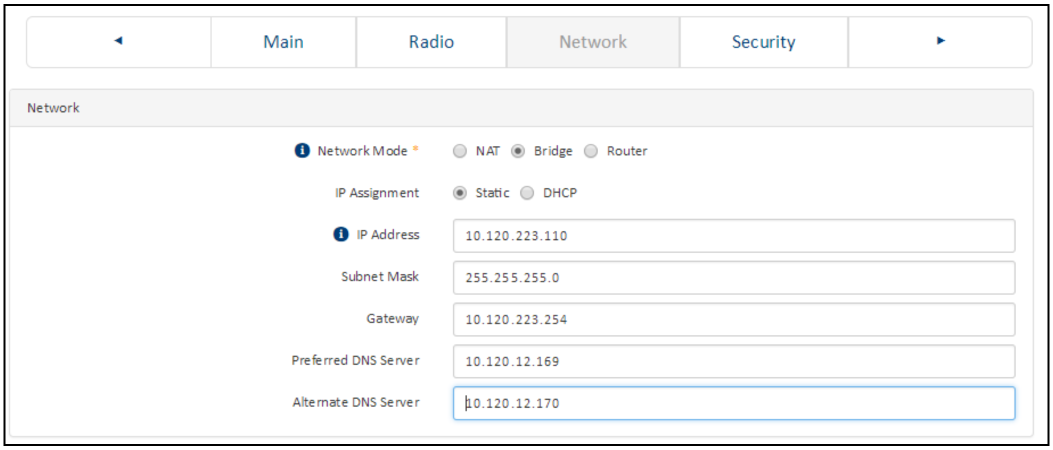
□ 5960 MHz □ 5965 MHz □ 5970 MHz

Figure 6: *Radio parameters page*

Attribute	Description
Radio	
Preferred APs	
SSID	The **Preferred Access Points SSID** defines the AP SSID to which the Subscriber Module (SM) device attempts the registration.
Wireless Security	**Open:** The SM device attempts the registration to preferred APs SSID with no security mechanism. **WPA2**: The WPA2 mechanism provides AES radio link encryption and SM network entry authentication. When enabled, the SM must register using the Authentication Pre-shared Key configured on the AP and SM.
WPA2 Pre-shared Key	The **Preferred Access Points WPA2 Pre-shared Key** must be configured on the SM device to match the pre-shared key configured on the Access Point for registration with WPA2 security.
Scan Channel Bandwidth	Configure the channel size used by the radio for RF transmission.
Radio Frequency Scan List	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the **Country** parameter. Ensure that a thorough spectrum analysis is completed before configuring this parameter.

Step 3: Network parameters

Figure 7 shows the Network parameters page.



Network

Network Mode * ○ NAT ● Bridge ○ Router

IP Assignment ● Static ○ DHCP

IP Address 10.120.223.110

Subnet Mask 255.255.255.0

Gateway 10.120.223.254

Preferred DNS Server 10.120.12.169

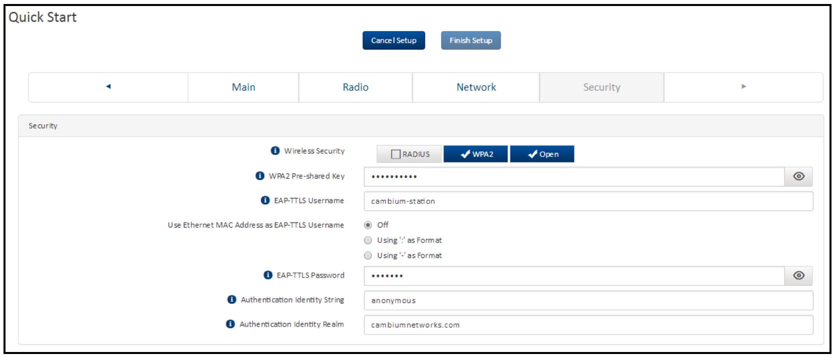
Alternate DNS Server 10.120.12.170

Figure 7: *Network parameters page*

Attribute	Description
Network	
Network Mode	**NAT:** The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination). **Bridge**: The SM acts as a switch and packets are forwarded or filtered based on their MAC destination address. **Router**: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination) using specific static routes and IP aliases configured by the operator.
IP Assignment	**Static:** Device management IP addressing is configured manually in fields **IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server**. **DHCP:** Device management IP addressing (**IP address, Subnet Mask, Gateway, and DNS Server**) is assigned via a network DHCP server, and parameters **IP Address, Subnet Mask, Gateway, Preferred DNS Server,** and **Alternate DNS Server** are not configurable.
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information through DHCP, the device management IP is set to fallback IP 192.168.0.1 (AP) or 192.168.0.2 (SM).
Subnet Mask	Defines the address range of the connected IP network. For example, if the **IP Address** is configured to **192.168.2.1** and **Subnet Mask** is configured to **255.255.255.0**, the device belongs to subnet **192.168.2.X**.
Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.

Step 4: Security parameters

Figure 8 shows the Security parameters page.



Wireless Security: ☐ RADIUS ✓ WPA2 ✓ Open

WPA2 Pre-shared Key: ••••••••••

EAP-TTLS Username: cambium-station

Use Ethernet MAC Address as EAP-TTLS Username: ● Off ○ Using ':' as Format ○ Using '-' as Format

EAP-TTLS Password: •••••••

Authentication Identity String: anonymous

Authentication Identity Realm: cambiumnetworks.com

Figure 8: *Security parameters page*

Attribute	Description
Network	
EAP-TTLS Username	Configure the EAP-TTLS Username to match the credentials on the RADIUS server being used for the network.
Use Ethernet MAC Address at EAP-TTLS Username	The device MAC Address can be used as the EAP-TTLS Username in either “:” or “-“ delimited format.
EAP-TTLS Password	Configure the EAP-TTLS Password to match the credentials on the RADIUS server being used for the network.
Authentication Identity String	Configure this identity string to match the credentials on the RADIUS server being used for the network. The default value for this parameter is **anonymous**.
Authentication Identity Realm	Configure this identity string to match the credentials on the RADIUS server being used for the network. The default value for this parameter is **cambiumnetworks.com**.

Using the menu options

Use the menu navigation bar in the left panel to navigate to the web pages. Some of the menu options are only displayed for specific system configurations. Refer to Table 1 to locate information about each web page.

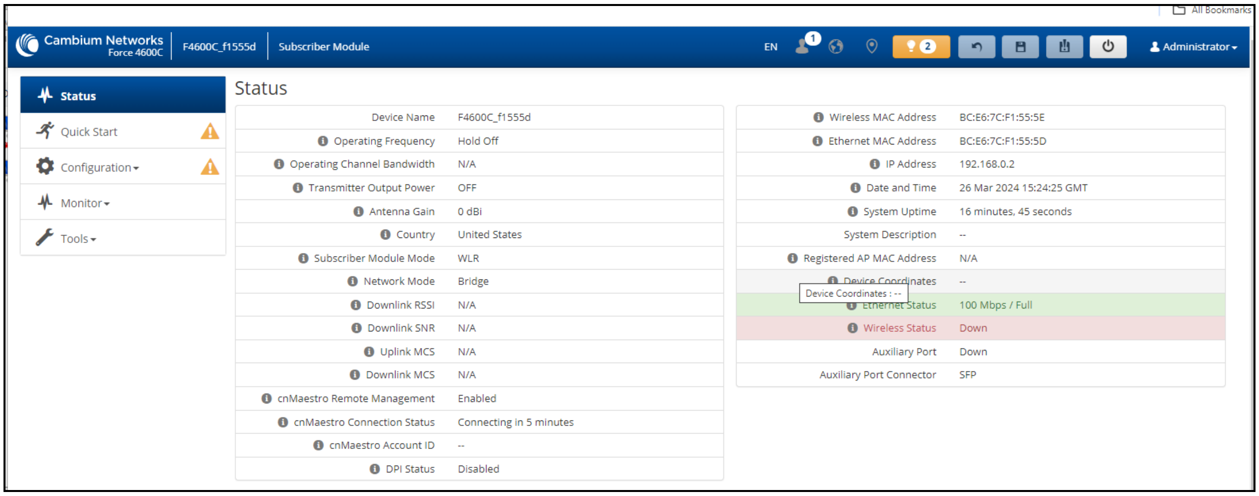
Table 1: Menu options and web pages

Main menu	Menu option	Web page information
Status		Status page
Installation		Installation page
Configuration		Configuration menu
	Radio	Configuration > Radio page
	System	Configuration > System page
	Network	Configuration > Network page
	Security	Configuration > Security page

Main menu	Menu option	Web page information
Monitor		Monitor menu
	Performance	Monitor > Performance page
	System	Monitor > System page
	Wireless	Monitor > Wireless page
	Throughput Chart	Monitor > Throughput Chart page
	GPS	Monitor > GPS page (Access Point mode)
	Network	Monitor > Network page
	System Log	Monitor > System Log page
Tools		Tools menu
	Software Upgrade	Tools > Software Upgrade page
	Backup / Restore	Tools > Backup/Restore page
	License Management	Tools > License Management page (Access Point Mode)
	Spectrum Analyzer	Tools > Spectrum Analyzer page
	eAlign (For SM only)	Tools > eAlign page
	Wireless Link Test	Tools > Wireless Link Test page
	Watchdog	Tools > Watchdog page
	Ping	Tools > Ping page
	Traceroute	Tools > Traceroute page

Status page

The status page describes the status information of the QoE device. Figure 9 shows the Status page.



Device Name	F4600C_f1555d
Operating Frequency	Hold Off
Operating Channel Bandwidth	N/A
Transmitter Output Power	OFF
Antenna Gain	0 dBi
Country	United States
Subscriber Module Mode	WLR
Network Mode	Bridge
Downlink RSSI	N/A
Downlink SNR	N/A
Uplink MCS	N/A
Downlink MCS	N/A
cnMaestro Remote Management	Enabled
cnMaestro Connection Status	Connecting in 5 minutes
cnMaestro Account ID	--
DPI Status	Disabled

Wireless MAC Address	BC:E6:7C:F1:55:5E
Ethernet MAC Address	BC:E6:7C:F1:55:5D
IP Address	192.168.0.2
Date and Time	26 Mar 2024 15:24:25 GMT
System Uptime	16 minutes, 45 seconds
System Description	--
Registered AP MAC Address	N/A
Device Coordinates	--
Ethernet Status	100 Mbps / Full
Wireless Status	Down
Auxiliary Port	Down
Auxiliary Port Connector	SFP

Figure 9: *Status page*

Table 132 Status page attributes

Attribute	Description
Device Name	The configured device name of the AP, used for identifying the device in an NMS such as the Cambium Network Services Server (CNSS).
SSID	The current configured name/SSID of the AP.
Operating Frequency	The current frequency carrier used for radio transmission, based on the configuration of the **Frequency Carrier** parameter (in DFS regions, if radar has been detected, this field may display either **DFS Alternate Frequency Carrier 1** or **DFS Alternate Frequency Carrier 2**).
Operating Channel Bandwidth	The current channel bandwidth used for radio transmission, based on the configuration of the **Channel Bandwidth** parameter.
Transmitter Output Power	The current operating transmit power of the AP.
Antenna Gain	The configured gain of the external antenna.
Country	The current configured country code, which has an effect on DFS operation and transmits power restrictions. Registered Subscriber Modules will inherit this country code when registration is complete (unless SM is locked to the US region).
Access Point Mode	**TDD**: The Access Point is operating in point-to-multipoint (PMP) mode using TDD scheduling. The AP can GPS synchronize in this mode (except when in Flexible mode). **ePTP Master**: The Access Point is operating as a Master in point-to-point mode. The AP does not support GPS Synchronization in this mode but can provide **significantly lower latency** than other modes. QoS (MIR and traffic priority) capability and Link Quality/Capacity indicators are not available in this mode. **PTP**: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling. The AP can GPS synchronize in this mode (except when in Flexible mode).

Attribute	Description
Downlink/Uplink Frame Ratio	The current configured schedule of downlink traffic to uplink traffic on the radio link. In other words, this ratio represents the amount of the total radio link's aggregate throughput that will be used for downlink resources and the amount of the total radio link's aggregate throughput that will be used for uplink resources.
Wireless Security	Currently configured authentication type used for radio link encryption as well as SM authentication.
cnMaestro Remote Management	Indicates whether the device is currently configured to be managed by the Cambium cloud management system – cnMaestro™.
cnMaestro Connection Status	The current management status of the device concerning the Cambium Cloud Server. When Enabled under **Configuration > System**, the device will be managed by the Cambium Remote Management System, which allows all Cambium devices to be managed from the Cambium Cloud Server.
cnMaestro Account ID	The ID that the device is currently using to be managed by the Cambium Cloud Server.
Wireless MAC Address	The MAC address of the device wireless interface.
Ethernet MAC Address	The MAC address of the device Ethernet (LAN) interface.
SFP Port MAC Address	The MAC address of the device SFP interface.
IP Address	The currently configured device IP address (LAN) is used for management access.
IPv6 Link Local Address	A link-local address is required for the IPv6-enabled interface (applications may rely on the link-local address even when there is no IPv6 routing). The IPv6 link-local address is comparable to the auto-configured IPv4 address 169.254.0.0/16.
IPv6 Address	The IPv6 address for device management.
Date and Time	The current date and time on the device, subject to the configuration of the parameter **Time Zone.**
System Uptime	The total uptime of the radio since the last reset.
System Description	The current configured system description.
Sync Source Status	Displays the current status of sync timing for the AP.
Device Coordinates	The current configured Latitude and Longitude coordinates in decimal format.
DFS Status	**N/A:** DFS operation is not required for the region configured in parameter **Country Code.** **Channel Availability Check**: Before transmitting, the device must check the configured **Frequency Carrier** for radar pulses for 60 seconds). If no radar pulses are detected, the device transitions to state **In-Service Monitoring.** **In-Service Monitoring**: Radio is transmitting and receiving normally while monitoring for radar pulses that require a channel move. **Radar Signal Detected**: The receiver has detected a valid radar pulse and is carrying out detect-and-avoid mechanisms (moving to an alternate channel).

Attribute	Description
	In-Service Monitoring at Alternative Channel: The radio has detected a radar pulse and has moved the operation to a frequency configured in **DFS Alternative Frequency Carrier 1** or **DFS Alternative Frequency Carrier 2.** **System Not In Service due to DFS**: The radio has detected a Radar pulse and has failed channel availability checks on all alternative frequencies. The non-occupancy time for the radio frequencies in which Radar detected is 30 minutes.
Ethernet Status	**Up**: The Ethernet (LAN) interface is functioning properly. This also displays the current port speed and duplex mode to which the Ethernet port has auto negotiated to or configured. **Down**: The Ethernet (LAN) interface is either disconnected or has encountered an error and is not servicing traffic.
Wireless Status	**Up**: The radio (WAN) interface is functioning properly **Down**: The radio (WAN) interface has encountered an error and is not servicing traffic.
SFP Port	Displays the current port speed and duplex mode to which the SFP port has auto-negotiated or displays the current port speed and duplex mode that have been configured manually.
SFP Port Type	Displays the type of SFP module connected to the device.
Registered Subscriber Modules	The total number of SMs currently registered to the AP.
Registered Elevate Subscriber Modules	The total number of ePMP Elevate (third-party software solution) subscribers registered to the AP.

Installation page

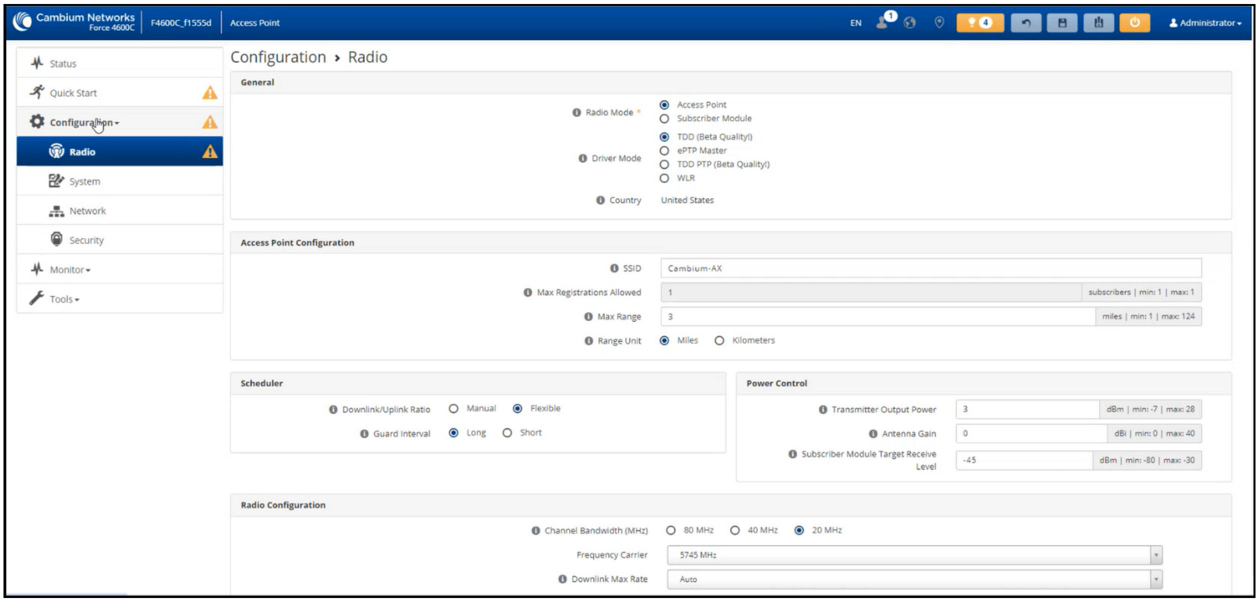
For more information on the installation page, refer to Using the installation wizard - Access Point and Using the installation wizard - Subscriber Module sections.

Configuration menu

Use the **Configuration** menu to access all applicable device configuration parameters.

Configuration > Radio page

Figure 10 and Figure 11 shows the Radio pages (AP mode and SM mode).



Configuration › Radio

General

Radio Mode * ● Access Point ○ Subscriber Module

Driver Mode ● TDD (Beta Quality!) ○ ePTP Master ○ TDD PTP (Beta Quality!) ○ WLR

Country United States

Access Point Configuration

SSID Cambium-AX

Max Registrations Allowed 1 subscribers | min: 1 | max: 1

Max Range 3 miles | min: 1 | max: 124

Range Unit ● Miles ○ Kilometers

Scheduler

Downlink/Uplink Ratio ○ Manual ● Flexible

Guard Interval ● Long ○ Short

Power Control

Transmitter Output Power 3 dBm | min: -7 | max: 28

Antenna Gain 0 dBi | min: 0 | max: 40

Subscriber Module Target Receive Level -45 dBm | min: -80 | max: -30

Radio Configuration

Channel Bandwidth (MHz) ○ 80 MHz ○ 40 MHz ● 20 MHz

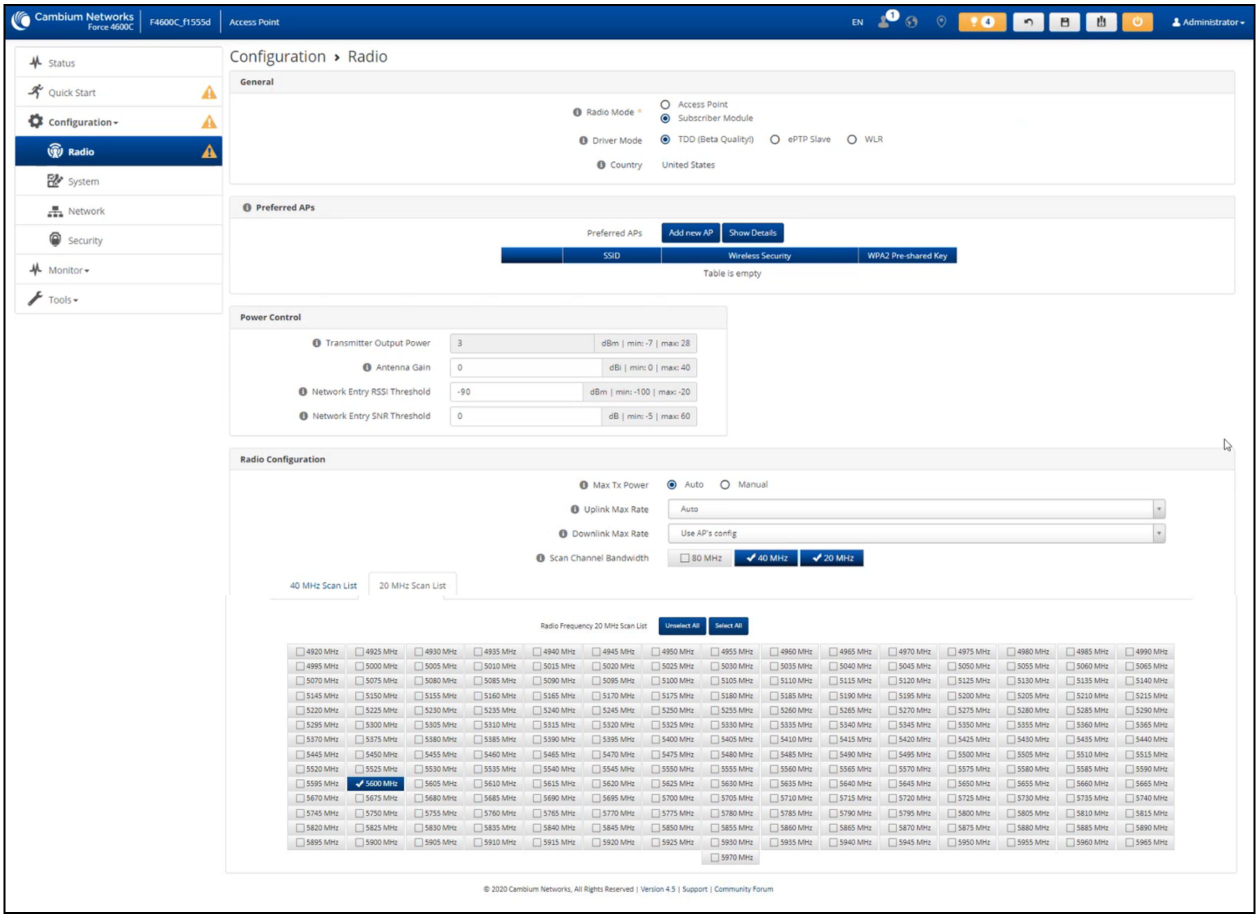
Frequency Carrier 5745 MHz

Downlink Max Rate Auto

Figure 10: *Configuration > Radio page (AP mode)*

Note

The **Trial Configuration** allows you to try a configuration change without applying the configuration.



Configuration › Radio

General

Radio Mode * ○ Access Point ● Subscriber Module

Driver Mode ● TDD (Beta Quality!) ○ ePTP Slave ○ WLR

Country United States

Preferred APs

Preferred APs Add new AP Show Details

	SSID	Wireless Security	WPA2 Pre-shared Key

Table is empty

Power Control

Transmitter Output Power	3	dBm | min: -7 | max: 28
Antenna Gain	0	dBi | min: 0 | max: 40
Network Entry RSSI Threshold	-90	dBm | min: -100 | max: -20
Network Entry SNR Threshold	0	dB | min: -5 | max: 60

Radio Configuration

Max Tx Power ● Auto ○ Manual

Uplink Max Rate Auto

Downlink Max Rate Use AP's config

Scan Channel Bandwidth □ 80 MHz ✓ 40 MHz ✓ 20 MHz

40 MHz Scan List | 20 MHz Scan List

Radio Frequency 20 MHz Scan List Unselect All Select All

□ 4920 MHz	□ 4925 MHz	□ 4930 MHz	□ 4935 MHz	□ 4940 MHz	□ 4945 MHz	□ 4950 MHz	□ 4955 MHz	□ 4960 MHz	□ 4965 MHz	□ 4970 MHz	□ 4975 MHz	□ 4980 MHz	□ 4985 MHz	□ 4990 MHz
□ 4995 MHz	□ 5000 MHz	□ 5005 MHz	□ 5010 MHz	□ 5015 MHz	□ 5020 MHz	□ 5025 MHz	□ 5030 MHz	□ 5035 MHz	□ 5040 MHz	□ 5045 MHz	□ 5050 MHz	□ 5055 MHz	□ 5060 MHz	□ 5065 MHz
□ 5070 MHz	□ 5075 MHz	□ 5080 MHz	□ 5085 MHz	□ 5090 MHz	□ 5095 MHz	□ 5100 MHz	□ 5105 MHz	□ 5110 MHz	□ 5115 MHz	□ 5120 MHz	□ 5125 MHz	□ 5130 MHz	□ 5135 MHz	□ 5140 MHz
□ 5145 MHz	□ 5150 MHz	□ 5155 MHz	□ 5160 MHz	□ 5165 MHz	□ 5170 MHz	□ 5175 MHz	□ 5180 MHz	□ 5185 MHz	□ 5190 MHz	□ 5195 MHz	□ 5200 MHz	□ 5205 MHz	□ 5210 MHz	□ 5215 MHz
□ 5220 MHz	□ 5225 MHz	□ 5230 MHz	□ 5235 MHz	□ 5240 MHz	□ 5245 MHz	□ 5250 MHz	□ 5255 MHz	□ 5260 MHz	□ 5265 MHz	□ 5270 MHz	□ 5275 MHz	□ 5280 MHz	□ 5285 MHz	□ 5290 MHz
□ 5295 MHz	□ 5300 MHz	□ 5305 MHz	□ 5310 MHz	□ 5315 MHz	□ 5320 MHz	□ 5325 MHz	□ 5330 MHz	□ 5335 MHz	□ 5340 MHz	□ 5345 MHz	□ 5350 MHz	□ 5355 MHz	□ 5360 MHz	□ 5365 MHz
□ 5370 MHz	□ 5375 MHz	□ 5380 MHz	□ 5385 MHz	□ 5390 MHz	□ 5395 MHz	□ 5400 MHz	□ 5405 MHz	□ 5410 MHz	□ 5415 MHz	□ 5420 MHz	□ 5425 MHz	□ 5430 MHz	□ 5435 MHz	□ 5440 MHz
□ 5445 MHz	□ 5450 MHz	□ 5455 MHz	□ 5460 MHz	□ 5465 MHz	□ 5470 MHz	□ 5475 MHz	□ 5480 MHz	□ 5485 MHz	□ 5490 MHz	□ 5495 MHz	□ 5500 MHz	□ 5505 MHz	□ 5510 MHz	□ 5515 MHz
□ 5520 MHz	□ 5525 MHz	□ 5530 MHz	□ 5535 MHz	□ 5540 MHz	□ 5545 MHz	□ 5550 MHz	□ 5555 MHz	□ 5560 MHz	□ 5565 MHz	□ 5570 MHz	□ 5575 MHz	□ 5580 MHz	□ 5585 MHz	□ 5590 MHz
□ 5595 MHz	✓ 5600 MHz	□ 5605 MHz	□ 5610 MHz	□ 5615 MHz	□ 5620 MHz	□ 5625 MHz	□ 5630 MHz	□ 5635 MHz	□ 5640 MHz	□ 5645 MHz	□ 5650 MHz	□ 5655 MHz	□ 5660 MHz	□ 5665 MHz
□ 5670 MHz	□ 5675 MHz	□ 5680 MHz	□ 5685 MHz	□ 5690 MHz	□ 5695 MHz	□ 5700 MHz	□ 5705 MHz	□ 5710 MHz	□ 5715 MHz	□ 5720 MHz	□ 5725 MHz	□ 5730 MHz	□ 5735 MHz	□ 5740 MHz
□ 5745 MHz	□ 5750 MHz	□ 5755 MHz	□ 5760 MHz	□ 5765 MHz	□ 5770 MHz	□ 5775 MHz	□ 5780 MHz	□ 5785 MHz	□ 5790 MHz	□ 5795 MHz	□ 5800 MHz	□ 5805 MHz	□ 5810 MHz	□ 5815 MHz
□ 5820 MHz	□ 5825 MHz	□ 5830 MHz	□ 5835 MHz	□ 5840 MHz	□ 5845 MHz	□ 5850 MHz	□ 5855 MHz	□ 5860 MHz	□ 5865 MHz	□ 5870 MHz	□ 5875 MHz	□ 5880 MHz	□ 5885 MHz	□ 5890 MHz
□ 5895 MHz	□ 5900 MHz	□ 5905 MHz	□ 5910 MHz	□ 5915 MHz	□ 5920 MHz	□ 5925 MHz	□ 5930 MHz	□ 5935 MHz	□ 5940 MHz	□ 5945 MHz	□ 5950 MHz	□ 5955 MHz	□ 5960 MHz	□ 5965 MHz
							□ 5970 MHz							

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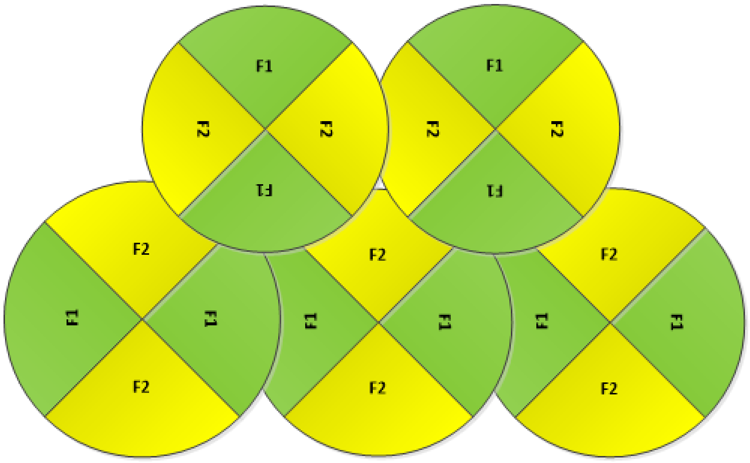
Figure 11: *Configuration > Radio page (SM mode)*

Table 133 Configuration > Radio page attributes

Attribute	Description
General	
Driver Mode	**TDD**: The device is operating in Point-to-Multipoint (PMP) mode using TDD scheduling. The AP can GPS synchronize in this mode. **ePTP Slave**: The SM is operating as a Slave in point-to-point mode. The AP and the system do not support GPS Synchronization in this mode but can provide significantly lower latency than other modes. QoS (MIR and traffic priority) capability and Link Quality/Capacity indicators are not available in this mode. **TDD PTP**: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling. The AP can GPS synchronize in this mode.
Radio Mode	**Access Point**: The unit controls the point-to-point link and its maintenance. On start-up, the Access Point transmits until a link with the Subscriber Module is made. **Subscriber Module**: The unit listens for its peer and only transmits when the peer has been identified.
Backward Compatibility (Access Point Mode)	**Enabled**: 802.11n ePMP subscribers can register to the AP (requires subscriber software upgrade).

