



ePMP™

User Guide

System Release 2.4

- Product Description
- System Planning
- Configuration
- Operation and Troubleshooting
- Legal and Reference Information

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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

Connectorized ePMP devices 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 307.

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.

USA and Canada specific information

The USA Federal Communications Commission (FCC) has asked manufacturers to implement special features to prevent interference to weather radar systems that operate in the band 5600 MHz to 5650 MHz. These features must be implemented in all products able to operate outdoors in the band 5470 MHz to 5725 MHz.

Manufacturers must ensure that such radio products cannot be configured to operate outside of FCC rules; specifically it must not be possible to disable or modify the radar protection functions that have been demonstrated to the FCC.

In order to comply with these FCC requirements, Cambium supplies variants of the ePMP for operation in the USA or Canada. These variants are only allowed to operate with license keys and country codes that comply with FCC/IC rules. In particular, operation of radio channels overlapping the band 5600-5650 MHz is not allowed and these channels are permanently barred.

In addition, other channels may also need to be barred when operating close to weather radar installations.



Note

To ensure compliance with FCC rules (KDB 443999: Interim Plans to Approve UNII Devices Operating in the 5470 - 5725 MHz Band with Radar Detection and DFS Capabilities), follow **Avoidance of weather radars** on page 61.

Other variants of the ePMP are available for use in the rest of the world, but these variants are not supplied to the USA or Canada except under strict controls, when they are needed for export and deployment outside the USA or Canada.

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)..

Avoidance of weather radars

The installer must be familiar with the requirements in FCC KDB 443999. Essentially, the installer must be able to:

- Access the FCC data base of weather radar location and channel frequencies.

- Use this information to correctly configure the product (using the GUI) to avoid operation on channels that must be avoided according to the guidelines that are contained in the KDB and explained in detail in this user guide.

In ETSI regions, the band 5600 MHz to 5650 MHz is reserved for the use of weather radars.

External antennas

When using a connectorized version of the product (as compared to the version with an integrated antenna), the conducted transmit power must be reduced to ensure the regulatory limit on transmitter EIRP is not exceeded. The installer must have an understanding of how to compute the effective antenna gain from the actual antenna gain and the antenna cable losses.

The product GUI automatically applies the correct conducted power limit to ensure that it is not possible for the installation to exceed the EIRP limit, when the appropriate values for antenna gain are entered into the GUI.

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 **System planning** on page 58.

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 set ups at base workshop before live deployments.

Contents

Safety and regulatory information.....	3
Important safety information	3
Important regulatory information	3
Contents	6
About This User Guide.....	10
General information	11
Version information	11
Contacting Cambium Networks	11
Problems and warranty	13
Security advice.....	14
Warnings, cautions, and notes	15
Caring for the environment.....	16
Product description	17
Overview of ePMP	18
Purpose	18
Key features	18
Typical deployment Equipment	19
Wireless operation.....	20
Time division duplexing.....	20
OFDM and channel bandwidth	20
Adaptive modulation	20
MIMO.....	20
Radar avoidance.....	21
Encryption	21
Country codes	21
PMP networks.....	22
Further reading on wireless operation	23
System management	24
Management agent	24
Web server.....	24
SNMP.....	26
Network Time Protocol (NTP).....	26
Cambium Network Services Server	26
Software upgrade.....	26
Further reading on system management	26
System hardware	27
Site planning.....	28
Site installation	28
Grounding and lightning protection.....	28
Lightning protection zones	29
Connectorized Module	30
Connectorized Module description.....	30
Connectorized part numbers	31
Connectorized module mounting bracket.....	31
Connectorized Module interfaces.....	32
Connectorized Module LEDs.....	33
Connectorized Module specifications.....	34
Connectorized Module heater	35

Connectorized Module and external antenna location	35
Connectorized Module wind loading	36
Connectorized Module software packages	36
Connectorized module antennas and antenna cabling.....	37
Antenna requirements.....	37
FCC and IC approved antennas.....	37
Integrated Module	38
Integrated Module description	38
Integrated Module part numbers.....	39
Integrated Module mounting bracket.....	39
Integrated Module interfaces	40
Integrated Module LEDs.....	41
Integrated Module specifications	41
Integrated Module heater	42
Integrated Module wind loading.....	42
Integrated Module software packages	43
Un-synced Connectorized Radio	44
Un-synced Connectorized Radio description	44
Un-synced Connectorized Radio part numbers.....	45
Un-synced Connectorized Radio mounting bracket.....	45
Un-synced Connectorized Radio Interfaces	46
Un-synced Connectorized Radio LEDs.....	46
Un-synced Connectorized Radio specifications	48
Un-synced Connectorized Radio heater	49
Un-synced Connectorized Radio and external antenna location	49
Un-synced connectorized Radio wind loading	50
Un-synced Connectorized Radio software packages.....	51
Un-synced connectorized radio antennas and antenna cabling.....	51
Antenna requirements.....	51
FCC and IC approved antennas.....	51
Power supply description	52
Power supply part numbers.....	52
Power supply interfaces	53
Power supply specifications.....	54
Power supply location.....	54
Ethernet cabling.....	55
Ethernet standards and cable lengths.....	55
Outdoor Cat5e cable.....	55
Surge Suppression unit.....	56
Cambium 600SSH details	57
System planning	58
Radio spectrum planning	59
General wireless specifications	59
Regulatory limits.....	60
Conforming to the limits.....	60
Available spectrum.....	60
Channel bandwidth.....	61
Avoidance of weather radars	61
Link planning	62
Range and obstacles.....	62
Path loss	62
Adaptive modulation	62

Planning for connectorized units.....	63
Calculating maximum power level for connectorized units	63
Data network planning.....	64
Ethernet interfaces.....	64
Management VLAN.....	64
Quality of service for bridged Ethernet traffic.....	65
Configuration.....	66
Preparing for configuration	67
Safety precautions	67
Regulatory compliance	67
Connecting to the unit	68
Configuring the management PC	68
Connecting to the PC and powering up	69
Using the web interface	70
Logging into the web interface.....	71
Layout of the web interface.....	72
Configuring connectorized radios using the Quick Start menu	81
Configuring SM units using the Quick Start menu.....	84
Using the AP menu options	87
AP Configure menu	88
AP Monitor menu	111
AP Tools menu	126
Using the SM menu options.....	146
SM Configuration menu	147
SM Monitor menu.....	177
SM Tools menu	194
Radius Server	208
Installing Free-radius on Ubuntu 12.04 LTS.....	208
Configuring Free-radius server	208
Configuring radius parameters on AP	210
Configuring radius parameters on SM	211
Configuring MIR profiles	212
Creating certificate for Radius server and SM device.....	213
Operation and Troubleshooting	218
General Planning for Troubleshooting	219
General Fault Isolation Process	219
Questions to Help Isolate the Problem.....	220
Upgrading device software.....	221
Upgrading on-board GPS chip firmware.....	222
Testing hardware	223
Checking the power supply LED	223
Power LED is off.....	223
Ethernet LED is off.....	223
Troubleshooting the radio link	225
Module has lost or does not establish radio connectivity	225
Link is unreliable or does not achieve data rates required.....	226
Module Has Lost or Does Not Gain GPS Synchronization.....	226
Using the device external reset button.....	227
Resetting the ePMP to factory defaults by power cycling.....	228
Legal and reference information.....	229

Cambium Networks end user license agreement	230
Acceptance of this agreement.....	230
Definitions.....	230
Grant of license.....	230
Conditions of use	230
Title and restrictions.....	231
Confidentiality.....	231
Right to use Cambium's name.....	232
Transfer	232
Updates	232
Maintenance	232
Disclaimer	232
Limitation of liability.....	233
U.S. government.....	233
Term of license	233
Governing law	233
Assignment.....	233
Survival of provisions.....	233
Entire agreement.....	234
Third party software	234
Preamble.....	244
TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION...	245
END OF TERMS AND CONDITIONS.....	250
Hardware warranty	301
Limit of liability	302
System threshold, output power and link loss	303
Compliance with safety standards	305
Electrical safety compliance.....	305
Electromagnetic compatibility (EMC) compliance.....	305
Human exposure to radio frequency energy	306
Compliance with radio regulations.....	316
Type approvals	316
FCC and ETSI compliance testing	316
Examples of regulatory limits.....	318
Notifications.....	335
2.4 GHz, 5.4 GHz regulatory compliance.....	335
5.8 GHz regulatory compliance.....	339
Thailand notification	343
Data throughput tables.....	344
Data throughput capacity.....	344
Radio Specifications	347
Connectorized Radio Specifications.....	347
Integrated Radio Specifications	351
Un-synced Connectorized Radio Specifications	355
Glossary.....	359

About This User Guide

This guide describes the planning, installation, configuration and operation of the Cambium ePMP Series of point-to-multipoint 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**
- **System planning**
- **Legal and reference information**

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

- **Configuration**
- **Operation and Troubleshooting**

For radio equipment installation, refer to the following guides:

- The *ePMP Quick Start Guide*
- The *ePMP Installation Guide*



Note

The *ePMP Installation Guide* is reproduced as an addendum to this user guide.

General information

VERSION INFORMATION

The following shows the issue status of this document:

Issue	Date of issue	Remarks
001v000	October 2013	System Release 1.0 (Software Release 1.1.6)
002v000	December 2013	System Release 1.0 (Software Release 1.2.3)
003v000	January 2014	System Release 1.0 (Software Release 1.3.4)
004v000	March 2014	System Release 1.0 (Software Release 1.4.1)
005v000	March 2014	System Release 1.0 (Software Release 1.4.3)
006v000	April 2014	System Release 1.0 (Software Release 1.4.4)
007v000	June 2014	System Release 2.0 (Software Release 2.0)
008v000	July 2014	System Release 2.1 (Software Release 2.1)
010v000	September 2014	System Release 2.2 (Software Release 2.2)
011v000	October 2014	System Release 2.3 (Software Release 2.3)
012v000	November 2014	System Release 2.3.1 (Software Release 2.3.1)
013v000	December 2014	System Release 2.3.3 (Software Release 2.3.3)
014v000	December 2014	System Release 2.3.4 (Software Release 2.3.4)
015v000	March 2015	System Release 2.4 (Software Release 2.4)

CONTACTING CAMBIUM NETWORKS

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

Purpose

Cambium Networks enhanced Point-To-Multipoint (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 **green text** in electronic versions, are active links to the references.

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents.

For feedback, e-mail to support@cambiumnetworks.com.

Problems and warranty

Reporting problems

If any problems are encountered when installing or operating this equipment, follow this procedure to investigate and report:

- 1 Search this document and the software release notes of supported releases.
- 2 Visit the support website:
<http://www.cambiumnetworks.com/support/epmp>
- 3 Ask for assistance from the Cambium product supplier.
- 4 Gather information from affected units, such as any available diagnostic downloads.
- 5 Escalate the problem by emailing or telephoning support:
<http://www.cambiumnetworks.com/support/contact-support>

Repair and service

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

Warranty

Cambium's standard hardware warranty is for one (1) year 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 PMP products or activate warranties, visit the support website.

For warranty assistance, contact the reseller or distributor.



Caution

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 deployment.

Warnings, cautions, and notes

The following describes how warnings and cautions are used in this document and in all documents of the Cambium Networks document set.

Warnings

Warnings 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.

Cautions

Cautions precede instructions and 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. A caution has the following format:



Caution

Caution text and consequence for not following the instructions in the caution.

Notes

A note means that there is a possibility of an undesirable situation or provides 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

<http://www.cambiumnetworks.com/support>

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.

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 deployment. 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 **18**.
- How the ePMP wireless link is operated, including modulation modes, power control and security is described under **Wireless operation** on page **20**.
- The ePMP management system, including the web interface, installation, configuration, alerts and upgrades is described in **System management** on page **24**.

Overview of ePMP

This section introduces the key features, typical uses, product variants and components of the ePMP.

PURPOSE

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

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.

KEY FEATURES

The ePMP is a high performance wireless bridge for Ethernet traffic with a maximum UDP throughput of 200+ Mbps (40 MHz Channel Bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. Its maximum LOS range is 13 mi (20 MHz channel bandwidth) or 9 mi (40 MHz channel bandwidth).

Utilizing GPS sync, the ePMP is an ideal fit for networks that require capacity and reliability for superior QoS in remote and underserved areas. The integrated PTP and PMP solution features an efficient GPS synchronized operational mode that permits highly scalable frequency reuse.

The ePMP operates in the unlicensed 5 GHz and 2.4 GHz bands and supports a channel bandwidth of up to 40 MHz. It is available with an integrated antenna or in connectorized version for use with an external antenna.

The wireless link is primarily TDD based. System Release 1.2.3 added a Flexible Frame Ratio option which provides improved latency and throughput under unsynchronized operational mode.

From a network point-of-view, the ePMP wireless link is a transparent Layer 2 bridge. It offers limited switching capability in order to support a primary and a secondary (future release) Ethernet port on the Subscriber Module.

ePMP supports quality of service (QoS) classification capability and supports three traffic priorities. Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

System Release 1.3.4 adds support for RADIUS EAP-TTLS authentication and VSA support for MIR.

When deployed with a sector antenna, the ePMP 1000 GPS Sync Radio can be configured as a GPS synchronized Access Point serving ePMP Integrated Radios configured as Subscriber Modules. When deployed with a high gain point to point antenna, the ePMP GPS Sync Radio can be configured to be a GPS Synchronized Backhaul Master, forming a PTP link with another ePMP Radio module.

A summary of the main ePMP characteristics is listed under **Table 1**.

Table 1 Main characteristics of the ePMP Series

Characteristic	Value
Topology	PMP or PTP
Wireless link condition	LOS, near LOS
Range	5 MHz: Up to 21 mi 10 MHz: Up to 17 mi 20 MHz: Up to 13 mi 40 MHz: Up to 9 mi
Scheduler	TDD (fixed ratios or Flexible), ePTP
Connectivity	Ethernet
Operating frequencies	Unlicensed bands, 5 GHz and 2.4 GHz
Channel bandwidth	5 MHz, 10 MHz, 20 MHz or 40 MHz
Data rate	200+ Mbps

TYPICAL DEPLOYMENT EQUIPMENT

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

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

- **Connectorized Radio with GPS Sync:** A connectorized outdoor transceiver unit containing all the radio, networking, and surge suppression electronics.
- **GPS Sync Connectorized Radio:** An indoor power supply module providing Power-over-Ethernet (PoE) supply and 1000/100/10 Base-TX to the Access Point.
- **Connectorized Radio Cabling and lightning protection:** Shielded Cat5e cables, grounding cables, and connectors.
- **Integrated Radio:** An integrated-antenna outdoor transceiver unit containing all the radio, networking, antenna, and surge suppression electronics.
- **Integrated or Un-sync Connectorized Radio:** A connectorized outdoor transceiver unit containing all the radio, networking and surge suppression electronics.
- **Integrated Radio Power Supply:** An indoor power supply module providing Power-over-Ethernet (PoE) supply and 100/10 Base-TX to the Subscriber Module.
- **Integrated Radio Cabling and lightning protection:** Shielded Cat5e cables and connectors

For more information about these components, including interfaces, specifications and Cambium part numbers, see [System hardware](#) on page 27.

Wireless operation

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

TIME DIVISION DUPLEXING

TDD cycle

ePMP links operate using Time Division Duplexing (TDD). The links employ a TDD cycle in which the APs determines which SMs 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. A flexible frame ratio is available as a fourth option where the AP dynamically determines the downlink and uplink ratio based on data demand in each direction.

OFDM AND CHANNEL BANDWIDTH

The ePMP series 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 5 MHz, 10 MHz, 20 MHz or 40 MHz, based on operator configuration.

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

ADAPTIVE MODULATION

The ePMP series can transport data over the wireless link using a number of different modulation modes ranging from 64-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 64QAM will transport data at a much higher rate than the less complex modulation modes, the receiver requires a much higher signal to noise ratio.

The ePMP series 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.

MIMO

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

The ePMP transmits two signals on the same radio frequency, one of which is 90 degrees offset from the other.

RADAR AVOIDANCE

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

To meet this requirement, the 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

The 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
- Frequency range



Caution

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

PMP NETWORKS

Using frequency planning

Frequency planning is the exercise of assigning operating channels to PMP units so as to minimize RF interference between links. Frequency planning must consider interference from any PMP unit to any other PMP unit in the network. Low levels of interference normally allow for stable operation and high link capacity.

The frequency planning task is made more straightforward by use of the following techniques:

- Using several different channels
- Separating units located on the same mast
- Configuring a 5 MHz guard band between adjacent sector operating band edges.

For help with planning networks, see [System planning](#). You can also contact your Cambium distributor or reseller.

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 is described under **Radio spectrum planning** on page **59**
- 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 **62**.
- The safety specifications against which the ePMP has been tested are listed under **Compliance with safety standards** on page **305**. 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 **316**.
- Compliance with the radio regulations that are enforced in various regions is explained under **Notifications** on page **332**.
- Tables and graphs to support calculation of the data rate capacity that can be provided by ePMP configurations are available at **Data throughput tables** on page **344**.

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

- The configuration parameters of the ePMP devices described under **Configuration** on page **66**.
- Post-installation procedures and troubleshooting tips explained under **Operation and Troubleshooting** on page **218**.

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 or over the air (SM).

The management agent supports the following interfaces:

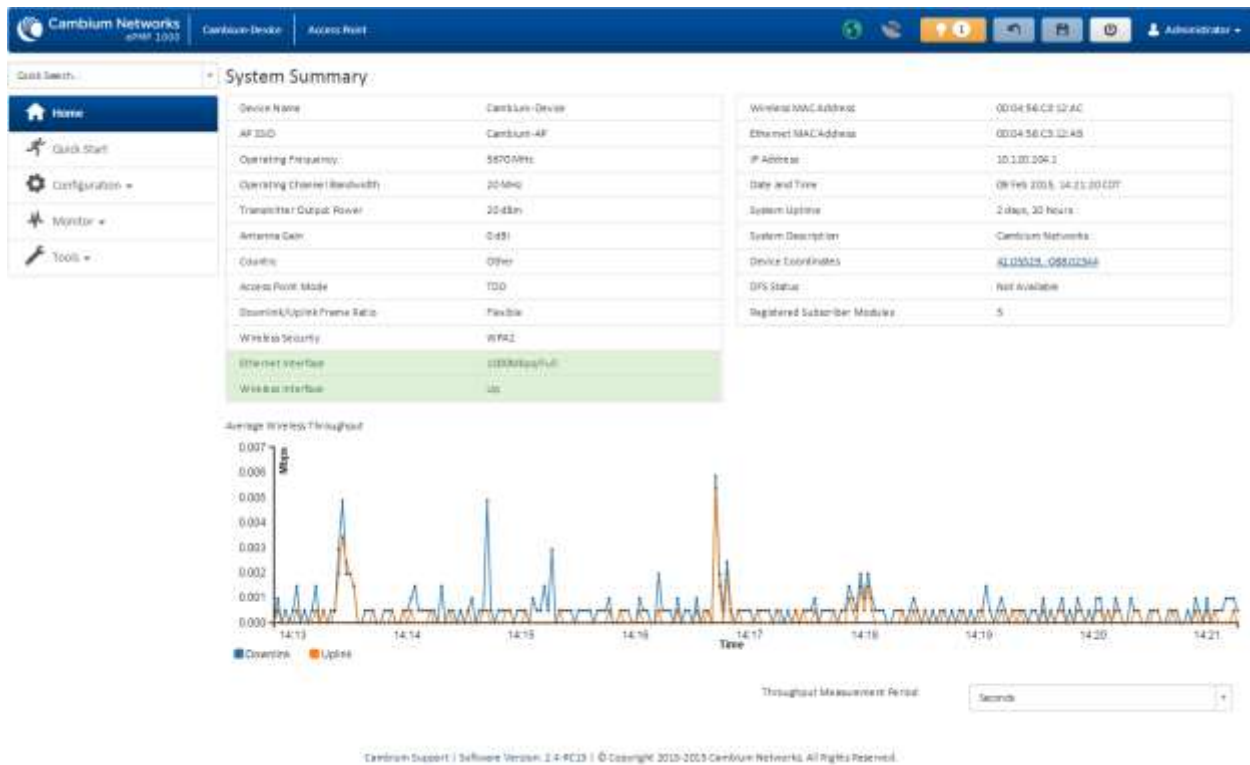
- Hypertext Transfer Protocol (HTTP)
- Hypertext Transfer Protocol secure (HTTPS)
- Simple Network Management Protocol (SNMP)
- Network Time Protocol (NTP)
- System logging (Syslog)
- Cambium Network Services Server (CNSS) software
- Dynamic Host Configuration Protocol (DHCP)

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.

Figure 1 AP web-based management screenshot



Web pages

The web-based management interfaces provide comprehensive web-based fault, configuration, performance and security management functions organized into the following web-pages and groups:

Access Point and Subscriber Module web-pages:

- **Dashboard:** The Dashboard web-page reports the general device status, session status, remote subscriber status, event log information, and network interface status.
- **Configure:** The Configuration web-page may be utilized for configuring general device parameters, as well as IP, radio, SNMP, Quality of Service (QoS), security, time, VLAN, protocol filtering, and unit settings.
- **Monitor:** The Monitor web-page reports detailed operating statistics for the radio link and network, and reports system log information.
- **Tools:** The tools web-page offers useful tools for device installation, configuration, and operation including software upgrade, backup/restore, spectrum analyzer, throughput test, ping test, and traceroute.
- **Quick Start:** The Quick Start web-page provides quick access to requisite parameters for radio link establishment and network access.

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.

ePMP devices may receive NTP data from a CMM3 or CMM4 module or an NTP server configured in the system's management network.

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

CAMBIUM NETWORK SERVICES SERVER

The Cambium Network Services Server (CNSS) may be used to monitor, configure, and upgrade Cambium network equipment.

For Cambium Network Services Server download, see <https://support.cambiumnetworks.com/files/cnss>.

SOFTWARE UPGRADE

Software upgrades may be issued via the radio web interface (**Tools => Software Upgrade**) or via CNSS (Cambium Networks Services Server).

For Software upgrades, see

<https://support.cambiumnetworks.com/files/epmp>.

FURTHER READING ON SYSTEM MANAGEMENT

For more information on system management, see:

- **AP System page** on page 101
- **SM System page** on page 158
- **Operation and Troubleshooting** on page 218

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 **28**.
- The connectorized module hardware, part numbers, mounting equipment, and specifications are described under **Connectorized Module** on page **30**.
- The SM hardware, part numbers, mounting equipment and specifications are described under **Integrated Module** on page **38**.
- The hardware, part numbers, mounting equipment and specifications are described under **Un-synced Connectorized Radio** on page **44**.
- The power supply hardware, part numbers and specifications are described under **Power supply** on page **52**.
- The AP antenna and part numbers are described under **Connectorized module antennas and antenna cabling** on page **37**.
- Cable standards and lengths are described under **Ethernet cabling** on page **55**.
- Surge suppression requirements and recommendations are described under **Surge Suppression unit** on page **56**.

Site planning

Conduct a site survey to ensure that the proposed AP and SM 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 AP or SM.

There is only one Ethernet interface, a copper Cat5e connection from the AP or SM to the AP/SM power supply and network terminating equipment. If a 1000 Base-TX (Gigabit) Ethernet connection is required at the AP, ensure that power supply N000900L001A is utilized.

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.

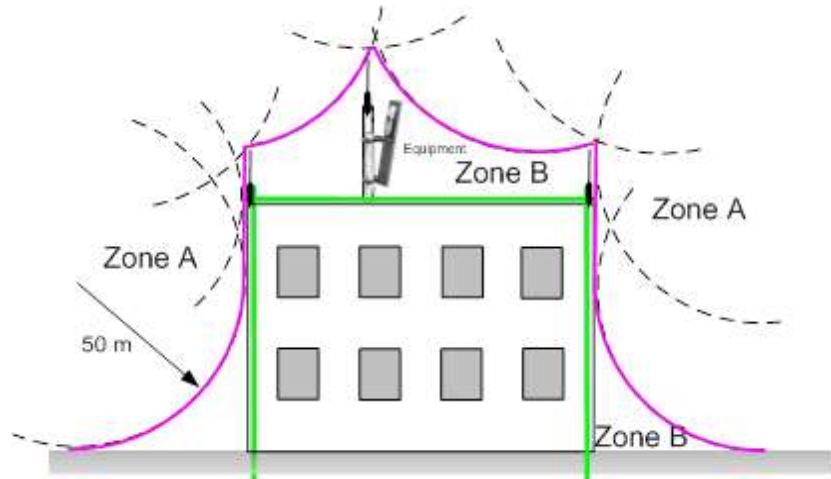
LIGHTNING PROTECTION ZONES

Use the rolling sphere method (**Figure 2**) 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 2 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.

Connectorized Module

For details of the ePMP connectorized hardware, see:

- [Connectorized Module description](#) on page 30
- [Connectorized part numbers](#) on page 31
- [Connectorized Module interfaces](#) on page 32
- [Connectorized Module specifications](#) on page 34
- [Connectorized Module and external antenna location](#) on page 35
- [Connectorized Module wind loading](#) on page 36
- [Connectorized Module software packages](#) on page 36
- [Connectorized module antennas and antenna cabling](#) on page 37

CONNECTORIZED MODULE DESCRIPTION

The connectorized ePMP device is a self-contained transceiver unit that houses both radio and networking electronics. The connectorized unit is designed to work with externally mounted antennas that have high gains. Connectorized units can cope with more difficult radio conditions. The unit is designed with female RP-SMA 50Ω antenna connections located at the top of the unit. An ePMP connectorized unit may function as an Access Point (AP) or a Subscriber Module (SM) in a Point-To-Multipoint (PMP) or in a Point-To-Point (PTP) network topology.



Note

To select antennas, RF cables and connectors for connectorized units, see [Connectorized module antennas and antenna cabling](#) on page 37.

Figure 3 ePMP Series Connectorized Radio with Sync



CONNECTORIZED PART NUMBERS

Choose the correct regional variant: one is for use in regions where FCC or IC licensing restrictions apply (FCC/IC), and the other is for use in ETSI countries or non-FCC/IC/ETSI-restricted regions.

Each of the parts listed in **Table 2** includes the following items:

- One connectorized unit
- One power supply 1000/100/10 Base-TX LAN injector

The GPS-capable parts listed in **Table 2** also ship with a GPS antenna.

Table 2 Connectorized part numbers

Cambium description	Cambium part number
ePMP GPS, Conn - 5 GHz - no power cord – ROW version	C050900A011A
ePMP GPS, Conn - 5 GHz – no power cord – EU version	C050900A013A
ePMP GPS, Conn - 5 GHz - US power cord – FCC version	C058900A112A
ePMP GPS, Conn - 2.4 GHz - US power cord	C024900A011A

Table 3 AP accessory part numbers

Cambium description	Cambium part number
ePMP Power Supply for GPS Radio - no cord (spare)	N000900L001A
ePMP Power Supply for non-GPS Radio - no cord (spare)	N000900L002A

CONNECTORIZED MODULE MOUNTING BRACKET

The connectorized unit is designed to be attached to a Cambium ePMP sector antenna (see **Table 10**). The Cambium ePMP sector antenna contains all of the mounting brackets, antenna cabling, and GPS antenna mounting for device deployment.

Figure 4 Connectorized module sector antenna



CONNECTORIZED MODULE INTERFACES

The connectorized module interfaces are illustrated in **Figure 5** and described in **Table 4**.

Figure 5 Connectorized module interfaces

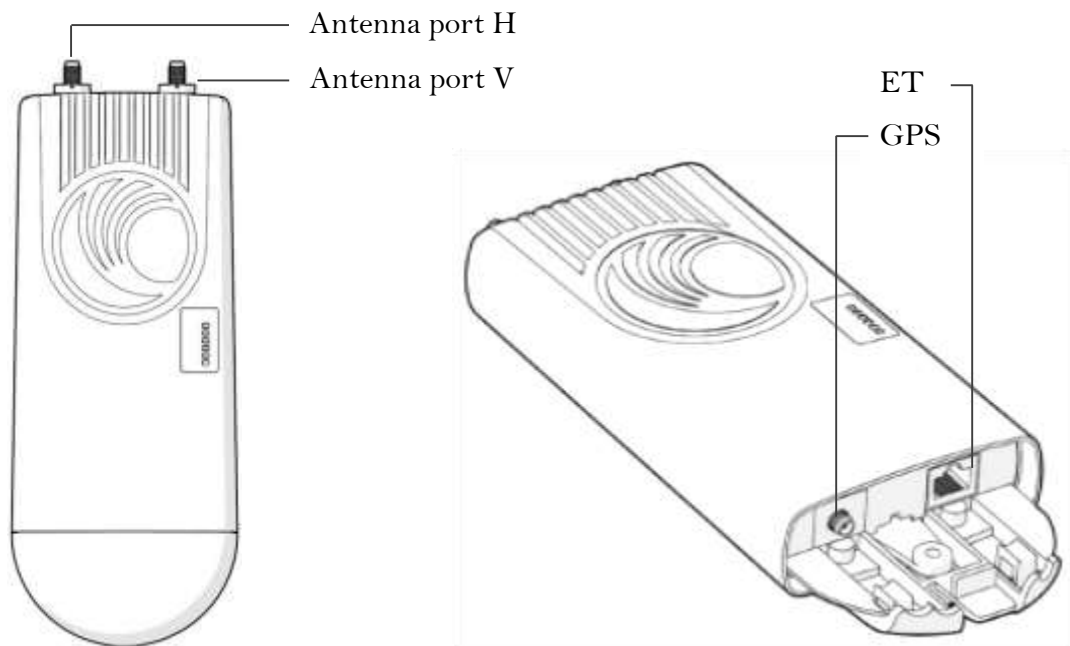
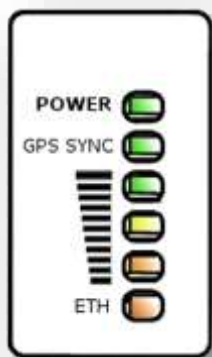



Table 4 Connectorized module interfaces

Name	Connector	Interface	Description
Antenna port H	RP-SMA, female	Antenna, H polarization	To/from H polarized antenna port
Antenna port V	RP-SMA, female	Antenna, V polarization	To/from V polarized antenna port
ETH	RJ45	PoE input	802.3af PoE Standard, as well as Proprietary power over Ethernet (PoE) twisted pair (for powering via CMM3/CMM4)
		10/100/1000 Base-TX Ethernet	Management and data
GPS	SMA, female	Antenna, GPS	To/from GPS antenna
Reset Button	Physical button	N/A	For resetting the radio and for setting the radio back to its factory default configuration. See Using the device external reset button on page 227.

CONNECTORIZED MODULE LEDS



LED	Function
POWER	Green: Power is applied to the device Unlit: No power is applied to the device or improper power source
GPS SYNC	Orange: AP has acquired a 1PPS GPS synchronization pulse either from the internal GPS module and antenna or from a connected CMM Unlit: 1PPS GPS not acquired, or Synchronization Source set to Internal (AP generating sync, not GPS-based)
	Reserved for future release
ETH	Once lit, blinking indicates Ethernet activity Red: 10BaseTX link Green: 100BaseTX link Orange: 1000BaseTX link Unlit: No Ethernet link established

CONNECTORIZED MODULE SPECIFICATIONS

The ePMP connectorized module conforms to the specifications listed in [Table 5](#) and [Table 6](#).

The connectorized module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [305](#) and provides internal surge suppression but does not provide lightning suppression.

For a full listing of connectorized radio specifications, see [Connectorized Radio Specifications](#) on page [347](#).

Table 5 Connectorized module physical specifications

Category	Specification
Dimensions (H x W x D)	Radio: 227 x 88 x 33 mm (8.9" x 3.5" x 1.3")
	Antenna: 529 x 124 x 53 mm (20.8" x 4.9" x 2.1")
Weight	.521 kg (1.15 lbs) without antenna
	4.5 kg (10 lbs) with antenna

Table 6 Connectorized module environmental specifications

Category	Specification
Temperature	-30°C (-22°F) to +55°C (131°F)
Wind loading	118 mph (190 kph) maximum. See Connectorized Module wind loading on page 36 for a full description.
Humidity	95% condensing
Environmental	IP55

CONNECTORIZED MODULE HEATER

At startup, if the ePMP connectorized 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 7 Connectorized module 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

CONNECTORIZED MODULE AND EXTERNAL ANTENNA LOCATION

Find a location for the device and external antenna 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 307.
- The equipment is lower than the top of the supporting structure (tower, mast or building) or its lightning air terminal.
- The location is not subject to excessive wind loading. For more information, see **Connectorized Module wind loading** on page 36.

CONNECTORIZED MODULE 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 is available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 190 Kph (118 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 8](#) and [Table 9](#).

Table 8 Connectorized module wind loading (Kg)

Type of ePMP device	Largest surface area (square meters)	Wind speed (meters per second)				
		30	40	50	60	70
Connectorized	0.13	12.2 Kg	21.7 Kg	34 Kg	49 Kg	66.6 Kg

Table 9 Connectorized module wind loading (lb)

Type of ePMP device	Largest surface area (square feet)	Wind speed (miles per hour)				
		80	100	120	140	150
Connectorized	1.39	37.4 lb	58.4 lb	84.1 lb	114.4 lb	131.4 lb

CONNECTORIZED MODULE SOFTWARE PACKAGES

Connectorized radios may be upgraded by downloading new software packages from the Cambium Networks website or by using the Cambium Network Services Server. The software packages applicable to ePMP connectorized radios are named:

- ePMP-GPS_Synced-v2.4.tar.gz

Connectorized module antennas and antenna cabling

Connectorized modules require external antennas connected using RF cable (included with Cambium ePMP sector antennas). For details of the antennas and accessories required for a connectorized ePMP installation, see:

- [Antenna requirements](#) on page 37
- [FCC and IC approved antennas](#) on page 37

ANTENNA REQUIREMENTS

For connectorized units operating in the USA or Canada 2.4 GHz, 5.2 GHz, 5.4 GHz or 5.8 GHz bands, choose external antennas from those listed in [FCC and IC approved antennas](#) on page 37. For installations in other countries, the listed antennas are advisory, not mandatory.

