



USER GUIDE

ePMP 3000 5 GHz Access Point Radio
ePMP 5 GHz Force 300-25 High Gain Radio
ePMP 5 GHz Force 300-16 Radio

System Release 4.3.2



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Safety and regulatory information

This section describes important safety and regulatory guidelines that must be observed by personnel installing or operating ePMP equipment.

Important safety information



Warning To prevent loss of life or physical injury, observe the safety guidelines in this section.

Power lines

Exercise extreme care when working near power lines.

Working at heights

Exercise extreme care when working at heights.

Grounding and protective earth

ePMP devices and mounting structures must be properly grounded to protect against lightning. It is the user's responsibility to install the equipment in accordance with national regulations. In the USA, follow Section 810 of the *National Electric Code, ANSI/NFPA No.70-1984* (USA). In Canada, follow Section 54 of the *Canadian Electrical Code*. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation be contracted to a professional installer.

Powering down before servicing

Always power down and unplug the equipment before servicing.

Primary disconnect device

The ePMP power supply is the primary disconnect device.

External cables

Safety may be compromised if outdoor rated cables are not used for connections that will be exposed to the outdoor environment.

RF exposure near the antenna

Strong radio frequency (RF) fields will be present close to the antenna when the transmitter is on. Always turn off the power to the ePMP device before undertaking maintenance activities in front of the antenna.

Minimum separation distances

Install the ePMP device so as to provide and maintain the minimum separation distances from all persons.

The minimum separation distances for each frequency variant are specified in [Calculated distances and power compliance margins](#) on page 6-89.

Important Regulatory Information

The ePMP product is certified as an unlicensed device in frequency bands where it is not allowed to cause interference to licensed services (called primary users of the bands).

Radar avoidance

In countries where radar systems are the primary band users, the regulators have mandated special requirements to protect these systems from interference caused by unlicensed devices. Unlicensed devices must detect and avoid co-channel operation with radar systems.

The ePMP provides detect and avoid functionality for countries and frequency bands requiring protection for radar systems.

Installers and users must meet all local regulatory requirements for radar detection. To meet these requirements, users must set the correct country code during commissioning of the ePMP equipment. If this is not done, installers and users may be liable to civil and criminal penalties.

Contact the Cambium helpdesk if more guidance is required.

Specific expertise and training required for professional installers

To ensure that the ePMP is installed and configured in compliance with the requirements of Industry Canada and the FCC, installers must have the radio engineering skills and training described in this section. This is particularly important when installing and configuring an ePMP system for operation in the 5 GHz band (5150 – 5250 MHz – FCC only, 5250 – 5350 MHz, 5470 – 5725 MHz and 5725 – 5850 MHz).

Ethernet networking skills

The installer must have the ability to configure IP addressing on a PC and to set up and control products using a web browser interface.

Lightning protection

To protect outdoor radio installations from the impact of lightning strikes, the installer must be familiar with the normal procedures for site selection, bonding and grounding. Installation guidelines for the ePMP can be found in section [Site planning](#) on page 2-13.

Training

The installer needs to have basic competence in radio and IP network installation. The specific requirements applicable to the ePMP must be gained by reading this user guide and by performing sample setups at base workshop before live installations.

About This User 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 radio network design, see:

- [Product description](#)
- [System hardware](#)
- [Site planning](#)
- [Legal and reference information](#)

For system configuration, monitoring and fault finding, see:

- [Using the Device Management Interface](#)
- [Operation and Troubleshooting](#)

General information

Version information

The following shows the issue status of this document:

| Issue | Date of issue | Remarks |
|------------------|---------------|------------------------|
| pmp-2461_000v012 | Jan 2019 | System Release 4.3.0.1 |

Contacting Cambium Networks

| | |
|------------------|---|
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| Main website: | http://www.cambiumnetworks.com |
| Sales enquiries: | solutions@cambiumnetworks.com |
| Address: | Cambium Networks Limited, 3800 Golf Road, Suite 360 Rolling Meadows, IL 60008 |

Purpose

Cambium Networks ePMP documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Cambium ePMP equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained.

Cambium disclaims all liability whatsoever, implied or expressed, for any risk of damage, loss or reduction in system performance arising directly or indirectly out of the failure of the customer, or anyone acting on the customer's behalf, to abide by the instructions, system parameters, or recommendations made in this document.

Cross references

References to external publications are shown in *italics*. Other cross references, emphasized in [blue text](#) in electronic versions, are active links to the references.

This document is divided into numbered chapters that are divided into sections. Sections are not numbered, but are individually named at the top of each page, and are listed in the table of contents.

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents. Send feedback to support@cambiumnetworks.com.

Problems and warranty

Reporting problems

At Cambium Networks, we know what it takes to keep a growing network running optimally. We provide multiple layers of support including training, online documentation, technical support, information-sharing with an experienced community of users, software downloads, warranty services, and repair.

Through the Cambium Support Center portal at <https://support.cambiumnetworks.com/> you can:

- Submit support requests
- Submit RMA request
- View support global contact numbers

Addition information including field service bulletins, license key information, warranty details, security advisories, Cambium Care program descriptions, regional codes for PTP solutions, and compliance requirements can be viewed at <https://www.cambiumnetworks.com/support/>.

Repair and service

If unit failure is suspected, obtain details of the Return Material Authorization (RMA) process from the support website.

Warranty

For products shipped after October 1st, 2018 Cambium's standard hardware warranty is for three (3) years from date of shipment from Cambium or a Cambium distributor. Cambium warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Cambium shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

To register ePMP products or activate warranties, visit the support website.

For warranty assistance, contact the reseller or distributor.



Attention Do not open the radio housing for repair or diagnostics; there are no serviceable parts within the housing.

Portions of Cambium equipment may be damaged from exposure to electrostatic discharge. Use precautions to prevent damage.

Security advice

Cambium Networks systems and equipment provide security parameters that can be configured by the operator based on their particular operating environment. Cambium recommends setting and using these parameters following industry recognized security practices. Security aspects to be considered are protecting the confidentiality, integrity, and availability of information and assets. Assets include the ability to communicate, information about the nature of the communications, and information about the parties involved.

In certain instances Cambium makes specific recommendations regarding security practices, however the implementation of these recommendations and final responsibility for the security of the system lies with the operator of the system.

Cambium Networks ePMP equipment is shipped with default web management interface login credentials. It is highly recommended that these usernames and passwords are modified prior to system installation.

Precautionary statements

The following describes how precautionary statements are 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 Warning text and consequence for not following the instructions in the warning.

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 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 Note text.

Caring for the environment

The following information describes national or regional requirements for the disposal of Cambium Networks supplied equipment and for the approved disposal of surplus packaging.

In EU countries



The following information is provided to enable regulatory compliance with the European Union (EU) directives identified and any amendments made to these directives when using Cambium equipment in EU countries.

Disposal of Cambium equipment

European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE)

Do not dispose of Cambium equipment in landfill sites. For disposal instructions, see

<https://support.cambiumnetworks.com>

Disposal of surplus packaging

Do not dispose of surplus packaging in landfill sites. In the EU, it is the individual recipient's responsibility to ensure that packaging materials are collected and recycled according to the requirements of EU environmental law.

In non-EU countries

In non-EU countries, dispose of Cambium equipment and all surplus packaging in accordance with national and regional regulations.

Chapter 1: Product description

This chapter provides a high level description of the ePMP product. It describes the function of the product, the main product variants and typical installation. It also describes the main hardware components.

The following topics are described in this chapter:

- The key features, typical uses, product variants and components of the ePMP are explained in [Overview of ePMP](#) on page 1-2.
- How the ePMP wireless link is operated, including modulation modes, power control and security is described under [Wireless operation](#) on page 1-6.
- The ePMP management system, including the web interface, installation, configuration, alerts and upgrades is described in [System management](#) on page 1-10.

Overview of ePMP

This section introduces the key features, typical uses, product variants and components of the ePMP portfolio as a whole (802.11n and 802.11ac products).

Purpose – ePMP Portfolio

Cambium ePMP Series products are designed for Ethernet bridging over point-to-multipoint and point-to-point microwave links in the unlicensed 2.4 GHz, 2.5 GHz (Brazil only), and 5 GHz bands. Users must ensure that the ePMP Series complies with local operating regulations.

ePMP devices support point-to-point microwave links in the unlicensed 5 GHz band.

The ePMP Series acts as a transparent bridge between two segments of the operator and customers' networks. In this sense, it can be treated as a virtual wired connection between the Access Point and the Subscriber Module. The ePMP Series forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward.

ePMP 3000 Key Features

ePMP 3000 Access Point

ePMP 3000 is a rugged high-capacity outdoor point-to-multipoint or point-to-point link wireless device in the unlicensed 5 GHz frequency bands with a maximum UDP sector throughput of up to 1+ Gbps (when operating with 80 MHz channel bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. It is available as a connectorized unit for use with a separate 4x4 MU-MIMO sector antenna and optional Smart Antenna (for uplink beam steering).

ePMP 3000 supports backward and forward compatibility with ePMP 802.11n devices to provide an immediate sector upgrade to 802.11ac Wave 2 performance, and also to support future upgrades of networks operating ePMP 1000/2000 Access Points.

ePMP 3000 is based on highly-integrated wireless semiconductor components designed to meet the IEEE 802.11ac standard, however the ePMP 3000 device has a proprietary air interface for the main point-to-multipoint or point-to-point link.

ePMP 3000 is powered by standard power-over-Ethernet to a 1000Base-T port.

Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

A summary of the main ePMP 3000 characteristics is listed under [Table 1](#).



Table 1 Main characteristics of the ePMP 3000 Series

| Characteristic | Value |
|-------------------------|---------------------------------|
| Topology | PMP or PTP |
| Wireless link condition | LOS, near LOS |
| Scheduler | TDD |
| Connectivity | Ethernet |
| Operating frequencies | Unlicensed bands, 5 GHz |
| Channel bandwidth | 20 MHz, 40 MHz, 80 MHz |
| Data rate | Up to 1+ Gbps Sector Throughput |

Force 300-25

Force 300-25 is a rugged high-capacity outdoor point-to-multipoint or point-to point link wireless device in the unlicensed 5 GHz frequency bands with a maximum UDP throughput of 500+ Mbps (when operating with 80 MHz channel bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. Force 300-25 is available as an integrated unit with a dual-polarized 25 dBi narrow Beamwidth dish antenna.

Force 300-25 is based on highly-integrated wireless semiconductor components designed to meet the IEEE 802.11ac standard, however the Force 300-25 device has a proprietary air interface for the main point-to-point link.

Force 300-25 is powered by standard power-over-Ethernet to a 1000Base-T port.

Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

A summary of the main Force 300-25 characteristics is listed under [Table 2](#).



Table 2 Main characteristics of the Force 300-25 Series

| Characteristic | Value |
|-------------------------|-------------------------|
| Topology | PMP, PTP |
| Wireless link condition | LOS, near LOS |
| Scheduler | TDD |
| Connectivity | Ethernet |
| Operating frequencies | Unlicensed bands, 5 GHz |
| Channel bandwidth | 20 MHz, 40 MHz, 80 MHz |
| Data rate | Up to 500+ Mbps |

Force 300-16

Force 300-16 is a rugged high-capacity outdoor point-to-multipoint or point-to-point link wireless device in the unlicensed 5 GHz frequency bands with a maximum UDP throughput of 500+ Mbps (when operating with 80 MHz channel bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. Force 300-16 is available as an integrated unit with a dual-polarized 16 dBi integrated antenna.

Force 300-16 is based on highly-integrated wireless semiconductor components designed to meet the IEEE 802.11ac standard, however the Force 300-16 device has a proprietary air interface for the main point-to-point link.

Force 300-16 is powered by standard power-over-Ethernet to a 1000Base-T port.

Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

A summary of the main Force 300-16 characteristics is listed under [Table 3](#).



Table 3 Main characteristics of the Force 300-16 Series

| Characteristic | Value |
|-------------------------|-------------------------|
| Topology | PMP, PTP |
| Wireless link condition | LOS, near LOS |
| Scheduler | TDD |
| Connectivity | Ethernet |
| Operating frequencies | Unlicensed bands, 5 GHz |
| Channel bandwidth | 20 MHz, 40 MHz, 80 MHz |
| Data rate | Up to 500+ Mbps |

Typical installation Equipment

The ePMP is a solution consisting of integrated outdoor units, indoor power supply units / LAN injectors, cabling and surge suppression equipment.

The main hardware components of an ePMP installation are as follows:

- **ePMP 3000 Access Point:** A connectorized outdoor transceiver unit containing all the radio, networking, and surge suppression electronics.
- **ePMP 3000 Access Point Power Supply:** An indoor power supply module providing Power-over-Ethernet (PoE) supply and 1000 / 100 Base-TX to the Access Point.
- **ePMP 3000 Access Point Radio Cabling and Lightning Protection:** Shielded Cat5e cables, grounding cables, surge suppressors, and connectors.
- **ePMP Smart Antenna and cabling (optional):** For Smart Beamforming, dynamically creates a narrow, targeted beam to each subscriber
- **Force 300-25 or Force 300-16 Integrated Radio:** An integrated outdoor transceiver unit containing all the radio, networking, and surge suppression electronics.
- **Force 300-25 or Force 300-16 Power Supply:** An indoor power supply module providing Power-over-Ethernet (PoE) supply and 100/1000 Base-T to the Force 300-25 device.
- **Force 300-25 or Force 300-16 Radio Cabling and Lightning Protection:** Shielded Cat5e cables, grounding cables, surge suppressors, and connectors.

For more information about these components, including interfaces, specifications and Cambium part numbers, see [System hardware](#) on page 2-12.

Wireless operation

This section describes how the ePMP wireless link is operated, including modulation modes, power control and security.

MU-MIMO

The ePMP 3000 MU-MIMO access point features an array of antennas. When multiple subscriber modules wish to communicate, the array is divided such that some antennas are used to communicate with one subscriber, while other antennas are used to communicate with another subscriber – simultaneously.

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

MIMO

Multiple-Input Multiple-Output (MIMO) technique provides protection against fading and increases the probability of a received decoded signal to be usable.

Smart Beamforming (ePMP 2000/3000 series)

ePMP 2000/3000 Smart Beamforming drastically reduces the effects of on-channel interference. The System learns the locations of each served Subscriber Module and forms a narrow beam towards the desired Subscriber Module while that radio is transmitting in the uplink. This reduces the gain on the uplink for on-channel interferers that are transmitting at an azimuth angle different than the Subscriber Module, delivering performance gains never before seen.



Smart Antenna Key Advantages:

- **Eliminate Uplink Interference:** Smart Beamforming delivers dramatic performance improvements when dealing with strong co-channel uplink interference, maximizing network performance.
- **Consistent Performance in High Interference:** By mitigating significant sources of interference, packet loss and retransmissions are kept to a minimum, keeping your network applications working at their best.
- **Improvement in Uplink and Downlink Performance:** By eliminating packet loss and retransmissions resulting from co-channel uplink interference, TCP retransmissions are greatly reduced. Other applications also show significant performance benefits.

Time division duplexing

TDD cycle

ePMP links operate using Time Division Duplexing (TDD). The links employ a TDD cycle in which the Access Point determines which Subscriber Modules may transmit and when based on the configured downlink/uplink ratio (duty cycle). Three fixed Downlink/Uplink frame ratios are available – 75/25, 50/50 and 30/70.

OFDM and channel bandwidth

ePMP 3000 transmits using Orthogonal Frequency Division Multiplexing (OFDM). This wideband signal consists of many equally spaced sub-carriers. Although each sub carrier 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.

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

Adaptive modulation

ePMP 3000 can transport data over the wireless link using a number of different modulation modes ranging from 256-QAM to QPSK. For a given channel bandwidth and TDD frame structure, each modulation mode transports data at a fixed rate. Also, the receiver requires a given signal to noise ratio in order to successfully demodulate a given modulation mode. Although the more complex modulations such as 256-QAM will transport data at a much higher rate than the less complex modulation modes, the receiver requires a much higher signal to noise ratio.

ePMP 3000 provides an adaptive modulation scheme where the receiver constantly monitors the quality of the received signal and notifies the far end of the link of the optimum modulation mode with which to transmit. In this way, optimum capacity is achieved at all times.

Radar avoidance

In regions where protection of radars is part of the local regulations, ePMP must detect interference from radar-like systems and avoid co-channel operation with these systems.

To meet this requirement, ePMP implements the following features:

- The equipment can only transmit on available channels, of which there are none at initial power up. The radar detection algorithm will always scan a usable channel for 60 seconds for radar interference before making the channel an available channel.
- This compulsory channel scan will mean that there is at least 60 seconds service outage every time radar is detected and that the installation time is extended by at least 60 seconds even if there is found to be no radar on the channel

There is a secondary requirement for bands requiring radar avoidance. Regulators have mandated that products provide a uniform loading of the spectrum across all devices. In general, this prevents operation with fixed frequency allocations. However:

- ETSI regulations do allow frequency planning of networks (as that has the same effect of spreading the load across the spectrum).
- The FCC does allow channels to be avoided if there is actually interference on them.



Note When operating in a region which requires DFS, ensure that the AP is configured with alternate frequencies and that the SM is configured to scan for these frequencies to avoid long outages.

Encryption

ePMP supports optional encryption for data transmitted over the wireless link. The encryption algorithm used is the Advanced Encryption Standard (AES) with 128-bit key size. AES is a symmetric encryption algorithm approved by U.S. Government organizations (and others) to protect sensitive information.

Country codes

Some aspects of wireless operation are controlled, enforced or restricted according to a country code. ePMP country codes represent individual countries (for example Denmark) or regulatory regions (for example FCC or ETSI).

Country codes affect the following aspects of wireless operation:

- Maximum transmit power
- Radar avoidance (future release)
- Frequency range



Attention To avoid possible enforcement action by the country regulator, always operate links in accordance with local regulations

Further reading on wireless operation

For information on planning wireless operation, see:

- The regulatory restrictions that affect radio spectrum usage, such as frequency range and radar avoidance are described under [Radio spectrum planning](#) on page 3-40.
- The factors to be taken into account when planning links such as range, path loss and data throughput are described under [Link planning](#) on page 3-43.
- The safety specifications against which the ePMP has been tested are listed under [Compliance with safety standards](#) on page 6-86 . It also describes how to keep RF exposure within safe limits.
- How ePMP complies with the radio regulations that are enforced in various countries is explained in [Compliance with radio regulations](#) on page 6-99.

For more information on configuring and operating the wireless link, see:

- The configuration parameters of the ePMP devices described under [Using the menu options](#) on page 4-15.
- Post-installation procedures and troubleshooting tips are explained under [Operation and Troubleshooting](#) on page 5-1.

System management

This section introduces the ePMP management system, including the web interface, installation, alerts and upgrades, configuration and management software.

Management agent

ePMP equipment is managed through an embedded management agent. Management workstations, network management systems or PCs can be connected to this agent using the module's Ethernet port, SFP port, over the air (Subscriber Module connection via Access Point) or by using the device WiFi management interface.

The management agent supports the following interfaces:

- Hypertext Transfer Protocol (HTTP)
- Hypertext Transfer Protocol secure (HTTPS)
- Simple Network Management Protocol (SNMP)
- Network Time Protocol (NTP)
- System logging (Syslog)
- cnMaestro™ Cloud-based or On-premises Management System
- Dynamic Host Configuration Protocol (DHCP)

Web server

The ePMP management agent contains a web server. The web server supports access via the HTTP and HTTPS interfaces.

Web-based management offers a convenient way to manage the ePMP equipment from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web-based interfaces are the only interfaces supported for installation of ePMP, and for the majority of ePMP configuration management tasks.

Identity-based user accounts

When identity-based user accounts are configured, a security officer can define from one to four user accounts, each of which may have one of the four possible roles:

- ADMINISTRATOR (default username/password “admin”), who has full read and write permission.
- INSTALLER (default username/password “installer”), who has permission to read and write parameters applicable to unit installation and monitoring.
- HOME (default username/password “home”), who has permission only to access pertinent information for support purposes
- READONLY (default username/password “readonly”), who has permission to only view the Monitor page.

SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v2c using one Management Information Base (MIB) file which is available for download from the Cambium Networks Support website (<https://support.cambiumnetworks.com/files/epmp>).

Network Time Protocol (NTP)

The clock supplies accurate date and time information to the system. It can be set to run with or without a connection to a network time server (NTP). It can be configured to display local time by setting the time zone and daylight saving in the Time web page.

If an NTP server connection is available, the clock can be set to synchronize with the server time at regular intervals.

eMP devices may receive NTP data from a CMM module or an NTP server configured in the system's management network.

The Time Zone option is configurable on the **Configure > System** page and may be used to offset the received NTP time to match the operator's local time zone.

Software upgrade

Software upgrades may be issued via the radio web interface (**Tools > Software Upgrade**) or via cnMaestro (cloud.cambiumnetworks.com). For software upgrades, see <https://support.cambiumnetworks.com/files/epmp>.

Further reading on system management

For more information on system management, see:

- [Operation and Troubleshooting](#) on page 5-1

Chapter 2: System hardware

This chapter describes the site planning and hardware components of an ePMP link.

The following topics are described in this chapter:

- Factors to be considered when planning the proposed network is described under [Site planning](#) on page [2-13](#).
- The ePMP 3000 Access Point hardware, part numbers, mounting equipment, and specifications are described under [ePMP 3000 Access Point](#) on page [2-16](#).
- The Force 300-25 module hardware, part numbers, mounting equipment, and specifications are described under [Force 300-25](#) on page [2-21](#).
- The Force 300-16 module hardware, part numbers, mounting equipment, and specifications are described under [Force 300-16](#) on page [2-27](#).
- The power supply hardware, part numbers and specifications are described under [Power Supply](#) on page [2-32](#).
- Cable standards and lengths are described under [Ethernet cabling](#) on page [2-35](#).
- Surge suppression requirements and recommendations are described under [Surge suppression unit](#) on page [2-37](#).

Site planning

Conduct a site survey to ensure that the proposed sites meet the requirements defined in this section.

Site installation

An ePMP site typically consists of a high supporting structure such as a mast, tower or building for the devices.

Find a location for the device that meets the following requirements:

- The equipment is high enough to achieve the best radio path.
- People can be kept a safe distance away from the equipment when it is radiating. The safe separation distances are defined in [Calculated distances and power compliance margins](#) on page 6-89.
- The equipment is lower than the top of the supporting structure (tower, mast or building) or its lightning air terminal.
- There is one Ethernet interface, a copper Cat5e connection from the device to the power supply and network terminating equipment.

Grounding and lightning protection

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path. The actual degree of protection required depends on local conditions and applicable local regulations. To adequately protect an ePMP installation, both ground bonding and transient voltage surge suppression are required.



Warning Electro-magnetic discharge (lightning) damage is not covered under warranty. The recommendations in this guide, when followed correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

Details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.



Note International and national standards take precedence over the requirements in this guide.

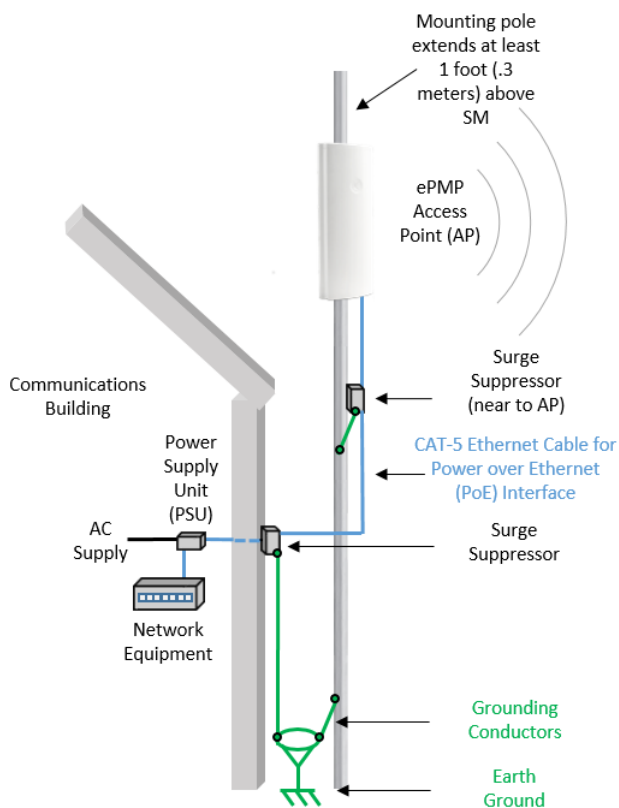


Figure 1 Access Point installation diagram

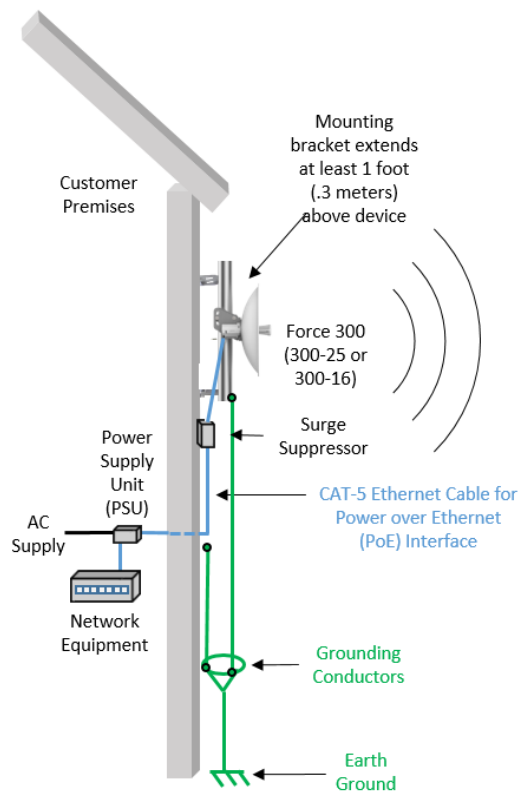
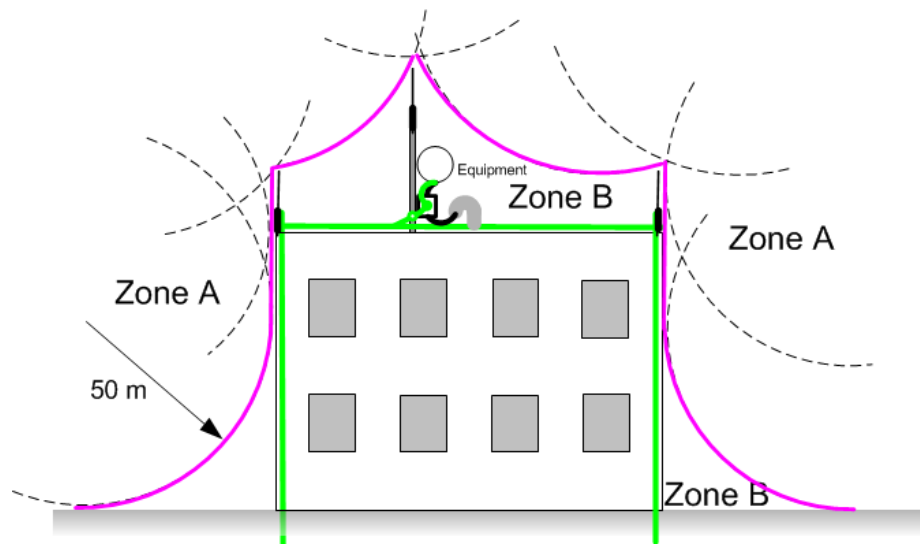


Figure 2 Subscriber / Point-to-Point installation diagram

Lightning protection zones

Use the rolling sphere method ([Figure 3](#)) to determine where it is safe to mount equipment. An imaginary sphere, typically 50 meters in radius, is rolled over the structure. Where the sphere rests against the ground and a strike termination device (such as a finial or ground bar), all the space under the sphere is considered to be in the zone of protection (Zone B). Similarly, where the sphere rests on two finials, the space under the sphere is considered to be in the zone of protection.