Attribute	Description
	Disabled: 802.11n ePMP subscribers are not able to register to the AP.
Country (Access Point Mode)	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point unless it is an FCC SKU in which case the country code is the United States or Canada. Country code defines the regulatory rules in use for the device.
Range Unit (Access Point Mode)	Units of measurement on the device are displayed in either miles (m) or kilometers (km).
Access Point Configuration (AP mode)	
Antenna (Access Point Mode)	**Sector:** Panel, 90° or Dual-Horn, 60° **Omni:** KP-5QSOMNI-13
SSID (Access Point Mode)	SSID is a unique identifier for a wireless LAN which is specified in the AP's beacon. (AP mode). SSID must be the same at both ends and different from the site name.
Max Registrations Allowed (Access Point Mode)	Based on a sector/network planning and subscriber service level implementations, this parameter allows setting the maximum number of subscribers that are allowed to register/gain network entry. The maximum number of subscribers allowed for each channel bandwidth is as follows: • **20/40 MHz**: 120 subscribers • **10 MHz**: 60 subscribers • **5 MHz**: 30 subscribers The maximum registrations allowed depending on the channel bandwidth of the current operating frequency which can be the primary **Frequency Carrier** or one of the alternate Frequency Carriers. For DFS regions, the maximum number of subscribers is based on the channel bandwidth of the current operating channel. That is **Frequency Carrier**, **Alternate Frequency Carrier 1**, or **Alternate Frequency Carrier 2**. The number of elevate devices that are allowed to register is specified by the applied license.
Max Range (Access Point Mode)	This parameter represents the cell coverage radius. Subscriber Modules outside the configured radius does not able to connect. It is recommended to configure Max Range to match the actual physical distance of the farthest subscriber.
Channel Bandwidth (Access Point Mode)	Configure the channel size used by the radio for RF transmission.
Frequency Carrier (Access Point Mode)	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the **Country** parameter. Ensure that a thorough spectrum analysis has been completed before configuring this parameter.
Frequency Reuse (Access Point Mode)	The **Frequency Reuse** parameter allows operators to define which APs are co-located (or within radio range) with other APs. This definition results in an automatic radio network modification such that self-interference is reduced amongst the co-located sectors.

Attribute	Description
	A network in which two frequencies **F1** and **F2** are reused throughout the installation is shown in Figure 11. Note that CMM3 and CMM4 devices cannot be used as synchronization sources for ePMP 3000, the parameter setting suggestions below serve as a guideline for mixed 802.11n and 802.11ac networks.  F1 F2 F2 F1 F1 F2 F2 F1 F2 F1 F1 F2 F2 F1 F1 F2 F2 F1 F1 F2 Figure 12: *Frequency reuse installation* The set of APs to configure the **Frequency Reuse** option is dependent on the GPS synchronization sources in the whole network, CMM3, CMM4, CMM5, or GPS. 0B0BThe GPS sync source is the same on all APs or is a combination of "GPS", "CMM4", "CMM5" In this configuration the GPS synchronization source in the whole network is one of the following: • GPS • CMM4 • CMM5 The rules in selecting the APs to enable the **Frequency Reuse** in this installation are: Only ONE of the APs on the same tower configured with the same frequency must be configured with the **Frequency Reuse Mode** parameter set to **Back Sector**; the other AP must be configured with **Frequency Reuse** set to **Front Sector**. Also, APs on different towers facing each other with overlapped coverage must be configured with **Frequency Reuse** set to **Back Sector.** 1B1BThe GPS sync source is a mixture of all types ("CMM3", "CMM4", "CMM5" or "GPS") In this configuration the GPS sync source in the whole network is one of the following: • (CMM3 and GPS) or • (CMM3 and CMM4 / CMM5) or

Attribute	Description
	• (CMM3 and CMM4 / CMM5 and GPS) The rules in selecting the APs to configure **Frequency Reuse** to **Frequency Reuse** to **Front Sector** or **Back Sector** in a mixture of sync sources installations are: Only ONE of the APs on the same tower configured with the same frequency must have **Frequency Reuse** set to **Back Sector** if the sync source of both APs is the same or the sync is a combination of GPS and CMM4 / CMM5; the other AP has the **Front Sector** ON. For the APs on different towers facing each other with overlapped coverage: • If both APs have the same sync source, then only ONE of them must have the **Back Sector** ON; the other AP shall have the **Front Sector** ON. • If one AP has GPS as sync source and the other one has CMM4 / CMM5 then only ONE of them must have **Back Sector** ON; the other AP shall have **Front Sector ON**. • If one AP has GPS or CMM4 / CMM5 as sync source and the other one has CMM3. • If the AP with CMM3 sync source has **Back Sector** ON, then the other AP (with GPS or CMM4 / CMM5 sync source) must have the **Back Sector ON**. • If the AP with CMM3 sync source has **Frequency Reuse** set to **Off**, then the other AP (with GPS or CMM4 CMM5 sync source) must have **Frequency Reuse** set to **OFF.**
Power Control	
Transmitter Output Power (Access Point Mode)	**Transmitter Output Power** is the total transmit power of the device. The device has four transmit chains and total transmit power sums the power from all chains. This does not include antenna gain. Transmitter Output Power may be limited by regulatory rules for the country in use.
Antenna Gain	The total gain of the antenna is being uses by the device.
Subscriber Module Target Receive Level (Access Point Mode)	Defines the desired received power level at the AP from the registered Subscriber Module. APs use this parameter to control the transmission power of the Subscriber Module to reduce system self-interference.
Network Entry RSSI Threshold (Subscriber Module Mode)	This defines the Downlink RSSI threshold below which a Subscriber Module does not register to an Access Point.
Network Entry SNR Threshold (Subscriber Module Mode)	This defines the Downlink Signal-to-Noise-Ratio (SNR) threshold below which the Subscriber Module does not register to an Access Point.
Synchronization (AP mode)	
Co-location Mode (Access Point Mode)	**Disabled:** The ePMP device can synchronize only with other ePMP APs.

Attribute	Description
	Enabled: The ePMP device can be configured to synchronize with PMP 100 or PMP 450 series of radios in addition to other ePMP APs. Refer to ePMP and PMP 100 Co-location and Migration Recommendations Guide for guidance on synchronizing ePMP and PMP 100. Verify that frame size (ms) is configured equally across the co-located installations.
Synchronization Source (Access Point Mode)	**GPS**: Synchronization timing is received through the AP's connected GPS antenna. Co-located or in-range APs receiving synchronization via GPS or CMM transmits and receive at the same time, thereby reducing self-interference. **CMM5**: Synchronization timing is received through the AP's Ethernet port through a connected Cambium Cluster Management Module 5 (CMM5). Co-located or in-range APs receiving synchronization through GPS or CMMI transmits and receive at the same time, thereby reducing self-interference. For more information on CMM configuration, refer to *PMP Synchronization Solutions User Guide*. If CMM is used, verify that the cables from the CMM to the network switch are at most 30 ft (shielded) or 10 ft (unshielded) and that the network switch is not PoE (802.3af). **Internal**: Synchronization timing is generated by the AP and the timing is not based on GPS pulses. APs using synchronization source of **Internal** does not transmit and receive in sync with other co-located or in-range APs, which introduces self-interference into the system.
Synchronization Holdoff Time (Access Point Mode)	The **Synchronization Holdoff Time** is designed to gracefully handle fluctuations/losses in the GPS synchronization signaling. After the AP has received a reliable synchronization pulse for at least 60 seconds, if there is a loss of synchronization signal, the **Synchronization Holdoff** timer is started. During the holdoff interval, all SM registrations are maintained. If a valid GPS synchronization pulse is regained during the holdoff interval, then the AP continues to operate normally. If a valid synchronization pulse is not regained from the GPS source during the holdoff interval, then the AP ceases radio transmission. The default is **30 seconds**.
Preferred Access Points (SM mode)	
Preferred Access Points list (Subscriber Module Mode)	The **Preferred Access Points List** is comprised of a list of up to 16 Access Point devices to which the SM device sequentially attempts registration. For each AP configured, if authentication is required, enter the **Wireless Security** type and **WPA2 Pre-shared Key** associated with the configured **SSID**.
Scheduler (AP mode)	
Downlink/Uplink Ratio (Access Point Mode)	The schedule of downlink traffic to uplink traffic on the radio link. The three options, **75/25**, **50/50,** and **30/70**, allow the radio to operate in a fixed ratio on every frame. In other words, this ratio represents the amount of the total radio link's aggregate throughput that is used for downlink resources, and the amount of the total radio link's aggregate throughput that is used for uplink resources.
Guard interval (Access Point Mode)	The purpose of the guard interval is to introduce immunity to propagation delays, echoes, and reflections, to which digital data is normally very sensitive. Longer guard periods allow more distant echoes to be tolerated. However, longer guard intervals reduce channel efficiency.

Attribute	Description
Downlink Max Rate (AP mode)	Specifies the maximum downlink MCS value that the Rate Adapt algorithm chooses for Radio 1. If an installation is exhibiting packet loss due to downlink interference, modifying **Downlink Max Rate** to limit the device's maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference. **Note** This setting is not available if the AP is set to ePTP Master mode.
Radio Configuration	
Maximum Tx Power (SM mode)	**Auto**: The AP can control, using ATPC (Automatic Transmit Power Control), the TX power of the SM up to the maximum capability of the SM’s transmitter (based on regulatory limits). **Manual**: The AP can control the TX power of the SM up to the value configured in the **Transmitter Power** field.
Transmitter Output Power (SM mode)	The total transmit power of the radio interface. The device has four transmit chains for each channel and total transmit power sums the power from all chains. This does not include antenna gain. Transmitter output power may be limited by regulatory rules for the country in use.
Uplink Maximum Rate (SM mode)	Specifies the maximum uplink MCS value that the Rate Adapt algorithm chooses for Radio 1. If an installation is exhibiting packet loss due to uplink interference, modifying **Uplink Max Rate** to limit the device's maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference. **Note** This setting is not available if the SM is set to ePTP Slave mode.
Scan Channel Bandwidth (Subscriber Module Mode)	The selected scan channel bandwidths are scanned by the SM. Any combination can be selected. When bandwidth is selected, a tab for the bandwidth appears and a listing of all available channels is presented once the tab for the bandwidth is selected. Each bandwidth tab contains a number on the left side. This number defines how many channels have been selected for that bandwidth. If no channels are selected for bandwidth, then all the channels are scanned.

The SM Quality of Service page

The ePMP platform supports three QoS priority levels (not available in ePTP Master mode) using air fairness, priority-based starvation avoidance scheduling algorithm.

Ordering of traffic amongst the priority levels is based on a percentage of total link throughput. In other words, all priorities receive some throughput so that low priority traffic is not starved from the transmission. In effect, the greatest amount of throughput is guaranteed to the VOIP priority level, then High, then Low.

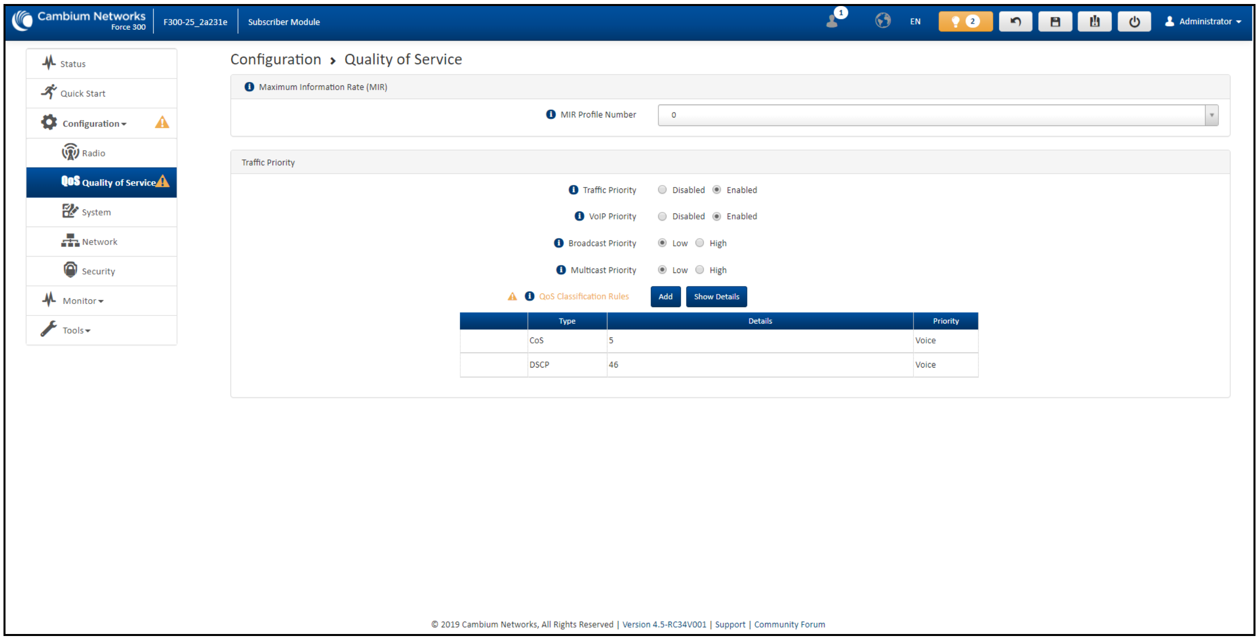
Priority Level	ePMP Traffic Priority Label
Highest Priority	VOIP (only utilized when **VOIP Enable** is set to **Enabled**)
Medium Priority	High
Lowest Priority	Low

By default, all traffic passed over the air interface is a low priority. The SM's QoS page may be utilized to map traffic to certain priority levels using QoS classification rules. The rules included in the table are enforced starting with the first row of the table.

Warning

Each additional traffic classification rule increases device CPU utilization. A good network traffic planning is required to efficiently use the device processor.

The ePMP platform also supports radio data rate-limiting (Maximum Information Rate (MIR)) based on the configuration of the MIR table. Operators may add up to 16 MIR profiles on the AP, each with unique limits for uplink and downlink data rates. The SM field **MIR Profile Setting** is used to configure the appropriate MIR profile for limiting the SM's data rate. Figure 13 shows the Quality of Service page.



Configuration › Quality of Service

Maximum Information Rate (MIR)

MIR Profile Number: 0

Traffic Priority

Traffic Priority: ○ Disabled ● Enabled

VoIP Priority: ○ Disabled ● Enabled

Broadcast Priority: ● Low ○ High

Multicast Priority: ● Low ○ High

QoS Classification Rules

	Type	Details	Priority
	CoS	5	Voice
	DSCP	46	Voice

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Figure 13: *Configuration > SM Quality of Service page*

Table 135 SM QoS attributes

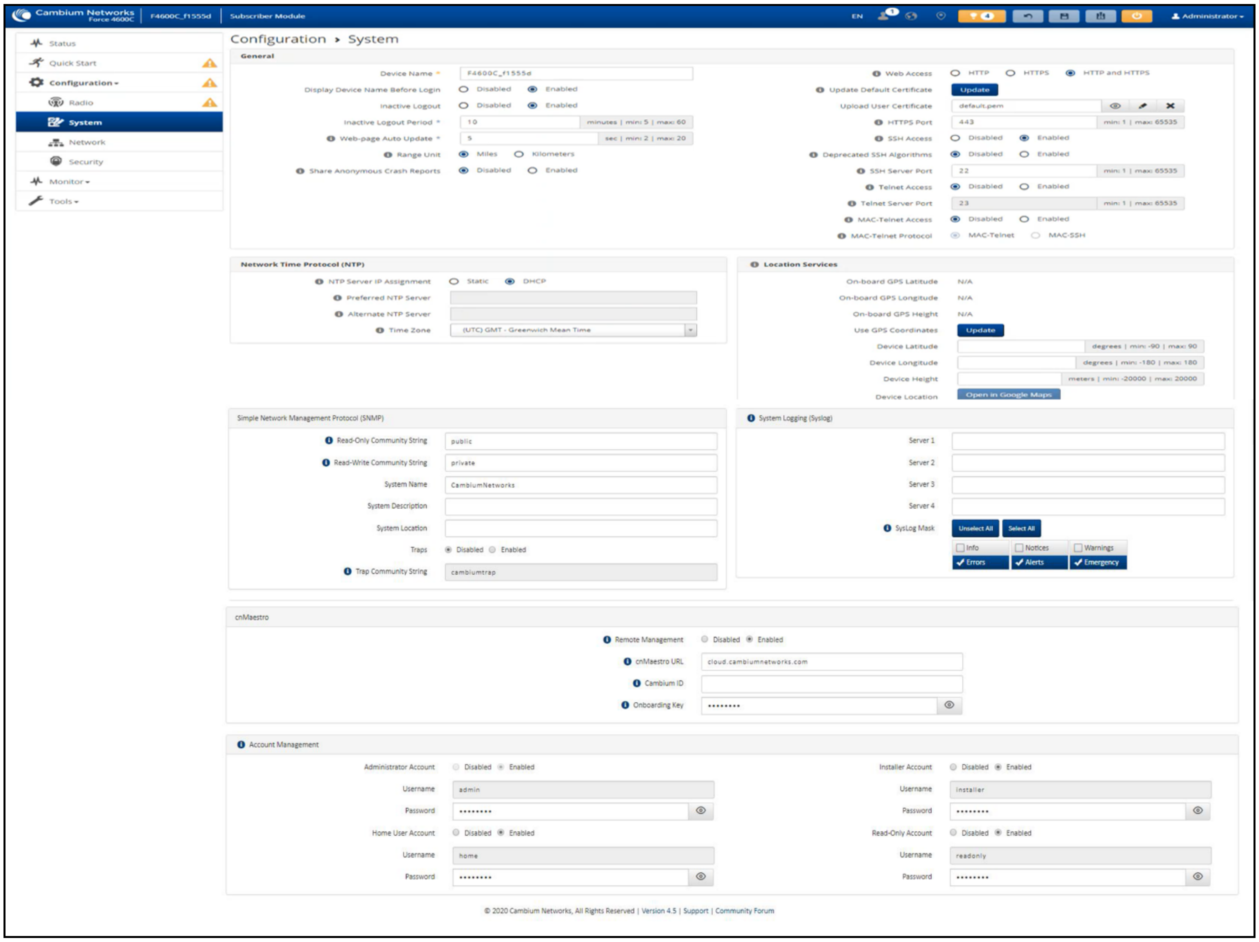
Attribute	Description
Maximum Information Rate (MIR)	
MIR Profile Number	Configure the desired MIR (Maximum Information Rate) profile for SM operation. This profile must be configured on the AP else the default profile (0) is used.
Traffic Priority	**Enabled**: The QoS Classification Rules table is editable and is utilized by the device to classify traffic. **Disabled**: The QoS Classification Rules table is greyed out and all traffic is sent at one priority level.
VoIP Priority	**Enabled**: When enabled, two entries are automatically added to the first and second rows of the QoS Classification Rules table, one with **Rule Type CoS** (5) and one with **Rule Type DSCP** (46). The addition of these rules ensures that VoIP traffic passed over the radio downlink is given the highest priority. The **CoS** and **DSCP** values may be modified to accommodate non-standard VoIP equipment.

Attribute	Description
Broadcast Priority	**Low Priority**: All Broadcast traffic sent over the uplink is prioritized as low priority and is delivered to the AP after scheduled high priority and VoIP traffic. **High Priority**: All Broadcast traffic sent over the uplink is prioritized as a high priority and is scheduled for delivery to the AP before low priority traffic but after VoIP traffic.
Multicast Priority	**Low Priority**: All Multicast traffic sent over the uplink is prioritized as low priority and is delivered to the AP after scheduled high priority and VoIP traffic. **High Priority**: All Multicast traffic sent over the uplink is prioritized as a high priority and is scheduled for delivery to the AP before low priority traffic but after VoIP traffic.
Subscriber Module Priority	**Normal**: SM gives priority to the packets as defined in the rules which can be **Low**, **High**, or **VoIP**. **Normal** priority allows data to be added to the appropriate **High**, **Low**, and **VoIP** queues based on the QoS rules. This is the default setting. If no rule is defined for a packet, then the packet priority is **Low**. **High**: SM places all data other than VoIP in the **High** queue. It is given higher priority than SMs configured with **Low** and **Normal** when there is contention for bandwidth under the AP. **Low**: **Low** priority places all data that is not VoIP in the **Low** priority queue. It will be given lower priority than SMs configured with **High** when there is contention for bandwidth under the same AP. **VoIP** queue is the highest priority queue followed by the **High** queue and then by the **Low** queue. Higher priority queues have preference over lower priority queues, but does not suffer them.
QoS Classification Rules	The QoS Classification Rules table contains all of the rules enforced by the device when passing traffic over the radio downlink. Traffic passed through the device is matched against each rule in the table; when a match is made the traffic is sent over the radio link using the priority defined in column **Traffic Priority**.
Type	**DSCP**: Differentiated Services Code Point; traffic prioritization is based on the 6-bit differentiated services field in the IP header present in the packet entering the Ethernet port. **CoS**: Class of Service; traffic prioritization is based on the 3-bit header present in the 802.1Q VLAN-tagged Ethernet frame header in the packet entering the SM's Ethernet port. **VLAN ID:** Traffic prioritization is based on the VLAN ID of the packet entering the SM's Ethernet port. **EtherType:** Traffic prioritization is based on a 2 octet Ethertype field in the Ethernet frame entering the SM's Ethernet port. The Ethertype is used to identify the protocol of the data in the payload of the Ethernet frame. **IP:** Traffic prioritization is based on the source and/or destination IP addresses of the packet entering the SM's Ethernet port. A subnet mask may be included to define a range of IP addresses to match. **MAC:** Traffic prioritization is based on the source and/or destination MAC addresses of the packet entering the SM's Ethernet port. A mask may be included to define a range of MAC addresses to match. The mask is made up of a hex representation of a series of 1s to start the mask and 0s that end the mask. A 1 may not follow a 0. Thus, FF:FF:FF:FF:00:00 is allowed, but FF:00:FF:FF:FF:FF is not. The MAC address is combined with the mask to define the range of allowed MAC addresses.
Details	The **Rule Details** column is used to further configure each classification rule specified in column **Rule Type**.
Priority	**High**: Traffic entering the SM's Ethernet port is prioritized as **high priority** for sending over the radio link (traffic will be sent after VOIP-classified traffic but before Low-classified traffic).

Attribute	Description
	Low: Traffic entering the SM’s Ethernet port is prioritized as **low priority** for sending over the radio link (traffic will be sent after VOIP-classified and High-classified traffic is sent).

Configuration > System page

Figure 14 shows the System page.



Configuration › System

General

Device Name * F4600C_f1555d
Display Device Name Before Login ○ Disabled ● Enabled
Inactive Logout ○ Disabled ● Enabled
Inactive Logout Period * 10 minutes | min: 5 | max: 60
Web-page Auto Update * 5 sec | min: 2 | max: 20
Range Unit ● Miles ○ Kilometers
Share Anonymous Crash Reports ● Disabled ○ Enabled

Web Access ○ HTTP ○ HTTPS ● HTTP and HTTPS
Update Default Certificate Update
Upload User Certificate default.pem
HTTPS Port 443 min: 1 | max: 65535
SSH Access ○ Disabled ● Enabled
Deprecated SSH Algorithms ● Disabled ○ Enabled
SSH Server Port 22 min: 1 | max: 65535
Telnet Access ● Disabled ○ Enabled
Telnet Server Port 23 min: 1 | max: 65535
MAC-Telnet Access ● Disabled ○ Enabled
MAC-Telnet Protocol ● MAC-Telnet ○ MAC-SSH

Network Time Protocol (NTP)

NTP Server IP Assignment ○ Static ● DHCP
Preferred NTP Server
Alternate NTP Server
Time Zone (UTC) GMT - Greenwich Mean Time

Location Services

On-board GPS Latitude N/A
On-board GPS Longitude N/A
On-board GPS Height N/A
Use GPS Coordinates Update
Device Latitude degrees | min: -90 | max: 90
Device Longitude degrees | min: -180 | max: 180
Device Height meters | min: -20000 | max: 20000
Device Location Open in Google Maps

Simple Network Management Protocol (SNMP)

Read-Only Community String public
Read-Write Community String private
System Name CambiumNetworks
System Description
System Location
Traps ● Disabled ○ Enabled
Trap Community String cambiumtrap

System Logging (Syslog)

Server 1
Server 2
Server 3
Server 4
SysLog Mask Unselect All Select All
□ Info □ Notices □ Warnings
✓ Errors ✓ Alerts ✓ Emergency

cnMaestro

Remote Management ○ Disabled ● Enabled
cnMaestro URL cloud.cambiumnetworks.com
Cambium ID
Onboarding Key ••••••••

Account Management

Administrator Account ○ Disabled ● Enabled
Username admin
Password ••••••••
Home User Account ○ Disabled ● Enabled
Username home
Password ••••••••

Installer Account ○ Disabled ● Enabled
Username installer
Password ••••••••
Read-Only Account ○ Disabled ● Enabled
Username readonly
Password ••••••••

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Figure 14: *Configuration > System page parameters*

Table 136 Configuration > System page attributes

Attribute	Description
General	
Device Name	The configured identifier is used in an NMS such as cnMaestro.
Display Device Name Before Login	**Disabled**: For security, the configured **Device Name** is hidden on the device login screen. **Enabled**: The configured **Device Name** is displayed upper-left on the device login screen.

Attribute	Description
Inactive Logout	**Disabled**: The device does not automatically log out users after a period of inactivity. **Enabled**: After the period configured in the **Inactive Logout Period** has elapsed, the device automatically log out the user.
Inactive Logout Period	Represents the amount of time for which a user remains logged in. After this period has elapsed, the user automatically logged out.
Web-page Auto Update	Configure the interval for which the device retrieves system statistics for display on the management interface. For example, if this setting is configured to 5 seconds, the statistics and status parameters displayed on the management interface is refreshed every 5 seconds (default). **Webpage Auto Update** is a session-only configuration change. It is updated with the *Enter* key and is not savable when using the **Save** button.
Range Unit	Units of measurement on the device are displayed in either miles (m) or kilometers (km).
Web Access	**HTTP**: The web management interface of the device is accessed through HTTP. **HTTPS:** The web management interface of the device may only be accessed through secure HTTPS.
HTTP Port	This specifies the TCP/UDP port to be used with HTTP or HTTPS. The default value for HTTP is 80 and HTTPS is 443.
SSH Access	**Disabled**: Access to the device through SSH is not possible. **Enabled:** Cambium Networks engineers can access the device through SSH which enables them to log in to the radio and troubleshoot. **SSH Access** is **Enabled** by default.
Telnet Access	**Disabled**: Command Line Interface access through Telnet is not allowed **Enabled:** Command Line Interface access through Telnet is allowed
Network Time Protocol (NTP)	
NTP Server IP Assignment	**Static**: The device retrieves NTP time data from the servers configured in fields NTP Server IP Address. **DHCP**: The device retrieves NTP time data from the server IP issued through a network DHCP server.
Preferred NTP Server	Configure the primary NTP server IP addresses from which the device retrieves time and date information.
Alternate NTP Server	Configure alternate or secondary NTP server IP addresses from which the device retrieves time and date information.
Time Zone	The Time Zone option may be used to offset the received NTP time to match the operator’s local time zone.
Location Services	
On-board GPS Latitude	GPS-retrieved Latitude information for the device in decimal format.
On-board GPS Longitude	GPS-retrieved Longitude information for the device in decimal format.