FCC AND IC APPROVED ANTENNAS

For connectorized units operating in the USA or Canada, choose external antennas from [Table 10](#). These are approved by the FCC for use with the product and are constrained by the following limits:

- 5 GHz – 15 dBi gain
- 2.4 GHz – 15 dBi gain



	Caution
Using other than approved antennas may cause measurements higher than reported for certification.	
	Caution
<p>This radio transmitter (IC certification number 109W-0005) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.</p>	
<p>Le présent émetteur radio (Numéro de certification IC 109W-0005) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.</p>	

Table 10 Allowed antennas for deployment in USA/Canada

Cambium part number	Antenna Type	Gain (dBi)
C050900D003A	5 GHz Sector Antenna – 90 degree	15
C050900D002A	5 GHz Sector Antenna – 120 degree	15
C024900D004A	2.4 GHz Sector Antenna – 90 / 120 degree	15

Integrated Module

For details of the ePMP integrated hardware, see:

- [Integrated Module description](#) on page 38
- [Integrated Module part numbers](#) on page 39
- [Integrated Module mounting bracket](#) on page 39
- [Integrated Module interfaces](#) on page 40
- [Integrated Module specifications](#) on page 41
- [Integrated Module heater](#) on page 42
- [Integrated Module wind loading](#) on page 42
- [Integrated Module software packages](#) on page 43.

INTEGRATED MODULE DESCRIPTION

The integrated module is a self-contained transceiver unit that houses both radio and networking electronics. An ePMP integrated unit may function as an Access Point (AP) or a Subscriber Module (SM) in a Point-To-Multipoint (PMP) or in a Point-To-Point (PTP) network topology.

Figure 6 ePMP Series Integrated Radio



INTEGRATED MODULE PART NUMBERS

Choose the correct regional variant: one is for use in regions where FCC or IC licensing restrictions apply (FCC/IC) and the other is for use in ETSI countries or the rest of the world (ETSI/RoW).

Each of the parts listed in **Table 11** includes the following items:

- One integrated module (with mounting bracket)
- One metal mounting strap
- Power supply

Table 11 Integrated module part numbers

Cambium description	Cambium part number
ePMP Integrated – 5 GHz – no power cord – ROW version	C050900C031A
ePMP Integrated – 5 GHz – EU power cord – EU version	C050900P033A
ePMP Integrated – 5 GHz – US power cord – FCC version	C058900C132A
ePMP Integrated - 2.4 GHz - US power cord	C024900C031A

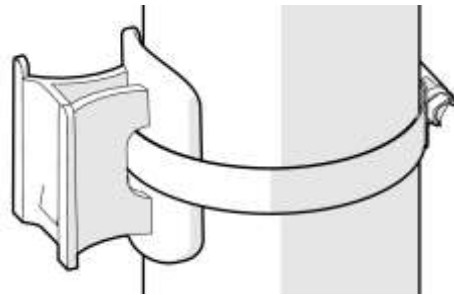
Table 12 Integrated module accessory part numbers

Cambium description	Cambium part number
ePMP Power Supply for non-GPS Radio - no cord (spare)	N000900L002A

INTEGRATED MODULE MOUNTING BRACKET

The integrated module is designed to be pole-mounted using the mounting strap and bracket provided in the box with the radio.

Figure 7 Integrated module mounting bracket



INTEGRATED MODULE INTERFACES

The integrated module interfaces are illustrated in [Figure 8](#) and described in [Table 13](#).

Figure 8 Integrated module interfaces

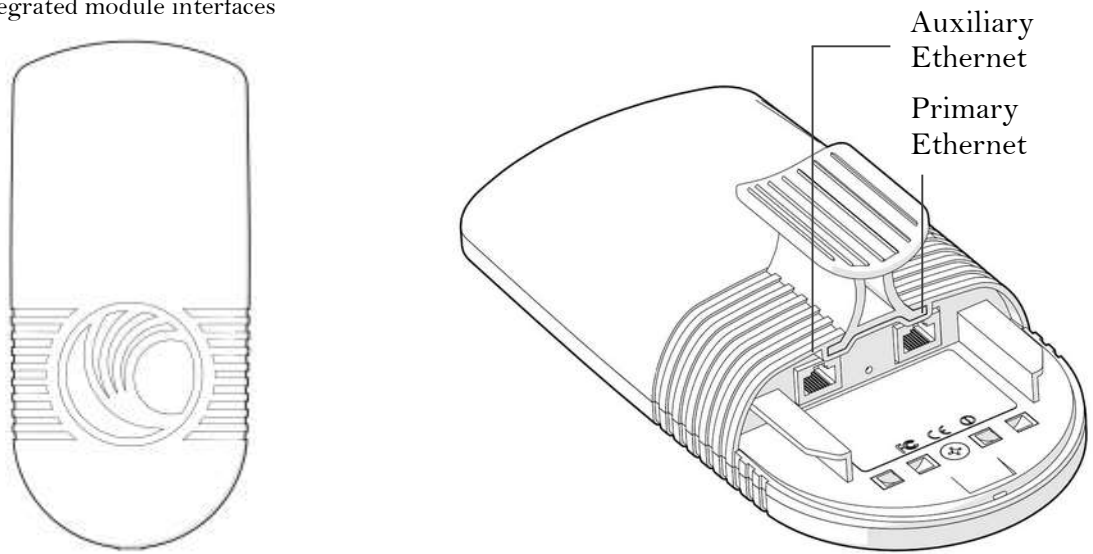
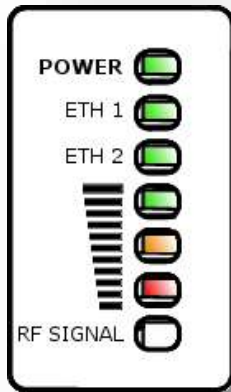


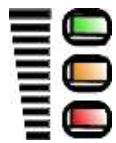
Table 13 Integrated module interfaces

Port name	Connector	Interface	Description
Primary Ethernet	RJ45	PoE input	Proprietary power over Ethernet (PoE) twisted pair (for powering via CMM3/CMM4)
		10/100 Base-TX Ethernet	Management and data
Auxiliary Ethernet (future release)	RJ45	Cambium proprietary PoE output, data bridging	Proprietary 30V PoE output for auxiliary devices (not 802.3af standard PoE)

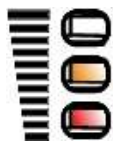
INTEGRATED MODULE LEDS



LED	Function
POWER	Green: Power is applied to the device
	Unlit: No power is applied to the device or improper power source
ETH 1	Main/Primary Ethernet port indicator
	Once lit, blinking indicates Ethernet activity
	Green: 10/100BaseTX link
ETH 2	Auxiliary/Secondary Ethernet port indicator
	Once lit, blinking indicates Ethernet activity
	Green: 10/100BaseTX link
RF SIGNAL	Radio scanning: LEDs light in an ascending sequence to indicate that the radio is scanning
	Radio registered: LEDs light to indicate the RSSI level at the device.



RSSI
> -60
dBm



-70 dBm
< RSSI ≤
-60 dBm



-80 dBm
< RSSI ≤
-70 dBm



RSSI
≤ -80
dBm

INTEGRATED MODULE SPECIFICATIONS

The ePMP integrated module conforms to the specifications listed in [Table 14](#) and [Table 15](#).

The integrated device meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [305](#) and provides internal surge suppression but does not provide lightning suppression.

For a full listing of integrated radio specifications, see [Integrated Radio Specifications](#) on page [351](#).

Table 14 Integrated module physical specifications

Category	Specification
Dimensions (H x W x D)	Radio: 29.1 x 14.5 x 8.3 cm (11.4 x 5.7 x 3.3 in)
Weight	0.49 kg (1.1 lbs)

Table 15 Integrated module environmental specifications

Category	Specification
Temperature	-30°C (-22°F) to +60°C (131°F)
Wind loading	90 mph (145 kph) maximum. See Integrated Module wind loading on page 42 for a full description.
Humidity	95% condensing
Environmental	IP55

INTEGRATED MODULE HEATER

Upon power on, if the ePMP integrated module device 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 integrated module continues its startup sequence.

The effect on integrated module startup time at various temperatures is defined in **Table 16**.

Table 16 Integrated module startup times based on ambient temperature

Initial Temperature	Startup time (from power on to operational)
-22° F (-30° C)	4 minutes
-4° F (-20° C)	2 minutes
14° F (-10° C)	1 minutes, 30 seconds

INTEGRATED MODULE WIND LOADING

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

The integrated module and its mounting bracket are capable of withstanding wind speeds of up to 145 Kph (90 mph).

Wind blowing on the integrated module will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the integrated module. 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 integrated module at different wind speeds, the resulting wind loadings are shown in [Table 17](#) and [Table 18](#).

Table 17 Integrated module wind loading (Kg)

Type of ePMP module	Largest surface area (square meters)	Wind speed (meters per second)				
		30	40	50	60	70
Integrated	0.042	4 Kg	7 Kg	11 Kg	15.8 Kg	21.6 Kg

Table 18 Integrated module wind loading (lb)

Type of ePMP module	Largest surface area (square feet)	Wind speed (miles per hour)				
		80	100	120	140	150
Integrated	0.45	12.1 lb	18.9 lb	27.2 lb	37 lb	42.5 lb

INTEGRATED MODULE SOFTWARE PACKAGES

Integrated radios may be upgraded by downloading new software packages from the Cambium Networks website or by using the Cambium Network Services Server. The software packages applicable to ePMP integrated radios are named:

- ePMP-NonGPS_Synced-v2.4.tar.gz

Un-synced Connectorized Radio

For details of the ePMP connectorized hardware, see:

- [Un-synced Connectorized Radio description](#) on page 44
- [Un-synced Connectorized Radio part numbers](#) on page 45
- [Un-synced Connectorized Radio Interfaces](#) on page 46
- [Un-synced Connectorized Radio specifications](#) on page 48
- [Un-synced Connectorized Radio and external antenna location](#) on page 49
- [Un-synced connectorized Radio wind loading](#) on page 50
- [Un-synced Connectorized Radio software packages](#) on page 51
- [Un-synced connectorized radio antennas and antenna cabling](#) on page 51

UN-SYNCD CONNECTORIZED RADIO DESCRIPTION

Figure 9 ePMP Series Un-synced Connectorized Radio

The connectorized ePMP device is a self-contained transceiver unit that houses both radio and networking electronics. The connectorized unit is designed to work with externally mounted antennas that have high gains. Connectorized units can cope with more difficult radio conditions. The unit is designed with female RP-SMA 50Ω antenna connections located at the top of the unit. An ePMP connectorized unit may function as an Access Point (AP) or a Subscriber Module (SM) in a Point-To-Multipoint (PMP) or in a Point-To-Point (PTP) network topology.



Note

To select antennas, RD cables and connectors for connectorized units, see [Un-synced connectorized radio antennas and antenna cabling](#) on page 51.

UN-SYNCD CONNECTORIZED RADIO PART NUMBERS

Choose the correct regional variant: one is for use in regions where FCC or IC licensing restrictions apply (FCC/IC) and the other is for use in ETSI countries or non-FCC/IC/ETSI-restricted regions.

Each of the parts listed in **Table 19** includes the following items:

- One connectorized unit
- One power supply 100/10 Base-TX LAN injector

Table 19 Un-synced Connectorized Radio part numbers

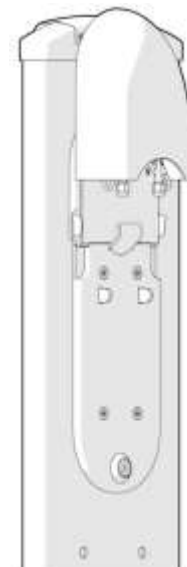
Cambium description	Cambium part number
ePMP Conn – 5 GHz – no power cord – ROW version	C050900A021A
ePMP Conn – 5 GHz – EU power cord – EU version	C050900A023A
ePMP Conn – 5 GHz – US power cord – FCC version	C058900A122A
ePMP Conn – 2.4 GHz – US power cord	C024900A021A

Table 20 AP accessory part numbers

Cambium description	Cambium part number
ePMP Power Supply for non-GPS Radio - no cord (spare)	N000900L002A

UN-SYNCD CONNECTORIZED RADIO MOUNTING BRACKET

Figure 10 Un-synced connectorized radio sector antenna



The un-synced connectorized unit is designed to be attached to a Cambium ePMP sector antenna or with a non-Cambium antenna.

UN-SYNCD CONNECTORIZED RADIO INTERFACES

The un-synced connectorized radio with interfaces are illustrated in [Figure 11](#) and described in [Table 21](#).

Figure 11 Un-synced connectorized radio interfaces

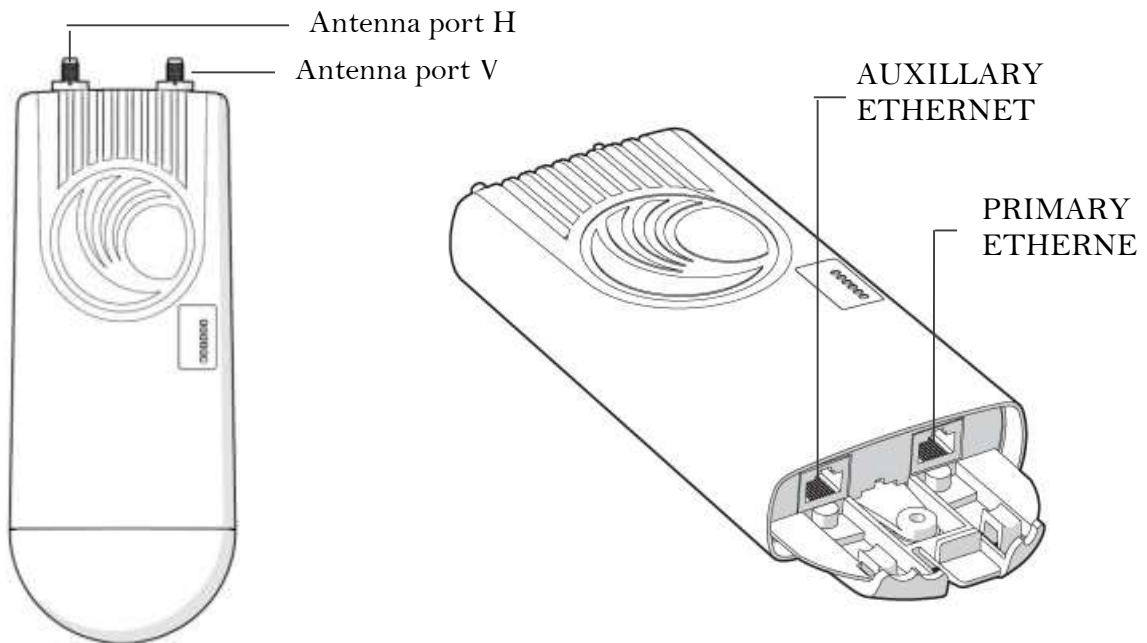
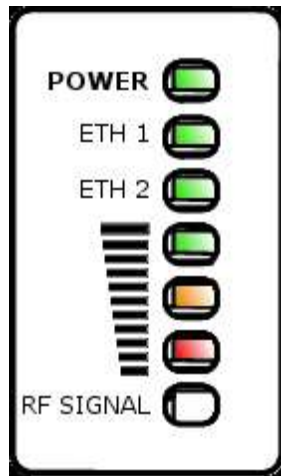



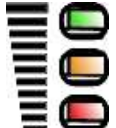
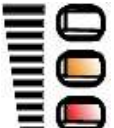


Table 21 Un-synced connectorized radio interfaces

Name	Connector	Interface	Description
Antenna port H	RP-SMA, female	Antenna, H polarization	To/from H polarized antenna port
Antenna port V	RP-SMA, female	Antenna, V polarization	To/from V polarized antenna port
Primary Ethernet	RJ45	PoE input	Proprietary power over Ethernet (PoE) twisted pair (for powering via CMM3/CMM4)
		10/100 Base-TX Ethernet	Management and data
Auxiliary Ethernet (future release)	RJ45	Cambium propriety PoE output, data bridging	Propriety 30V PoE output for auxiliary devices (not 802.3af standard PoE)
Reset Button	Physical button	N/A	For resetting the radio and for resetting the radio back to its factory default configuration, see Using the device external reset button on page 227 .

UN-SYNCD CONNECTORIZED RADIO LEDS



LED	Function
POWER	Green: Power is applied to the device Unlit: No power is applied to the device or improper power source
ETH 1	Main/Primary Ethernet port indicator Once lit, blinking indicates Ethernet activity Green: 10/100BaseTX link
ETH 2	Auxiliary/Secondary Ethernet port indicator Once lit, blinking indicates Ethernet activity Green: 10/100BaseTX link Radio scanning: LEDs light in an ascending sequence to indicate that the radio is scanning Radio registered: LEDs light to indicate the RSSI level at the device.
	Reserved for future release

	RSSI > -60 dBm		-70 dBm < RSSI ≤ -60 dBm		-80 dBm < RSSI ≤ -70 dBm		RSSI ≤ -80 dBm
---	----------------------	---	--------------------------------	---	--------------------------------	---	----------------------

UN-SYNCD CONNECTORIZED RADIO SPECIFICATIONS

The ePMP un-synced connectorized radio conforms to the specifications listed in [Table 22](#) and [Table 23](#).

The connectorized module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [305](#) and provides internal surge suppression but does not provide lightning suppression.

For a full listing of connectorized radio specifications, see [Connectorized Radio Specifications](#) on page [347](#).

Table 22 Un-synced connectorized radio physical specifications

Category	Specification
Dimensions (H x W x D)	Radio: 227 x 88 x 33 mm (8.9" x 3.5" x 1.3")
	Antenna: 529 x 124 x 53 mm (20.8" x 4.9" x 2.1")
Weight	.521 kg (1.15 lbs) without antenna
	4.5 kg (10 lbs) with antenna

Table 23 Un-synced connectorized radio environmental specifications

Category	Specification
Temperature	-30°C (-22°F) to +55°C (131°F)
Wind loading	118 mph (190 kph) maximum. See Un-synced connectorized Radio wind loading on page 50 for a full description.
Humidity	95% condensing
Environmental	IP55

UN-SYNCD CONNECTORIZED RADIO HEATER

On startup, if the ePMP un-synced connectorized radio 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 transfer heat to the device until the startup completes. 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 24](#).

Table 24 Un-synced connectorized radio 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

UN-SYNCD CONNECTORIZED RADIO AND EXTERNAL ANTENNA LOCATION

Find a location for the device and external antenna that meets the following requirements:

- The equipment is high enough to achieve the best radio path.
- People are 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 307.
- The equipment is lower than the top of the supporting structure (tower, mast or building) or its lightning air terminal.
- The location is not subjected to excessive wind loading. For more information, see [Un-synced connectorized Radio wind loading](#) on page 50.

UN-SYNCD CONNECTORIZED RADIO 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 must be available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 190 kph (118 mph).

Wind speeds on the device subjects the mounting structure to significant lateral force. The magnitude of the force depends on both the 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 25](#) and [Table 26](#).

Table 25 Un-syncd connectorized radio wind loading (Kg)

Type of ePMP device	Largest surface area (square meters)	Wind speed (meters per second)				
		30	40	50	60	70
Connectorized	0.13	12.2 Kg	21.7 Kg	34 Kg	49 Kg	66.6 Kg

Table 26 Un-syncd connectorized radio wind loading (lb)

Type of ePMP device	Largest surface area (square feet)	Wind speed (miles per hour)				
		80	100	120	140	150
Connectorized	1.39	37.4 lb	58.4 lb	84.1 lb	114.4 lb	131.4 lb

UN-SYNCD CONNECTORIZED RADIO SOFTWARE PACKAGES

Un-syncd connectorized radio may be upgraded by downloading new software packages from the Cambium Networks website or by using the Cambium Network Services Server. The software packages applicable to ePMP Un-syncd connectorized radio are named:

- ePMP-NonGPS_Syncd-v2.4.tar.gz

UN-SYNCD CONNECTORIZED RADIO ANTENNAS AND ANTENNA CABLING

Un-syncd connectorized radio requires external antennas connected using RF cable (included with Cambium ePMP sector antennas). For details of the antennas and accessories required for a connectorized ePMP installation, see:

- **Antenna requirements** on page 37
- **FCC and IC approved antennas** on page 37

ANTENNA REQUIREMENTS

For connectorized units operating in the USA or Canada 2.4 GHz, 5.4 GHz or 5.8 GHz bands, choose external antennas from those listed in **FCC and IC approved antennas** on page 37. For installations in other countries, the listed antennas are advisory, not mandatory.

FCC AND IC APPROVED ANTENNAS

For connectorized units operating in the USA or Canada, choose external antennas from **Table 27**. These are approved by the FCC for use with the product and are constrained by the following limits:

- 5 GHz – 15 dBi gain
- 2.4 GHz – 15 dBi gain



Caution

Using other than approved antennas may cause measurements higher than reported for certification.

This radio transmitter (IC certification number 109W-0005) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (Numéro de certification IC 109W-0005) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Table 27 Allowed antennas for deployment in USA/Canada – 5 GHz

Cambium part number	Antenna Type	Gain (dBi)
C050900D003A	5 GHz Sector Antenna – 90 degree	15
C050900D002A	5 GHz Sector Antenna – 120 degree	15
C024900D004A	2.4 GHz Sector Antenna - 90 / 120 degree	15

Power supply

For details of the ePMP power supply units, see:

- **Power supply description** on page 52
- **Power supply part numbers** on page 52
- **Power supply interfaces** on page 53
- **Power supply specifications** on page 54
- **Power supply location** on page 54

POWER SUPPLY DESCRIPTION

The power supply is an indoor unit that is connected to the connectorized or integrated 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. For cord part numbers, see **Table 28**. The power supplies listed in **Table 28** may be used for both connectorized and integrated modules, however, only N000900L001A provides a Gigabit Ethernet interface (connectorized modules only).

Table 28 Power supply component part numbers

Cambium description	Cambium part number
ePMP Pwr Supply for GPS Radio - no cord (spare)	N000900L001A
ePMP Pwr Supply for non-GPS Radio - no cord (spare)	N000900L002A

POWER SUPPLY INTERFACES

The power supply interfaces are illustrated in **Figure 12** and described in **Table 29** and **Table 31**.

Figure 12 Power supply interfaces

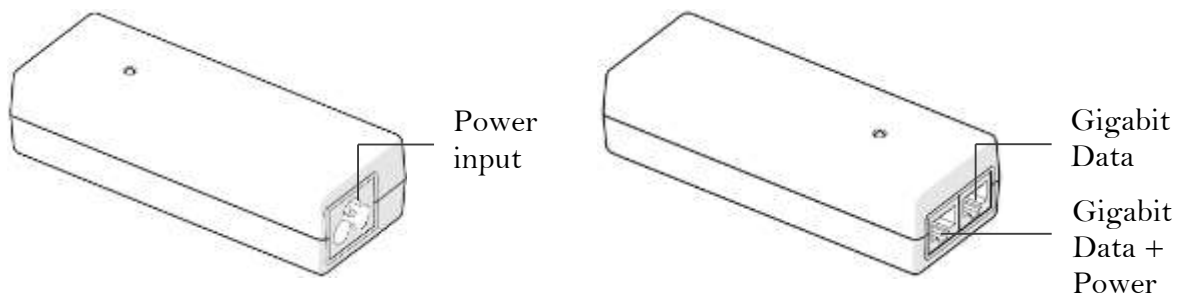


Table 29 Power supply interface functions - N000900L001A


Interface	Function
Power input	Mains power input.
Gigabit Data + Power	RJ45 socket for connecting Cat5e cable to radio
	 Note This port provides a Gigabit Ethernet interface to ePMP GPS Synced connectorized radios. To ePMP integrated radios, this port provides a 10/100 Mbit/sec Ethernet interface.
Gigabit Data	RJ45 socket for connecting Cat5e cable to network.

Table 30 Power supply interface functions - N000900L002A

Interface	Function
Power input	Mains power input.
10/100 Mbit/sec Data + Power	RJ45 socket for connecting Cat5e cable to radio
10/100 Mbit/sec 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](#). These specifications apply to all ePMP product variants.

Table 32 Power supply physical specifications

Category	Specification
Dimensions (H x W x D)	11.8 x 4.4 x 3.2 cm (4.66 x 1.75 x 1.25 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 efficiency level 'V'
Over Current Protection	Zener clamping (38V to 45V)
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 55
- **Outdoor Cat5e cable** on page 55

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)
N000900L001A	Power Supply for Radio with Gigabit Ethernet (no cord)	330 feet (100m)
N000900L002A	Power Supply for Radio with 100Mbit Ethernet (no cord)	330 feet (100m)

(*1) Maximum length of Ethernet cable from AP/SM to power supply

OUTDOOR CAT5E CABLE

For copper connections from the device to the power supply, use Cat5e cable that is shielded with copper-plated steel.



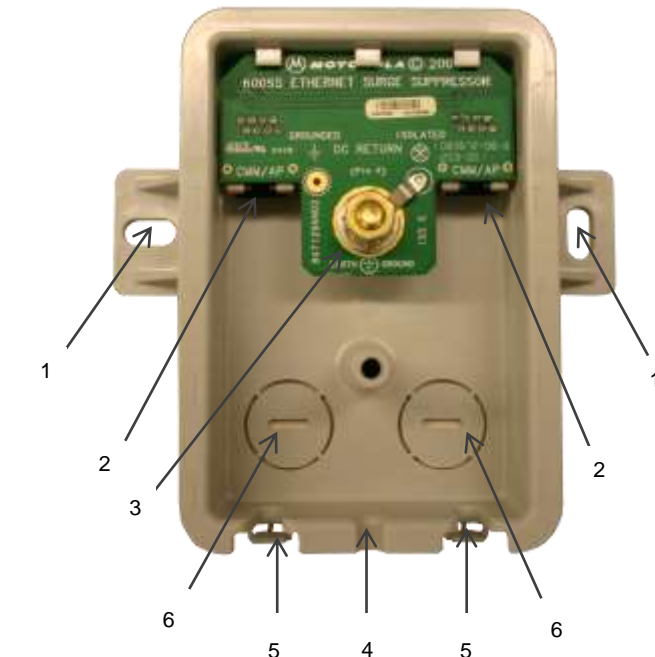
Caution

Always use Cat5e cable that is shielded with copper-plated steel. Alternative types of Ethernet cables are not supported by Cambium Networks.

Surge Suppression unit

The ePMP integrated and connectorized units both contain 1 Joule-rated surge suppression built into the device. With this built-in surge suppression, it is not required to install a surge suppressor at the unit's mounting location. However, it is required to install a surge suppressor at the Ethernet cable's building ingress into the power supply's indoor location. For installations that do not require Gigabit (1000 Mbit/sec) Ethernet, a Cambium 600SSH surge suppressor may be used. For more details, see [Cambium 600SSH details](#).

CAMBIUM 600SSH DETAILS



Note

For connectorized module installations requiring Gigabit (1000 Mbit/sec) Ethernet surge suppression, utilize the following:

Mfr	Part	Description
L-COM	AL-CAT6JW	Outdoor 10/100/1000 Base-T CAT6 PoE Compatible Lightning Protector
L-COM	AL-CAT6HPJW	Outdoor 10/100/1000 Base-T CAT6 PoE Compatible Lightning Protector – High Power (protection comparable to 600SSH)

- 1 Holes—for mounting the Surge Suppressor to a flat surface (such as an outside wall). The distance between centers is 4.25 inches (108 mm).
- 2 RJ-45 connectors—One side (neither side is better than the other for this purpose) connects to the product (AP, SM, or cluster management module). The other connects to the AC adaptor's Ethernet connector.
- 3 Ground post and washer—use heavy gauge (10 AWG or 6 mm²) copper wire for connection. Refer to local electrical codes for exact specifications.



Note

The 600SSH surge suppressor is shipped in the “isolated” position (pin 4 isolated by 68V from protective earth). If packet error issues occur over the Ethernet link (verify by pinging the device through the 600SSH), configure the 600SSH to “grounded” position (by moving the 600SSH switch from “isolated” to “ground”) to avoid ground loops that may be present in the system.

- 4 Ground Cable Opening—route the 10 AWG (6 mm²) ground cable through this opening.
- 5 CAT-5 Cable Knockouts—route the two CAT-5 cables through these openings, or alternatively through the Conduit Knockouts.
- 6 Conduit Knockouts—on the back of the case, near the bottom. Available for installations where cable is routed through building conduit.

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 59.
- Factors to be considered when planning links such as range, path loss and throughput are described under **Link planning** on page 62.
- Factors to be considered when planning to use connectorized APs with external antennas in ePMP links are described under **Planning for connectorized units** on page 63.
- The grounding and lightning protection requirements of a ePMP installation is described under **Grounding and lightning protection** on page 28.
- Factors to be considered when planning ePMP data networks are described under **Data network planning** on page 64.

Radio spectrum planning

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



Caution

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 or not.

GENERAL WIRELESS SPECIFICATIONS

The wireless specifications that apply to all ePMP variants are listed under **Table 36**. The wireless specifications that are specific to each frequency variant are listed in **Table 37**.

Table 36 ePMP wireless specifications (all variants)

Item	Specification
Channel selection	Automatic and Manual selection (fixed frequency).
Manual power control	To avoid interference to other users of the band, maximum power can be set lower than the default power limit.
Integrated device antenna type	Patch antenna
Duplex scheme	Adaptive TDD (with optional Standard 802.11n Wi-Fi on SM)
Range	21 mi (5 MHz channel bandwidth) 17 mi (10 MHz channel bandwidth) 13 mi (20 MHz channel bandwidth) 9 mi (40 MHz channel bandwidth)
Over-the-air encryption	AES
Error Correction	FEC

Table 37 ePMP wireless specifications (per frequency band)

Item	5 GHz	2.4 GHz
RF band (GHz)	5150 - 5875 MHz	2407 - 2472 MHz
Channel bandwidth	5 MHz, 10 MHz, 20 MHz or 40 MHz	5 MHz, 10 MHz, 20 MHz or 40 MHz
Typical antenna gain	Connectorized antenna – 15 dBi Integrated patch antenna – 13 dBi Reflector dish antenna – 6 dBi	Connectorized antenna - 15 dBi Integrated patch antenna - 11 dBi Reflector dish antenna – 8 dBi
Antenna beamwidth (Integrated)	24° azimuth, 12° elevation	24° azimuth, 12° elevation
Antenna beamwidth	10° azimuth, 25° elevation	10° azimuth, 28° elevation

(Relector dish)

REGULATORY LIMITS

The local regulator may restrict frequency usage and channel width and may limit the amount of conducted or radiated transmitter power. For details of these restrictions, see [Examples of regulatory limits](#) on page 317.

Many countries impose EIRP limits (Allowed EIRP) on products operating in the bands used by the ePMP Series. For example, in the 5 GHz and 2.4 GHz bands, these limits are calculated as follows:

- In the 5.2 GHz (5250 MHz to 5350 MHz) and 5.4 GHz (5470 MHz to 5725 MHz) band, the EIRP must not exceed the lesser of 30 dBm or $(17 + 10 \times \text{Log Channel width in MHz})$ dBm.
- 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.
- In the 2.4 GHz band (2400 MHz to 2500 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 and 2.4 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 using connectorized APs with external antennas, the regulations may require the maximum transmit power to be reduced. To ensure that regulatory requirements are met for connectorized installations, see [Calculating maximum power level for connectorized units](#) on page 63. When operating in ETSI regions, it is required to enter a license key in the ePMP web management interface to unlock 5.8 GHz band frequencies. This key may be obtained from <https://support.cambiumnetworks.com/licensekeys/epmp>.
- When installing 5.4 GHz links in the USA, it may be necessary to avoid frequencies used by Terminal Doppler Weather Radar (TDWR) systems. For more information, see [Avoidance of weather radars](#) on page 61.

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.



Note

In Italy, there is a regulation which requires a general authorization of any 5.4 GHz radio link which is used outside the operator's own premises. It is the responsibility of the installer or operator to have the link authorized. For details, see:

http://www.sviluppoeconomico.gov.it/index.php?option=com_content&view=article&idmenu=672&idarea1=593&andor=AND&idarea2=1052&id=68433§ionid=1,16&viewType=1&showMenu=1&showCat=1&idarea3=0&andorcat=AND&partebassaType=0&idareaCalendario1=0&MvediT=1&idarea4=0&showArchiveNewsBotton=0&directionidUser=0

For the form that must be used for general authorization, see:

http://www.sviluppoeconomico.gov.it/images/stories/mise_extra/Allegato%20n19.doc

Certain regulations have allocated certain channels as unavailable for use:

- ETSI has allocated part of the 5.4 GHz band to weather radar.
- UK and some other European countries have allocated part of the 5.8 GHz band to Road Transport and Traffic Telematics (RTTT) systems.

For details of these restrictions, see **Examples of regulatory limits** on page 317.

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 the UK and some other 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.

For more information about configuring the **Country Code** parameter, see **AP Radio page** on page 89 and **SM Radio page** on page 148.

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 317.

Wider a channel bandwidth greater is its capacity. As narrower channel bandwidths take up lesser 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.