Figure 3 Rolling sphere method to determine the lightning protection zones

Assess locations on masts, towers and buildings to determine if the location is in Zone A or Zone B:

- **Zone A:** In this zone a direct lightning strike is possible. Do not mount equipment in this zone.
- **Zone B:** In this zone, direct EMD (lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount equipment in this zone.



Warning

Do not mount equipment in Zone A which can put the equipment, structures and life at risk.

ePMP 3000 Access Point

For details of the ePMP 3000 Access Point hardware, see:

- [ePMP 3000 Access Point description](#) on page 2-16
- [ePMP 3000 Access Point part numbers](#) on page 2-16
- [ePMP 3000 Access Point mounting bracket](#) on page 2-18

ePMP 3000 Access Point description

Figure 4 ePMP 3000 Access Point

The ePMP 3000 device is a self-contained transceiver unit that houses both radio and networking electronics.



ePMP 3000 Access Point part numbers

Choose the correct regional variant to adhere to local licensing restrictions.

Each of the parts listed in [Table 2](#) includes the following items:

- One connectorized unit
- One power supply 1000/100 Base-TX LAN injector (excluding C050910AZ01A, C050910D301A)
- One line cord (excluding C050910A001A, C050910AZ01A, C050910D301A)

Table 4 ePMP 3000 Access Point part numbers

| Cambium description | Cambium part number |
|--|----------------------------|
| ePMP 3000 5 GHz Access Point Radio (FCC) (US cord) | C058910A102A |
| ePMP 3000 5 GHz Access Point Radio (IC) (Canada/US cord) | C050910A104A |
| ePMP 3000 5 GHz Access Point Radio (EU) (EU cord) | C050910A203A |
| ePMP 3000 5 GHz Access Point Radio (EU) (UK cord) | C050910A303A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (no cord) | C050910A001A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (US cord) | C050910A101A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (EU cord) | C050910A201A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (UK cord) | C050910A301A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (India cord) | C050910A401A |
| ePMP 3000 5GHz Access Point Radio (India) (India Cord) | C050910A402A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (China cord) | C050910A501A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (Brazil cord) | C050910A601A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (Argentina cord) | C050910A701A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (ANZ cord) | C050910A801A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (South Africa cord) | C050910A901A |
| ePMP 3000 5 GHz Access Point Radio (ROW) (No PSU) | C050910AZ01A |
| ePMP 4x4 MU-MIMO Sector Antenna (for ePMP3000AP) | C050910D301A |

Table 5 ePMP 3000 accessory part numbers

| Cambium description | Cambium part number |
|---|----------------------------|
| PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply | N000900L001 |
| CABLE, UL POWER SUPPLY CORD SET, ARGENTINA | N000900L013 |
| CABLE, UL POWER SUPPLY CORD SET, AUS/NZ | N000900L011 |
| CABLE, UL POWER SUPPLY CORD SET, Brazil | N000900L010 |
| CABLE, UL POWER SUPPLY CORD SET, CHINA | N000900L015 |
| CABLE, UL POWER SUPPLY CORD SET, EU | N000900L008 |
| CABLE, UL POWER SUPPLY CORD SET, INDIA | N000900L012 |
| CABLE, UL POWER SUPPLY CORD SET, UK | N000900L009 |
| CABLE, UL POWER SUPPLY CORD SET, US | N000900L007 |

ePMP 3000 Access Point mounting bracket

Figure 5 ePMP 3000 Access Point module mounting bracket

The ePMP 3000 Access Point module is designed to be mounted with a sector antenna or pole-mounted using the mounting bracket provided in the box with the radio.



ePMP 3000 Access Point Interfaces

The Ethernet port is located on the bottom of the unit. This interface is described in [Table 6](#).

Table 6 ePMP 3000 Series – rear interfaces

| Port name | Connector | Interface | Description |
|-----------|-----------|------------------------------------|---------------------------|
| Eth | RJ45 | PoE input | Power over Ethernet (PoE) |
| | | 100/1000BASE-T Ethernet | Data |
| SFP | SFP | Optical or Copper Gigabit Ethernet | Management and/or data |

ePMP 3000 Access Point specifications

The ePMP 3000 connectorized module conforms to the specifications listed in [Table 7](#) and [Table 8](#). The connectorized module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [6-87](#) and provides internal surge suppression but does not provide lightning suppression.

Table 7 ePMP 3000 Access Point physical specifications

| Category | Specification |
|--------------------------------------|--|
| Dimensions (Length x Width x Height) | 22.2 cm x 12.4 cm x 4.5 cm (8.75 in x 4.9 in x 1.75 in) without brackets |
| Weight | 0.7 kg (1.5 lbs) without brackets |

Table 8 ePMP 3000 Access Point environmental specifications

| Category | Specification |
|---------------|--|
| Temperature | -30°C (-22°F) to +55°C (131°F) |
| Wind loading | 124 mph (200 kph) maximum. See ePMP 3000 Access Point wind loading (Kg) on page 2-20 for a full description. |
| Humidity | 95% condensing |
| Environmental | IP55 |

ePMP 3000 Access Point heater

At startup, if the ePMP 3000 Access Point module temperature is at or below 32° F (0° C), an internal heater is activated to ensure that the device is able to successfully begin operation. The unit's heater is only activated when the unit is powered on and will not apply heat to the device once startup is complete. When the unit temperature is greater than 32° F (0° C), the heater is deactivated and the unit continues its startup sequence.

The effect on device startup time at various temperatures is defined in [Table 7](#).

Table 9 ePMP 3000 Access Point startup times based on ambient temperature

| Initial Temperature | Startup time (from power on to operational) |
|---------------------|---|
| -22° F (-30° C) | 20 minutes |
| -4° F (-20° C) | 6 minutes |
| 14° F (-10° C) | 2 minutes, 30 seconds |

ePMP 3000 Access Point wind loading

Ensure that the device and the structure on which it is mounted are capable of withstanding the prevalent wind speeds at a proposed ePMP site. Wind speed statistics are available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 200 kph (124 mph).

Wind blowing on the device will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the device. Wind loading is estimated using the following formulae:

$$\text{Force (in kilograms)} = 0.1045aV^2$$

Where:

a

Is:

surface area in square meters

V

wind speed in meters per second

$$\text{Force (in pounds)} = 0.0042Av^2$$

Where:

A

Is:

surface area in square feet

v

wind speed in miles per hour

Applying these formulae to the ePMP device at different wind speeds, the resulting wind loadings are shown in [Table 10](#) and [Table 11](#).

Table 10 ePMP 3000 Access Point wind loading (Kg)

| Type of ePMP device | Largest surface area (square meters) | Wind speed (meters per second) | | |
|--|--------------------------------------|--------------------------------|----------|----------|
| | | 40 | 50 | 60 |
| ePMP 3000 Access Point with Sector Antenna | 0.13 | 21.74 Kg | 33.96 Kg | 48.91 Kg |

Table 11 ePMP 3000 Access Point wind loading (lb)

| Type of ePMP device | Largest surface area (square feet) | Wind speed (miles per hour) | | |
|--|------------------------------------|-----------------------------|----------|----------|
| | | 80 | 100 | 120 |
| ePMP 3000 Access Point with Sector Antenna | 1.4 | 37.63 lb | 58.80 lb | 84.67 lb |

ePMP 3000 Access Point software packages

ePMP 3000 Access Point devices may be upgraded by downloading new software packages from the Cambium Networks website or by using cnMaestro. The software packages applicable to ePMP integrated radios are named:

- ePMP-AC-v4.3.0.1.img (or higher version number)

Force 300-25

For details of the Force 300-25 hardware, see:

- [Force 300-25 Integrated description](#) on page 2-21
- [Force 300-25 part numbers](#) on page 2-22
- [Force 300-25 mounting bracket](#) on page 2-23
- [Force 300-25 specifications](#) on page 2-24
- [Force 300-25 heater](#) on page 2-24
- [Force 300-25 wind loading](#) on page 2-25
- [Force 300-25 software packages](#) on page 2-26

Force 300-25 Integrated description

The Force 300-25 device is a self-contained transceiver unit that houses both radio and networking electronics.

Figure 6 Force 300-25 Integrated



Force 300-25 part numbers

Choose the correct regional variant to adhere to local licensing restrictions.

Each of the parts listed in [Table 12](#) includes the following items:

- One integrated unit
- One power supply 1000/100 Base-TX LAN injector (excluding C050910CZ01A)
- One line cord (excluding C050910CA01A, C050910CZ01A)

Table 12 Force 300-25 part numbers

| Cambium description | Cambium part number |
|--|---------------------|
| ePMP Force 300-25-25 5 GHz High Gain Radio (FCC) (US Cord) | C058910C102A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (IC) (Canada/US Cord) | C050910C104A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (EU) (EU Cord) | C050910C203A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (EU) (UK Cord) | C050910C303A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (no Cord) | C050910C001A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (US Cord) | C050910C101A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (EU Cord) | C050910C201A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (UK Cord) | C050910C301A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (India Cord) | C050910C401A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (China Cord) | C050910C501A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (Brazil Cord) | C050910C601A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (Argentina Cord) | C050910C701A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (ANZ Cord) | C050910C801A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (South Africa Cord) | C050910C901A |
| ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (No PSU) | C050910CZ01A |

Table 13 Force 300-25 accessory part numbers

| Cambium description | Cambium part number |
|---|---------------------|
| PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply | N000900L001 |
| CABLE, UL POWER SUPPLY CORD SET, ARGENTINA | N000900L013 |
| CABLE, UL POWER SUPPLY CORD SET, AUS/NZ | N000900L011 |
| CABLE, UL POWER SUPPLY CORD SET, Brazil | N000900L010 |
| CABLE, UL POWER SUPPLY CORD SET, CHINA | N000900L015 |
| CABLE, UL POWER SUPPLY CORD SET, EU | N000900L008 |

| | |
|--|-------------|
| CABLE, UL POWER SUPPLY CORD SET, INDIA | N000900L012 |
| CABLE, UL POWER SUPPLY CORD SET, UK | N000900L009 |
| CABLE, UL POWER SUPPLY CORD SET, US | N000900L007 |

Force 300-25 mounting bracket

Figure 7 Force 300-25 module mounting bracket

The Force 300-25 module is designed to be pole-mounted using the mounting bracket provided in the box with the radio.



Force 300-25 Interfaces

The Ethernet port is located on the rear of the integrated unit. This interface is described in [Table 14](#).

Table 14 Force 300-25 Series – rear interfaces

| Port name | Connector | Interface | Description |
|-----------|-----------|-------------------------|----------------------------|
| Eth | RJ45 | PoE input | Power over Ethernet (PoE). |
| | | 100/1000BASE-T Ethernet | Data |

Force 300-25 specifications

The Force 300-25 integrated module conforms to the specifications listed in [Table 15](#) and [Table 16](#). The integrated module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page 6-87 and provides internal surge suppression but does not provide lightning suppression.

Table 15 Force 300-25 physical specifications

| Category | Specification |
|-------------------------------|-----------------------------------|
| Dimensions (Diameter x Depth) | 47 cm x 31 cm (18.5 in x 12.2 in) |
| Weight | 2.4 kg (5.2 lbs) |

Table 16 Force 300-25 environmental specifications

| Category | Specification |
|---------------|---|
| Temperature | -30°C (-22°F) to +55°C (131°F) |
| Wind loading | 124 mph (200 kph) maximum. See Force 300-25 wind loading on page 2-25 for a full description. |
| Humidity | 95% condensing |
| Environmental | IP55 |

Force 300-25 heater

At startup, if the Force 300-25 module temperature is at or below 32° F (0° C), an internal heater is activated to ensure that the device is able to successfully begin operation. The unit's heater is only activated when the unit is powered on and will not apply heat to the device once startup is complete. When the unit temperature is greater than 32° F (0° C), the heater is deactivated and the unit continues its startup sequence.

The effect on device startup time at various temperatures is defined in [Table 17](#).

Table 17 Force 300-25 startup times based on ambient temperature

| Initial Temperature | Startup time (from power on to operational) |
|---------------------|---|
| -22° F (-30° C) | 20 minutes |
| -4° F (-20° C) | 6 minutes |
| 14° F (-10° C) | 2 minutes, 30 seconds |

Force 300-25 wind loading

Ensure that the device and the structure on which it is mounted are capable of withstanding the prevalent wind speeds at a proposed ePMP site. Wind speed statistics are available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 200 kph (124 mph).

Wind blowing on the device will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the device. Wind loading is estimated using the following formulae:

$$\text{Force (in kilograms)} = 0.1045aV^2$$

Where:

a

V

Is:

surface area in square meters

wind speed in meters per second

$$\text{Force (in pounds)} = 0.0042Av^2$$

Where:

A

v

Is:

surface area in square feet

wind speed in miles per hour

Applying these formulae to the ePMP device at different wind speeds, the resulting wind loadings are shown in [Table 18](#) and [Table 19](#).

Table 18 Force 300-25 wind loading (Kg)

| Type of ePMP device | Largest surface area (square meters) | Wind speed (meters per second) | | |
|-------------------------|--------------------------------------|--------------------------------|---------|----------|
| | | 40 | 50 | 60 |
| Force 300-25 Integrated | 0.15 | 25.08 Kg | 39.2 Kg | 56.43 Kg |

Table 19 Force 300-25 wind loading (lb)

| Type of ePMP device | Largest surface area (square feet) | Wind speed (miles per hour) | | |
|-------------------------|------------------------------------|-----------------------------|----------|----------|
| | | 80 | 100 | 120 |
| Force 300-25 Integrated | 1.61 | 43.28 lb | 67.62 lb | 97.37 lb |

Force 300-25 software packages

Force 300-25 devices may be upgraded by downloading new software packages from the Cambium Networks website or by using cnMaestro. The software packages applicable to ePMP integrated radios are named:

- ePMP-AC-v4.3.0.1.img (or higher version number)

Force 300-16

For details of the Force 300-16 hardware, see:

- [Force 300-16 Integrated description](#) on page 2-27
- [Force 300-16 part numbers](#) on page 2-27
- [Force 300-16 Interfaces](#) on page 2-28
- [Force 300-16 specifications](#) on page 2-29
- [Force 300-16 heater](#) on page 2-29
- [Force 300-16 software packages](#) on page 2-30

Force 300-16 Integrated description

The Force 300-16 device is a self-contained transceiver unit that houses both radio and networking electronics.



Figure 8 Force 300-16 Integrated

Force 300-16 part numbers

Choose the correct regional variant to adhere to local licensing restrictions.

Each of the parts listed includes the following items:

- One integrated unit
- One power supply 1000/100 Base-TX LAN injector (excluding C050910CZ11A)
- One line cord (excluding C050910C011A, C050910CZ11A)

Table 20 Force 300-25 part numbers

| Cambium description | Cambium part number |
|---|---------------------|
| ePMP 5 GHz Force 300-16 Radio (FCC) (US cord) | C058910C112A |
| ePMP 5 GHz Force 300-16 Radio (IC) (Canada/US cord) | C050910C114A |
| ePMP 5 GHz Force 300-16 Radio (EU) (EU cord) | C050910C213A |

| | |
|---|--------------|
| ePMP 5 GHz Force 300-16 Radio (EU) (UK cord) | C050910C313A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (no cord) | C050910C011A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (US cord) | C050910C111A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (EU cord) | C050910C211A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (UK cord) | C050910C311A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (India cord) | C050910C411A |
| ePMP 5 GHz Force 300-16 Radio (India) (India cord) | C050910C412A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (China cord) | C050910C511A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (Brazil cord) | C050910C611A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (Argentina cord) | C050910C711A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (ANZ cord) | C050910C811A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (South Africa cord) | C050910C911A |
| ePMP 5 GHz Force 300-16 Radio (ROW) (No PSU) | C050910CZ11A |

Table 21 Force 300-16 accessory part numbers

| Cambium description | Cambium part number |
|---|---------------------|
| PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply | N000900L001 |
| CABLE, UL POWER SUPPLY CORD SET, ARGENTINA | N000900L013 |
| CABLE, UL POWER SUPPLY CORD SET, AUS/NZ | N000900L011 |
| CABLE, UL POWER SUPPLY CORD SET, Brazil | N000900L010 |
| CABLE, UL POWER SUPPLY CORD SET, CHINA | N000900L015 |
| CABLE, UL POWER SUPPLY CORD SET, EU | N000900L008 |
| CABLE, UL POWER SUPPLY CORD SET, INDIA | N000900L012 |
| CABLE, UL POWER SUPPLY CORD SET, UK | N000900L009 |
| CABLE, UL POWER SUPPLY CORD SET, US | N000900L007 |

Force 300-16 Interfaces

The Ethernet port is located on the rear of the integrated unit.

Table 22 Force 300-16 Series – rear interfaces

| Port name | Connector | Interface | Description |
|-----------|-----------|-----------|----------------------------|
| Eth | RJ45 | PoE input | Power over Ethernet (PoE). |

| | |
|-------------------------|------|
| 100/1000BASE-T Ethernet | Data |
|-------------------------|------|

Force 300-16 specifications

The Force 300-16 integrated module conforms to the specifications listed in [Table 23](#) and [Table 24](#). The integrated module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page 6-87 and provides internal surge suppression but does not provide lightning suppression.

Table 23 Force 300-16 physical specifications

| Category | Specification |
|-------------------------------|--|
| Dimensions (Diameter x Depth) | 12.4 cm x 25.1 cm x 11.9 cm (4.9 in x 9.9 in x 4.7 in) – with mounting bracket |
| Weight | 0.5 kg (1.1 lbs) – with mounting bracket |

Table 24 Force 300-16 environmental specifications

| Category | Specification |
|---------------|---|
| Temperature | -30°C (-22°F) to +60°C (140°F) |
| Wind loading | 112 mph (180 kph) maximum. See Force 300-16 wind loading on page 2-30 for a full description. |
| Environmental | IP55 |

Force 300-16 heater

At startup, if the Force 300-16 module temperature is at or below 32° F (0° C), an internal heater is activated to ensure that the device is able to successfully begin operation. The unit's heater is only activated when the unit is powered on and will not apply heat to the device once startup is complete. When the unit temperature is greater than 32° F (0° C), the heater is deactivated and the unit continues its startup sequence.

The effect on device startup time at various temperatures is defined in [Table 25](#).

Table 25 Force 300-16 startup times based on ambient temperature

| Initial Temperature | Startup time (from power on to operational) |
|---------------------|---|
| -22° F (-30° C) | 20 minutes |
| -4° F (-20° C) | 6 minutes |
| 14° F (-10° C) | 2 minutes, 30 seconds |

Force 300-16 wind loading

Ensure that the device and the structure on which it is mounted are capable of withstanding the prevalent wind speeds at a proposed ePMP site. Wind speed statistics are available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 180 kph (124 mph).

Wind blowing on the device will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the device. Wind loading is estimated using the following formulae:

$$\text{Force (in kilograms)} = 0.1045aV^2$$

Where:

a

V

Is:

surface area in square meters

wind speed in meters per second

$$\text{Force (in pounds)} = 0.0042Av^2$$

Where:

A

v

Is:

surface area in square feet

wind speed in miles per hour

Applying these formulae to the ePMP device at different wind speeds, the resulting wind loadings are shown in [Table 26](#) and [Table 27](#).

Table 26 Force 300-16 wind loading (Kg)

| Type of ePMP device | Largest surface area (square meters) | Wind speed (meters per second) | | |
|-------------------------|--------------------------------------|--------------------------------|------|--------|
| | | 30 | 40 | 50 |
| Force 300-16 Integrated | 0.03 | 2.8 Kg | 5 Kg | 7.8 Kg |

Table 27 Force 300-16 wind loading (lb)

| Type of ePMP device | Largest surface area (square feet) | Wind speed (miles per hour) | | |
|-------------------------|------------------------------------|-----------------------------|---------|---------|
| | | 80 | 100 | 120 |
| Force 300-16 Integrated | 0.34 | 9.1 lb | 14.3 lb | 20.6 lb |

Force 300-16 software packages

Force 300-16 devices may be upgraded by downloading new software packages from the Cambium Networks website or by using cnMaestro. The software packages applicable to ePMP integrated radios are named:

- ePMP-AC-v4.3.0.1.img (or higher version number)

Power Supply

For details of the ePMP power supply units, see:

- [Power supply description](#) on page 2-32
- [Power supply part numbers](#) on page 2-32
- [Power supply interfaces](#) on page 2-32
- [Power supply specifications](#) on page 2-34
- [Power supply location](#) on page 2-34

Power supply description

The power supply is an indoor unit that is connected to the ePMP module and network terminating equipment using Cat5e cable with RJ45 connectors. It is also plugged into an AC or DC power supply so that it can inject Power over Ethernet (PoE) into the module.

Power supply part numbers

Each module requires one power supply and one power supply line cord (line cord included with radio device, see [Table 12](#)).

Table 28 Power supply component part numbers

| Cambium description | Cambium part number | Device Compatibility |
|---|---------------------|------------------------------|
| ePMP Pwr Supply for GPS Radio - no cord (spare) | N000900L001 | Force 300-25 Force 300-16 |
| POWER SUPPLY, 30W, 56V – Gbps support | N000000L034 | ePMP 3000 Access Point |



Attention Each ePMP device must be powered by the corresponding power supply listed in [Table 28](#).

Power supply interfaces

The power supply interfaces are illustrated in [Figure 9](#) and described in [Table 29](#) and [Table 31](#).

Figure 9 Power supply interfaces

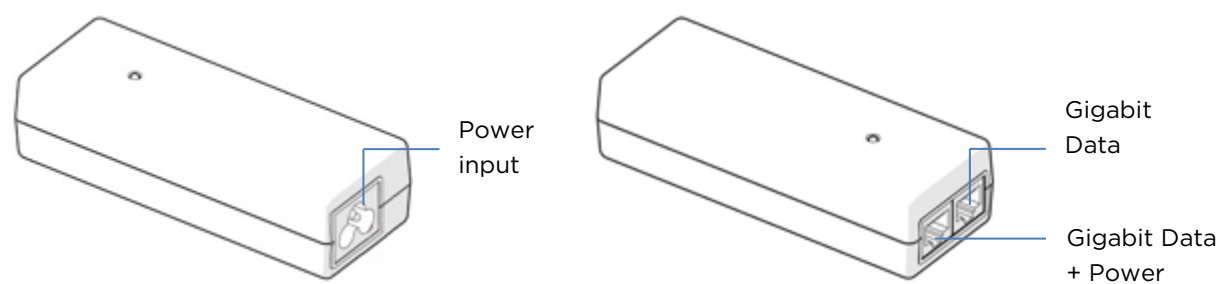


Table 29 Power supply interface functions - N000900L001

| Interface | Function |
|----------------------|--|
| Power input | Mains power input. |
| Power output | 30V |
| Gigabit Data + Power | RJ45 socket for connecting Cat5e cable to radio |
| Gigabit Data | RJ45 socket for connecting Cat5e cable to network. |

Table 30 Power supply interface functions - N000000L034

| Interface | Function |
|----------------------|--|
| Power input | Mains power input. |
| Power output | 56V |
| Gigabit Data + Power | RJ45 socket for connecting Cat5e cable to radio |
| Gigabit Data | RJ45 socket for connecting Cat5e cable to network. |

Table 31 Power Supply LED functions

| LED | Function |
|---------------|------------------------|
| Power (green) | Power supply detection |

Power supply specifications

The ePMP power supply conforms to the specifications listed in [Table 32](#), [Table 33](#), and [Table 34](#).

Table 32 Power supply physical specifications

| Category | Specification |
|------------------------|--|
| Dimensions (H x W x D) | 14 x 6.5 x 3.6 cm (5.5 x 2.55 x 1.42 in) |
| Weight | 0.26 lbs |

Table 33 Power supply environmental specifications

| Category | Specification |
|-------------------------------|----------------|
| Ambient Operating Temperature | 0° C to +40° C |
| Humidity | 20% - 90% |

Table 34 Power supply electrical specifications

| Category | Specification |
|-------------------------|--|
| AC Input | 100 to 240 VAC |
| Efficiency | Meets Energy Level 6 |
| Over Current Protection | Short circuit, with auto recovery |
| Hold up time | 10 ms minimum at maximum load, 120 VAC |

Power supply location

Find a location for the power supply that meets the following requirements:

- The power supply can be mounted on a wall or other flat surface.
- The power supply is kept dry, with no possibility of condensation, flooding or rising damp.
- The power supply can be accessed to view status indicators.
- The power supply can be connected to the ePMP module drop cable and network terminating equipment.
- The power supply can be connected to a mains or DC power supply that meets the requirements defined in [Table 34](#).

Ethernet cabling

For details of the Ethernet cabling components of an ePMP installation, see:

- [Ethernet standards and cable lengths](#) on page 2-35
- [Outdoor Cat5e cable](#) on page 2-35

Ethernet standards and cable lengths

All configurations require a copper Ethernet connection from the power supply port to the power supply and network terminating equipment.

For each power supply, the maximum permitted drop cable length is specified in [Table 35](#).

Table 35 Power supply drop cable length restrictions

| Part number | Description | Maximum cable length (*1) |
|-------------|-----------------------------|---------------------------|
| N000900L001 | Power Supply for Radio with | 330 feet (100m) |
| N000000L034 | Gigabit Ethernet (no cord) | |

(*1) Maximum length of Ethernet cable from device to network device needs to follow 802.3 standards. If the power supply is not the network device the cable from the power supply to the network device must be included in the total maximum cable length.

Outdoor Cat5e cable

Cambium Industrial Cable

Cambium Industrial Cable uses 24-gauge solid bare copper conductors, covered by bonded-pair polymer insulation. The conductors are protected by double layer shielding consisting of a solid foil layer under braided tinned copper mesh, providing excellent shielding while maximizing flexibility. And, the cable is jacketed by industrial grade UV-resistant, abrasion-resistant, and oil-resistant PVC.

Cambium's Industrial RJ45 connectors are specifically designed to work optimally with Cambium Industrial Cable.

The connectors are fully shielded with integrated strain relief for greater pull strength, utilize a staggered contact design that minimizes crosstalk and maximizes electrical performance, and the contacts are plated with 50 micro-inch thick 24 carat gold, exceeding TIA-1096 specifications and ensuring the best possible connection and oxidation resistance.

Cambium Networks' industrial grade cable is well suited for high-quality durable installations of subscriber modules, access points and enterprise point-to-point links as well as in tactical non-permanent deployments of infrastructure.

Table 36 Cambium Industrial Cable component part numbers

| Cambium description | Cambium part number |
|---|---------------------|
| Industrial Grade CAT 5 Cable 50 meter unterminated | N000000L106A |
| Industrial Grade CAT 5 Cable 100 meter unterminated | N000000L106A |
| Industrial Grade CAT 5 Cable 300 meter unterminated | N000000L108A |
| Industrial Grade RJ45 Connector 100 Pack | C000000L109A |
| Termination Tool for C000000L109A RJ45 connectors | C000000L110A |

Surge suppression unit

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path.

The actual degree of protection required depends on local conditions and applicable local regulations. To adequately protect an ePMP installation, both ground bonding and transient voltage surge suppression are required.

Network operators should always follow best-practices for grounding and lightning protection. Doing so will minimize network outages and reduce the associated costs of tower climbs and equipment repair/replacement.



Note Lightning-prone installations can be improved by:

- Installing a surge suppressor near the device (transient surge suppression)
- Grounding the device to the pole (ground bonding)
- Lowering the device/dish such that it is not the highest metallic object on the pole.

Gigabit Ethernet Surge Suppressor

The Gigabit Ethernet Surge Suppressor is critical for lightning protection to minimize the potential for damage.



Table 37 Surge suppressor component part numbers

| Cambium description | Cambium part number | Device Compatibility |
|--------------------------------|---------------------|------------------------------|
| Gigabit Surge Suppressor (30V) | C000000L065A | Force 300-25 Force 300-16 |
| Gigabit Surge Suppressor (56V) | C000000L033A | ePMP 3000 Access Point |



Attention Choose the 30V or 56V surge suppressor option based on your installed device power rating. Installing a 30V surge suppressor for a 56V device or a 56V surge suppressor for a 30V device may result in inadequate surge protection. Reference [Table 37](#).

cnPulse sync generator

cnPulse is the latest GPS synchronization generation device designed specifically for Cambium Networks PMP and PTP radios. The cnPulse module is IP67 (weather proof and supports a wide temperature range for rugged environments. The GPS receiver is highly reliable and supports both GPS and GNSS signals.

cnPulse receives its power from the CAT-5 drop cable in mode 2 so no external power supply is required. There are no configuration or software settings required. For ePMP 3000, cnPulse is deployed in-line with the radio's CAT-5 drop cable.