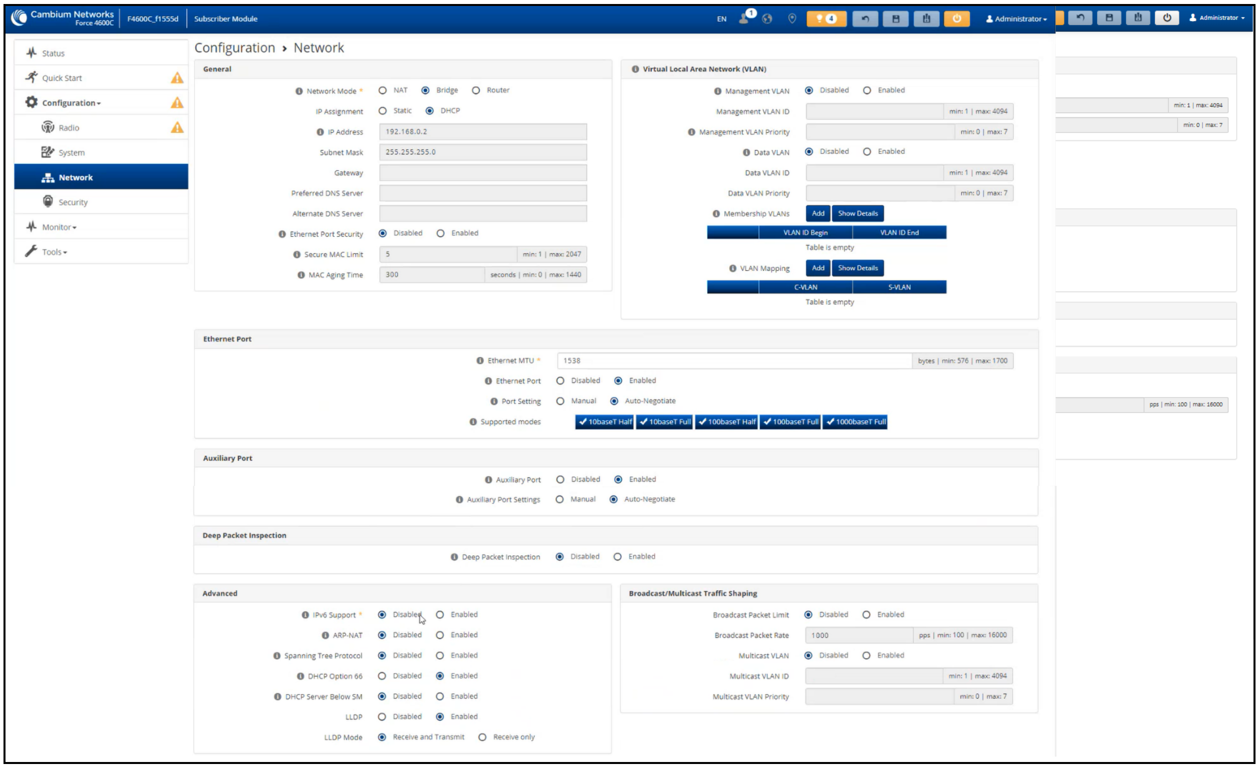
Attribute	Description
On-board GPS Height	GPS-retrieved height information for the device in meters.
Use GPS Coordinates Update	Click **Update** to retrieve device location and height information via the connected GPS source.
Device Latitude	Configure Latitude information for the device in decimal format.
Device Longitude	Configure Longitude information for the device in decimal format.
Device Height	Configure height above sea level for the device in meters.
Device Location Open in Google Maps	Hyperlink to display the device location in Google Maps
Simple Network Management Protocol (SNMP)	
Read-Only Community String	Specify a control string that can allow a Network Management Station (NMS) to read SNMP information. No spaces are allowed in this string. This password will never authenticate an SNMP user or an NMS to read/write access. The **Read-only Community String** value is clear text and is readable by a packet monitor.
Read-Write Community String	Specify a control string that can allow a Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string.
System Name	Specify a string to associate with the physical module. This parameter can be polled by the NMS. Special characters are supported.
System Description	Specify a description string to associate with the physical module. This parameter can be polled by the NMS. Special characters are supported.
System Location	Specify a description string to associate with the physical location. This parameter can be polled by the NMS. Special characters are supported.
Traps	**Disabled**: SNMP traps for system events are not sent from the device. **Enabled**: SNMP traps for system events are sent to the servers configured in table **Trap Servers**.
Trap Community String	Configure an SNMP Trap Community String which is processed by the servers configured in **Trap Servers**. This string is used by the trap server to decide whether or not to process the traps incoming from the device. That is, for traps to successfully be received by the trap server, the community string must match.
System Logging (Syslog)	
Server 1-4	Specify up to four Syslog servers to which the device sends Syslog messages.
Syslog Mask	Configure the levels of Syslog messages which the devices send to the servers configured in parameters **Server 1-4.** ⚡ **Caution**

Attribute	Description
	Choose only the Syslog levels for the appropriate installation. Excessive logging can cause the device log file to fill and starts overwriting the previous entries.
cnMaestro	
Remote Management	When **Enabled**, the device is managed by cnMaestro - the Cambium Networks Remote Management System, allows all Cambium Networks devices to be managed in the cloud.
cnMaestro URL	Configure the URL of cnMaestro. The default value is https://cloud.cambiumnetworks.com.
Cambium ID	Configure the Cambium ID that the device uses for onboarding on to cnMaestro.
Onboarding Key	Configure the password/key associated with the **Cambium-ID** that the device uses for onboarding on to cnMaestro.
Account Management	
Administrator Account	The Administrator account has full read and write permissions for the device. **Disabled**: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled. **Enabled**: The user is granted access to the device management interface.
Username	The username associated with the administrator account is used upon device login.
Password	Configure a custom password to secure the device. Only the **Administrator** account can override this password. The password character display may be toggled using the visibility icon 👁.
Installer Account	The Installer account has permissions to read and write parameters applicable to unit installation and monitoring. **Disabled**: The disabled user is not granted access to the device management interface. **Enabled**: The user is granted access to the device management interface.
Username	The username associated with the installer account used upon device login.
Password	Configure a custom password to secure the device. Only the **Administrator** account can override this password. The password character display may be toggled using the visibility icon 👁.
Home User Account	The Home User account has permission to access pertinent information for support purposes. **Disabled**: The disabled user is not granted access to the device management interface. **Enabled**: The user is granted access to the device management interface.
Username	The username associated with the home user account is used upon device login.

Attribute	Description
Password	Configure a custom password to secure the device. Only the **Administrator** account can override this password. The password character display may be toggled using the visibility icon 👁.
Read-Only Account	The Read-Only account has permission to view only the **Monitor** page. **Disabled**: The disabled user is not granted access to the device management interface. **Enabled**: The user is granted access to the device management interface.
Username	The username associated with the read-only account used upon device login.
Password	Configure a custom password to secure the device. Only the **Administrator** account can override this password. The password character display may be toggled using the visibility icon 👁.

Configuration > Network page

Figure 15 shows the Network page (AP mode).



Configuration › Network

General

Network Mode * ○ NAT ● Bridge ○ Router

IP Assignment ○ Static ● DHCP

IP Address 192.168.0.2

Subnet Mask 255.255.255.0

Gateway

Preferred DNS Server

Alternate DNS Server

Ethernet Port Security ● Disabled ○ Enabled

Secure MAC Limit 5 min: 1 | max: 2047

MAC Aging Time 300 seconds | min: 0 | max: 1440

Virtual Local Area Network (VLAN)

Management VLAN ● Disabled ○ Enabled

Management VLAN ID min: 1 | max: 4094

Management VLAN Priority min: 0 | max: 7

Data VLAN ● Disabled ○ Enabled

Data VLAN ID min: 1 | max: 4094

Data VLAN Priority min: 0 | max: 7

Membership VLANs Add Show Details

	VLAN ID Begin	VLAN ID End

Table is empty

VLAN Mapping Add Show Details

	C-VLAN	S-VLAN

Table is empty

Ethernet Port

Ethernet MTU * 1538 bytes | min: 576 | max: 1700

Ethernet Port ○ Disabled ● Enabled

Port Setting ○ Manual ● Auto-Negotiate

Supported modes ✓ 10baseT Half ✓ 10baseT Full ✓ 100baseT Half ✓ 100baseT Full ✓ 1000baseT Full

Auxiliary Port

Auxiliary Port ○ Disabled ● Enabled

Auxiliary Port Settings ○ Manual ● Auto-Negotiate

Deep Packet Inspection

Deep Packet Inspection ● Disabled ○ Enabled

Advanced

IPv6 Support * ● Disabled ○ Enabled

ARP-NAT ● Disabled ○ Enabled

Spanning Tree Protocol ● Disabled ○ Enabled

DHCP Option 66 ○ Disabled ● Enabled

DHCP Server Below SM ● Disabled ○ Enabled

LLDP ○ Disabled ● Enabled

LLDP Mode ● Receive and Transmit ○ Receive only

Broadcast/Multicast Traffic Shaping

Broadcast Packet Limit ● Disabled ○ Enabled

Broadcast Packet Rate 1000 pps | min: 100 | max: 16000

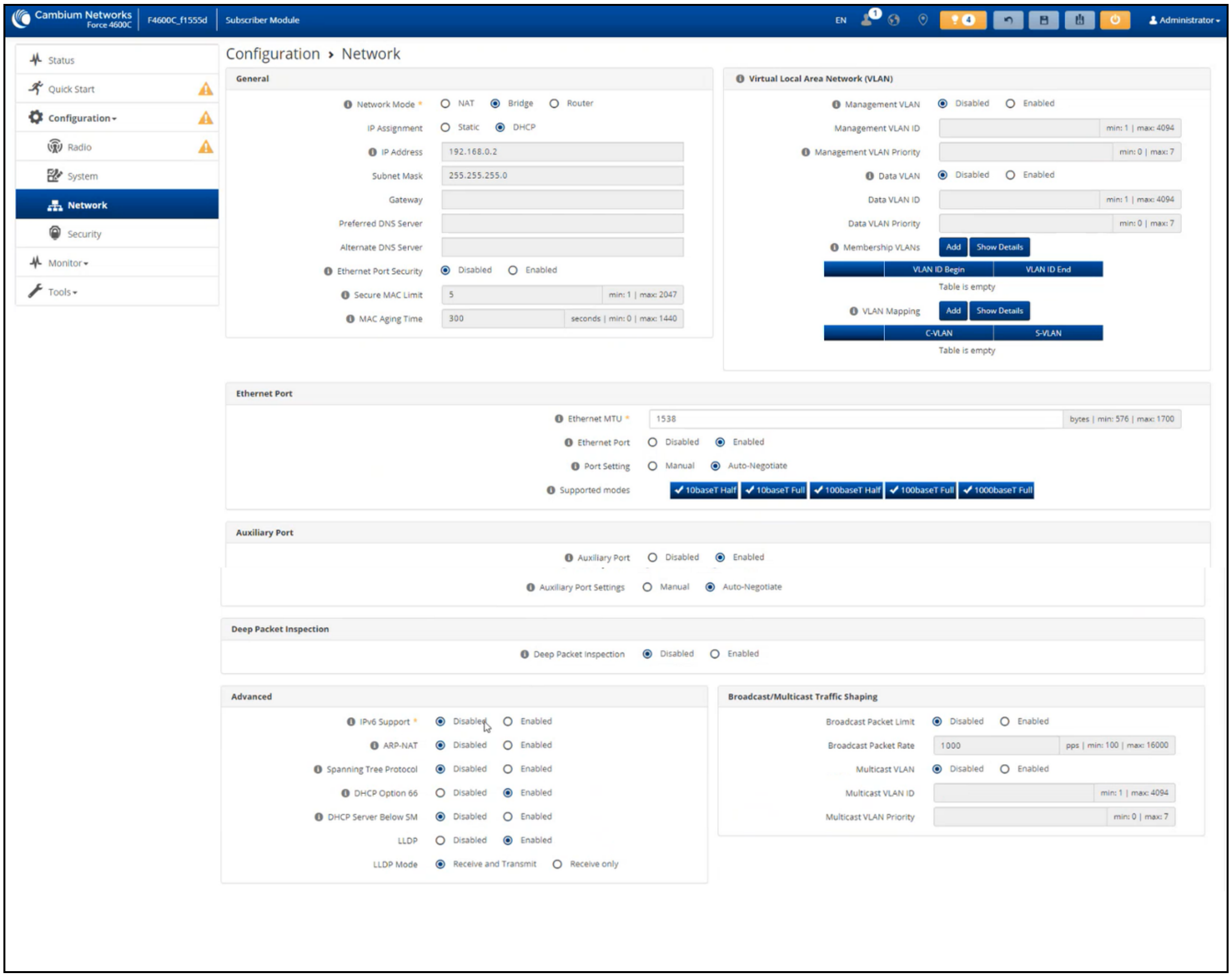
Multicast VLAN ● Disabled ○ Enabled

Multicast VLAN ID min: 1 | max: 4094

Multicast VLAN Priority min: 0 | max: 7

Figure 15: *Configuration > Network page (AP mode)*

Figure 16 shows the Network page (SM mode, Bridge Network mode).



Configuration › Network

General

Network Mode * ○ NAT ● Bridge ○ Router

IP Assignment ○ Static ● DHCP

IP Address: 192.168.0.2

Subnet Mask: 255.255.255.0

Gateway:

Preferred DNS Server:

Alternate DNS Server:

Ethernet Port Security ● Disabled ○ Enabled

Secure MAC Limit: 5 (min: 1 | max: 2047)

MAC Aging Time: 300 (seconds | min: 0 | max: 1440)

Virtual Local Area Network (VLAN)

Management VLAN ● Disabled ○ Enabled

Management VLAN ID: (min: 1 | max: 4094)

Management VLAN Priority: (min: 0 | max: 7)

Data VLAN ● Disabled ○ Enabled

Data VLAN ID: (min: 1 | max: 4094)

Data VLAN Priority: (min: 0 | max: 7)

Membership VLANs: Add | Show Details

	VLAN ID Begin	VLAN ID End

Table is empty

VLAN Mapping: Add | Show Details

	C-VLAN	S-VLAN

Table is empty

Ethernet Port

Ethernet MTU *: 1538 (bytes | min: 576 | max: 1700)

Ethernet Port ○ Disabled ● Enabled

Port Setting ○ Manual ● Auto-Negotiate

Supported modes: ✓ 10baseT Half ✓ 10baseT Full ✓ 100baseT Half ✓ 100baseT Full ✓ 1000baseT Full

Auxiliary Port

Auxiliary Port ○ Disabled ● Enabled

Auxiliary Port Settings ○ Manual ● Auto-Negotiate

Deep Packet Inspection

Deep Packet Inspection ● Disabled ○ Enabled

Advanced

IPv6 Support * ● Disabled ○ Enabled

ARP-NAT ● Disabled ○ Enabled

Spanning Tree Protocol ● Disabled ○ Enabled

DHCP Option 66 ○ Disabled ● Enabled

DHCP Server Below SM ● Disabled ○ Enabled

LLDP ○ Disabled ● Enabled

LLDP Mode ● Receive and Transmit ○ Receive only

Broadcast/Multicast Traffic Shaping

Broadcast Packet Limit ● Disabled ○ Enabled

Broadcast Packet Rate: 1000 (pps | min: 100 | max: 16000)

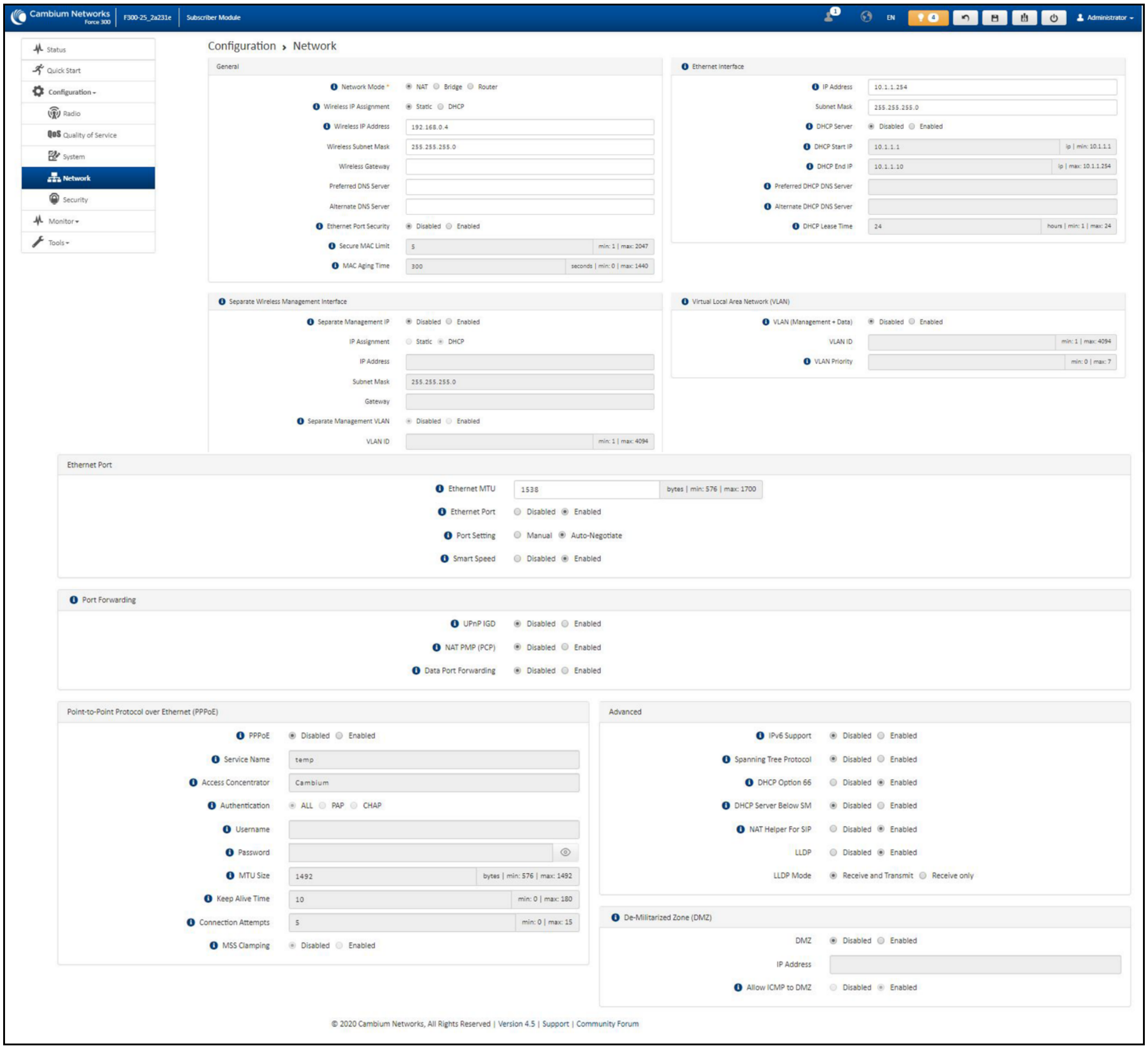
Multicast VLAN ● Disabled ○ Enabled

Multicast VLAN ID: (min: 1 | max: 4094)

Multicast VLAN Priority: (min: 0 | max: 7)

Figure 16: *Configuration > Network page (SM mode, Bridge Network mode)*

Figure 17 shows the Configuration > Network page (SM mode, NAT Network mode) .



Configuration › Network

General

Network Mode *: ● NAT ○ Bridge ○ Router
Wireless IP Assignment: ● Static ○ DHCP
Wireless IP Address: 192.168.0.4
Wireless Subnet Mask: 255.255.255.0
Wireless Gateway:
Preferred DNS Server:
Alternate DNS Server:
Ethernet Port Security: ● Disabled ○ Enabled
Secure MAC Limit: 5 (min: 1 | max: 2047)
MAC Aging Time: 300 (seconds | min: 0 | max: 1440)

Ethernet Interface

IP Address: 10.1.1.254
Subnet Mask: 255.255.255.0
DHCP Server: ● Disabled ○ Enabled
DHCP Start IP: 10.1.1.1 (ip | min: 10.1.1.1)
DHCP End IP: 10.1.1.10 (ip | max: 10.1.1.254)
Preferred DHCP DNS Server:
Alternate DHCP DNS Server:
DHCP Lease Time: 24 (hours | min: 1 | max: 24)

Separate Wireless Management Interface

Separate Management IP: ● Disabled ○ Enabled
IP Assignment: ○ Static ● DHCP
IP Address:
Subnet Mask: 255.255.255.0
Gateway:
Separate Management VLAN: ● Disabled ○ Enabled
VLAN ID: (min: 1 | max: 4094)

Virtual Local Area Network (VLAN)

VLAN (Management + Data): ● Disabled ○ Enabled
VLAN ID: (min: 1 | max: 4094)
VLAN Priority: (min: 0 | max: 7)

Ethernet Port

Ethernet MTU: 1538 (bytes | min: 576 | max: 1700)
Ethernet Port: ○ Disabled ● Enabled
Port Setting: ○ Manual ● Auto-Negotiate
Smart Speed: ○ Disabled ● Enabled

Port Forwarding

UPnP IGD: ● Disabled ○ Enabled
NAT PMP (PCP): ● Disabled ○ Enabled
Data Port Forwarding: ● Disabled ○ Enabled

Point-to-Point Protocol over Ethernet (PPPoE)

PPPoE: ● Disabled ○ Enabled
Service Name: temp
Access Concentrator: Cambium
Authentication: ● ALL ○ PAP ○ CHAP
Username:
Password:
MTU Size: 1492 (bytes | min: 576 | max: 1492)
Keep Alive Time: 10 (min: 0 | max: 180)
Connection Attempts: 5 (min: 0 | max: 15)
MSS Clamping: ● Disabled ○ Enabled

Advanced

IPv6 Support: ● Disabled ○ Enabled
Spanning Tree Protocol: ● Disabled ○ Enabled
DHCP Option 66: ○ Disabled ● Enabled
DHCP Server Below SM: ● Disabled ○ Enabled
NAT Helper For SIP: ○ Disabled ● Enabled
LLDP: ○ Disabled ● Enabled
LLDP Mode: ● Receive and Transmit ○ Receive only

De-Militarized Zone (DMZ)

DMZ: ● Disabled ○ Enabled
IP Address:
Allow ICMP to DMZ: ○ Disabled ● Enabled

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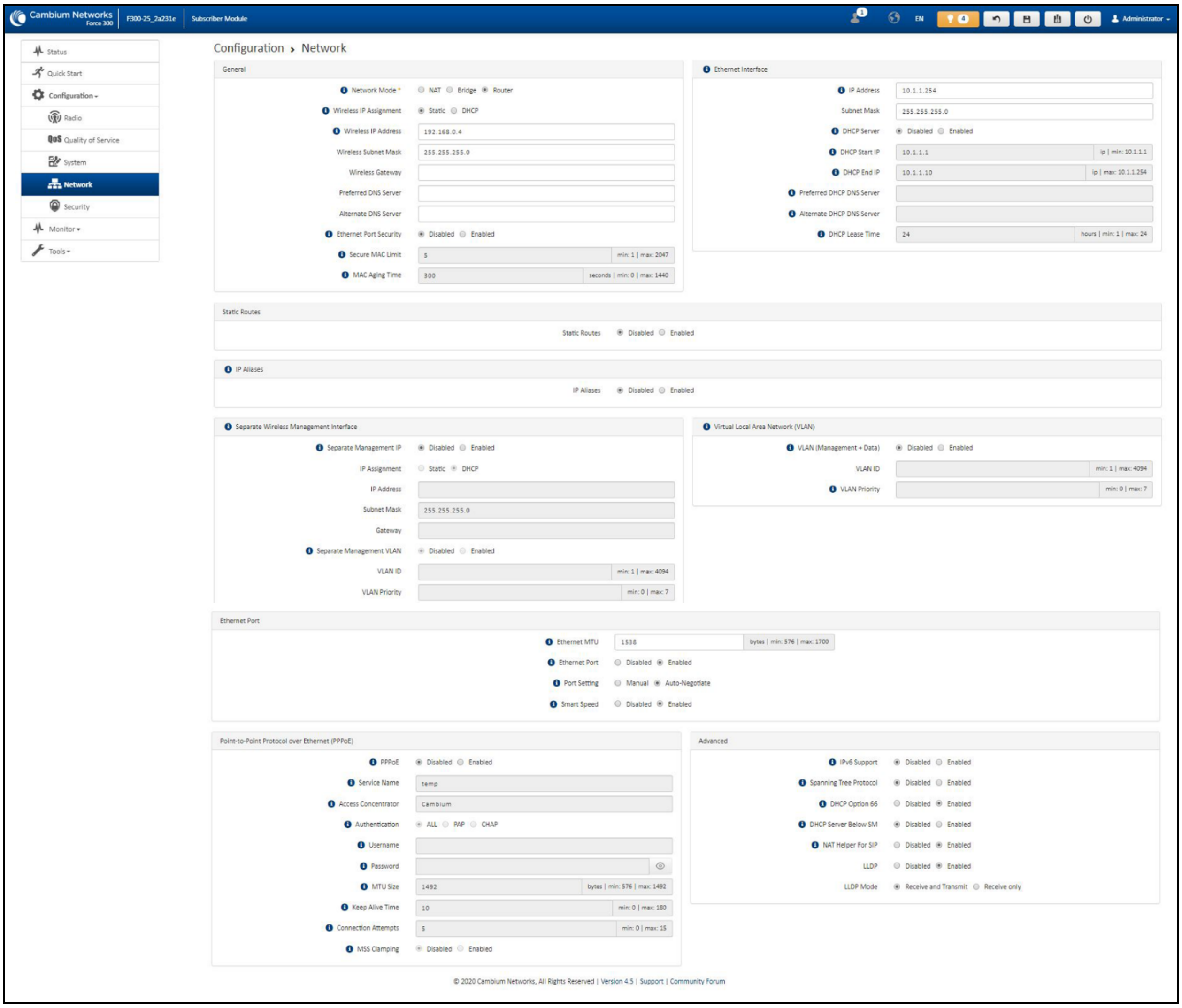
Figure 17: *Configuration > Network page (SM mode, NAT Network mode)*

Figure 18 shows the Configuration > Network page (SM mode, Router mode).



Configuration › Network

General

Network Mode * ○ NAT ○ Bridge ● Router
Wireless IP Assignment ● Static ○ DHCP
Wireless IP Address 192.168.0.4
Wireless Subnet Mask 255.255.255.0
Wireless Gateway
Preferred DNS Server
Alternate DNS Server
Ethernet Port Security ● Disabled ○ Enabled
Secure MAC Limit 5 min: 1 | max: 2047
MAC Aging Time 300 seconds | min: 0 | max: 1440

Ethernet Interface

IP Address 10.1.1.254
Subnet Mask 255.255.255.0
DHCP Server ● Disabled ○ Enabled
DHCP Start IP 10.1.1.1 ip | min: 10.1.1.1
DHCP End IP 10.1.1.10 ip | max: 10.1.1.254
Preferred DHCP DNS Server
Alternate DHCP DNS Server
DHCP Lease Time 24 hours | min: 1 | max: 24

Static Routes

Static Routes ● Disabled ○ Enabled

IP Aliases

IP Aliases ● Disabled ○ Enabled

Separate Wireless Management Interface

Separate Management IP ● Disabled ○ Enabled
IP Assignment ○ Static ● DHCP
IP Address
Subnet Mask 255.255.255.0
Gateway
Separate Management VLAN ● Disabled ○ Enabled
VLAN ID min: 1 | max: 4094
VLAN Priority min: 0 | max: 7

Virtual Local Area Network (VLAN)

VLAN (Management + Data) ● Disabled ○ Enabled
VLAN ID min: 1 | max: 4094
VLAN Priority min: 0 | max: 7

Ethernet Port

Ethernet MTU 1538 bytes | min: 576 | max: 1700
Ethernet Port ○ Disabled ● Enabled
Port Setting ○ Manual ● Auto-Negotiate
Smart Speed ○ Disabled ● Enabled

Point-to-Point Protocol over Ethernet (PPPoE)

PPPoE ● Disabled ○ Enabled
Service Name temp
Access Concentrator Cambium
Authentication ● ALL ○ PAP ○ CHAP
Username
Password
MTU Size 1492 bytes | min: 576 | max: 1492
Keep Alive Time 10 min: 0 | max: 180
Connection Attempts 5 min: 0 | max: 15
MSS Clamping ● Disabled ○ Enabled

Advanced

IPv6 Support ● Disabled ○ Enabled
Spanning Tree Protocol ● Disabled ○ Enabled
DHCP Option 66 ○ Disabled ● Enabled
DHCP Server Below SM ● Disabled ○ Enabled
NAT Helper For SIP ○ Disabled ● Enabled
LLDP ○ Disabled ● Enabled
LLDP Mode ● Receive and Transmit ○ Receive only

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Figure 18: *Configuration > Network page (SM mode, Router mode)*

Table 137 Configuration > Network page attributes

Attribute	Description
General	
Network Mode	**NAT**: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination). **Bridge**: The SM acts as a switch and packets are forwarded or filtered based on their MAC destination address. **Router**: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination) using specific static routes and IP aliases configured by the operator.
IP Assignment	**Static:** Device management IP addressing is configured manually in fields **IP Address, Subnet Mask, Gateway, Preferred DNS Server,** and **Alternate DNS Server**.

Attribute	Description
	DHCP: Device management IP addressing (**IP address, Subnet Mask, Gateway, and DNS Server**) is assigned through a network DHCP server, and parameters **IP Address, Subnet Mask, Gateway, Preferred DNS Server,** and **Alternate DNS Server** are not configurable.
Wireless IP Assignment (NAT mode, Router mode)	**Static**: Wireless IP address is configured manually in fields **Wireless IP Address, Wireless IP Subnet Mask, Wireless Gateway IP Address, Preferred DNS IP Address,** and **Alternate DNS IP Address**. **DHCP**: Device management IP addressing (**Wireless IP address, Wireless Subnet mask, Wireless Gateway,** and **DNS server**) is assigned through a network DHCP server.
IP Address Wireless IP Address (NAT mode, Router mode)	Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information through DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).
Subnet Mask Wireless IP Address (NAT mode, Router mode)	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Gateway Wireless Gateway (NAT mode, Router mode)	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.
IPv6 Assignment	IPv6 Assignment specifies how the IPv6 address is obtained. **Static**: Device management IP addressing is configured manually in fields IPv6 Address and IPv6 Gateway. **DHCPv6**: Device management IP addressing (IP address and gateway) is assigned via a network DHCP server, and parameters IPv6 Address and IPv6 Gateway are unused. If the DHCPv6 server is not available previous static IPv6 address will be used as a fallback IPv6 address. If no previous static IPv6 address is available, no IPv6 address will be assigned. DHCPv6 will occur over the wireless interface by default.
IPv6 Address	Internet Protocol version 6 (IPv6) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. IPv6 addresses are represented by eight groups of four hexadecimal digits separated by colons.
IPv6 Gateway	Configure the IPv6 address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Ethernet Port Security Subscriber Module Mode)	**Disabled:** No MAC address limit/gaining timers are imposed for bridging at the SM device Ethernet port.

Attribute	Description
	Enabled: By configuring **Secure MAC Limit** and **MAC Aging Time**, a limit is imposed on the number and duration of bridged devices connected to the SM Ethernet port.
Secure MAC Limit (SM mode)	Configure the number of simultaneous secure MAC addresses that is allowed at the Ethernet interface of the SM
MAC Aging Time (SM mode)	Configure the time for which the secure MAC addresses should be allowed to age. Once the Aging timer expires for a MAC address, it is removed from the internal table and no longer count as an active MAC. Set the time to 0 to disable aging.
Ethernet Interface (Subscriber Module NAT Mode, Router Mode)	
IP Address (SM NAT mode, Router mode)	Ethernet interface Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.
Subnet Mask (SM NAT mode, Router Mode)	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device belongs to subnet 192.168.2.X.
DHCP Server (SM NAT mode, Router mode)	**Disabled**: Use this setting when SM is in NAT or Router mode if there is an existing DHCP Server below the SM handing out IP Addresses or if all devices below the SM is configured with static IP Addresses. **Enabled**: Use this setting when SM is in NAT or Router mode, to use the SM's local/onboard DHCP server to hand out IP addresses to its clients.
DHCP Start IP (SM NAT mode, Router mode)	Configure the first address which is issued to a DHCP client. Upon additional DHCP requests, the DHCP Start IP is incremented until the local DHCP End IP is reached.
DHCP End IP (SM NAT mode, Router mode)	Configure the highest IP address in the DHCP pool that can be issued to a DHCP client.
Preferred DHCP DNS Server (SM NAT mode, Router mode)	Configure the primary DNS Server IP address which is used to configure DHCP clients (if local DHCP Server is set to **Enabled**).
Alternate DHCP DNS Server (SM NAT Mode, Router mode)	Configure the secondary DNS Server IP address which is used to configure DHCP clients (if local DHCP Server is set to **Enabled**).
DHCP Lease Time (SM NAT Mode, Router mode)	Configure the time for which a DHCP IP address is leased. When the lease time expires, the DHCP client must renew IP addresses through DHCP request.
PPPoE	**Point-to-Point Protocol over Ethernet**: Used for encapsulating PPP frames inside Ethernet frames.
Service Name	Optional entry to set a specific service name to connect to for the PPPoE session. If this is left blank the SM accepts the first service option that comes back from the Access Concentrator specified below, if any. This is limited to 32 characters.
Access Concentrator	An optional entry to set a specific Access Concentrator to connect to for the PPPoE session. If this is blank, the SM accepts the first Access Concentrator which matches the service name (if specified). This is limited to 32 characters.
Static Routes (Subscriber Module Router Mode)	
Static Routes (SM Router mode)	When **Enabled**, it allows the operator to create static routes that apply to both the Wireless and Ethernet interface of the SM.