AVOIDANCE OF WEATHER RADARS

To comply with FCC rules (KDB 443999: Interim Plans to Approve UNII Devices Operating in the 5470 - 5725 MHz Band with Radar Detection and DFS Capabilities), units which are installed within 35 km (22 miles) of a Terminal Doppler Weather Radar (TDWR) system (or have a line of sight propagation path to such a system) must be configured to avoid any frequency within +30 MHz or -30 MHz of the frequency of the TDWR device. This requirement applies even if the master is outside the 35 km (22 miles) radius but communicates with outdoor clients which may be within the 35 km (22 miles) radius of the TDWRs.

The requirement for ensuring 30 MHz frequency separation is based on the best information available to date. If interference is not eliminated, a distance limitation based on line-of-sight from TDWR will need to be used. In addition, devices with bandwidths greater than 20 MHz may require greater frequency separation.

When planning a link in the USA, visit <http://spectrumbridge.com/udia/home.aspx>, enter the location of the planned link and search for TDWR radars. If a TDWR system is located within 35 km (22 miles) or has line of sight propagation to the PMP device, perform the following tasks:

- Register the installation on <http://spectrumbridge.com/udia/home.aspx>.
- Make a list of channel center frequencies that must be barred, that is, those falling within +30 MHz or -30 MHz of the frequency of the TDWR radars.

In ETSI regions, the band 5600 MHz to 5650 MHz is reserved for the use of weather radars.

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:

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

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.

Planning for connectorized units

This section describes factors to be taken into account when planning to use connectorized APs with external antennas in ePMP networks.

CALCULATING MAXIMUM POWER LEVEL FOR CONNECTORIZED UNITS

If a connectorized ePMP link is to be installed in a country that imposes an EIRP limit in the selected band, choose an external antenna and RF cable that will not cause the ePMP to exceed the EIRP limit. To calculate the highest setting of Maximum Power Level that will be permitted, use this formula:

$$\text{Maximum Power Level (dBm)} = \text{Allowed EIRP (dBm)} - \text{Antenna Gain (dBi)} + \text{Cable Loss (dB)}$$

Where:

Is:

Maximum Power Level (dBm)	the highest permissible setting of the Maximum Power Level attribute in the Step 2: Wireless Configuration page,
Allowed EIRP (dBm)	the EIRP limit allowed by the regulations,
Antenna Gain (dBi)	the gain of the chosen antenna,
Cable Loss (dB)	the loss of the RF cable connecting the AP to the antenna.

As the 2.4 GHz, 5.4 GHz and 5.8 GHz have an operating bandwidth of 5 MHz, 10 MHz, 20 MHz or 40 MHz then the maximum allowed EIRP depends on the operating bandwidth of the radio as shown in [Table 38](#).

Table 38 Normal EIRP limits with operating channel bandwidth

Operating bandwidth (MHz)	Allowed EIRP (dBm) at 5.2 GHz	Allowed EIRP (dBm) at 5.4 GHz	Allowed EIRP (dBm) at 5.8 GHz	Allowed EIRP (dBm) at 2.4 GHz
5, 10, 20, 40	24 - 30	24 - 30	36	36

The settings to be used for regions with the EIRP limits in [Table 38](#) are shown in [Table 39](#).

Table 39 Setting maximum transmit power to meet general EIRP limits

Antenna	Maximum available antenna gain (dBi)	Operating bandwidth (MHz)	Transmitter Output Power parameter setting (dBm)			
			5.2 GHz	5.4 GHz	5.8 GHz	2.4 GHz
Connectorized module Sector antenna	15	5, 10, 20, 40	15	15	21	21



Note

Calculations under [Table 39](#) are on the basis of 0.5 dB cable loss and the highest gain antennas per size of which Cambium Networks are aware. At these operating frequencies, antenna cable losses even with short cables are unlikely to ever be below 0.5 dB for practical installations and cable diameters.

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 ePMP Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	10BASE-Te/100BASE-Tx/1000BASE-T IEEE 802.3 IEEE 802.3af (PoE) IEEE802.3u compliant Auto-negotiation
QoS	Proprietary QoS
Interface	10/100/1000BaseT (RJ-45)
Data Rates	See Data throughput tables on page 344 .
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 AP/SM 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 AP/SM 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.

Configuration

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 **67**
- **Using the web interface** on page **70**
- **Configuring connectorized radios using the Quick Start menu** on page **81**
- **Configuring SM units using the Quick Start menu** on page **84**
- **Using the AP menu options** on page **87**
- **Using the SM menu options** on page **146**

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 305, in particular the minimum separation distances.

Observe the following guidelines:

Never work in front of the antenna when the AP 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, see **Compliance with radio regulations** on page 316.

Connecting to the unit

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

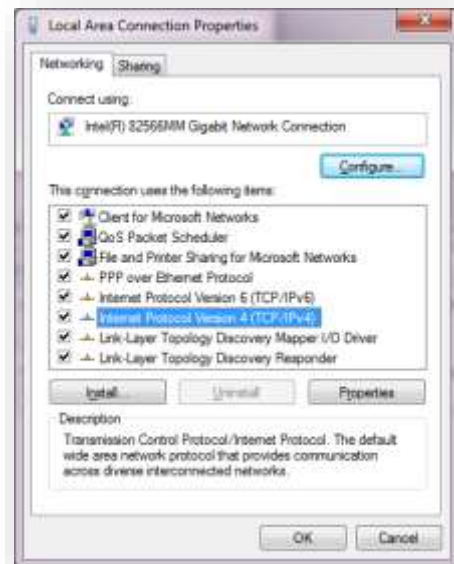
- **Configuring the management PC** on page 68
- **Connecting to the PC and powering up** on page 69

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 192.168.0.X network, avoiding:

192.168.0.1, 192.168.0.2 and 192.168.0.3

A good example is 192.168.0.100:

- 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 – see the *ePMP Installation Guide* for more information).
- 2 Connect the PC Ethernet port to the LAN (AP: “Gigabit Data”, SM: “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 [223](#).

Using the web interface

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

- [Logging into the web interface](#) on page 71
- [Layout of the web interface](#) on page 72
- [Configuring connectorized radios using the Quick Start menu](#) on page 81
- [Configuring SM units using the Quick Start menu](#) on page 84
- [Using the AP menu options](#) on page 87

LOGGING INTO THE WEB INTERFACE

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

Equipment and tools:

- Connectorized or integrated device connected to power supply by Ethernet cable.
- PC connected to power supply by Ethernet cable.
- Power Supply powered up.
- Supported browser – Chrome v29, Firefox v24, Internet Explorer 10, Safari v5.

Procedure:

- 1 Start the web browser from the management PC.

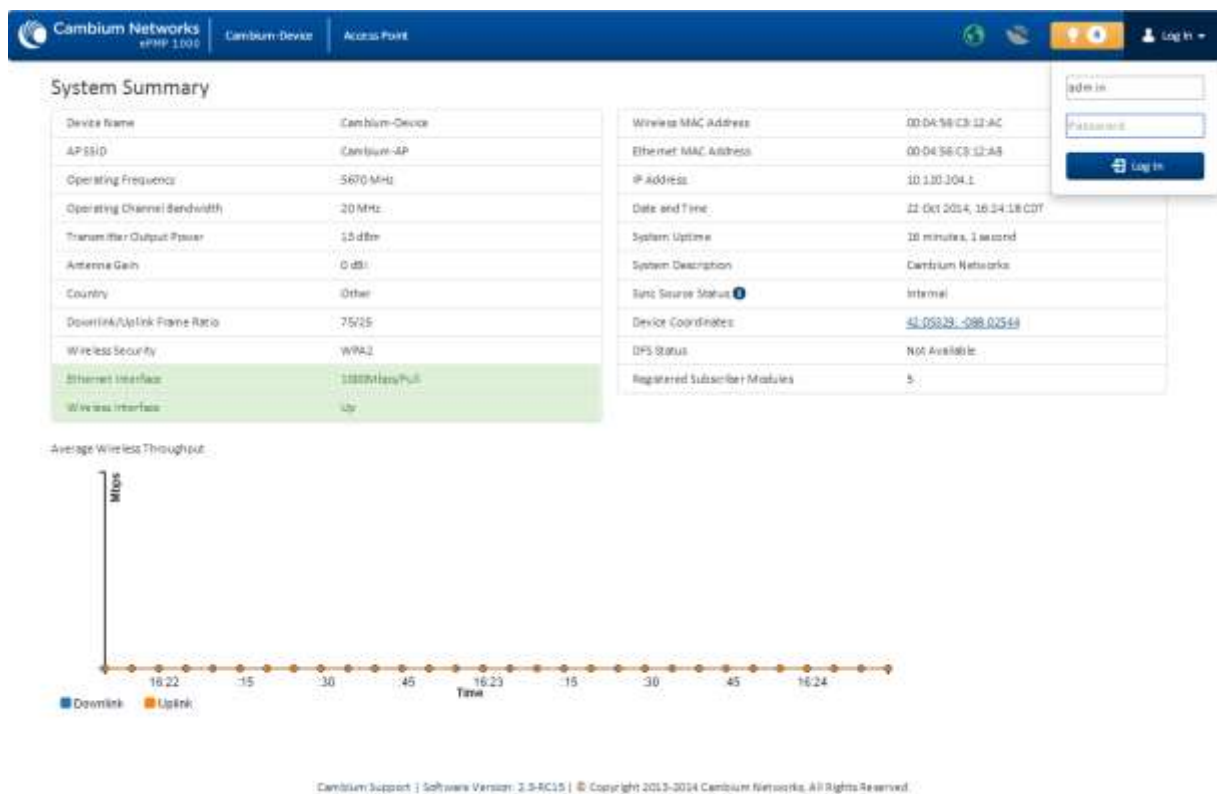
- 2 Type the IP address of the unit into the address bar. The factory default IP address is either 192.168.0.1 (AP mode) or 192.168.0.2 (SM mode). Press **ENTER**. The web interface dashboard and login input is displayed.



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 fallback IP 192.168.0.1 (AP mode), 192.168.0.2 (SM mode), 192.168.0.3 (Spectrum Analyzer mode) or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port.

With Release 2.1, the fallback IP address has changed from 10.1.1.254 to 169.254.1.1.



- 3 Enter **Username** (default: admin) and **Password** (default: admin) at top right corner.
- 4 Click **Login**.



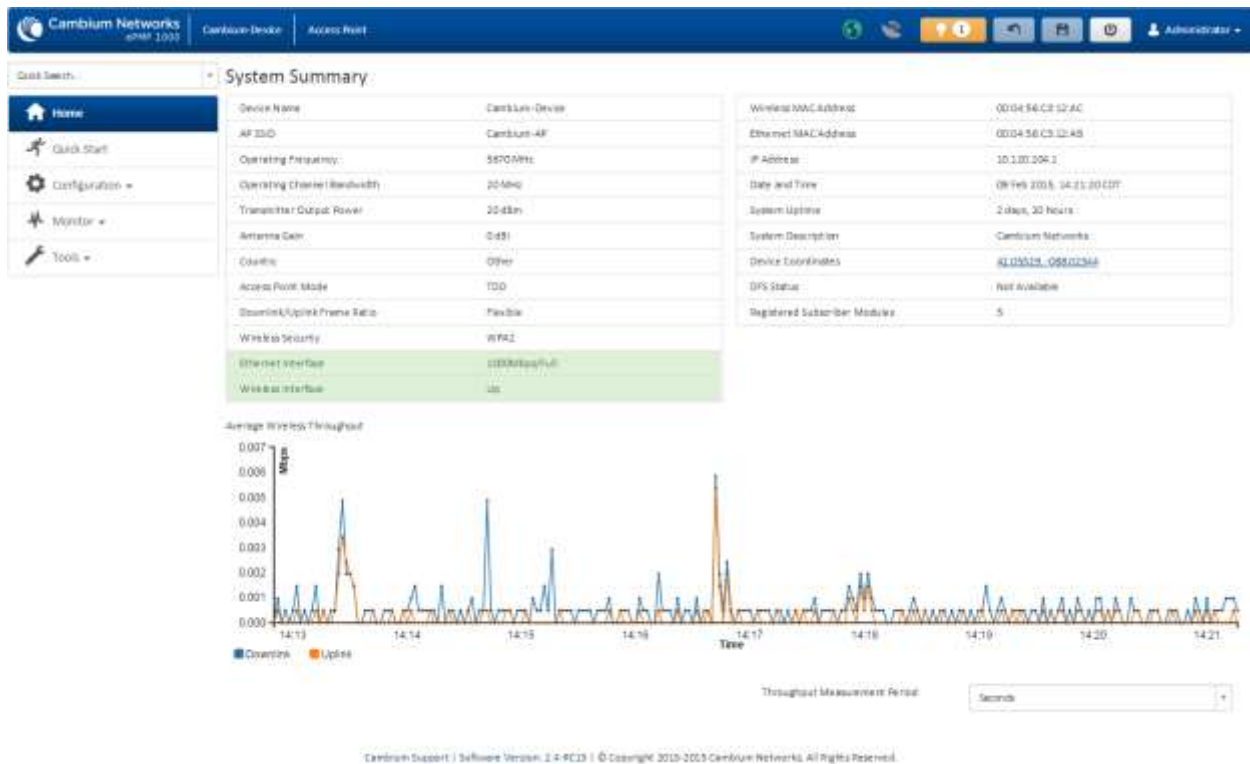
Note

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 => User Account Management**.

LAYOUT OF THE WEB INTERFACE



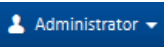



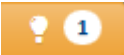

After logging in, the web interface first displays a dashboard view of vital system status and statistics. Also, the first level of navigation is displayed across the top (**Configure, Monitor, Tools** and **Quick Start**). To return to this display at any time, click the **Home** (🏠) icon or device name (i.e. “ePMP Access Point”)




Figure 13 GUI dashboard



The top of the interface contains the following attributes:

Table 41 GUI status bar attributes

Icon	Attribute	Meaning
	Cambium Networks logo	Hyperlink to the Cambium Networks website.
	Home Icon	Link to the device dashboard.
	Login Level indicator	Displays the current user login level.
	Internet Connectivity Indicator	<p>Green indicates that the AP has IP connectivity to the configured DNS server.</p> <p>Grey indicates that the AP has no IP connectivity to the configured DNS server.</p> <hr/> <p> Note</p> <p>The Internet Connectivity Indicator state is determined by receipt of ping responses from the configured DNS server.</p>
	GPS Synchronization Receive Indicator	<p>Green indicates that the AP is receiving a valid GPS synchronization timing pulse via a connected GPS antenna or a CMM.</p> <p>Red indicates that the AP is not receiving GPS synchronization due to lack of satellite fix.</p> <p>Grey indicates that the AP is not receiving GPS synchronization due to configuration of Synchronization Source to Internal.</p>
	Notifications Button	<p>The Notifications button may be clicked to display system messaging. When a new notification is available, the icon is highlighted and displays the number of notifications available. The outer icon highlighting indicates the type of notification pending:</p> <p>Green: Successful operation has completed (i.e. Changes successfully saved)</p> <p>Grey: Informational message (i.e. tips regarding GUI operation)</p> <p>Blue: Operations information message (i.e. Initializing upgrade...)</p> <p>Orange: Warning message (i.e. Login session has expired)</p> <p>Red: Error message (i.e. Software update file download failed)</p>
	Undo Button	The Undo button may be used to undo changes prior to a Save operation. All changes made on any section of the GUI are undone.

Icon	Attribute	Meaning
	Save Button	The Save button is used to commit configuration changes to the device. When configuration changes are made, the outer area of the icon is highlighted blue to indicate that a save operation is required.
	Reset Button	The Reset button is used to reset the device. When a configuration change requires a radio reset, the outer area of this icon is highlighted orange to indicate that a reset is necessary to complete the change.
	Logout Button	The Logout button is used to logout from the current session and return to the initial GUI landing page (login screen).

The bottom of the interface contains the following attributes:

Table 42 GUI footer attributes

Attribute	Meaning
Cambium Support link	Hyperlink to the Cambium Networks support website.
Software Version link	The current software version is reported in the footer bar and may be clicked to navigate to the Cambium Networks software support website.
Copyright	Copyright information.

The AP dashboard contains the following attributes:

Table 43 AP dashboard 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).
AP 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.
Antenna Gain	The configured gain of the external antenna.

Attribute	Meaning
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.
Ethernet Interface	<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 Interface	<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>
Wireless MAC Address	The MAC address of the device wireless interface.
Ethernet MAC Address	The MAC address of the device Ethernet (LAN) interface.
IP Address	The current configured device IP address (LAN) used for management access.
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 source (GPS, CMM or Internal) of sync timing for the AP.
Device Coordinates	The current configured Latitude and Longitude coordinates in decimal format.

Attribute	Meaning
DFS Status	Current DFS operational status.
Registered Subscriber Modules	The total number of SMs currently registered to the AP.

The SM dashboard is as shown in **Figure 14** and the attributes are explained in **Table 44**.

Figure 14 SM Dashboard



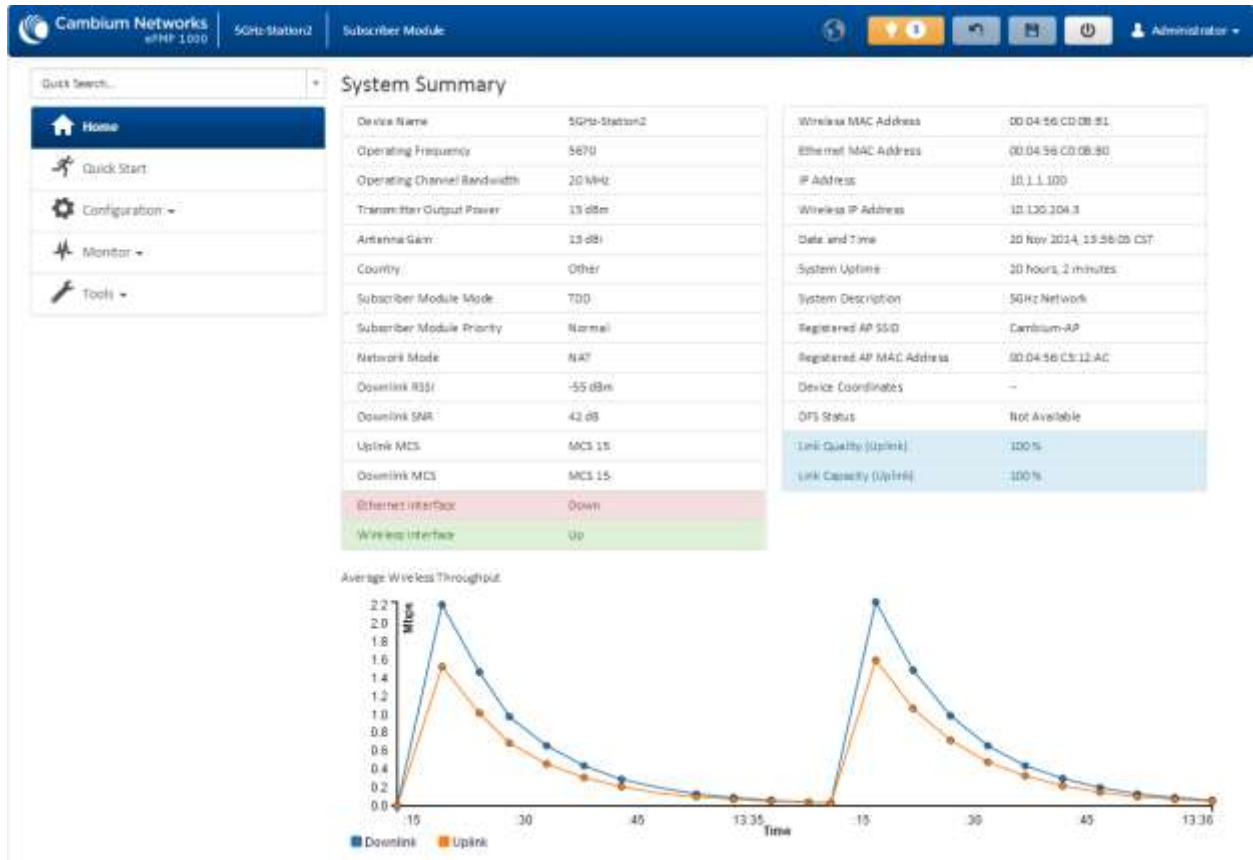
Table 44 SM Dashboard Attributes

Attribute	Meaning
Device Name	The configured device name of the SM, used for identifying the device in an NMS such as the Cambium Network Services Server (CNSS).
Operating Frequency	The current operating frequency.
Operating Channel Bandwidth	The current operating width of the channel used for the radio link.
Transmitter Output Power	The current power level at which the SM is transmitting (which is adjusted dynamically by the AP based on radio conditions).
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).
Subscriber Module Mode	<p>TDD: The SM is operating in the proprietary TDD mode and will only connect to another ePMP Access Point.</p> <p>Standard WiFi: The SM is operating in the Standard 802.11n WiFi mode and will be able to connect to any Access Point operating in standard WiFi mode.</p> <p>ePTP Slave: The SM is operating as a Slave in point-to-point mode. The AP and the system do not support GPS Synchronization in this mode but are 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>
Subscriber Module Priority	The configured priority of the SM in the sector.
Network Mode	<p>Bridge: The SM acts as a switch and the packets are forwarded or filtered based on their MAC destination address.</p> <p>NAT: The SM acts as a router and the packets are forwarded or filtered based on their IP header (source or destination) which can be grouped into subnets for finer granularity.</p>
Downlink RSSI	The Received Signal Strength Indicator, which is a measurement of the power level being received by the SM's antenna.
Downlink SNR	The Signal to Noise Ratio, which is an expression of the carrier signal quality with respect to signal noise and co-channel interference (or both).
Uplink MCS	Modulation and Coding Scheme – indicates the modulation mode used for the radio uplink, based on radio conditions (MCS 1-7, 9-15).
Downlink MCS	Modulation and Coding Scheme – indicates the modulation mode used for the radio downlink, based on radio conditions (MCS 1-7, 9-15).

Attribute	Meaning
Ethernet Interface	<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 Interface	<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>
Wireless MAC Address	The MAC address of the device Wireless interface.
Ethernet MAC Address	The MAC address of the device LAN (Ethernet) interface.
IP Address	The current configured device IP address (LAN, Ethernet interface) used for management access.
Wireless IP Address	The current configured device IP address (Wireless interface), when the SM is in Router (NAT) mode.
Separate Wireless Management IP Address	The current configured device IP address (Separate Wireless Management interface) used for management access, when the SM is in Router (NAT) mode.
Date and Time	The current date and time on the device, subject to the configuration of parameter Time Zone . If an NTP server is not specified, the date and time will begin from factory default upon radio startup.
System Uptime	The total uptime of the radio since the last reset.
System Description	The current configured system description.
Registered AP SSID	The AP SSID of the AP to which the SM is registered.
Registered AP MAC Address	The Wireless MAC Address of the AP to which the SM is registered.
Device Coordinates	The current configured Latitude and Longitude coordinates in decimal format.
DFS Status	Current DFS operational status.
Link Quality (Uplink)	The Uplink quality based on the current MCS and Packet Error Rate (PER).
Link Capacity (Uplink)	The uplink capacity based on the current MCS with respect to the highest supported MCS (MCS15).

The GUI interface consists of two levels of navigation – the first-level navigation buttons on the top (**Configure**, **Monitor**, **Tools** and **Quick Start**) as well as the context-based second-level navigations on the left-hand side of the interface. After a second-level navigation section has been chosen, the resulting configuration parameters are displayed in the main GUI pane. Each subsection of parameters may be configured to display a clean view of only basic parameters, or the display may also be configured to display a comprehensive listing of advanced parameters.

Figure 15 GUI first-level and second-level navigation



Configuring connectorized radios using the Quick Start menu

The **Quick Start** tab contains a listing of parameters required to configure a simple radio link and to configure requisite networking parameters. After configuring an AP, SM and resetting both devices, the SM is ready to associate (register) to the AP.

Figure 16 AP Quick Start menu

The screenshot displays the Cambium Networks ePMP web interface. The top navigation bar includes the Cambium Networks logo and the text "ePMP 3.10.0". Below this, there are tabs for "Cambium Device" and "Access Point". The left sidebar contains a "Quick Search" bar and a list of navigation icons: Home, Quick Start, Configuration, Radio (highlighted), Quality of Service, System, Network, Security, Monitor, and Tools. The main content area is titled "Configuration > Radio". It is divided into several sections:

- General:**
 - Radio Mode:** Access Point (selected), Subscriber Module, Spectrum Analyzer.
 - Access Point Mode:** TDD (selected), ePTP Master, PTP.
 - Country:** Other (selected).
 - Range Unit:** Miles, Kilometers (selected).
 - Point-to-Point Access:** OFF (selected), First Subscriber Module, MAC Filtering.
 - Subscriber Module Wireless MAC:** 88:94:96:C0:00:74.
- Access Point Configuration:**
 - AP SID:** Cambium-AP.
 - Max Registrations Allowed:** 60 (min: 1, max: 120).
 - Max Range:** 5 (min: 1, max: 64) kilometers.
 - Automatic Channel Selection:** Disabled (selected), Enabled.
 - Channel Bandwidth:** 5 MHz, 10 MHz, 20 MHz, 40 MHz (selected).
 - Frequency Carrier:** 5470 MHz.
 - Frequency Reuse:** OFF (selected), Front Sector, Back Sector.
 - Alternate Frequency Carrier 1 Channel Bandwidth:** 5 MHz, 10 MHz, 20 MHz, 40 MHz (selected).
 - Alternate Frequency Carrier 1:** -
 - Alternate Frequency Carrier 2 Channel Bandwidth:** 5 MHz, 10 MHz, 20 MHz, 40 MHz (selected).
 - Alternate Frequency Carrier 2:** -
 - Downlink Max Rate:** 100Mbps.
- Power Control:**
 - Transmitter Output Power:** 18 dBm (min: -24, max: 30).
 - Antenna Gain:** 0 dBi (min: 0, max: 30).
 - Subscriber Module Target Receive Level:** -43 dBm (min: -80, max: -40).
- Scheduler:**
 - Downlink/Uplink Rate:** TS/25 (selected), 50/50, 50/70, Flexible.
 - Carrier Sense:** Disabled (selected), Enabled.
 - AP Management Packet Rate:** MCS0, MCS1 (selected).
- Synchronization:**
 - Synchronization Source:** GPS (selected), OMM, Internal.
 - Synchronization Holdoff Time:** 30 sec (min: 10, max: 86400).

To configure an AP via the Quick Start menu, follow this:

Procedure:

- 1 Start the web browser from the management PC.
- 2 Navigate to the **Quick Start** menu
- 3 Configure the parameter **Radio Mode**:

This parameter controls the function of the device – All ePMP devices may be configured to operate as an Access Point (AP), Subscriber Module (SM) or as a Spectrum Analyzer. For initial link bring-up, choose **AP**

4 Configure the parameter **Access Point Mode**:

This parameter controls the mode of operation of the Access Point – An AP may be configured to operate in TDD mode for multipoint access, PTP mode for point-to-point access using TDD or as an ePTP Master. For initial link bring-up, choose **TDD**. When the AP is an **ePTP Master**, the system does not support GPS Synchronization 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.

5 Configure the parameter **Country**:

Country settings affect the radios in the following ways:

- Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain)
- DFS operation is enabled based on the configured country code, if applicable
- Frequency selection limiting (based on valid frequencies for the configured **Country**)

Select the country in which your network will be operating.

6 Configure the parameter **Automatic Channel Selection (ACS)**:

When ACS is enabled, the AP will automatically scan the available spectrum and choose a channel with the lowest occupancy. For more information on this parameter please see [AP Automatic Channel Selection page](#) on page 138.

7 Configure the parameter **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 Code** parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter.

8 Configure parameter **AP SSID (Name)**:

The **AP SSID (Name)** is used to identify the AP and is used to configure the SM with the appropriate AP with which to register. Ensure that this parameter is configured uniquely for each AP in the network.

9 Configure the parameter **Downlink/Uplink Ratio**:

Specify the percentage of the aggregate throughput for the downlink (frames transmitted from the AP to the SM). For example, if the aggregate (uplink and downlink total) throughput on the AP is 90 Mbps, then 75/25 specified for this parameter allocates 67.5 Mbps for the downlink and 22.5 Mbps for the uplink. The default for this parameter is 75/25.



Caution

You must set this parameter exactly the same for all APs in a cluster.

10 Configure the parameter **Synchronization Source**:

This parameter defines the timing source for the device which can be GPS-based or internally generated. Select **GPS** if the AP will receive synchronization pulses from a connected GPS antenna. Select **CMM** if the device will receive GPS synchronization pulses from a co-located Cambium Cluster Management Module (see *PMP Synchronization Solutions User Guide*). Select **Internal** if no GPS synchronization source is available (in this mode, transmission between co-located devices will create radio interference). If **Flexible** is chosen as the **DL/UL Ratio** or if the **Access Point Mode** is chosen as **ePTP Master**, then this parameter will be greyed out.

11 Configure the parameter IP Assignment:

If **DHCP** is selected, the DHCP server automatically assigns the IP configuration (Ethernet (LAN) IP Address, Ethernet (LAN) IP Subnet Mask, Gateway IP Address (LAN)) and the values of those individual parameters (below) are not used. To configure a simple test network, select mode **Static**.

12 Configure the parameter IP address:

Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. To configure a simple test network, this field may be left at default (192.168.0.1).

13 Configure the parameter Subnet Mask:

The Subnet Mask defines the address range of the connected IP network. To configure a simple test network, this field may be left at default (255.255.255.0).

14 Configure the parameter Gateway:


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. To configure a simple test network, this parameter may be left at default (blank).

15 Configure the parameter Wireless Security:

Open: All SMs requesting network entry are allowed registration.

WPA2: The WPA2 mechanism provides AES radio link encryption and SM network entry authentication. When enabled, the SM must register using the **Authentication Pre-shared Key** configured on the AP and SM.

16 Configure the parameter WPA2 Pre-shared Key

Configure this key on the AP and then configure each of the network SMs with this key to complete the authentication configuration. This key must be between 8 to 128 symbols. Click the visibility icon  to toggle the display of the key's contents.

17 Click the Save icon, then click the Reset icon

Configuring SM units using the Quick Start menu

The **Quick Start** tab contains a simple listing of parameters required to configure a simple radio link and to configure requisite networking parameters.