For more information, please see:

<http://community.cambiumnetworks.com/t5/cnPulse/bd-p/cnPulse>



Chapter 3: System planning

This chapter provides information to help the user to plan an ePMP link.

The following topics are described in this chapter:

- How to plan ePMP links to conform to the regulatory restrictions that apply in the country of operation is explained under [Radio spectrum planning](#) on page 3-40.
- Factors to be considered when planning links such as range, path loss and throughput are described under [Link planning](#) on page 3-43.
- The grounding and lightning protection requirements of a ePMP installation are described under [Grounding and lightning protection](#) on page 2-13.
- Factors to be considered when planning ePMP data networks are described under [Data network planning](#) on page 3-45.

Radio spectrum planning

This section describes how to plan ePMP links to conform to the regulatory restrictions that apply in the country of operation.



Attention The user must ensure ePMP product operates in accordance to local regulatory limits.



Note Contact the applicable radio regulator to check if registration of the ePMP link is required.

General wireless specifications

The wireless specifications that apply to ePMP 802.11ac variants are listed under [Table 38](#). The wireless specifications that are specific to each frequency variant are listed in [Table 39](#).

Table 38 Wireless specifications (all variants)

| Item | Specification |
|--------------------------------|--|
| Channel selection | Manual selection (fixed frequency) |
| | Automatic Channel Selection |
| Manual power control | To avoid interference to other users of the band, maximum power can be set lower than the default power limit. |
| Maximum transmit power | ePMP 3000 Access Point: 33 dBm |
| | Force 300-25: 29 dBm |
| | Force 300-16: 29 dBm |
| Integrated device antenna type | Force 300-25: Dish antenna |
| | Force 300-16: Integrated patch |
| Duplex scheme | Adaptive TDD |
| Over-the-air encryption | AES |
| Error Correction | FEC |

Table 39 Wireless specifications, 5 GHz band

| Item | 5 GHz |
|---|---|
| RF band (GHz) | 4.910 – 5.970 MHz |
| Channel bandwidth | 20 MHz, 40 MHz, or 80 MHz |
| Typical antenna gain | Integrated dish antenna – 25 dBi |
| | Integrated patch antenna – 16 dBi |
| | Sector antenna – 17 dBi |
| Antenna 3dB beamwidth (Integrated dish) | Sector Antenna: 70° azimuth, 6° elevation |
| | Integrated Dish: 6-10° azimuth, 6-10° elevation |
| | Integrated Patch: 15° azimuth, 30° elevation |

Regulatory limits

The local regulator may restrict frequency usage and channel width and may limit the amount of conducted or radiated transmitter power.

Many countries impose EIRP limits (Allowed EIRP) on products operating in the bands used by the ePMP Series. For example, in the 5 GHz band, these limits are calculated as follows:

- In the 5.8 GHz band (5725 MHz to 5875 MHz), the EIRP must not exceed the lesser of 36 dBm or $(23 + 10 \times \text{Log Channel width in MHz})$ dBm.

Some countries (for example the USA) impose conducted power limits on products operating in the 5 GHz band.

Conforming to the limits

Ensure the link is configured to conform to local regulatory requirements by configuring the correct country code (located in the web management interface, under **Configure > Radio**). In the following situations, the country code does not automatically prevent operation outside the regulations:

- When operating in ETSI regions, it is required to enter a license key in the ePMP web management interface to unlock valid country-specific frequencies. This key may be obtained from <https://support.cambiumnetworks.com/licensekeys/epmp>.

Available spectrum

The available spectrum for operation depends on the region. When configured with the appropriate country code, the unit will only allow operation on those channels which are permitted by the regulations.

Certain regulations have allocated certain channels as unavailable for use:

- Some European countries have allocated part of the 5.8 GHz band to Road Transport and Traffic Telematics (RTTT) systems.

Where regulatory restrictions apply to certain channels, these channels are barred automatically by the use of the correct country code. For example, at 5.8 GHz in some European countries, the RTTT band 5795 MHz to 5815 MHz is barred. With the appropriate country code configured for this region, the ePMP will not operate on channels within this band.

The number and identity of channels barred by the license key and country code is dependent on the channel bandwidth.

Channel bandwidth

Select the required channel bandwidth for the link. The selection depends upon the ePMP frequency variant and country code, as specified on page [6-100](#).

The wider a channel bandwidth the greater is its capacity. As narrower channel bandwidths take up less spectrum, selecting a narrow channel bandwidth may be a better choice when operating in locations where the spectrum is very busy.

Both ends of the link must be configured to operate on the same channel bandwidth.

Link planning

This section describes factors to be taken into account when planning links, such as range, obstacles path loss and throughput.

Range and obstacles

Calculate the range of the link and identify any obstacles that may affect radio performance.

Perform a survey to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is necessary in order to achieve an accurate link feasibility assessment.

Path loss

Path loss is the amount of attenuation the radio signal undergoes between the two ends of the link. The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin). The following calculation needs to be performed to judge whether a particular link can be installed:

$$L_{free_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where:

Is:

| | |
|-------------------|---------------------------|
| L_{free_space} | Free Space Path Loss (dB) |
| L_{excess} | Excess Path Loss (dB) |
| L_{fade} | Fade Margin Required (dB) |
| $L_{seasonal}$ | Seasonal Fading (dB) |
| $L_{capability}$ | Equipment Capability (dB) |

Free space path loss is a major determinant in received (Rx) signal level. Rx signal level, in turn, is a major factor in the system operating margin (fade margin), which is calculated as follows:

$$\text{System Operating Margin (fade margin) dB} = \text{Rx signal level (dB)} - \text{Rx sensitivity (dB)}$$

Thus, the fade margin is the difference between strength of the received signal and the strength that the receiver requires for maintaining a reliable link.

Adaptive modulation

Adaptive modulation ensures that the highest throughput that can be achieved instantaneously will be obtained, taking account of propagation and interference. When the link has been installed, web pages provide information about the link loss currently measured by the equipment, both instantaneously and averaged.

Data network planning

This section describes factors to be considered when planning ePMP data networks.

Ethernet interfaces

The ePMP Ethernet ports conform to the specifications listed in [Table 40](#).

Table 40 Ethernet bridging specifications

| Ethernet Bridging | Specification |
|-------------------------------------|--|
| Protocol | 10BASE-Te/100BASE-Tx/1000BASE-T IEEE 802.3 |
| | IEEE 802.3at (PoE) |
| | IEEE802.3u compliant Auto-negotiation |
| Interface | 10/100/1000BaseT (RJ-45) |
| Maximum Ethernet Frame Size | 1700 bytes |
| Service classes for bridged traffic | 3 classes |



Note Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

Management VLAN

Decide if the IP interface of the device management agent will be connected in a VLAN. If so, decide if this is a standard (IEEE 802.1Q) VLAN or provider bridged (IEEE 802.1ad) VLAN, and select the VLAN ID for this VLAN.

Use of a separate management VLAN is strongly recommended. Use of the management VLAN helps to ensure that the device management agent cannot be accessed by customers.

Quality of service for bridged Ethernet traffic

Decide how quality of service will be configured in ePMP to minimize frame loss and latency for high priority traffic. Wireless links often have lower data capacity than wired links or network equipment like switches and routers, and quality of service configuration is most critical at network bottlenecks.

ePMP provides three priority types for traffic waiting for transmission over the wireless link – Voice, High and Low. Low is the lowest priority and Voice is the highest priority. Traffic is scheduled using strict priority; in other words, traffic in a given priority is transmitted when all higher-priority transmissions are complete.

Chapter 4: Using the Device Management Interface

This chapter describes all configuration and alignment tasks that are performed when an ePMP system is deployed.

Configure the units by performing the following tasks:

- [Preparing for configuration](#) on page 4-2
- [Connecting to the unit](#) on page 4-3
- [Using the web interface](#) on page 4-5
- [Using the installation wizard - Access Point](#) on page 4-6
- [Using the installation wizard - Subscriber Module](#) on page 4-11
- [Using the menu options](#) on page 4-15

Preparing for configuration

This section describes the checks to be performed before proceeding with unit configuration.

Safety precautions

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



Warning Ensure that personnel are 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](#) on page 6-86, in particular the minimum separation distances.

Observe the following guidelines:

Never work in front of the antenna when the device is powered. Always power down 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, [Compliance with safety standards](#) on page 6-87.

Connecting to the unit

To connect the unit to a management PC, use the following procedures:

- [Configuring the management PC](#) on page 4-3
- [Connecting to the PC and powering up](#) on page 4-4

Configuring the management PC

Use this procedure to configure the local management PC to communicate with the ePMP module.

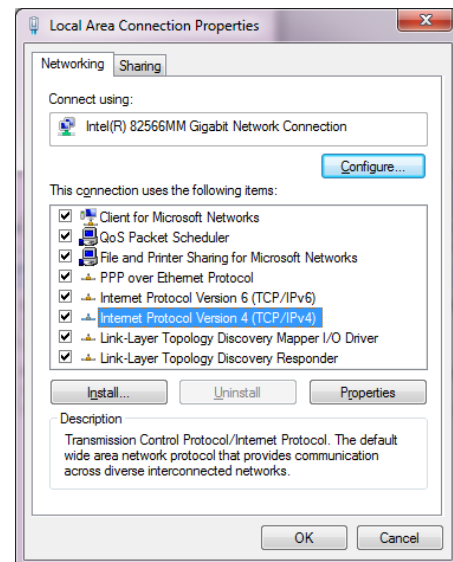
Procedure:

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

In Windows 7 this is found in **Control Panel > Network and Internet > Network Connections > Local Area Connection**.

- 2 Select the Internet Protocol (TCP/IP) item:

- 3 Click **Properties**.



- 4 Enter an IP address that is valid for the 169.254.1.x network, avoiding 169.254.1.1. A good example is 169.254.1.100:
- 5 Enter a subnet mask of 255.255.255.0.
Leave the default gateway blank.
- 6 Click OK, then click Close

Connecting to the PC and powering up

Use this procedure to connect a management PC directly to the ePMP for configuration and alignment purposes and to power up the ePMP device.

Procedure:

- 1 Check that the device and power supply are correctly connected (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 mains or battery power to the power supply. The green Power LED must illuminate continuously.



Note If the Power and Ethernet LEDs do not illuminate correctly, see [Testing hardware](#) on page 5-4.

Using the web interface

To understand how to use the ePMP web interface, see:

- [Logging into the web interface](#) on page 4-5

Logging into the web interface

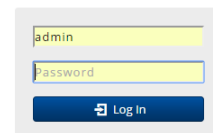
Use this procedure to log into the web interface as a system administrator.

Equipment and tools:

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

Procedure:

- 1 Check that the device and power supply are correctly connected (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 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.
- 4 Connect the power supply to power mains
- 5 In your browser, navigate to the device default IP address **169.254.1.1**.



The screenshot shows a web login interface. It has two input fields: the first is labeled 'admin' and the second is labeled 'password'. Below these fields is a blue button with a white arrow icon and the text 'Log In'.

- 6 Login with username **admin** and password **admin**



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.



Note New ePMP devices all contain default username and password configurations. It is recommended to change these password configurations immediately. These passwords may be configured in the management GUI in section **Configuration > System > Account Management**.

Using the installation wizard – Access Point

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

Start Setup

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

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

Installation wizard step 1 – Main system parameters

Quick Start

Cancel Setup Finish Setup

| | | | | | |
|---|------|-------|---------|----------|---|
| ◀ | Main | Radio | Network | Security | ▶ |
|---|------|-------|---------|----------|---|

Main

Device Name *

ePMP3000

Backward Compatibility

☒ Disabled ☐ Enabled

SSID

GetElevated

| Attribute | Meaning |
|------------------------|--|
| Main | |
| Device Name | The configured identifier used in an NMS such as cnMaestro |
| Backward Compatibility | Enabled: 802.11n ePMP subscribers are able to register to the AP (requires subscriber software upgrade). Disabled: 802.11n ePMP subscribers are not able to register to the AP. |
| SSID | SSID is a unique identifier for a wireless LAN which is specified in the Access Point's beacon. (Access Point Mode). SSID must be same at both ends and different to site name. |

Installation wizard step 2 – Radio parameters

Quick Start

Cancel Setup

Finish Setup

◀

Main

Radio

Network

Security

▶

Radio

Country

United States

Driver Mode

☒ TDD

☐ TDD PTP

Downlink/Uplink Ratio

☒ 75/25

☐ 50/50

☐ 30/70

Max Range

1

miles | min: 1 | max: 124

Channel Bandwidth

☒ 20 MHz

☐ 40 MHz

☐ 80 MHz (Beta Quality!)

Frequency Carrier

5825 MHz

▼

| Attribute | Meaning |
|-----------------------|---|
| Radio | |
| 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 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 is able to GPS synchronize in this mode. TDD PTP: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling. The AP is able to 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 cell coverage radius. Subscriber Modules outside the configured radius will not be 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 |

| Attribute | Meaning |
|-----------|---|
| | parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter. |

Installation wizard step 3 – Network parameters

Quick Start

Cancel

Finish Setup

◀

Main

Radio

Network

Security

▶

Network

IP Assignment

☒ Static ☐ DHCP

i

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

| Attribute | Meaning |
|----------------|---|
| 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. 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 | Meaning |
|----------------------|---|
| Subnet Mask | Defines the address range of the connected IP network. For example, if 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. |

Installation wizard step 4 – Security parameters

Quick Start

Cancel

Finish Setup

◀

Main

Radio

Network

Security

▶

Security

Wireless Security

☐ Open

☒ WPA2

☐ RADIUS

WPA2 Pre-shared Key

.....

👁

Servers

Add

Show Details

| | IP Address | Port | |
|----------------|------------|------|--|
| Table is empty | | | |

GUI User Authentication

☒ Device Local Only

☐ Remote RADIUS Server Only

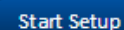
☐ Remote RADIUS Server and Fallback to Local

| Attribute | Meaning |
|-------------------|---|
| Network | |
| Wireless Security | Open: All Subscriber Module devices requesting network entry are allowed registration. |

| Attribute | Meaning |
|-------------------------|--|
| | <p>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 Access Point and Subscriber Module.</p> <p>RADIUS: Enables Subscriber Module authentication via a pre-configured Radius server.</p> |
| WPA2 Pre-shared Key | Configure this key on the Access Point, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols. |
| Servers | <p>Up to 3 RADIUS servers can be configured on the device with the following attributes:</p> <p>IP Address: IP Address of the RADIUS server on the network.</p> <p>Port: The RADIUS server port. Default is 1812.</p> <p>Secret: Secret key that is used to communicate with the RADIUS server.</p> |
| GUI User Authentication | <p>This parameter applies to both the AP and its registered SMs.</p> <p>Device Local Only: The device GUI authentication is local to the device using one of the accounts configured under Configuration > System > Account Management.</p> <p>Remote RADIUS Server Only: The device GUI authentication is performed using a RADIUS server.</p> <p>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.</p> |

Using the installation wizard – Subscriber Module

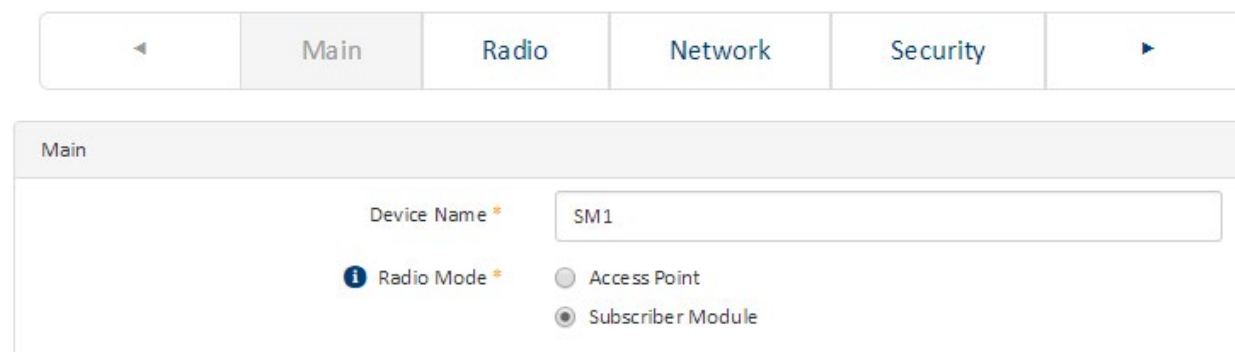
The ePMP device features a guided configuration mechanism for configuring key parameters for link operation.



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

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

Installation wizard step 1 – Main system parameters



The form shows a navigation bar with tabs: Main, Radio, Network, and Security. The 'Main' tab is selected. Below the tabs, the 'Main' section contains two fields: 'Device Name' with a text input containing 'SM1', and 'Radio Mode' with two radio button options: 'Access Point' and 'Subscriber Module'. The 'Subscriber Module' option is selected.

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

Installation wizard step 2 – Radio parameters

Main
Radio
Network
Security

Preferred APs
Add new AP
Show Details

SSID
Wireless Security
WPA2 pre-shared key

Table is empty

Scan Channel Bandwidth
80 MHz
40 MHz
20 MHz

20 MHz Scan List

Radio Frequency 20 MHz Scan List
Unselect All
Select All

| | | | | | | | | | | | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|-----------------------------------|-----------------------------------|-----------------------------------|
| <input type="checkbox"/> 4820 MHz | <input type="checkbox"/> 4825 MHz | <input type="checkbox"/> 4830 MHz | <input type="checkbox"/> 4835 MHz | <input type="checkbox"/> 4840 MHz | <input type="checkbox"/> 4845 MHz | <input type="checkbox"/> 4850 MHz | <input type="checkbox"/> 4855 MHz | <input type="checkbox"/> 4860 MHz | <input type="checkbox"/> 4865 MHz | <input type="checkbox"/> 4870 MHz | <input type="checkbox"/> 4875 MHz | <input type="checkbox"/> 4880 MHz | <input type="checkbox"/> 4885 MHz | <input type="checkbox"/> 4890 MHz | <input type="checkbox"/> 4895 MHz |
| <input type="checkbox"/> 4900 MHz | <input type="checkbox"/> 4905 MHz | <input type="checkbox"/> 4910 MHz | <input type="checkbox"/> 4915 MHz | <input type="checkbox"/> 4920 MHz | <input type="checkbox"/> 4925 MHz | <input type="checkbox"/> 4930 MHz | <input type="checkbox"/> 4935 MHz | <input type="checkbox"/> 4940 MHz | <input type="checkbox"/> 4945 MHz | <input type="checkbox"/> 4950 MHz | <input type="checkbox"/> 4955 MHz | <input type="checkbox"/> 4960 MHz | <input type="checkbox"/> 4965 MHz | <input type="checkbox"/> 4970 MHz | <input type="checkbox"/> 4975 MHz |
| <input type="checkbox"/> 4980 MHz | <input type="checkbox"/> 4985 MHz | <input type="checkbox"/> 4990 MHz | <input type="checkbox"/> 4995 MHz | <input type="checkbox"/> 5000 MHz | <input type="checkbox"/> 5005 MHz | <input type="checkbox"/> 5010 MHz | <input type="checkbox"/> 5015 MHz | <input type="checkbox"/> 5020 MHz | <input type="checkbox"/> 5025 MHz | <input type="checkbox"/> 5030 MHz | <input type="checkbox"/> 5035 MHz | <input type="checkbox"/> 5040 MHz | <input type="checkbox"/> 5045 MHz | <input type="checkbox"/> 5050 MHz | <input type="checkbox"/> 5055 MHz |
| <input type="checkbox"/> 5060 MHz | <input type="checkbox"/> 5065 MHz | <input type="checkbox"/> 5070 MHz | <input type="checkbox"/> 5075 MHz | <input type="checkbox"/> 5080 MHz | <input type="checkbox"/> 5085 MHz | <input type="checkbox"/> 5090 MHz | <input type="checkbox"/> 5095 MHz | <input type="checkbox"/> 5100 MHz | <input type="checkbox"/> 5105 MHz | <input type="checkbox"/> 5110 MHz | <input type="checkbox"/> 5115 MHz | <input type="checkbox"/> 5120 MHz | <input type="checkbox"/> 5125 MHz | <input type="checkbox"/> 5130 MHz | <input type="checkbox"/> 5135 MHz |
| <input type="checkbox"/> 5140 MHz | <input type="checkbox"/> 5145 MHz | <input type="checkbox"/> 5150 MHz | <input type="checkbox"/> 5155 MHz | <input type="checkbox"/> 5160 MHz | <input type="checkbox"/> 5165 MHz | <input type="checkbox"/> 5170 MHz | <input type="checkbox"/> 5175 MHz | <input type="checkbox"/> 5180 MHz | <input type="checkbox"/> 5185 MHz | <input type="checkbox"/> 5190 MHz | <input type="checkbox"/> 5195 MHz | <input checked="" type="checkbox"/> 5200 MHz | <input type="checkbox"/> 5205 MHz | <input type="checkbox"/> 5210 MHz | <input type="checkbox"/> 5215 MHz |
| <input type="checkbox"/> 5220 MHz | <input type="checkbox"/> 5225 MHz | <input type="checkbox"/> 5230 MHz | <input type="checkbox"/> 5235 MHz | <input type="checkbox"/> 5240 MHz | <input type="checkbox"/> 5245 MHz | <input type="checkbox"/> 5250 MHz | <input type="checkbox"/> 5255 MHz | <input type="checkbox"/> 5260 MHz | <input type="checkbox"/> 5265 MHz | <input type="checkbox"/> 5270 MHz | <input type="checkbox"/> 5275 MHz | <input type="checkbox"/> 5280 MHz | <input type="checkbox"/> 5285 MHz | <input type="checkbox"/> 5290 MHz | <input type="checkbox"/> 5295 MHz |
| <input type="checkbox"/> 5300 MHz | <input type="checkbox"/> 5305 MHz | <input type="checkbox"/> 5310 MHz | <input type="checkbox"/> 5315 MHz | <input type="checkbox"/> 5320 MHz | <input type="checkbox"/> 5325 MHz | <input type="checkbox"/> 5330 MHz | <input type="checkbox"/> 5335 MHz | <input type="checkbox"/> 5340 MHz | <input type="checkbox"/> 5345 MHz | <input type="checkbox"/> 5350 MHz | <input type="checkbox"/> 5355 MHz | <input type="checkbox"/> 5360 MHz | <input type="checkbox"/> 5365 MHz | <input type="checkbox"/> 5370 MHz | <input type="checkbox"/> 5375 MHz |
| <input type="checkbox"/> 5380 MHz | <input type="checkbox"/> 5385 MHz | <input type="checkbox"/> 5390 MHz | <input type="checkbox"/> 5395 MHz | <input type="checkbox"/> 5400 MHz | <input type="checkbox"/> 5405 MHz | <input type="checkbox"/> 5410 MHz | <input type="checkbox"/> 5415 MHz | <input type="checkbox"/> 5420 MHz | <input type="checkbox"/> 5425 MHz | <input type="checkbox"/> 5430 MHz | <input type="checkbox"/> 5435 MHz | <input type="checkbox"/> 5440 MHz | <input type="checkbox"/> 5445 MHz | <input type="checkbox"/> 5450 MHz | <input type="checkbox"/> 5455 MHz |
| <input type="checkbox"/> 5460 MHz | <input type="checkbox"/> 5465 MHz | <input type="checkbox"/> 5470 MHz | <input type="checkbox"/> 5475 MHz | <input type="checkbox"/> 5480 MHz | <input type="checkbox"/> 5485 MHz | <input type="checkbox"/> 5490 MHz | <input type="checkbox"/> 5495 MHz | <input type="checkbox"/> 5500 MHz | <input type="checkbox"/> 5505 MHz | <input type="checkbox"/> 5510 MHz | <input type="checkbox"/> 5515 MHz | <input type="checkbox"/> 5520 MHz | <input type="checkbox"/> 5525 MHz | <input type="checkbox"/> 5530 MHz | <input type="checkbox"/> 5535 MHz |
| <input type="checkbox"/> 5540 MHz | <input type="checkbox"/> 5545 MHz | <input type="checkbox"/> 5550 MHz | <input type="checkbox"/> 5555 MHz | <input type="checkbox"/> 5560 MHz | <input type="checkbox"/> 5565 MHz | <input type="checkbox"/> 5570 MHz | <input type="checkbox"/> 5575 MHz | <input type="checkbox"/> 5580 MHz | <input type="checkbox"/> 5585 MHz | <input type="checkbox"/> 5590 MHz | <input type="checkbox"/> 5595 MHz | <input type="checkbox"/> 5600 MHz | <input type="checkbox"/> 5605 MHz | <input type="checkbox"/> 5610 MHz | <input type="checkbox"/> 5615 MHz |
| <input type="checkbox"/> 5620 MHz | <input type="checkbox"/> 5625 MHz | <input type="checkbox"/> 5630 MHz | <input type="checkbox"/> 5635 MHz | <input type="checkbox"/> 5640 MHz | <input type="checkbox"/> 5645 MHz | <input type="checkbox"/> 5650 MHz | <input type="checkbox"/> 5655 MHz | <input type="checkbox"/> 5660 MHz | <input type="checkbox"/> 5665 MHz | <input type="checkbox"/> 5670 MHz | <input type="checkbox"/> 5675 MHz | <input type="checkbox"/> 5680 MHz | <input type="checkbox"/> 5685 MHz | <input type="checkbox"/> 5690 MHz | <input type="checkbox"/> 5695 MHz |
| <input type="checkbox"/> 5700 MHz | <input type="checkbox"/> 5705 MHz | <input type="checkbox"/> 5710 MHz | <input type="checkbox"/> 5715 MHz | <input type="checkbox"/> 5720 MHz | <input type="checkbox"/> 5725 MHz | <input type="checkbox"/> 5730 MHz | <input type="checkbox"/> 5735 MHz | <input type="checkbox"/> 5740 MHz | <input type="checkbox"/> 5745 MHz | <input type="checkbox"/> 5750 MHz | <input type="checkbox"/> 5755 MHz | <input type="checkbox"/> 5760 MHz | <input type="checkbox"/> 5765 MHz | <input type="checkbox"/> 5770 MHz | <input type="checkbox"/> 5775 MHz |
| <input type="checkbox"/> 5780 MHz | <input type="checkbox"/> 5785 MHz | <input type="checkbox"/> 5790 MHz | <input type="checkbox"/> 5795 MHz | <input type="checkbox"/> 5800 MHz | <input type="checkbox"/> 5805 MHz | <input type="checkbox"/> 5810 MHz | <input type="checkbox"/> 5815 MHz | <input type="checkbox"/> 5820 MHz | <input type="checkbox"/> 5825 MHz | <input type="checkbox"/> 5830 MHz | <input type="checkbox"/> 5835 MHz | <input type="checkbox"/> 5840 MHz | <input type="checkbox"/> 5845 MHz | <input type="checkbox"/> 5850 MHz | <input type="checkbox"/> 5855 MHz |
| <input type="checkbox"/> 5860 MHz | <input type="checkbox"/> 5865 MHz | <input type="checkbox"/> 5870 MHz | <input type="checkbox"/> 5875 MHz | <input type="checkbox"/> 5880 MHz | <input type="checkbox"/> 5885 MHz | <input type="checkbox"/> 5890 MHz | <input type="checkbox"/> 5895 MHz | <input type="checkbox"/> 5900 MHz | <input type="checkbox"/> 5905 MHz | <input type="checkbox"/> 5910 MHz | <input type="checkbox"/> 5915 MHz | <input type="checkbox"/> 5920 MHz | <input type="checkbox"/> 5925 MHz | <input type="checkbox"/> 5930 MHz | <input type="checkbox"/> 5935 MHz |
| <input type="checkbox"/> 5940 MHz | <input type="checkbox"/> 5945 MHz | <input type="checkbox"/> 5950 MHz | <input type="checkbox"/> 5955 MHz | <input type="checkbox"/> 5960 MHz | <input type="checkbox"/> 5965 MHz | <input type="checkbox"/> 5970 MHz | <input type="checkbox"/> 5975 MHz | <input type="checkbox"/> 5980 MHz | <input type="checkbox"/> 5985 MHz | <input type="checkbox"/> 5990 MHz | <input type="checkbox"/> 5995 MHz | <input type="checkbox"/> 6000 MHz | <input type="checkbox"/> 6005 MHz | <input type="checkbox"/> 6010 MHz | <input type="checkbox"/> 6015 MHz |

| Attribute | Meaning |
|---------------------------|--|
| Radio | |
| Preferred APs | |
| SSID | The Preferred Access Points SSID defines the Access Point SSID to which the Subscriber Module device will attempt registration. |
| Wireless Security | <p>Open: The Subscriber Module device will attempt registration to the Preferred Access Points SSID with no security mechanism.</p> <p>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 Access Point and Subscriber Module.</p> |
| WPA2 Pre-shared Key | The Preferred Access Points WPA2 Pre-shared Key must be configured on the Subscriber Module 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 has been completed prior to configuring this parameter. |

Installation wizard step 3 – Network parameters

| | | | | | |
|---|------|-------|---------|----------|---|
| ◀ | Main | Radio | Network | Security | ▶ |
|---|------|-------|---------|----------|---|

Network

Network Mode * ☐ NAT ☒ Bridge ☐ Router

IP Assignment ☒ Static ☐ DHCP

IP Address

Subnet Mask

Gateway

Preferred DNS Server

Alternate DNS Server

| Attribute | Meaning |
|----------------|---|
| Network | |
| Network Mode | <p>NAT: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination).</p> <p>Bridge: The SM acts as a switch and packets are forwarded or filtered based on their MAC destination address.</p> <p>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.</p> |
| IP Assignment | <p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>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.</p> |
| IP Address | <p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p>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).</p> |
| Subnet Mask | <p>Defines the address range of the connected IP network. For example, if 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.</p> |

| Attribute | Meaning |
|----------------------|---|
| 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. |

Installation wizard step 4 – Security parameters

The screenshot shows the 'Security' tab in the installation wizard. At the top, there are navigation buttons: Main, Radio, Network, and Security (selected). Below the navigation bar, the 'Security' section is displayed. It includes a 'Wireless Security' section with three options: RADIUS (unchecked), WPA2 (checked), and Open (checked). Below this, there are several fields and options: 'WPA2 Pre-shared Key' (password field), 'EAP-TTLS Username' (text field with value 'cambium-station'), 'Use Ethernet MAC Address as EAP-TTLS Username' (radio button, currently 'Off'), 'EAP-TTLS Password' (password field), 'Authentication Identity String' (text field with value 'anonymous'), and 'Authentication Identity Realm' (text field with value 'cambiumnetworks.com').

| Attribute | Meaning |
|---|---|
| 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. 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. Default value for this parameter is “cambiumnetworks.com”. |

Using the menu options

Use the menu navigation bar in the left panel to navigate to each web page. Some of the menu options are only displayed for specific system configurations. Use [Table 41](#) to locate information about using each web page.