Attribute	Description
	This allows operators to configure a custom table of explicit paths between networks. Static routing is often used as a method to reduce the overhead of processing dynamic routes through a network when the specific path is known (or, it is simpler to define a specific path). Static routing is also used as a backup when dynamic routing protocols fail to complete a route from one network to another. In router mode, the Static Routes table is referenced by the SM to forward/filter packets to a particular destination configured by the user based on the IP addressing information contained in the table. Since static routes do not change with network changes, it is recommended to only use static routes for simple network paths that are not prone to frequent changes (requiring updates to the routes configured on the ePMP SM). It is important to consider each hop in a static route's path to ensure that the routing equipment has been configured to statically or dynamically route packets to the proper destination. Otherwise, network communication fails. Network Address Translation (NAT) is not performed when the SM is in Router mode.
Target Network IP (SM Router mode)	Configure the target subnet/network's IP address to which the SM should route the packets.
Subnet Mask (SM Router mode)	Configure the subnet mask for the **Target Network IP** address.
Gateway (SM Router mode)	Configure the gateway to which packets that match the **Target Network IP Address** and **Subnet Mask** are sent.
Description (SM Router mode)	Provide a description to easily identify the static route and its purpose.
IP Aliases (Subscriber Module Router Mode)	
IP Aliases (SM Router mode)	When **Enabled**, IP aliases allow the operator to associate more than one IP address to the Ethernet interface of the SM. This configuration of multiple IP addresses for the SM's Ethernet interface allows connections to multiple networks, often used as a mechanism for management access to the device from a convenient networking path.
IP Address (SM Router mode)	Configure the IP address for the alias.
Subnet Mask (SM Router mode)	Configure the subnet mask for the alias.
Description (SM Router mode)	Provide a description to easily identify the IP alias and its purpose/connected network.
Separate Wireless Management Interface (SM NAT mode, Router mode)	
Separate Management IP (SM NAT mode, Router mode)	**Disabled:** When disabled, the Wireless IP is the management interface for the SM. **Enabled:** When enabled, the IP Address below is the management interface for the SM.
IP Assignment (SM NAT mode, Router mode)	**Static:** Separate Wireless Management Interface is configured manually in fields **IP Address, Subnet Mask** and **Gateway**.

Attribute	Description
	DHCP: Management IP addressing (**IP Address, Subnet Mask, Gateway, and DNS Server**) is assigned through a network DHCP server.
IP Address (SM NAT mode, Router mode)	Configure the IP address that is used to access the SM's management interface when in NAT mode. The Wireless IP (public IP) does not allow management access.
Subnet Mask (SM NAT mode, Router mode)	Defines the address range of the connected IP network. For example, if the IP Address is configured to 192.168.2.1 and Subnet Mask is configured to 255.255.255.0, the device wireless interface belongs to the subnet 192.168.2.X.
Gateway (SM NAT mode, Router mode)	Configure the IP address of a computer on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Separate Management VLAN (SM NAT mode, Router mode)	**Enabled:** A VLAN configuration establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data based on the VLAN architecture. For the network operator, this provides flexibility in network segmentation, simpler management, and enhanced security. When the SM is in NAT mode, the Separate Wireless Management VLAN configuration applies to management data. **Disabled**: When disabled, the SM does not have a unique management VLAN.
VLAN ID (SM NAT mode, Router mode)	Configure this parameter to include the device's management traffic on a separate VLAN network.
VLAN Priority (SM NAT mode, Router mode)	ePMP radios can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **Data VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to the management data of the device. This parameter only takes effect if the Separate Wireless Management VLAN parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for management traffic on the configured VLAN ID originating from the SM. The default value is 0.
Virtual Local Area Network (VLAN)	
Management VLAN (AP mode)	**Enabled:** The AP management interface can be assigned to a management VLAN to separate management traffic (remote module management via SNMP or HTTP) from user traffic (such as internet browsing, voice, or video. Once the management interface is enabled for a VLAN, an AP's management interface can be accessed only by packets tagged with a VLAN ID matching the management VLAN ID. A VLAN configuration establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data based on the VLAN architecture. For the network operator, this provides flexibility in network segmentation, simpler management, and enhanced security. **Disabled:** When disabled, all IP management traffic is allowed to the device.
VLAN (Management + Data) (SM mode)	**Enabled:** The device management interface can be assigned to a Management VLAN to separate management traffic (remote module management through SNMP or HTTP) from user traffic (such as internet browsing, voice, or video. Once the management interface is enabled for a VLAN, the management interface can be accessed only by packets tagged with a VLAN ID matching the management VLAN ID.

Attribute	Description
	A VLAN configuration establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data based on the VLAN architecture. For the network operator, this provides flexibility in network segmentation, simpler management, and enhanced security. **Disabled:** When disabled, all IP management traffic is allowed to the device.
VLAN ID (NAT mode, Router mode)	Configure this parameter to include the device's management traffic on a separate VLAN network.
VLAN Priority (NAT mode, Router mode)	ePMP radios can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **Data VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to the device management data. This parameter only takes effect if the Separate Wireless Management VLAN parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for management traffic on the configured VLAN ID originating from the SM. The default value is 0.
Management VLAN ID (AP mode) (SM Bridge mode)	Configure this parameter to include the device's management traffic on a separate VLAN network. For example, if Management VLAN ID is set to 2, UI access is allowed only from frames tagged with VLAN ID 2. This parameter takes effect only if the MGMT VLAN parameter is enabled.
Management VLAN Priority (AP mode) (SM Bridge mode)	ePMP devices can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **Management VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to the device management traffic. This parameter only takes effect if the Management VLAN parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for traffic on the management VLAN originating from the Subscriber Module. The default value is 0.
Data VLAN (SM mode) (Bridge mode)	**Enabled**: A VLAN tag is added to all untagged traffic entering the Salve device LAN port before sending it to the Access Point and remove tags in the opposite direction from traffic (tagged with Data VLAN ID) entering on the SM device WAN port before sending to the SM device LAN port. **Disabled**: When disabled, no changes are made to untagged traffic passing through the SM device.
Data VLAN ID (SM mode) (Bridge mode)	Configure this parameter to include this VLAN tag to all untagged traffic entering on the Subscriber Module device LAN port before sending it to the Access Point device and remove tags in the opposite direction from traffic (tagged with Data VLAN ID) entering on the Subscriber Module device WAN port before sending to the SM device LAN port.
Data VLAN Priority (SM mode) (Bridge mode)	ePMP devices can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **Data VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to device user data. This parameter only takes effect if the **Data VLAN** parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for traffic on the **Data VLAN** originating from the SM device. The default value is 0.

Attribute	Description
Membership VLAN (SM Bridge mode)	Configure the **Membership VLAN Table** to include the SM in one or more VLANs. When the SM receives a packet tagged from either the Ethernet (LAN) or Wireless (WAN) side with a VLAN ID which is contained in the **Membership VLAN Table**, the packet is forwarded and sent out to the other interface. When the SM receives a packet tagged with a VLAN ID that is not present in the **Membership VLAN Table**, the frame is dropped (assuming there is at least one VLAN ID present in the Membership VLAN table or configured as a Data VLAN).
VLAN Mapping (SM Bridge mode)	Configure the **VLAN Mapping Table** to map the C-VLAN of traffic ingressing the Ethernet (LAN) port of the SM to an S-VLAN before being forwarded to the air interface on the UL. In the DL direction, the SM will automatically un-map the S-VLAN to the C-VLAN before forwarding the tagged packets to the Ethernet (LAN) interface of the SM.
C-VLAN (SM Bridge mode)	Configure the C-VLAN ID of the tagged traffic for which the mapping needs to occur. The C-VLAN ID must be entered in the SM VLAN Membership VLAN table.
S-VLAN (SM Bridge mode)	Configure the S-VLAN ID to which the tagged traffic needs to be mapped. The S-VLAN ID must be entered in the SM VLAN Membership VLAN table.
Ethernet Port	
Ethernet MTU	Specify the device MTU or Maximum Transmission Unit; the size in bytes of the largest data unit that the device is configured to process. Larger MTU configurations can enable the network to operate with greater efficiency, but in the case of retransmissions due to packet errors, efficiency is reduced since large packets must be resent in the event of an error.
Ethernet Port (SM mode)	**Disabled**: The primary Ethernet port is disabled (a mechanism for restricting access for non-payment). **Enabled:** The primary Ethernet port is enabled.
Port Setting	Allows the Gigabit Ethernet port duplex settings and port speed to be either manually configured or auto-negotiate with the connected Ethernet device on the other end of the link. Guidelines for using **Port Setting**: • If auto-negotiation is turned on, this applies to both **Port Speed** and **Port Duplex Mode**. • If the other end of the Ethernet connection supports auto-negotiation, then select **Auto-Negotiate**. • If the other end of the Ethernet connection does not support auto-negotiation, then select **Manual** and both ends of the link should manually set the port speed and port duplex mode.
Port Speed	With **Port Setting** configured to **Manual**, the Gigabit Ethernet port speed can be forced to 1000 Mbps, 100 Mbps, or 10 Mbps.
Port Duplex mode	With **Port Setting** configured to **Manual**, the Gigabit Ethernet port duplex mode can be forced to **Full** or **Half**.
Port Forwarding (Subscriber Module Mode) (NAT Mode)	

Attribute	Description
UPnP IGD (SM mode) (NAT mode)	Universal Plug and Play (UPnP) is a set of networking protocols that permits networked devices, such as personal computers, printers, Internet gateways, Wi-Fi APs, and mobile devices to seamlessly discover each other's presence on the network and establish functional network services for data sharing, communications, and entertainment. UPnP is intended primarily for residential networks without enterprise-class devices. With UPnP IGD and PCP protocols, ePMP supports explicit dynamic port mappings. Enable UPnP IGD (Internet Gateway Device) to allow the ePMP device to use the IGD profile for UPnP support.
NAT PMP (PCP) (SM mode) (NAT mode)	The PCP (Port Control Protocol) allows an IPv6 or IPv4 host to control how incoming IPv6 or IPv4 packets are translated and forwarded by a Network Address Translator (NAT) or simple firewall, and also allows a host to optimize its outgoing NAT keepalive messages. PCP was standardized as a successor to the NAT Port Mapping Protocol (NAT-PMP), with which it shares similar protocol concepts and packet formats. Enable this parameter to allow the ePMP device to use the PCP protocol for UPnP support.
Data Port Forwarding (SM mode) (NAT mode)	The Data Port Forwarding Table is used to define which range of wireless ports are forwarded to a LAN (SM local network) IP address below the SM.
Protocol (SM mode) (NAT mode)	**UDP**: Packet forwarding decisions are based on UDP packets. **TCP**: Packet forwarding decisions are based on TCP packets.
Port Begin (SM mode) (NAT mode)	Configure the beginning of the range of wireless ports to match for forwarding to LAN IP.
Port End (SM mode) (NAT mode)	Configure the end of the range of wireless ports to match for forwarding to LAN IP.
Forwaring IP (SM mode) (NAT mode)	Configure the LAN IP of the device situated below the SM which receives the packets forwarded based on the separate management IP port forwarding table configuration.
Mapped Port (SM mode) (NAT mode)	Configure the port of the device situated below the SM which receives the packets forwarded based on the Data Port Forwarding Table configuration.
Point-to-Point Protocol over Ethernet (PPPoE) (SM mode) (NAT mode, Router mode)	
PPPoE (SM mode) (NAT mode, Router mode)	Point-to-Point Protocol over Ethernet: Used for encapsulating PPP frames inside Ethernet frames.
Service Name (SM mode) (NAT mode, Router mode)	Optional entry to set a specific service name to connect to for the PPPoE session. If this is left blank the SM accepts the first service option that comes back from the Access Concentrator specified below, if any. This is limited to 32 characters.
Access Concentrator (SM mode) (NAT mode, Router mode)	Optional entry to set a specific Access Concentrator to connect to for the PPPoE session. If this is blank, the SM accepts the first Access Concentrator which matches the service name (if specified). This is limited to 32 characters.

Attribute	Description
Authentication (SM mode) (NAT mode, Router mode)	**ALL:** This means that CHAP authentication is attempted first, then PAP authentication. The same password is used for both types. **CHAP:** This means that CHAP authentication is attempted. **PAP:** This means that PAP authentication is attempted.
Username (SM mode) (NAT mode, Router mode)	This is the CHAP/PAP username that is used. This is limited to 32 characters.
Password (SM mode) (NAT mode, Router mode)	This is the CHAP/PAP password that is used. This is limited to 32 characters.
MTU Size (SM mode) (NAT mode, Router mode)	Maximum Transmission Unit; the size in bytes of the largest data unit that the device is configured to process inside the PPPoE tunnel. This field allows the operator to specify the largest MTU value to use in the PPPoE session if PPPoE MSS Clamping is Enabled. The user is able to enter an MTU value up to 1492. However, if the MTU determined in LCP negotiations is less than this user-specified value, the SM uses the smaller value as its MTU for the PPPoE link.
Keep Alive Time (SM mode) (NAT Mode, Router Mode)	Configure the Keep Alive Time to allow the radio to keep the PPPoE session up after establishment. As an example, if this field is set to 5, the PPPoE client sends a keep-alive message to the PPPoE server every 5 seconds. If there is no acknowledgment, it sends the **Keep alive** message to the server four more times (for a total of five times) before tearing down the PPPoE session. Setting this to 12 means the keep-alive message is sent every 12 seconds and when there is no acknowledgment, the client tries for a total of 12 times every 12 seconds before tearing down the PPPoE session.
MSS Clamping (SM mode) (NAT mode, Router mode)	**Disabled:** The SM PPPoE session allows any MTU size determined by other devices in the PPPoE session during the LCP negotiations. **Enabled:** The SM PPPoE session enforces a max MTU size determined by the PPPoE MTU Size setting for all devices in the PPPoE session during the LCP negotiations unless one of the devices enforces an MTU setting that is smaller in value.
SFP Port (Access Point Mode)	
SFP Port (AP mode)	**Disabled**: The SFP port is inactive. **Enabled**: The SFP port is active.
Advanced	
IPv6 Support	System-wide IPv6 Protocol Support. When enabled, appropriate IPv6 modules and services are loaded.
Spanning Tree Protocol	**Disabled**: When disabled, Spanning Tree Protocol (802.1d) functionality is disabled at the Access Point. **Enabled**: When enabled, Spanning Tree Protocol (802.1d) functionality is enabled at the Access Point, allowing for the prevention of Ethernet bridge loops.

Attribute	Description
DHCP Server Below Subscriber Module (SM mode)	**Disabled**: This blocks DHCP servers connected to the SM device LAN side from handing out IP addresses to DHCP clients above the SM device (wireless side). **Enabled**: This allows DHCP servers connected to the SM device LAN side to assign IP addresses to DHCP clients above the SM device (wireless side). This configuration is typical in PTP links.
Management Access (AP mode)	**Ethernet**: Only allow access to the AP's web management interface through a local Ethernet (LAN) connection. In this configuration, the AP's web management interface may not be accessed from over the air (from a device situated below the SM). **Ethernet and Wireless**: Allow access to the AP's web management interface through a local Ethernet (LAN) connection and from over the air (from a device situated below the SM). APs configured with Management Access Interface set to Ethernet and Ethernet and Wireless are susceptible to unauthorized access.
SM Traffic Isolation (AP mode)	**Disabled**: This is the default mode. When SM isolation is disabled, an SM can communicate with another SM, when both the SMs are associated with the same Access Point (AP). **Enabled**: When the SM Isolation feature is **Enabled**, an SM is unable to communicate with another SM (peer-to-peer traffic) when both the SMs are associated with the same AP. This feature essentially enables the AP to drop the packets to avoid peer-to-peer traffic scenarios.
DHCP Option 82 (AP mode)	**Disabled:** The device does not insert the **remote-id** (option ID 0x2) and the **circuit-id** (ID 0x01). DHCP Option 82 is 'Disabled' by default. **Enabled**: The device inserts **remote-id** (option ID 0×2) to be the SM MAC address and the **circuit-id** (ID 0×01) to be the AP's MAC address. Those two fields are used to identify the remote device and connection from which the DHCP request was received.
LLDP	The Link Layer Discovery Protocol (LLDP) is a vendor-neutral link layer protocol (as specified in IEEE 802.1AB) used by ePMP for advertising its identity, capabilities, and neighbors on the Ethernet/wired interface. **Disabled:** ePMP does not receive or transmit LLDP packets from/to its neighbors. **Enabled:** ePMP can receive LLDP packets from its neighbors and send LLDP packets to its neighbors, depending on the LLDP Mode configuration below.
LLDP Mode	**Receive and Transmit**: ePMP sends and receives LLDP packets to/from its neighbors on the Ethernet/LAN interface. **Receive Only**: ePMP receives LLDP packets from its neighbors on the Ethernet/LAN interface and discovers them.
PPPoE Intermediate Agent	When enabled, during the PPPoE Discovery phase the AP inserts access loop identification into the PPPoE PADR packets. This mechanism helps the service provider to distinguish between end hosts connected via Ethernet as an access device (typically, home routers situated below an ePMP subscriber device). On the AP, PPPoE Intermediate Agent enables subscriber line identification by tagging Ethernet frames of corresponding users with Vendor-Specific PPPoE Tags **Circuit ID** (defining AP name, frame, slot, port, and VLAN ID information) and **Remote ID** (defining user phone number).

Attribute	Description
Broadcast / Multicast Traffic Shaping (SM mode) (Bridge mode)	
Broadcast Packet Limit (SM mode) (Bridge mode)	**Enabled**: This allows the user to set the **Broadcast Packet Rate** below. Configure this parameter to limit the number of broadcast packets that will be allowed on the ingress of the radio's Ethernet port. Set the packets per second value to limit the impact of events such as broadcast storms. **Disabled**: There is no limit on the amount of broadcast traffic allowed into the ingress of the radio's Ethernet port.
Broadcast Packet Rate (SM mode) (Bridge mode)	Set the packets per second value to limit the amount of broadcast traffic allowed on the ingress on the radio's Ethernet port. The packets per second limit can be set individually on each ePMP radio. The range is 100 to 16000 packets per second. The default is **1000**.
Reliable Multicast	**Enabled**: This feature allows ePMP to support IGMP capable devices. Once a multicast group is identified, the AP allows multicast traffic to be sent only to the SMs within the multicast group. The SMs support up to 5 unique multicast groups. Also, when this option is enabled, the multicast traffic is sent to the SMs using the current Downlink MCS rate. **Disabled**: ePMP supports IGMP capable devices but the multicast traffic is sent using MCS 1 on the downlink to all SMs, regardless of the multicast group.
Multicast Group Limit (SM mode) (Bridge mode)	Configure the maximum number of simultaneous multicast groups that the SM allows from devices below it. The default is **3**.
Multicast VLAN (SM mode) (Bridge mode)	**Enabled:** A VLAN tag is added to all untagged multicast traffic entering the SM's LAN port before sending it to the AP and remove tags in the opposite direction from traffic (tagged with Multicast VLAN ID) entering on the SM's WAN port before sending to the SM's LAN port. **Disabled:** When disabled, no changes are made to untagged multicast traffic passing through the SM.
Multicast VLAN ID (SM mode) (Bridge mode)	Configure this parameter to include this VLAN tag to all untagged **multicast** traffic entering on the SM's LAN port before sending it to the AP and remove tags in the opposite direction from multicast traffic (tagged with Multicast VLAN ID) entering on the SM's WAN port before sending to the SM's LAN port.
Multicast VLAN Priority (SM mode) (Bridge mode)	ePMP radios can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **Multicast VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to the device's **multicast** data. This parameter only takes effect if the **Multicast VLAN** parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for traffic on the **Multicast VLAN** originating from the SM. The default value is 0.
De-Militarized Zone (Subscriber Module NAT Mode)	
DMZ (SM NAT mode)	**Disabled:** Packets arriving on the wireless interface destined for the Ethernet side of the network are dropped if a session does not exist between the Source IP (Wireless) and Destination IP (Ethernet). By default, NAT requires the sessions to be initiated from the Ethernet side before a packet is accepted from the Wireless to the Wired side.

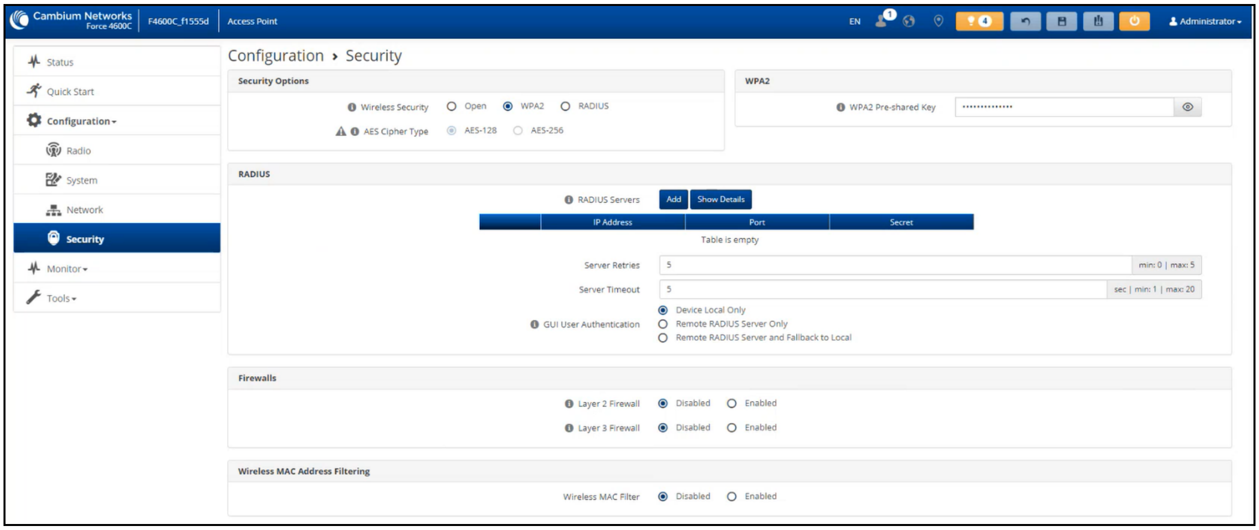
Attribute	Description
	Enabled: Any packets with an unknown destination port (not associated with an existing session or not defined in the port forwarding rules) are automatically sent to the device configured with DMZ IP Address.
IP Address (SM NAT mode)	Configure the IP address of an SM-connected device that is allowed to provide network services to the wide-area network.
Allow ICMP to DMZ (SM NAT mode)	**Enabled:** ICMP packets are forwarded to the DMZ IP **Disabled:** SM answers ICMP requests, and SM **Wireless IP Address** becomes reachable by ping when DMZ is enabled.

Configuration > Security page

The **Security** page is used to configure system security features including authentication and Layer2/Layer3 Firewall rules. Figure 19 and Figure 20 shows the Security page (AP mode) and Security page (SM mode).

Attention

If a device firewall rule is added with **Action** set to **Deny** and **Interface** set to **LAN** or **WAN** and no other rule attribute is configured, the device drops all Ethernet or wireless traffic, respectively. Ensure that all firewall rules are specific to the type of traffic which must be denied and that no rules exist in the devices with the only Action set to **Deny** and Interface set to **LAN** or **WAN**. To regain access to the device, perform a factory default.



Configuration › Security

Security Options

Wireless Security ○ Open ● WPA2 ○ RADIUS

AES Cipher Type ● AES-128 ○ AES-256

WPA2

WPA2 Pre-shared Key ••••••••••••••

RADIUS

RADIUS Servers Add Show Details

	IP Address	Port	Secret

Table is empty

Server Retries 5 min: 0 | max: 5

Server Timeout 5 sec | min: 1 | max: 20

GUI User Authentication ● Device Local Only ○ Remote RADIUS Server Only ○ Remote RADIUS Server and Fallback to Local

Firewalls

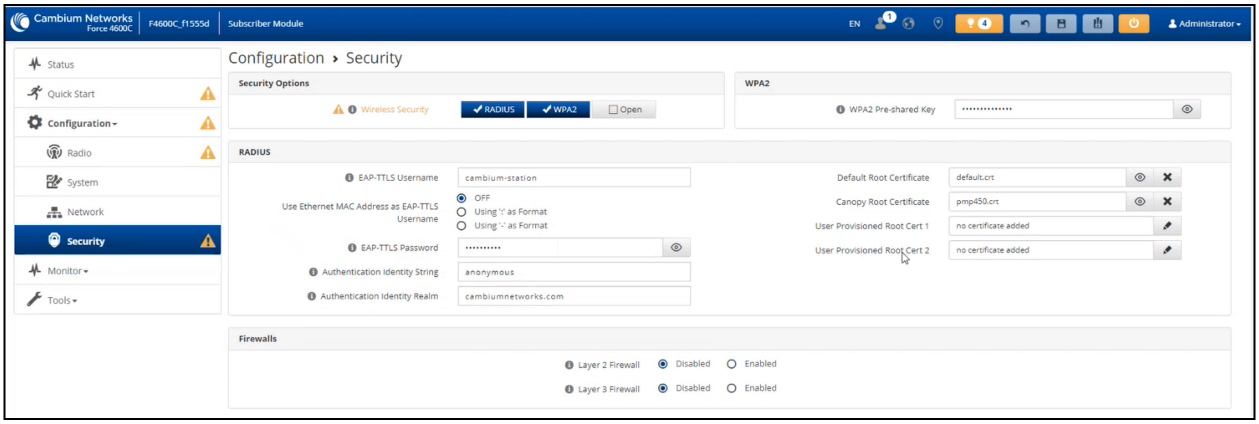
Layer 2 Firewall ● Disabled ○ Enabled

Layer 3 Firewall ● Disabled ○ Enabled

Wireless MAC Address Filtering

Wireless MAC Filter ● Disabled ○ Enabled

Figure 19: *Configuration > Security page (AP mode)*



Configuration › Security

Security Options

Wireless Security: ☑ RADIUS ☑ WPA2 □ Open

WPA2

WPA2 Pre-shared Key: ••••••••••••••

RADIUS

EAP-TTLS Username: cambium-station

Use Ethernet MAC Address as EAP-TTLS Username: ● OFF ○ Using ':' as Format ○ Using '-' as Format

EAP-TTLS Password: ••••••••••

Authentication Identity String: anonymous

Authentication Identity Realm: cambiumnetworks.com

Default Root Certificate: default.crt

Canopy Root Certificate: pmp450.crt

User Provisioned Root Cert 1: no certificate added

User Provisioned Root Cert 2: no certificate added

Firewalls

Layer 2 Firewall: ● Disabled ○ Enabled

Layer 3 Firewall: ● Disabled ○ Enabled

Figure 20: *Configuration > Security page (SM mode)*

Table 2: Configuration > Security page attributes

Attribute	Description
Security Options	
Wireless Security (AP mode)	For AP mode devices, select the security mode enforced upon network entry. For SM mode devices, select the security mode utilized upon network entry attempts. **Open:** All SM devices requesting network entry are allowed registration. **WPA2:** The WPA2 mechanism provides AES radio link encryption and SM network entry authentication. When enabled, the SM must register using the authentication pre-shared key configured on the AP and SM. **RADIUS**: Enables SM authentication through a pre-configured Radius server.
WPA2	
WPA2 Pre-shared Key	Configure this key on the AP, then configure the SM with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.
RADIUS (AP mode)	
Servers (AP mode)	For more Radio servers, click **Add**. Up to three Radius servers can be configured on the device with the following attributes: • **IP Address:** IP Address of the Radius server on the network. • **Port:** The Radius server port. The default is 1812. • **Secret:** Secret key that is used to communicate with the RADIUS server.
Server Retries (AP mode)	The number of times the radio retries authentication with the configured Radius server before it fails authentication of the SM.
Server Timeout (AP mode)	Timeout between each retry with the configured RADIUS server before it fails authentication of the SM.
GUI User Authentication (AP mode)	This applies to both the AP and its registered SMs.