Figure 17 SM Quick Start menu

General

Radio Mode: ☐ Access Point ☒ Subscriber Module ☐ Spectrum Analyzer

Subscriber Module Mode: ☐ TSO ☐ Standard WPA ☐ WPA Slave

Country: Fellow AP's Country

Device Name: Cambium-SM1

Network Mode: ☒ AP ☐ Bridge

Wireless IP Assignment: ☒ Static ☐ DHCP

Wireless IP Address: 10.120.204.102

Wireless Subnet Mask: 255.255.255.0

Wireless Gateway: 10.120.204.254

Wireless Security

WPA2 Pre-shared Key: *****

EAP-TTLS Username: ePMP

EAP-TTLS Password: ****

Authentication Identity String: anonymous

Authentication Identity Realm: cambiumnetworks.com

Preferred AP: Add Compact View

AP ID	Wireless Security
Cambium-AP1	EAP-TTLS, WPA2, Open
Cambium-AP2	EAP-TTLS, WPA2, Open
Cambium-AP3	EAP-TTLS, WPA2, Open
Cambium-AP4	EAP-TTLS, WPA2, Open
Cambium-AP5	EAP-TTLS, WPA2, Open

Subscriber Module Scanning

Scan Channel Bandwidth: ☒ 5 MHz ☒ 10 MHz ☒ 40 MHz ☒ 80 MHz

40 MHz Scan List 10 MHz Scan List 5 MHz Scan List 20 MHz Scan List

Radio Frequency 20 MHz Scan List

<input type="checkbox"/> 8100 MHz	<input type="checkbox"/> 8185 MHz	<input type="checkbox"/> 8270 MHz	<input type="checkbox"/> 8355 MHz	<input type="checkbox"/> 8440 MHz	<input type="checkbox"/> 8525 MHz	<input type="checkbox"/> 8610 MHz	<input type="checkbox"/> 8695 MHz	<input type="checkbox"/> 8780 MHz	<input type="checkbox"/> 8865 MHz	<input type="checkbox"/> 8950 MHz	<input type="checkbox"/> 9035 MHz	<input type="checkbox"/> 9120 MHz	<input type="checkbox"/> 9205 MHz	<input type="checkbox"/> 9290 MHz	<input type="checkbox"/> 9375 MHz	<input type="checkbox"/> 9460 MHz	<input type="checkbox"/> 9545 MHz	<input type="checkbox"/> 9630 MHz	<input type="checkbox"/> 9715 MHz	<input type="checkbox"/> 9800 MHz	<input type="checkbox"/> 9885 MHz	<input type="checkbox"/> 9970 MHz	<input type="checkbox"/> 10055 MHz	<input type="checkbox"/> 10140 MHz	<input type="checkbox"/> 10225 MHz	<input type="checkbox"/> 10310 MHz	<input type="checkbox"/> 10395 MHz	<input type="checkbox"/> 10480 MHz	<input type="checkbox"/> 10565 MHz	<input type="checkbox"/> 10650 MHz	<input type="checkbox"/> 10735 MHz	<input type="checkbox"/> 10820 MHz	<input type="checkbox"/> 10905 MHz	<input type="checkbox"/> 10990 MHz	<input type="checkbox"/> 11075 MHz	<input type="checkbox"/> 11160 MHz	<input type="checkbox"/> 11245 MHz	<input type="checkbox"/> 11330 MHz	<input type="checkbox"/> 11415 MHz	<input type="checkbox"/> 11500 MHz	<input type="checkbox"/> 11585 MHz	<input type="checkbox"/> 11670 MHz	<input type="checkbox"/> 11755 MHz	<input type="checkbox"/> 11840 MHz	<input type="checkbox"/> 11925 MHz	<input type="checkbox"/> 12010 MHz	<input type="checkbox"/> 12095 MHz	<input type="checkbox"/> 12180 MHz	<input type="checkbox"/> 12265 MHz	<input type="checkbox"/> 12350 MHz	<input type="checkbox"/> 12435 MHz	<input type="checkbox"/> 12520 MHz	<input type="checkbox"/> 12605 MHz	<input type="checkbox"/> 12690 MHz	<input type="checkbox"/> 12775 MHz	<input type="checkbox"/> 12860 MHz	<input type="checkbox"/> 12945 MHz	<input type="checkbox"/> 13030 MHz	<input type="checkbox"/> 13115 MHz	<input type="checkbox"/> 13200 MHz	<input type="checkbox"/> 13285 MHz	<input type="checkbox"/> 13370 MHz	<input type="checkbox"/> 13455 MHz	<input type="checkbox"/> 13540 MHz	<input type="checkbox"/> 13625 MHz	<input type="checkbox"/> 13710 MHz	<input type="checkbox"/> 13795 MHz	<input type="checkbox"/> 13880 MHz	<input type="checkbox"/> 13965 MHz	<input type="checkbox"/> 14050 MHz	<input type="checkbox"/> 14135 MHz	<input type="checkbox"/> 14220 MHz	<input type="checkbox"/> 14305 MHz	<input type="checkbox"/> 14390 MHz	<input type="checkbox"/> 14475 MHz	<input type="checkbox"/> 14560 MHz	<input type="checkbox"/> 14645 MHz	<input type="checkbox"/> 14730 MHz	<input type="checkbox"/> 14815 MHz	<input type="checkbox"/> 14900 MHz	<input type="checkbox"/> 14985 MHz	<input type="checkbox"/> 15070 MHz	<input type="checkbox"/> 15155 MHz	<input type="checkbox"/> 15240 MHz	<input type="checkbox"/> 15325 MHz	<input type="checkbox"/> 15410 MHz	<input type="checkbox"/> 15495 MHz	<input type="checkbox"/> 15580 MHz	<input type="checkbox"/> 15665 MHz	<input type="checkbox"/> 15750 MHz	<input type="checkbox"/> 15835 MHz	<input type="checkbox"/> 15920 MHz	<input type="checkbox"/> 16005 MHz	<input type="checkbox"/> 16090 MHz	<input type="checkbox"/> 16175 MHz	<input type="checkbox"/> 16260 MHz	<input type="checkbox"/> 16345 MHz	<input type="checkbox"/> 16430 MHz	<input type="checkbox"/> 16515 MHz	<input type="checkbox"/> 16600 MHz	<input type="checkbox"/> 16685 MHz	<input type="checkbox"/> 16770 MHz	<input type="checkbox"/> 16855 MHz	<input type="checkbox"/> 16940 MHz	<input type="checkbox"/> 17025 MHz	<input type="checkbox"/> 17110 MHz	<input type="checkbox"/> 17195 MHz	<input type="checkbox"/> 17280 MHz	<input type="checkbox"/> 17365 MHz	<input type="checkbox"/> 17450 MHz	<input type="checkbox"/> 17535 MHz	<input type="checkbox"/> 17620 MHz	<input type="checkbox"/> 17705 MHz	<input type="checkbox"/> 17790 MHz	<input type="checkbox"/> 17875 MHz	<input type="checkbox"/> 17960 MHz	<input type="checkbox"/> 18045 MHz	<input type="checkbox"/> 18130 MHz	<input type="checkbox"/> 18215 MHz	<input type="checkbox"/> 18300 MHz	<input type="checkbox"/> 18385 MHz	<input type="checkbox"/> 18470 MHz	<input type="checkbox"/> 18555 MHz	<input type="checkbox"/> 18640 MHz	<input type="checkbox"/> 18725 MHz	<input type="checkbox"/> 18810 MHz	<input type="checkbox"/> 18895 MHz	<input type="checkbox"/> 18980 MHz	<input type="checkbox"/> 19065 MHz	<input type="checkbox"/> 19150 MHz	<input type="checkbox"/> 19235 MHz	<input type="checkbox"/> 19320 MHz	<input type="checkbox"/> 19405 MHz	<input type="checkbox"/> 19490 MHz	<input type="checkbox"/> 19575 MHz	<input type="checkbox"/> 19660 MHz	<input type="checkbox"/> 19745 MHz	<input type="checkbox"/> 19830 MHz	<input type="checkbox"/> 19915 MHz	<input type="checkbox"/> 20000 MHz	<input type="checkbox"/> 20085 MHz	<input type="checkbox"/> 20170 MHz	<input type="checkbox"/> 20255 MHz	<input type="checkbox"/> 20340 MHz	<input type="checkbox"/> 20425 MHz	<input type="checkbox"/> 20510 MHz	<input type="checkbox"/> 20595 MHz	<input type="checkbox"/> 20680 MHz	<input type="checkbox"/> 20765 MHz	<input type="checkbox"/> 20850 MHz	<input type="checkbox"/> 20935 MHz	<input type="checkbox"/> 21020 MHz	<input type="checkbox"/> 21105 MHz	<input type="checkbox"/> 21190 MHz	<input type="checkbox"/> 21275 MHz	<input type="checkbox"/> 21360 MHz	<input type="checkbox"/> 21445 MHz	<input type="checkbox"/> 21530 MHz	<input type="checkbox"/> 21615 MHz	<input type="checkbox"/> 21700 MHz	<input type="checkbox"/> 21785 MHz	<input type="checkbox"/> 21870 MHz	<input type="checkbox"/> 21955 MHz	<input type="checkbox"/> 22040 MHz	<input type="checkbox"/> 22125 MHz	<input type="checkbox"/> 22210 MHz	<input type="checkbox"/> 22295 MHz	<input type="checkbox"/> 22380 MHz	<input type="checkbox"/> 22465 MHz	<input type="checkbox"/> 22550 MHz	<input type="checkbox"/> 22635 MHz	<input type="checkbox"/> 22720 MHz	<input type="checkbox"/> 22805 MHz	<input type="checkbox"/> 22890 MHz	<input type="checkbox"/> 22975 MHz	<input type="checkbox"/> 23060 MHz	<input type="checkbox"/> 23145 MHz	<input type="checkbox"/> 23230 MHz	<input type="checkbox"/> 23315 MHz	<input type="checkbox"/> 23400 MHz	<input type="checkbox"/> 23485 MHz	<input type="checkbox"/> 23570 MHz	<input type="checkbox"/> 23655 MHz	<input type="checkbox"/> 23740 MHz	<input type="checkbox"/> 23825 MHz	<input type="checkbox"/> 23910 MHz	<input type="checkbox"/> 23995 MHz	<input type="checkbox"/> 24080 MHz	<input type="checkbox"/> 24165 MHz	<input type="checkbox"/> 24250 MHz	<input type="checkbox"/> 24335 MHz	<input type="checkbox"/> 24420 MHz	<input type="checkbox"/> 24505 MHz	<input type="checkbox"/> 24590 MHz	<input type="checkbox"/> 24675 MHz	<input type="checkbox"/> 24760 MHz	<input type="checkbox"/> 24845 MHz	<input type="checkbox"/> 24930 MHz	<input type="checkbox"/> 25015 MHz	<input type="checkbox"/> 25100 MHz	<input type="checkbox"/> 25185 MHz	<input type="checkbox"/> 25270 MHz	<input type="checkbox"/> 25355 MHz	<input type="checkbox"/> 25440 MHz	<input type="checkbox"/> 25525 MHz	<input type="checkbox"/> 25610 MHz	<input type="checkbox"/> 25695 MHz	<input type="checkbox"/> 25780 MHz	<input type="checkbox"/> 25865 MHz	<input type="checkbox"/> 25950 MHz	<input type="checkbox"/> 26035 MHz	<input type="checkbox"/> 26120 MHz	<input type="checkbox"/> 26205 MHz	<input type="checkbox"/> 26290 MHz	<input type="checkbox"/> 26375 MHz	<input type="checkbox"/> 26460 MHz	<input type="checkbox"/> 26545 MHz	<input type="checkbox"/> 26630 MHz	<input type="checkbox"/> 26715 MHz	<input type="checkbox"/> 26800 MHz	<input type="checkbox"/> 26885 MHz	<input type="checkbox"/> 26970 MHz	<input type="checkbox"/> 27055 MHz	<input type="checkbox"/> 27140 MHz	<input type="checkbox"/> 27225 MHz	<input type="checkbox"/> 27310 MHz	<input type="checkbox"/> 27395 MHz	<input type="checkbox"/> 27480 MHz	<input type="checkbox"/> 27565 MHz	<input type="checkbox"/> 27650 MHz	<input type="checkbox"/> 27735 MHz	<input type="checkbox"/> 27820 MHz	<input type="checkbox"/> 27905 MHz	<input type="checkbox"/> 27990 MHz	<input type="checkbox"/> 28075 MHz	<input type="checkbox"/> 28160 MHz	<input type="checkbox"/> 28245 MHz	<input type="checkbox"/> 28330 MHz	<input type="checkbox"/> 28415 MHz	<input type="checkbox"/> 28500 MHz	<input type="checkbox"/> 28585 MHz	<input type="checkbox"/> 28670 MHz	<input type="checkbox"/> 28755 MHz	<input type="checkbox"/> 28840 MHz	<input type="checkbox"/> 28925 MHz	<input type="checkbox"/> 29010 MHz	<input type="checkbox"/> 29095 MHz	<input type="checkbox"/> 29180 MHz	<input type="checkbox"/> 29265 MHz	<input type="checkbox"/> 29350 MHz	<input type="checkbox"/> 29435 MHz	<input type="checkbox"/> 29520 MHz	<input type="checkbox"/> 29605 MHz	<input type="checkbox"/> 29690 MHz	<input type="checkbox"/> 29775 MHz	<input type="checkbox"/> 29860 MHz	<input type="checkbox"/> 29945 MHz	<input type="checkbox"/> 30030 MHz	<input type="checkbox"/> 30115 MHz	<input type="checkbox"/> 30200 MHz	<input type="checkbox"/> 30285 MHz	<input type="checkbox"/> 30370 MHz	<input type="checkbox"/> 30455 MHz	<input type="checkbox"/> 30540 MHz	<input type="checkbox"/> 30625 MHz	<input type="checkbox"/> 30710 MHz	<input type="checkbox"/> 30795 MHz	<input type="checkbox"/> 30880 MHz	<input type="checkbox"/> 30965 MHz	<input type="checkbox"/> 31050 MHz	<input type="checkbox"/> 31135 MHz	<input type="checkbox"/> 31220 MHz	<input type="checkbox"/> 31305 MHz	<input type="checkbox"/> 31390 MHz	<input type="checkbox"/> 31475 MHz	<input type="checkbox"/> 31560 MHz	<input type="checkbox"/> 31645 MHz	<input type="checkbox"/> 31730 MHz	<input type="checkbox"/> 31815 MHz	<input type="checkbox"/> 31900 MHz	<input type="checkbox"/> 31985 MHz	<input type="checkbox"/> 32070 MHz	<input type="checkbox"/> 32155 MHz	<input type="checkbox"/> 32240 MHz	<input type="checkbox"/> 32325 MHz	<input type="checkbox"/> 32410 MHz	<input type="checkbox"/> 32495 MHz	<input type="checkbox"/> 32580 MHz	<input type="checkbox"/> 32665 MHz	<input type="checkbox"/> 32750 MHz	<input type="checkbox"/> 32835 MHz	<input type="checkbox"/> 32920 MHz	<input type="checkbox"/> 33005 MHz	<input type="checkbox"/> 33090 MHz	<input type="checkbox"/> 33175 MHz	<input type="checkbox"/> 33260 MHz	<input type="checkbox"/> 33345 MHz	<input type="checkbox"/> 33430 MHz	<input type="checkbox"/> 33515 MHz	<input type="checkbox"/> 33600 MHz	<input type="checkbox"/> 33685 MHz	<input type="checkbox"/> 33770 MHz	<input type="checkbox"/> 33855 MHz	<input type="checkbox"/> 33940 MHz	<input type="checkbox"/> 34025 MHz	<input type="checkbox"/> 34110 MHz	<input type="checkbox"/> 34195 MHz	<input type="checkbox"/> 34280 MHz	<input type="checkbox"/> 34365 MHz	<input type="checkbox"/> 34450 MHz	<input type="checkbox"/> 34535 MHz	<input type="checkbox"/> 34620 MHz	<input type="checkbox"/> 34705 MHz	<input type="checkbox"/> 34790 MHz	<input type="checkbox"/> 34875 MHz	<input type="checkbox"/> 34960 MHz	<input type="checkbox"/> 35045 MHz	<input type="checkbox"/> 35130 MHz	<input type="checkbox"/> 35215 MHz	<input type="checkbox"/> 35300 MHz	<input type="checkbox"/> 35385 MHz	<input type="checkbox"/> 35470 MHz	<input type="checkbox"/> 35555 MHz	<input type="checkbox"/> 35640 MHz	<input type="checkbox"/> 35725 MHz	<input type="checkbox"/> 35810 MHz	<input type="checkbox"/> 35895 MHz	<input type="checkbox"/> 35980 MHz	<input type="checkbox"/> 36065 MHz	<input type="checkbox"/> 36150 MHz	<input type="checkbox"/> 36235 MHz	<input type="checkbox"/> 36320 MHz	<input type="checkbox"/> 36405 MHz	<input type="checkbox"/> 36490 MHz	<input type="checkbox"/> 36575 MHz	<input type="checkbox"/> 36660 MHz	<input type="checkbox"/> 36745 MHz	<input type="checkbox"/> 36830 MHz	<input type="checkbox"/> 36915 MHz	<input type="checkbox"/> 37000 MHz	<input type="checkbox"/> 37085 MHz	<input type="checkbox"/> 37170 MHz	<input type="checkbox"/> 37255 MHz	<input type="checkbox"/> 37340 MHz	<input type="checkbox"/> 37425 MHz	<input type="checkbox"/> 37510 MHz	<input type="checkbox"/> 37595 MHz	<input type="checkbox"/> 37680 MHz	<input type="checkbox"/> 37765 MHz	<input type="checkbox"/> 37850 MHz	<input type="checkbox"/> 37935 MHz	<input type="checkbox"/> 38020 MHz	<input type="checkbox"/> 38105 MHz	<input type="checkbox"/> 38190 MHz	<input type="checkbox"/> 38275 MHz	<input type="checkbox"/> 38360 MHz	<input type="checkbox"/> 38445 MHz	<input type="checkbox"/> 38530 MHz	<input type="checkbox"/> 38615 MHz	<input type="checkbox"/> 38700 MHz	<input type="checkbox"/> 38785 MHz	<input type="checkbox"/> 38870 MHz	<input type="checkbox"/> 38955 MHz	<input type="checkbox"/> 39040 MHz	<input type="checkbox"/> 39125 MHz	<input type="checkbox"/> 39210 MHz	<input type="checkbox"/> 39295 MHz	<input type="checkbox"/> 39380 MHz	<input type="checkbox"/> 39465 MHz	<input type="checkbox"/> 39550 MHz	<input type="checkbox"/> 39635 MHz	<input type="checkbox"/> 39720 MHz	<input type="checkbox"/> 39805 MHz	<input type="checkbox"/> 39890 MHz	<input type="checkbox"/> 39975 MHz	<input type="checkbox"/> 40060 MHz	<input type="checkbox"/> 40145 MHz	<input type="checkbox"/> 40230 MHz	<input type="checkbox"/> 40315 MHz	<input type="checkbox"/> 40400 MHz	<input type="checkbox"/> 40485 MHz	<input type="checkbox"/> 40570 MHz	<input type="checkbox"/> 40655 MHz	<input type="checkbox"/> 40740 MHz	<input type="checkbox"/> 40825 MHz	<input type="checkbox"/> 40910 MHz	<input type="checkbox"/> 40995 MHz	<input type="checkbox"/> 41080 MHz	<input type="checkbox"/> 41165 MHz	<input type="checkbox"/> 41250 MHz	<input type="checkbox"/> 41335 MHz	<input type="checkbox"/> 41420 MHz	<input type="checkbox"/> 41505 MHz	<input type="checkbox"/> 41590 MHz	<input type="checkbox"/> 41675 MHz	<input type="checkbox"/> 41760 MHz	<input type="checkbox"/> 41845 MHz	<input type="checkbox"/> 41930 MHz	<input type="checkbox"/> 42015 MHz	<input type="checkbox"/> 42100 MHz	<input type="checkbox"/> 42185 MHz	<input type="checkbox"/> 42270 MHz	<input type="checkbox"/> 42355 MHz	<input type="checkbox"/> 42440 MHz	<input type="checkbox"/> 42525 MHz	<input type="checkbox"/> 42610 MHz	<input type="checkbox"/> 42695 MHz	<input type="checkbox"/> 42780 MHz	<input type="checkbox"/> 42865 MHz	<input type="checkbox"/> 42950 MHz	<input type="checkbox"/> 43035 MHz	<input type="checkbox"/> 43120 MHz	<input type="checkbox"/> 43205 MHz	<input type="checkbox"/> 43290 MHz	<input type="checkbox"/> 43375 MHz	<input type="checkbox"/> 43460 MHz	<input type="checkbox"/> 43545 MHz	<input type="checkbox"/> 43630 MHz	<input type="checkbox"/> 43715 MHz	<input type="checkbox"/> 43800 MHz	<input type="checkbox"/> 43885 MHz	<input type="checkbox"/> 43970 MHz	<input type="checkbox"/> 44055 MHz	<input type="checkbox"/> 44140 MHz	<input type="checkbox"/> 44225 MHz	<input type="checkbox"/> 44310 MHz	<input type="checkbox"/> 44395 MHz	<input type="checkbox"/> 44480 MHz	<input type="checkbox"/> 44565 MHz	<input type="checkbox"/> 44650 MHz	<input type="checkbox"/> 44735 MHz	<input type="checkbox"/> 44820 MHz	<input type="checkbox"/> 44905 MHz	<input type="checkbox"/> 44990 MHz	<input type="checkbox"/> 45075 MHz	<input type="checkbox"/> 45160 MHz	<input type="checkbox"/> 45245 MHz	<input type="checkbox"/> 45330 MHz	<input type="checkbox"/> 45415 MHz	<input type="checkbox"/> 45500 MHz	<input type="checkbox"/> 45585 MHz	<input type="checkbox"/> 45670 MHz	<input type="checkbox"/> 45755 MHz	<input type="checkbox"/> 45840 MHz	<input type="checkbox"/> 45925 MHz	<input type="checkbox"/> 46010 MHz	<input type="checkbox"/> 46095 MHz	<input type="checkbox"/> 46180 MHz	<input type="checkbox"/> 46265 MHz	<input type="checkbox"/> 46350 MHz	<input type="checkbox"/> 46435 MHz	<input type="checkbox"/> 46520 MHz	<input type="checkbox"/> 46605 MHz	<input type="checkbox"/> 46690 MHz	<input type="checkbox"/> 46775 MHz	<input type="checkbox"/> 46860 MHz	<input type="checkbox"/> 46945 MHz	<input type="checkbox"/> 47030 MHz	<input type="checkbox"/> 47115 MHz	<input type="checkbox"/> 47200 MHz	<input type="checkbox"/> 47285 MHz	<input type="checkbox"/> 47370 MHz	<input type="checkbox"/> 47455 MHz	<input type="checkbox"/> 47540 MHz	<input type="checkbox"/> 47625 MHz	<input type="checkbox"/> 47710 MHz	<input type="checkbox"/> 47795 MHz	<input type="checkbox"/> 47880 MHz	<input type="checkbox"/> 47965 MHz	<input type="checkbox"/> 48050 MHz	<input type="checkbox"/> 48135 MHz	<input type="checkbox"/> 48220 MHz	<input type="checkbox"/> 48305 MHz	<input type="checkbox"/> 48390 MHz	<input type="checkbox"/> 48475 MHz	<input type="checkbox"/> 48560 MHz	<input type="checkbox"/> 48645 MHz	<input type="checkbox"/> 48730 MHz	<input type="checkbox"/> 48815 MHz	<input type="checkbox"/> 48900 MHz	<input type="checkbox"/> 48985 MHz	<input type="checkbox"/> 49070 MHz	<input type="checkbox"/> 49155 MHz	<input type="checkbox"/> 49240 MHz	<input type="checkbox"/> 49325 MHz	<input type="checkbox"/> 49410 MHz	<input type="checkbox"/> 49495 MHz	<input type="checkbox"/> 49580 MHz	<input type="checkbox"/> 49665 MHz	<input type="checkbox"/> 49750 MHz	<input type="checkbox"/> 49835 MHz	<input type="checkbox"/> 49920 MHz	<input type="checkbox"/> 50005 MHz	<input type="checkbox"/> 50090 MHz	<input type="checkbox"/> 50175 MHz	<input type="checkbox"/> 50260 MHz	<input type="checkbox"/> 50345 MHz	<input type="checkbox"/> 50430 MHz	<input type="checkbox"/> 50515 MHz	<input type="checkbox"/> 50600 MHz	<input type="checkbox"/> 50685 MHz	<input type="checkbox"/> 50770 MHz	<input type="checkbox"/> 50855 MHz	<input type="checkbox"/> 50940 MHz	<input type="checkbox"/> 51025 MHz	<input type="checkbox"/> 51110 MHz	<input type="checkbox"/> 51195 MHz	<input type="checkbox"/> 51280 MHz	<input type="checkbox"/> 51365 MHz	<input type="checkbox"/> 51450 MHz	<input type="checkbox"/> 51535 MHz	<input type="checkbox"/> 51620 MHz	<input type="checkbox"/> 51705 MHz	<input type="checkbox"/> 51790 MHz	<input type="checkbox"/> 51875 MHz	<input type="checkbox"/> 51960 MHz	<input type="checkbox"/> 52045 MHz	<input type="checkbox"/> 52130 MHz	<input type="checkbox"/> 52215 MHz	<input type="checkbox"/> 52300 MHz	<input type="checkbox"/> 52385 MHz	<input type="checkbox"/> 52470 MHz	<input type="checkbox"/> 52555 MHz	<input type="checkbox"/> 52640 MHz	<input type="checkbox"/> 52725 MHz	<input type="checkbox"/> 52810 MHz	<input type="checkbox"/> 52895 MHz	<input type="checkbox"/> 52980 MHz	<input type="checkbox"/> 53065 MHz	<input type="checkbox"/> 53150 MHz	<input type="checkbox"/> 53235 MHz	<input type="checkbox"/> 53320 MHz	<input type="checkbox"/> 53405 MHz	<input type="checkbox"/> 53490 MHz	<input type="checkbox"/> 53575 MHz	<input type="checkbox"/> 53660 MHz	<input type="checkbox"/> 53745 MHz	<input type="checkbox"/> 53830 MHz	<input type="checkbox"/> 53915 MHz	<input type="checkbox"/> 54000 MHz	<input type="checkbox"/> 54085 MHz	<input type="checkbox"/> 54170 MHz	<input type="checkbox"/> 54255 MHz	<input type="checkbox"/> 54340 MHz	<input type="checkbox"/> 54425 MHz	<input type="checkbox"/> 54510 MHz	<input type="checkbox"/> 54595 MHz	<input type="checkbox"/> 54680 MHz	<input type="checkbox"/> 54765 MHz	<input type="checkbox"/> 54850 MHz	<input type="checkbox"/> 54935 MHz	<input type="checkbox"/> 55020 MHz	<input type="checkbox"/> 55105 MHz	<input type="checkbox"/> 55190 MHz	<input type="checkbox"/> 55275 MHz	<input type="checkbox"/> 55360 MHz	<input type="checkbox"/> 55445 MHz	<input type="checkbox"/> 55530 MHz	<input type="checkbox"/> 55615 MHz	<input type="checkbox"/> 55700 MHz	<input type="checkbox"/> 55785 MHz	<input type="checkbox"/> 55870 MHz	<input type="checkbox"/> 55955 MHz	<input type="checkbox"/> 56040 MHz	<input type="checkbox"/> 56125 MHz	<input type="checkbox"/> 56210 MHz	<input type="checkbox"/> 56295 MHz	<input type="checkbox"/> 56380 MHz	<input type="checkbox"/> 56465 MHz	<input type="checkbox"/> 56550 MHz	<input type="checkbox"/> 56635 MHz	<input type="checkbox"/> 56720 MHz	<input type="checkbox"/> 56805 MHz	<input type="checkbox"/> 56890 MHz	<input type="checkbox"/> 56975 MHz	<input type="checkbox"/> 57060 MHz	<input type="checkbox"/> 57145 MHz	<input type="checkbox"/> 57230 MHz	<input type="checkbox"/> 57315 MHz	<input type="checkbox"/> 57400 MHz	<input type="checkbox"/> 57485 MHz	<input type="checkbox"/> 57570 MHz	<input type="checkbox"/> 57655 MHz	<input type="checkbox"/> 57740 MHz	<input type="checkbox"/> 57825 MHz	<input type="checkbox"/> 57910 MHz	<input type="checkbox"/> 58000 MHz	<input type="checkbox"/> 58085 MHz	<input type="checkbox"/> 58170 MHz	<input type="checkbox"/> 58255 MHz	<input type="checkbox"/> 58340 MHz	<input type="checkbox"/> 58425 MHz	<input type="checkbox"/> 58510 MHz	<input type="checkbox"/> 58595 MHz	<input type="checkbox"/> 58680 MHz	<input type="checkbox"/> 58765 MHz	<input type="checkbox"/> 58850 MHz	<input type="checkbox"/> 58935 MHz	<input type="checkbox"/> 59020 MHz	<input type="checkbox"/> 59105 MHz	<input type="checkbox"/> 59190 MHz	<input type="checkbox"/> 59275 MHz	<input type="checkbox"/> 59360 MHz	<input type="checkbox"/> 59445 MHz	<input type="checkbox"/> 59530 MHz	<input type="checkbox"/> 59615 MHz	<input type="checkbox"/> 59700 MHz	<input type="checkbox"/> 59785 MHz	<input type="checkbox"/> 59870 MHz	<input type="checkbox"/> 59955 MHz	<input type="checkbox"/> 60040 MHz	<input type="checkbox"/> 60125 MHz	<input type="checkbox"/> 60210 MHz	<input type="checkbox"/> 60295 MHz	<input type="checkbox"/> 60380 MHz	<input type="checkbox"/> 60465 MHz	<input type="checkbox"/> 60550 MHz	<input type="checkbox"/> 60635 MHz	<input type="checkbox"/> 60720 MHz	<input type="checkbox"/> 60805 MHz	<input type="checkbox"/> 60890 MHz	<input type="checkbox"/> 60975 MHz	<input type="checkbox"/> 61060 MHz
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4 Configure the parameter **Subscriber Module Mode:**

This parameter controls the mode of operation of the Subscriber Module – An SM may be configured to operate in **TDD** mode for point-to-point and point-to-multipoint access, **Standard WiFi** mode providing the capability to connect to any AP operating in standard WiFi mode or as an **ePTP Slave**. For initial link bring-up, choose **TDD**. When the SM is an **ePTP Slave**, the system does not support GPS Synchronization 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.

5 The **Country** is automatically retrieved from the AP and requires no configuration.

Country settings affect the radios in the following ways:

- Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain)
- DFS operation is enabled based on the configured country code, if applicable
- Frequency range of operation depending on local limitations

6 Configure the parameter **Device Name:**

The SM Device Name is used to identify the device on the network. This parameter may be modified or left at the default value of **Cambium-SM**.

7 Configure the parameter **Network Mode:**

NAT: The SM acts as a router and packets are forwarded or filtered based on their IP header (source or destination).

Bridge: The SM acts as a switch and packets are forwarded or filtered based on their MAC destination address.

8 Configure the parameter **Wireless IP Assignment:**

If **DHCP** is selected, the DHCP server automatically assigns the IP configuration (Ethernet (LAN) IP Address, Ethernet (LAN) IP Subnet Mask, Gateway IP Address (LAN)) and the values of those individual parameters (below) are not used. To configure a simple test network, this parameter must be configured to **Static**.

9 Configure the parameter **Wireless IP Address:**

Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. To configure a simple test network, this field must be configured to 192.168.0.2.


10 Configure the parameter **Wireless Subnet Mask:**

The Subnet Mask defines the address range of the connected IP network. To configure a simple test network, this field may be left at default (255.255.255.0).

11 Configure the parameter **Wireless Gateway:**

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. To configure a simple test network, this parameter may be left at default (blank).

12 Configure the parameter **WPA2 Pre-shared Key:**

Configure each of the network SMs with this key (matching the AP's configured key) to complete the authentication configuration. This key must be between 8 to 128 symbols. Click the visibility icon  to toggle the display of the key's contents.

13 Configure the parameter **EAP-TTLS Username:**

Configure each of the network SMs with this EAP-TTLS Username (matching the credentials on the RADIUS server being used for the network).

14 Configure the parameter EAP-TTLS Password:

Configure each of the network SMs with this EAP-TTLS Password (matching the credentials on the RADIUS server being used for the network). Click the visibility icon  to toggle the display of the password's contents.

15 Configure the parameter Authentication Identity String:

Configure each of the network SMs with this Identity string (matching the credentials on the RADIUS server being used for the network). Default value for this parameter is “anonymous”.

16 Configure the parameter Authentication Identity Realm:

Configure each of the network SMs with this Identity realm (matching the credentials on the RADIUS server being used for the network). Default value for this parameter is “cambiumnetworks.com”.

17 Configure the Preferred AP's

The **Preferred AP's** is comprised of a list of up to 16 APs to which the SM sequentially attempts registration. For each AP configured, if authentication is required, enter a **Pre-shared Key** associated with the configured **AP SSID**. If this list is empty or if none of the configured APs are found, the SM scans and registers to the best AP signal found (with matching radio and/or authentication settings).

18 Configure the parameter Subscriber Module Scanning:

The Radio Scan List determines the frequencies for which the SM scans for AP signaling. For a simple radio network setup, click **Select All** to scan all frequencies.

19 Click the Save icon, then click the Reset icon

Using the AP menu options

Use the menu navigation bar in the top and left panels to navigate to each web page. The functional areas that may be accessed from each menu option are listed in **Table 45**. Some of the parameters are only displayed for specific system configurations.

Table 45 Functional areas accessed from each menu option

Menu option	Menu Details
Quick Start	Configuring connectorized radios using the Quick Start menu on page 81
Configure	AP Configure menu on page 88
Radio	AP Radio page on page 89
Quality of Service	AP Quality of Service page on page 98
System	AP System page on page 101
Network	AP Network page on page 105
Security	AP Security page on page 109
Monitor	AP Monitor menu on page 111
Performance	AP Performance page on page 112
System Status	AP System page on page 116
Wireless Status	AP Wireless page on page 118
GPS Status	AP GPS page on page 120
Network Status	AP Network page on page 122
System Log	AP System Log page on page 125
Tools	AP Tools menu on page 126
Software Upgrade	AP Software Upgrade page on page 127
Backup / Restore	AP Backup/Restore page on page 129
eDetect	AP eDetect page on page 132
Spectrum Analyzer	AP Spectrum Analyzer page on page 135
Automatic Channel Selection	AP Automatic Channel Selection page on page 138
eAlign	AP eAlign page on page 140
Wireless Link Test	AP Wireless Link Test page on page 142
Ping	AP Ping page on page 144
Traceroute	AP Traceroute page on page 145

AP CONFIGURE MENU

Use the **Configure** menu to access all applicable device configuration parameters. The configuration menu contains the following pages:

- **AP Radio page** on page **89**
- **AP Quality of Service page** on page **98**
- **AP System page** on page **101**
- **AP Network page** on page **105**
- **AP Security page** on page **109**

AP Radio page

Use the Radio page to configure the device radio interface parameters.



Caution

Plan Configuration modifications since modifying radio parameters may result in a wireless outage.