Table 41 Menu options and web pages

| Main menu | Menu option | Web page information |
|---------------|--------------------|---|
| Status | | Status page on page 4-16 |
| Installation | | Installation page on page 4-19 |
| Configuration | | Configuration menu on page 4-19 |
| | Radio | Configuration > Radio page on page 4-20 |
| | System | Configuration > System page on page 4-28 |
| | Network | Configuration > Network page on page 4-33 |
| | Security | Configuration > Security page on page 4-50 |
| Monitor | | Monitor menu on page 4-54 |
| | Performance | Monitor > Performance page on page 4-55 |
| | System | Monitor > System page on page 4-60 |
| | Wireless | Monitor > Wireless Page on page 4-62 |
| | Throughput Chart | Monitor > Throughput Chart page on page 4-67 |
| | GPS | Monitor > GPS page (Access Point Mode) on page 4-67 |
| | Network | Monitor > Network page on page 4-69 |
| | System Log | Monitor > System Log Page on page 4-72 |
| Tools | | Tools menu on page 4-72 |
| | Software Upgrade | Tools > Software Upgrade page on page 4-72 |
| | Backup / Restore | Tools > Backup/Restore page on page 4-74 |
| | License Management | Tools > License Management page (Access Point Mode) on page 4-76 |
| | Spectrum Analyzer | Tools > Spectrum Analyzer page on page 4-78 |
| | eAlign | Tools > eAlign page on page 4-80 |
| | Wireless Link Test | Tools > Wireless Link Test page on page 4-81 |
| | Watchdog | Tools > Watchdog page on page 4-83 |

| Main menu | Menu option | Web page information |
|-----------|-------------|---|
| | Ping | Tools > Ping page on page 4-84 |
| | Traceroute | Tools > Traceroute page on page 4-85 |

Status page

Figure 10 Status page

The screenshot shows the Cambium Networks ePMP3000 web interface. The top navigation bar includes the Cambium Networks logo, device model (ePMP3000), and the role (Access Point). The sidebar on the left contains icons for Status, Installation, Configuration, Monitor, and Tools. The main content area is titled 'Status' and contains two tables of device information.

| Status | |
|-----------------------------|--|
| Device Name | ePMP3000 |
| SSID | GetElevated |
| Operating Frequency | 5 200 MHz |
| Operating Channel Bandwidth | 20 MHz |
| Transmitter Output Power | 8 dBm |
| Antenna Gain | 17 dBi |
| Country | United States |
| Access Point Mode | TDD |
| Downlink/Uplink Frame Ratio | 75/25 |
| Wireless Security | WPA2 |
| cnMaestro Remote Management | Enabled |
| cnMaestro Connection Status | Connected to cloud.cambiumnetworks.com |
| cnMaestro Account ID | CAMB IUM_NA_SALES |

| | |
|---------------------------------------|---|
| Wireless MAC Address | 00:04:56:20:9D:FA |
| Ethernet MAC Address | 00:04:56:20:9D:F9 |
| SFP Port MAC Address | 00:04:56:20:9D:FB |
| IP Address | 10.120.223.101 |
| Date and Time | 16 Nov 2018, 08:02:23 CDT |
| System Uptime | 15 hours, 0 minute |
| System Description | -- |
| Sync Source Status | GPS Sync Up |
| Device Coordinates | 42.05291030000001, -88.02544669999997 |
| DFS Status | Not Available |
| Ethernet Status | 1 000 Mbps / Full |
| Wireless Status | Up |
| SFP Port | Down |
| SFP Port Type | N/A |
| Registered Subscriber Modules | 2 |
| Registered Elevate Subscriber Modules | 0 |

Table 42 Status page attributes

| Attribute | Meaning |
|-----------------------------|--|
| 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 a 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. |

| Attribute | Meaning |
|-----------------------------|---|
| Antenna Gain | The configured gain of the external antenna. |
| Country | The current configured country code, which has an effect on DFS operation and transmit power restrictions. Registered Subscriber Modules will inherit this country code when registration is complete (unless SM is locked to US region). |
| Access Point Mode | <p>TDD: The Access Point is operating in point-to-multipoint (PMP) mode using TDD scheduling. The AP is able to GPS synchronize in this mode (except when in Flexible mode).</p> <p>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 is able to provide significantly lower latency than other modes. QoS (MIR and traffic priority) capability and Link Quality/Capacity indicators are not available in this mode.</p> <p>PTP: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling. The AP is able to GPS synchronize in this mode (except when in Flexible mode).</p> |
| 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 | The current 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 – <i>cnMaestro</i> ™. |
| cnMaestro Connection Status | The current management status of the device with respect to 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 current configured device IP address (LAN) used for management access. |

| Attribute | Meaning |
|-------------------------|---|
| 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 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 | <p>N/A: DFS operation is not required for the region configured in parameter Country Code.</p> <p>Channel Availability Check: Prior to 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.</p> <p>In-Service Monitoring: Radio is transmitting and receiving normally while monitoring for radar pulses which require a channel move.</p> <p>Radar Signal Detected: The receiver has detected a valid radar pulse and is carrying out detect-and-avoid mechanisms (moving to an alternate channel).</p> <p>In-Service Monitoring at Alternative Channel: The radio has detected a radar pulse and has moved operation to a frequency configured in DFS Alternative Frequency Carrier 1 or DFS Alternative Frequency Carrier 2.</p> <p>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.</p> |
| Ethernet Status | <p>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 for.</p> <p>Down: The Ethernet (LAN) interface is either disconnected or it has encountered an error and is not servicing traffic.</p> |
| Wireless Status | <p>Up: The radio (WAN) interface is functioning properly</p> <p>Down: The radio (WAN) interface has encountered an error and is not servicing traffic.</p> |

| Attribute | Meaning |
|---------------------------------------|---|
| 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

See [Using the installation wizard – Access Point](#) on page 4-6 and [Using the installation wizard – Subscriber Module](#) on page 4-11.

Configuration menu

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

Configuration > Radio page

Figure 11 Configuration > Radio page (Access Point Mode)

The screenshot displays the 'Configuration > Radio' page for an Access Point in Access Point Mode. The interface includes a left-hand navigation menu with options: Status, Installation, Configuration (selected), Radio (selected), System, Network, Security, Monitor, and Tools. The main content area is divided into several sections:

- General:** Includes Driver Mode (radio buttons for TDD and TDD FTF), Backward Compatibility (Beta Quality) (radio buttons for Disabled and Enabled), Country (dropdown menu set to United States), and Range Unit (radio buttons for Miles and Kilometers).
- MIMO Configuration:** Includes MIMO Mode (radio buttons for OFF, 4x2 Single-User, and 4x4 MIMO-User).
- Access Point Configuration:** Includes SSID (text field set to Cambium-ESK-AP), Max Registrations Allowed (text field set to 120), Max Range (text field set to 3), Channel Bandwidth (radio buttons for 20 MHz, 40 MHz, and 80 MHz (Beta Quality)), Frequency Carrier (dropdown menu set to 5200 MHz), and Frequency Reuse (radio buttons for OFF, Front Sector, and Back Sector).
- Power Control:** Includes Transmitter Output Power (text field set to 3), Antenna Gain (text field set to 0), and Subscriber Module Target Receive Level (text field set to -40).
- Synchronization:** Includes Co-location Mode (radio buttons for Disabled and Enabled), Synchronization Source (radio buttons for GPS, CMMS, and Internal), and Synchronization Holdoff Time (text field set to 1000).
- Scheduler:** Includes Downlink/Uplink Ratio (radio buttons for 75/25, 50/50, and 30/70), Guard Interval (radio buttons for Long and Short), and Downlink Max Rate (dropdown menu set to QPSK 9-256-QAM 5/6).

Figure 12 Configuration > Radio page (Subscriber Module Mode)

Configuration > Radio

General

Radio Mode **Access Point** ☒ Access Point ☐ Subscriber Module

Driver Mode **TDD**

Power Control

Antenna Gain **16** dB | min: 16 | max: 40

Network Entry RSSI Threshold **-90** dBm | min: -100 | max: -20

Network Entry SNR Threshold **0** dB | min: -5 | max: 60

Preferred APs

Preferred APs **Add new AP** **Show Details**

| SSID | Wireless Security | WPA2 Pre-shared Key |
|-------------|-------------------|---------------------|
| GetElevated | WPA2 | ***** |

Radio Configuration

Max Tx Power **Auto** ☒ Auto ☐ Manual

Transmitter Output Power **7** dBm | min: 3 | max: 30

Downlink Max Rate **DS MCS 9 - 256-QAM 5/6**

Scan Channel Bandwidth ☐ 80 MHz ☒ 40 MHz ☒ 20 MHz

20 MHz Scan List **40 MHz Scan List**

Radio Frequency 40 MHz Scan List **Unselect All** **Select All**

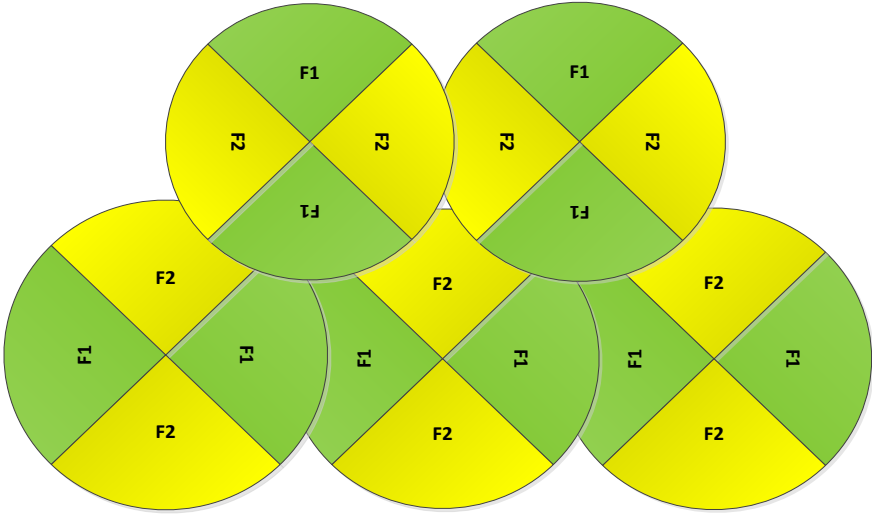
| | | | | | | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|--|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

Table 43 Configuration > Radio page attributes

| Attribute | Meaning |
|----------------|--|
| General | |
| Driver Mode | <p>TDD: The device is operating in point-to-multipoint (PMP) mode using TDD scheduling. The AP is able to GPS synchronize in this mode.</p> <p>TDD PTP: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling. The AP is able to GPS synchronize in this mode.</p> |

| Attribute | Meaning |
|---|---|
| Radio Mode | Access Point: The unit controls the point-to-point link and its maintenance. On startup, 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 are able to register to the AP (requires subscriber software upgrade). 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 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). |
| MIMO Configuration (Access Point Mode) | |
| MIMO Mode (Access Point Mode) | Downlink beamforming modes based on channel measurement via sounding procedure: OFF: Sounding and beamforming are disabled 4x2 Single-User: Enables Single User beamforming mode based on periodic sounding 4x4 Multi-User: Extends Single User beamforming mode with MU-MIMO to transmit data frames to 2 subscribers simultaneously |
| Access Point Configuration (Access Point Mode) | |
| SSID (Access Point Mode) | SSID is a unique identifier for a wireless LAN which is specified in the Access Point's beacon. (Access Point Mode). SSID must be same at both ends and different to site name. |

| Attribute | Meaning |
|--|--|
| Max Registrations Allowed (Access Point Mode) | <p>Based on sector / network planning and subscriber service level implementations, this parameter allows to set 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</p> <p>The maximum registrations allowed depends on the channel bandwidth of the current Operating Frequency which can be the primary Frequency Carrier or one of the alternate Frequency Carriers.</p> <p>For DFS regions, the maximum number of subscribers is based on the channel bandwidth of the current operating channel, i.e. Frequency Carrier, Alternate Frequency Carrier 1 or Alternate Frequency Carrier 2.</p> <p>The number of Elevate devices that are allowed to register is specified by the applied license.</p> |
| Max Range (Access Point Mode) | <p>This parameter represents cell coverage radius. Subscriber Modules outside the configured radius will not be able to connect. It is recommended to configure Max Range to match the actual physical distance of the farthest subscriber.</p> |
| Channel Bandwidth (Access Point Mode) | <p>Configure the channel size used by the radio for RF transmission.</p> |
| Frequency Carrier (Access Point Mode) | <p>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 prior to configuring this parameter.</p> |
| Frequency Reuse (Access Point Mode) | <p>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.</p> <p>A network in which two frequencies “F1” and “F2” are reused throughout the installation is shown in Figure 13.</p> <p>Please note, while 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.</p> <p>Figure 13 Frequency reuse installation</p> |

| Attribute | Meaning |
|-----------|--|
| |  |
| | <p>The set of APs to configure the Frequency Reuse option on is dependent on the GPS synchronization sources in the whole network, CMM3, CMM4, CMM5 or GPS.</p> <p>The GPS sync source is the same on all APs or is a combination of “GPS”, “CMM4”, “CMM5”</p> <p>In this configuration the GPS synchronization source in the whole network is one of the following:</p> <ul style="list-style-type: none">• GPS• CMM4• CMM5 <p>The rules in selecting the APs to enabling the Frequency Reuse in this installation are:</p> <p>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.</p> <p>Also, APs on different towers facing each other with overlapped coverage must be configured with Frequency Reuse set to Back Sector.</p> <p>The GPS sync source is a mixture of all types (“CMM3”, “CMM4”, “CMM5” or “GPS”)</p> <p>In this configuration the GPS sync source in the whole network is one of the following:</p> <ul style="list-style-type: none">• (CMM3 and GPS) or• (CMM3 and CMM4 / CMM5) or• (CMM3 and CMM4 / CMM5 and GPS) |

| Attribute | Meaning |
|---|--|
| | <p>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:</p> <p>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 will have the Front Sector ON.</p> <p>For the APs on different towers facing each other with overlapped coverage:</p> <p>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.</p> <p>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.</p> <p>If one AP has GPS or CMM4 / CMM5 as sync source and the other one has CMM3 then:</p> <p>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.</p> <p>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.</p> |
| 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 in use by the device. |
| Subscriber Module Target Receive Level (Access Point Mode) | Defines the desired receive power level at the Access Point from registered Subscriber Module. Access Points use this parameter to control the transmission power of the Subscriber Module in order to reduce system self-interference. |
| Network Entry RSSI Threshold (Subscriber Module Mode) | This defines the Downlink RSSI threshold below which a Subscriber Module will not register to a Access Point. |
| Network Entry SNR Threshold | This defines the Downlink Signal-to-Noise-Ratio (SNR) threshold below which the Subscriber Module will not register to a Access Point. |

| Attribute | Meaning |
|---|--|
| (Subscriber Module Mode) | |
| Synchronization (Access Point Mode) | |
| Co-location Mode (Access Point Mode) | <p>Disabled: The ePMP device is able to synchronize only with other ePMP Access Points.</p> <p>Enabled: The ePMP device can be configured to synchronize with PMP 100 or PMP 450 series of radios in addition to other ePMP Access Points. Please refer to the 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.</p> |
| Synchronization Source (Access Point Mode) | <p>GPS: Synchronization timing is received via the AP's connected GPS antenna. Co-located or in-range APs receiving synchronization via GPS or CMM transmits and receives at the same time, thereby reducing self-interference.</p> <p>CMM5: Synchronization timing is received via the AP's Ethernet port via a connected Cambium Cluster Management Module 5 (CMM5). Co-located or in-range APs receiving synchronization via GPS or CMM will transmit and receive at the same time, thereby reducing self-interference. For more information on CMM configuration, refer to the <i>PMP Synchronization Solutions User Guide</i>.</p> <p>If a CMM is being 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).</p> <p>Internal: Synchronization timing is generated by the AP and the timing is not based on GPS pulses.</p> <p>APs using Synchronization Source of Internal will not transmit and receive in sync with other co-located or in-range APs, which introduces self-interference into the system.</p> |
| Synchronization Holdoff Time (Access Point Mode) | <p>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. Default is 30 seconds.</p> |
| Preferred Access Points (Subscriber Module Mode) | |

| Attribute | Meaning |
|--|---|
| 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 Subscriber Module device sequentially attempts registration. For each Access Point configured, if authentication is required, enter the Wireless Security type and WPA2 Pre-shared Key associated with the configured SSID . |
| Scheduler (Access Point 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 will be used for downlink resources, and the amount of the total radio link's aggregate throughput that will be 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 the channel efficiency. |
| Downlink Max Rate (Access Point Mode) | Specifies the maximum downlink MCS value that the Rate Adapt algorithm will choose for Radio 1. If an installation is exhibiting packet loss due to downlink interference, modifying Downlink Max Rate to limit the device maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference. |
| Radio Configuration | |
| Max Tx Power (Subscriber Module Mode) | <p>Auto: The Access Point can control, using ATPC (Automatic Transmit Power Control), the TX power of the Subscriber Module up to the maximum capability of the Subscriber Module's transmitter (based on regulatory limits).</p> <p>Manual: The Access Point can control the TX power of the Subscriber Module up to the value configured in the Transmitter Power field.</p> |
| Transmitter Output Power (Subscriber Module 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 Max Rate (Subscriber Module Mode) | Specifies the maximum uplink MCS value that the Rate Adapt algorithm will choose for Radio 1. If an installation is exhibiting packet loss due to uplink interference, modifying Uplink Max Rate to limit the device maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference. |

| Attribute | Meaning |
|--|--|
| Scan Channel Bandwidth (Subscriber Module Mode) | <p>The selected scan channel bandwidths are scanned by the Subscriber Module. Any combination may be selected.</p> <p>When a 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 may contain a number on the left side. This number defines how many channels have been selected for that bandwidth.</p> <p>If no channels are selected for a bandwidth, then all channels are scanned.</p> |

Configuration > System page



Figure 14 Configuration > System page


The screenshot displays the 'Configuration > System' page in the Cambium Networks Portal 220. The left sidebar contains navigation links: Status, Installation, Configuration, Radio, System (selected), Network, Security, Monitor, and Tools. The main content area is divided into several configuration sections:

- General:** Includes fields for Device Name (SM1), Display Device Name Before Login (Disabled/Enabled), Inactive Logout (Disabled/Enabled), Inactive Logout Period (10 m), Web-page Auto Update (5 sec), Web Access (HTTP/HTTPS), HTTP Port (80), SSH Access (Disabled/Enabled), Telnet Access (Disabled/Enabled), Range Unit (Miles/Kilometers), NTP Server IP Assignment (Static/DHCP), Preferred NTP Server (8.8.8.8), Alternate NTP Server, Time Zone (UTC-05:00 CDT - Central Daylight Time (North America)), Device Latitude, Device Longitude, Device Height, and Device Location (with a 'Open in Google Maps' button).
- Simple Network Management Protocol (SNMP):** Includes Read-Only Community String (public), Read-Write Community String (private), System Name (CambiumNetworks), System Description, System Location, Traps (Disabled/Enabled), and Trap Community String (cambiustrap).
- Location Services:** Includes Device Latitude, Device Longitude, Device Height, and Device Location.
- System Logging (Syslog):** Includes Server 1 through Server 4, Syslog Mask (Unselect All/Select All), and checkboxes for Info, Notices, Warnings, Errors, Alerts, and Emergency.
- onMaestro:** Includes Remote Management (Disabled/Enabled), onMaestro URL (cloud.cambiumnetworks.com), Cambium ID, and Onboarding Key.
- Account Management:** Includes Administrator Account (Disabled/Enabled), Username (admin), Password, Home User Account (Disabled/Enabled), Username (home), Password, Installer Account (Disabled/Enabled), Username (installer), Password, and Read-Only Account (Disabled/Enabled), Username (readonly), Password.

Table 44 Configuration > System page attributes

| Attribute | Meaning |
|------------------------------------|---|
| General | |
| Device Name | The configured identifier used in an NMS such as cnMaestro. |
| Display Device Name Before Login | <p>Disabled: For security, the configured Device Name is hidden on the device login screen.</p> <p>Enabled: The configured Device Name is displayed upper-left on the device login screen.</p> |
| Inactive Logout | <p>Disabled: The device will not automatically log out users after a period of inactivity.</p> <p>Enabled: After the period configured in Inactive Logout Period has lapsed, the device will automatically log out the user.</p> |
| Inactive Logout Period | Represents the amount of time for which a user will remain logged in. After this period has lapsed, the user will be automatically logged out. |
| Web-page Auto Update | <p>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 will be refreshed every 5 seconds (default).</p> <p>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.</p> |
| Range Unit | Units of measurement on the device are displayed in either miles (m) or kilometers (km). |
| Web Access | <p>HTTP: The device web management interface is accessed via HTTP.</p> <p>HTTPS: The device web management interface may only be accessed via secure HTTPS.</p> |
| HTTP Port | This specifies the TCP/UDP port to be used with HTTP or HTTPS. The default value for HTTP is 80 and for HTTPS is 443. |
| SSH Access | <p>Disabled: Access to the device through SSH is not possible.</p> <p>Enabled: Cambium engineers can access the device through SSH which enables them to login to the radio and troubleshoot. SSH Access is Enabled by default.</p> |
| Telnet Access | <p>Disabled: Command Line Interface access via Telnet is not allowed</p> <p>Enabled: Command Line Interface access via Telnet is allowed</p> |
| 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. |

| Attribute | Meaning |
|---|--|
| | DHCP: The device retrieves NTP time data from the server IP issued via a network DHCP server. |
| Preferred NTP Server | Configure the primary NTP server IP addresses from which the device will retrieve time and date information. |
| Alternate NTP Server | Configure an 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. |
| On-board GPS Height | GPS-retrieved height information for the device in meters. |
| Use GPS Coordinates  | 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  | Hyperlink to display the device location in Google Maps |
| Simple Network Management Protocol (SNMP) | |
| Read-Only Community String | <p>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.</p> <p>The Read-only Community String value is clear text and is readable by a packet monitor.</p> |
| 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. |

| Attribute | Meaning |
|--------------------------------|--|
| 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 a 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 (i.e. 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 Choose only the syslog levels appropriate for your installation. Excessive logging can cause the device log file to fill and begin overwriting previous entries. |
| cnMaestro | |
| Remote Management | When Enabled , the device will be managed by cnMaestro - the Cambium Remote Management System, which allows all Cambium 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 will use for on-boarding on to cnMaestro. |
| Onboarding Key | Configure the password/key associated with the Cambium-ID that the device will use for on-boarding 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, used upon device login. |

| Attribute | Meaning |
|-------------------|---|
| Password | Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  . |
| Installer Account | <p>The Installer account has permissions to read and write parameters applicable to unit installation and monitoring.</p> <p>Disabled: The disabled user is not granted access to the device management interface.</p> <p>Enabled: The user is granted access to the device management interface.</p> |
| Username | The username associated with the installer account, used upon device login. |
| Password | Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  . |
| Home User Account | <p>The Home User account has permissions to access pertinent information for support purposes.</p> <p>Disabled: The disabled user is not granted access to the device management interface.</p> <p>Enabled: The user is granted access to the device management interface.</p> |
| Username | The username associated with the home user account, used upon device login. |
| Password | Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  . |
| Read-Only Account | <p>The Read-Only account has permissions to view the Monitor page only.</p> <p>Disabled: The disabled user is not granted access to the device management interface.</p> <p>Enabled: The user is granted access to the device management interface.</p> |
| Username | The username associated with the read-only account, used upon device login. |
| Password | Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  . |

Configuration > Network page

Figure 15 Configuration > Network page (Access Point Mode)

The screenshot displays the Configuration > Network page for a Cambium Networks ePMP 3000 device in Access Point Mode. The interface includes a left sidebar with navigation options: Status, Installation, Configuration, Radio, System, Network (selected), Security, Monitor, and Tools. The main content area is titled 'Configuration > Network' and contains several configuration sections:

- General:**
 - IP Assignment: ☒ Static ☐ DHCP
 - IP Address: 10.120.223.101
 - 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
- Virtual Local Area Network (VLAN):**
 - Management VLAN: ☒ Disabled ☐ Enabled
 - Management VLAN ID: [Field] (min: 1 | max: 4094)
 - Management VLAN Priority: [Field] (min: 0 | max: 7)
- Ethernet Port:**
 - Ethernet MTU: 1700 (bytes | min: 576 | max: 1700)
 - Port Setting: ☐ Manual ☒ Auto-Negotiate
- SFP Port:**
 - SFP Port: ☒ Disabled ☐ Enabled
- Advanced:**
 - IPv6 Support: ☒ Disabled ☐ Enabled
 - Spanning Tree Protocol: ☒ Disabled ☐ Enabled
 - Management Access: ☐ Ethernet ☒ Ethernet And Wireless
 - SM Traffic Isolation: ☒ Disabled ☐ Enabled
 - DHCP Option 82: ☒ Disabled ☐ Enabled
 - LLDP: ☐ Disabled ☒ Enabled
 - LLDP Mode: ☒ Receive and Transmit ☐ Receive only