Attribute	Description
	Device Local Only: The device's GUI authentication is local to the device using one of the accounts configured under **Configuration** > **System** > **Account Management**. **Remote RADIUS Server Only:** The UI authentication of the device is performed using a RADIUS server. **Remote RADIUS Server and Fallback to Local:** The UI authentication of the device is performed using a RADIUS server. Upon failure of authentication through a RADIUS server, the authentication falls back to one of the local accounts configured under **Configuration** > **System** > **Account Management**.
EAP-TTLS Username (SM mode)	Configure the EAP-TTLS Username to match the credentials on the RADIUS server being used for the network.
Use Ethernet MAC Address at EAP-TTLS Username (SM mode)	The device MAC Address can be used as the EAP-TTLS Username in either ":" or "-" delimited format.
EAP-TTLS Password (SM mode)	Configure the EAP-TTLS Password to match the credentials on the RADIUS server being used for the network.
Authentication Identity String (SM mode)	Configure this Identity string to match the credentials on the RADIUS server being used for the network. The default value for this parameter is **anonymous**.
Authentication Identity Realm (SM mode)	Configure this Identity string to match the credentials on the RADIUS server being used for the network. The default value for this parameter is **cambiumnetworks.com**.
Default Root Certificate (SM mode)	Default EAP-TTLS root certificate that must match the certificate on the RADIUS server.
Canopy Root Certificate (SM mode)	PMP 450 default EAP-TTLS root certificate to match the certificate on the RADIUS server used with current PMP 450 installations.
User Provisioned Root Cert 1 (SM mode)	Import a user certificate if a certificate different from the default certificates is needed.
User Provisioned Root Cert 2 (SM mode)	Import a second user certificate if a certificate different from the default or 1st user provisioned certificate is needed.
Firewalls	
Layer 2 Firewall	**Enabled**: Modifications to the Layer 2 Firewall Table are allowed and rules are enforced. **Disabled**: Modifications to the Layer 2 Firewall Table are not allowed and rules are not enforced.
Layer 2 Firewall Rules	The Layer 2 firewall table may be used to configure rules matching layer 2 (MAC layer) traffic which results in forwarding or dropping the traffic over the radio link or Ethernet interface.
Layer 3 Firewall	**Disabled**: Modifications to the Layer 3 Firewall Table are not allowed and rules are not enforced. **Enabled**: Modifications to the Layer 3 Firewall Table are allowed and rules are enforced.
Layer 3 Firewall Rules	The Layer 3 firewall table may be used to configure rules matching layer 3 (IP layer) traffic which results in forwarding or dropping the traffic over the radio link or Ethernet interface.
Wireless MAC Address Filtering (Access Point Mode)	

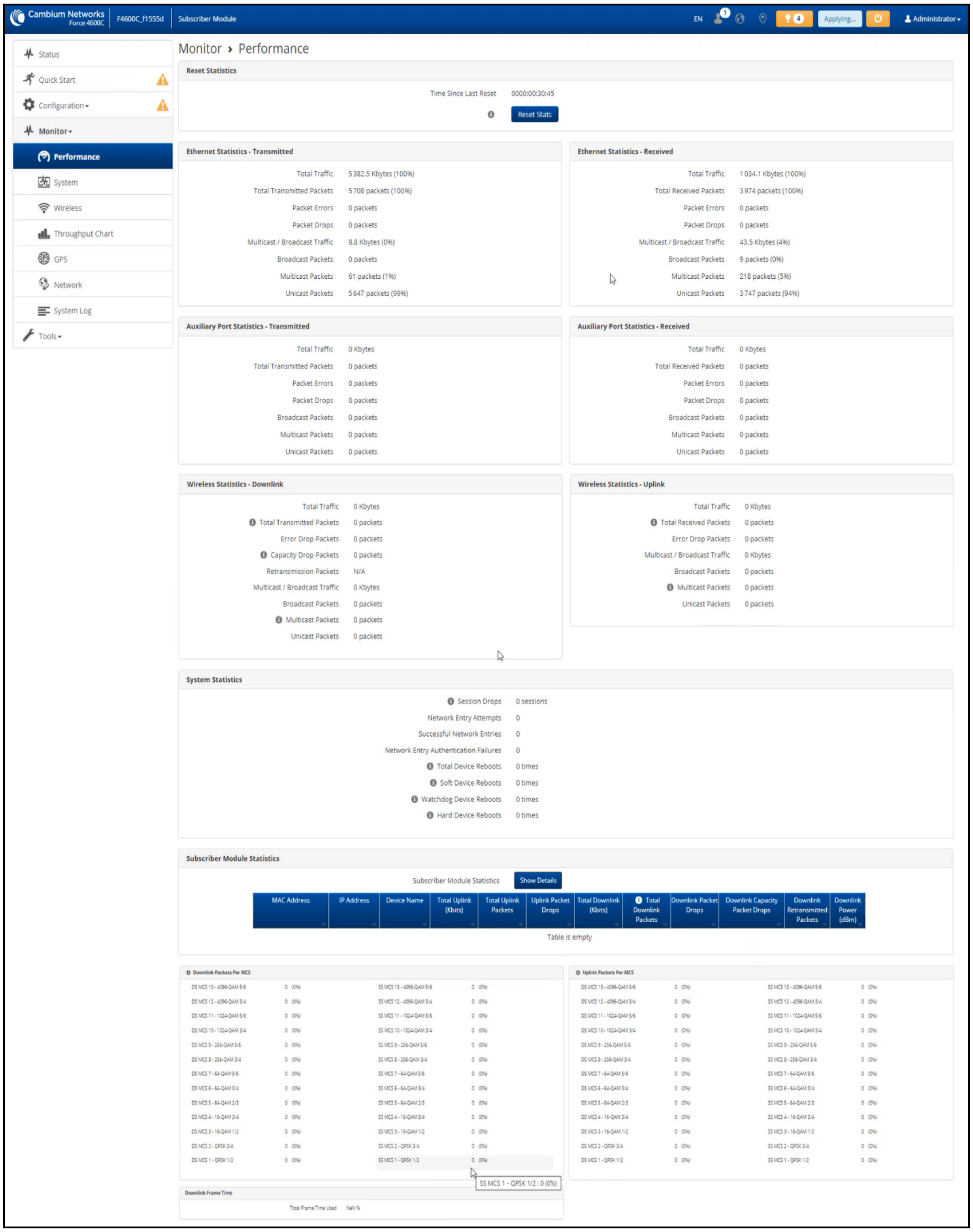
Attribute	Description
Wireless MAC Filter (AP mode)	**Disabled:** SMs with any MAC Address are allowed to register to the AP. **Enabled:** SMs with specific MAC addresses can be allowed (permit) or denied (prevent) registration with the AP as configured under the **MAC Filter List**.
Wireless MAC Filter Policy (AP mode)	**Prevent:** All MAC Addresses configured under the MAC Filter List are denied registration to the AP. **Permit:** Only the MAC Addresses configured under the MAC Filter List are allowed to register to the AP.
Wireless MAC Filter List (AP mode)	Configure the SM's MAC addresses that are permitted or prevented from registering to the AP.
MAC Address (AP mode)	MAC Address of the SM.
Description (AP mode)	Friendly description to identify the SM.

Monitor menu

This section is used to analyze and troubleshoot network performance and operation. Use the **Monitor menu** to access device and network statistics and status information.

Monitor > Performance page

Figure 22 shows the Performance page.



Monitor › Performance

Reset Statistics

Time Since Last Reset	0000:00:30:45

Ethernet Statistics - Transmitted

Total Traffic	5 382.5 Kbytes (100%)
Total Transmitted Packets	5 708 packets (100%)
Packet Errors	0 packets
Packet Drops	0 packets
Multicast / Broadcast Traffic	8.8 Kbytes (0%)
Broadcast Packets	0 packets
Multicast Packets	61 packets (1%)
Unicast Packets	5 647 packets (99%)

Ethernet Statistics - Received

Total Traffic	1 034.1 Kbytes (100%)
Total Received Packets	3 974 packets (100%)
Packet Errors	0 packets
Packet Drops	0 packets
Multicast / Broadcast Traffic	43.5 Kbytes (4%)
Broadcast Packets	9 packets (0%)
Multicast Packets	218 packets (5%)
Unicast Packets	3 747 packets (94%)

Auxiliary Port Statistics - Transmitted

Total Traffic	0 Kbytes
Total Transmitted Packets	0 packets
Packet Errors	0 packets
Packet Drops	0 packets
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Auxiliary Port Statistics - Received

Total Traffic	0 Kbytes
Total Received Packets	0 packets
Packet Errors	0 packets
Packet Drops	0 packets
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Wireless Statistics - Downlink

Total Traffic	0 Kbytes
Total Transmitted Packets	0 packets
Error Drop Packets	0 packets
Capacity Drop Packets	0 packets
Retransmission Packets	N/A
Multicast / Broadcast Traffic	0 Kbytes
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Wireless Statistics - Uplink

Total Traffic	0 Kbytes
Total Received Packets	0 packets
Error Drop Packets	0 packets
Multicast / Broadcast Traffic	0 Kbytes
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

System Statistics

Session Drops	0 sessions
Network Entry Attempts	0
Successful Network Entries	0
Network Entry Authentication Failures	0
Total Device Reboots	0 times
Soft Device Reboots	0 times
Watchdog Device Reboots	0 times
Hard Device Reboots	0 times

Subscriber Module Statistics

Subscriber Module Statistics

MAC Address	IP Address	Device Name	Total Uplink (Kbits)	Total Uplink Packets	Uplink Packet Drops	Total Downlink (Kbits)	Total Downlink Packets	Downlink Packet Drops	Downlink Capacity Packet Drops	Downlink Retransmitted Packets	Downlink Power (dBm)

Table is empty

Downlink Packets Per MCS

DS MCS 13 - 4096-QAM 5/6	0 (0%)	SS MCS 13 - 4096-QAM 5/6	0 (0%)
DS MCS 12 - 4096-QAM 3/4	0 (0%)	SS MCS 12 - 4096-QAM 3/4	0 (0%)
DS MCS 11 - 1024-QAM 5/6	0 (0%)	SS MCS 11 - 1024-QAM 5/6	0 (0%)
DS MCS 10 - 1024-QAM 3/4	0 (0%)	SS MCS 10 - 1024-QAM 3/4	0 (0%)
DS MCS 9 - 256-QAM 5/6	0 (0%)	SS MCS 9 - 256-QAM 5/6	0 (0%)
DS MCS 8 - 256-QAM 3/4	0 (0%)	SS MCS 8 - 256-QAM 3/4	0 (0%)
DS MCS 7 - 64-QAM 5/6	0 (0%)	SS MCS 7 - 64-QAM 5/6	0 (0%)
DS MCS 6 - 64-QAM 3/4	0 (0%)	SS MCS 6 - 64-QAM 3/4	0 (0%)
DS MCS 5 - 64-QAM 2/3	0 (0%)	SS MCS 5 - 64-QAM 2/3	0 (0%)
DS MCS 4 - 16-QAM 3/4	0 (0%)	SS MCS 4 - 16-QAM 3/4	0 (0%)
DS MCS 3 - 16-QAM 1/2	0 (0%)	SS MCS 3 - 16-QAM 1/2	0 (0%)
DS MCS 2 - QPSK 3/4	0 (0%)	SS MCS 2 - QPSK 3/4	0 (0%)
DS MCS 1 - QPSK 1/2	0 (0%)	SS MCS 1 - QPSK 1/2	0 (0%)

SS MCS 1 - QPSK 1/2 : 0 (0%)

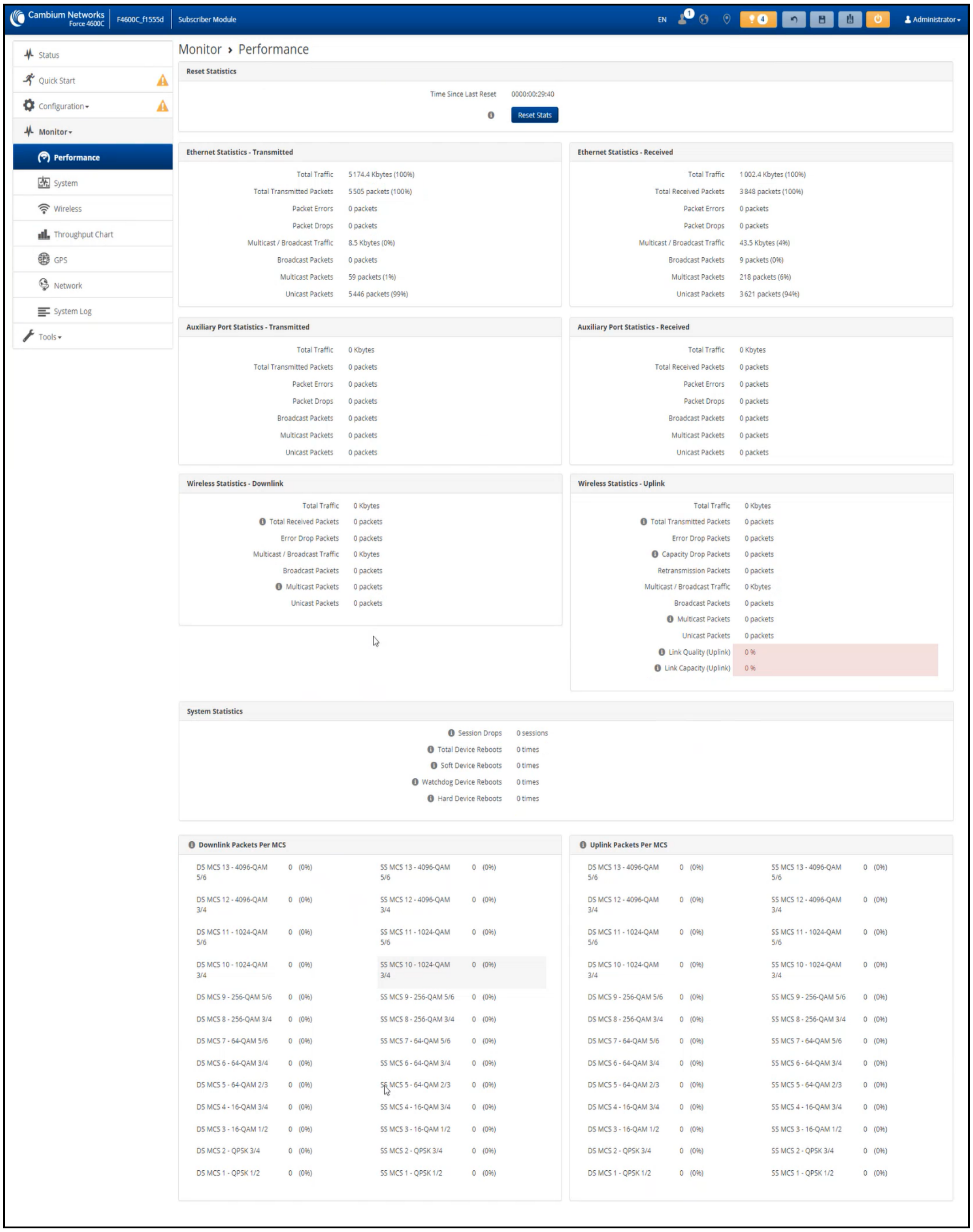
Uplink Packets Per MCS

DS MCS 13 - 4096-QAM 5/6	0 (0%)	SS MCS 13 - 4096-QAM 5/6	0 (0%)
DS MCS 12 - 4096-QAM 3/4	0 (0%)	SS MCS 12 - 4096-QAM 3/4	0 (0%)
DS MCS 11 - 1024-QAM 5/6	0 (0%)	SS MCS 11 - 1024-QAM 5/6	0 (0%)
DS MCS 10 - 1024-QAM 3/4	0 (0%)	SS MCS 10 - 1024-QAM 3/4	0 (0%)
DS MCS 9 - 256-QAM 5/6	0 (0%)	SS MCS 9 - 256-QAM 5/6	0 (0%)
DS MCS 8 - 256-QAM 3/4	0 (0%)	SS MCS 8 - 256-QAM 3/4	0 (0%)
DS MCS 7 - 64-QAM 5/6	0 (0%)	SS MCS 7 - 64-QAM 5/6	0 (0%)
DS MCS 6 - 64-QAM 3/4	0 (0%)	SS MCS 6 - 64-QAM 3/4	0 (0%)
DS MCS 5 - 64-QAM 2/3	0 (0%)	SS MCS 5 - 64-QAM 2/3	0 (0%)
DS MCS 4 - 16-QAM 3/4	0 (0%)	SS MCS 4 - 16-QAM 3/4	0 (0%)
DS MCS 3 - 16-QAM 1/2	0 (0%)	SS MCS 3 - 16-QAM 1/2	0 (0%)
DS MCS 2 - QPSK 3/4	0 (0%)	SS MCS 2 - QPSK 3/4	0 (0%)
DS MCS 1 - QPSK 1/2	0 (0%)	SS MCS 1 - QPSK 1/2	0 (0%)

Downlink Frame Time

Total Frame Time Used	NaN %

Figure 21: *Monitor > Performance page (SM mode)*



Reset Statistics

Time Since Last Reset	0000:00:29:40

Ethernet Statistics - Transmitted

Total Traffic	5 174.4 Kbytes (100%)
Total Transmitted Packets	5 505 packets (100%)
Packet Errors	0 packets
Packet Drops	0 packets
Multicast / Broadcast Traffic	8.5 Kbytes (0%)
Broadcast Packets	0 packets
Multicast Packets	59 packets (1%)
Unicast Packets	5 446 packets (99%)

Ethernet Statistics - Received

Total Traffic	1 002.4 Kbytes (100%)
Total Received Packets	3 848 packets (100%)
Packet Errors	0 packets
Packet Drops	0 packets
Multicast / Broadcast Traffic	43.5 Kbytes (4%)
Broadcast Packets	9 packets (0%)
Multicast Packets	218 packets (6%)
Unicast Packets	3 621 packets (94%)

Auxiliary Port Statistics - Transmitted

Total Traffic	0 Kbytes
Total Transmitted Packets	0 packets
Packet Errors	0 packets
Packet Drops	0 packets
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Auxiliary Port Statistics - Received

Total Traffic	0 Kbytes
Total Received Packets	0 packets
Packet Errors	0 packets
Packet Drops	0 packets
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Wireless Statistics - Downlink

Total Traffic	0 Kbytes
Total Received Packets	0 packets
Error Drop Packets	0 packets
Multicast / Broadcast Traffic	0 Kbytes
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets

Wireless Statistics - Uplink

Total Traffic	0 Kbytes
Total Transmitted Packets	0 packets
Error Drop Packets	0 packets
Capacity Drop Packets	0 packets
Retransmission Packets	0 packets
Multicast / Broadcast Traffic	0 Kbytes
Broadcast Packets	0 packets
Multicast Packets	0 packets
Unicast Packets	0 packets
Link Quality (Uplink)	0 %
Link Capacity (Uplink)	0 %

System Statistics

Session Drops	0 sessions
Total Device Reboots	0 times
Soft Device Reboots	0 times
Watchdog Device Reboots	0 times
Hard Device Reboots	0 times

Downlink Packets Per MCS

DS MCS 13 - 4096-QAM 5/6	0	(0%)	SS MCS 13 - 4096-QAM 5/6	0	(0%)
DS MCS 12 - 4096-QAM 3/4	0	(0%)	SS MCS 12 - 4096-QAM 3/4	0	(0%)
DS MCS 11 - 1024-QAM 5/6	0	(0%)	SS MCS 11 - 1024-QAM 5/6	0	(0%)
DS MCS 10 - 1024-QAM 3/4	0	(0%)	SS MCS 10 - 1024-QAM 3/4	0	(0%)
DS MCS 9 - 256-QAM 5/6	0	(0%)	SS MCS 9 - 256-QAM 5/6	0	(0%)
DS MCS 8 - 256-QAM 3/4	0	(0%)	SS MCS 8 - 256-QAM 3/4	0	(0%)
DS MCS 7 - 64-QAM 5/6	0	(0%)	SS MCS 7 - 64-QAM 5/6	0	(0%)
DS MCS 6 - 64-QAM 3/4	0	(0%)	SS MCS 6 - 64-QAM 3/4	0	(0%)
DS MCS 5 - 64-QAM 2/3	0	(0%)	SS MCS 5 - 64-QAM 2/3	0	(0%)
DS MCS 4 - 16-QAM 3/4	0	(0%)	SS MCS 4 - 16-QAM 3/4	0	(0%)
DS MCS 3 - 16-QAM 1/2	0	(0%)	SS MCS 3 - 16-QAM 1/2	0	(0%)
DS MCS 2 - QPSK 3/4	0	(0%)	SS MCS 2 - QPSK 3/4	0	(0%)
DS MCS 1 - QPSK 1/2	0	(0%)	SS MCS 1 - QPSK 1/2	0	(0%)

Uplink Packets Per MCS

DS MCS 13 - 4096-QAM 5/6	0	(0%)	SS MCS 13 - 4096-QAM 5/6	0	(0%)
DS MCS 12 - 4096-QAM 3/4	0	(0%)	SS MCS 12 - 4096-QAM 3/4	0	(0%)
DS MCS 11 - 1024-QAM 5/6	0	(0%)	SS MCS 11 - 1024-QAM 5/6	0	(0%)
DS MCS 10 - 1024-QAM 3/4	0	(0%)	SS MCS 10 - 1024-QAM 3/4	0	(0%)
DS MCS 9 - 256-QAM 5/6	0	(0%)	SS MCS 9 - 256-QAM 5/6	0	(0%)
DS MCS 8 - 256-QAM 3/4	0	(0%)	SS MCS 8 - 256-QAM 3/4	0	(0%)
DS MCS 7 - 64-QAM 5/6	0	(0%)	SS MCS 7 - 64-QAM 5/6	0	(0%)
DS MCS 6 - 64-QAM 3/4	0	(0%)	SS MCS 6 - 64-QAM 3/4	0	(0%)
DS MCS 5 - 64-QAM 2/3	0	(0%)	SS MCS 5 - 64-QAM 2/3	0	(0%)
DS MCS 4 - 16-QAM 3/4	0	(0%)	SS MCS 4 - 16-QAM 3/4	0	(0%)
DS MCS 3 - 16-QAM 1/2	0	(0%)	SS MCS 3 - 16-QAM 1/2	0	(0%)
DS MCS 2 - QPSK 3/4	0	(0%)	SS MCS 2 - QPSK 3/4	0	(0%)
DS MCS 1 - QPSK 1/2	0	(0%)	SS MCS 1 - QPSK 1/2	0	(0%)

Figure 22: *Monitor > Performance page (SM mode)*

Table 139 Monitor > Performance page attributes

Attribute	Description
Reset Statistics	
Time Since Last Reset	Time since the stats were last reset.

Attribute	Description
Ethernet Statistics – Transmitted	
Total Traffic	The total amount of traffic in KB transferred from the device Ethernet interface.
Total Packets	The total number of packets transferred from the device Ethernet interface.
Packet Errors	The total number of packets transmitted out of the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	The total number of packets dropped before sending out from the device's Ethernet interface due to Ethernet setup or filtering issues.
Broadcast Packets	The total number of broadcast packets sent through the device Ethernet interface.
Multicast Packets	The total number of multicast packets sent through the device Ethernet interface.
Ethernet Statistics – Received	
Total Traffic	The total amount of traffic in KB received by the device Ethernet interface.
Total Packets	The total number of packets received by the device Ethernet interface.
Packet Errors	The total number of packets received by the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	The total number of packets dropped before sending out from the device's wireless interface due to Ethernet setup or filtering issues.
Broadcast Packets	The total number of broadcast packets received through the device Ethernet interface.
Multicast Packets	The total number of multicast packets received through the device Ethernet interface.
SFP Statistics – Transmitted	
Total Traffic	The total amount of traffic in KB transferred from the device SFP interface.
Total Packets	The total number of packets transferred from the device SFP interface.
Packet Errors	The total number of packets transmitted out of the device SFP interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	The total number of packets dropped before sending out from the device's SFP interface due to setup or filtering issues.
Broadcast Packets	The total number of broadcast packets sent through the device SFP interface.
Multicast Packets	The total number of multicast packets sent through the device SFP interface.
SFP Statistics - Received	
Total Traffic	The total amount of traffic in KB received by the device SFP interface.
Total Packets	The total number of packets received by the device SFP interface.
Packet Errors	The total number of packets received by the device SFP interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	The total number of packets dropped before sending out of the device wireless interface due to SFP setup or filtering issues.
Broadcast Packets	The total number of broadcast packets received through the device SFP interface.

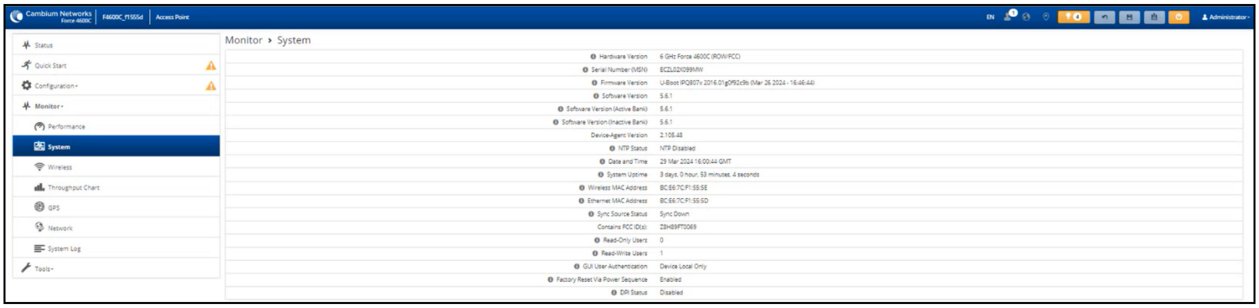
Attribute	Description
Multicast Packets	The total number of multicast packets received through the device SFP interface.
Wireless Statistics – Downlink	
Total Traffic	The total amount of traffic transmitted out of the device wireless interface in Kbits.
Total Packets	The total number of packets transmitted out of the device wireless interface.
Error Drop Packets	The total number of packets dropped after transmitting out of the device Wireless interface due to RF errors (No acknowledgment and other RF related packet error).
Capacity Drop Packets (AP mode)	The total number of packets dropped after transmitting out of the device wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Retransmission Packets (AP mode)	The total number of packets re-transmitted after transmitting out of the device's wireless interface due to the packets not being received by the receiving device.
Multicast / Broadcast Traffic	The total amount of multicast and broadcast traffic transmitted out of the device wireless interface in KB.
Broadcast Packets	The total number of broadcast packets transmitted out of the device wireless interface.
Multicast Packets	The total number of multicast packets transmitted out of the device wireless interface.
Wireless Statistics – Uplink	
Total Traffic	The total amount of traffic received through the device wireless interface in KB.
Total Packets	The total number of packets received through the device wireless interface.
Error Drop Packets	The total number of packets dropped before sending out of the device Ethernet interface due to RF errors (packet integrity error and other RF-related packet error).
Capacity Drop Packets (SM mode)	The total number of packets dropped after transmitting out of the device wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Multicast / Broadcast Traffic	The total amount of multicast and broadcast traffic received on the device wireless interface in KB.
Broadcast Packets	The total number of broadcast packets received on the device wireless interface.
Multicast Packets	The total number of multicast packets received on the device wireless interface.
Link Quality (Uplink) (SM mode)	Defines the Packet Error Rate (PER) in the uplink direction by percentage. A background color corresponds to a percentage range: • Blue is between 80 and 100%. • Green is between 50 and 80%. • Yellow is between 30 and 50%. • Red is between 0 and 30%.
Link Capacity (Uplink) (SM mode)	Defines the capacity of the uplink as defined by MCS. DS MCS 9 provides the greatest capacity. SS MCS 1 provides the least. The capacity of the link is defined as the percentage throughput of the actual link as compared to a link that was always running at DS MCS 9. A background color corresponds to a percentage range:

Attribute	Description
	• Blue is between 80 and 100%. • Green is between 50 and 80%. • Yellow is between 30 and 50%. • Red is between 0 and 30%.
System Statistics	
Session Drops	Indicates the total number of Subscriber Module sessions dropped on the AP.
Link Drop Counter	Indicates the total number of times the wireless link was lost.
Total Device Reboots	Indicates the total number of times the device has been rebooted since the statistics were last reset from the **GUI**, **CLI**, or **SNMP**.
Soft Device Reboots	Indicates the number of times the device has been rebooted by the user through **GUI**, **CLI**, or **SNMP** since the statistics were last reset from the **GUI**, **CLI**, or **SNMP**.
Hard Device Reboots	Indicates the number of times the device has been rebooted via power feeding and due to power outage since the statistics were last reset from the **GUI**, **CLI**, or **SNMP**.
Network Entry Attempts (AP mode)	The total number of Network Entry Attempts by Subscriber Module devices.
Successful Network Entries (AP mode)	The total number of successful network entry attempts.
Network Entry Authentication Failures (AP mode)	The total number of failed Network Entry Attempts by SM devices.
Radar (DFS) Detections	
Subscriber Module Statistics (AP mode)	
MAC Address	MAC Address of the Subscriber Module connected to the AP.
Total Uplink (KB)	The total amount of traffic received through the AP wireless interface from the Subscriber Module in KB.
Total Uplink Packets	The total number of packets received through the AP wireless interface from this SM.
Uplink Packet Drops	The total number of packets dropped before sending out of the AP Ethernet interface due to RF errors (packet integrity error and other RF-related packet error) from the SM.
Total Downlink (KB)	The total amount of traffic transmitted out of the AP wireless interface in KB.
Total Downlink Packets	The total number of packets transmitted out of the AP wireless interface.
Downlink Packet Drops	The total number of packets dropped after transmitting out of the AP wireless interface due to RF errors (No acknowledgment and other RF-related packet errors).
Downlink Capacity Packet Drops	The total number of packets dropped after transmitting out of the AP Wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).

Attribute	Description
Downlink Retransmitted Packets	The total number of packets re-transmitted after transmitting out of the AP Wireless interface due to the packets not being received by the SM.
Downlink Power (dBm)	The transmit power of the AP for the downlink packets to the SM.
Downlink Packets per MCS	
MCS 1 - MCS 9 DS / SS	The number of packets (and percentage of total packets) transmitted out of the device wireless interface for every modulation mode used by the device transmitter, based on radio conditions. DS represents dual-stream transmissions and SS represents single-stream transmissions.
Uplink Packets per MCS	
MCS 1 - MCS 9 DS / SS	The number of packets (and percentage of total packets) received on the device wireless interface for every modulation mode, based on radio conditions. DS represents dual-stream transmissions and SS represents single-stream transmissions.
Downlink Frame Time	
Total Frame Time Used (AP mode)	Percentage of frame time used in the uplink.

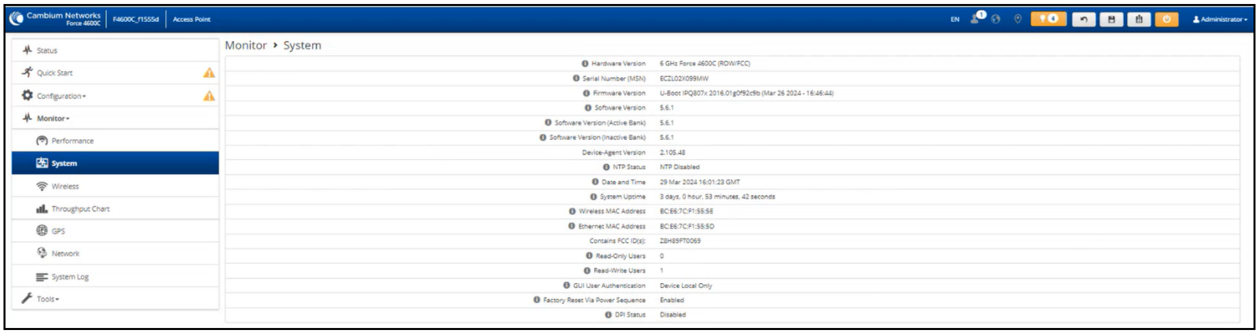
Monitor > System page

Figure 23 shows the System page.