Figure 18 AP Radio page

Configuration > Radio

General

- Radio Mode:**
 - ☒ Access Point
 - ☐ Subscriber Module
 - ☐ Spectrum Analyzer
- Access Point Mode:**
 - ☒ TDD
 - ☐ ePTP Master
 - ☐ PTP
- Country:** Ghana
- Range Unit:**
 - ☐ Miles
 - ☒ Kilometers
- Point-to-Point Access:**
 - ☒ DPP
 - ☐ First Subscriber Module
 - ☐ MAC Filtering
- Subscriber Module Wireless MAC:** 00:04:00:00:00:00

Access Point Configuration

- AP SWID:** Cambium-AP
- Max Registrations Allowed:** 60 (min: 1, max: 120)
- Max Range:** 5 (min: 1, max: 64)
- Automatic Channel Selection:**
 - ☒ Disabled
 - ☐ Enabled
- Channel Bandwidth:**
 - ☒ 5 MHz
 - ☐ 10 MHz
 - ☐ 20 MHz
 - ☐ 40 MHz
- Frequency Carrier:** 5470 MHz
- Frequency Reuse:**
 - ☒ Off
 - ☐ Front Sector
 - ☐ Back Sector
- Alternate Frequency Carrier 1 Channel Bandwidth:**
 - ☒ 5 MHz
 - ☐ 10 MHz
 - ☐ 20 MHz
 - ☐ 40 MHz
- Alternate Frequency Carrier 1:** -
- Alternate Frequency Carrier 2 Channel Bandwidth:**
 - ☒ 5 MHz
 - ☐ 10 MHz
 - ☐ 20 MHz
 - ☐ 40 MHz
- Alternate Frequency Carrier 2:** -
- Downlink Max Rate:** 100 Mbps

Power Control

- Transmitter Output Power:** 18 dBm (min: 04, max: 30)
- Antenna Gain:** 0 dBi (min: 0, max: 30)
- Subscriber Module Target Receive Level:** -88 dBm (min: -80, max: -40)

Scheduler

- Downlink/Uplink Rate:**
 - ☒ TS/25
 - ☐ 50/50
 - ☐ 50/70
 - ☐ Flexible
- Carrier Sense:**
 - ☒ Disabled
 - ☐ Enabled
- AP Management Packet Rate:**
 - ☒ MCSD
 - ☐ MCS1

Synchronization

- Synchronization Source:**
 - ☒ GPS
 - ☐ EMM
 - ☐ Internal
- Synchronization Holdoff Time:** 30 sec (min: 10, max: 86400)

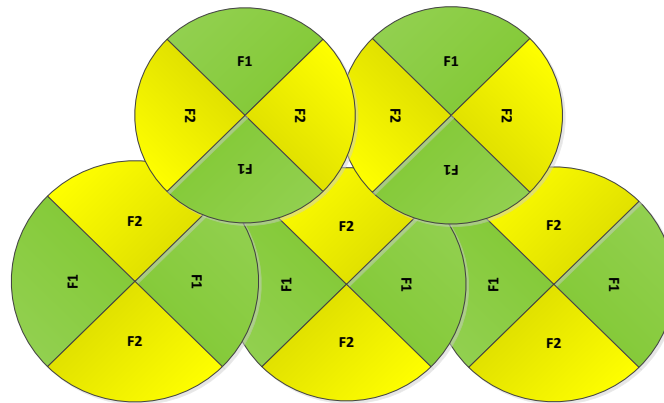
Table 46 AP Radio Configuration attributes

Attribute	Meaning
General	
Radio Mode	This parameter controls the function of the device – All ePMP devices may be configured to operate as an Access Point (AP), Subscriber Module (SM) or as a Spectrum Analyzer. For initial link bring-up, choose AP .
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>
Country	<p>From the drop-down list, select the country in which the radio is operating.</p> <p>Country Code settings affect the radios in the following ways:</p> <ul style="list-style-type: none"> • Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain) • DFS operation is enabled based on the configured country code, if applicable • Frequency selection limiting, based on regional limitations
Range Unit	<p>Miles: The Max Range setting and resulting frame calculations are configured in units of miles.</p> <p>Kilometers: The Kilometers setting and resulting frame calculations are configured in units of kilometers.</p>
Point-to-Point Access	<p>Off: The system is configured to operate in PMP mode (i.e. more than one SM may connect to the AP).</p> <p>First Subscriber Module: The system is configured to accept only the 1st registered SM. Network entry is denied for all subsequent SM network entry requests.</p> <p>MAC Filtering: The system is configured to accept only one SM registration, and this registration is limited by SM MAC Address (the SM Wireless MAC Address).</p>
Subscriber Module Wireless MAC	<p>Configure the Wireless MAC Address of the sole SM which is granted registration to the AP. All other network entry attempts are rejected by the AP. The SM's Preferred AP List may be configured with the destination point-to-point AP to ensure that the SM connects with the intended AP.</p>

Attribute	Meaning
Access Point Configuration	
AP SSID	The AP SSID is used to identify the AP and is used to configure the SM with the appropriate AP with which to register. Ensure that this parameter is configured uniquely for each AP in the network.
Max Registrations Allowed	<p>Based on sector/network planning and SM service level implementations, this parameter allows the user to set the maximum number of SMs that are allowed to register/network entry. The maximum number of SMs allowed for each channel bandwidth is as follows:</p> <p>20/40 MHz : 120 subscribers</p> <p>10 MHz : 60 subscribers</p> <p>5 MHz: 30 subscribers</p> <p>Default value is 60.</p> <p>For DFS regions, the max number of SMs will be limited based on the channel bandwidth of the current operating channel, i.e. Frequency Carrier, Alternate Frequency Carrier 1 or Alternate Frequency Carrier 2.</p>
Max Range	<p>Enter a number of miles or kilometers for the furthest distance from which an SM is allowed to register to this AP. Do not set the distance to any greater number of miles. A greater distance:</p> <ul style="list-style-type: none"> • does not increase the power of transmission from the AP. • can reduce aggregate throughput. <p>Regardless of this distance, the SM must meet the minimum requirements for an acceptable link. The AP will reject any SM network entry attempts from outside the configured maximum range. Default value is 3 miles.</p> <div data-bbox="462 1199 516 1251" data-label="Image"></div> <p>Caution</p> <p>If the AP is in a cluster or is in range of another AP, then you must set this parameter on all other APs in the cluster and in range exactly the same. Otherwise, overlapping RF transmissions will introduce system interference.</p>
Automatic Channel Selection	<p>Enabled – This enables the Automatic Channel Selection (ACS) feature. ACS allows the radio to scan the entire band (governed by the Country setting) and chooses a channel with the lowest channel occupancy i.e. lowest interference level. To run the ACS feature (once enabled), the radio will have to be rebooted or manually triggered using Tools->Automatic Channel Selection. When ACS is running, the radio measures the occupancy level of the channel (measured in terms of an internal interference metric) and uses an algorithm to make a decision to choose the best channel within the band. The channel chosen is not based just on the occupancy level channel but also the occupancy level of adjacent channels.</p> <p>Disabled – ACS is disabled and the operator should configure a Frequency Carrier manually.</p> <div data-bbox="462 1808 516 1860" data-label="Image"></div> <p>Note</p>

Attribute	Meaning
	The channel bandwidth configured prior to enabling and running ACS will be used to automatically select a channel. For ex: If the operator manually configured a channel bandwidth of 20MHz, ACS will scan and choose a channel of 20MHz wide channel. To switch ACS to 40MHz or other channel bandwidth, the operator should disable ACS, manually configure 40MHz or desired channel bandwidth on the radio, then enable and run ACS.
Channel Bandwidth	Configure the channel size used by the radio for RF transmission. This value must match between the AP and SMs.
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 Code parameter.
Frequency Reuse	<p>The Frequency Reuse Mode 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 deployment is shown in Figure 19.</p>

Figure 19 Frequency reuse deployment



The set of APs to configure the **Frequency Reuse Mode** option on is dependent on the GPS synchronization sources in the whole network, CMM3, CMM4 or “onboard GPS” (GUI options are: **GPS** or **CMM**).

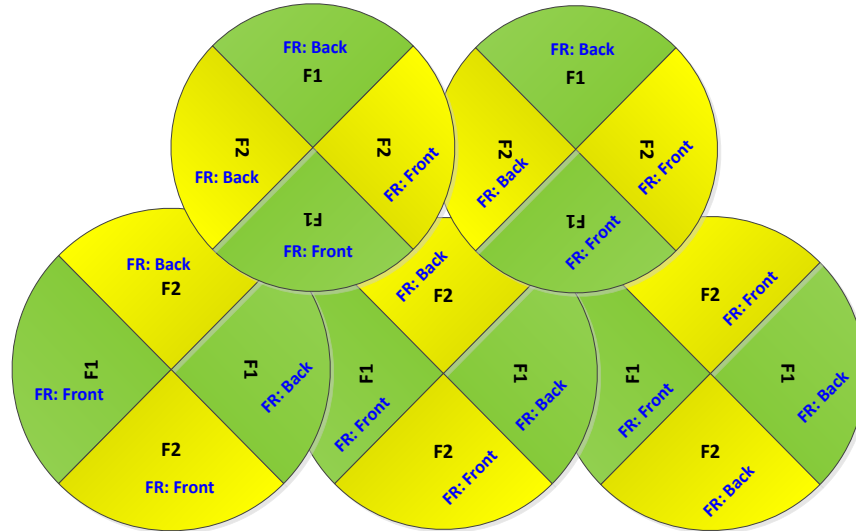
The GPS sync source is the same on all APs or is a combination of “onboard GPS” and CMM4

In this configuration the GPS synchronization source in the whole network is one of the following:

- 1- “onboard GPS” or
- 2- CMM4 or
- 3- CMM3 or
- 4- Mix of “onboard GPS” and CMM4 (but NOT CMM3)

Attribute	Meaning
	For instructions on how to configure Frequency Reuse Mode to ensure that interference is reduced throughout the deployment, see Figure 20 .

Figure 20 Frequency reuse configuration example



The rules in selecting the APs to enabling the **Frequency Reuse Mode** in this deployment are:

- 1- 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 **Frequency-Reuse-Back**; the other AP must be configured with **Frequency Reuse Mode** set to **Frequency-Reuse-Front**.
Also, APs on different towers facing each other with overlapped coverage must be configured with **Frequency Reuse Mode** set to **Frequency-Reuse-Back**.

The GPS sync source is a mixture of all types (CMM3, CMM4 & “onboard GPS”)

In this configuration the GPS sync source in the whole network is one of the following:

- 1- (CMM3 and “onboard GPS”) or
- 2- (CMM3 and CMM4) or
- 3- (CMM3 and CMM4 and “onboard GPS”)

For more examples of which APs to enable the **Frequency Reuse Mode** feature in this mixture of sync sources, see [Figure 21](#) and [Figure 22](#).

Attribute

Meaning

Figure 21 Example 1 - Frequency reuse configuration, mixture of GPS synchronization sources

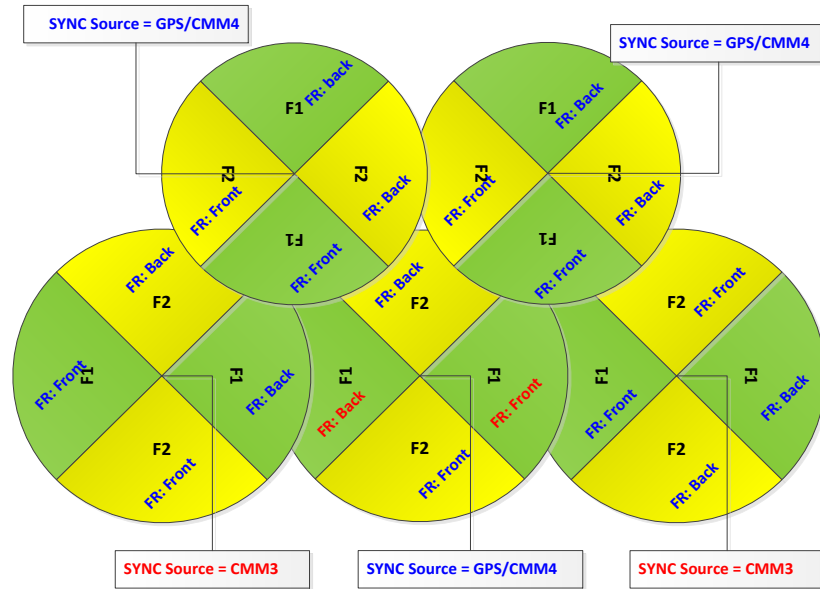
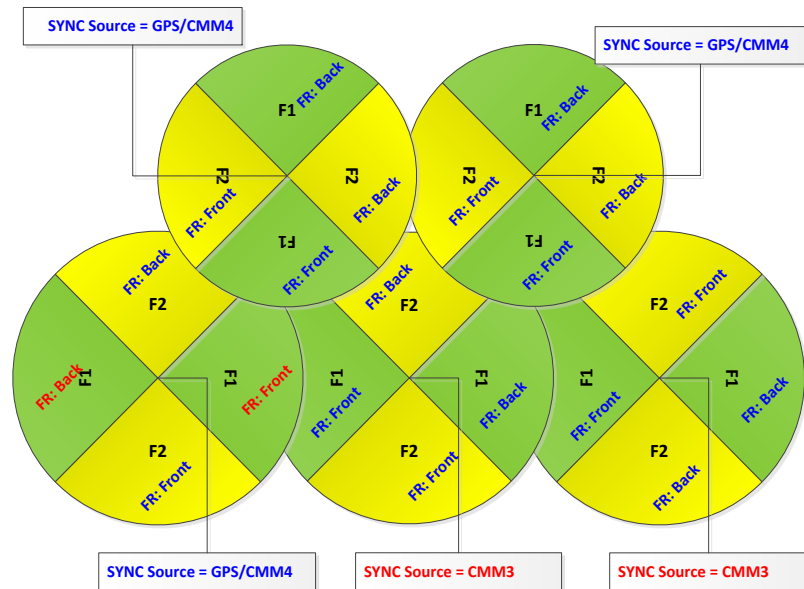


Figure 22 Example 2 - Frequency Reuse Configuration with Mixture of GPS sources



The rules in selecting the APs to configure **Frequency Reuse Mode** to **Frequency Reuse Mode** to **Frequency-Reuse-Front** or **Frequency-Reuse-Back** in a mixture of sync sources deployments are:

- 1- Only ONE of the APs on the same tower configured with the same frequency must have **Frequency Reuse Mode** set to **Frequency-Reuse-**

Attribute	Meaning
	<p>Back if the sync source of both APs is the same or the sync is a combination of “onboard GPS” and CMM4; the other AP will have the Frequency-Reuse-Front ON.</p> <p>2- For the APs on different towers facing each other with overlapped coverage:</p> <ol style="list-style-type: none"> If both APs have the same sync source then only ONE of them must have the Frequency-Reuse-Back ON; the other AP shall have the Frequency-Reuse-Front ON. If one AP has “onboard GPS” as sync source and the other one has CMM4 then only ONE of them must have Frequency-Reuse - Back ON; the other AP shall have Frequency-Reuse-Front ON. If one AP has “onboard GPS” or CMM4 as sync source and the other one has CMM3 then: <ol style="list-style-type: none"> If the AP with CMM3 sync source has Frequency-Reuse-Back ON, then the other AP (with “onboard GPS” or CMM4 sync source) must have the Frequency-Reuse-Back ON. If the AP with CMM3 sync source has Frequency Reuse Mode set to Off, then the other AP (with “onboard GPS” or CMM4 sync source) must have Frequency Reuse Mode set to Off.
Alternate Frequency Carrier 1 Channel Bandwidth	Configure the first channel bandwidth configuration that will be used for RF transmission if DFS detection causes the radio to switch from using the channel bandwidth configured in Channel Bandwidth .
Alternate Frequency Carrier 1	Configure the first frequency that will be used for RF transmission if DFS detection causes the radio to switch from using the frequency configured in Frequency Carrier . It is important to set this frequency also in the SM Scan List .
Alternate Frequency Carrier 2 Channel Bandwidth	Configure the second channel bandwidth configuration that will be used for RF transmission if DFS detection causes the radio to switch from using the channel bandwidth configured in Channel Bandwidth .
Alternate Frequency Carrier 2	Configure the second frequency that is used for RF transmission if DFS detection causes the radio to switch from using the frequencies configured in Frequency Carrier and DFS Alternate Frequency Carrier 1 . It is important to set this frequency also in the SM Scan List .
Downlink Max Rate	Configure the maximum MCS (Modulation and Coding Scheme) that the AP should use in the Downlink. For example: Setting this parameter to MCS12 will prevent the AP's rate adapt algorithm from using MCS13 through MCS15. Not available when AP is an ePTP Master .

Attribute	Meaning
Power Control	
Transmitter Output Power	<p>This value represents the combined power of the AP's two transmitters. This value may be automatically adjusted based on the configuration of the parameter Country Code.</p> <p>Nations and regions may regulate transmitter output power. For example</p> <ul style="list-style-type: none"> • 2.4 GHz and 5 GHz modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance. <p>The professional installer of the equipment has the responsibility to</p> <ul style="list-style-type: none"> • maintain awareness of applicable regulations. • calculate the permissible transmitter output power for the module. • confirm that the initial power setting is compliant with national or regional regulations • confirm that the power setting is compliant following any reset of the module to factory defaults.
Antenna Gain	<p>This value represents the amount of gain introduced by an external antenna (minus cable loss). This value is used in calculating the unit's Equivalent Isotropic Radiated Power (EIRP) level. For certain Country Code configurations, the unit's EIRP may be limited based on regional regulations.</p>
Subscriber Module Target Receive Level	<p>Each SM's transmitter output power is automatically set by the AP. The AP monitors the received power from each SM and adjusts each SM's transmitter output power so that the received power at the AP from the SM is not greater than what is configured in SM Target Received Power Level. These automatic power adjustments ensure that the SM is not transmitting excessive energy (raising system noise level) and that the SM is able to achieve an optimal modulation state (and maximum achievable throughput).</p> <p>Nominally, target receive levels must be set lesser than -60 dBm in order to prevent interference from co-located co-channel sectors.</p>
Scheduler	
Downlink/Uplink Ratio	<p>Configure the schedule of downlink traffic to uplink traffic on the radio link. The first 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. The fourth option, Flexible, allows the radio to dynamically choose the amount of the total radio's aggregate throughput that is used for downlink and uplink resources, every frame.</p> <div data-bbox="485 1677 540 1732" data-label="Image"> </div> <p>Caution</p> <p>Setting this parameter to Flexible causes the radio to operate in unsynchronized mode. For all other settings, if the AP is in a cluster or is in range of another AP, then you must set this parameter on all other APs in the cluster and in range exactly the same. Otherwise, overlapping RF transmissions will introduce system</p>

Attribute	Meaning
	interference.
Carrier Sense	<p>Enabled – The device tries to detect the presence of a carrier wave from another AP/SM before attempting to transmit. This is to prevent the overlapping or corruption of the RF signal when the system is in noisy or interference RF environment. The device delays transmitting the wireless packets until the wireless channel is clear. This is only applicable in Flexible mode and on a non-DFS channel.</p> <p>Disabled – The device does not check for any other transmission.</p>
AP Management Packet Rate	<p>MCS0: The system is configured to use MCS0 rate for all management messages. This allows for improved link stability and range in high interference environment.</p> <p>MCS1: The system is configured to use MCS1 rate for all management messages. This allows for slightly higher sector throughput. This is the default setting.</p>
Synchronization	
Synchronization Source	<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>CMM: Synchronization timing is received via the AP's Ethernet port via a connected Cambium Cluster Management Module (CMM). 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>Internal: Synchronization timing is generated by the AP and the timing is not based on GPS pulses.</p> <div data-bbox="487 1087 539 1138" data-label="Image"> </div> <p>Caution</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>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	<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>

AP Quality of Service page

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

Priority Level	ePMP Traffic Priority Label
Highest Priority (Served first)	VOIP (only utilized when VOIP Enable is set to Enabled)
Medium Priority (Served once highest priority traffic is sent)	High
Lowest Priority (Served once Highest and Medium priority traffic is sent)	Low

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



Caution

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

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

Figure 23 AP Quality of Service page

The screenshot displays the 'Configuration > Quality of Service' page in the Cambium Networks ePMP 1050 web interface. The left sidebar contains navigation links: Home, Quick Start, Configuration, Radio, Quality of Service (selected), System, Network, Security, Monitor, and Tools. The main content area is divided into two sections: 'Maximum Information Rate' and 'Traffic Priority'.

Maximum Information Rate (MIR) Section:

- Maximum Information Rate (MIR) is set to **Disabled** (radio button).
- Buttons: **Add** and **Compact View**.
- Table with columns: **Number**, **Description**, **Downlink MIR (Kbps)**, and **Uplink MIR (Kbps)**.

Traffic Priority Section:

- Traffic Priority: **Enabled** (radio button).
- VOIP Priority: **Enabled** (radio button).
- Broadcast Priority: **Low** (radio button).
- Multicast Priority: **Low** (radio button).
- Buttons: **Add** and **Compact View**.
- Table for QoS Classification Rules:

Type	Details	Priority
CoS	CoS - 3	Voice
DSCP	DSCP - 46	Voice

Table 47 AP Radio Configuration attributes

Attribute	Meaning
Maximum Information Rate	
Maximum Information Rate (MIR)	<p>Disabled: When disabled, RF transmission is only limited by the capacity of the link (and any active QoS classification rules).</p> <p>Enabled: When enabled, all downlink and uplink traffic is limited based on the profiles configured in the MIR table.</p>
MIR Profiles	The MIR (Maximum Information Rate) table is comprised of up to sixteen profiles which, after configured, may be set on the SM to employ a certain service level or data rate.
Number	Assign a profile number to each row in the AP MIR table. This profile number is then set on each SM to limit data transfer rates based on the operator's configuration of the MIR table and its profiles.
Description	Assign a logical description for each service level. For example, a tiered service-level provider may deploy service levels "Gold", "Silver" and "Bronze" or "20 Mbps", "10 Mbps" and "5 Mbps" to offer a clear description.
Downlink MIR (kbps)	Specify the downlink rate at which the AP is allowed to transmit for this configured profile.
Uplink MIR (kbps)	Specify the uplink rate at which the AP is allowed to transmit for this configured profile.
Traffic Priority	
Traffic Priority	<p>Disabled: No traffic prioritization is performed. All traffic is treated with equal priority (low priority).</p> <p>Enabled: Traffic prioritization is enabled and specific types of traffic can be prioritized using the fields below.</p>
VOIP Priority	<p>Enabled: When enabled, two entries are automatically added to the first and second rows of the QoS Classification Rules table, one with Rule Type CoS (5) and one with Rule Type DSCP (46). The addition of these rules ensures that VoIP traffic passed over the radio downlink is given highest priority. The CoS and DSCP values may be modified to accommodate non-standard VoIP equipment.</p> <p>Disabled: When disabled, VoIP traffic is scheduled normally along with all other user data.</p>
Broadcast Priority	<p>Low Priority: All Broadcast traffic sent over the downlink is prioritized as low priority and is delivered to the SM after scheduled high priority and VoIP traffic.</p> <p>High Priority: All Broadcast traffic sent over the downlink is prioritized as high priority and is scheduled for delivery to SMs before low priority traffic but after VoIP traffic.</p>

Attribute	Meaning
Multicast Priority	<p>Low Priority: All Multicast traffic sent over the downlink is prioritized as low priority, and will be delivered to the SM after scheduled high priority and VoIP traffic.</p> <p>High Priority: All Multicast traffic sent over the downlink is prioritized as high priority and is scheduled for delivery to SMs before low priority traffic but after VoIP traffic.</p>
QoS Classification Rules	The QoS Classification Rules table contains all of the rules enforced by the device when passing traffic over the radio downlink. Traffic passed through the device is matched against each rule in the table; when a match is made the traffic is sent over the radio link using the priority defined in column Traffic Priority .
Type	<p>CoS: Class of Service; traffic prioritization is based on the 3-bit header present in the 802.1Q VLAN-tagged Ethernet frame header in the packet entering the AP's Ethernet port.</p> <p>VLAN ID: traffic prioritization is based on the VLAN ID of the packet entering the AP's Ethernet port.</p> <p>EtherType: traffic prioritization is based on the two octet Ethertype field in the Ethernet frame entering the AP's Ethernet port. The Ethertype is used to identify the protocol of the data in the payload of the Ethernet frame.</p> <p>IP: traffic prioritization is based on the source and (or) destination IP address of the packet entering the AP's Ethernet port. A subnet mask may be included to define a range of IP addresses to match.</p> <p>MAC: traffic prioritization is based on the source and (or) destination MAC address of the packet entering the AP's Ethernet port. A mask may be included to define a range of MAC addresses to match. The mask is made up of a hex representation of a series of 1s to start the mask and 0s that end the mask. A 1 may not follow a 0. Thus FF:FF:FF:FF:00:00 is allowed, but FF:00:FF:FF:FF:FF is not. The MAC address is combined with the mask to define the range of allowed MAC addresses.</p>
Details	Represents the details of the Class of Service (CoS) present in the packet entering the AP's Ethernet port.
Priority	Represents the QoS classification rule priority.

AP System page

The AP's **System** page is used to configure system parameters, services, time settings, SNMP and syslog.

Figure 24 AP System page

Configuration > System

General

Device Name:

Webpage Auto Update: min: 0 | max: 20

Web Service

Web Service: ☒ HTTP ☐ HTTPS

HTTP Port: min: 0 | max: 65535

HTTPS Port: min: 0 | max: 65535

SSI Service

SSI Service: ☒ Disabled ☐ Enabled

Network Time Protocol (NTP)

NTP Server IP Assignment: ☒ Manic ☐ DHCP

Preferred NTP Server:

Alternate NTP Server:

Time Zone:

Location Services

Obtain from Internal GPS: ☒ Populate

Device Latitude: degrees | min: -90 | max: 90

Internal GPS Latitude:

Device Longitude: degrees | min: -180 | max: 180

Internal GPS Longitude:

Device Height: meters | min: 0 | max: 3000

Internal GPS Height:

User Account Management

Administrator Username:

Administrator Password:

Installer Account: ☒ Disabled ☐ Enabled

Installer Username:

Installer Password:

Home User Account: ☒ Disabled ☐ Enabled

Home User Username:

Home User Password:

Read-Only Account: ☒ Disabled ☐ Enabled

Read-Only Username:

Read-Only Password:

Simple Network Management Protocol (SNMP)

Read-Only Community String:

Read-Write Community String:

Trap: ☒ Disabled ☐ Enabled

Trap Community String:

Trap Devices:

Device IP	Device Port

System Name:

System Description:

System Logging (Syslog)

Server 1 IP:

Server 2 IP:

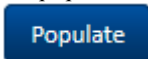
Server 3 IP:




Server 4 IP:



System Log Mask:

System Log Mask
<input checked="" type="checkbox"/> Debug <input checked="" type="checkbox"/> Info <input checked="" type="checkbox"/> Notice <input checked="" type="checkbox"/> Warning <input checked="" type="checkbox"/> Error <input checked="" type="checkbox"/> Critical Error <input checked="" type="checkbox"/> Alert <input checked="" type="checkbox"/> Emergency

Table 48 AP System attributes

Attribute	Meaning
General	
Device Name	Specifies the name of the AP.
Webpage Auto Update	Configure the interval for which the device retrieves system statistics for display on the management interface. For example, if this setting is configured to 5 seconds, the statistics and status parameters displayed on the management interface will be refreshed every 5 seconds (default).
Web Service	
Web Service	HTTP: Access to the device management GUI is conducted via HTTP. HTTPS: Access to the device management GUI is conducted via HTTPS.
HTTP Port	If Web Service is set to HTTP , configure the port which the device uses to service incoming HTTP requests for management GUI access.
HTTPS Port	If Web Service is set to HTTPS , configure the port which the device uses to service incoming HTTPS requests for management GUI access.
SSH Service	
SSH Service	Disabled: If the SSH port to the device is 'Disabled', access to the device through SSH is not possible. Enabled: If the SSH port to the device is 'Enabled', Cambium engineers can access the device through SSH which enables them to login to the radio and troubleshoot. SSH port is 'Enabled' by default.
Network Time Protocol	
NTP Server IP Assignment	Static: The device retrieves NTP time data from the servers configured in fields NTP Server IP Address . DHCP: The device retrieves NTP time data from the server IP issued 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	
Obtain from Internal GPS	On a GPS Synchronized ePMP radio, the Device coordinates can be populated using the information retrieved from the on-board GPS chip. Click the  button to automatically populate the Device Latitude and Device Longitude fields using the coordinates provided by the on-board GPS chip.
Device Latitude	Configure Latitude information for the device in decimal format.

Attribute	Meaning
Internal GPS Latitude	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Latitude information from the on-board GPS chip.
Device Longitude	Configure Longitude information for the device in decimal format.
Internal GPS Longitude	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Longitude information from the on-board GPS chip.
Device Height	Configure height above sea level for the device in meters.
Internal GPS Height	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device height above sea level from the on-board GPS chip.
User Account Management	
Administrator Username	<p>Read-only listing of available login levels.</p> <ul style="list-style-type: none"> ADMINISTRATOR, full read write permissions. INSTALLER, permissions to read and write parameters applicable to unit installation and monitoring. HOME, permissions only to access pertinent information for support purposes. READONLY has permission to only view the Monitor page.
Administrator Password	Configure a custom password for Administrator account. The password character display may be toggled using the visibility icon  .
Installer Account	<p>Disabled: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled.</p> <p>Enabled: The user is granted access to the device management interface.</p>
Installer Username	Provide the 'Installer Username' in this box.
Installer 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>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>
Home User Username	Provide the Home User 'Username' in this box.
Home User Password	Configure a custom password to secure the device in order access pertinent information for support purpose only. The password character display may be toggled using the visibility icon  .
Read-Only Account	<p>Disabled: The disabled user is not granted access to the device management interface, even on a 'Read-Only' access.</p> <p>Enabled: The user is granted 'Read-Only' access to the device management interface.</p>

Attribute	Meaning
Read-Only Username	Provide the Read Only 'Username' in this box.
Read-Only Password	Provide the password that can be used for 'Read-only' access. Password character display may be toggled using the visibility icon  .
Simple Network Management Protocol (SNMP)	
Read-Only Community String	Specify a control string that can allow a Network Management Station (NMS) such as the Cambium Networks Services Server (CNSS) to read SNMP information. No spaces are allowed in this string. This password will never authenticate an SNMP user or an NMS to read/write access. The SNMP Read-only Community String value is clear text and is readable by a packet monitor.
Read-Write Community String	Specify a control string that can allow a Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string.
Traps	Disabled: SNMP traps for system events are not sent from the device. Enabled: SNMP traps for system events are not sent to the servers configured in table SNMP Trap Servers .
Trap Community String	Configure a SNMP Trap Community String which is processed by the servers configured in SNMP 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).
Trap Servers	The SNMP Trap Servers table is used to configure trap destinations for SNMP traps generated by the device.
Server IP	Configure the IP address of each SNMP trap server target.
Server Port	Configure the port to which SNMP traps are sent from the ePMP device.
System Name	Specify a string to associate with the physical module. This parameter can be polled by the Cambium Networks Services Server (CNSS) or an NMS. Special characters are supported.
System Description	Specify a description string to associate with the physical module. This parameter can be polled by the Cambium Networks Services Server (CNSS) or an NMS. Special characters are supported.
Syslog Server IP 1-4	Specify up to four syslog servers to which the device sends syslog messages.
System Log Mask	Configure the levels of syslog messages which the devices send to the servers configured in parameters Syslog Server IP 1-4 .  Caution Choose only the syslog levels appropriate for your deployment. Excessive logging can cause the device log file to fill and begin overwriting previous entries.

AP Network page

The AP's Network page is used to configure system networking parameters and VLAN parameters.

Figure 25 AP Network page

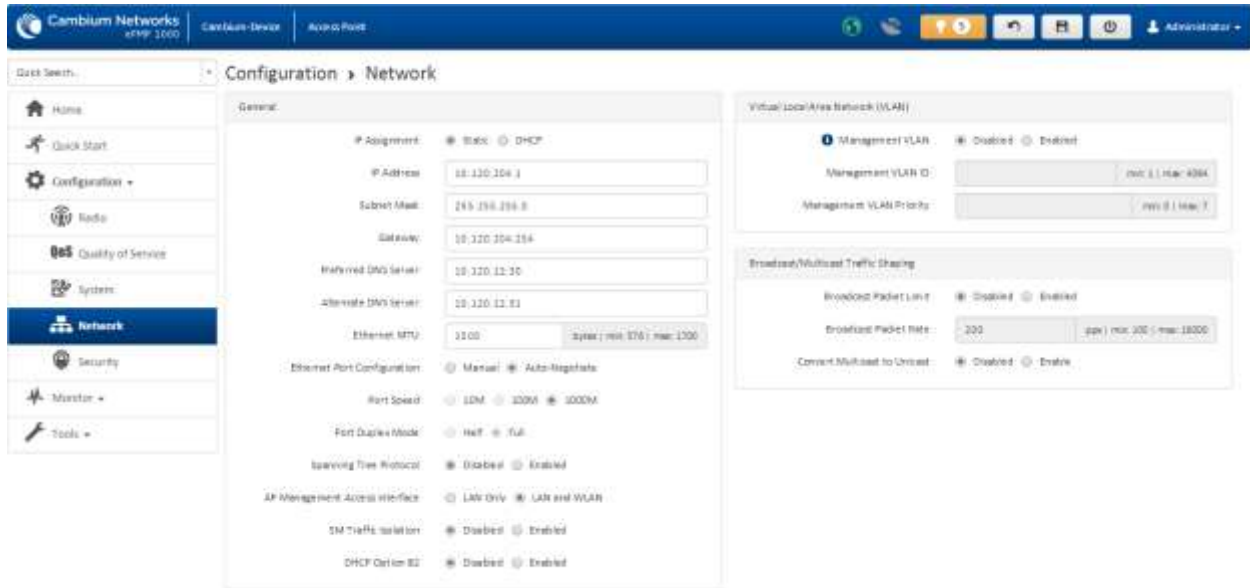




Table 49 AP Network attributes

Attribute	Meaning
General	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields Device IP Address (LAN), IP Subnet Mask (LAN), Gateway IP Address (LAN) and DNS Server IP Address (LAN).</p> <p>DHCP: Device management IP addressing (IP address, subnet mask, gateway, and DNS server) is assigned via a network DHCP server, and parameters Device IP Address (LAN), IP Subnet Mask (LAN), Gateway IP Address (LAN), and DNS Server IP Address (LAN) are unused.</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> <div>  <p>Note</p> </div> <p>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 fallback IP 192.168.0.1 (AP mode), 192.168.0.2 (SM mode), 192.168.0.3 (Spectrum Analyzer mode) or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port with IP 169.254.1.1.</p>
Subnet Mask	<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	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.
Ethernet MTU	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. Packets received by the device larger than the configured MTU are dropped.
Ethernet Port Configuration	<p>Manual: The LAN Ethernet port speed and duplex mode can be manually configured.</p> <p>Auto-Negotiate: The AP auto negotiates the LAN Ethernet port speed and duplex mode with the device connected to it.</p>
Port Speed	With “Ethernet Port Configuration” the LAN Ethernet port speed can be forced to 1000 Mbps, 100 Mbps or 10 Mbps.
Port Duplex Mode	With “Ethernet Port Configuration” the LAN Ethernet port duplex mode can be forced into Full or Half.
Spanning Tree Protocol	<p>Disabled: When disabled, Spanning Tree Protocol (802.1d) functionality is disabled at the AP.</p> <p>Enabled: When enabled, Spanning Tree Protocol (802.1d) functionality is enabled at the AP, allowing for prevention of Ethernet bridge loops.</p>
AP Management Access Interface	<p>LAN Only: Only allow access to the AP’s web management interface via a local Ethernet (LAN) connection. In this configuration, the AP’s web management interface may not be accessed from over the air (i.e. from a device situated below the SM).</p> <p>LAN and WLAN: Allow access to the AP’s web management interface via a local Ethernet (LAN) connection and from over the air (i.e. from a device situated below the SM).</p> <hr/> <div style="display: flex; align-items: center;">  <div style="margin-left: 5px;">Caution</div> </div> <p>APs configured with AP Management Access Interface set to LAN and WLAN are susceptible to unauthorized access.</p>
SM Traffic Isolation	<p>Enabled: When SM Isolation feature is “enabled”, SM#1 will not be able to communicate with SM#2 (peer-to-peer traffic) when both the SM’s 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> <p>Disabled: Default is set to “DISABLE” mode. When SM isolation is disabled, SM#1 is able to communicate with SM#2, when both the SM’s are associated to the same Access Point (AP).</p>

DHCP Option 82

Enabled: ePMP inserts “remote-id” (option ID 0x2) to be the SM’s MAC address and the “circuit-id” (ID 0x01) to be the AP’s MAC address. Those two fields are used to identify the remote device and connection from which the DHCP request was received.