Figure 16 Configuration > Network page (Subscriber Module Mode, Bridge Network Mode)

The screenshot displays the Cambium Networks configuration interface for a Subscriber Module (SM1) in Bridge Network Mode. The interface is divided into several sections:

- Left Sidebar:** Contains navigation links for Status, Installation, Configuration, Radio, System, Network (selected), Security, Monitor, and Tools.
- Configuration > Network:**
 - General:**
 - Network Mode: ☒ Bridge
 - IP Assignment: ☒ Static
 - 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
 - Ethernet Port Security: ☒ Disabled
 - Secure MAC Limit: 5
 - MAC Aging Time: 300
 - Ethernet Port:**
 - Ethernet MTU: 1538
 - Ethernet Port: ☒ Enabled
 - Port Setting: ☒ Auto-negotiate
 - Advanced:**
 - IPv6 Support: ☒ Disabled
 - ARP-NAT: ☒ Disabled
 - Spanning Tree Protocol: ☒ Disabled
 - DHCP Server Below SM: ☒ Disabled
 - LLDP: ☒ Disabled
 - LLDP Mode: ☒ Receive and Transmit
 - Broadcast/Multicast Traffic Shaping:**
 - Broadcast Packet Limit: ☒ Disabled
 - Broadcast Packet Rate: 1000
 - Multicast Group Limit: 3
 - Multicast VLAN: ☒ Disabled
 - Multicast VLAN ID: min: 1 | max: 4094
 - Multicast VLAN Priority: min: 0 | max: 7
- Virtual Local Area Network (VLAN):**
 - Management VLAN: ☒ Disabled
 - Management VLAN ID: min: 1 | max: 4094
 - Management VLAN Priority: min: 0 | max: 7
 - Data VLAN: ☒ Disabled
 - Data VLAN ID: min: 1 | max: 4094
 - Data VLAN Priority: min: 0 | max: 7
 - Membership VLANs: Add, Show Details
 - VLAN ID Begin: min: 1 | max: 4094
 - VLAN ID End: min: 1 | max: 4094
 - VLAN Mapping: Add, Show Details
 - C-VLAN: min: 1 | max: 4094
 - S-VLAN: min: 1 | max: 4094

Figure 17 Configuration > Network page (Subscriber Module Mode, NAT Network Mode)

Configuration > Network

General

- Network Mode**: ☒ NAT ☐ Bridge ☐ Router
- Wireless IP Assignment**: ☐ Static ☒ DHCP
- Wireless IP Address**: 192.168.0.2
- 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)

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

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)
- MSS Clamping**: ☒ Disabled ☐ Enabled

Advanced

- IPv6 Support**: ☒ Disabled ☐ Enabled
- Spanning Tree Protocol**: ☒ 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

Figure 18 Configuration > Network page (Subscriber Module Mode, Router Mode)

The screenshot displays the 'Configuration > Network' page for a Cambium Networks device in Subscriber Module Mode, Router Mode. The interface is organized into several sections:

- General:**
 - Network Mode: ☒ NAT ☐ Bridge ☐ Router
 - Wireless IP Assignment: ☐ Static ☒ DHCP
 - Wireless IP Address: 192.168.0.2
 - 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
- 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)
 - Miss Clamping: ☒ Disabled ☐ Enabled
- Advanced:**
 - IPv6 Support: ☒ Disabled ☐ Enabled
 - Spanning Tree Protocol: ☒ Disabled ☐ Enabled
 - DHCP Server Below SM: ☒ Disabled ☐ Enabled
 - NAT Helper For SIP: ☒ Disabled ☐ Enabled
 - LLDP: ☐ Disabled ☒ Enabled
 - LLDP Mode: ☒ Receive and Transmit ☐ Receive only

Table 45 Configuration > Network page attributes

| Attribute | Meaning |
|----------------|---|
| General | |
| Network Mode | NAT: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination). |

| Attribute | Meaning |
|---|---|
| | <p>Bridge: The SM acts as a switch and packets are forwarded or filtered based on their MAC destination address.</p> <p>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.</p> |
| IP Assignment | <p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>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.</p> |
| Wireless IP Assignment (NAT Mode, Router Mode) | <p>Static: Wireless IP addressing 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.</p> <p>DHCP: Device management IP addressing (Wireless IP address, Wireless Subnet mask, Wireless Gateway and DNS server) is assigned via a network DHCP server.</p> |
| IP Address Wireless IP Address (NAT Mode, Router Mode) | <p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p>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).</p> |
| Subnet Mask Wireless IP Address (NAT Mode, Router Mode) | <p>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.</p> |
| Gateway Wireless Gateway (NAT Mode, Router Mode) | <p>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.</p> |
| Preferred DNS Server | <p>Configure the primary IP address of the server used for DNS resolution.</p> |
| Alternate DNS Server | <p>Configure the secondary IP address of the server used for DNS resolution.</p> |
| IPv6 Assignment | <p>IPv6 Assignment specifies how the IPv6 address is obtained.</p> <p>Static: Device management IP addressing is configured manually in fields IPv6 Address and IPv6 Gateway.</p> |

| Attribute | Meaning |
|---|---|
| | 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 Subscriber Module device Ethernet port. 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 Subscriber Module Ethernet port. |
| Secure MAC Limit (Subscriber Module Mode) | Configure the number of simultaneous secure MAC addresses that will be allowed at the Ethernet interface of the Subscriber Module |
| MAC Aging Time (Subscriber Module 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 will be 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 (Subscriber Module 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 (Subscriber Module 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. |
| DHCP Server (Subscriber Module 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 will be 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. |

| Attribute | Meaning |
|---|--|
| DHCP Start IP (Subscriber Module NAT Mode, Router Mode) | Configure the first address which will be issued to a DHCP client. Upon additional DHCP requests, the DHCP Start IP is incremented until local DHCP End IP is reached. |
| DHCP End IP (Subscriber Module 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 (Subscriber Module NAT Mode, Router Mode) | Configure the primary DNS Server IP address which will be used to configure DHCP clients (if local DHCP Server is set to Enabled). |
| Alternate DHCP DNS Server (Subscriber Module NAT Mode, Router Mode) | Configure the secondary DNS Server IP address which will be used to configure DHCP clients (if local DHCP Server is set to Enabled). |
| DHCP Lease Time (Subscriber Module 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 addressing via DHCP request. |
| Static Routes (Subscriber Module Router Mode) | |
| Static Routes (Subscriber Module Router Mode) | <p>When Enabled, it allows the operator to create static routes that will apply to both the Wireless and Ethernet interface of the SM.</p> <p>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.</p> <p>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.</p> <p>Since static routes do not change with network changes, it is recommended to only use static routes for simple network paths which are not prone to frequent changes (requiring updates to the routes configured on the ePMP SM).</p> |

| Attribute | Meaning |
|---|--|
| | <p>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, the network communication will fail.</p> <p>Network Address Translation (NAT) is not performed when the SM is in Router mode.</p> |
| Target Network IP (Subscriber Module Router Mode) | Configure the target subnet/network's IP address to which the SM should route the packets. |
| Subnet Mask (Subscriber Module Router Mode) | Configure the subnet mask for the Target Network IP address. |
| Gateway (Subscriber Module Router Mode) | Configure the gateway to which packets that match the Target Network IP Address and Subnet Mask are sent. |
| Description (Subscriber Module Router Mode) | Provide a description to easily identify the static route and its purpose. |
| IP Aliases (Subscriber Module Router Mode) | |
| IP Aliases (Subscriber Module Router Mode) | <p>When Enabled, IP aliases allow the operator to associate more than one IP address to the Ethernet interface of the SM.</p> <p>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.</p> |
| IP Address (Subscriber Module Router Mode) | Configure the IP address for the alias. |
| Subnet Mask (Subscriber Module Router Mode) | Configure the subnet mask for the alias. |
| Description (Subscriber Module Router Mode) | Provide a description to easily identify the IP alias and its purpose/connected network. |
| Separate Wireless Management Interface (Subscriber Module NAT Mode, Router Mode) | |
| Separate Management IP | Disabled: When disabled, the Wireless IP is the management interface for the SM. |

| Attribute | Meaning |
|---|---|
| (Subscriber Module NAT Mode, Router Mode) | Enabled: When enabled, the IP Address below is the management interface for the SM. |
| IP Assignment (Subscriber Module NAT Mode, Router Mode) | Static: Separate Wireless Management Interface is configured manually in fields IP Address , Subnet Mask and Gateway . DHCP: Management IP addressing (IP Address , Subnet Mask , Gateway and DNS Server) is assigned via a network DHCP server. |
| IP Address (Subscriber Module NAT Mode, Router Mode) | Configure the IP address that will be used to access the SM's management interface when in NAT mode. The Wireless IP (public IP) will not allow management access. |
| Subnet Mask (Subscriber Module NAT Mode, Router Mode) | Defines the address range of the connected IP network. For example, if IP Address is configured to 192.168.2.1 and Subnet Mask is configured to 255.255.255.0, the device wireless interface will belong to subnet 192.168.2.X. |
| Gateway (Subscriber Module 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 (Subscriber Module 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 is applicable to management data. Disabled: When disabled, the SM does not have a unique management VLAN. |
| VLAN ID (Subscriber Module NAT Mode, Router Mode) | Configure this parameter to include the device's management traffic on a separate VLAN network. |
| VLAN Priority (Subscriber Module 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 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. |

| Attribute | Meaning |
|--|--|
| Virtual Local Area Network (VLAN) | |
| Management VLAN (Access Point Mode) | <p>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.</p> <p>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.</p> <p>Disabled: When disabled, all IP management traffic is allowed to the device.</p> |
| VLAN (Management + Data) (Subscriber Module Mode) | <p>Enabled: The device 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, the management interface can be accessed only by packets tagged with a VLAN ID matching the management VLAN ID.</p> <p>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.</p> <p>Disabled: When disabled, all IP management traffic is allowed to the device.</p> |
| 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) | <p>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 device management data.</p> <p>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.</p> |
| Management VLAN ID (Access Point Mode) (Subscriber Module 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, GUI access will only be allowed from frames tagged with VLAN ID 2. This parameter only takes effect if the MGMT VLAN parameter is enabled. |

| Attribute | Meaning |
|--|---|
| Management VLAN Priority (Access Point Mode) (Subscriber Module Bridge Mode) | <p>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 device management traffic.</p> <p>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.</p> |
| Data VLAN (Subscriber Module Mode) (Bridge Mode) | <p>Enabled: A VLAN tag will be 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 Subscriber Module device WAN port before sending to the Subscriber Module device LAN port.</p> <p>Disabled: When disabled, no changes are made to untagged traffic passing through the Subscriber Module device.</p> |
| Data VLAN ID (Subscriber Module Mode) (Bridge Mode) | <p>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 Subscriber Module device LAN port.</p> |
| Data VLAN Priority (Subscriber Module Mode) (Bridge Mode) | <p>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.</p> <p>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 Subscriber Module device. The default value is 0.</p> |
| Membership VLAN (Subscriber Module Bridge Mode) | <p>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 the other interface. When the SM receives a packet tagged with a VLAN ID which 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).</p> |
| VLAN Mapping (Subscriber Module Bridge Mode) | <p>Configure the VLAN Mapping Table to map the C-VLAN of traffic ingressing the Ethernet (LAN) port of the SM to a 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.</p> |

| Attribute | Meaning |
|--|--|
| C-VLAN (Subscriber Module 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 (Subscriber Module Bridge Mode) | Configure the S-VLAN ID to which the tagged traffic needs to be mapped to. 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 (Subscriber Module 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-negotiated with the connected Ethernet device on the other end of the link. Guidelines for using Port Setting : When 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 Auto-Negotiate should be selected. If the other end of the Ethernet connection does not support auto-negotiation, then Manual should be selected 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) | |
| UPnP IGD (Subscriber Module 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 access points 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 will support explicit dynamic port mappings. |

| Attribute | Meaning |
|---|---|
| | Enable UPnP IGD (Internet Gateway Device) to allow the ePMP device to use IGD profile for UPnP support. |
| NAT PMP (PCP) (Subscriber Module Mode) (NAT Mode) | <p>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.</p> <p>Enable this parameter to allow the ePMP device to use PCP protocol for UPnP support.</p> |
| Data Port Forwarding (Subscriber Module Mode) (NAT Mode) | The Data Port Forwarding Table is used to define which range of wireless ports that are forwarded to a LAN (SM local network) IP address below the SM. |
| Protocol (Subscriber Module Mode) (NAT Mode) | <p>UDP: Packet forwarding decisions are based on UDP packets.</p> <p>TCP: Packet forwarding decisions are based on TCP packets.</p> |
| Port Begin (Subscriber Module Mode) (NAT Mode) | Configure the beginning of the range of wireless ports to match for forwarding to LAN IP. |
| Port End (Subscriber Module Mode) (NAT Mode) | Configure the end of the range of wireless ports to match for forwarding to LAN IP. |
| Forwarding IP (Subscriber Module 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 (Subscriber Module 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) (Subscriber Module Mode) | |

| Attribute | Meaning |
|--|---|
| (NAT Mode, Router Mode) | |
| PPPoE (Subscriber Module Mode) (NAT Mode, Router Mode) | Point-to-Point Protocol over Ethernet: Used for encapsulating PPP frames inside Ethernet frames. |
| Service Name (Subscriber Module Mode) (NAT Mode, Router Mode) | An 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 (Subscriber Module Mode) (NAT Mode, Router Mode) | 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. |
| Authentication (Subscriber Module Mode) (NAT Mode, Router Mode) | ALL: This means that CHAP authentication will be attempted first, then PAP authentication. The same password is used for both types. CHAP: This means that CHAP authentication will be attempted. PAP: This means that PAP authentication will be attempted. |
| Username (Subscriber Module Mode) (NAT Mode, Router Mode) | This is the CHAP/PAP username that is used. This is limited to 32 characters. |
| Password (Subscriber Module Mode) (NAT Mode, Router Mode) | This is the CHAP/PAP password that is used. This is limited to 32 characters. |

| Attribute | Meaning |
|--|--|
| MTU Size (Subscriber Module 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 will be 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 (Subscriber Module 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 will send a keep alive message to the PPPoE server every 5 seconds. If there is no acknowledgement, it sends the 'Keep alive' message to the server 4 more times (for a total of 5 times) before tearing down the PPPoE session. Setting this to 12 will mean the keep alive message will be sent every 12 seconds and when there is no acknowledgement, the client will try for a total of 12 times every 12 seconds before tearing down the PPPoE session. |
| MSS Clamping (Subscriber Module 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 a MTU setting that is smaller in value. |
| SFP Port (Access Point Mode) | |
| SFP Port (Access Point 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 will be 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 prevention of Ethernet bridge loops. |
| DHCP Server Below Subscriber Module (Subscriber Module Mode) | Disabled: This blocks DHCP servers connected to the Subscriber Module device LAN side from handing out IP addresses to DHCP clients above the Subscriber Module device (wireless side). Enabled: This allows DHCP servers connected to the Subscriber Module device LAN side to assign IP addresses to DHCP clients above the Subscriber Module device (wireless side). This configuration is typical in PTP links. |

| Attribute | Meaning |
|---|--|
| Management Access (Access Point Mode) | <p>Ethernet: Only allow access to the Access Point's web management interface via a local Ethernet (LAN) connection. In this configuration, the Access Point's web management interface may not be accessed from over the air (i.e. from a device situated below the Subscriber Module).</p> <p>Ethernet and Wireless: Allow access to the Access Point's web management interface via a local Ethernet (LAN) connection and from over the air (i.e. from a device situated below the Subscriber Module).</p> <p>Access Points configured with Management Access Interface set to Ethernet and Ethernet and Wireless are susceptible to unauthorized access.</p> |
| SM Traffic Isolation (Access Point Mode) | <p>Disabled: This is the default mode. When SM isolation is disabled, an SM is able to communicate with another SM, when both the SMs are associated to the same Access Point (AP).</p> <p>Enabled: When 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 Access Point (AP). This feature essentially enables the AP to drop the packets to avoid peer-to-peer traffic scenario.</p> |
| DHCP Option 82 (Access Point Mode) | <p>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.</p> <p>Enabled: The device inserts "remote-id" (option ID 0x2) to be the Subscriber Module MAC address and the "circuit-id" (ID 0x01) to be the Access Point's MAC address. Those two fields are used to identify the remote device and connection from which the DHCP request was received.</p> |
| LLDP | <p>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.</p> <p>Disabled: ePMP does not receive or transmit LLDP packets from/to its neighbors.</p> <p>Enabled: ePMP can receive LLDP packets from its neighbors and send LLDP packets to its neighbors, depending on the LLDP Mode configuration below.</p> |
| LLDP Mode | <p>Receive and Transmit: ePMP sends and receives LLDP packets to/from its neighbors on the Ethernet/LAN interface.</p> <p>Receive Only: ePMP receives LLDP packets from its neighbors on the Ethernet/LAN interface and discovers them.</p> |
| Broadcast / Multicast Traffic Shaping (Subscriber Module Mode) (Bridge Mode) | |
| Broadcast Packet Limit (Subscriber Module Mode) (Bridge Mode) | <p>Enabled: This allows the user to set the Broadcast Packet Rate below. Configure this parameter to limit the amount 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.</p> |

| Attribute | Meaning |
|--|---|
| | Disabled: There is no limit on the amount of broadcast traffic that will be allowed into the ingress of the radio's Ethernet port. |
| Broadcast Packet Rate (Subscriber Module Mode) (Bridge Mode) | Set the packets per second value to limit the amount of broadcast traffic that will be 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 . |
| Multicast Group Limit (Subscriber Module Mode) (Bridge Mode) | Configure the maximum number of simultaneous multicast groups that the SM will allow from devices below it. The default is 3 . |
| Multicast VLAN (Subscriber Module Mode) (Bridge Mode) | <p>Enabled: A VLAN tag will be 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.</p> <p>Disabled: When disabled, no changes are made to untagged multicast traffic passing through the SM.</p> |
| Multicast VLAN ID (Subscriber Module 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 (Subscriber Module Mode) (Bridge Mode) | <p>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 device multicast data.</p> <p>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.</p> |
| De-Militarized Zone (Subscriber Module NAT Mode) | |
| DMZ (Subscriber Module NAT Mode) | <p>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.</p> <p>Enabled: Any packets with an unknown destination port (not associated to an existing session or not defined in the port forwarding rules) are automatically sent to the device configured with DMZ IP Address.</p> |

| Attribute | Meaning |
|--|---|
| IP Address (Subscriber Module NAT Mode) | Configure the IP address of an SM-connected device which is allowed to provide network services to the wide-area network. |
| Allow ICMP to DMZ (Subscriber Module 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 enabled |

Configuration > Security page

The **Security** page is used to configure system security features including authentication and Layer2/Layer3 Firewall rules.



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 are configured, the device will drop 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 only Action set to Deny and Interface set to **LAN** or **WAN**. To regain access to the device, perform a factory default.

Figure 19 Configuration > Security page (Access Point Mode)

The screenshot displays the 'Configuration > Security' page for a Cambium Networks eMP3000 device in Access Point Mode. The left sidebar contains navigation links: Status, Installation, Configuration (selected), Radio, System, Network, Security (highlighted), Monitor, and Tools. The main content area is titled 'Configuration > Security' and includes the following sections:

- Security Options:** Radio buttons for Wireless Security (selected), Open, WPA2, and RADIUS.
- WPA2:** A section for WPA2 Pre-shared Key with a masked input field and a toggle for visibility.
- RADIUS:**
 - Servers:** A table with columns for IP Address, Port, and Secret. The table is currently empty.
 - Server Retries:** A numeric input field set to 5, with a range of min: 0 | max: 5.
 - Server Timeout:** A numeric input field set to 5, with a range of sec | min: 1 | max: 20.
 - GUI User Authentication:** Radio buttons for Device Local Only (selected), Remote RADIUS Server Only, and Remote RADIUS Server and Fallback to Local.
- Firewalls:** Radio buttons for Layer 2 Firewall and Layer 3 Firewall, each with options for Disabled (selected) and Enabled.
- Wireless MAC Address Filtering:** A section for Wireless MAC Filter with options for Disabled (selected) and Enabled.

Figure 20 Configuration > Security page (Subscriber Module Mode)

The screenshot shows the 'Configuration > Security' page for a Cambium Networks Force 220 Subscriber Module. The left sidebar contains navigation links: Status, Installation, Configuration (selected), Radio, System, Network, Security (highlighted), Monitor, and Tools. The main content area is titled 'Configuration > Security' and contains three sections:

- Security Options:** A message states 'Preferred APs configured. Security Options not available.'
- RADIUS:**
 - EAP-TTLS Username:** cambium-station
 - Use Ethernet MAC Address as EAP-TTLS Username:** Radio buttons for 'Off' (selected), 'Using ":" as Format', and 'Using "/" as Format'.
 - EAP-TTLS Password:** A masked password field with a toggle for visibility.
 - 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:** Radio buttons for 'Disabled' (selected) and 'Enabled'.
 - Layer 3 Firewall:** Radio buttons for 'Disabled' (selected) and 'Enabled'.

Table 46 Configuration > Security page attributes

| Attribute | Meaning |
|--|---|
| Security Options | |
| Wireless Security (Access Point Mode) | <p>For Access Point mode devices, select the security mode enforced upon network entry.</p> <p>For Subscriber Module mode devices, select the security mode utilized upon network entry attempts.</p> <p>Open: All Subscriber Module devices requesting network entry are allowed registration.</p> <p>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 Access Point and Subscriber Module.</p> <p>RADIUS: Enables Subscriber Module authentication via a pre-configured Radius server.</p> |
| WPA2 | |
| WPA2 Pre-shared Key | Configure this key on the Access Point, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols. |
| RADIUS (Access Point Mode) | |
| Servers (Access Point Mode) | <p>For more Radio servers, click Add. Up to 3 Radius servers can be configured on the device with the following attributes:</p> <p>IP Address: IP Address of the Radius server on the network.</p> |

| Attribute | Meaning |
|---|---|
| | Port: The Radius server port. Default is 1812. Secret: Secret key that is used to communicate with the Radius server. |
| Server Retries (Access Point Mode) | Number of times the radio will retry authentication with the configured Radius server before it fails authentication of the SM. |
| Server Timeout (Access Point Mode) | Timeout between each retry with the configured Radius server before it fails authentication of the SM. |
| GUI User Authentication (Access Point Mode) | This applies to both the AP and its registered SMs. 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 device's GUI authentication is performed using a RADIUS server. Remote RADIUS Server and Fallback to Local: The device's 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. |
| EAP-TTLS Username (Subscriber Module 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 (Subscriber Module Mode) | The device MAC Address can be used as the EAP-TTLS Username in either ":" or "-" delimited format. |
| EAP-TTLS Password (Subscriber Module Mode) | Configure the EAP-TTLS Password to match the credentials on the RADIUS server being used for the network. |
| Authentication Identity String (Subscriber Module Mode) | Configure this Identity string to match the credentials on the RADIUS server being used for the network. Default value for this parameter is anonymous . |
| Authentication Identity Realm (Subscriber Module Mode) | Configure this Identity string to match the credentials on the RADIUS server being used for the network. Default value for this parameter is cambiumnetworks.com . |

| Attribute | Meaning |
|--|--|
| Default Root Certificate (Subscriber Module Mode) | Default EAP-TTLS root certificate that must match the certificate on the RADIUS server. |
| Canopy Root Certificate (Subscriber Module 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 (Subscriber Module Mode) | Import a user certificate if a certificate different from the default certificates is needed. |
| User Provisioned Root Cert 2 (Subscriber Module Mode) | Import a second user certificate if a certificate different from the default or 1 st user provisioned certificate is needed. |
| Firewalls | |
| Layer 2 Firewall | <p>Enabled: Modifications to the Layer 2 Firewall Table are allowed and rules are enforced.</p> <p>Disabled: Modifications to the Layer 2 Firewall Table are not allowed and rules are not enforced.</p> |
| Layer 2 Firewall Rules | The Layer 2 firewall table may be used to configure rules matching layer 2 (MAC layer) traffic which result in forwarding or dropping the traffic over the radio link or Ethernet interface. |
| Layer 3 Firewall | <p>Disabled: Modifications to the Layer 3 Firewall Table are not allowed and rules are not enforced.</p> <p>Enabled: Modifications to the Layer 3 Firewall Table are allowed and rules are enforced.</p> |
| Layer 3 Firewall Rules | The Layer 3 firewall table may be used to configure rules matching layer 3 (IP layer) traffic which result in forwarding or dropping the traffic over the radio link or Ethernet interface. |
| Wireless MAC Address Filtering (Access Point Mode) | |
| Wireless MAC Filter (Access Point Mode) | <p>Disabled: SMs with any MAC Address are allowed to register to the AP.</p> <p>Enabled: SMs with specific MAC address can be allowed (Permit) or denied (Prevent) registration with the AP as configured under the MAC Filter List.</p> |
| Wireless MAC Filter Policy | Prevent: All MAC Addresses configured under the MAC Filter List are denied registration to the AP. |


| Attribute | Meaning |
|---|---|
| (Access Point Mode) | Permit: Only the MAC Addresses configured under the MAC Filter List are allowed to register to the AP. |
| Wireless MAC Filter List (Access Point Mode) | Configure the SM's MAC addresses that will be permitted or prevented from registering to the AP. |
| MAC Address (Access Point Mode) | MAC Address of the SM |
| Description (Access Point Mode) | Friendly description to identify the SM |

Monitor menu

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

Monitor > Performance page


Figure 21 Monitor > Performance page


Camblum Networks


eRMP 3000


eRMP3000


Access Point


1






3







Administrator

Status

Installation

Configuration

Monitor

Performance

System

Wireless

Throughput Chart

GPS

Network

System Log

Tools

Monitor > Performance

Reset Statistics

Time Since Last Reset0000:19:01:38

Reset Stats

Ethernet Statistics - Transmitted

Total Traffic982 928 Kbits (100%)

Total Packets205 880 packets (100%)

Packet Errors0 packets

Packet Drops0 packets

Broadcast Packets2 082 packets (1%)

Multicast Packets2 282 packets (1%)

Ethernet Statistics - Received

Total Traffic146 776 Kbits (100%)

Total Packets188 423 packets (100%)

Packet Errors0 Kbits

Packet Drops0 packets

Broadcast Packets0 packets

Multicast Packets34 193 packets (18%)

SFP Statistics - Transmitted

Total Traffic0 Kbits

Total Packets0 packets

Packet Errors0 packets

Packet Drops0 packets

Broadcast Packets0 packets

Multicast Packets0 packets

SFP Statistics - Received

Total Traffic0 Kbits

Total Packets0 packets

Packet Errors0 packets

Packet Drops0 packets

Broadcast Packets0 packets

Multicast Packets0 packets

Wireless Statistics - Downlink

Total Traffic5 305 277 Kbits (100%)

Total Packets559 956 packets (100%)

Error Drop Packets34 packets (0%)

Capacity Drop Packets0 packets

Retransmission Packets14 689 packets (2%)

Multicast / Broadcast Traffic12 295 Kbit

Broadcast Packets22 packets (0%)

Multicast Packets34 200 packets (6%)

Wireless Statistics - Uplink

Total Traffic1 265 754 Kbits (100%)

Total Packets192 140 packets (100%)

Error Drop Packets1 packets (0%)

Multicast / Broadcast Traffic9 468 Kbits

Broadcast Packets3 packets (0%)

Multicast Packets1 459 packets (0%)

System Statistics

Session Drops2 215 sessions

Link Drop Counter2 219 times

Total Device Reboots0 times

Soft Device Reboots0 times

Hard Device Reboots0 times

Network Entry Attempts2 217

Successful Network Entries3

Network Entry Authentication Failures2 056

Radar (DFS) Detections0

Subscriber Module Statistics

Subscriber Module Statistics

Show Details

| MAC Address | 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) |
|-------------------|----------------------|----------------------|---------------------|------------------------|------------------------|-----------------------|--------------------------------|--------------------------------|----------------------|
| 00:04:56:20:5f:af | 697 069 | 101 285 | 1 | 2 381 090 | 243 742 | 0 | 23 | 8 369 | 8 |
| 00:04:56:20:5e:e0 | 328 971 | 45 434 | 0 | 1 882 733 | 173 292 | 0 | 0 | 5 802 | 8 |