Hardware Version 6 GHz Force 4600C (ROW/FCC)
Serial Number (MSN) ECZL02X099MW
Firmware Version U-Boot IPQ807x 2016.01g0f92c9b (Mar 26 2024 - 16:46:44)
Software Version 5.6.1
Software Version (Active Bank) 5.6.1
Software Version (Inactive Bank) 5.6.1
Device-Agent Version 2.105.48
NTP Status NTP Disabled
Date and Time 29 Mar 2024 16:00:44 GMT
System Uptime 3 days, 0 hour, 53 minutes, 4 seconds
Wireless MAC Address BC:E6:7C:F1:55:5E
Ethernet MAC Address BC:E6:7C:F1:55:5D
Sync Source Status Sync Down
Contains FCC ID(s): Z8H89FT0069
Read-Only Users 0
Read-Write Users 1
GUI User Authentication Device Local Only
Factory Reset Via Power Sequence Enabled
DPI Status Disabled

Figure 23: *Monitor > System page (AP mode)*



Hardware Version 6 GHz Force 4600C (ROW/FCC)
Serial Number (MSN) ECZL02X099MW
Firmware Version U-Boot IPQ807x 2016.01g0f92c9b (Mar 26 2024 - 16:46:44)
Software Version 5.6.1
Software Version (Active Bank) 5.6.1
Software Version (Inactive Bank) 5.6.1
Device-Agent Version 2.105.48
NTP Status NTP Disabled
Date and Time 29 Mar 2024 16:01:23 GMT
System Uptime 3 days, 0 hour, 53 minutes, 42 seconds
Wireless MAC Address BC:E6:7C:F1:55:5E
Ethernet MAC Address BC:E6:7C:F1:55:5D
Contains FCC ID(s): Z8H89FT0069
Read-Only Users 0
Read-Write Users 1
GUI User Authentication Device Local Only
Factory Reset Via Power Sequence Enabled
DPI Status Disabled

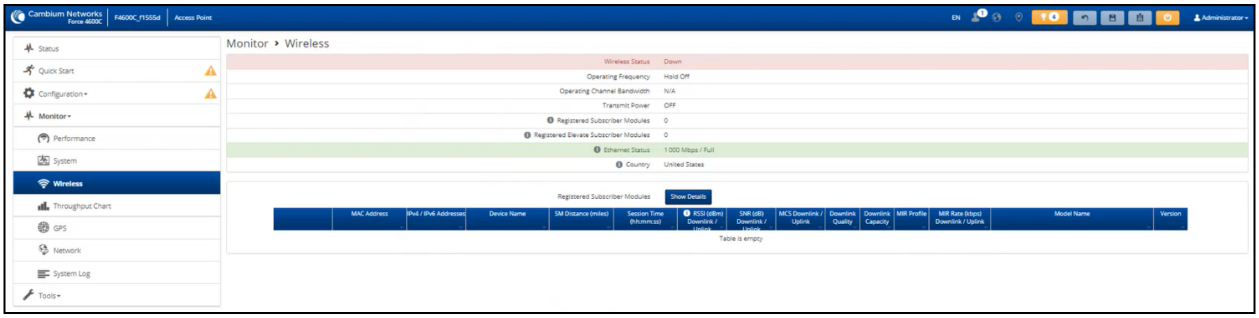
Figure 24: *Monitor > System page (SM mode)*

Table 140 Monitor > System page attributes

Attribute	Description
Hardware Version	Board hardware version information.
Serial Number (MSN)	Serial Number information.
Firmware Version	U-Boot version information.
Software Version	The currently operating version of software on the device.
Software Version (Active Bank)	The currently operating version of software on the device.
Software Version (Inactive Bank)	The backup software version on the device is used upon failure of the active bank. Two software upgrades in sequence updates both the **Active Software Bank Version** and the **Inactive Software Bank Version**.
Device-Agent Version	The operating version of the device agent, which is used for communication with cnMaestro.
NTP Status	Indicates whether time and date have been obtained from the NTP server.
Date and Time	Current date and time, subject to time zone offset introduced by the configuration of the device **Time Zone** parameter. Until a valid NTP server is configured, this field displays the time configured from the factory.
System Uptime	The total system uptime since the last device reset.
Wireless MAC Address	The hardware address of the device's wireless interface.
Ethernet MAC Address	The hardware address of the device LAN (Ethernet) interface.
Read-Only Users	Displays the number of active Read-Only users logged into the radio.
Read-Write Users	Displays the number of active Read-Write users logged into the radio.
GUI User Authentication	The method by which users are authenticated when logging into the device management interface.
Factory Reset Via Power Sequence	**Enabled**: When Enabled under **Tools** > **Backup/Restore** > **Reset Via Power Sequence**, it is possible to reset the radio’s configuration to factory defaults using the power cycle sequence explained under Resetting ePMP to factory defaults by power cycling. **Disabled**: When disabled, it is not possible to factory default the radio’s configuration using the power cycle sequence.
DPI Status	**Enabled**: DPI Status is enabled. **Disabled**: DPI Status is disabled.

Monitor > Wireless page

Figure 25 and Figure 26 shows Wireless page (AP mode) and Wireless page (SM mode).



Monitor › Wireless

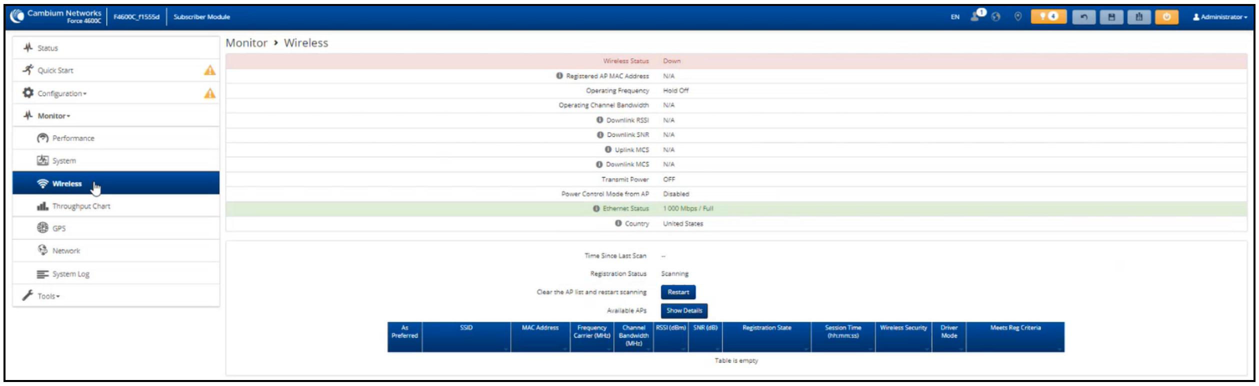
Wireless Status	Down
Operating Frequency	Hold Off
Operating Channel Bandwidth	N/A
Transmit Power	OFF
Registered Subscriber Modules	0
Registered Elevate Subscriber Modules	0
Ethernet Status	1 000 Mbps / Full
Country	United States

Registered Subscriber Modules Show Details

	MAC Address	IPv4 / IPv6 Addresses	Device Name	SM Distance (miles)	Session Time (hh:mm:ss)	RSSI (dBm) Downlink / Uplink	SNR (dB) Downlink / Uplink	MCS Downlink / Uplink	Downlink Quality	Downlink Capacity	MIR Profile	MIR Rate (kbps) Downlink / Uplink	Model Name	Version

Table is empty

Figure 25: *Monitor > Wireless page (AP Mode)*



Monitor › Wireless

Wireless Status	Down
Registered AP MAC Address	N/A
Operating Frequency	Hold Off
Operating Channel Bandwidth	N/A
Downlink RSSI	N/A
Downlink SNR	N/A
Uplink MCS	N/A
Downlink MCS	N/A
Transmit Power	OFF
Power Control Mode from AP	Disabled
Ethernet Status	1 000 Mbps / Full
Country	United States

Time Since Last Scan	--
Registration Status	Scanning
Clear the AP list and restart scanning	Restart
Available APs	Show Details

As Preferred	SSID	MAC Address	Frequency Carrier (MHz)	Channel Bandwidth (MHz)	RSSI (dBm)	SNR (dB)	Registration State	Session Time (hh:mm:ss)	Wireless Security	Driver Mode	Meets Reg Criteria

Table is empty

Figure 26: *Monitor > Wireless page (SM Mode)*

Table 141 Monitor > Wireless page attributes

Attribute	Description
Registered Access Point SSID (SM mode only	SSID of the AP to which the SM is registered.
Wireless Status (AP mode)	**Up**: The wireless interface of the device is functioning and sending beacons. **Down**: The wireless interface of the device has encountered an error disallowing full operation. Reset the device to re-initiate the wireless interface.
Wireless Status (SM mode)	**Up**: The device wireless interface is functioning and the device has completed network entry. **Down**: The device's wireless interface has encountered an error disallowing full operation. Evaluate radio and security configuration on the AP and SM device to determine the network entry failure.
Registered AP MAC Address (SM mode)	Wireless MAC address of the AP to which the SM is registered.
Range (SM mode)	The calculated distance from the AP, determined by radio signal propagation delay.
Operating Frequency	The current frequency at which the device is operating.
Operating Channel Bandwidth	The current channel size at which the device is transmitting and receiving.
DFS Status	**N/A:** DFS operation is not required for the region configured in parameter **Country Code.**

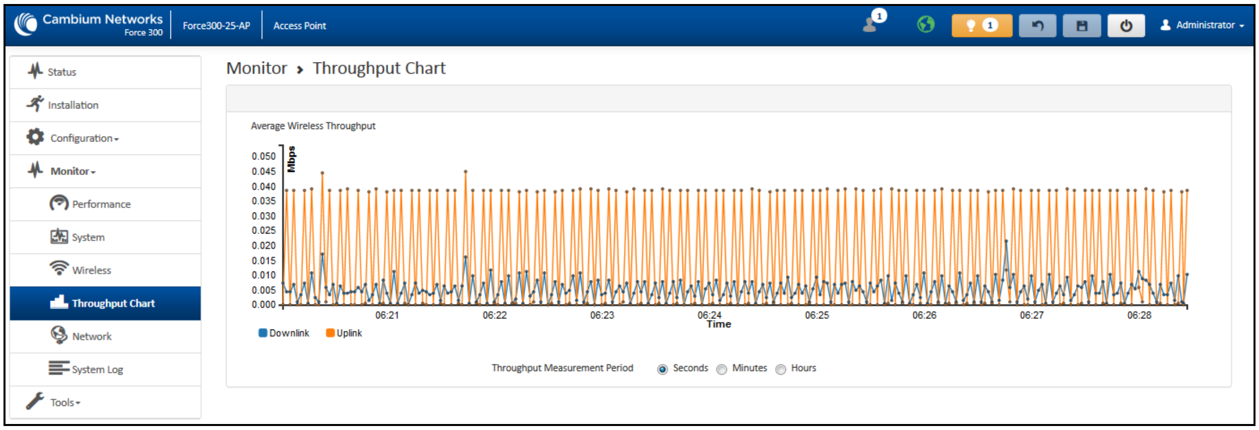
Attribute	Description
	Channel Availability Check: Before transmitting, the device must check the configured **Frequency Carrier** for radar pulses for 60 seconds). If no radar pulses are detected, the device transitions to state **In-Service Monitoring.** **In-Service Monitoring**: Radio is transmitting and receiving normally while monitoring for radar pulses that require a channel move. **Radar Signal Detected**: The receiver has detected a valid radar pulse and is carrying out detect-and-avoid mechanisms (moving to an alternate channel). **In-Service Monitoring at Alternative Channel**: The radio has detected a radar pulse and has moved the operation to a frequency configured in **DFS Alternative Frequency Carrier 1** or **DFS Alternative Frequency Carrier 2.** **System Not In Service due to DFS**: The radio has detected a radar pulse and has failed channel availability checks on all alternative frequencies. The non-occupancy time for the radio frequencies in which radar was detected is 30 minutes.
Downlink SNR (SM mode)	The Signal-to-Noise Ratio of the signal being received from the AP.
Transmitter Power	The current power level at which the device is transmitting.
Uplink MCS (AP mode)	Specifies the current MCS utilized for uplink transmission.
Registered Subscriber Modules (AP mode)	The count of registered AP.
Ethernet Status	The speed and duplex at which the configured LAN port is operating.
Country	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point unless it is an FCC SKU in which case the country code is the United States or Canada. Country code defines the regulatory rules in use for the device.
Registered Subscriber Modules (AP mode) Deregister	Use the **Registered Subscriber Modules** table to monitor the registered Subscriber Module device, their key RF status, and statistics information. The Subscriber management interface may also be accessed by clicking the hyperlinks in the **IPv4 / IPv6 Addresses** and **Device Name** columns. Click **Deregister** to disassociate the SM device from the AP.
MAC Address (AP Mode)	The MAC address of the SM wireless interface.
IPv4 / IPv6 Addresses (AP mode)	The IP address of the SM wireless interface.
Device Name (AP mode)	The configured device name of the SM wireless interface.
SM Distance (miles)	Indicates the calculated distance of the SM from the AP.
Session Time (hh:mm:ss) (AP mode)	The time duration for which the SM has been registered and in session with the AP.
RSSI (dBm) Downlink / Uplink	Indicates the estimated RSSI of the AP at the SM (first value) and the RSSI of the SM measured at the AP (second value).

Attribute	Description
SNR (dB) Downlink / Uplink	Indicates the estimated SNR of the AP at the SM (first value) and the SRN of the SM measured at the AP (second value).
MCS Downlink / Uplink (AP mode)	Current MCS at which the downlink (first value) and uplink (second value) are operating.
Downlink Quality (AP mode)	The downlink quality is based on the current MCS and PER (Packet Error Rate) for this SM.
Downlink Capacity (AP mode)	The downlink capacity is based on the current DL MCS for the highest supported MCS (MCS15). The downlink capacity is based on the current DL MCS for the highest supported MCS (MCS15).
MU-MIMO Gain	Indicates if MU-MIMO is supported by the subscriber and the MU-MIMO gain achieved by MU-MIMO capable subscribers.
Model Name	Model of SM.
Add As Preferred (SM mode)	Click **Add** to add the AP to the **Preferred Access Points List** under **Configuration** > **Radio**.
SSID (SM mode)	The SSID of the visible AP.
MAC Address (SM mode)	The MAC address of the visible AP.
Frequency Carrier (MHz) (SM mode)	The current operating frequency of the visible AP.
Channel Bandwidth (MHz) (SM mode)	The current operating channel bandwidth of the visible AP.
RSSI (dBm) (SM mode)	The current measured Received Signal Strength Indicator at the AP.
SNR (dB) (SM mode)	The current measured Signal-to-Noise Ratio (SNR) of the SM to AP link.
Registration State (SM mode)	The indication of the result of the Subscriber Module device network entry attempt: • **Successful**: The SM registration is successful. • **Failed - Out of Range**: The SM is out of the Access Point's configured maximum range (**Max Range** parameter). • **Failed- Capacity limit reached at Access Point**: The AP is no longer allowing SM network entry due to capacity reached. • **Failed - No Allocation on Access Point**: The SM to AP handshaking failed due to a misconfigured pre-shared key between the SM and AP. • **Failed - SW Version Incompatibility:** The version of software resident on the AP is older than the software version on the SM. • **Failed - PTP Mode: ACL Policy**: The AP is configured with **PTP Access** set to **MAC Limited** and the SM's MAC address is not configured in the AP's **PTP MAC Address** field.

Attribute	Description
	• **Failed - Other**: The AP does not have the required available memory to allow network entry.
Session Time (hh:mm:ss) (SM Mode)	This timer indicates the time elapsed since the SM registered to the AP.
Wireless Security (SM mode)	This field indicates the security state of the AP to SM link.
Meets Reg Criteria (SM Mode)	**Yes**: The scanned AP meets the Network Entry criteria defined by the internal Network Algorithm. **No:** The scanned AP does not meet the Network Entry criteria defined by the internal Network Algorithm.

Monitor > Throughput Chart page

Use the Throughput Chart page to reference a line chart visual representation of system throughput over time. The blue line indicates downlink throughput and the orange line indicates uplink throughput. The X-axis may be configured to display data over seconds, minutes, or hours, and the Y-axis is adjusted automatically based on average throughput. Hover over data points to display details. Figure 27 shows the Throughput Chart page.



Throughput Measurement Period ● Seconds ○ Minutes ○ Hours

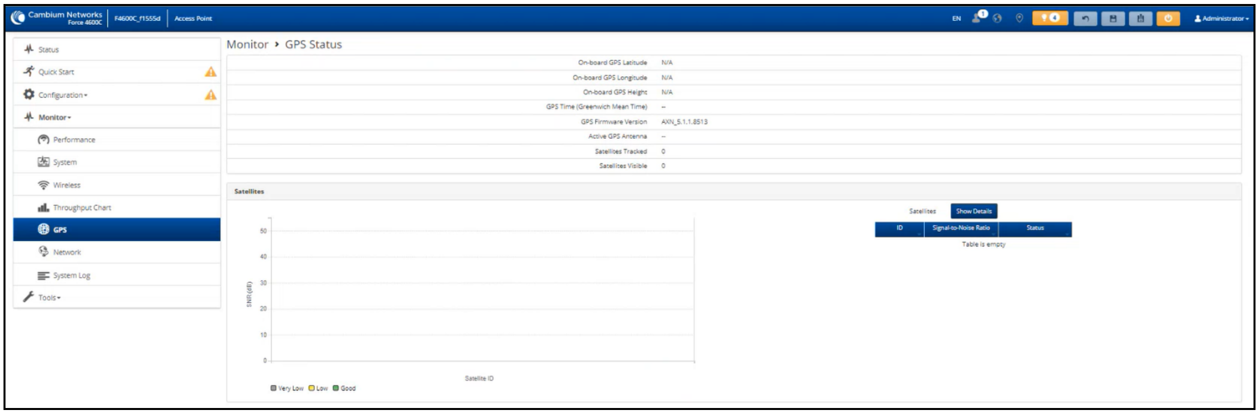
Figure 27: *Monitor > Throughput Chart page*

Table 142 Monitor > Throughput Chart page attributes

Attribute	Description
Throughput Measurement Period	Adjust the X-axis to display throughput intervals in seconds, minutes, or hours.

Monitor > GPS page

Use the GPS Status page to reference key information about the device's GPS readings, tracked satellites, and firmware version. Figure 28 shows the GPS page .



On-board GPS Latitude	N/A
On-board GPS Longitude	N/A
On-board GPS Height	N/A
GPS Time (Greenwich Mean Time)	--
GPS Firmware Version	AXN_5.1.1.8513
Active GPS Antenna	--
Satellites Tracked	0
Satellites Visible	0

Satellites

ID	Signal-to-Noise Ratio	Status

Table is empty

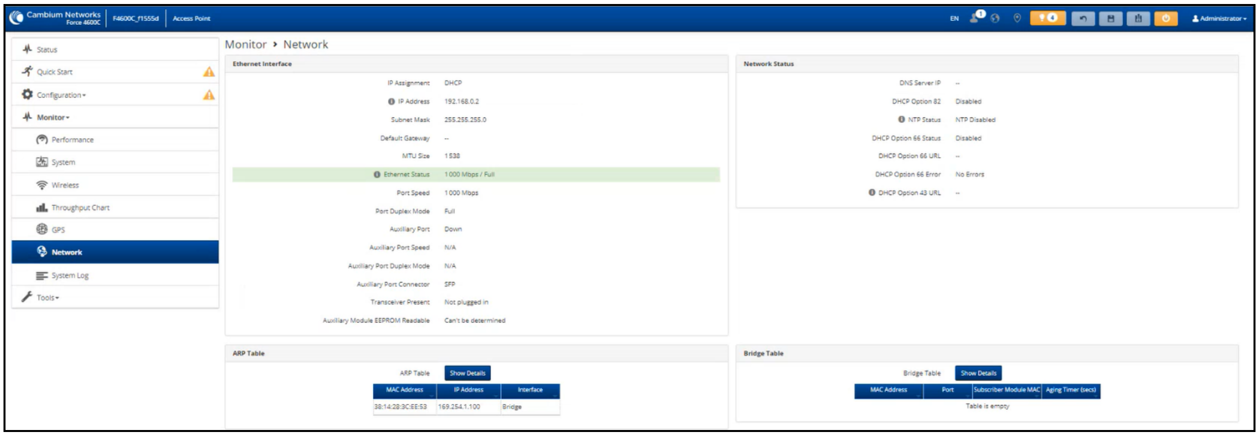
Figure 28: *Monitor > GPS page attributes*

Table 143 Monitor > GPS page attributes (AP mode)

Attribute	Description
On-board GPS Latitude (AP mode)	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Latitude information from the on-board GPS chip.
On-board GPS Longitude (AP mode)	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Longitude information from the on-board GPS chip.
On-board GPS Height (AP mode)	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device height above sea level from the onboard GPS chip.
GPS Time (Greenwich Mean Time) (AP mode)	On a GPS Synchronized ePMP radio, the field is automatically populated with the time from the onboard GPS chip.
GPS Firmware version (AP mode)	On a GPS Synchronized ePMP radio, the field indicates the current firmware version of the onboard GPS chip.
Satellites Tracked (AP mode)	On a GPS Synchronized ePMP radio, the field indicates the number of satellites currently tracked by the onboard GPS chip.
Satellites Visible (AP mode)	On a GPS Synchronized ePMP radio, the field indicates the number of satellites visible to the onboard GPS chip.
Satellites (AP mode)	The **Satellites** table provides information about each satellite that is visible or tracked along with the Satellite ID and Signal to Noise Ratio (SNR) of the satellite.
ID (AP mode)	Represents the Satellite ID.
Signal-to-Noise Ratio (AP mode)	This is an expression of the carrier signal quality concerning signal noise.
Status (AP mode)	Status of each Satellite available.

Monitor > Network page

Use the Network Status page to reference key information about the device network status. Figure 29 shows the Network page (AP mode).



Monitor > Network

Ethernet Interface

IP Assignment	DHCP
IP Address	192.168.0.2
Subnet Mask	255.255.255.0
Default Gateway	--
MTU Size	1538
Ethernet Status	1000 Mbps / Full
Port Speed	1000 Mbps
Port Duplex Mode	Full
Auxiliary Port	Down
Auxiliary Port Speed	N/A
Auxiliary Port Duplex Mode	N/A
Auxiliary Port Connector	SFP
Transceiver Present	Not plugged in
Auxiliary Module EEPROM Readable	Can't be determined

Network Status

DNS Server IP	--
DHCP Option 82	Disabled
NTP Status	NTP Disabled
DHCP Option 66 Status	Disabled
DHCP Option 66 URL	--
DHCP Option 66 Error	No Errors
DHCP Option 43 URL	--

ARP Table

ARP Table

MAC Address	IP Address	Interface
38:14:28:3C:EE:53	169.254.1.100	Bridge

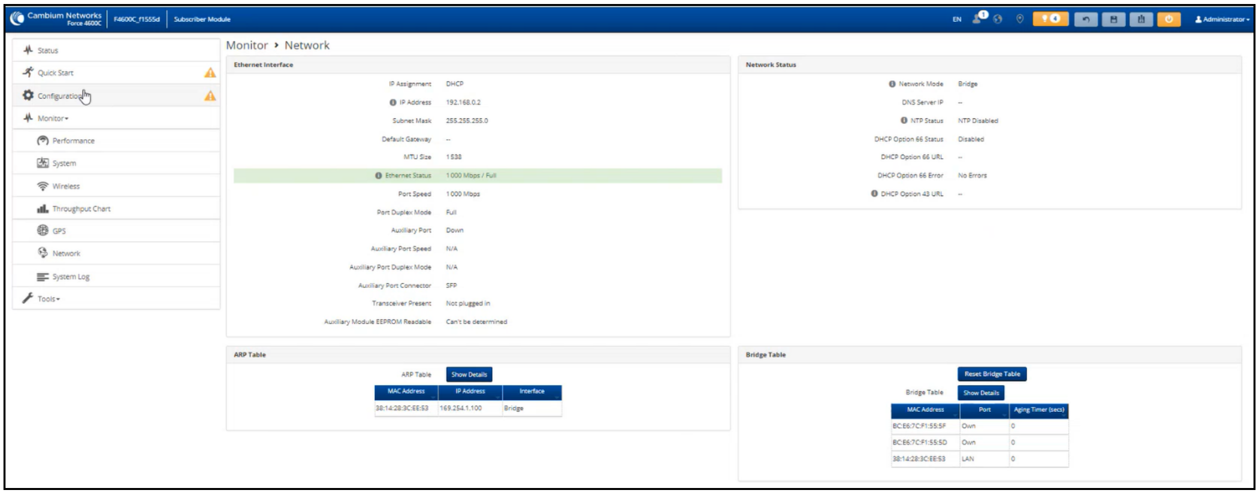
Bridge Table

Bridge Table

MAC Address	Port	Subscriber Module MAC	Aging Timer (secs)

Table is empty

Figure 29: *Monitor > Network page (AP mode)*



Monitor > Network

Ethernet Interface

IP Assignment	DHCP
IP Address	192.168.0.2
Subnet Mask	255.255.255.0
Default Gateway	--
MTU Size	1538
Ethernet Status	1000 Mbps / Full
Port Speed	1000 Mbps
Port Duplex Mode	Full
Auxiliary Port	Down
Auxiliary Port Speed	N/A
Auxiliary Port Duplex Mode	N/A
Auxiliary Port Connector	SFP
Transceiver Present	Not plugged in
Auxiliary Module EEPROM Readable	Can't be determined

Network Status

Network Mode	Bridge
DNS Server IP	--
NTP Status	NTP Disabled
DHCP Option 66 Status	Disabled
DHCP Option 66 URL	--
DHCP Option 66 Error	No Errors
DHCP Option 43 URL	--

ARP Table

ARP Table

MAC Address	IP Address	Interface
38:14:28:3C:EE:53	169.254.1.100	Bridge

Bridge Table

Bridge Table

MAC Address	Port	Aging Timer (secs)
BC:E6:7C:F1:55:5F	Own	0
BC:E6:7C:F1:55:5D	Own	0
38:14:28:3C:EE:53	LAN	0

Figure 30: *Monitor > Network page (SM mode)*

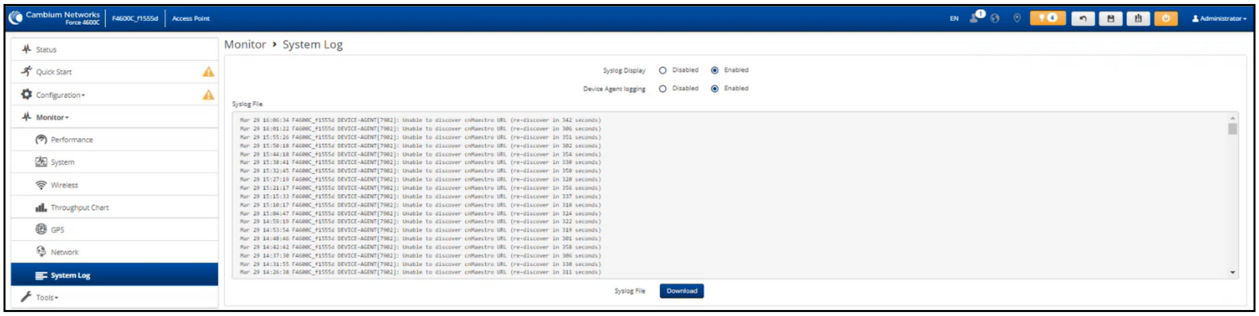
Table 144 Monitor > Network page attributes

Attribute	Description
Ethernet Interface	
IP Assignment	**Static**: Device management IP addressing is configured manually in fields **IP Address, Subnet Mask, Gateway, Preferred DNS Server**, and **Alternate DNS Server**. **DHCP**: Device management IP addressing (**IP Address, Subnet Mask, Gateway**, and **DNS Server**) is assigned through a network DHCP server, and parameters **IP Address, Subnet Mask, Gateway, Preferred DNS Server,** and **Alternate DNS Server** are not configurable.
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).

Attribute	Description
Subnet Mask	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Default Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
MTU Size	The currently configured **Maximum Transmission Unit** for the device Ethernet (LAN) interface. Larger MTU configurations can enable the network to operate with greater efficiency, but in the case of retransmissions due to packet errors, efficiency is reduced since large packets must be resent in the event of an error.
Main PSU Port	The speed and duplex at which the configured LAN port is operating.
Port Speed	The speed at which the configured LAN port is operating.
Port Duplex Mode	The duplex at which the configured LAN port is operating.
Network Status	
DNS Server IP	The configured IP address(es) of the network DNS servers.
DHCP Option 82	Status of DHCP Option 82 operation in the network.
NTP Status	Represents the status of NTP retrieval in the network.
ARP Table	
MAC Address	MAC Address of the devices on the bridge.
IP Address	IP Address of the devices on the bridge.
Interface	The interface on which the ePMP identified the devices on.
Bridge Table	
MAC Address	The hardware address of the ePMP device.
Port	The port to which the device is connected.
SM MAC	MAC Address for the connected SM device.
Aging Timer (secs)	Time set for the MAC addresses in the Bridge table before renewal.

Monitor > System Log page

The **System Log** page is used to view the device system log and to download the log file to the accessing PC/device. Figure 31 shows the System Log page.



Monitor › System Log

Syslog Display ○ Disabled ● Enabled

Device Agent logging ○ Disabled ● Enabled

Syslog File

```
Mar 29 16:06:34 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 342 seconds)
Mar 29 16:01:22 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 306 seconds)
Mar 29 15:55:26 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 351 seconds)
Mar 29 15:50:18 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 302 seconds)
Mar 29 15:44:18 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 354 seconds)
Mar 29 15:38:41 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 330 seconds)
Mar 29 15:32:45 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 350 seconds)
Mar 29 15:27:19 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 320 seconds)
Mar 29 15:21:17 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 356 seconds)
Mar 29 15:15:33 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 337 seconds)
Mar 29 15:10:17 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 310 seconds)
Mar 29 15:04:47 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 324 seconds)
Mar 29 14:59:19 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 322 seconds)
Mar 29 14:53:54 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 319 seconds)
Mar 29 14:48:46 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 301 seconds)
Mar 29 14:42:42 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 358 seconds)
Mar 29 14:37:30 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 306 seconds)
Mar 29 14:31:55 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 330 seconds)
Mar 29 14:26:38 F4600C_f1555d DEVICE-AGENT[7902]: Unable to discover cnMaestro URL (re-discover in 311 seconds)
```

Syslog File

Figure 31: *Monitor > System Log page*

Table 145 Monitor > System Log page attributes

Attribute	Description
Syslog Display	**Enabled**: The system log file is displayed on the management UI. **Disabled**: The system log file is hidden on the management UI.
Device Agent logging	**Enabled**: Device Agent logging is enabled. **Disabled**: Device Agent logging is disabled.
Download	Used to download the full system log file to a connected PC or device.