Disabled: When ‘Disabled’, ePMP does not insert the “remote-id” (option ID 0x2) and the “circuit-id” (ID 0x01). DHCP Option 82 is ‘Disabled’ by default.

Virtual Local Area Network (VLAN)

Management VLAN

Enabled: The AP management interface can be assigned to a Management VLAN to separate management traffic (remote module management via SNMP or HTTP) from user traffic (such as internet browsing, voice, or video). Once the management interface is enabled for a VLAN, an AP’s management interface can be accessed only by packets tagged with a VLAN ID matching the management VLAN ID.

A VLAN configuration establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data based on the VLAN architecture. For the network operator, this provides flexibility in network segmentation, simpler management and enhanced security.

Disabled: When disabled, all IP management traffic is allowed to the device.

Management VLAN ID

Configure this parameter to include the device’s management traffic on a separate VLAN network. For example, if **MGMT VLAN ID** is set to 2, GUI access will only be allowed from IP packets tagged with VLAN ID 2.

Management VLAN Priority

ePMP radios can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. **MGMT VLAN Priority** represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to device management traffic.

This parameter only takes effect if the MGMT 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 SM. The default value is 0.

Broadcast/Multicast Traffic Shaping

Broadcast Packet Limit

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.

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

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 **200**.

Convert Multicast to
Unicast

Enabled: This feature allows ePMP to support IGMP capable devices. Once a multicast group is identified, the AP allows multicast traffic to be sent **only** to the SMs within the multicast group. The SMs support up to 5 unique multicast groups. In addition, when this option is enabled, the multicast traffic is sent to the SMs using the current Downlink MCS rate.

Disabled: ePMP will still support IGMP capable devices but the multicast traffic will be sent using MCS 1 on the downlink to all SMs, regardless of the multicast group.

AP Security page

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



Caution

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 26 AP Security page

The screenshot displays the 'Configuration > Security' page in the Cambium Networks ePMP 1000 web interface. The left sidebar shows navigation options: Home, Quick Start, Configuration, Radio, Quality of Service, System, Network, Security (selected), Monitor, and Tools. The main content area is divided into three sections:

- Security Options:** Includes radio buttons for 'Wireless Security', 'Open', 'WPA2', and 'RADIUS'. 'RADIUS' is currently selected.
- WPA2:** Contains a 'WPA2 Pre-shared Key' field with masked characters (*****).
- RADIUS:** Features a 'Servers' table with columns for IP Address, Port, and Secret. Below the table are input fields for 'Server Retries' (set to 1) and 'Server Timeout' (set to 5).

The 'Firewalls' section at the bottom includes options for 'Layer 2 Firewall' and 'Layer 3 Firewall', both currently set to 'Disabled'. Each section has an 'Add' button and a 'Back to Wide View' button.

	IP Address	Port	Secret
	10.120.134.128	1812	*****
	10.120.134.77	1812	*****
	10.120.134.128	1812	*****

Table 50 AP Security attributes

Attribute	Meaning
Security Options	
Wireless Security	<p>Open: All SMs requesting network entry are allowed registration.</p> <p>WPA2: The WPA2 mechanism provides AES radio link encryption and SM network entry authentication. When enabled, the SM must register using the Authentication Pre-shared Key configured on the AP and SM.</p> <p>RADIUS: Enables the connection to a pre-configured RADIUS server.</p>
WPA2	
WPA2 Pre-shared Key	Configure this key on the AP. Then configure each of the network SMs with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.
RADIUS	
Servers	<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> <p>Port: The Radius server port. Default is 1812.</p> <p>Secret: Secret key that is used to communicate with the Radius server.</p>
Server Retries	Number of times the radio will retry authentication with the configured Radius server before it fails authentication of the SM.
Server Timeout	Timeout between each retry with the configured Radius server before it fails authentication of the SM.
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>
Firewall Rules	When the SM is configured with SM Network Mode set to Bridge , 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>Enabled: Modifications to the Layer 3 Firewall Table are allowed and rules are enforced.</p> <p>Disabled: Modifications to the Layer 3 Firewall Table are not allowed and rules are not enforced.</p>
Firewall Rules	When the SM is configured with SM Network Mode set to NAT , 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.

AP 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.

The **Monitor** menu contains the following pages:

- **AP Performance page** on page **112**
- **AP System page** on page **116**
- **AP Wireless page** on page **118**
- **AP GPS page** on page **120**
- **AP Network page** on page **122**
- **AP System Log page** on page **125**

AP Performance page

Use the Performance page to monitor system status and statistics to analyze and troubleshoot network performance and operation.

Figure 27 AP Performance page

Monitor > Performance

Time Since Last Reset: 000001-01-22

Ethernet Statistics - Transmitted

Total Traffic	974974 Kbits
Total Packets	531637
Packet Errors	0
Packet Drops	0
Multicast / Broadcast Traffic	2474 Kbits
Broadcast Packets	7552
Multicast Packets	0

Ethernet Statistics - Received

Total Traffic	98570 Kbits
Total Packets	53073
Packet Errors	0
Packet Drops	0
Multicast / Broadcast Traffic	17810 Kbits
Broadcast Packets	13810
Multicast Packets	13822

Wireless Statistics - Downlink

Total Traffic	12770 Kbits
Total Packets	7397
Error Drop Packets	0
Capacity Drop Packets	0
Retransmission Packets	0
Multicast / Broadcast Traffic	3806 Kbits
Broadcast Packets	4052
Multicast Packets	3751

Wireless Statistics - Uplink

Total Traffic	61775 Kbits
Total Packets	32806
Error Drop Packets	0
Multicast / Broadcast Traffic	407 Kbits
Broadcast Packets	1448
Multicast Packets	0

System Statistics

Sensor Drops	0
Device Resets	15
Network Entry Attempts	5
Successful Network Entries	5
Network Entry Authentication Failures	0
Radio (DFS) Detections	0

Subscriber Module Statistics

Compact View

MAC Address	Total Uplink	Total Uplink Packets	Uplink Packet Drops	Total Downlink	Total Downlink Packets	Downlink Packet Drops	Downlink Capacity Packet Drops	Downlink Retransmission Packets	Downlink Power
00:04:56:C4:52:A0	171 Kbits	145	0	165 Kbits	348	0	0	0	18 dBm
00:04:56:C0:08:81	171 Kbits	145	0	165 Kbits	348	0	0	0	18 dBm
00:04:56:C0:08:F6	655 Kbits	888	0	710 Kbits	887	0	0	0	16 dBm
00:04:56:C0:08:F9	648 Kbits	878	0	702 Kbits	872	0	0	0	16 dBm
00:04:56:C0:0A:C3	61729 Kbits	8755	0	7228 Kbits	5352	0	0	0	16 dBm

Downlink Packets per MCS

MCS 0	0 (0.0%)
MCS 1	7858 (11.0%)
MCS 2	57 (0.4%)
MCS 3	9 (0.1%)
MCS 4	5 (0.0%)
MCS 5	10 (0.1%)
MCS 6	72 (0.3%)
MCS 7	84 (0.6%)
MCS 8	0 (0.0%)
MCS 9	519 (3.4%)
MCS 10	965 (3.7%)
MCS 11	370 (2.4%)
MCS 12	91 (0.6%)
MCS 13	99 (0.6%)
MCS 14	113 (0.7%)
MCS 15	5198 (15.4%)

Uplink Packets per MCS

MCS 0	0 (0.0%)
MCS 1	6 (0.0%)
MCS 2	72 (0.6%)
MCS 3	8 (0.1%)
MCS 4	5 (0.0%)
MCS 5	6 (0.0%)
MCS 6	55 (0.4%)
MCS 7	55 (0.4%)
MCS 8	0 (0.0%)
MCS 9	517 (4.4%)
MCS 10	533 (4.2%)
MCS 11	701 (5.7%)
MCS 12	59 (0.5%)
MCS 13	61 (0.5%)
MCS 14	55 (0.4%)
MCS 15	10101 (62.4%)

Downlink Frame Time

Total Frame Time Used	2.3%
-----------------------	------

Uplink Frame Time

Total Frame Time Used	99.0%
-----------------------	-------

Table 51 AP Performance page attributes

Attribute	Meaning
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 AP's Ethernet interface.
Total Packets	Total number of packets transferred from the AP's Ethernet interface.
Packet Errors	Total number of packets transmitted out of the AP's 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 AP's Ethernet interface due to Ethernet setup or filtering issues.
Multicast/Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits sent via the AP's Ethernet interface.
Broadcast Packets	Total number of broadcast packets sent via the AP's Ethernet interface.
Multicast Packets	Total number of multicast packets sent via the AP's Ethernet interface.
Ethernet Statistics - Received	
Total Traffic	Total amount of traffic in Kbits received by the AP's Ethernet interface.
Total Packets	Total number of packets received by the AP's Ethernet interface.
Packet Errors	Total number of packets received by the AP's 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 AP's wireless interface due to Ethernet setup or filtering issues.
Multicast/Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits received by the AP's Ethernet interface.
Broadcast Packets	Total number of broadcast packets received via the AP's Ethernet interface.
Multicast Packets	Total number of multicast packets received via the AP's Ethernet interface.
Wireless Statistics – Downlink	
Total Traffic	Total amount of traffic transmitted out of the AP's wireless interface in Kbits.
Total Packets	Total number of packets transmitted out of the AP's wireless interface.
Error Drop Packets	Total number of packets dropped after transmitting out of the AP's Wireless interface due to RF errors (No acknowledgement and other RF related packet error).
Capacity Drop Packets	Total number of packets dropped after transmitting out of the AP's Wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Retransmission Packets	Total number of packets re-transmitted after transmitting out of the AP's Wireless interface due to the packets not being received by the SMs.

Attribute	Meaning
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic transmitted out of the AP's wireless interface in Kbits.
Broadcast Packets	Total number of broadcast packets transmitted out of the AP's wireless interface.
Multicast Packets	Total number of multicast packets transmitted out of the AP's wireless interface.
Wireless Statistics – Uplink	
Total Traffic	Total amount of traffic received via the AP's wireless interface in Kbits.
Total Packets	Total number of packets received via the AP's wireless interface.
Error Drop Packets	Total number of packets dropped prior to sending out of the AP's Ethernet interface due to RF errors (packet integrity error and other RF related packet error).
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic received on the AP's wireless interface in Kbits.
Broadcast packets	Total number of broadcast packets received on the AP's wireless interface.
Multicast Packets	Total number of multicast packets received on the AP's wireless interface.
System Statistics	
Session Drops	Total number of SM sessions dropped on the AP.
Device Reboots	Total number of reboots of the AP.
Network Entry Attempts	Total number of Network Entry Attempts by all the SMs on the AP.
Successful Network Attempts	Total number of successful network entry attempts.
Network Entry Authentication Failures	Total number of failed Network Entry Attempts by all the SMs on the AP.
Radar (DFS) Detections	Total number of DFS events that were detected by the AP.
Subscriber Module Statistics	
MAC Address	MAC Address of the SM connected to the AP.
Total Uplink	Total amount of traffic received via the AP's wireless interface from this SM in Kbits.
Total Uplink Packets	Total number of packets received via the AP's wireless interface from this SM.
Uplink Packet Drops	Total number of packets dropped prior to sending out of the AP's Ethernet interface due to RF errors (packet integrity error and other RF related packet error) from this SM.
Total Downlink	Total amount of traffic transmitted out of the AP's wireless interface in Kbits.
Total Downlink Packets	Total number of packets transmitted out of the AP's wireless interface.

Attribute	Meaning
Downlink Packet Drops	Total number of packets dropped after transmitting out of the AP's 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 AP's 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 AP's Wireless interface due to the packets not being received by the SM.
Downlink Power	The transmit power of the AP for the downlink packets to the SM.
Downlink Packets per MCS	
MCS 0 through MCS 15	Number of packets (and percentage of total packets) transmitted out of the AP's wireless interface for every modulation mode used by the AP's transmitter, based on radio conditions.
Uplink Packets per MCS	
MCS 0 through MCS 15	Number of packets (and percentage of total packets) received on the AP's wireless interface for every modulation mode, based on radio conditions.
Downlink Frame Time	
Total Frame Time Used	Percentage of frame time used in the downlink.
Uplink Frame Time	
Total Frame Time Used	Percentage of frame time used in the uplink.

AP System page

Use the System Status page to reference key system information.

Figure 28 AP System Status page

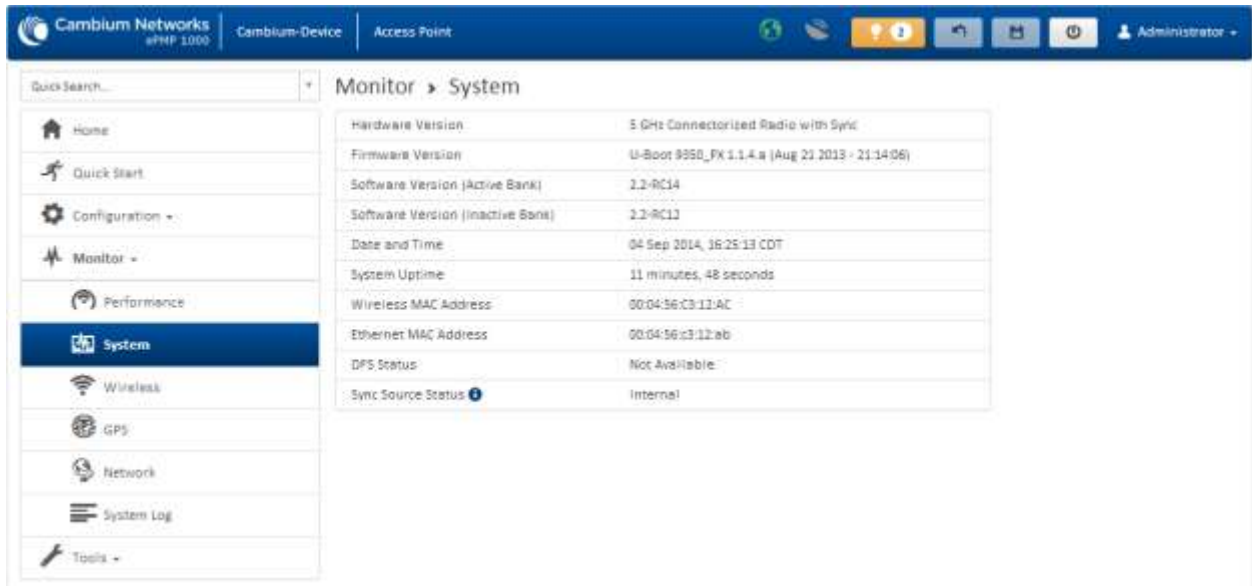


Table 52 AP System Status page attributes

Attribute	Meaning
Hardware Version	Board hardware version information.
Firmware Version	U-Boot version information.
Software Version (Active Bank)	The currently operating version of software on the ePMP device.
Software Version (Inactive Bank)	The backup software version on the ePMP 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 .
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.

Attribute	Meaning
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>
Sync Source Status	Displays the current source (GPS, CMM or Internal) of sync timing for the AP.

AP Wireless page

Use the **Wireless** Status page to reference key information about the radio's wireless interface and connected SMs.

Figure 29 AP Wireless Status page

SM MAC Address	SM IP Address	SM Name	Disconnect Time	Upload MBS	Download MBS (Down)	Upload MBS	Download MBS	Upload MCS	Download MCS	MBS Profile Number	Upload Rate (Kbps)	Download Rate (Kbps)	Download Quality	Download Capacity	Session Time
00:04:5B:C8:5A:AE	10.130.104.106	5G-Hz-G5-Station6	disconnect	-53	-65	43	40	15	30	0	1000000	1000000	100%	100%	01:42:24
00:04:5B:C8:09:81	10.130.104.105	5G-Hz-Station2	disconnect	-50	-48	48	47	15	30	0	1000000	1000000	100%	100%	01:42:18
00:04:5B:C8:0B:76	10.130.104.104	5G-Hz-Station3	disconnect	-52	-53	44	45	15	35	3	9000	10000	100%	100%	01:42:04
00:04:5B:C8:0B:79	10.130.104.103	5G-Hz-Station1	disconnect	-51	-54	44	42	15	35	0	1000000	1000000	100%	100%	01:41:54
00:04:5B:C8:0A:C1	10.130.104.101	5G-Hz-Station5	disconnect	-52	-51	44	45	15	35	0	1000000	1000000	100%	100%	01:41:42

Table 53 AP Wireless Status page attributes

Attribute	Meaning
Operating Frequency	The current frequency at which the AP is operating.
Operating Channel Bandwidth	The current channel size at which the AP is transmitting and receiving.
Transmitter Output Power	The current power level at which the AP is transmitting.
Registered Subscriber Modules	The total number of SMs which are currently registered to the AP.
Ethernet Interface	Up: The Ethernet (LAN) interface is functioning properly. Down: The Ethernet (LAN) interface has encountered an error and is not servicing traffic.
Wireless Interface	Up: The radio (WAN) interface is functioning properly. Down: The radio (WAN) interface has encountered an error and is not servicing traffic.
Current Country Code	The current country code at which the AP is operating.
Total Multicast groups	Displays the current number of multicast groups that the AP has identified from IGMP devices connected to the registered SMs.
Registered Subscriber Modules	Use the Registered Subscriber Modules table to monitor registered SMs, their key RF status and statistics information.
SM MAC Address	The MAC address of the SM wireless interface.

Attribute	Meaning
SM IP Address	The IP address of the SM wireless interface.
SM Name	Device Name of the SM
Disconnect SM	Clicking this button disconnects the SM from the AP
Uplink RSSI	Current receive signal strength of the SM at the AP, in the uplink
Downlink RSSI (Estim.)	Current estimated receive signal strength of the SM in the downlink
Uplink SNR	Current Signal-to-Noise of the SM in the uplink
Downlink SNR	Current Signal-to-Noise of the SM in the downlink
Uplink MCS	Current MCS at which the SM is operating on the uplink
Downlink MCS	Current MCS at which the SM is operating on the downlink
MIR Profile	Current MIR profile assigned to this SM
Uplink Rate (kbps)	Current uplink MIR assigned to this SM in kbps
Downlink Rate (kbps)	Current downlink MIR assigned to this SM in kbps
Downlink Quality	The downlink quality based on the current MCS and PER for this SM
Downlink Capacity	The downlink capacity based on the current DL MCS with respect to the highest supported MCS (MCS15). Not available in ePTP Master mode.
Session Time	Time duration for which the SM has been registered and in session with the AP.

AP GPS page

Use the GPS Status page to reference key information about the radio's configured GPS coordinates.

Figure 30 AP GPS Status page

ID	Signal-to-Noise Ratio	Status
20	31	tracked
12	33	tracked
1	37	tracked
14	35	tracked
51	32	tracked
22	34	tracked
32	38	tracked
25	36	tracked
18	33	tracked
11	35	tracked
36	0	visible

Table 54 AP GPS Status page attributes

Attribute	Meaning
Internal GPS Latitude	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Latitude information from the on-board GPS chip.
Internal GPS Longitude	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device Longitude information from the on-board GPS chip.
Internal GPS Height	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)	On a GPS Synchronized ePMP radio, the field is automatically populated with the time from the on-board GPS chip.
GPS Firmware version	On a GPS Synchronized ePMP radio, the field indicates the current firmware version of the on-board GPS chip.

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

AP Network page

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

Figure 31 AP Network Status page

The screenshot displays the 'Monitor > Network' page in the Cambium Networks ePMP 1.030 interface. The left sidebar contains navigation links: Home, Quick Start, Configuration, Monitor (selected), Performance, System, Wireless, GPS, Network, System Log, and Tools. The main content area is divided into several sections:

- Ethernet Status:**
 - IP Assignment: Static
 - Ethernet Interface: Up
 - IP Address: 10.120.204.1
 - Subnet Mask: 255.255.255.0
 - MTU Size: 1500 bytes
 - Port Speed: 1000 Mbps
 - Port Duplex Mode: Full
- Wireless Status:**
 - Wireless Interface: Up
 - IP Address: —
 - Subnet Mask: —
 - Default Gateway: 10.120.204.254
- Network Status:**
 - DNS Server IP: 10.120.12.30, 10.120.12.31
 - DHCP Option 82: Disabled
- Multicast Status:**
 - Multicast Processing: Fixed MCs
- ARP Table:**
 - Buttons: ARP Table, Compact View

MAC Address	IP Address	Interface
00:22:BE:6E:40:00	10.120.204.254	Bridge
- Bridge Table:**
 - Buttons: Bridge Table, Compact View

MAC Address	Port	Subscriber Module MAC	Aging Timer (secs)
00:04:56:C4:53:A2	WLAN	N/A	4
00:04:56:CD:0B:F9	WLAN	N/A	8
00:04:56:CD:0A:C1	WLAN	N/A	0
00:04:56:CD:0B:FE	WLAN	N/A	8
00:04:56:CD:0B:81	WLAN	N/A	46
00:04:56:C3:12:AC	Own	N/A	0

Table 55 AP Network Status page attributes

Attribute	Meaning
Ethernet Status	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields Device IP Address (LAN), IP Subnet Mask (LAN), Gateway IP Address (LAN) and DNS Server IP Address (LAN).</p> <p>DHCP: Device management IP addressing (IP address, subnet mask, gateway, and DNS server) is assigned via a network DHCP server, and parameters Device IP Address (LAN), IP Subnet Mask (LAN), Gateway IP Address (LAN), and DNS Server IP Address (LAN) are unused.</p>

Attribute	Meaning
Ethernet Interface	<p>Up: The device Ethernet interface is functioning and passing data.</p> <p>Down: The device Ethernet interface has encountered an error disallowing full operation. Reset the device to reinitiate the Ethernet interface.</p>
IP Address	The current IP Address mode of the device (static or DHCP).
Subnet Mask	The currently configured device IP subnet mask.
MTU Size	The currently configured Maximum Transmission Unit for the AP's 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.
Port Speed	The current Ethernet port speed of the radio.
Port Duplex Mode	The current Ethernet port duplex mode of the radio.
Wireless Status	
Wireless Interface	<p>Up: The device wireless interface is functioning and passing data</p> <p>Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface.</p>
IP address	Currently unused.
Subnet Mask	Currently unused.
Default Gateway	IP address that is currently assigned.
Network Status	
DNS Server IP	Represents the IP address of the DNS Server.
DHCP Option 82	<p>Enabled: ePMP inserts "remote-id" (option ID 0x2) to be SM's MAC address and the "circuit-id" (ID 0x01) to be the AP's MAC address. Those two fields are used to identify the remote device and connection where the DHCP request was received and DHCP server can assign IP address accordingly.</p> <p>Disabled: When 'Disabled', AP passes the bootP traffic unaffected. DHCP Option 82 is 'Disabled' by default.</p>
Multicast Status	
Multicast Processing	<p>Displays the rate at which multicast traffic is sent on the downlink.</p> <p>Fixed MCS: Multicast traffic is sent to the SMs on the downlink at MCS 1.</p> <p>Converted to Unicast: Multicast traffic is converted to unicast and sent to the SMs at the current MCS capability on the downlink.</p>
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 AP identified the devices on.
Bridge Table	

Attribute	Meaning
MAC address	The hardware address of the AP.
Port	The port to which the device is connected.
Subscriber Module MAC	MAC Address for one of the connected SMs.
Aging Timer (secs)	Time set for the MAC addresses in the Bridge table.

AP System Log page

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

Figure 32 AP System Log page

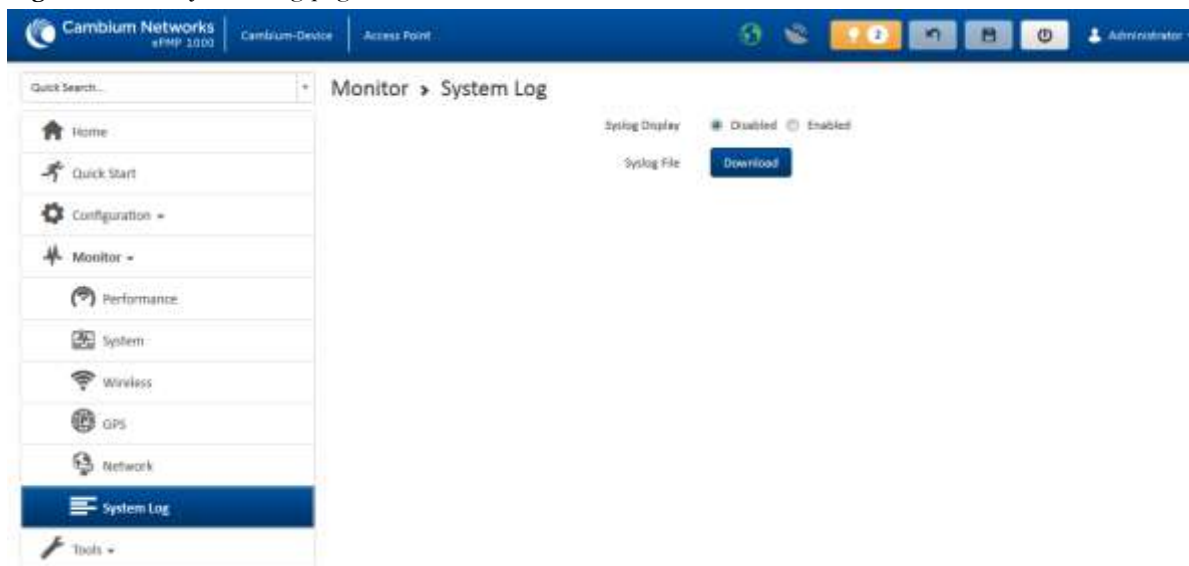


Table 56 AP System Log attributes

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.

AP TOOLS MENU

The **AP Tools** menu provides several options for upgrading device software, configuration backup/restore, analyzing RF spectrum, testing device throughput, and running ping and traceroute tests.

- **AP Software Upgrade page** on page **127**
- **AP Backup/Restore page** on page **129**
- **AP eDetect page** on page **132**
- **AP Spectrum Analyzer page** on page **135**
- **AP Automatic Channel Selection page** on page **138**
- **AP eAlign page** on page **140**
- **AP Wireless Link Test page** on page **142**
- **AP Ping page** on page **144**
- **AP Traceroute page** on page **145**

AP Software Upgrade page

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

Caution

Read the Release Notes associated with each software release.

Figure 33 AP Software Upgrade page

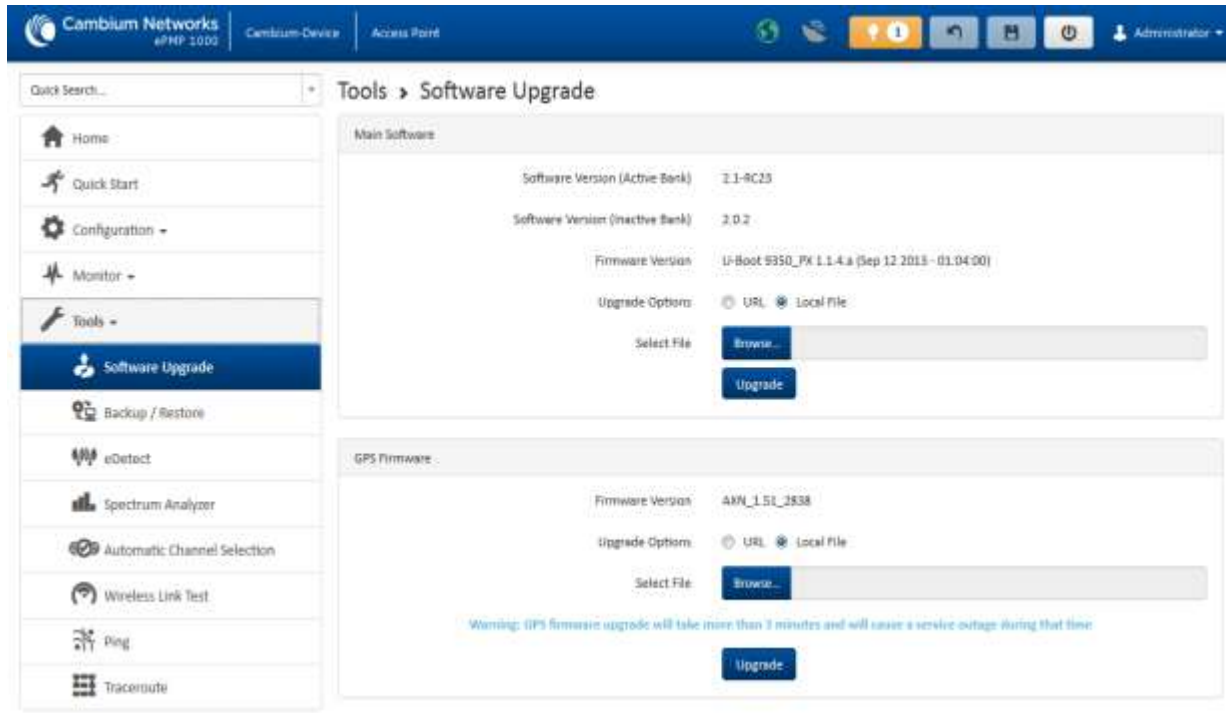




Table 57 AP Software Upgrade attributes

Attribute	Meaning
Main Software	
Software Version (Active Bank)	The current software running on the device.
Software Version (Inactive Bank)	When the Active Bank Software (current) is corrupt and cannot power up for 8 consecutive reboots, the Inactive Software becomes the Active software and powers up the device.
Firmware Version	The current U-Boot version.

Attribute	Meaning
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.
GPS Firmware	
Firmware Version	The current firmware of the on-board GPS chip (AXN_1.51_2801). After upgrading, this version should show as AXN_1.51_2838 .
Upgrade Options	<p>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>.</p> <p>Local File: Click Browse to select the local file containing the GPS firmware upgrade package.</p>
	 Note <p>If the “GPS Firmware Version” under Monitor=>GPS Status shows “NOT AVAILABLE”, it means that the on-board GPS chip has locked up. A power cycle of the ePMP unit is required to restore the connectivity to the chip before performing the GPS firmware upgrade.</p>
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.
	 Note <p>Use the same package that is used to upgrade the device’s software. The new GPS firmware is part of the software upgrade packages.</p>

To upgrade the device software from a local file (or network-accessible file), follow this:

Procedure:

- 1 Download the software upgrade packages from <https://support.cambiumnetworks.com/files/epmp>
- 2 Clear the accessing browser cache
- 3 On the device GUI, navigate to **Tools => Software Upgrade**.
- 4 Select the **Software Upgrade Source** which represents the location of your software upgrade packages
- 5 Based on the configuration of **Software Upgrade Source**, enter either the **Software Upgrade Source** or click the **Browse** button and locate the software package
- 6 Click **Upgrade**
- 7 When the upgrade completes successfully, click the **Reset** icon

To upgrade the GPS firmware from a local file (or network-accessible file), follow this:

Procedure:

- 1 Download the software upgrade packages from <https://support.cambiumnetworks.com/files/epmp>
- 2 Clear the accessing browser cache
- 3 On the device GUI, navigate to **Tools => Software Upgrade**
- 4 Select the **Upgrade Options** under **GPS Firmware** which represents the location of your software upgrade packages
- 5 Based on the configuration of **GPS Firmware Source**, enter either the **Upgrade Source** or click the **Browse** button and locate the firmware package
- 6 Click **Upgrade**
- 7 When the upgrade completes successfully, click the **Reset** icon

AP Backup/Restore page

Use the AP Backup/Restore page to perform the following functions:

- Back up the configuration in either text (.json) format or binary (.bin) format.
- Restore the configuration of using a configuration file that was previously backed up.
- Reset the device to its factory default configuration. For more factory defaulting methods, see:
 - [Using the device external reset button](#) on page 227
 - [Resetting the ePMP to factory defaults by power cycling](#) on page 228

Figure 34 AP Backup / Restore page

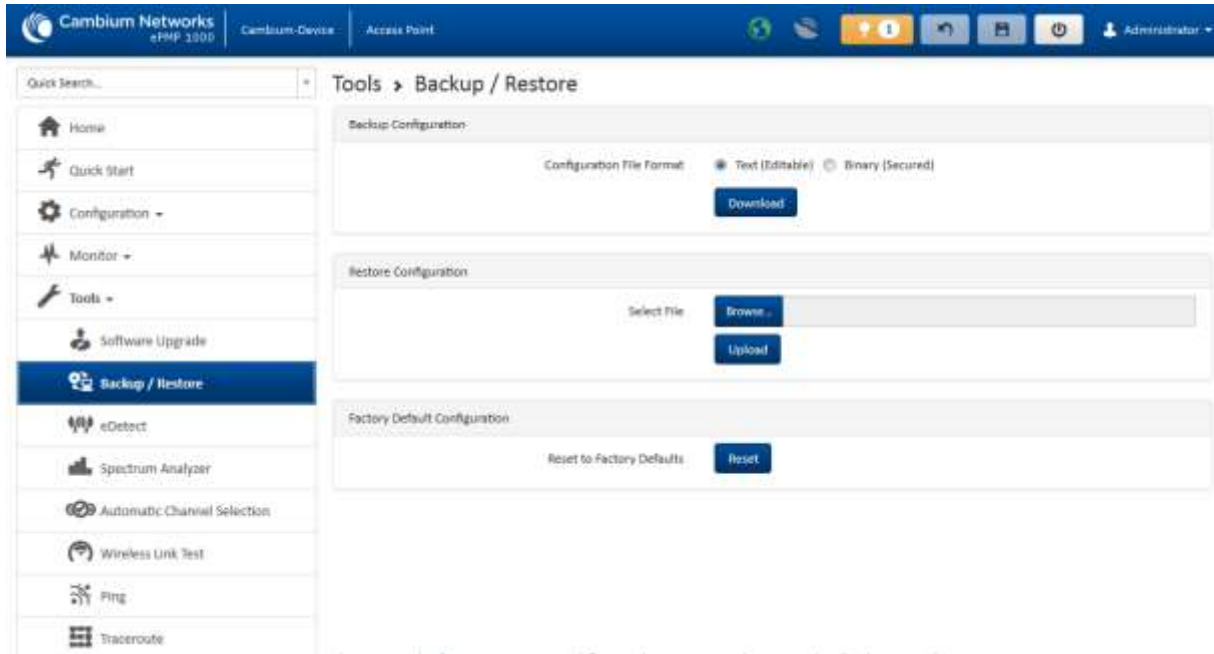


Table 58 AP Backup / Restore attributes

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.
Factory Default Configuration	
Reset to Factory Defaults	<p>Use this button to reset the device to its factory default configuration.</p> <hr/> <div data-bbox="487 766 540 819" data-label="Image"> </div> <p>Caution</p> <p>A reset to factory default configuration resets all device parameters. The AP will cease to transmit and any registered SMs will lose their session.</p>

AP eDetect page

The eDetect tool (not available in ePTP Master mode) is used to measure the 802.11 interference at the ePMP radio or system when run from the AP, on the current operating channel. When the tool is run, the ePMP device processes all frames received from devices not connected to the ePMP system and collects the interfering frame's information such as MAC Address, RSSI, and MCS. Use the AP eDetect page to perform the following functions:

- Collect information about interferers system wide on the AP and the SMs connected to it to display on the APs GUI.
- Collect information about interferers locally at the AP only to display on the AP's GUI.