Download Packets Per MCS

| | | | |
|------------------------|-----------------|------------------------|---------------|
| DS MCS 9 - 256-QAM 5/6 | 486 472 (86.9%) | SS MCS 9 - 256-QAM 5/6 | 92 (0%) |
| DS MCS 8 - 256-QAM 3/4 | 29 189 (5.2%) | SS MCS 8 - 256-QAM 3/4 | 52 (0%) |
| DS MCS 7 - 64-QAM 5/6 | 475 (0.1%) | SS MCS 7 - 64-QAM 5/6 | 81 (0%) |
| DS MCS 6 - 64-QAM 3/4 | 100 (0%) | SS MCS 6 - 64-QAM 3/4 | 94 (0%) |
| DS MCS 5 - 64-QAM 2/3 | 78 (0%) | SS MCS 5 - 64-QAM 2/3 | 79 (0%) |
| DS MCS 4 - 16-QAM 3/4 | 99 (0%) | SS MCS 4 - 16-QAM 3/4 | 70 (0%) |
| DS MCS 3 - 16-QAM 1/2 | 79 (0%) | SS MCS 3 - 16-QAM 1/2 | 90 (0%) |
| DS MCS 2 - QPSK 3/4 | 77 (0%) | SS MCS 2 - QPSK 3/4 | 6 413 (1.1%) |
| DS MCS 1 - QPSK 1/2 | 8 (0%) | SS MCS 1 - QPSK 1/2 | 36 483 (6.5%) |

Uplink Packets Per MCS

| | | | |
|------------------------|-----------------|------------------------|--------------|
| DS MCS 9 - 256-QAM 5/6 | 113 193 (58.9%) | SS MCS 9 - 256-QAM 5/6 | 3 620 (1.9%) |
| DS MCS 8 - 256-QAM 3/4 | 25 195 (13.1%) | SS MCS 8 - 256-QAM 3/4 | 3 215 (1.7%) |
| DS MCS 7 - 64-QAM 5/6 | 19 811 (7.2%) | SS MCS 7 - 64-QAM 5/6 | 1 433 (0.7%) |
| DS MCS 6 - 64-QAM 3/4 | 10 074 (5.2%) | SS MCS 6 - 64-QAM 3/4 | 895 (0.5%) |
| DS MCS 5 - 64-QAM 2/3 | 6 444 (3.4%) | SS MCS 5 - 64-QAM 2/3 | 945 (0.5%) |
| DS MCS 4 - 16-QAM 3/4 | 3 065 (1.6%) | SS MCS 4 - 16-QAM 3/4 | 456 (0.2%) |
| DS MCS 3 - 16-QAM 1/2 | 782 (0.4%) | SS MCS 3 - 16-QAM 1/2 | 241 (0.1%) |
| DS MCS 2 - QPSK 3/4 | 291 (0.2%) | SS MCS 2 - QPSK 3/4 | 6 320 (3.3%) |
| DS MCS 1 - QPSK 1/2 | 40 (0%) | SS MCS 1 - QPSK 1/2 | 2 106 (1.1%) |

Downlink Frame Time

Total Frame Time Used0%

PAGE 4-55

Table 47 Monitor > Performance page attributes

| Attribute | Meaning |
|--|---|
| Reset Statistics | |
| Time Since Last Reset | Time since the stats were last reset. |
| Ethernet Statistics – Transmitted | |
| Total Traffic | Total amount of traffic in Kbits transferred from the device Ethernet interface. |
| Total Packets | Total number of packets transferred from the device Ethernet interface. |
| Packet Errors | Total number of packets transmitted out of the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size. |
| Packet Drops | Total number of packets dropped prior to sending out of the device Ethernet interface due to Ethernet setup or filtering issues. |
| Broadcast Packets | Total number of broadcast packets sent via the device Ethernet interface. |
| Multicast Packets | Total number of multicast packets sent via the device Ethernet interface. |
| Ethernet Statistics – Received | |
| Total Traffic | Total amount of traffic in Kbits received by the device Ethernet interface. |
| Total Packets | Total number of packets received by the device Ethernet interface. |
| Packet Errors | Total number of packets received by the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size. |
| Packet Drops | Total number of packets dropped prior to sending out of the device wireless interface due to Ethernet setup or filtering issues. |
| Broadcast Packets | Total number of broadcast packets received via the device Ethernet interface. |
| Multicast Packets | Total number of multicast packets received via the device Ethernet interface. |
| SFP Statistics – Transmitted | |
| Total Traffic | Total amount of traffic in Kbits transferred from the device SFP interface. |
| Total Packets | Total number of packets transferred from the device SFP interface. |
| Packet Errors | Total number of packets transmitted out of the device SFP interface with errors due to collisions, CRC errors, or irregular packet size. |
| Packet Drops | Total number of packets dropped prior to sending out of the device SFP interface due to setup or filtering issues. |
| Broadcast Packets | Total number of broadcast packets sent via the device SFP interface. |
| Multicast Packets | Total number of multicast packets sent via the device SFP interface. |
| SFP Statistics – Received | |
| Total Traffic | Total amount of traffic in Kbits received by the device SFP interface. |

| Attribute | Meaning |
|--|---|
| Total Packets | Total number of packets received by the device SFP interface. |
| Packet Errors | Total number of packets received by the device SFP interface with errors due to collisions, CRC errors, or irregular packet size. |
| Packet Drops | Total number of packets dropped prior to sending out of the device wireless interface due to SFP setup or filtering issues. |
| Broadcast Packets | Total number of broadcast packets received via the device SFP interface. |
| Multicast Packets | Total number of multicast packets received via the device SFP interface. |
| Wireless Statistics – Downlink | |
| Total Traffic | Total amount of traffic transmitted out of the device wireless interface in Kbits. |
| Total Packets | Total number of packets transmitted out of the device wireless interface. |
| Error Drop Packets | Total number of packets dropped after transmitting out of the device Wireless interface due to RF errors (No acknowledgement and other RF related packet error). |
| Capacity Drop Packets (Access Point Mode) | 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 (Access Point Mode) | Total number of packets re-transmitted after transmitting out of the device wireless interface due to the packets not being received by the receiving device. |
| Multicast / Broadcast Traffic | Total amount of multicast and broadcast traffic transmitted out of the device wireless interface in Kbits. |
| Broadcast Packets | Total number of broadcast packets transmitted out of the device wireless interface. |
| Multicast Packets | Total number of multicast packets transmitted out of the device wireless interface. |
| Wireless Statistics – Uplink | |
| Total Traffic | Total amount of traffic received via the device wireless interface in Kbits. |
| Total Packets | Total number of packets received via the device wireless interface. |
| Error Drop Packets | Total number of packets dropped prior to sending out of the device Ethernet interface due to RF errors (packet integrity error and other RF related packet error). |
| Capacity Drop Packets (Subscriber Module Mode) | 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 | Total amount of multicast and broadcast traffic received on the device wireless interface in Kbits. |

| Attribute | Meaning |
|--|--|
| Broadcast Packets | Total number of broadcast packets received on the device wireless interface. |
| Multicast Packets | Total number of multicast packets received on the device wireless interface. |
| Link Quality (Uplink) (Subscriber Module 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) (Subscriber Module Mode) | Defines the capacity of the uplink as defined by MCS. DS MCS 9 provides the greatest capacity. SS MCS 1 provides the least. 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. 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 Access Point. |
| 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 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 (Access Point Mode) | Total number of Network Entry Attempts by Subscriber Module devices. |
| Successful Network Entries (Access Point Mode) | Total number of successful network entry attempts. |

| Attribute | Meaning |
|---|--|
| Network Entry Authentication Failures (Access Point Mode) | Total number of failed Network Entry Attempts by Subscriber Module devices. |
| Radar (DFS) Detections | |
| Subscriber Module Statistics (Access Point Mode) | |
| MAC Address | MAC Address of the Subscriber Module connected to the Access Point. |
| Total Uplink (Kbits) | Total amount of traffic received via the Access Point wireless interface from the Subscriber Module in Kbits. |
| Total Uplink Packets | Total number of packets received via the Access Point wireless interface from this Subscriber Module. |
| Uplink Packet Drops | Total number of packets dropped prior to sending out of the Access Point Ethernet interface due to RF errors (packet integrity error and other RF related packet error) from the Subscriber Module. |
| Total Downlink (Kbits) | Total amount of traffic transmitted out of the Access Point wireless interface in Kbits. |
| Total Downlink Packets | Total number of packets transmitted out of the Access Point wireless interface. |
| Downlink Packet Drops | Total number of packets dropped after transmitting out of the Access Point wireless interface due to RF errors (No acknowledgement and other RF related packet error). |
| Downlink Capacity Packet Drops | Total number of packets dropped after transmitting out of the Access Point Wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors). |
| Downlink Retransmitted Packets | Total number of packets re-transmitted after transmitting out of the Access Point Wireless interface due to the packets not being received by the Subscriber Module. |
| Downlink Power (dBm) | The transmit power of the Access Point for the downlink packets to the Subscriber Module. |
| Downlink Packets Per MCS | |
| MCS 1 – MCS 9 DS / SS | <p>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.</p> <p>DS represents dual-stream transmissions and SS represents single-stream transmissions.</p> |
| Uplink Packets Per MCS | |

| Attribute | Meaning |
|--|---|
| MCS 1 – MCS 9 DS / SS | 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 (Access Point Mode) | Percentage of frame time used in the uplink. |

Monitor > System page

Figure 22 Monitor > System page

| | |
|----------------------------------|--|
| Monitor > System | |
| Hardware Version | ePMP3000 (FCC) |
| Serial Number (MSN) | E8UFOB69CSZN |
| Firmware Version | U-Boot IPQ806x 2012.07.29 (Aug 22 2018 - 12:38:40) |
| Software Version | 4.3-RC41 |
| Software Version (Active Bank) | 4.3-RC41 |
| Software Version (Inactive Bank) | 4.3-RC36 |
| Device-Agent Version | 2.105.19 |
| NTP Status | NTP Enabled, Date and Time is not obtained |
| Date and Time | 16 Nov 2018, 12:16:42 CDT |
| System Uptime | 19 hours, 14 minutes |
| Wireless MAC Address | 00:04:56:20:9D:FA |
| Ethernet MAC Address | 00:04:56:20:9D:F9 |
| SFP Port MAC Address | 00:04:56:20:9D:F8 |
| Sync Source Status | GPS Sync Up |
| Read-Only Users | 0 |
| Read-Write Users | 1 |
| GUI User Authentication | Device Local Only |
| Factory Reset Via Power Sequence | Enabled |
| cnMaestro Connection Status | Connected to cloud.cambiumnetworks.com |
| cnMaestro Account ID | CAMBIUM_NA_SALES |

Table 48 Monitor > System page attributes

| Attribute | Meaning |
|--------------------------------|--|
| 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. |

| Attribute | Meaning |
|----------------------------------|--|
| Software Version (Inactive Bank) | The backup software version on the device, used upon failure of the active bank. Two software upgrades in sequence will update 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 has been obtained from NTP server. |
| Date and Time | Current date and time, subject to time zone offsets introduced by the configuration of the device Time Zone parameter. Until a valid NTP server is configured, this field will display 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 wireless interface. |
| Ethernet MAC Address | The hardware address of the device LAN (Ethernet) interface. |
| SFP Port MAC Address | The hardware address of the device SFP interface. |
| Sync Source Status | The status of the configured GPS synchronization source. |
| 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 on page 5-9. Disabled: When Disabled, it is not possible to factory default the radio's configuration using the power cycle sequence. |
| cnMaestro Connection Status | The current management status of the device with respect to 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. |

Monitor > Wireless Page

Figure 23 Monitor > Wireless page (Access Point Mode)

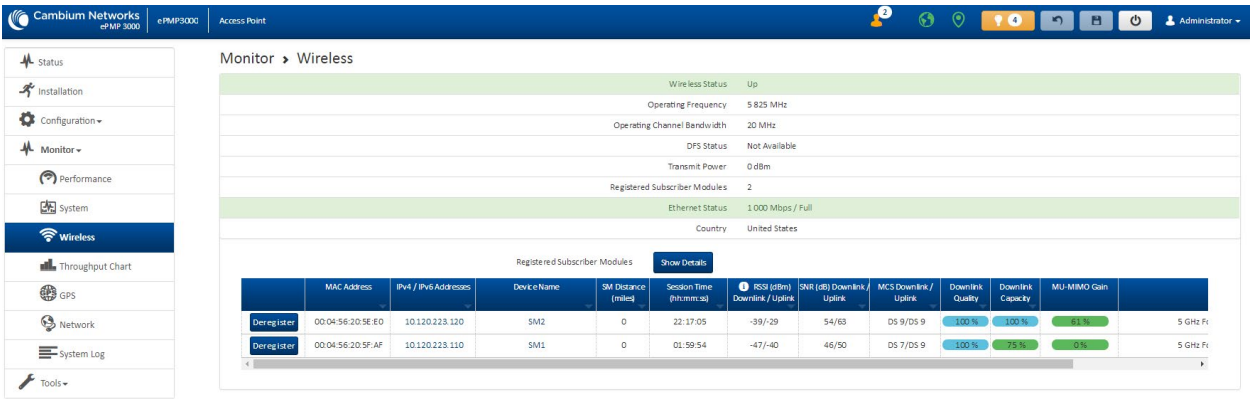


Figure 24 Monitor > Wireless page (Subscriber Module Mode)

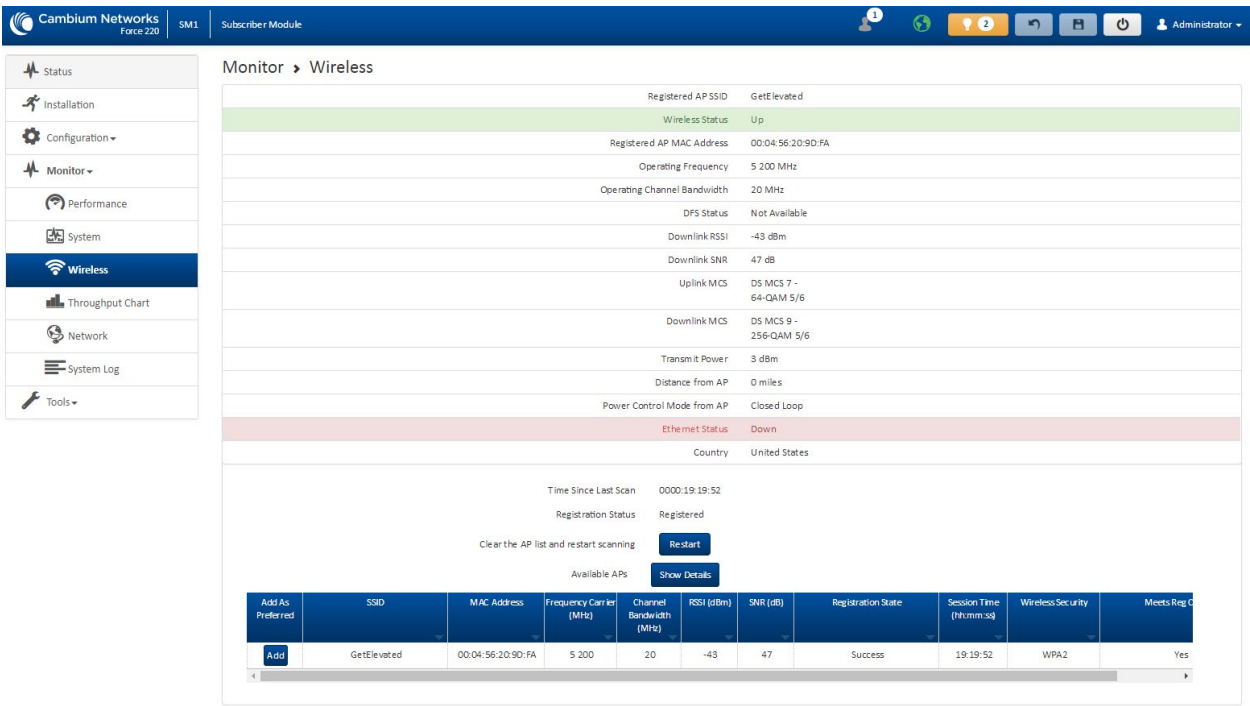
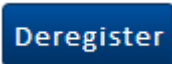



Table 49 Monitor > Wireless page attributes

| Attribute | Meaning |
|---|--|
| Registered Access Point SSID (Subscriber Module Mode only) | SSID of the Access Point to which the Subscriber Module is registered. |

| Attribute | Meaning |
|---|---|
| Wireless Status (Access Point Mode) | Up: The device wireless interface is functioning and sending beacons. Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface. |
| Wireless Status (Subscriber Module Mode) | Up: The device wireless interface is functioning and the device has completed network entry. Down: The device wireless interface has encountered an error disallowing full operation. Evaluate radio and security configuration on the Access Point and Subscriber Module device to determine the network entry failure. |
| Registered Access Point MAC Address (Subscriber Module Mode) | Wireless MAC address of the Access Point to which the Subscriber Module is registered. |
| Range (Subscriber Module Mode) | The calculated distance from the Access Point, 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 . Channel Availability Check: Prior to 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 which 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 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 RSSI | The level of signal being received from the Access Point. |

| Attribute | Meaning |
|--|--|
| (Subscriber Module Mode) | |
| Downlink SNR (Subscriber Module Mode) | The Signal-to-Noise Ratio of the signal being received from the Access Point. |
| Transmitter Power | The current power level at which the device is transmitting. |
| Uplink MCS (Subscriber Module Mode) | Specifies the current MCS utilized for uplink transmission. |
| Registered Subscriber Modules (Access Point Mode) | The count of registered Subscriber Modules. |
| 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 United States or Canada. Country code defines the regulatory rules in use for the device. |
| Registered Subscriber Modules (Access Point Mode)  | <p>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.</p> <p>Click the Deregister button to disassociate the Subscriber Module device from the Access Point.</p> |
| MAC Address (Access Point Mode) | The MAC address of the Subscriber Module wireless interface. |
| IPv4 / IPv6 Addresses (Access Point Mode) | The IP address of the Subscriber Module wireless interface. |
| Device Name (Access Point Mode) | The configured device name of the Subscriber Module wireless interface. |

| Attribute | Meaning |
|---|--|
| SM Distance (miles) | Indicates the calculated distance of the Subscriber Module from the Access Point. |
| Session Time (hh:mm:ss) (Access Point Mode) | Time duration for which the Subscriber Module has been registered and in session with the Access Point. |
| 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). |
| 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 (Access Point Mode) | Current MCS at which the downlink (first value) and uplink (second value) are operating. |
| Downlink Quality (Access Point Mode) | The downlink quality based on the current MCS and PER (Packet Error Rate) for this SM. |
| Downlink Capacity (Access Point Mode) | The downlink capacity based on the current DL MCS with respect to the highest supported MCS (MCS15). The downlink capacity based on the current DL MCS with respect to 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 Subscriber Module |
| Add As Preferred (Subscriber Module Mode) | Click the Add  button to add the Access Point to the Preferred Access Points List under Configuration>Radio . |
| SSID (Subscriber Module Mode) | The SSID of the visible Access Point. |
| MAC Address (Subscriber Module Mode) | The MAC address of the visible Access Point. |
| Frequency Carrier (MHz) (Subscriber Module Mode) | The current operating frequency of the visible Access Point. |

| Attribute | Meaning |
|---|---|
| Channel Bandwidth (MHz) (Subscriber Module Mode) | The current operating channel bandwidth of the visible Access Point. |
| RSSI (dBm) (Subscriber Module Mode) | The current measured Received Signal Strength Indicator at the Access Point. |
| SNR (dB) (Subscriber Module Mode) | The current measured Signal-to-Noise Ratio of the Subscriber Module to Access Point link. |
| Registration State (Subscriber Module Mode) | <p>The indication of the result of the Subscriber Module device network entry attempt:</p> <p>Successful: Subscriber Module registration is successful</p> <p>Failed: Out of Range: The Subscriber Module is out of the Access Point's configured maximum range (Max Range parameter)</p> <p>Failed: Capacity limit reached at Access Point: The Access Point is no longer allowing Subscriber Module network entry due to capacity reached</p> <p>Failed: No Allocation on Access Point: The Subscriber Module to Access Point handshaking failed due to a misconfigured pre-shared key between the Subscriber Module and Access Point</p> <p>Failed: SW Version Incompatibility: The version of software resident on the Access Point is older than the software version on the Subscriber Module</p> <p>Failed: PTP Mode: ACL Policy: The Access Point is configured with PTP Access set to MAC Limited and the Subscriber Module's MAC address is not configured in the Access Point's PTP MAC Address field</p> <p>Failed: Other: The Access Point does not have the required available memory to allow network entry</p> |
| Session Time (hh:mm:ss) (Subscriber Module Mode) | This timer indicates the time elapsed since the Subscriber Module registered to the Access Point. |
| Wireless Security (Subscriber Module Mode) | This field indicates the security state of the Access Point to Subscriber Module link. |
| Meets Reg Criteria (Subscriber Module Mode) | Yes: The scanned Access Point meets the Network Entry criteria defined by the internal Network Algorithm. |

| Attribute | Meaning |
|-----------|---|
| | No: The scanned Access Point 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 25 Monitor > Throughput Chart page

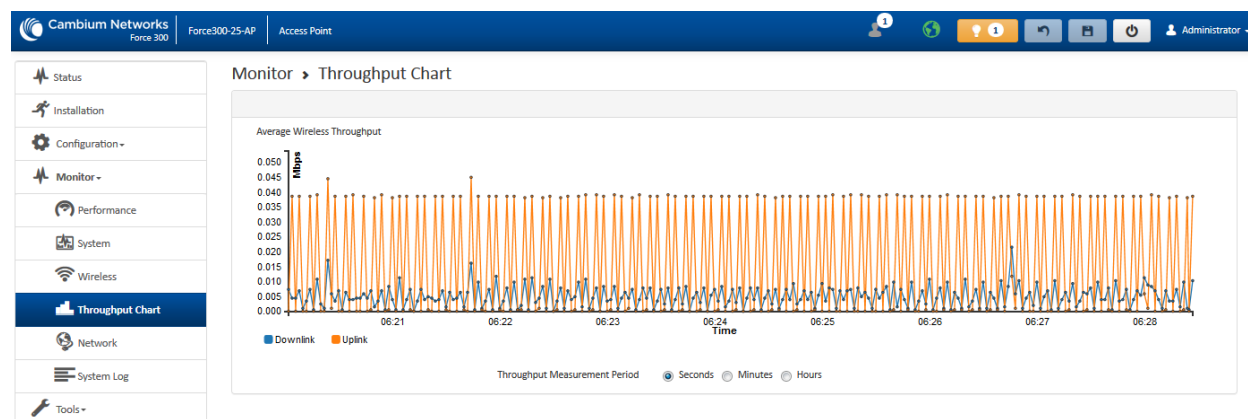


Table 50 Monitor > Throughput Chart page attributes

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

Monitor > GPS page (Access Point Mode)

Use the GPS Status page to reference key information about the device GPS readings, tracked satellites, and firmware version.

Figure 26 Monitor > GPS page attributes (Access Point Mode)

The screenshot shows the Cambium Networks ePMP 3000 web interface in Access Point Mode. The left sidebar lists various system management options. The main content area is titled 'Monitor > GPS Status' and displays a table of GPS-related attributes. Below the table is a 'Satellites' section with a 'Show Details' button and a table with columns for ID, Signal-to-Noise Ratio, and Status. The status bar at the top indicates the user is an Administrator.

| Attribute | Value |
|--------------------------------|----------|
| 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 5.11 |
| Satellites Tracked | 0 |
| Satellites Visible | 0 |

Satellites

Table is empty

Table 51 Monitor > GPS page attributes (Access Point Mode)

| Attribute | Meaning |
|---|---|
| On-board GPS Latitude (Access Point 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 (Access Point 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 (Access Point Mode) | On a GPS Synchronized ePMP radio, the field is automatically populated with the Device height above sea level from the on-board GPS chip. |
| GPS Time (Greenwich Mean Time) (Access Point Mode) | On a GPS Synchronized ePMP radio, the field is automatically populated with the time from the on-board GPS chip. |
| GPS Firmware version (Access Point Mode) | On a GPS Synchronized ePMP radio, the field indicates the current firmware version of the on-board GPS chip. |

| Attribute | Meaning |
|--|--|
| Satellites Tracked (Access Point Mode) | On a GPS Synchronized ePMP radio, the field indicates the number of satellites current tracked by the on-board GPS chip. |
| Satellites Visible (Access Point Mode) | On a GPS Synchronized ePMP radio, the field indicates the number of satellites visible to the on-board GPS chip. |
| Satellites (Access Point 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 (Access Point Mode) | Represents the Satellite ID. |
| Signal-to-Noise Ratio (Access Point Mode) | This is an expression of the carrier signal quality with respect to signal noise. |
| Status (Access Point Mode) | Status of each Satellite available. |

Monitor > Network page

Use the Network Status page to reference key information about the device network status.

Figure 27 Monitor > Network page

The screenshot shows the 'Monitor > Network' page in the Cambium Networks eMP3000 management interface. The left sidebar contains navigation options: Status, Installation, Configuration, Monitor (selected), Performance, System, Wireless, Throughput Chart, GPS, Network, System Log, and Tools. The main content area is divided into several sections:

- Ethernet Interface:** Displays configuration for the Ethernet interface.

| | |
|----------------------|-------------------|
| IP Assignment | Static |
| IP Address | 10.120.223.101 |
| Subnet Mask | 255.255.255.0 |
| Default Gateway | 10.120.223.254 |
| MTU Size | 1700 |
| Ethernet Status | 1 000 Mbps / Full |
| Port Speed | 1 000 Mbps |
| Port Duplex Mode | Full |
| SFP Port | Down |
| SFP Port Speed | N/A |
| SFP Port Duplex Mode | N/A |
| SFP Port Type | N/A |
- Network Status:** Displays network status information.

| | |
|----------------|--|
| DNS Server IP | 10.120.12.169, 10.120.12.170 |
| DHCP Option 82 | Disabled |
| NTP Status | NTP Enabled, Date and Time is not obtained |
- ARP Table:** Displays the ARP table.

| MAC Address | IP Address | Interface |
|-------------------|----------------|-----------|
| 00:22:BE:6E:40:00 | 10.120.223.254 | Bridge |
- Bridge Table:** Displays the bridge table.

| MAC Address | Port | Subscriber Module MAC | Aging Timer (secs) |
|-------------------|------|-----------------------|--------------------|
| 00:04:56:20:9D:FA | Ovn | N/A | 0 |
| 00:04:56:20:5F:AF | WLAN | N/A | 0 |
| 00:04:56:20:5E:E0 | WLAN | N/A | 1 |
| 00:04:56:20:5F:88 | WLAN | N/A | 21 |
| 00:04:56:20:5F:34 | WLAN | N/A | 34 |

Table 52 Monitor > Network page attributes

| Attribute | Meaning |
|---------------------------|--|
| Ethernet Interface | |
| IP Assignment | <p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>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.</p> |
| 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 | Meaning |
|-----------------------|--|
| | 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). |
| 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 | 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. |
| Subscriber Module MAC | MAC Address for the connected Subscriber Module device. |
| Aging Timer (secs) | Time set for the MAC addresses in the Bridge table before renewal. |

Monitor > System Log Page

Use the System Log page to view the device system log and to download the log file to the accessing PC/device.