Tools menu

The **Tools** menu provides several options for upgrading device software, configuration backup/restore, managing licenses, analyzing RF spectrum, testing the wireless link, testing network connectivity, and analyzing interferers.

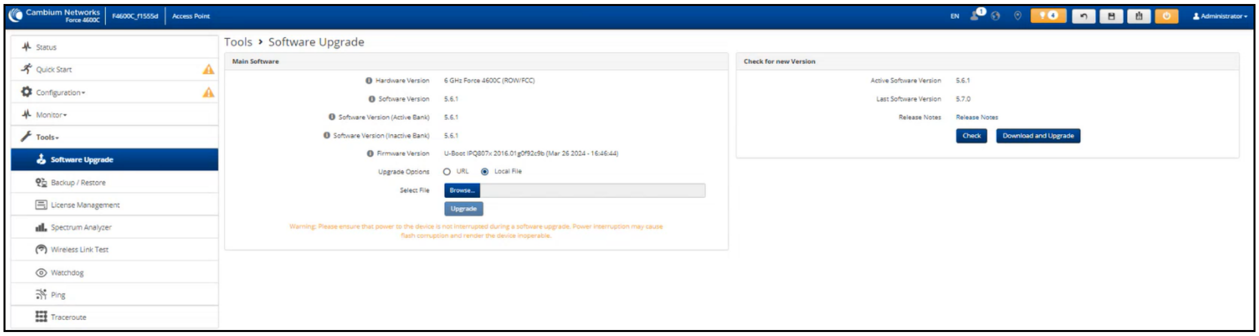
Tools > Software Upgrade page

The **Software Upgrade** page is used to update the device radio software to take advantage of new software features and improvements. Figure 32 shows the Software Upgrade page.

Attention

Refer to **Release Notes** associated with each software release for special notices, feature updates, resolved software issues, and known software issues.

The Release Notes can be found at Cambium Networks Support Center.



Main Software

Hardware Version: 6 GHz Force 4600C (ROW/FCC)

Software Version: 5.6.1

Software Version (Active Bank): 5.6.1

Software Version (Inactive Bank): 5.6.1

Firmware Version: U-Boot IPQ807x 2016.01g0f92c9b (Mar 26 2024 - 16:46:44)

Upgrade Options: ○ URL ● Local File

Select File

Warning: Please ensure that power to the device is not interrupted during a software upgrade. Power interruption may cause flash corruption and render the device inoperable.

Check for new Version

Active Software Version: 5.6.1

Last Software Version: 5.7.0

Release Notes: Release Notes

Figure 32: *Tools > Software Upgrade page*

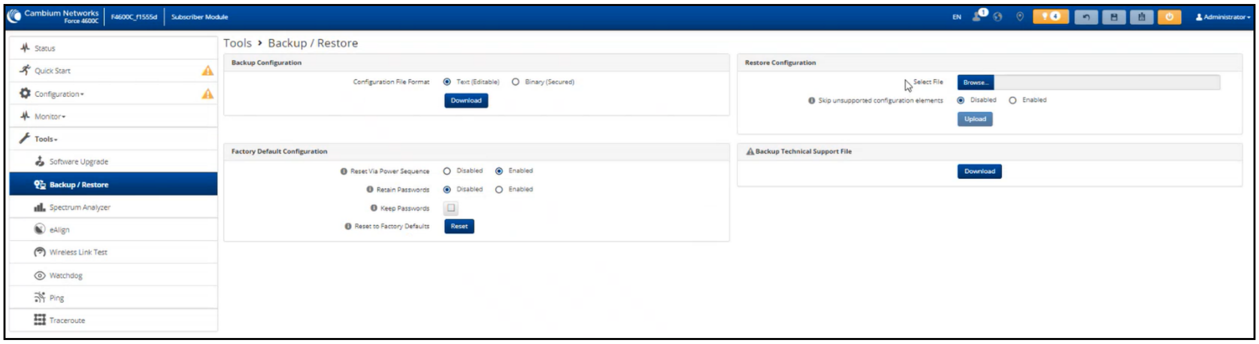
Table 146 Tools > Software Upgrade page attributes

Attribute	Description
Main Software	
Hardware Version	Defines the board type and frequency band of operation.
Software Version	Defines the current operating software version.

Attribute	Description
Software Version (Active Bank)	ePMP devices two banks of flash memory which each contain a version of the software. The version of the software last upgraded onto the flash memory is made the active bank. This software is used by the device when rebooted.
Software Version (Inactive Bank)	The version of the software that was the Active Bank is made the Inactive Bank when another version of the software is upgraded onto the Flash memory. The Inactive Bank of the software is used by the device in case the Active Bank cannot be used due to a failure condition.
Firmware Version	The current U-boot version.
Upgrade Options	**URL**: A web server may be used to retrieve software upgrade packages (downloaded to the device through the webserver). For example, if a web server is running at IP address 192.168.2.1 and the software upgrade packages are located in the home directory, an operator may select an option **From URL** and configure the **Software Upgrade Source** field to **http://192.168.2.1/<software_upgrade_package>.** **Local File**: Click **Browse** to select the local file containing the software upgrade package.
Select File	Click **Browse** to select a local file (located on the device accessing the web management interface) for upgrading the device software.
Upgrade	Click the **Upgrade** button to begin the software upgrade process. Ensure that the power to the device is not interrupted during a software upgrade. Power interruption may cause flash corruption and render the device inoperable.
Check for new Version	
Active Software Version	The current Firmware of the on-board GPS chip.
Last Software Version	The earlier Firmware of the on-board GPS chip.
Release Notes	Click **Release Notes**and download the latest Release Notes.

Tools > Backup/Restore page

The **Backup/Restore** page is used to update the device radio software to take advantage of new software features and improvements. Figure 33 shows the Backup/Restore page.



Tools › Backup / Restore

Backup Configuration

Configuration File Format ● Text (Editable) ○ Binary (Secured)

Factory Default Configuration

Reset Via Power Sequence ○ Disabled ● Enabled

Retain Passwords ● Disabled ○ Enabled

Keep Passwords □

Reset to Factory Defaults

Restore Configuration

Select File

Skip unsupported configuration elements ● Disabled ○ Enabled

Backup Technical Support File

Figure 33: *Tools > Backup/Restore page*

Table 147 Tools > Backup/Restore page attributes

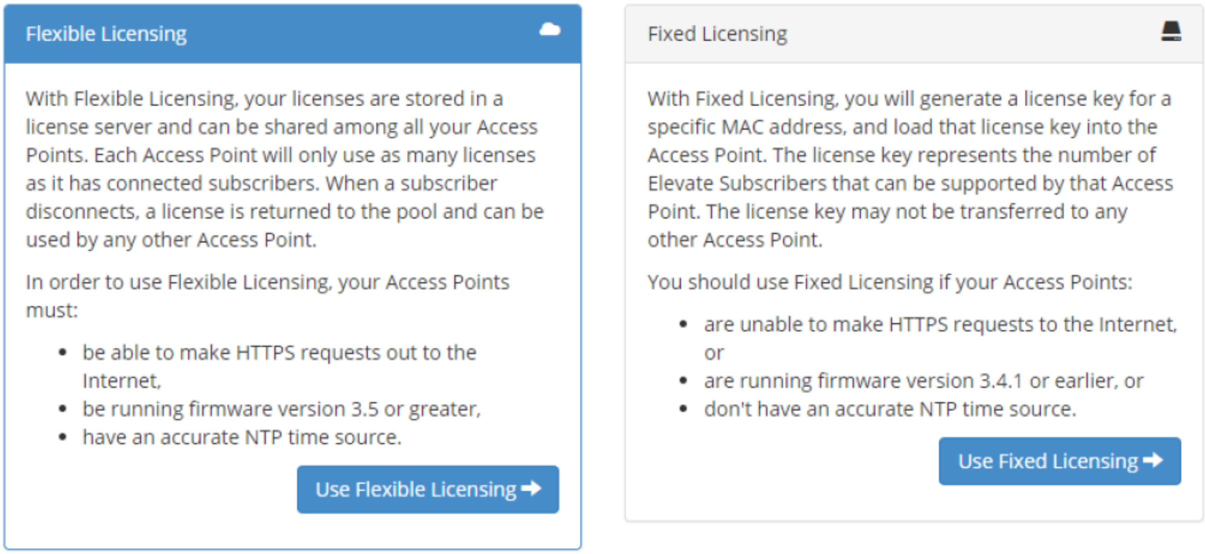
Attribute	Description
Backup Configuration	
Configuration File Format	**Text (Editable)**: This option downloads the configuration file in the **.json** format and can be viewed and/or edited using a standard text editor. **Binary (Secured)**: This option downloads the configuration file in the .bin format, and cannot be viewed and/or edited using an editor. Use this format for a secure backup.
Restore Configuration	
Select File	Click **Browse** and select a local file (located on the device accessing the web management interface) for restoring the device configuration.
Skip unsupported configuration elements	In the case of configuration incompatibility, the unsupported configuration elements can be ignored and skipped.
Factory Default Configuration	
Reset Via Power Sequence	**Enabled**: When enabled, it is possible to reset the radio's configuration to factory defaults using the power cycle sequence explained under Resetting ePMP to factory defaults by power cycling. **Disabled**: When disabled, it is not possible to factory default the radio's configuration using the power cycle sequence.
Retain Passwords	When set to **Enabled**, then after a factory default of the radio for any reason, the passwords used for UI and CLI access does not be defaulted and remains unchanged. The default value of this field is **Disabled**. If the passwords cannot be retrieved after the factory default, access to the radio will be lost/unrecoverable. This feature prevents unauthorized users from gaining access to the radio for any reason, including theft.
Keep Passwords	When the **Keep Passwords** checkbox is selected, the passwords used for GUI and CLI access will not be the default and remains unchanged. This is a one-time option, and it does not apply to factory default procedures completed by power cycling (Reset through the Power Sequence).
Reset to Factory Defaults	Use this button to reset the device to its factory default configuration. A reset to factory default configuration resets all device parameters. With the SM device in the default configuration, it may not be able to register to an AP device configured for your network.
Backup Technical Support File	
Download	The Backup Technical Support File is a compressed archive of the applicable statistics and configuration parameters used by Cambium Networks Support for troubleshooting. This file is downloaded from the ePMP device to the accessing device.

Tools > License Management page (Access Point mode)

The AP's **License Management** page is used to:

- Install licensing for ePMP Elevate subscriber access allotments
- Convert the AP from Lite (10 subscribers) to Full (120 subscribers)
- Configure the Country Code ETSI-locked devices.

There are two types of ePMP elevate license management mechanisms available on the ePMP device – Flexible and Fixed, described below:



Flexible Licensing

With Flexible Licensing, your licenses are stored in a license server and can be shared among all your Access Points. Each Access Point will only use as many licenses as it has connected subscribers. When a subscriber disconnects, a license is returned to the pool and can be used by any other Access Point.

In order to use Flexible Licensing, your Access Points must:

- be able to make HTTPS requests out to the Internet,
- be running firmware version 3.5 or greater,
- have an accurate NTP time source.

Fixed Licensing

With Fixed Licensing, you will generate a license key for a specific MAC address, and load that license key into the Access Point. The license key represents the number of Elevate Subscribers that can be supported by that Access Point. The license key may not be transferred to any other Access Point.

You should use Fixed Licensing if your Access Points:

- are unable to make HTTPS requests to the Internet, or
- are running firmware version 3.4.1 or earlier, or
- don't have an accurate NTP time source.

Figure 34: *AP ePMP Elevate license management options*

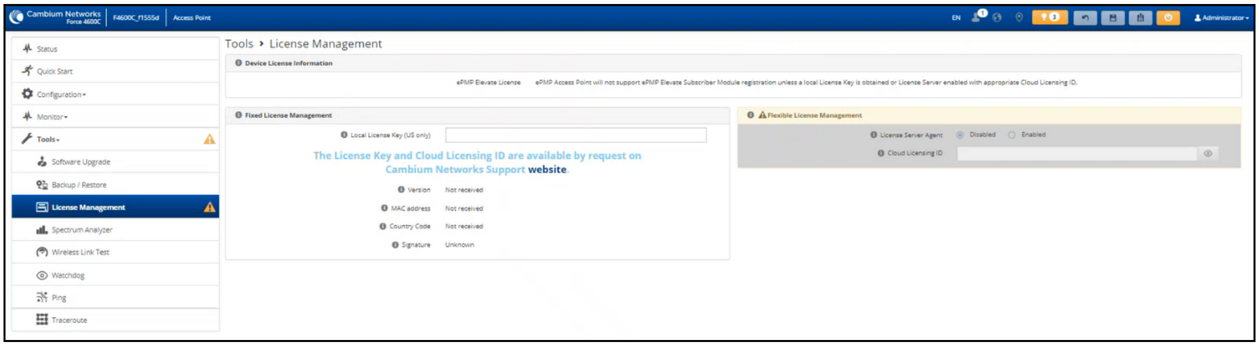
Note

Elevate Flexible Licensing is available only for ePMP AP devices with GPS sync.

Country Code configuration for ETSI locked device and Full Capacity Keys for AP Lite devices are available only via Fixed License Management. Elevate is available via Fixed or Flexible License Management. Figure 35 shows the License Management page.

Note

To use flexible licensing, the AP must have DNS server access to be able to resolve URLs (and communicate with the license server). Also, the AP must have a valid, accurate time server (NTP) connection.



Tools › License Management

Device License Information

ePMP Elevate License: ePMP Access Point will not support ePMP Elevate Subscriber Module registration unless a local License Key is obtained or License Server enabled with appropriate Cloud Licensing ID.

Fixed License Management

Local License Key (US only):

The License Key and Cloud Licensing ID are available by request on Cambium Networks Support website.

Version: Not received

MAC address: Not received

Country Code: Not received

Signature: Unknown

Flexible License Management

License Server Agent: ● Disabled ○ Enabled

Cloud Licensing ID:

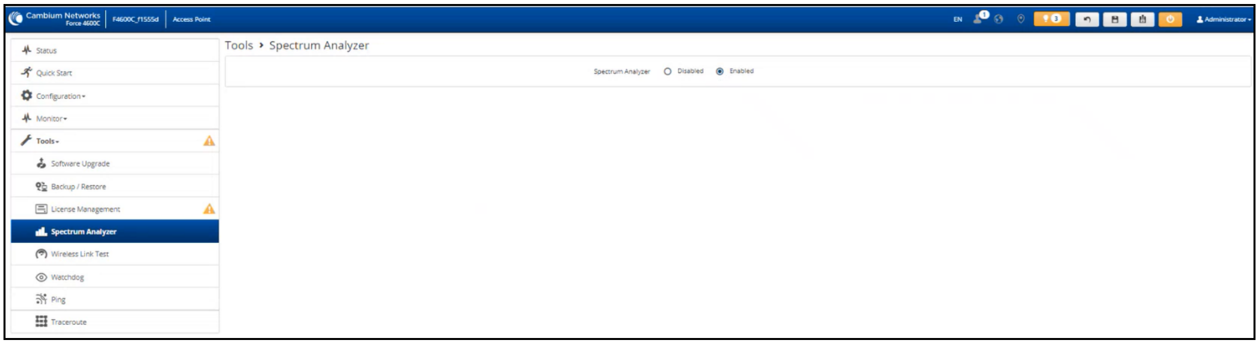
Figure 35: *Tools > License Management page*

Table 148 Tools > License Management attributes

Attribute	Description
Flexible License Management	
License Server Agent	**Disabled:** No communication with the License Server is established. **Enabled:** Enables the **License Server** functionality to obtain the number of allowed ePMP Elevate SMs to be connected to the AP.
Cloud Licensing ID	This field represents a Cambium Networks customer identification used for AP identification on the License Server. This identifier is generated upon License Entitlement activation at the Cambium Networks web-based Support Center.
Connection Status	The **Connection Status** displays the License Server process state when the **License Server Agent** is **Enabled**. This status may also be referenced on the device **Home** page.
Enable Proxy	**Disabled**: The AP must have a valid internet connection to reach the license server. **Enabled**: A proxy server is specific for the license server access from a private network.
Proxy Server IP Address	Specify the IP address of the proxy server used for internet access from a private network.
Proxy Server Port	Specify the port used on the proxy server for internet access from a private network.
Refresh Requests Failed	The number of failed refresh (polling) requests to the License Server. The **ePMP Elevate Subscriber Module Limit** resets to 1 after the 3rd failed refresh request.
Update Requests Failed	The number of failed updates (licensing information transfer) requests to the License Server. The **ePMP Elevate Subscriber Module Limit** resets to 1 after the 5th failed updated request.
NTP Status	Represents whether the current time and date are retrieved from the configured NTP server.
ePMP Elevate Subscriber Module Limit	The number of ePMP Elevate devices allowed to register to the AP.
Flexible License Management	
Local License Key	The **License Key** is obtained from Cambium Networks Support Site and must be entered into this field to enable additional functionality (registration capacity, ePMP Elevate support) of the ePMP device.
Version	Specifies the licensing version scheme for the license key.
MAC address	The MAC Address is extracted from the license key and must match the MAC Address of this device for the licenses to be enacted.
Country Code	A two-character value representing the licensed country.
Subscriber Module Limit	ePMP Lite / Force 110 devices are limited to 10 SMs in AP TDD mode. **SM Limit** displays **Unlocked** if a license is present which allows no limit of SMs to register to the device in AP TDD mode.
Signature	A valid license key must have a valid signature included. The status is displayed after a license key is entered and saved. Licenses can only be used if the signature is valid.

Tools > Spectrum Analyzer page

The Spectrum Analyzer page is used to display the spectrum analyzer. Figure 36 shows the Spectrum Analyzer page.

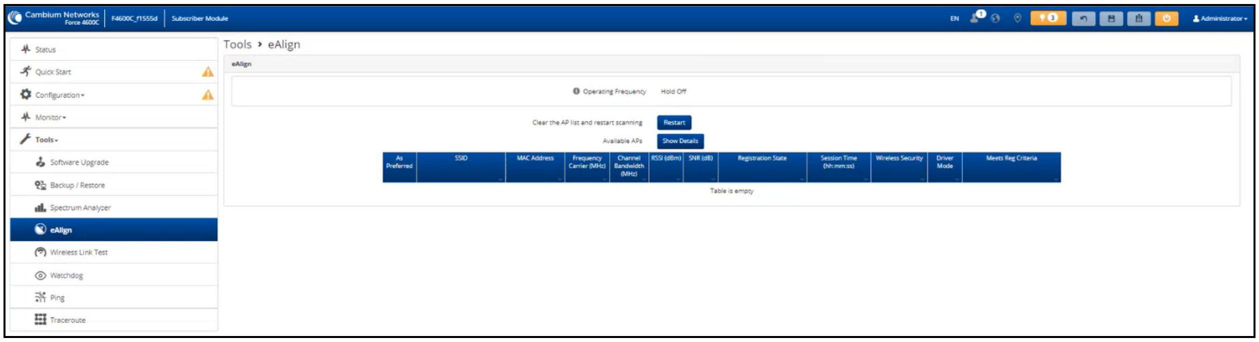


Spectrum Analyzer ○ Disabled ● Enabled

Figure 36: *The Spectrum Analyzer page*

Tools > eAlign page (Subscriber Module mode)

The eAlign page is used to aid with subscriber link alignment. Figure 37 shows the eAlign page.



Operating Frequency Hold Off

Clear the AP list and restart scanning

Available APs

As Preferred	SSID	MAC Address	Frequency Carrier (MHz)	Channel Bandwidth (MHz)	RSSI (dBm)	SNR (dB)	Registration State	Session Time (hh:mm:ss)	Wireless Security	Driver Mode	Meets Reg Criteria

Table is empty

Figure 37: *Tools > eAlign page*

Note

A valid link to an SM is required to provide meaningful RSSI measurements.

ePMP supports Automatic Transmit Power Control (ATPC) where the Subscriber Module devices are instructed by the Access Point to adjust their Tx power for the Subscriber Module device signal (UL RSSI) to arrive at the Access Point at a predetermined RSSI level (configurable on the Access Point under **Configuration > Radio > Power Control > Subscriber Module Target Receive Level**). This feature is beneficial to keep the overall noise floor in the sector to an acceptable level. However, the feature negates the purpose of eAlign measurements on the Access Point device since, during the alignment, the Subscriber Module may constantly change its Tx power. It is recommended to turn off ATPC and set the Subscriber Module Tx power to maximum allowable power during alignment.

While aligning the link using eAlign, perform the following steps:

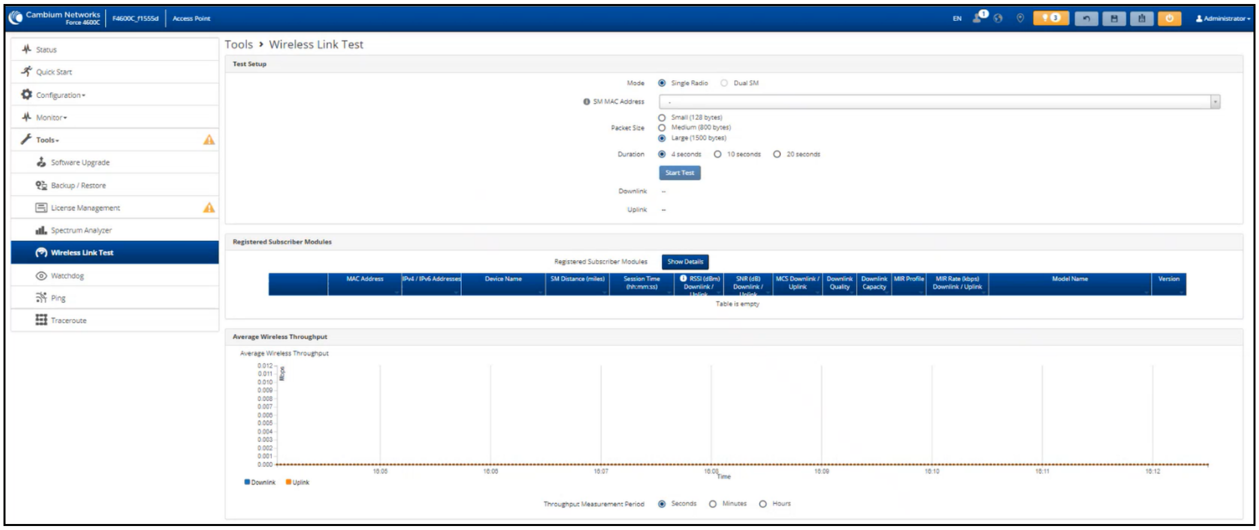
1. On the Subscriber Module, set **Configuration > Radio > Power Control > Max Tx Power to Manual**.
2. Set **Configuration > Radio > Power Control > Transmitter Power** to 26 dBm (or maximum value allowed by regulations).
3. Click **Save.**
4. Perform link alignment using eAlign.

5. Once alignment is complete, set **Configuration > Radio > Power Control > Max Tx Power** back to **Auto**.

6. Click **Save.**

Tools > Wireless Link Test page

The Wireless Link Test page is used to conduct a simple test of wireless throughput. This allows the user to determine the throughput that can be expected on a particular link without having to use external tools. Figure 38 shows the Wireless Link Test page.



Tools › Wireless Link Test

Test Setup

Mode ● Single Radio ○ Dual SM

SM MAC Address -

Packet Size ○ Small (128 bytes) ○ Medium (800 bytes) ● Large (1500 bytes)

Duration ● 4 seconds ○ 10 seconds ○ 20 seconds

Downlink --

Uplink --

Registered Subscriber Modules

Registered Subscriber Modules

	MAC Address	IPv4 / IPv6 Addresses	Device Name	SM Distance (miles)	Session Time (hh:mm:ss)	RSSI (dBm) Downlink / Uplink	SNR (dB) Downlink / Uplink	MCS Downlink / Uplink	Downlink Quality	Downlink Capacity	MIR Profile	MIR Rate (kbps) Downlink / Uplink	Model Name	Version

Table is empty

Average Wireless Throughput

Throughput Measurement Period ● Seconds ○ Minutes ○ Hours

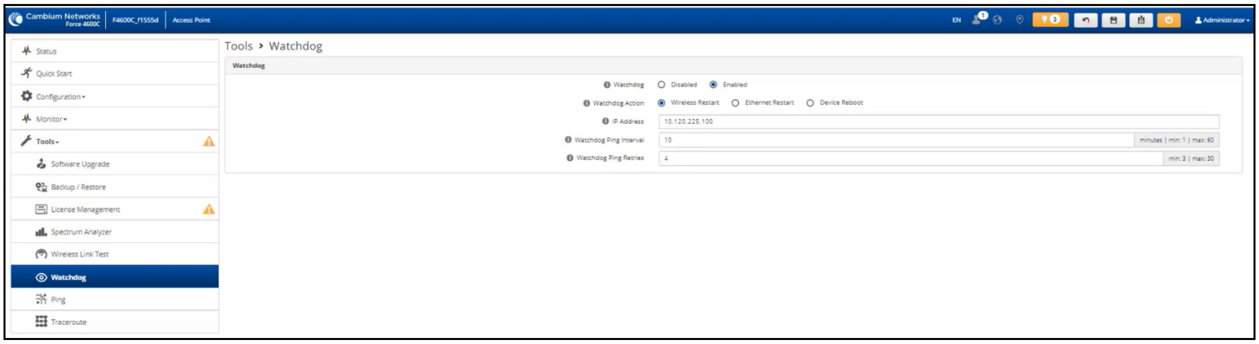
Figure 38: *Tools > Wireless Link Test page*

Table 149 Tools > Wireless Link Test page attributes

Attribute	Description
Test Setup	
Mode	**Single Radio:** The link test is conducted between the AP and one SM. **Dual SM:** The link test is conducted between the AP and two grouped SM (must be operating in MU-MIMO mode).
SM MAC Address	Choose the MAC Address of the SM with which the wireless link test is conducted.
Packet Size	Choose the Packet Size to use for the throughput test.
Duration	Choose the time duration in seconds to use for the throughput test.
Downlink	Indicates the result of the throughput test on the downlink, in Mbps.
Uplink	Indicates the result of the throughput test on the uplink, in Mbps.
Average	An auto-adjusting chart displaying the average throughput of the link.
Registered SM	Provides information about the wireless link of each registered SM.

Tools > Watchdog page

The Watchdog performs ping checks to determine the reachability of a target IP address. If the target IP address is unreachable, a chosen action is performed. Figure 39 shows the Watchdog page.



Tools > Watchdog

Watchdog

Watchdog ○ Disabled ● Enabled

Watchdog Action ● Wireless Restart ○ Ethernet Restart ○ Device Reboot

IP Address 10.120.225.100

Watchdog Ping Interval 10 minutes | min: 1 | max: 60

Watchdog Ping Retries 4 min: 3 | max: 30

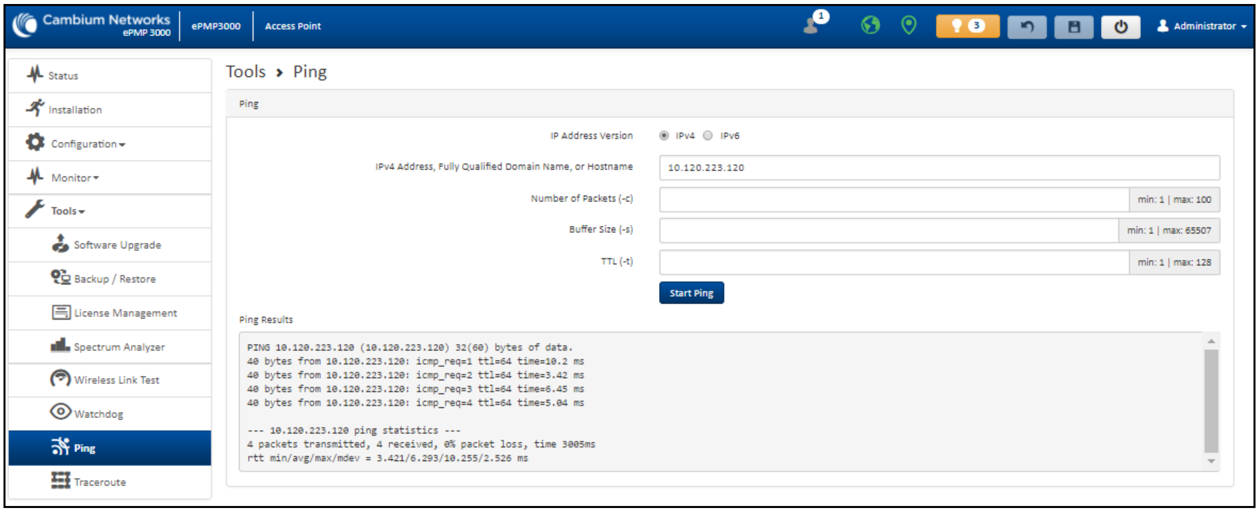
Figure 39: *Tools > Watchdog page*

Table 150 Tools > Watchdog page attributes

Attribute	Description
Test Setup	
Watchdog	**Disabled**: The device does not ping a specified IP address periodically for verification of connectivity **Enabled**: The device periodically pings the IP address specified. If IP connectivity is lost, the action defined in **Watchdog Action** is performed.
Watchdog Action	**Wireless Restart**: In case of lost ping connectivity to the specified IP address, the device automatically restarts the wireless interface. **Ethernet Restart**: In case of lost ping connectivity to the specified IP address, the device automatically restarts the Ethernet interface. **Device Reboot**: In case of lost ping connectivity to the specified IP address, the device automatically reboots.
IP Address	Indicates the target IP address for which the device attempts ping connectivity diagnostics.
Watchdog Ping Interval	Indicates the interval in minutes between each ping connectivity diagnostic.
Watchdog Ping Retries	Indicates the number of ping retries executed by the device before considering the test failed (and conducting the action defined in **Watchdog Action**).

Tools > Ping page

The Ping page is used to conduct a simple test of IP connectivity to other devices that are reachable from the network. If no ping response is received or if **Destination Host Unreachable** is reported, the target may be down, there may be no route back to the device, or there may be a failure in the network hardware (DNS server failure).