Figure 35 AP eDetect page

Tools > eDetect

eDetect

Detecting Device: ☐ AP ☐ AP/SMs

Detection Duration: sec | min: 1 | max: 120

Start/Stop:

Export to CSV:

Status: Stopped

AP SSID: Cambium-AP

Detection Results

Device Instant Health	Detecting Device Info			Interferers' Info		
	Device MAC	Device RSSI (dBm)	Device MCS	Interferers' MAC	Interferers' RSSI (dBm)	Interferers' Max MCS

Table 59 AP eDetect attributes

Attribute	Meaning
Detecting Device	<p>AP: Choosing this option will collect information about interferers local to the AP.</p> <p>AP/SMs: Choosing this option collect information about interferers system wide i.e. interferers local to the AP as well as interferers at the SMs connected to the AP.</p>
Detection Duration	<p>Configure the duration for which the AP (and SMs) scan for interferers.</p> <div data-bbox="488 443 537 495" data-label="Image"></div> <p>Caution</p> <p>During the scanning period, the AP continues servicing the SMs under it, and there is no outage (unlike running a Spectrum Analyzer). There may be a negligible degradation in overall sector throughput.</p>
Start/Stop	Use to start or stop the interference detection.
Export to CSV	Choose this option to export the detection results to .csv format.
Status	Current status of the Interference Detection tool.
AP SSID	The current configured name/SSID of the AP.
Detection Results	Use the Detection Results table to monitor interferers at the AP and at the registered SMs and their key RF parameters.
Device Instant Health	<p>This is an indicator of the device's health in terms of channel conditions in the presence of interferer(s).</p> <p>Green: Indicates that the channel is relatively clean and has good C/I levels (>25dB). The interference level is low.</p> <p>Yellow: Indicates that the channel has moderate or intermittent interference (C/I between 10dB and 25dB).</p> <p>Red: Indicates that the channel has high interference and poor C/I levels (<10dB).</p>
Device MAC	The MAC address of the AP and/or SMs wireless interface.
Device RSSI (dBm)	The Received Signal Strength Indicator, which is a measurement of the power level being received by the device's antenna.
Device MCS	Modulation and Coding Scheme – indicates the modulation mode used for the radio's receiver side, based on radio conditions (MCS 1-7, 9-15).
Interferers' MAC	The MAC address of the interferer's wireless interface.
Interferers' RSSI (dBm)	The Received Signal Strength Indicator, which is a measurement of the interferer's power level being received by the device's antenna.
Interferers' MCS	Modulation and Coding Scheme – indicates the modulation mode used by the interferer, based on radio conditions (MCS 1-15).

**Note**

The system is operational when the eDetect tool is initiated. The detection is done during the transmission period within the TDD frame. And it is possible that the AP detects another AP on its back sector as an interferer when it is using the same frequency carrier in a GPS Synchronized system. Also, since the detection happens when the system is operational, there may be a negligible degradation in overall sector throughput when run from the AP.

AP Spectrum Analyzer page

Use the AP Spectrum Analyzer page download the spectrum analyzer tool.

To download the spectrum analyzer tool, the AP **Device Mode** must be set to **Spectrum Analyzer**.

Java Runtime Environment is required to run the AP spectrum analyzer.



Caution

Conducting spectrum analysis causes the AP to enter scan mode and the AP drops all RF connections.

Vary the days and times when you analyze the spectrum in an area. The RF environment can change throughout the day or throughout the week.

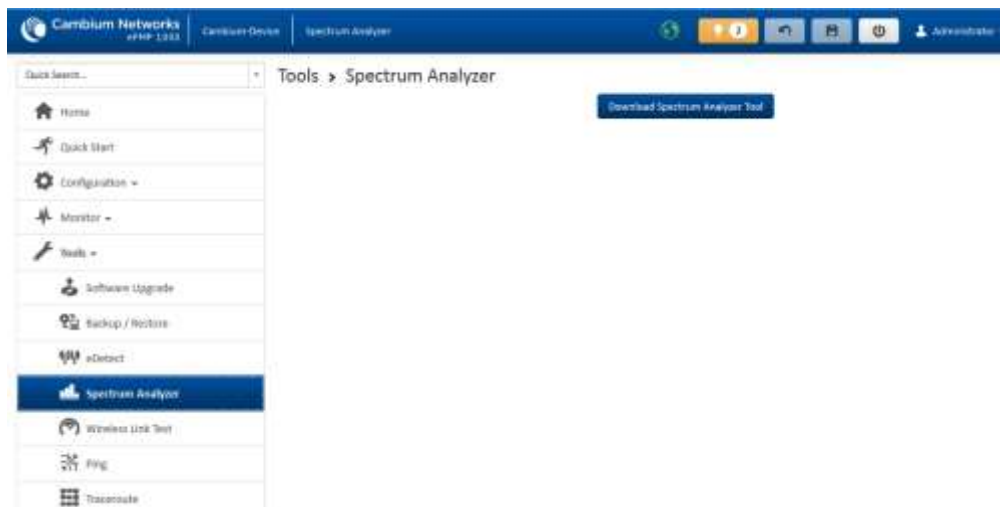
To conduct a spectrum analysis, follow this:

Required Software:

- Java Run-time Environment (JRE)

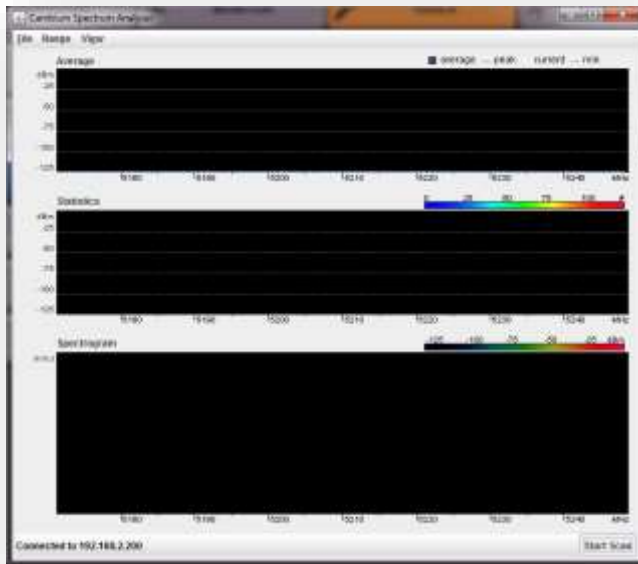
Procedure:

- 1 On the AP GUI, navigate to **Configuration => Radio**
- 2 Change the **Radio Mode** to **Spectrum Analyzer**
- 3 Click the **Save** button
- 4 Click the **Reset** button
- 5 Login to the AP GUI and navigate to **Tools => Spectrum Analyzer**.



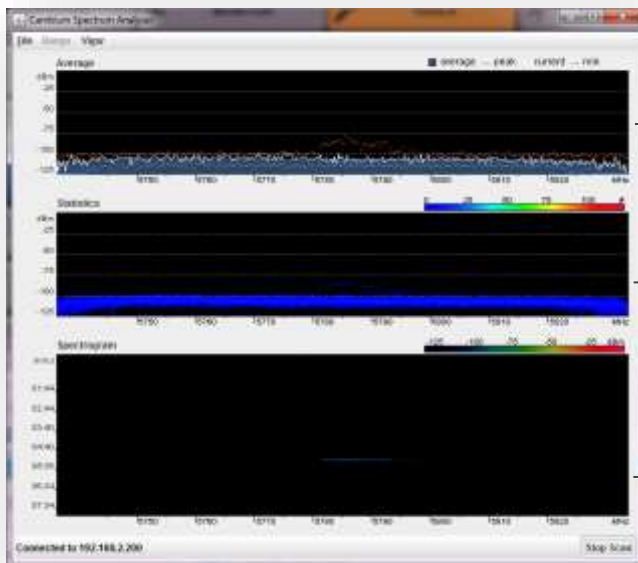
- 6 Click **Download Spectrum Analyzer Tool**
- 7 Locate the folder to which the spectrum analyzer tool was saved and 'Double-click' on file `csa.jnlp` to launch the tool
- 8 If a security warning window appears, check the box next to *"I accept the risk and want to run this application"*

- 9 In the security warning window, click **Run**
The spectrum analyzer interface is displayed



- 10 Click **Range** to configure the range of frequencies to scan.

- 11 Click **Start Scan** to begin scanning



Display of the average, peak, current, and minimum power levels for the configured range

Statistical display of the number of times each frequency in the range was scanned

Spectrogram display of the energy levels detected throughout the configured range, over time

Once the scanning completes, follow these steps to return the device to AP operation:

Procedure:

- 1** In the spectrum analyzer application, click **Stop Scan**
- 2** Close the spectrum analyzer application by clicking **File => Exit**
- 3** On the AP GUI, navigate to **Configure => Radio**
- 4** Configure **Device Mode** to **AP**
- 5** Click the **Save** button
- 6** Click the **Reset** button

AP Automatic Channel Selection page

Use the Automatic Channel Selection page to use the Automatic Channel Selection feature to allow the AP to choose the best channel possible under the current RF environment. This feature is not available when the AP is in ePTP Master mode.

Figure 36 AP Automatic Channel Selection

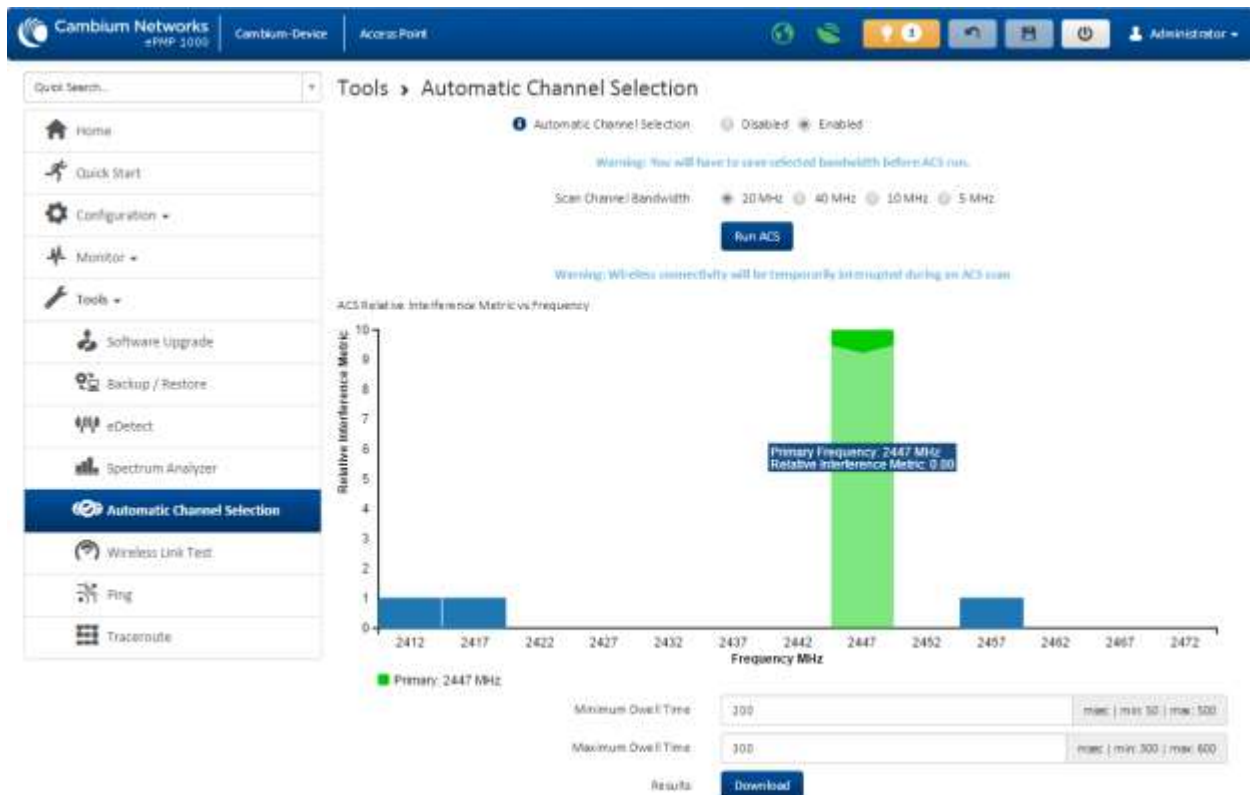


Table 60 Automatic Channel Selection

Attribute	Meaning
Automatic Channel Selection	<p>Enabled – This enables the Automatic Channel Selection (ACS) feature. ACS allows the radio to scan the entire band (governed by the Country setting) and chooses a channel with the lowest channel occupancy i.e. lowest interference level. To run the ACS feature (once enabled), the radio will have to be rebooted or manually triggered using Tools->Automatic Channel Selection. When ACS is running, the radio measures the occupancy level of the channel (measured in terms of an internal interference metric) and uses an algorithm to make a decision to choose the best channel within the band. The channel chosen is not based just on the occupancy level channel but also the occupancy level of adjacent channels.</p> <p>Disabled – ACS is disabled and the operator should configure a Frequency Carrier manually.</p> <div data-bbox="500 674 557 726" data-label="Image"> </div> <p>Note</p> <p>The channel bandwidth configured prior to enabling and running ACS will be used to automatically select a channel. For ex: If the operator manually configured a channel bandwidth of 20MHz, ACS will scan and choose a channel of 20MHz wide channel. To switch ACS to 40MHz or other channel bandwidth, the operator should disable ACS, manually configure 40MHz or desired channel bandwidth on the radio, then enable and run ACS.</p>
Scan Channel Bandwidth	Configure the channel size for which the radio needs to scan the band.
Minimum Dwell Time	Configure the minimum time in milliseconds for which the radio needs to scan a channel to measure channel occupancy or interference levels. Default is 200 ms.
Maximum Dwell Time	Configure the maximum time in milliseconds for which the radio needs to scan a channel to measure channel occupancy or interference levels. Default is 300 ms.
Results	Click this button to download the most recent ACS results in .csv format.

AP eAlign page

Use the eAlign page to aid with link alignment.



Note

eAlign is available on the AP when the **Access Point Mode** is set to **PTP** only. A valid link to an SM is required to provide meaningful RSSI measurements.

Figure 37 AP eAlign



Table 61 eAlign

Attribute	Meaning
Operating Frequency	The current frequency at which the AP is operating.
Registered SM MAC Address	The MAC address of the SM that is registered to the AP.
Current RSSI	Current RSSI value measured on the uplink by the AP's receiver.
Peak RSSI	Peak RSSI value measured by the AP's receiver from the time the user navigated to the eAlign page.
Reset Measurements	Click this button to reset all current measurements.

**Caution**

ePMP supports Automatic Transmit Power Control (ATPC) where the SMs are instructed by the AP to adjust their Tx power in order for the SM's signal (UL RSSI) to arrive at the AP at a predetermined RSSI level (configurable on the AP 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 and is critical for deploying a GPS Synchronized system. However, the feature negates the purpose of eAlign measurements on the AP since, during the alignment, the SM may constantly change its Tx power. It is recommended to turn off ATPC and set the SM's Tx power to maximum allowable power during alignment.

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

Procedure:

- 1** On the SM, set Configuration->Radio->Power Control->Tx Power Manual Limit to **Max Tx Output Power**
- 2** Set Configuration->Radio->Power Control->Transmitter Output Power to **30 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->Tx Power Manual Limit back to **Auto**
- 6** Click the **Save** button

AP Wireless Link Test page

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

Figure 38 AP Wireless Link Test

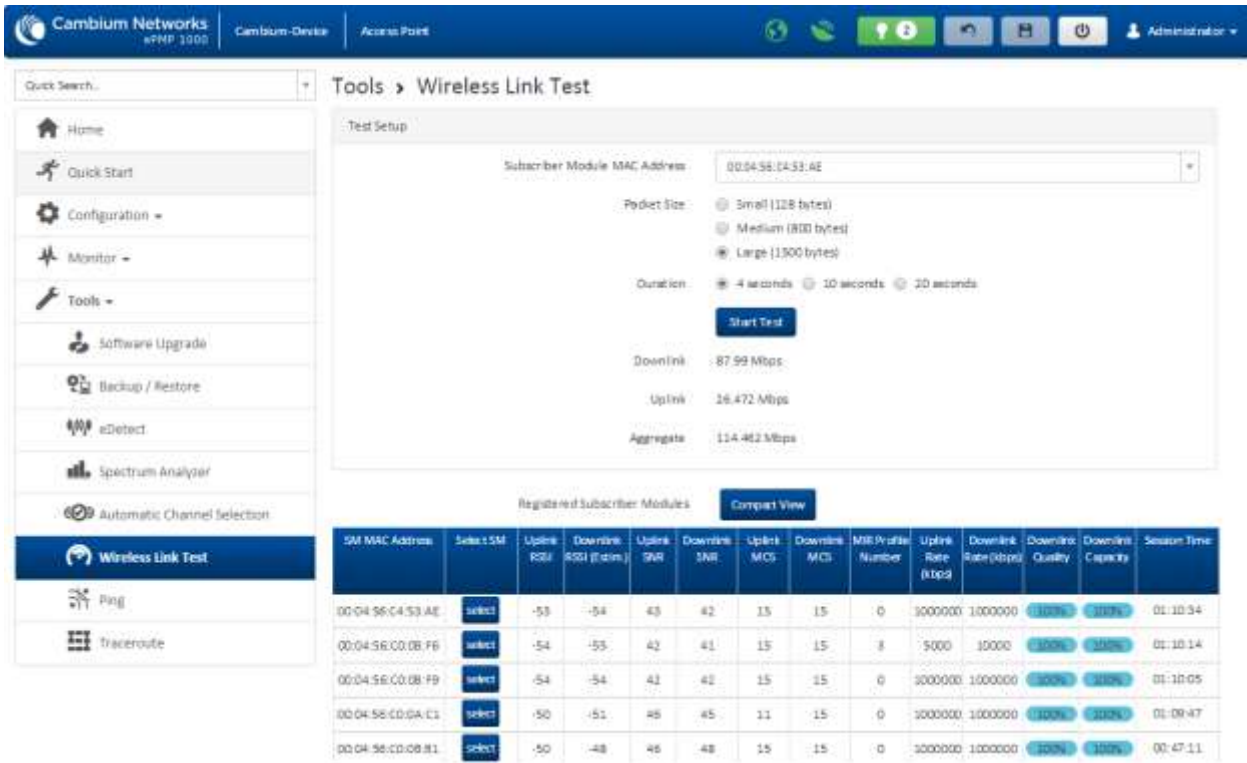


Table 62 AP Wireless Link Test attributes

Attribute	Meaning
Test Setup	
Subscriber Module MAC Address	Enter the MAC Address of one of the connected SMs or simply click the Select button of the SM desired in the “Registered Subscriber Modules” list.
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.
Aggregate	This field indicates the result of the aggregate throughput on the link, in Mbps. Displayed only when Downlink/Uplink Ratio is set to 75/25, 50/50 or 30/70.

Registered Subscriber Modules	Use the Connected SM List table to monitor registered SMs and their key RF status and statistics information. Click Select on the SM that is desired to be used in the throughput test.
-------------------------------	--

AP Ping page

Use the AP Ping page to conduct a simple test of AP 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 AP, or there may be a failure in the network hardware (i.e. DNS server failure).

Figure 39 AP Ping page

Table 63 AP Ping attributes

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

AP Traceroute page

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

Figure 40 AP Traceroute page

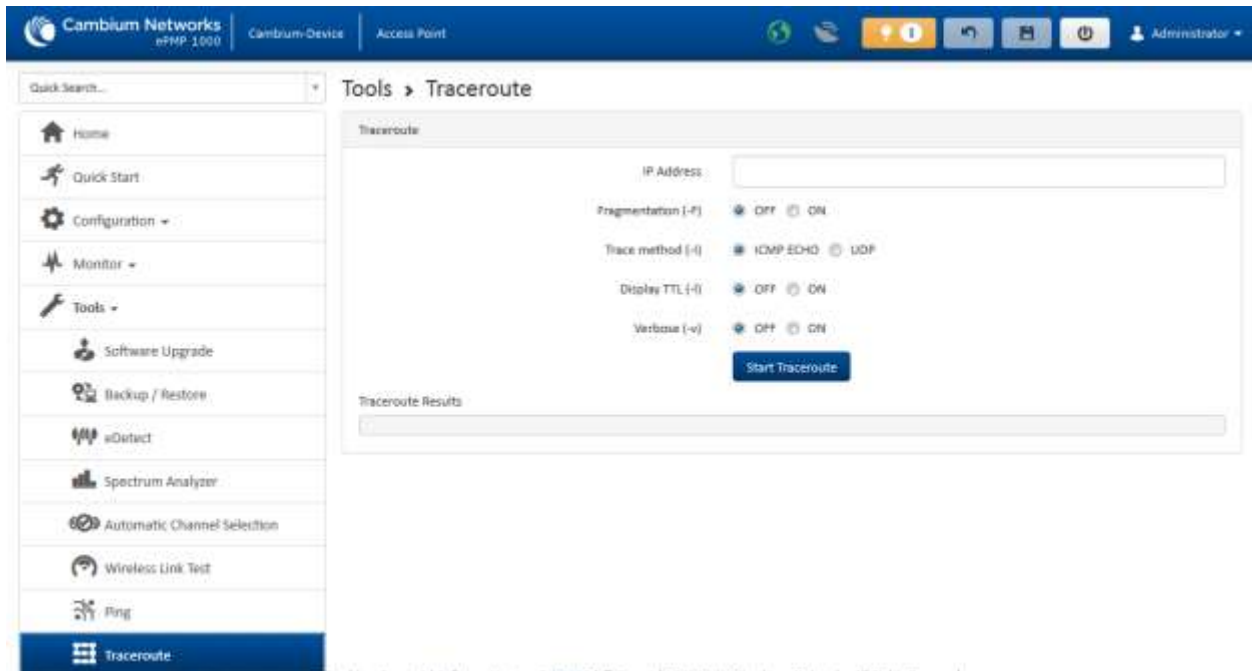


Table 64 AP Traceroute attributes

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 (-l)	ICMP ECHO: Use ICMP ECHO for traceroute probes. UDP: Use UDP for traceroute probes.
Display TTL (-l)	ON: Display TTL values for each hop on the route. OFF: Suppress display of TTL values for each hop on the route.
Verbose (-v)	ON: ICMP packets other than TIME_EXCEEDED and UNREACHABLE are displayed in the output. OFF: Suppress display of extraneous ICMP messaging.
Traceroute Results	Traceroute test results are displayed in the box.

Using the SM menu options

Use the menu navigation bar in the top and left panels to navigate to each web page. The functional area that may be accessed from each menu option is listed under **Table 45**. Some of the parameters are only displayed for specific system configurations.

Table 65 Functional areas accessed from each menu option

Menu option	Menu Details
Quick Start	Configuring SM units using the Quick Start menu on page 84
Configure	SM Configuration menu on page 147
Radio	SM Radio page on page 148
Quality of Service	SM Quality of Service page on page 151
System	SM System page on page 158
Network	SM Network page on page 162
Security	SM Security page on page 175
Monitor	SM Monitor menu on page 177
Performance	SM Performance page on page 178
System Status	SM System page on page 181
Wireless Status	SM Wireless page on page 183
Network Status	SM Network page on page 186
System Log	SM System Log page on page 193
Tools	SM Tools menu on page 194
Software Upgrade	SM Software Upgrade page on page 195
Backup / Restore	SM Backup / Restore page on page 197
eDetect	SM eDetect page on page 199
Spectrum Analyzer	SM Spectrum Analyzer page on page 201
eAlign	SM eAlign page on page 204
Wireless Link Test	SM Wireless Link Test page on page 205
Ping	SM Ping page on page 206
Traceroute	SM Traceroute page on page 207

SM CONFIGURATION MENU

Use the **Configuration** menu to access all applicable device configuration parameters. It contains the following pages:

- **SM Radio page** on page **148**
- **SM Quality of Service page** on page **151**
- **SM System page** on page **158**
- **SM Network page** on page **162**
- **SM Security page** on page **175**

SM Radio page

Use the Radio page to configure the device radio interface parameters.



Caution

Modifying radio parameters may result in a wireless outage. Plan configuration modifications accordingly.

Figure 41 SM Radio page (TDD or ePTP Slave mode)

Cambium-SM1

Subscriber Module

Quick Search...

Home

Quick Start

Configuration

Radio

Quality of Service

System

Network

Security

Monitor

Tools

Configuration > Radio

General

Radio Mode

Access Point

Subscriber Module

Spectrum Analyzer

Subscriber Module Mode

TDD

Standard WiFi

eFTP Slave

Country

Follow AP's Country

Length Unit

Miles

Kilometers

Subscriber Module Configuration

Uplink Max Rate

MCS15

Preferred AP List

Preferred APs

Add

Compact View

	AP SSID	Wireless Security	WPA2 Pre-shared Key
	Cambium-AP	EAP-TTLS, WPA2, Open	*****
	Cambium-AP2	EAP-TTLS, WPA2, Open	*****
	Cambium-AP3	EAP-TTLS, WPA2, Open	*****
	Cambium-AP4	EAP-TTLS, WPA2, Open	*****
	Cambium-AP5	EAP-TTLS, WPA2, Open	*****

Subscriber Module Scanning

Scan Channel Bandwidth

unselect all

select all

5 MHz

10 MHz

40 MHz

20 MHz

40 MHz Scan List

20 MHz Scan List

10 MHz Scan List

05 MHz Scan List

Radio Frequency 20 MHz Scan List

unselect all

select all

<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 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 checked="" 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	

Power Control

Tx Power Manual Limit

Auto

Max Tx Output Power

Transmitter Output Power

8 dBm | min: -24 | max: 30

Antenna Gain

13 dBi | min: 13 | max: 30

Network Entry RSSI Threshold

-85 dBm | min: -100 | max: -20

Network Entry SNR Threshold

0 dB | min: -5 | max: 60

Table 66 SM Radio Configuration attributes (TDD mode or ePTP Slave mode)

Attribute	Meaning
General	
Radio Mode	This parameter controls the function of the device – All ePMP devices may be configured to operate as an Access Point (AP) , Subscriber Module (SM) or as a Spectrum Analyzer .
Subscriber Module Mode	<p>This parameter controls the wireless mode of operation of the SM.</p> <p>TDD: The SM is operating in the proprietary TDD mode and will only connect to another ePMP Access Point.</p> <p>Standard WiFi: The SM is operating in the Standard 802.11n WiFi mode and will be able to connect to any Access Point operating in standard 802.11n WiFi mode.</p> <p>ePTP Slave: The SM is operating as a Slave in point-to-point mode. The AP and the system do not support GPS Synchronization in this mode but are 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>
Country	<p>The SM automatically inherits the Country Code setting of the AP (except for US-locked devices).</p> <p>Country settings affect the radios in the following ways:</p> <ul style="list-style-type: none"> • Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain) • DFS operation is enabled based on the configured country code, if applicable • Frequency selection is based on local regulatory limits
Length Unit	The unit of measurement used for reporting Distance from AP .
Subscriber Module Configuration	
Uplink Max Rate	Configure the maximum MCS (Modulation and Coding Scheme) that the SM should use in the uplink. For example: Setting this parameter to MCS12 will prevent the SM's rate adapt algorithm from using MCS13 through MCS15. Not available when SM is in ePTP Slave or Standard WiFi mode.
Preferred AP List	
Preferred APs	The Preferred AP List is comprised of a list of up to 16 APs to which the SM sequentially attempts registration. For each AP configured, if authentication is required, enter a Pre-shared Key associated with the configured AP SSID .



Attribute	Meaning
Subscriber Module Scanning	
Scan Channel Bandwidth	<p>Click the  button to unselect all channel bandwidths. The SM will not scan for any frequencies.</p> <p>Click the  button to select all channel bandwidths. The SM will scan all channel bandwidths, i.e 5 MHz, 10 MHz, 20 MHz and 40 MHz.</p> <p>Alternately choose individual channel bandwidth tabs and/or frequencies within each channel bandwidth tab for a customized scan list.</p>
Power Control	
Tx Power Manual Limit	<p>Auto: The Access Point can control, using ATPC (Automatic Transmit Power Control), the TX power of the SM up to the maximum capability of the SM's transmitter (based on regulatory limits).</p> <p>Max Tx Output Power: The Access Point can control the TX power of the SM up to the value configured in the Transmitter Output Power field below.</p>
Transmitter Output Power	When Max Tx Output Power is selected, the SM will not transmit higher than the configured value in the field. Determines the maximum output power of the transmitter. The actual output power may be lower due to Automatic Transmit Power Control (ATPC), where the AP instructs the SM to lower its power to meet the SM target Receive Level configured on the AP.
Antenna Gain	This value represents the amount of gain introduced by the unit's internal antenna. This parameter is read-only for Integrated radios.
Network Entry RSSI Threshold	Set this parameter to the minimum Received Signal Strength Indicator (RSSI) at the SM required for the SM to attempt registration to an AP. For example, if the AP RSSI Threshold is set to -80 dBm, and the SM is receiving the AP signal at -85 dBm (RSSI = -85 dBm), the SM will not attempt to register to the AP.
Network Entry SNR Threshold	Set this parameter to the minimum Signal-to-Noise Ratio (SNR) at the SM required for the SM to attempt registration to an AP. For example, if the AP SNR Threshold is set to 30 dB and the SM is calculating its DL SNR as 25 dB, the SM will not attempt to register to the AP.