Figure 28 Monitor > System Log page

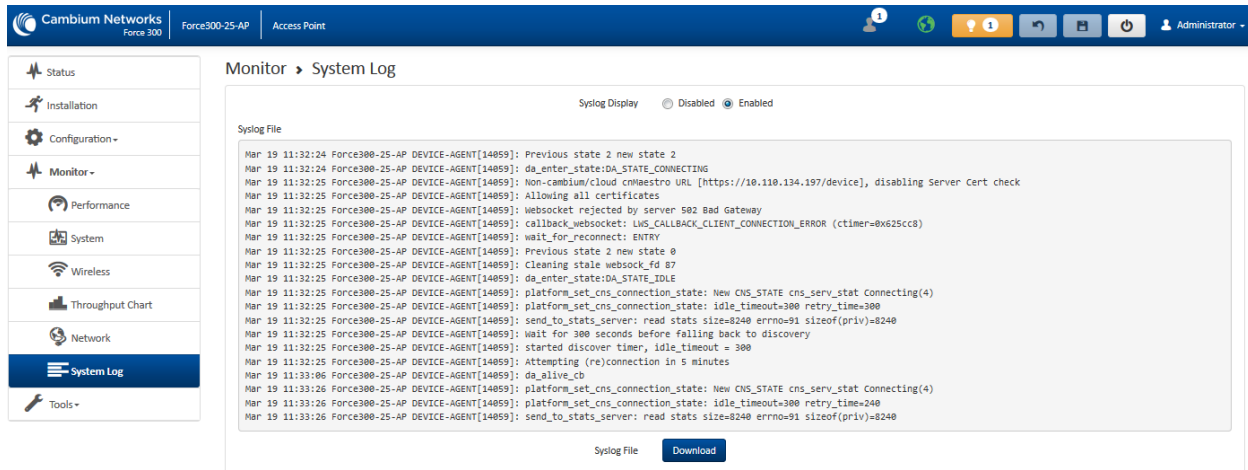


Table 53 Monitor > System Log page attributes

| Attribute | Meaning |
|----------------|--|
| Syslog Display | Enabled: The system log file is displayed on the management GUI. Disabled: The system log file is hidden on the management GUI. |
| Download | Use this button 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.

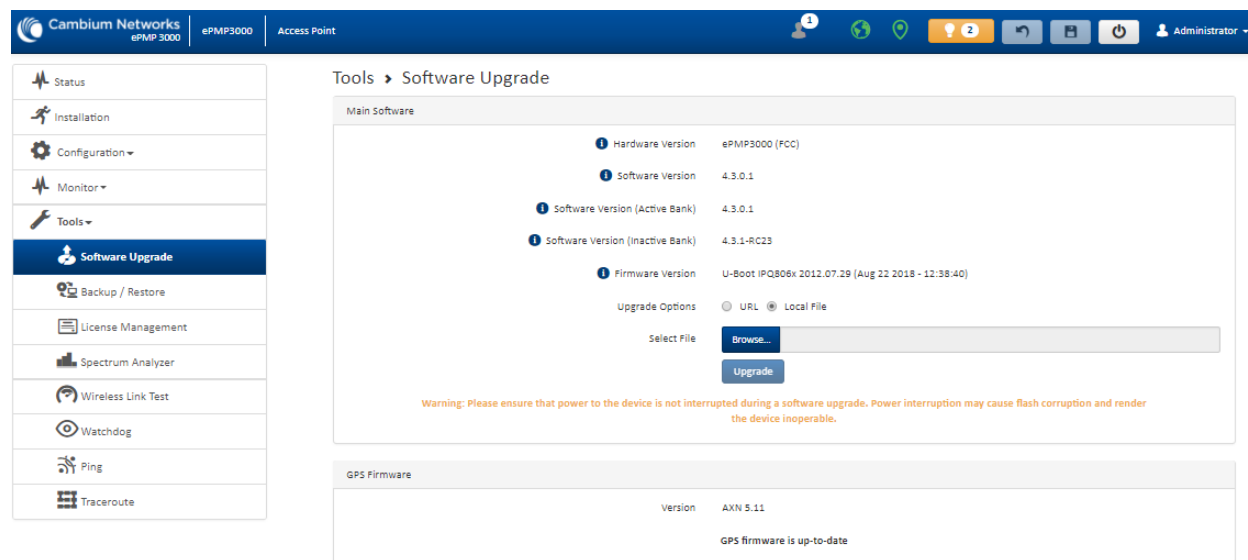
Tools > Software Upgrade page

Use the **Software Upgrade** page to update the device radio software to take advantage of new software features and improvements.



Attention Please read the Release Notes associated with each software release for special notices, feature updates, resolved software issues, and known software issues.

The Release Notes may be accessed at the [Cambium Support Center](#).

Figure 29 Tools > Software Upgrade page**Table 54** Tools > Software Upgrade page attributes

| Attribute | Meaning |
|----------------------------------|---|
| Main Software | |
| Hardware Version | Defines the board type and frequency band of operation. |
| Software Version | Defines the current operating software version. |
| Software Version (Active Bank) | ePMP devices two banks of flash memory which each contain a version of software. The version of software last upgraded onto the Flash memory is made the Active Bank. This software will be used by the device when rebooted. |
| Software Version (Inactive Bank) | The version of software that was the Active Bank is made the Inactive Bank when another version of software is upgraded onto the Flash memory. The Inactive Bank of software will be 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 | <p>URL: A webserver may be used to retrieve software upgrade packages (downloaded to the device via the webserver). For example, if a webserver is running at IP address 192.168.2.1 and the software upgrade packages are located in the home directory, an operator may select option From URL and configure the Software Upgrade Source field to http://192.168.2.1/<software_upgrade_package>.</p> <p>Local File: Click Browse to select the local file containing the software upgrade package.</p> |
| Select File | Click Browse to select a local file (located on the device accessing the web management interface) for upgrading the device software. |

| Attribute | Meaning |
|---------------------|---|
| Upgrade | Click the Upgrade button to begin the software upgrade process. 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. |
| GPS Firmware | |
| Firmware Version | The current firmware of the on-board GPS chip. |
| Upgrade Options | URL: A webserver may be used to retrieve GPS firmware upgrade packages (downloaded to the device via the webserver). For example, if a webserver is running at IP address 192.168.2.1 and the firmware upgrade packages are located in the home directory, an operator may select option From URL and configure the GPS Firmware Upgrade Source field to http://192.168.2.1/<firmware_upgrade_package> . Local File: Click Browse to select the local file containing the GPS firmware upgrade package. |
| Select File | Click Browse to select a local file (located on the device accessing the web management interface) for upgrading the on-board GPS chip firmware. |

Tools > Backup/Restore page

Use the **Backup/Restore** page to update the device radio software to take advantage of new software features and improvements.

Figure 30 Tools > Backup/Restore page

The screenshot displays the Cambium Networks ePMP 3000 Access Point web management interface. The top navigation bar includes the Cambium Networks logo, model number (ePMP 3000), device type (Access Point), and user information (Administrator). A left sidebar contains various tool icons: Status, Installation, Configuration, Monitor, Tools, Software Upgrade, **Backup / Restore** (highlighted), License Management, Spectrum Analyzer, Wireless Link Test, Watchdog, Ping, and Traceroute.

The main content area is titled "Tools > Backup / Restore" and contains four sections:

- Backup Configuration:** Includes a "Configuration File Format" section with radio buttons for "Text (Editable)" (selected) and "Binary (Secured)". A "Download" button is present.
- Restore Configuration:** Includes a "Select File" section with a "Browse..." button. Below it, there is a "Skip unsupported configuration elements" checkbox (checked) and radio buttons for "Disabled" (selected) and "Enabled". An "Upload" button is at the bottom.
- Factory Default Configuration:** Includes several checkboxes: "Reset Via Power Sequence" (checked), "Retain Passwords" (checked), "Keep Passwords" (checked), and "Reset to Factory Defaults" (checked). Radio buttons for "Disabled" and "Enabled" are also present for the first three items. A "Reset" button is at the bottom.
- Backup Technical Support File:** Includes a "Download" button.

Table 55 Tools > Backup/Restore page attributes

| Attribute | Meaning |
|---|---|
| Backup Configuration | |
| Configuration File Format | <p>Text (Editable): Choosing this option will download the configuration file in the .json format, and can be viewed and/or edited using a standard text editor.</p> <p>Binary (Secured): Choosing this option will download the configuration file in the .bin format, and cannot be viewed and/or edited using an editor. Use this format for a secure backup.</p> |
| Restore Configuration | |
| Select File | Click Browse to select a local file (located on the device accessing the web management interface) for restoring the device configuration. |
| Skip unsupported configuration elements | In case of configuration incompatibility the unsupported configuration elements can be ignored and skipped. |
| Factory Default Configuration | |
| Reset Via Power Sequence | <p>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 on page 5-9.</p> <p>Disabled: When Disabled, it is not possible to factory default the radio's configuration using the power cycle sequence.</p> |
| Retain Passwords | <p>When set to Enabled, then after a factory default of the radio for any reason, the passwords used for GUI and CLI access will not be defaulted and will remain unchanged. The default value of this field is Disabled.</p> <p>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.</p> |
| Keep Passwords | When the Keep Passwords checkbox is selected, the passwords used for GUI and CLI access will not be defaulted and will remain unchanged. This is one-time option, and it does not apply to factory default procedures completed by power cycling (Reset Via Power Sequence). |
| Reset to Factory Defaults | <p>Use this button to reset the device to its factory default configuration.</p> <p>A reset to factory default configuration resets all device parameters. With the Subscriber Module device in default configuration it may not be able to register to a Access Point device configured for your network.</p> |
| Backup Technical Support File | |
| Download | The Backup Technical Support File is a compressed archive of the applicable statistics and configuration parameters used by Cambium 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 subscriber) to Full (120 subscriber)
- 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:

Figure 31 AP ePMP Elevate license management options

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.

[Use Flexible Licensing →](#)

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.

[Use Fixed Licensing →](#)

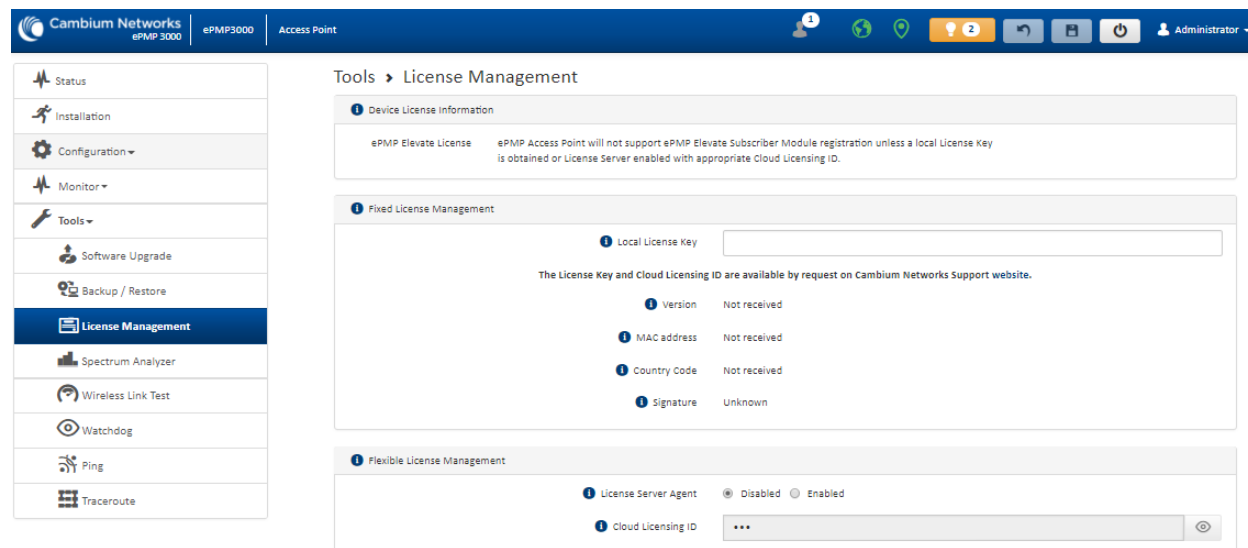


Note Elevate Flexible Licensing is available only for ePMP AP devices with GPS sync.

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.



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.

Figure 32 Tools > License Management page**Table 56** Tools > License Management attributes

| Attribute | Meaning |
|------------------------------------|---|
| Flexible License Management | |
| License Server Agent | Disabled: No communication with the License Server is established Enabled: Enables 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 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 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 |

| Attribute | Meaning |
|--------------------------------------|---|
| 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 3 rd failed refresh request. |
| Update Requests Failed | The number of failed update (licensing information transfer) requests to the License Server. The ePMP Elevate Subscriber Module Limit resets to 1 after the 5 th failed updated request. |
| NTP Status | Represents whether or not the current time and date have been 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 support.cambiumnetworks.com 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 will display 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

Use the **Spectrum Analyzer** page to measure signal levels of frequencies across the full range of the device or in a custom range.

Figure 33 Tools > Spectrum Analyzer page**Table 57** Tools > Spectrum Analyzer page attributes

| Attribute | Meaning |
|-------------------------|---|
| Spectrum Analyzer | <p>Disabled: The Spectrum Analyzer process is not running on the device.</p> <p>Enabled: The Spectrum Analyzer process is running on the device, necessary for displaying results in the web management interface.</p> |
| Range | <p>Full Available Range: The entire operating range of the device will be scanned.</p> <p>Custom: The device scans only the range defined by Lower Frequency and Upper Frequency.</p> |
| Lower / Upper Frequency | When Range is configured to Custom , indicates the range in MHz for which the device will scan. |
| cnDiscovery Mode | <p>Light: Only management frames will be captured for interferer detection. Some interferers may not be discovered. Scanning results may slightly vary from actual environmental conditions.</p> <p>Hard: Management, control, and data frames will be captured for interferer detection. All Interferers will be discovered. It is recommended to use this mode with caution, as it may result in performance degradation.</p> |
| Scanning | Click Pause to pause scanning, and Clear Data to reset the displayed results. |

Tools > eAlign page

Use the eAlign page to aid with subscriber link alignment.

Figure 34 Tools > eAlign page



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



Attention eMPM supports Automatic Transmit Power Control (ATPC) where the Subscriber Module devices are instructed by the Access Point to adjust their Tx power in order 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.

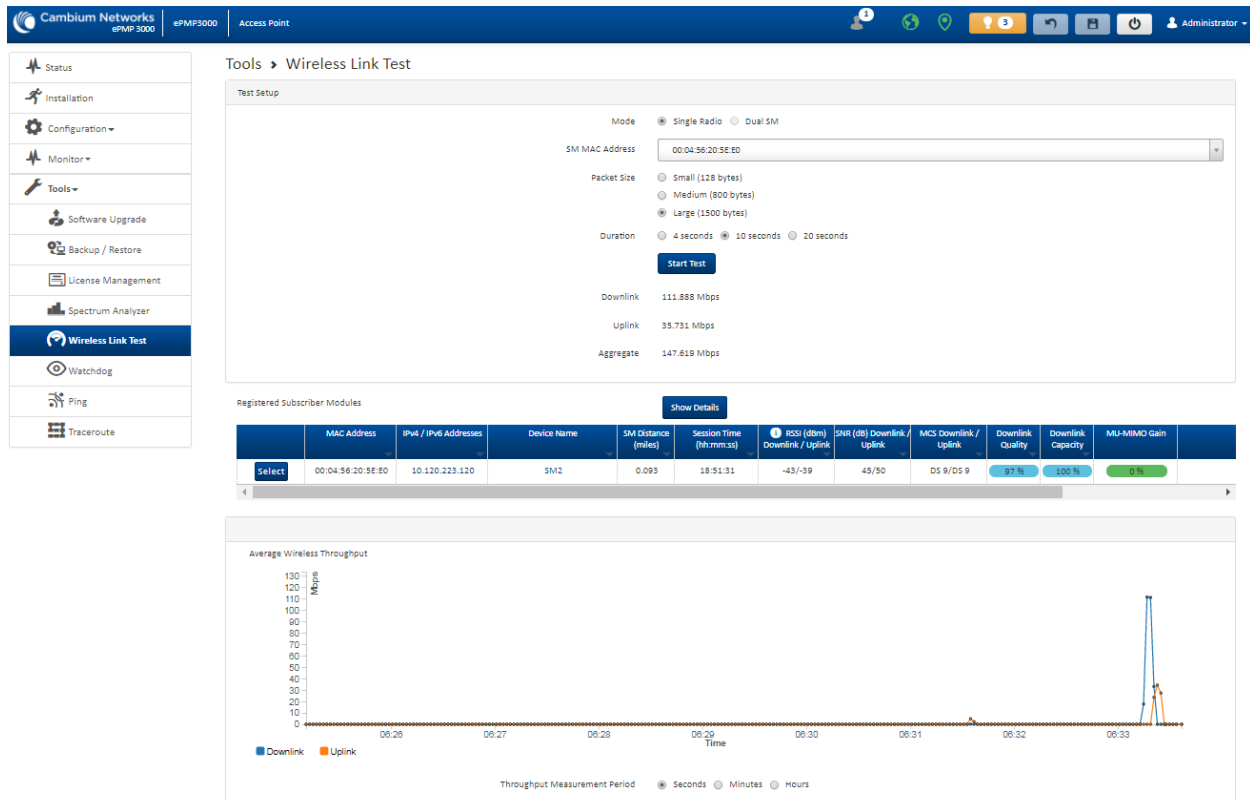
While aligning the link using eAlign, please follow these steps:

Procedure:

- 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 the Save button
- 4 Perform link alignment using eAlign
- 5 Once alignment is complete, set Configuration>Radio>Power Control>Max Tx Power back to Auto
- 6 Click the Save button

Tools > Wireless Link Test page

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

Figure 35 Tools > Wireless Link Test page**Table 58** Tools > Wireless Link Test page attributes

| Attribute | Meaning |
|-------------------|--|
| Test Setup | |
| Mode | <p>Single Radio: The link test is conducted between the Access Point and one Subscriber Module</p> <p>Dual SM: The link test is conducted between the Access Point and two grouped Subscriber Modules (must be operating in MU-MIMO mode).</p> |
| SM MAC Address | Choose the MAC Address of the Subscriber Module with which the wireless link test will be 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 | This field indicates the result of the throughput test on the downlink, in Mbps |
| Uplink | This field indicates the result of the throughput test on the uplink, in Mbps |
| Average | Auto-adjusting chart displaying the average throughput of the link |

| Attribute | Meaning |
|-------------------------------|---|
| Registered Subscriber Modules | This table provides information about the wireless link of each registered Subscriber Module. |

Tools > Watchdog page

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 36 Tools > Watchdog page

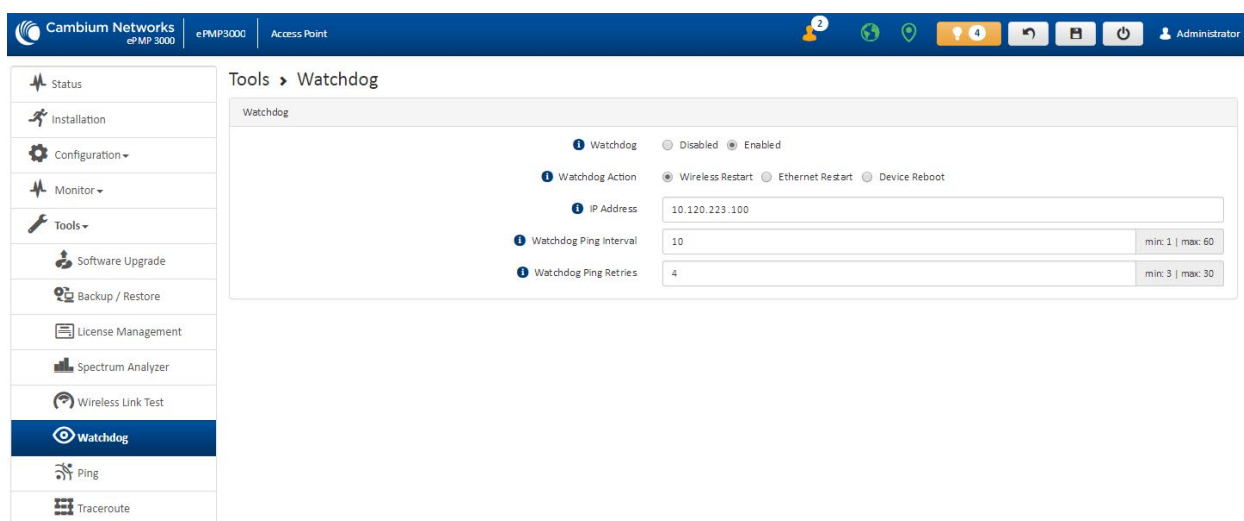


Table 59 Tools > Watchdog page attributes

| Attribute | Meaning |
|-------------------|---|
| Test Setup | |
| Watchdog | <p>Disabled: The device does not ping a specified IP address periodically for verification of connectivity</p> <p>Enabled: The device periodically pings the IP address specified. If IP connectivity is lost, the action defined in Watchdog Action is performed.</p> |
| Watchdog Action | <p>Wireless Restart: In case of lost ping connectivity to the specified IP address, the device automatically restarts the wireless interface.</p> <p>Ethernet Restart: In case of lost ping connectivity to the specified IP address, the device automatically restarts the Ethernet interface.</p> <p>Device Reboot: In case of lost ping connectivity to the specified IP address, the device automatically reboots.</p> |

| Attribute | Meaning |
|------------------------|--|
| 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 prior to considering the test failed (and conducting the action defined in Watchdog Action). |

Tools > Ping page

Use the Ping page to conduct a simple test of IP connectivity to other devices which 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 (i.e. DNS server failure).

Figure 37 Tools > Ping page

Table 60 Tools > Ping page attributes

| Attribute | Meaning |
|------------------------|--|
| Ping | |
| IP Address Version | IPv4: The ping test is conducted via IPv4 protocol. IPv6: The ping test is conducted via 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. |

| Attribute | Meaning |
|--------------|---|
| 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 | Results of the Ping test are displayed in the box. |

Tools > Traceroute page

Use the Traceroute page to display the route (path) and associated diagnostics for IP connectivity between the device and the destination specified.

Figure 38 Tools > Traceroute page

The screenshot displays the Traceroute configuration interface. The top navigation bar includes the Cambium Networks logo and user information. The left sidebar lists various system management tools. The main content area is titled 'Tools > Traceroute'. It features a text input field for the destination IP address, currently set to '10.120.223.120'. Below this are four rows of settings, each with a label and radio button options: 'Fragmentation (-F)' with OFF and ON options; 'Trace method (-I)' with ICMP ECHO (selected) and UDP options; 'Display TTL (-l)' with OFF and ON options; and 'Verbose (-v)' with OFF and ON options. A 'Start Traceroute' button is positioned below these settings. The 'Traceroute Results' section at the bottom shows the command 'traceroute to 10.120.223.120 (10.120.223.120), 30 hops max, 38 byte packets' and a table of results for the first hop.

| Hop | IP Address | RTT (ms) |
|-----|----------------|----------------------------|
| 1 | 10.120.223.120 | 7.411 ms 5.695 ms 3.519 ms |

Table 61 Tools > Traceroute page attributes

| Attribute | Meaning |
|--------------------|---|
| Traceroute | |
| IP Address | Enter the IP address of the target of the traceroute diagnostic. |
| Fragmentation (-F) | ON: Allow source and target to fragment probe packets. OFF: Do not fragment probe packets (on 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. |

| Attribute | Meaning |
|--------------------|---|
| Traceroute Results | Traceroute test results are displayed in the box. |

Chapter 5: Operation and Troubleshooting

This chapter provides instructions for operators of ePMP networks. The following topics are described:

- [General Planning for Troubleshooting](#) on page 5-2
- [Upgrading device software](#) on page 5-3
- [Testing hardware](#) on page 5-4
- [Troubleshooting the radio link](#) on page 5-7
- [Resetting ePMP to factory defaults by power cycling](#) on page 5-9

General Planning for Troubleshooting

Effective troubleshooting depends in part on measures that you take before you experience trouble in your network. Cambium recommends the following measures for each site:

Procedure:

- 1** Identify troubleshooting tools that are available at your site (such as a protocol analyzer).
- 2** Identify commands and other sources that can capture baseline data for the site. These may include:
 - Ping
 - tracert or traceroute
 - Throughput Test results
 - Throughput data
 - Configure GUI page captures
 - Monitor GUI page captures
 - Session logs
- 3** 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 advantage of new features and software improvements for the ePMP system, monitor the Cambium Networks PMP Software website: <https://support.cambiumnetworks.com/files/epmp>

To upgrade the device software, follow this procedure:

Procedure:

- 1 Log in to the device GUI via 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
- 5 Click **Upgrade**
Do not power off the unit in the middle of an upgrade process.
- 6 Once the software upgrade is complete, click the **Reset** icon.

Testing hardware

This section describes how to test the hardware when it fails on startup or during operation.

Before testing hardware, confirm that all outdoor cables, that is those that connect the device to equipment inside the building, are of the supported type, as defined in [Ethernet cabling](#) on page 2-35

Checking the power supply LED

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

- The Power (green) LED illuminates steadily.

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](#) on page 5-4
- [Ethernet LED is off](#) on page 5-4

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 mains power supply is working, for example, check the plug. If the power supply is working, report a suspected power supply fault to Cambium Networks.

Ethernet LED is off

Meaning: There is no Ethernet traffic between the device and 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 is correct and not crossed.

Test Ethernet packet errors reported by the device

Log into 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 abandon this procedure and consider using the procedure [Test ping packet loss](#) on page 5-5.

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. Please refer to the 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 10 in 1 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.

Procedure:

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 will take 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 how many 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.

Troubleshooting the radio link

This section describes how to test 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.

Module has lost or does not establish radio connectivity

If there is no wireless activity, follow this:

Procedure:

- 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 Access Point, 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 Access Point and the Subscriber Module **Preferred Access Points List**.
- 6 Check that the software at each end of the link is the same version.
- 7 Check that the desired Access Point SSID is configured in the Subscriber Module **Preferred Access Points List**.
- 8 On the Subscriber Module, check the **DL RSSI** and **DL CINR** values. Verify that for the Subscriber Module 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.

Link is unreliable or does not achieve data rates required

If there is some activity but the link is unreliable or does not achieve the data rates required, proceed as follows:

Procedure:

- 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 your Quality of Service configuration and ensure that traffic is properly classified and prioritized.

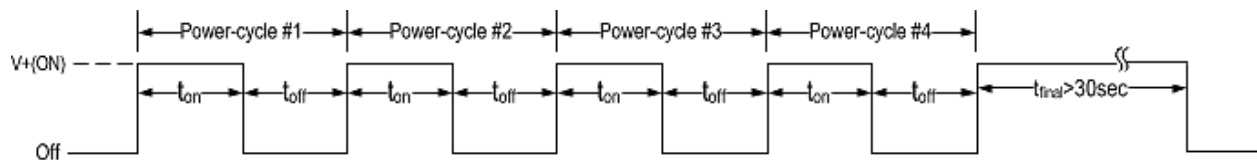
Resetting ePMP to factory defaults by power cycling

Operators may reset an ePMP radio to 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 [Figure 39](#).

Procedure:

- 1 Remove the Ethernet cable from 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 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 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 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 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 will go through an additional reset automatically). This will reset the current configuration files to factory default configuration (e.g. IP addresses, Device mode, RF configuration etc.). The device can be pinged from a PC to check if boot up is complete (Successful ping replies indicates 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 39 Power cycle timings



Where:

V+(ON)

Off

t_{on}

t_{off}

Is:

Power through PoE has been applied to the device

Power through PoE has been removed from the device

Time duration for which the device has been powered on. This should be 3-5 seconds.

Time duration for which the device has been powered off. This should be 3-5 seconds.

Chapter 6: Legal and reference information

This chapter provides legal notices including software license agreements.



Attention Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

The following topics are described in this chapter:

- [Cambium Networks end user license agreement](#) on page 6-2
- [Hardware warranty](#) on page 6-84
- [Limit of liability](#) on page 6-85
- [Compliance with safety standards](#) on page 6-86 lists the safety specifications against which the ePMP has been tested and certified. It also describes how to keep RF exposure within safe limits.
- [Compliance with radio regulations](#) on page 6-99 describes how the ePMP complies with the radio regulations that are enforced in various countries.
- [Notifications](#) on page 6-102 contains notes made to regulatory bodies for the ePMP.