IP Address Version ● IPv4 ○ IPv6

IPv4 Address, Fully Qualified Domain Name, or Hostname: 10.120.223.120

Number of Packets (-c): min: 1 | max: 100

Buffer Size (-s): min: 1 | max: 65507

TTL (-t): min: 1 | max: 128

Ping Results

```
PING 10.120.223.120 (10.120.223.120) 32(60) bytes of data.
40 bytes from 10.120.223.120: icmp_req=1 ttl=64 time=10.2 ms
40 bytes from 10.120.223.120: icmp_req=2 ttl=64 time=3.42 ms
40 bytes from 10.120.223.120: icmp_req=3 ttl=64 time=6.45 ms
40 bytes from 10.120.223.120: icmp_req=4 ttl=64 time=5.04 ms

--- 10.120.223.120 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 3.421/6.293/10.255/2.526 ms
```

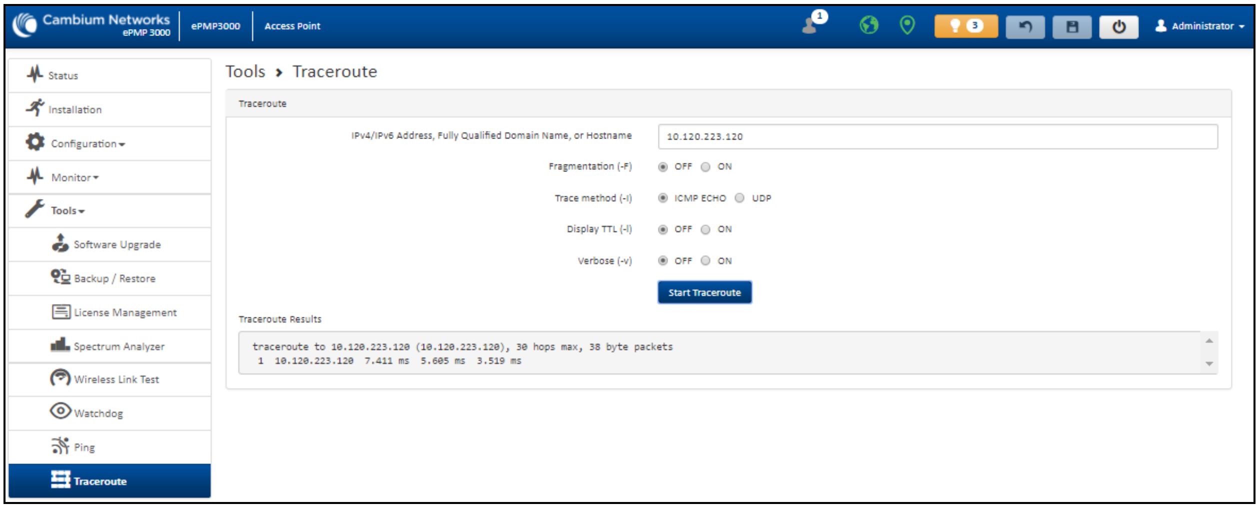
Figure 40: *Tools > Ping page*

Table 151 Tools > Ping page attributes

Attribute	Description
Ping	
IP Address Version	**IPv4:** The ping test is conducted via the IPv4 protocol. **IPv6**: The ping test is conducted via the IPv6 protocol.
IP Address	Enter the IP address of the ping target.
Number of packets (-c)	Enter the total number of ping requests to send to the target.
Buffer size (-s)	Enter the number of data bytes to be sent.
TTL (-t)	Set the IP Time-To-Live (TTL) for multicast packets. This flag applies if the ping target is a multicast address.
Ping results	The results of the ping test are displayed in the box.

Tools > Traceroute page

The Traceroute page is used to display the route (path) and associated diagnostics for IP connectivity between the device and the destination specified. Figure 41 shows the Traceroute page.



IPv4/IPv6 Address, Fully Qualified Domain Name, or Hostname: 10.120.223.120

Fragmentation (-F): ● OFF ○ ON

Trace method (-I): ● ICMP ECHO ○ UDP

Display TTL (-l): ● OFF ○ ON

Verbose (-v): ● OFF ○ ON

Traceroute Results

```
traceroute to 10.120.223.120 (10.120.223.120), 30 hops max, 38 byte packets
 1  10.120.223.120  7.411 ms  5.605 ms  3.519 ms
```

Figure 41: *Tools > Traceroute page*

Table 152 Tools > Traceroute page attributes

Attribute	Description
Traceroute	
IP Address	Enter the IP address of the target of the traceroute diagnostic.
Fragmentation (-F)	**ON:** Allow the source and target to fragment probe packets. **OFF:** Do not fragment probe packets (on the source or target).
Trace method (-I)	**ICMP ECHO:** Use ICMP ECHO for traceroute probes. **UDP:** Use UDP for traceroute probes.
Display TTL (-l)	**ON:** Display TTL values for each hop on the route. **OFF:** Suppress display of TTL values for each hop on the route.
Verbose (-v)	**ON:** ICMP packets other than TIME_EXCEEDED and UNREACHABLE are displayed in the output. **OFF**: Suppress display of extraneous ICMP messaging.
Traceroute Results	Traceroute test results are displayed in the box.

Automated Frequency Coordination (AFC) 6 GHz

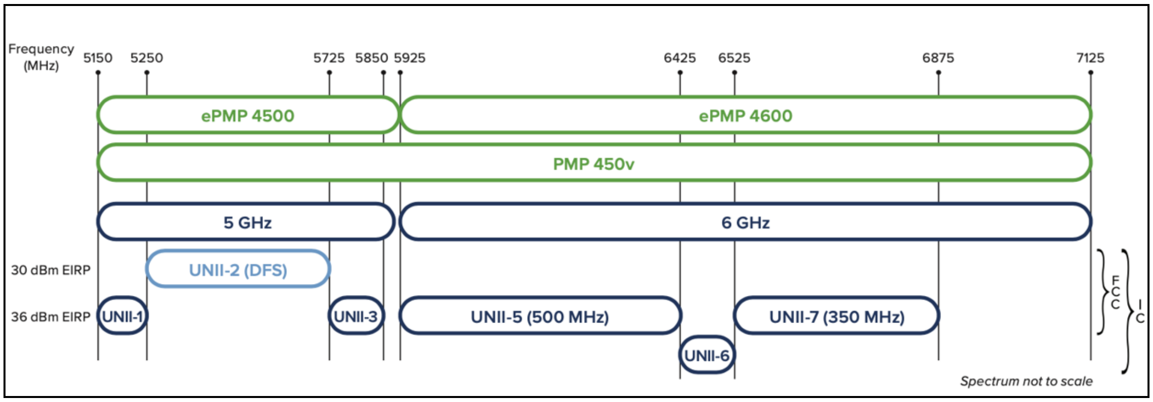
In this release, Automated Frequency Coordination (AFC) functionality has been introduced for ePMP 6 GHz (ePMP 4600x/Force 46xx) platforms.

The AFC establishes the regulations for the unlicensed use of the 6 GHz band (5.925 GHz- 7.125 GHz), aimed at mitigating potential interference from the conventional high-power access devices and the stationary client devices to the licensed microwave receivers and specific radio astronomy observatories operating within this frequency range.

The following are the objectives and rules for AFC:

- Prioritize and protect incumbent 6 GHz licensed microwave networks.
- 6 GHz unlicensed networks can only use channels that are not previously assigned to the licensed microwave.
- Can use any channel that is not protected by the AFC.
- There is no prioritization or channel assignment as shown in Figure 42.

Figure 42: *Channel assignment*



Operation rules

The following are the operation rules for 6 GHz:

- Requires the use of AFC.
- UNII-5 and UNII-7 are allowed for fixed outdoor use at 36 dBm EIRP in the United States.
- Canada allows UNII-6.
- All SMs and APs require specific GPS receiver from the manufacturer to indicate location.

Configuring AFC

You must configure AFC on the device. Figure 43 shows the operation of the AFC.

Figure 43: *Operation of the AFC*

Prerequisites

The following are the prerequisites to configure AFC on the device:

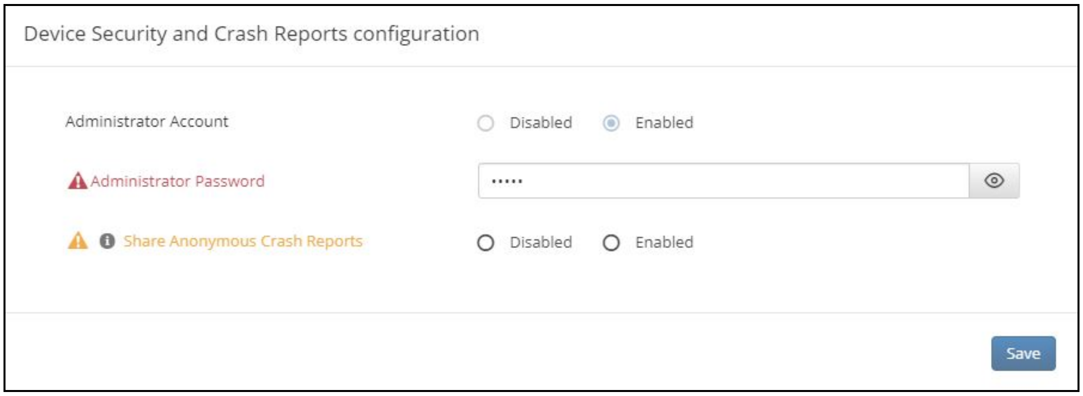
- A GPS receiver is required on all radios (SMs and APs).
- Each radio must separately query the AFC with its precise location and the pre-shared encryption key.
- An optional proxy server can be configured. All transactions use HTTPS queries once at start-up, and then every 24 hours or after each configuration change.
- Queries are not latency sensitive and require negligible throughput.
- APs and SMs are configured to Fixed Client Mode that does not transmit unless in compliance with the AFC response.

Configuring AFC on the device

To configure an AFC on the device, perform the following steps:

1. If you login for the first time, then type the administrator password and save it, as shown in Figure 44.

   Figure 44: *Password dialog box*

   Device Security and Crash Reports configuration

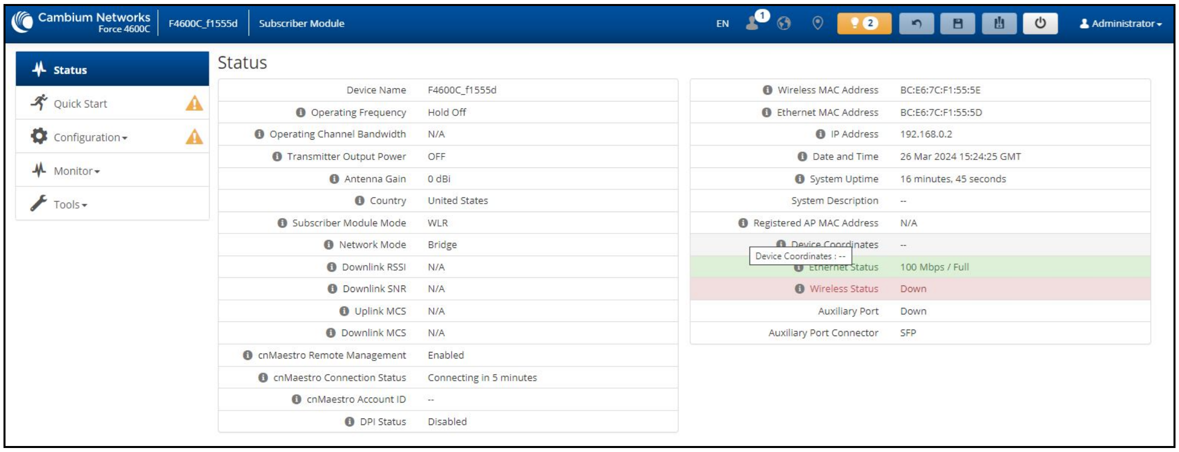
   Administrator Account ○ Disabled ● Enabled

   Administrator Password ••••••

   Share Anonymous Crash Reports ○ Disabled ○ Enabled

   After login, the status page appears, as shown in Figure 45.

   Figure 45: *The status page*

   Status

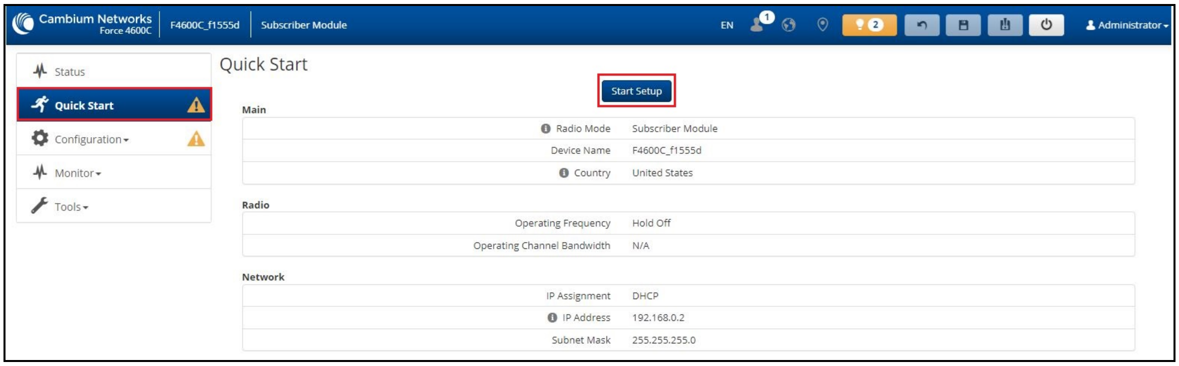
Device Name	F4600C_f1555d
Operating Frequency	Hold Off
Operating Channel Bandwidth	N/A
Transmitter Output Power	OFF
Antenna Gain	0 dBi
Country	United States
Subscriber Module Mode	WLR
Network Mode	Bridge
Downlink RSSI	N/A
Downlink SNR	N/A
Uplink MCS	N/A
Downlink MCS	N/A
cnMaestro Remote Management	Enabled
cnMaestro Connection Status	Connecting in 5 minutes
cnMaestro Account ID	--
DPI Status	Disabled

Wireless MAC Address	BC:E6:7C:F1:55:5E
Ethernet MAC Address	BC:E6:7C:F1:55:5D
IP Address	192.168.0.2
Date and Time	26 Mar 2024 15:24:25 GMT
System Uptime	16 minutes, 45 seconds
System Description	--
Registered AP MAC Address	N/A
Device Coordinates	--
Ethernet Status	100 Mbps / Full
Wireless Status	Down
Auxiliary Port	Down
Auxiliary Port Connector	SFP

   Device Coordinates : --

2. Navigate to **Quick Start** and click **Start Setup**, as shown in Figure 46.

Figure 46: *The Quick Start page*



Quick Start

Main

Radio Mode	Subscriber Module
Device Name	F4600C_f1555d
Country	United States

Radio

Operating Frequency	Hold Off
Operating Channel Bandwidth	N/A

Network

IP Assignment	DHCP
IP Address	192.168.0.2
Subnet Mask	255.255.255.0

3. In the **Configuration** tab, select the required elements and configure AFC on the device.

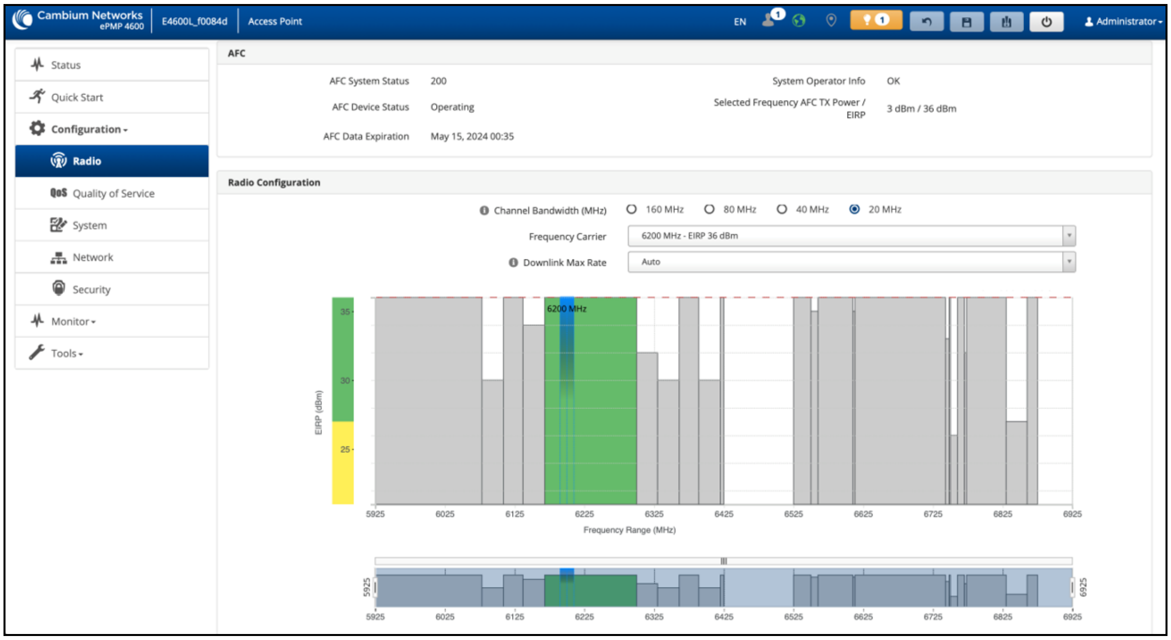
By default, AFC is enabled and it does not require any additional configuration.

To use the AFC feature, the APs and SMs must:

- be able to make HTTPS requests out to the Internet.
- be running Firmware version of 5.7-RC63 or higher.
- have a DNS server configured.
- have a GPS signal.

To enable the **Spectrum Analyzer** chart, navigate to **Configuration** > **Radio**, as shown in Figure 47. The AFC chart gives more data to chose best channel.

Figure 47: *The AFC chart page*



AFC

AFC System Status	200	System Operator Info	OK
AFC Device Status	Operating	Selected Frequency AFC TX Power / EIRP	3 dBm / 36 dBm
AFC Data Expiration	May 15, 2024 00:35		

Radio Configuration

Channel Bandwidth (MHz) ○ 160 MHz ○ 80 MHz ○ 40 MHz ● 20 MHz

Frequency Carrier: 6200 MHz - EIRP 36 dBm

Downlink Max Rate: Auto

The radio configuration section displays the data obtained from the AFC server in the chart format that simplifies the process of the best operational channel selection for the FCC APs.

The chart demonstrates available channels and Tx power allowed accordingly. The chart scale can be changed for accurate data analysis using the lower chart. You can edit the chart and configure the channel directly from the chart.

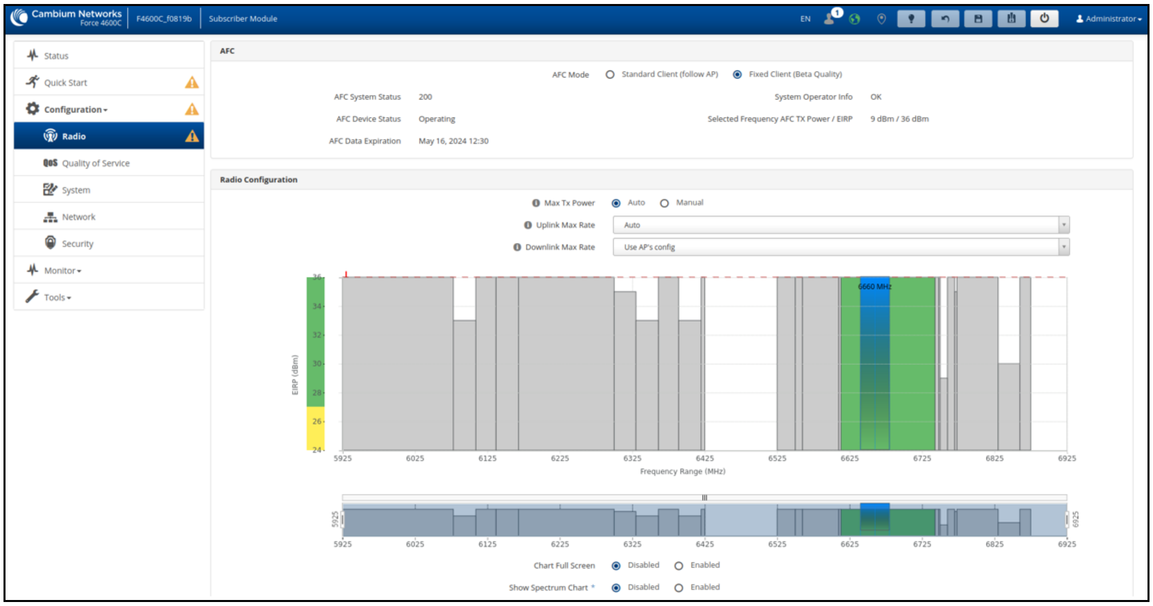
The following operational modes are allowed on the SM side:

- Standard Client Mode (Default)
- Fixed Client Mode

When SM operates in Standard Client mode, it follows AP (that interacts with AFC and gets allowed channels and EIRPs accordingly) and EIRP 6 dBm lower, then the maximum EIRP advertised to AP and it is registered by an AFC server.

When SM operates in Fixed Client mode, it sends the request to AFC server and gets individual respond that allows to get maximum EIRP up to 36 dBm, as shown in Figure 48.

Figure 48: *The radio configuration page*



AFC

AFC Mode ○ Standard Client (follow AP) ● Fixed Client (Beta Quality)

AFC System Status 200

AFC Device Status Operating

AFC Data Expiration May 16, 2024 12:30

System Operator Info OK

Selected Frequency AFC TX Power / EIRP 9 dBm / 36 dBm

Radio Configuration

Max Tx Power ● Auto ○ Manual

Uplink Max Rate: Auto

Downlink Max Rate: Use AP's config

Chart Full Screen ● Disabled ○ Enabled

Show Spectrum Chart * ● Disabled ○ Enabled

Run the following command in the cnMaestro Template for Fixed Client mode configuration.

```
{
"wireless":
{
"@wifi-iface[0]":
{
"afc_sta_mode": "1"
}
}
}
```

The following are the SNMP parameters available on the system:

```
cambiumAfcEventWaitTrap - .1.3.6.1.4.1.17713.21.0.17
cambiumAfcTxOffTrap - .1.3.6.1.4.1.17713.21.0.18
cambiumAfcExpiryTrap - .1.3.6.1.4.1.17713.21.0.19
```

```
cambiumAfcEventOperatingTrap - .1.3.6.1.4.1.17713.21.0.20
```

Operation and Troubleshooting

This section provides instructions for operators of ePMP networks. The following topics are described in this section:

- General Planning for troubleshooting
- Upgrading device software
- Testing the hardware
- Troubleshooting the radio link
- Resetting ePMP to factory defaults by power cycling

General Planning for troubleshooting

Effective troubleshooting depends in part on measures taken before experiencing the trouble in the network. Cambium Networks recommends the following measures for each site:

- Identify troubleshooting tools that are available at your site (such as a protocol analyzer).
- Identify commands and other sources that can capture baseline data for the site. These include:
  - Ping
  - tracert or traceroute
  - Throughput Test results
  - Throughput data
  - Configure GUI page captures
  - Monitor GUI page captures
  - Session logs
- Start a log for the site, including:
- Operating procedures
  - Site-specific configuration records
  - Network topology
  - Software releases
  - Types of hardware deployed
  - Site-specific troubleshooting process
  - Escalation procedures
  - GPS latitude/longitude of each network element

Upgrading device software

To take an advantage of new features and software improvements for the ePMP system, visit Cambium Networks ePMP Software website: https://support.cambiumnetworks.com/files/epmp

To upgrade the device software, perform the following steps:

1. Login to the device UI through the management IP.
2. Navigate to page **Tools** > **Software Upgrade**.
3. Under the **Main Software** section, set the **Upgrade Option** to **URL** to pull the software file from a network software server or select **Local File** to upload a file from the accessing device.
   If **URL** is selected, enter the server IP address, Server Port, and File path.
4. If **Local File** is selected, click **Browse** to launch the file selection dialogue.

   Click **Upgrade**
5. Do not power off the unit in the middle of an upgrade process.
6. Once the software upgrade is complete, click the **Reset** icon.

Troubleshooting the radio link

This section describes the process of testing the link when there is no radio communication, when it is unreliable, or when the data throughput rate is too low. It may be necessary to test both ends of the link.

The module has lost or does not establish radio connectivity

If there is no wireless activity, then perform the following steps:

1. Check that the devices are configured with the same **Frequency Carrier**.
2. Check that the **Channel Bandwidth** is configured the same at both ends of the link.
3. On the AP, verify that the **Max Range** setting is configured to a distance slightly greater than the distance between the Access Point and the other end of the link.
4. Check that the Access Point **Synchronization Source** is configured properly based on the network configuration.
5. Verify the authentication settings on the devices. if **Authentication Type** is set to **WPA2**, verify that the **Pre-shared Key** matches between the AP and the SM **Preferred Access Points List**.
6. Check that the software at each end of the link is the same version.
7. Check that the desired AP SSID is configured in the SM **Preferred Access Points List**.
8. On the SM, check the **DL RSSI** and **DL CINR** values. Verify that for the SM installed distance, that the values are consistent with the values reported by the LINKPlanner tool.
9. Check Tx Power on the devices.
10. Check that the link is not obstructed or misaligned.
11. Check the DFS status page (**Monitor**, **System Status**) at each end of the link and establish that there is a quiet wireless channel to use.

12. If there are no faults found in the configuration and there is absolutely no wireless signal, retry the installation procedure.

13. If this does not work then report a suspected device fault to Cambium Networks.

Module exhibiting frequent boots or disconnects

For any Force 300-16 units exhibiting frequent disconnects or reboots, the 4.4 official release must be applied twice to ensure both banks are updated. Once completed, ensure both banks are running 4.4 under **Monitor** > **System**. In general, this practice can be followed for all 802.11ac models as they support two banks for software storage.

Link is unreliable or does not achieve the data rates required

If there is some activity, but the link is unreliable or does not achieve the data rates required, then perform the following steps:

1. Check that the interference has not increased by monitoring the uplink and downlink CINR values reported in the Access Point page **Monitor** > **Wireless Status**.

2. Check that the RSSI values reported at the device are proper based on the distance of the link - the LINKPlanner tool is designed to estimate these values.

3. Check that the path loss is low enough for the communication rates required.

4. Check that the device has not become misaligned.

5. Review the Quality of Service configuration and ensure that traffic is properly classified and prioritized.

Resetting ePMP to factory defaults by power cycling

Operators may reset an ePMP radio to the default factory configuration by a sequence of power cycling (removing and re-applying power to the device). This procedure allows operators to perform a factory default reset without a tower climb or additional tools. The procedure is depicted in .

1. Remove the Ethernet cable from the PoE jack of the power supply for at least 10 seconds.

2. Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds**and disconnect the cable to power off the ePMP device for 3-5 seconds. (1st power cycle).

3. Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds**and disconnect the cable to power off the ePMP device for 3-5 seconds. (2nd power cycle).

4. Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds**and disconnect the cable to power off the ePMP device for 3-5 seconds. (3rd power cycle).

5. Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds**and disconnect the cable to power off the ePMP device for 3-5 seconds. (4th power cycle).

6. Reconnect the Ethernet cable to re-supply power to the ePMP device for at least **30 seconds** and allow it to go through the boot-up procedure

> **Note**
>
> Device goes through an additional reset automatically. This resets the current configuration files to factory default configuration (such as IP addresses, Device mode, and RF configuration). The device can be pinged from a PC to check if boot-up is complete (Successful ping replies indicate boot-up is complete).

7. Access the ePMP device using the default IP address of 192.168.0.1 (AP) or 192.168.0.2 (SM).

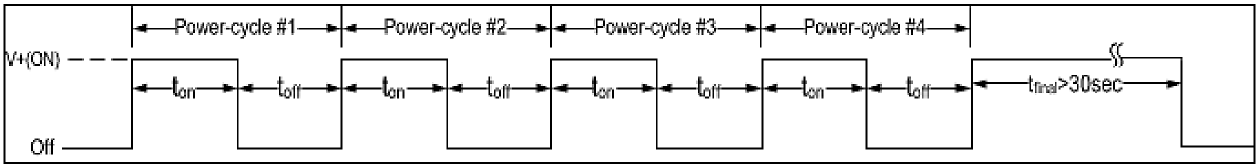


Figure 49: *Power cycle timings*

Where:	Is:
V+(ON)	Power through PoE has been applied to the device
Off	Power through PoE has been removed from the device
t_{on}	The time duration for which the device is powered on. This should be 3-5 seconds.
t_{off}	The time duration for which the device is powered off. This should be 3-5 seconds.

Glossary

Term	Definition
AES	Advanced Encryption Standard
ANSI	American National Standards Institute
CINR	Carrier to Interference plus Noise Ratio
CMM	Cluster Management Module
DFS	Dynamic Frequency Selection
EIRP	Equivalent Isotropically Radiated Power
EMC	Electromagnetic Compatibility
EMD	Electromagnetic Discharge
ETH	Ethernet
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FEC	Forward Error Correction
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IC	Industry Canada
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
LAN	Local Area Network
LED	Light Emitting Diode
LoS	Line of Sight
MIMO	Multiple In Multiple Out
MIR	Maximum Information Rate
MU-MIMO	Multi-User Multiple In Multiple Out
MTU	Maximum Transmission Unit
nLOS	Near Line of Sight
NTP	Network Time Protocol
OFDM	Orthogonal Frequency Division Multiplexing
PC	Personal Computer
PMP	Point to Multipoint
PTP	Point to Point

Term	Definition
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keyed
RF	Radio Frequency
RMA	Return Merchandise Authorization
RSSI	Received Signal Strength Indication
RTTT	Road Transport and Traffic Telematics
RX	Receive
SAR	Standard Absorption Rate
SNMP	Simple Network Management Protocol
SW	Software
TDD	Time Division Duplex
TDWR	Terminal Doppler Weather Radar
TX	Transmit
UNII	Unlicensed National Information Infrastructure
URL	Uniform Resource Locator

Cambium Networks

Cambium Networks delivers wireless communications that work for businesses, communities, and cities worldwide. Millions of our radios are deployed to connect people, places and things with a unified wireless fabric that spans multiple standards and frequencies of fixed wireless and Wi-Fi, all managed centrally via the cloud. Our multi-gigabit wireless fabric offers a compelling value proposition over traditional fiber and alternative wireless solutions. We work with our Cambium certified ConnectedPartners to deliver purpose-built networks for service provider, enterprise, industrial, and government connectivity solutions in urban, suburban, and rural environments, with wireless that just works.

User Guides	http://www.cambiumnetworks.com/guides
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Warranty	https://www.cambiumnetworks.com/support/standard-warranty/
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