Cambium Networks end user license agreement

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lzma

LZMA SDK 4.65

LZMA SDK provides the documentation, samples, header files,
libraries,
and tools you need to develop applications that use LZMA
compression.

LZMA is default and general compression method of 7z format
in 7-Zip compression program (www.7-zip.org). LZMA provides high
compression ratio and very fast decompression.

LZMA is an improved version of famous LZ77 compression algorithm.
It was improved in way of maximum increasing of compression ratio,
keeping high decompression speed and low memory requirements for
decompressing.

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LZMA SDK Contents

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| | <p>LZMA SDK includes:</p> <ul style="list-style-type: none"> - ANSI-C/C++/C#/Java source code for LZMA compressing and decompressing - Compiled file->file LZMA compressing/decompressing program for Windows system |
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bc

```
/* A Bison parser, made by GNU Bison 2.1. */

/* Skeleton parser for Yacc-like parsing with Bison,
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/* As a special exception, when this file is copied by Bison into a
   Bison output file, you may use that output file without restriction.
   This special exception was added by the Free Software Foundation
   in version 1.24 of Bison. */

/* Written by Richard Stallman by simplifying the original so called
   ``semantic'' parser. */

/* All symbols defined below should begin with yy or YY, to avoid
   infringing on user name space. This should be done even for local
   variables, as they might otherwise be expanded by user macros.
   There are some unavoidable exceptions within include files to
   define necessary library symbols; they are noted "INFRINGES ON
   USER NAME SPACE" below. */
```

bridge-utils

```
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 */
```

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Julian Seward, jseward@bzip.org
bzip2/libbzip2 version 1.0.6 of 6 September 2010

conntrack-tools

```
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loginrec.h

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| zlib | <p>/* zlib.h -- interface of the 'zlib' general purpose compression library version 1.2.8, April 28th, 2013</p> <p>Copyright (C) 1995-2013 Jean-loup Gailly and Mark Adler</p> <p>This software is provided 'as-is', without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.</p> <p>Permission is granted to anyone to use this software for any purpose, including commercial applications, and to alter it and redistribute it freely, subject to the following restrictions:</p> <ol style="list-style-type: none"> 1. The origin of this software must not be misrepresented; you must not claim that you wrote the original software. If you use this software in a product, an acknowledgment in the product documentation would be appreciated but is not required. 2. Altered source versions must be plainly marked as such, and must not be misrepresented as being the original software. 3. This notice may not be removed or altered from any source distribution. <p>Jean-loup Gailly Mark Adler jloup@gzip.org madler@alumni.caltech.edu</p> <p>The data format used by the zlib library is described by RFCs (Request for Comments) 1950 to 1952 in the files http://tools.ietf.org/html/rfc1950 (zlib format), rfc1951 (deflate format) and rfc1952 (gzip format). */</p> |

Hardware warranty

Cambium's standard hardware warranty is for one (1) year from date of shipment from Cambium Networks or a Cambium Point-To-Multipoint Distributor. Cambium Networks warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Cambium Networks shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

Limit of liability

IN NO EVENT SHALL CAMBIUM NETWORKS BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY, EVEN IF CAMBIUM NETWORKS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.) IN NO CASE SHALL CAMBIUM'S LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.

System threshold, output power and link loss

For up-to-date data, please refer to:

- [LINKPlanner](#)

Compliance with safety standards

This section lists the safety specifications against which the ePMP has been tested and certified. It also describes how to keep RF exposure within safe limits.

Electrical safety compliance

The ePMP hardware has been tested for compliance to the electrical safety specifications listed in [Table 62](#).

Table 62 ePMP safety compliance specifications

| Region | Standard |
|---------------|---|
| USA | UL 60950-1, 2 nd Edition |
| Canada | CSA C22.2 No.60950 2 nd Edition |
| International | International CB certified and certified to IEC 60950-1:2005 (modified) plus EN60950-1:2006 + A1:2010 |

Electromagnetic compatibility (EMC) compliance

The ePMP complies with European EMC Specification EN301 489-1 with testing carried out to the detailed requirements of EN301 489-4.

The EMC specification type approvals that have been granted for ePMP are listed under [Table 63](#).

Table 63 EMC emissions compliance

| Region | Specification (Type Approvals) |
|--------|---|
| USA | FCC CFR 47 Part 15 class B |
| Canada | RSS210, Issue 8 RSS247, Issue 1 (May 2015) |
| Europe | ETSI EN301 489-4 |

Human exposure to radio frequency energy

Standards

Relevant standards (USA and EC) applicable when working with RF equipment are:

- ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations.
- *Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).*
- US FCC limits for the general population. See the FCC web site <http://www.fcc.gov> and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base Subscriber Modules and fixed terminal Subscriber Modules for wireless telecommunication systems (110 MHz - 40 GHz).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base Subscriber Modules and fixed terminal Subscriber Modules for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - general public.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site <http://www.icnirp.de/> and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

Power density exposure limit

Install the radios for the ePMP family of PMP wireless solutions so as to provide and maintain the minimum separation distances from all persons.

The applicable power density exposure limit from the standards (see [Human exposure to radio frequency energy](#) on page 6-88) is:

- **10 W/m²** for RF energy in the 5 GHz frequency band.

Calculation of power density

Peak power density in the far field of a radio frequency point source is calculated as follows:



Note The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

$$S = \frac{P \cdot G}{4\pi d^2}$$

Where:

Is:

| | |
|---|--|
| S | power density in W/m ² |
| P | maximum average transmit power capability of the radio, in W |
| G | total Tx gain as a factor, converted from dB |
| d | distance from point source, in m |

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P \cdot G}{4\pi \cdot S}}$$

Calculated distances and power compliance margins

The calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination is shown in the tables below. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Explanation of terms used:

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m²)

d – minimum distance from point source (meters)

R – recommended distances (meters)

Table 64 through Table 69 below list the power compliance margins for the following ePMP 3000 Access Point devices:

| Part Number | FCC ID | Industry Canada |
|--------------|-------------|-----------------|
| C058910A102A | Z8H89FT0024 | 109W-0024 |
| C050910A104A | | |

Table 64 ePMP 3000 Access Point Power compliance margins, 5.1 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|----------------|----------|----|--------------------------|----------|----------|
| AP | 20 MHz | Sector, 18 dBi | 0.031 | 63 | 10 | 0.12 | 0.3 |
| AP | 80 MHz | Sector, 18 dBi | 0.018 | 63 | 10 | 0.09 | 0.1 |

Table 65 ePMP 3000 Access Point Power compliance margins, 5.8 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|----------------|----------|----|--------------------------|----------|----------|
| AP | 20 MHz | Sector, 18 dBi | 0.062 | 63 | 10 | 0.18 | 0.3 |
| AP | 80 MHz | Sector, 18 dBi | 0.017 | 63 | 10 | 0.09 | 0.1 |

Table 66 ePMP 3000 Access Point Power compliance margins, 5.8 GHz, ISED

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | S @ 20 cm (W/m ²) |
|--------------|----------------------|----------------|----------|----|--------------------------|----------|----------|----------------------------------|
| AP | 20 MHz | Sector, 18 dBi | 0.062 | 63 | 9.69 | 0.18 | 0.3 | 7.72 |
| AP | 80 MHz | Sector, 18 dBi | 0.017 | 63 | 9.69 | 0.10 | 0.3 | 2.20 |



Note Gain of antenna in dBi = $10 \cdot \log(G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At EU 5.8 GHz the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

Table 67 ePMP 3000 Access Point Power compliance margins, 5.8 GHz (EIRP 36 dBm)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|----------------|----------|----|--------------------------|----------|----------|
| AP | 20 MHz | Sector, 18 dBi | 0.063 | 63 | 10 | 0.18 | 0.3 |
| AP | 80 MHz | Sector, 18 dBi | 0.063 | 63 | 10 | 0.18 | 0.3 |



Note If there are no EIRP limits in the country of installation, use the distance calculations in [Table 68](#) and [Table 69](#).

Table 68 ePMP 3000 Access Point Power compliance margins, 5.1 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|----------------|----------|----|--------------------------|----------|----------|
| AP | 20 MHz | Sector, 18 dBi | 1.585 | 63 | 10 | 1.41 | 2.0 |
| AP | 80 MHz | Sector, 18 dBi | 1.585 | 63 | 10 | 1.41 | 2.0 |

Table 69 ePMP 3000 Access Point Power compliance margins, 5.8 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P | G | S | d | R |
|--------------|----------------------|---------|---|---|---|---|---|
|--------------|----------------------|---------|---|---|---|---|---|

| | | | (W) | | (W/m ²) | (m) | (m) |
|----|--------|----------------|-------|----|---------------------|------|-----|
| AP | 20 MHz | Sector, 18 dBi | 1.585 | 63 | 10 | 1.41 | 2.0 |
| AP | 80 MHz | Sector, 18 dBi | 1.585 | 63 | 10 | 1.41 | 2.0 |

Table 70 through Table 73 below list the power compliance margins for the following Force 300-25 devices:

| Part Number | FCC ID | Industry Canada |
|--------------|-------------|-----------------|
| C058910C102A | Z8H89FT0017 | 109W-0017 |
| C050910C104A | | |

Table 70 Force 300-25 Power compliance margins, 5.1 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|-------------------------|----------|-----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.000389 | 316 | 10 | 0.03 | 0.1 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.000141 | 316 | 10 | 0.02 | 0.1 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.957194 | 2 | 10 | 0.11 | 0.3 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.058614 | 2 | 10 | 0.03 | 0.1 |

Table 71 Force 300-25 Power compliance margins, 5.8 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|-------------------------|----------|-----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.001660 | 316 | 10 | 0.06 | 0.1 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.000719 | 316 | 10 | 0.04 | 0.1 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.997700 | 2 | 10 | 0.11 | 0.3 |
| PTP | 80 MHz | On-board, 2 dBi | 0.276058 | 2 | 10 | 0.06 | 0.1 |

SM

Table 72 Force 300-25 Power compliance margins, 5.1 GHz, ISEDC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | S @ 20 cm (W/m ²) |
|--------------|----------------------|----------------------------|----------|-----|--------------------------|----------|----------|-------------------------------------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.000389 | 316 | 9.01 | 0.03 | 0.1 | 0.24 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.000141 | 316 | 9.01 | 0.02 | 0.1 | 0.09 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.957194 | 2 | 9.01 | 0.12 | 0.3 | 3.02 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.058614 | 2 | 9.01 | 0.03 | 0.1 | 0.18 |

Table 73 Force 300-25 Power compliance margins, 5.8 GHz, ISEDC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | S @ 20 cm (W/m ²) |
|--------------|----------------------|----------------------------|----------|-----|--------------------------|----------|----------|----------------------------------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.001660 | 316 | 9.69 | 0.07 | 0.1 | 1.04 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.000719 | 316 | 9.69 | 0.04 | 0.1 | 0.45 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.997700 | 2 | 9.69 | 0.11 | 0.3 | 3.15 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.276058 | 2 | 9.69 | 0.06 | 0.1 | 0.87 |



Note Gain of antenna in dBi = $10 \cdot \log (G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At EU 5.8 GHz the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

Table 74 Force 300-25 Power compliance margins, 5.8 GHz (EIRP 36 dBm)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|----------------------------|----------|-----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.012589 | 316 | 10 | 0.18 | 0.2 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.012589 | 316 | 10 | 0.18 | 0.2 |



Note If there are no EIRP limits in the country of installation, use the distance calculations in [Table 75](#) and [Table 76](#).

Table 75 Force 300-25 Power compliance margins, 5.1 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|-------------------------|----------|-----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.794 | 316 | 10 | 1.41 | 2.0 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.794 | 316 | 10 | 1.41 | 2.0 |

Table 76 Force 300-25 Power compliance margins, 5.8 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|-------------------------|----------|-----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Integrated Dish, 25 dBi | 0.794 | 316 | 10 | 1.41 | 2.0 |
| PTP SM | 80 MHz | Integrated Dish, 25 dBi | 0.794 | 316 | 10 | 1.41 | 2.0 |

[Table 77](#) through [Table 83](#) below list the power compliance margins for the following Force 300-16 devices:

| Part Number | FCC ID | Industry Canada |
|--------------|-------------|-----------------|
| C058910C112A | Z8H89FT0016 | 109W-0016 |
| C058910C114A | | |

Table 77 Force 300-16 Power compliance margins, 5.1 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.021 | 40 | 10 | 0.08 | 0.1 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.013 | 40 | 10 | 0.06 | 0.1 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.678 | 2 | 10 | 0.09 | 0.1 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.089 | 2 | 10 | 0.03 | 0.1 |

Table 78 Force 300-16 Power compliance margins, 5.8 GHz, FCC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.830 | 40 | 10 | 0.51 | 0.7 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.1 | 40 | 10 | 0.18 | 0.3 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.830 | 2 | 10 | 0.11 | 0.3 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.389 | 2 | 10 | 0.07 | 0.1 |

Table 79 Force 300-16 Power compliance margins, 5.1 GHz, ISEDC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | S @ 20 cm (W/m ²) |
|--------------|----------------------|------------------------|----------|----|--------------------------|----------|----------|-------------------------------------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.021 | 40 | 9.01 | 0.09 | 0.1 | 1.69 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.013 | 40 | 9.01 | 0.07 | 0.1 | 1.02 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.678 | 2 | 9.01 | 0.10 | 0.3 | 2.14 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.089 | 2 | 9.01 | 0.04 | 0.1 | 0.28 |

Table 80 Force 300-16 Power compliance margins, 5.8 GHz, ISEDC

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | S @ 20 cm (W/m ²) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|----------------------------------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.830 | 40 | 9.69 | 0.18 | 0.3 | 65.72 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.1 | 40 | 9.69 | 0.18 | 0.3 | 7.92 |
| PTP SM | 20 MHz | On-board, 2 dBi | 0.830 | 2 | 9.69 | 0.10 | 0.2 | 2.62 |
| PTP SM | 80 MHz | On-board, 2 dBi | 0.389 | 2 | 9.69 | 0.07 | 0.1 | 1.23 |



Note Gain of antenna in dBi = $10 \cdot \log (G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At EU 5.8 GHz the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

Table 81 Force 300-16 Power compliance margins, 5.8 GHz (EIRP 36 dBm)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.1 | 40 | 10 | 0.18 | 0.3 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.1 | 40 | 10 | 0.18 | 0.3 |



Note If there are no EIRP limits in the country of installation, use the distance calculations in [Table 82](#) and [Table 83](#).

Table 82 Force 300-16 Power compliance margins, 5.1 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.794 | 40 | 10 | 0.5 | 1.0 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.794 | 40 | 10 | 0.5 | 1.0 |

Table 83 Force 300-16 Power compliance margins, 5.8 GHz (full Tx power)

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) |
|--------------|----------------------|---------------------|----------|----|--------------------------|----------|----------|
| PTP SM | 20 MHz | Patch Array, 16 dBi | 0.794 | 40 | 10 | 0.5 | 1.0 |
| PTP SM | 80 MHz | Patch Array, 16 dBi | 0.794 | 40 | 10 | 0.5 | 1.0 |

Compliance with radio regulations

This section describes how the ePMP complies with the radio regulations that are enforced in various countries.



Attention Changes or modifications not expressly approved by Cambium Networks could void the user's authority to operate the system.

Type approvals

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency bands in which the system operates may be unlicensed and, in these bands, the system can be used provided it does not cause interference. The system is not guaranteed protection against interference from other products and installations.

The radio specification type approvals that have been granted for ePMP frequency variants are listed under [Table 63](#).

Table 84 Force 300-25 Radio certifications

| Frequency band | Region | Regulatory approvals |
|----------------|--------|---|
| 5 GHz | USA | FCC Part 15 Class B |
| | Canada | IC RSS-210 Issue 8, Annex 8 (or latest) |
| | | IC RSS247 Issue 1 (May 2015) |
| | Europe | ETSI EN302 502 v1.2.1 |
| | | ETSI EN301 893 v1.7.1 |

FCC and ETSI compliance testing

The system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation. To comply with FCC RF exposure limits for general population or uncontrolled exposure, the antenna(s) used for the ePMP transmitter must be installed to ensure a separation distance specified in Table 64 through Table 83 from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM Responsibilities to comply with FCC and Industry Canada Regulations

The ePMP Module is certified for integration into products only by OEM integrators under the following conditions:

1. The antenna(s) must be installed such that a minimum separation distance specified in Table 64 through Table 83 is maintained between the radiator (antenna) and all persons at all times.
2. The transmitter module must not be co-located or operate in conjunction with any other antenna or transmitter. As long as the two conditions above are met, further transmitter testing is not required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).



Note In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID cannot be used.



Note A Class B Digital Device is a device that is marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.

Notwithstanding that Cambium Networks has designed (and qualified) the ePMP products to generally meet the Class B requirement to minimize the potential for interference, the ePMP product range is not marketed for use in a residential environment.

End Product Labelling

The ePMP Module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

Table 85 ePMP Product labeling

| Device | Label |
|------------------------|---|
| ePMP 3000 Access Point | “Contains Transmitter Module FCC ID: Z8H89FT0024” or “Contains FCC ID: Z8H89FT0024” |
| Force 300-25 | “Contains Transmitter Module FCC ID: Z8H89FT0017” or “Contains FCC ID: Z8H89FT0017” |
| Force 300-16 | “Contains Transmitter Module FCC ID: Z8H89FT0016” or “Contains FCC ID: Z8H89FT0016” |

Notifications

This section contains notifications of compliance with the radio regulations that are enforced in various regions.

5.1 GHz regulatory compliance

The ePMP complies with the regulations that are enforced in the USA, Canada and Europe. The relevant notifications are specified in this section.

5.1 GHz FCC and IC notification

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification.

This device complies with part 15.407 of the US FCC Rules and Regulations and with RSS-210 Issue 8 of Industry Canada. 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. In Canada, users must be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5470 – 5725 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN). To comply with FCC/IC RF exposure limits for general population or uncontrolled exposure, the antenna(s) used for the ePMP transmitter must be installed at a separation distance specified in Table 64 through Table 83.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. 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 these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

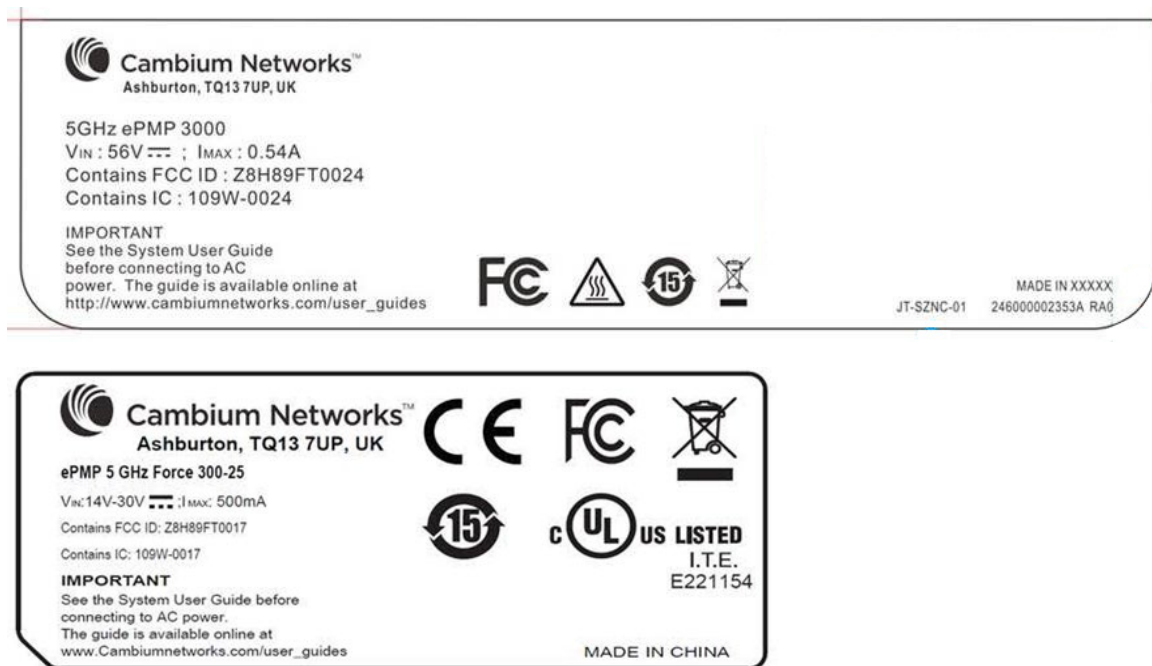
FCC IDs and Industry Canada Certification Numbers are reproduced on the product label ([Figure 40](#)).

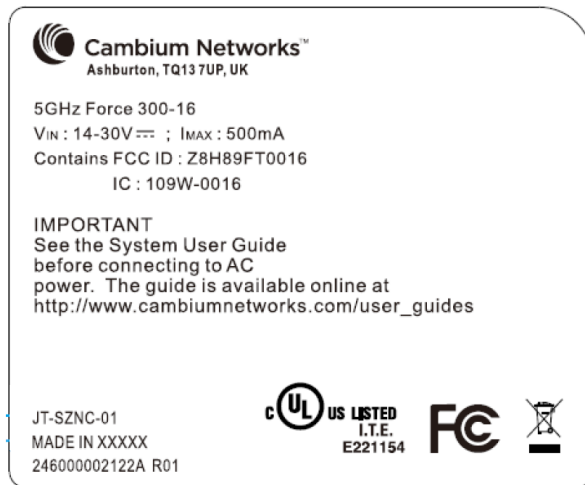
End Product Labelling

The ePMP Module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

Table 86 Product labeling

| Device | Label |
|------------------------|---|
| ePMP 3000 Access Point | “Contains Transmitter Module FCC ID: Z8H89FT0024” or “Contains FCC ID: Z8H89FT0024” |
| Force 300-25 | “Contains Transmitter Module FCC ID: Z8H89FT0017” or “Contains FCC ID: Z8H89FT0017” |
| Force 300-16 | “Contains Transmitter Module FCC ID: Z8H89FT0016” or “Contains FCC ID: Z8H89FT0016” |

Figure 40 FCC and IC certifications on 5 GHz product labels



Wherever necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

5.8 GHz regulatory compliance

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency band in which the system operates is “license exempt” and the system is allowed to be used provided it does not cause interference. The licensing authority does not guaranteed protection against interference from other products and installations.

U.S. Federal Communication Commission (FCC)

This device complies with part 15 of the US 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US 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 these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

Industry Canada (IC)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B conforme à la norme NMB-003 du Canada.

RSS-GEN issue 3 (7.1.3) Licence-Exempt Radio Apparatus:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

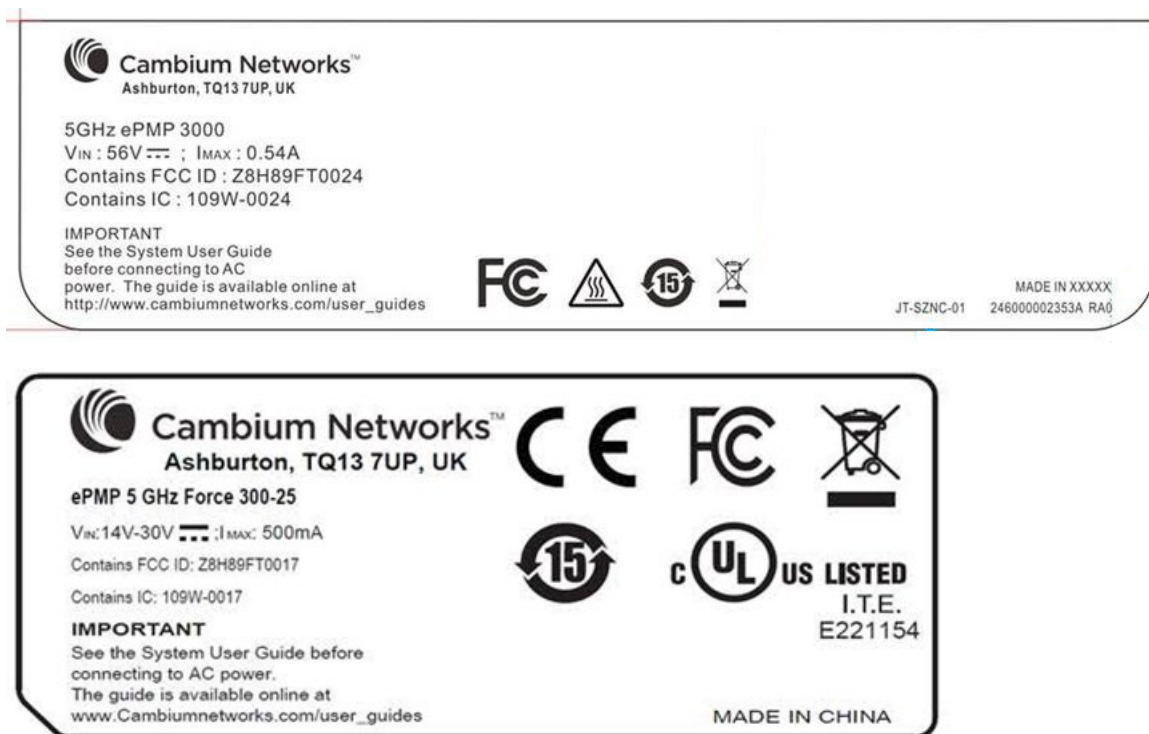
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

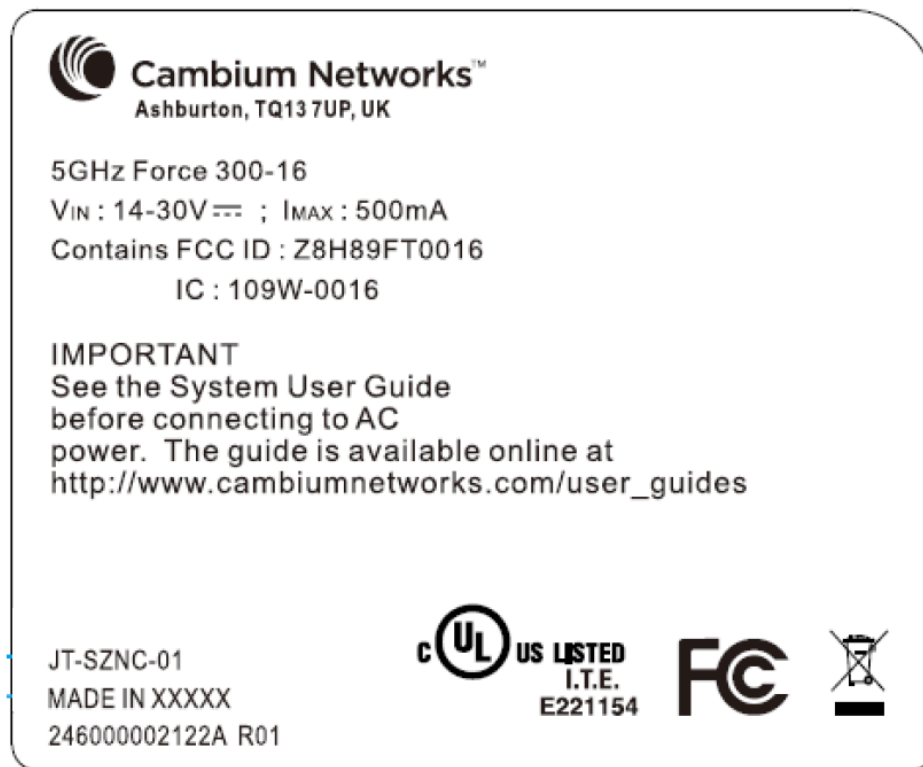
In Canada, high power radars are allocated as primary users (meaning they have priority) of the 5650 – 5850 MHz spectrum. These radars could cause interference or damage to license-exempt local area network (LE-LAN) devices.

Product labels

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (Figure 41).

Figure 41 FCC and IC certifications on 5.8 GHz product label





Wherever necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

Radio Specifications



Product Specifications

For up-to-date performance and mechanical specifications for ePMP products, please visit:

<https://www.cambiumnetworks.com/products/pmp-distribution/>

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 |
| 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 |
| 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 |