Figure 42 SM Radio page (Standard WiFi mode)

Cambium Networks ePMP 1000 Cambium-SM1 Subscriber Module

Quick Search... Configuration > Radio

Home Quick Start Configuration Radio System Network Security Monitor Tools

General

Radio Mode: ☐ Access Point ☒ Subscriber Module ☐ Spectrum Analyzer

Subscriber Module Mode: ☐ TDG ☒ Standard WiFi ☐ ePTP Slave

Country: Follow AP's Country

Fallback Country: Other

Length Unit: ☒ Miles ☐ Kilometers

Subscriber Module Configuration

Distance to AP: 1 miles | min: 1 | max: 33

Preferred AP List

Preferred APs Add Compact View

	AP SSID	Wireless Security	WPA2 Pre-shared Key
<input type="checkbox"/>	Cambium-AP	EAP-TTLS, WPA2, Open	*****
<input type="checkbox"/>	Cambium-AP2	EAP-TTLS, WPA2, Open	*****
<input type="checkbox"/>	Cambium-AP3	EAP-TTLS, WPA2, Open	*****
<input type="checkbox"/>	Cambium-AP4	EAP-TTLS, WPA2, Open	*****
<input type="checkbox"/>	Cambium-AP5	EAP-TTLS, WPA2, Open	*****

Subscriber Module Scanning

Scan Channel Bandwidth: ☒ 40 MHz ☒ 20 MHz

40 MHz Scan List 20 MHz Scan List

Radio Frequency 20 MHz Scan List unselect all select all

<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 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 checked="" 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	

Power Control

Tx Power Manual Limit ☒ Auto ☐ Max Tx Output Power



Transmitter Output Power: 8 dBm | min: -24 | max: 30

Antenna Gain: 13 dBi | min: 13 | max: 30

Network Entry RSSI Threshold: -85 dBm | min: -100 | max: -20

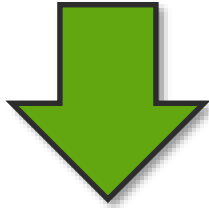
Table 67 SM Radio Configuration attributes (Standard WiFi mode)

Attribute	Meaning
General	
Radio Mode	This parameter controls the function of the device – All ePMP devices may be configured to operate as an Access Point (AP) , Subscriber Module (SM) or as a Spectrum Analyzer .
Subscriber Module Mode	<p>This parameter controls the wireless mode of operation of the SM.</p> <p>TDD: The SM is operating in the proprietary TDD mode and will only connect to another ePMP Access Point.</p> <p>Standard WiFi: The SM is operating in the Standard 802.11n WiFi mode and will be able to connect to any Access Point operating in standard 802.11n WiFi mode.</p> <p>ePTP Slave: The SM is operating as a Slave in point-to-point mode. The AP and the system do not support GPS Synchronization in this mode but are 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>
Fallback Country	<p>The SM automatically inherits the Country Code setting of the AP (except for US-locked devices).</p> <p>Fallback Country is used by the SM if the AP does not provide a Country Code to the SM during registration and affect the radios in the following ways:</p> <ul style="list-style-type: none"> • Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain) • DFS operation is enabled based on the configured country code, if applicable • Frequency selection is based on local regulatory limits
Length Unit	The unit of measurement used for configuring Distance to AP .
Subscriber Module Configuration	
Distance to AP	In Standard WiFi mode, this parameter represents cell coverage radius. SMs outside the configured radius will not achieve optimal throughput. It is recommended to configure Distance to AP to match the actual physical maximum range of the farthest subscriber . This must be configured to match the range of the farthest subscriber on all SMs under the AP regardless of their respective distance from the AP.
Preferred AP List	
Preferred APs	The Preferred AP List is comprised of a list of up to 16 APs to which the SM sequentially attempts registration. For each AP configured, if authentication is required, enter a Pre-shared Key associated with the configured AP SSID .

Attribute	Meaning
Subscriber Module Scanning	
Scan Channel Bandwidth	<p>Click the  button to unselect all channel bandwidths. The SM will not scan for any frequencies.</p> <p>Click the  button to select all channel bandwidths. The SM will scan all channel bandwidths, i.e 5 MHz, 10 MHz, 20 MHz and 40 MHz.</p> <p>Alternately choose individual channel bandwidth tabs and/or frequencies within each channel bandwidth tab for a customized scan list.</p>
Power Control	
Tx Power Manual Limit	<p>Auto: The Access Point can control, using ATPC (Automatic Transmit Power Control), the TX power of the SM up to the maximum capability of the SM's transmitter (based on regulatory limits).</p> <p>Max Tx Output Power: The Access Point can control the TX power of the SM up to the value configured in the Transmitter Output Power field below.</p>
Transmitter Output Power	The SM will not transmit higher than the configured value in the field. Determines the maximum output power of the transmitter. The actual output power may be lower due to Automatic Transmit Power Control (ATPC), where the AP instructs the SM to lower its power to meet the SM target Receive Level configured on the AP.
Antenna Gain	This value represents the amount of gain introduced by the unit's internal antenna. This parameter is read-only for Integrated radios.

SM Quality of Service page

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

ePMP Traffic Priority Label	Priority Level	Priority
VOIP	Highest Priority (Served first)	
High	Medium Priority (Served once highest priority traffic is sent)	
Low	Lowest Priority (Serviced once Highest and Medium priority traffic is sent)	

- VoIP Priority (only utilized when **VOIP Enable** is set to **Enabled**)
- High Priority
- Low Priority

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



Caution

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

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

Figure 43 SM Quality of Service page

Table 68 SM Quality of Service attributes

Attribute	Meaning
Maximum Information Rate	
MIR Profiles	Configure the desired MIR (Maximum Information Rate) profile for SM operation. This profile must be configured on the AP else the default profile (0) is used.
Traffic Priority	
Traffic Priority	<p>Enabled: The QoS Classification Rules table is editable and is utilized by the device to classify traffic.</p> <p>Disabled: The QoS Classification Rules table is greyed-out and all traffic is sent at one priority level.</p>
VOIP Priority	<p>Enabled: When enabled, two entries are automatically added to the first and second rows of the QoS Classification Rules table, one with Rule Type CoS (5) and one with Rule Type DSCP (46). The addition of these rules ensures that VoIP traffic passed over the radio downlink is given highest priority. The CoS and DSCP values may be modified to accommodate non-standard VoIP equipment.</p>
Broadcast Priority	<p>Low Priority: All Broadcast traffic sent over the uplink is prioritized as low priority and is delivered to the AP after scheduled high priority and VoIP traffic.</p> <p>High Priority: All Broadcast traffic sent over the uplink is prioritized as high priority and is scheduled for delivery to the AP before low priority traffic but after VoIP traffic.</p>

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

Attribute	Meaning
Details	The Rule Details column is used to further configure each classification rule specified in column Rule Type .
Priority	High: Traffic entering the SM's Ethernet port is prioritized as "high priority" for sending over the radio link (traffic will be sent after VOIP-classified traffic, but before Low-classified traffic). Low: Traffic entering the SM's Ethernet port is prioritized as "low priority" for sending over the radio link (traffic will be sent after VOIP-classified and High-classified traffic is sent).

SM System page

The SM's System page is used to configure system parameters, services, time settings, SNMP and syslog.

Figure 44 SM System page

Configuration > System

General

Device Name:

Webpage Auto Update: sec | min: 2 | max: 20

SSH Service

SSH Service: ☐ Disabled ☒ Enabled

Web Service

Web Service: ☒ HTTP ☐ HTTPS

HTTP Port: min: 0 | max: 65535

HTTPS Port: min: 0 | max: 65535

Network Time Protocol (NTP)

NTP Server IP Assignment: ☒ Static ☐ DHCP

Preferred NTP Server:

Alternate NTP Server:

Time Zone:

Location Services

Device Latitude: degrees | min: -90 | max: 90

Device Longitude: degrees | min: -180 | max: 180

Device Height: meters | min: -20000 | max: 20000

Internal GPS Height: N/A

User Account Management

Administrator Username:

Administrator Password:

Installer Account: ☐ Disabled ☒ Enabled

Installer Username:

Installer Password:

Home User Account: ☐ Disabled ☒ Enabled

Home User Username:

Home User Password:

Read-Only Account: ☐ Disabled ☒ Enabled

Read-Only Username:

Read-Only Password:

Simple Network Management Protocol (SNMP)

Read-Only Community String:

Read-Write Community String:

Traps: ☐ Disabled ☒ Enabled

Trap Community String:

Trap Servers:

	Server IP	Server Port
<input type="button" value="Up"/> <input type="button" value="Down"/> <input type="button" value="X"/>	10.120.143.176	162

System Name:

System Description:

System Logging (Syslog)

Server 1 IP:

Server 2 IP:

Server 3 IP:




Server 4 IP:

System Log Mask:

<input checked="" type="checkbox"/> Info	<input checked="" type="checkbox"/> Notices
<input checked="" type="checkbox"/> Warnings	<input checked="" type="checkbox"/> Errors
<input checked="" type="checkbox"/> Critical Errors	<input checked="" type="checkbox"/> Alerts
<input checked="" type="checkbox"/> Emergency	

Table 69 SM System attributes

Attribute	Meaning
General	
Device Name	The Device Name is used to identify the SM on the network, and may be retrieved by a NMS such as the Cambium Network Services Server (CNSS).
Webpage Auto Update	Configure the interval for which the device retrieves system statistics for display on the management interface. For example, if this setting is configured to 5 seconds, the statistics and status parameters displayed on the management interface will be refreshed every 5 seconds.
Web Service	
Web Service	HTTP: Access to the device management GUI is conducted via HTTP. HTTPS: Access to the device management GUI is conducted via HTTPS.
HTTP Port	If Web Service is set to HTTP , configure the port which the device uses to service incoming HTTP requests for management GUI access.
HTTPS Port	If Web Service is set to HTTPS , configure the port which the device uses to service incoming HTTPS requests for management GUI access.
SSH Service	
SSH Service	Disabled: If the SSH port to the device is 'Disabled', access to the device through SSH is not possible. Enabled: If the SSH port to the device is 'Enabled', Cambium engineers can access the device through SSH which enables them to login to the radio and troubleshoot. SSH port is 'Enabled' by default.
Network Time Protocol (NTP)	
NTP Server IP Assignment	Static: The device retrieves NTP time data from the servers configured in fields Preferred NTP Server and Alternate NTP Server . DHCP: The device retrieves NTP time data from the server IP issued via a network DHCP server.
Preferred NTP Server	Configure primary NTP server IP address from which the device retrieves time and date information.
Alternate NTP Server	Configure secondary or alternate NTP server IP address 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	
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 the Height above sea level for the device, in meters.

Attribute	Meaning
Internal GPS Height	On a GPS Synchronized ePMP radio, the field is automatically populated with the Device height above sea level from the on-board GPS chip.
User Account Management	
Administrator Username	Read-only listing of available login levels. <ul style="list-style-type: none"> ADMINISTRATOR, full read write permissions. INSTALLER, permissions to read and write parameters applicable to unit installation and monitoring. HOME USER, permissions only to access pertinent information for support purposes. READONLY, permissions only to view the Monitor page.
Administrator Password	Configure a custom password configuration for each user to secure the device. The password character display may be toggled using the visibility icon  .
Installer Account	<p>Disabled: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled.</p> <p>Enabled: The user is granted access to the device management interface.</p>
Installer Username	Read-only listing of available login levels: <ul style="list-style-type: none"> INSTALLER, permissions to read and write parameters applicable to unit installation and monitoring. HOME USER, permissions only to access pertinent information for support purposes. READONLY, permissions only to view the Monitor page.
Installer Password	Configure a custom password configuration for each user to secure the device. The password character display may be toggled using the visibility icon  .
Home User Account	<p>Disabled: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled.</p> <p>Enabled: The user is granted access to the device management interface.</p>
Home User Username	Read-only listing of available login levels: <ul style="list-style-type: none"> HOME USER, permissions only to access pertinent information for support purposes. READONLY, permissions only to view the Monitor page.
Home User Password	Configure a custom password configuration for each user to secure the device. The password character display may be toggled using the visibility icon  .
Read-Only Account	<p>Disabled: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled.</p> <p>Enabled: The user is granted access to the device management interface.</p>

Attribute	Meaning
Read-only Username	READONLY, permissions only to view the Monitor page.
Read-only Password	Configure a custom password configuration for each user to secure the device.
Simple Network Management Protocol (SNMP)	
Read-only Community String	Specify a community string that allows a Network Management Station (NMS) such as the Cambium Networks Services Server (CNSS) to read SNMP information. No spaces are allowed in this string. This password will never authenticate an SNMP user or an NMS to read/write access. The SNMP Read-only Community String value is clear text and is readable by a packet monitor.
Read-write Community String	Specify a community string that allows a Network Management Station (NMS) to not only read SNMP information but also write SNMP values that are defined as writeable in the radio. No spaces are allowed in this string.
Traps	Disabled: With this setting, the radio does not send traps Enabled: Setting this enables the radio to send SNMP traps to the configured SNMP Trap Server.
Trap Community String	Specify a control string to match the Trap Community String on the SNMP Trap server. No spaces are allowed in this string.
Trap Servers	The SNMP Trap Servers table contains all of the SNMP Trap servers the radio can send SNMP traps. Configure the IP Address which the device uses to send SNMP traps.
Server IP	Specify up to four SNMP Trap Servers to which the device will send SNMP traps.
Server Port	Configure port which the device uses to send SNMP traps.
System Name	Specify a string to associate with the physical module. This parameter can be polled by the Cambium Networks Services Server (CNSS) or an NMS. Special characters are supported.
System Description	Specify a description string to associate with the physical module. This parameter can be polled by the Cambium Networks Services Server (CNSS) or an NMS. Special characters are supported.
System Logging (Syslog)	
Server 1-4 IP	Specify up to four syslog servers to which the device sends syslog messages.
System Log Mask	Configure the levels of syslog messages which the devices send to the servers configured in parameters Syslog Server IP 1-4

SM Network page

The SM's **Network** page is used to configure system networking parameters and VLAN parameters. Parameter availability is based on the configuration of the **SM Network Mode** parameter.

Figure 45 SM Network page, NAT mode

Cambium Networks

enPne 1000

Cambium-SM1

Subscriber Module

Home

Quick Start

Configuration

Radio

Quality of Service

System

Network

Security

Monitor

Tools

Quick Search...

Configuration > Network

General

Network Mode

☒ NAT
 ☐ Bridge

Wireless IP Assignment

☒ Static
 ☐ DHCP

Wireless IP Address

10.120.204.102

Wireless Subnet Mask

255.255.255.0

Wireless Gateway

10.120.204.254

Preferred DNS Server

10.120.12.30

Alternate DNS Server

10.120.12.31

Separate Wireless Management IP

☒ Disabled
 ☐ Enable

Separate Wireless Management IP Address Mode

☐ Static
 ☒ DHCP

Separate Wireless Management IP Address

Separate Wireless Management IP Mask

Separate Wireless Management Gateway

Ethernet MTU

1500

bytes | min: 576 | max: 1700

Ethernet Port Configuration

☐ Manual
 ☒ Auto-Negotiate

Port Speed

☐ 10M
 ☒ 100M

Port Duplex Mode

☐ Half
 ☒ Full

Auxiliary Port

☐ Disabled
 ☒ Enabled

Auxiliary Port Configuration

☐ Manual
 ☒ Auto-Negotiate

Auxiliary Port Speed

☐ 10 Mbps
 ☒ 100 Mbps

Auxiliary Port Duplex Mode

☐ Half
 ☒ Full

Auxiliary Port PoE

☒ Disabled
 ☐ Enabled

Spanning Tree Protocol

☒ Disabled
 ☐ Enabled

LAN Port Security

☒ Disabled
 ☐ Enabled

Number of Secure MAC Addresses

5

min: 1 | max: 254

Security MAC Address Aging Time

300

seconds | min: 0 | max: 1440

DHCP Servers Below SM

☒ Disabled
 ☐ Enabled

Ethernet Interface

IP Address

10.1.1.100

Subnet Mask

255.255.255.0

DHCP Server

☐ Disabled
 ☒ Enabled

DHCP Start IP

10.1.1.1

DHCP End IP

10.1.1.2

Preferred DHCP DNS Server

10.120.12.30

Alternate DHCP DNS Server

10.120.12.31

DHCP Lease Time

24

hours | min: 1 | max: 24

DHCP Clients

Add

Compact View

	MAC	IP	Name

Port Forwarding

Port Forwarding

☐ Disabled
 ☒ Enabled

Ports

Add

Compact View

	Protocol	Wireless Port Begin	Wireless Port End	Port Forwarding IP
	TCP+UDP	63	63	10.1.1.1
	TCP+UDP	64	64	10.1.1.2

Point-to-Point Protocol over Ethernet (PPPoE)

PPPoE

☒ Disabled
 ☐ Enabled

Service Name

ABC

Access Concentrator

MikroTik

Authentication

☒ ALL
 ☐ PAP
 ☐ CHAP

Username

sla3

Password

MTU Size

1492

bytes | min: 576 | max: 1492

Keep Alive Time

30

min: 0 | max: 380

MSS Clamping

☒ Disabled
 ☐ Enabled

De-Militarized Zone (DMZ)

DMZ

☒ Disabled
 ☐ Enabled

IP Address

Virtual Local Area Network (VLAN)

VLAN (Management + Data)

☒ Disabled
 ☐ Enabled

VLAN ID

min: 1 | max: 4094

VLAN Priority

min: 0 | max: 7

Separate Wireless Management VLAN

☒ Disabled
 ☐ Enabled

Separate Wireless Management VLAN ID

min: 1 | max: 4094

Separate Wireless Management VLAN Priority


min: 0 | max: 7

Table 70 SM Network attributes, NAT mode

Attribute	Meaning
General	
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>
Wireless IP Assignment	<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 (IP address, subnet mask, gateway and DNS server) is assigned via a network DHCP server.</p>
Wireless IP Address	Wireless Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.
Wireless Subnet Mask	Defines the address range of the connected IP network. For example, if Wireless IP Address is configured to 192.168.2.1 and Wireless IP Subnet Mask is configured to 255.255.255.0, the device wireless interface will belong to subnet 192.168.2.X.
Wireless Gateway	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.
Preferred DNS Server	Configure The IP address of the preferred server used for DNS resolution.
Alternate DNS Server	Configure The IP address of the alternate server used for DNS resolution.
Separate Wireless Management IP	<p>Disabled: When disabled, the Wireless IP is the management interface for the SM.</p> <p>Enabled: When enabled, the Separate Wireless Management IP Address is the management interface for the SM.</p>
Separate Wireless Management IP Address Mode	<p>Static: Separate Wireless Management IP addressing is configured manually in fields Separate Wireless Management IP Address, Separate Wireless Management IP Mask and Separate Wireless Management Gateway.</p> <p>DHCP: Device management IP addressing (IP address, subnet mask, gateway and DNS server) is assigned via a network DHCP server.</p>
Separate Wireless Management IP Address	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.
Separate Wireless Management IP Mask	Defines the address range of the connected IP network. For example, if Wireless IP Address is configured to 192.168.2.1 and Wireless IP Subnet Mask is configured to 255.255.255.0, the device wireless interface will belong to subnet 192.168.2.X.

Separate Wireless Management Gateway	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.
Ethernet MTU	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 Configuration	<p>Manual: The LAN Ethernet port speed and duplex mode can be manually configured.</p> <p>Auto-negotiate: The AP auto negotiates the LAN Ethernet port speed and duplex mode with the device connected to it.</p>
Port Speed	With “Ethernet Port Configuration” set to Manual , the LAN Ethernet port speed can be forced to 1000 Mbps (only GPS Synchronized radio), 100 Mbps or 10 Mbps.
Port Duplex Mode	With “Ethernet Port Configuration” set to Manual , the LAN Ethernet port duplex mode can be forced to Full or Half.
Auxiliary Port	<p>Disabled: When disabled, the LAN Auxiliary port on the SM is shut down.</p> <p>Enabled: When enabled, LAN Auxiliary port on the SM is up and able to bridge traffic with the primary Ethernet port. Default value is Enabled.</p>
Auxiliary Port Configuration	<p>Manual: The LAN Auxiliary port speed and duplex mode can be manually configured.</p> <p>Auto-negotiate: The AP auto negotiates the LAN Auxiliary port speed and duplex mode with the device connected to it.</p>
Auxiliary Port Speed	With “Auxiliary Port Configuration” set to Manual , the LAN Auxiliary port speed can be forced to 1000 Mbps (only GPS Synchronized radio), 100 Mbps or 10 Mbps.
Auxiliary Port Duplex Mode	With “Auxiliary Port Configuration” set to Manual , the LAN Auxiliary port duplex mode can be forced to Full or Half.
Auxiliary Port PoE	<p>Disabled: When disabled, the LAN Auxiliary port on the SM will not provide proprietary PoE out. Default value is Disabled.</p> <p>Enabled: When enabled, LAN Auxiliary port on the SM will provide proprietary PoE out to power external PoE devices such as another ePMP radio or a PoE camera.</p>
Spanning Tree Protocol	<p>Disabled: When disabled, Spanning Tree Protocol (802.1d) functionality is disabled at the SM.</p> <p>Enabled: When enabled, Spanning Tree Protocol (802.1d) functionality is enabled at the SM, allowing for the prevention of Ethernet bridge loops.</p>

LAN Port Security	<p>Disabled: When disabled, any number of devices (MAC Addresses) can connect via the SM's Ethernet (LAN) port.</p> <p>Enabled: When enabled, the number of devices (MAC Addresses) that can connect via the SM's Ethernet (LAN) port can be restricted with the fields below.</p>
Number of Secure MAC Addresses	Specify the maximum number of unique devices (MAC Addresses) that can connect via the SM's Ethernet (LAN) port. Range is 1 – 254 devices.
Security MAC Address Aging Time	Specify the aging timer in seconds. The aging timer will determine the duration for which the SM will maintain the MAC Address in its bridge table. The timer is restarted any time traffic from a specific MAC address is received on the LAN port. Once the timer expires, the MAC Address is removed from the SM's bridge table.
DHCP Servers Below SM	<p>Disabled: This blocks DHCP servers connected to the SM's LAN side from handing out IP addresses to DHCP clients above the SM (wireless side).</p> <p>Enabled: This allows DHCP servers connected to the SM's LAN side to assign IP addresses to DHCP clients above the SM (wireless side). This configuration is typical in PTP links.</p>
Ethernet Interface	
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.
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.
Gateway	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.
DHCP Server	<p>Disabled: Use this setting when SM is in NAT 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.</p> <p>Enabled: Use this setting when SM is in NAT mode, to use the SM's local/onboard DHCP server to hand out IP addresses to its clients.</p>
DHCP Start IP	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	Configure the highest IP address in the DHCP pool that can be issued to a DHCP client.
Preferred DHCP DNS Server	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	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	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.
DHCP Clients	The DHCP Client List table identifies hardware situated below the SM which shall be issued DHCP IP addressing information. The SM acts as a DHCP server, responding to requests from hardware connected to the SM.
MAC	Configure the physical address of the device which will retrieve DHCP IP addressing information from the SM.
IP	Configure the IP address which will be assigned to the device.
Name	Configure a logical name for the device configured (i.e. VoIP Phone1, or Network Camera1).
Port Forwarding	
Port Forwarding	<p>The SM port forwarding functionality may be used to configure the SM to route external network services to an internal IP address so that end devices (situated below the SM) are reachable from external networks.</p> <hr/> <div>  Caution </div> <p>Opening ports for forwarding may introduce a network security risk.</p>
Ports	The Port Forwarding Table is used to define which range of wireless ports are forwarded to which LAN (SM local network) IP addresses.
Protocol	<p>UDP: Packet forwarding decisions are based on UDP packets.</p> <p>TCP: Packet forwarding decisions are based on TCP packets.</p>
Wireless Port Begin	Configure the beginning of the range of wireless ports to match for forwarding to LAN IP .
Wireless Port End	Configure the end of the range of wireless ports to match for forwarding to LAN IP .
Ethernet IP	Configure the LAN IP of the device situated below the SM which receives the packets forwarded based on the Port Forwarding Table configuration.
Point-to-Point Protocol over Ethernet (PPoE)	
PPPoE	Point-to-Point Protocol over Ethernet: Used for Encapsulating PPP frames inside Ethernet frames.
Service Name	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	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	<p>ALL: This means that CHAP authentication will be attempted first, then PAP authentication. The same password is used for both types.</p> <p>CHAP: This means that CHAP authentication will be attempted.</p> <p>PAP: This means that PAP authentication will be attempted.</p>
Username	This is the CHAP/PAP username that is used. This is limited to 32 characters.
Password	This is the CHAP/PAP password that is used. This is limited to 32 characters.
MTU Size	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	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	<p>Disabled: The SM PPPoE session allows any MTU size determined by other devices in the PPPoE session during the LCP negotiations.</p> <p>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.</p>
De-Militarized Zone (DMZ)	
DMZ	<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) is automatically sent to the device configured with DMZ IP Address."</p>
IP Address	Configure the IP address of an SM connected device which is allowed to provide network services to the wide-area network.
Virtual Local Area Management (VLAN)	

VLAN (Management + Data)	<p>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 VLAN configuration is applicable to both management and user data.</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 and data traffic is allowed to the device.</p>
VLAN ID	Configure this parameter to include the device's management and user traffic on a separate VLAN network.
VLAN Priority	<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 user and management data.</p> <p>This parameter only takes effect if the 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 configured VLAN ID originating from the SM. The default value is 0.</p>
Separate Wireless Management VLAN	<p>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.</p> <p>Disabled: When disabled, the SM does not have a unique management VLAN.</p>
Separate Wireless Management VLAN ID	Configure this parameter to include the device's management traffic on a separate VLAN network.
Separate Wireless Management VLAN Priority	<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>

Figure 46 SM Network page, Bridge mode

Camium Networks
v1.0.0.0

5210-Station3

Subscription Module

Quick Search...

Configuration > Network

Home

Quick Start

Configuration

Radio

Quality of Service

System

Network

Security

Monitor

Tools

General

Network Mode: ☒ NAT ☐ Bridge

IP Assignment: ☒ Static ☐ DHCP

IP Address: 10.120.104.134

Subnet Mask: 255.255.255.0

Gateway: 10.120.104.254

Preferred DNS Server: 10.120.11.30

Alternate DNS Server: 10.120.11.11

Ethernet MTU: 1500 (min: 576 / max: 6709)

Ethernet Port Configuration: ☐ Manual ☒ Auto-Negotiate

Port Speed: ☐ 10M ☒ 100M ☐ 1000M

Port Duplex Mode: ☐ Half ☒ Full

Auxiliary Port: ☒ Disabled ☐ Enabled

Auxiliary Port Configuration: ☐ Manual ☒ Auto-Negotiate

Auxiliary Port Speed: ☐ 10 Mbps ☒ 100 Mbps

Auxiliary Port Duplex Mode: ☐ Half ☒ Full

Auxiliary Port PoE: ☒ Disabled ☐ Enabled

Spanning Tree Protocol: ☒ Disabled ☐ Enabled

LAN Port Security: ☒ Disabled ☐ Enabled

Number of Secure MAC Addresses: 0 (min: 1 / max: 254)

Security MAC Address Aging Time: 300 (min: 0 / max: 1440)

DHCP Servers Below SW: ☒ Disabled ☐ Enabled

Virtual Local Area Network (VLAN)

Management VLAN: ☒ Disabled ☐ Enabled

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

Management VLAN Priority: (min: 1 / max: 7)

Data VLAN: ☒ Disabled ☐ Enabled

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

Data VLAN Priority: (min: 1 / max: 7)

Membership VLANs:

	VLAN ID Begin	VLAN ID End
	100	100

VLAN Mapping:

	V-VLAN	S-VLAN
	100	100

Broadcast/Multicast Traffic Stacking

Broadcast Packet Limit: ☒ Disabled ☐ Enabled

Broadcast Packet Rate: 1000 (min: 100 / max: 10000)

Multicast Group Limit: 4 (min: 1 / max: 5)

Multicast VLAN: ☒ Disabled ☐ Enabled

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

Multicast VLAN Priority: (min: 1 / max: 7)



Table 71 SM Network attributes, Bridge mode

Attribute	Meaning
General	
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>
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 unused.</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> <div data-bbox="487 846 544 898" data-label="Image"> </div> <p>Note</p> <p>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 fall back to IP 192.168.0.1 (AP mode), 192.168.0.2 (SM mode), 192.168.0.3 (Spectrum Analyzer mode) or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port with IP 169.254.1.1. 169.254.1.1 is a local IP and is independent of the NAT local subnet or the wireless IP.</p>
Subnet Mask	Defines the address range of the connected IP network. For example, if IP Address, Subnet Mask, Gateway, Preferred DNS Server and Alternate DNS Server are configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Gateway	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.
Preferred DNS Server	Configure the IP address of the preferred server used for DNS resolution.
Alternate DNS Server	Configure the IP address of the alternate server used for DNS resolution.
Ethernet MTU	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 Configuration	<p>Manual: The LAN Ethernet port speed and duplex mode can be manually configured.</p> <p>Auto-negotiate: The AP auto negotiates the LAN Ethernet port speed and duplex mode with the device connected to it.</p>

Port Speed	With “Ethernet Port Configuration”, the LAN Ethernet port speed can be forced to 1000 Mbps (only GPS Sync’d radio), 100 Mbps or 10 Mbps.
Port Duplex Mode	With “Ethernet Port Configuration”, the LAN Ethernet port duplex mode can be forced to Full or Half.
Auxiliary Port	<p>Disabled: When disabled, the LAN Auxiliary port on the SM is shut down.</p> <p>Enabled: When enabled, LAN Auxiliary port on the SM is up and able to bridge traffic with the primary Ethernet port. Default value is Enabled.</p>
Auxiliary Port Configuration	<p>Manual: The LAN Auxiliary port speed and duplex mode can be manually configured.</p> <p>Auto-negotiate: The AP auto negotiates the LAN Auxiliary port speed and duplex mode with the device connected to it.</p>
Auxiliary Port Speed	With “Auxiliary Port Configuration” set to Manual , the LAN Auxiliary port speed can be forced to 1000 Mbps (only GPS Synchronized radio), 100 Mbps or 10 Mbps.
Auxiliary Port Duplex Mode	With “Auxiliary Port Configuration” set to Manual , the LAN Auxiliary port duplex mode can be forced to Full or Half.
Auxiliary Port PoE	<p>Disabled: When disabled, the LAN Auxiliary port on the SM will not provide proprietary PoE out. Default value is Disabled.</p> <p>Enabled: When enabled, LAN Auxiliary port on the SM will provide proprietary PoE out to power external PoE devices such as another ePMP radio or a PoE camera.</p>
Spanning Tree Protocol	<p>Disabled: When disabled, Spanning Tree Protocol (802.1d) functionality is disabled at the SM.</p> <p>Enabled: When enabled, Spanning Tree Protocol (802.1d) functionality is enabled at the SM, allowing for the prevention of Ethernet bridge loops.</p>
LAN Port Security	<p>Disabled: When disabled, any number of devices (MAC Addresses) can connect via the SM’s Ethernet (LAN) port.</p> <p>Enabled: When enabled, the number of devices (MAC Addresses) that can connect via the SM’s Ethernet (LAN) port can be restricted with the fields below.</p>
Number of Secure MAC Addresses	Specify the maximum number of unique devices (MAC Addresses) that can connect via the SM’s Ethernet (LAN) port. Range is 1 – 254 devices.
Security MAC Address Aging Time	Specify the aging timer in seconds. The aging timer will determine the duration for which the SM will maintain the MAC Address in its bridge table. The timer is restarted any time traffic from a specific MAC address is received on the LAN port. Once the timer expires, the MAC Address is removed from the SM’s bridge table.
DHCP Servers Below SM	<p>Disabled: This blocks DHCP servers connected to the SM’s LAN side from handing out IP addresses to DHCP clients above the SM (wireless side).</p> <p>Enabled: This allows DHCP servers connected to the SM’s LAN side to assign IP addresses to DHCP clients above the SM (wireless side). This configuration is typical in PTP links.</p>

Virtual Local Area Network (VLAN)

Management VLAN	<p>Enabled: The SM 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 SM'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. For the network operator, this provides flexibility in network segmentation, simpler management and enhanced security.</p> <p>Disabled: When disabled, all untagged IP management traffic is allowed to the device.</p>
Management VLAN ID	<p>Configure this parameter to include the device's management traffic on a separate VLAN network. For example, if MGMT 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.</p>
Management VLAN Priority	<p>ePMP radios can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. MGMT 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 MGMT 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 SM. The default value is 0.</p>
Data VLAN	<p>Enabled: A VLAN tag will be added to all untagged traffic entering the SM's LAN port before sending it to the AP and remove tags in the opposite direction from traffic (tagged with Data 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 traffic passing through the SM.</p>
Data VLAN ID	<p>Configure this parameter to include this VLAN tag to all untagged traffic entering on the SM's LAN port before sending it to the AP and remove tags in the opposite direction from traffic (tagged with Data VLAN ID) entering on the SM's WAN port before sending to the SM's LAN port.</p>
Data VLAN Priority	<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 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 SM. The default value is 0.</p>

Membership VLANs	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).
VLAN ID Begin	Configure the first VLAN ID for the VLAN range.
VLAN ID End	Configure the last VLAN ID for the VLAN range.
VLAN Mapping	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.
C-VLAN	<p>Configure the C-VLAN ID of the tagged traffic for which the mapping needs to occur</p> <div>  <p>Note</p> </div> <p>The C-VLAN ID must be entered in the SM VLAN Membership VLAN table.</p>
S-VLAN	<p>Configure the S-VLAN ID to which the tagged traffic needs to be mapped to.</p> <div>  <p>Note</p> </div> <p>The S-VLAN ID must be entered in the SM VLAN Membership VLAN table.</p>
Broadcast/Multicast Traffic Shaping	
Broadcast Packet Limit	<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> <p>Disabled: There is no limit on the amount of broadcast traffic that will be allowed into the ingress of the radio's Ethernet port.</p>
Broadcast Packet Rate	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	Configure the maximum number of simultaneous multicast groups that the SM will allow from devices below it. The default (and maximum) is 5 .

Multicast VLAN	<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	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	<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>

SM Security page

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



Caution

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 47 SM Security page

The screenshot displays the 'Configuration > Security' page in the Cambium Networks ePMP 1000 web interface. The left sidebar contains navigation links: Home, Quick Start, Configuration, Radio, Quality of Service, System, Network, Security (selected), Monitor, and Tools. The main content area is divided into three sections:

- Security Options:** Includes 'Wireless Security' with tabs for WPA2, WPA3, and Open. The WPA2 tab is active, showing a 'WPA2 Pre-shared Key' field with masked characters.
- RADIUS:** Contains fields for EAP-TTLS Username (ePMP), EAP-TTLS Password (masked), Authentication Identity String (anonymous), Authentication Identity Realm (cambiumnetworks.com), Default Root Certificate (default.crt), Default Capry Root Certificate (pmp450.crt), and two User Provisioned Root Certificate fields (both set to 'no certificate added').
- Firewalls:** Includes 'Layer 2 Firewall' and 'Layer 3 Firewall' sections. Each section has a radio button to toggle between 'Disabled' (selected) and 'Enabled', and a 'Firewall Rules' section with 'Add' and 'Back to Wide View' buttons.

Table 72 SM Security attributes

Attribute	Meaning
Security Options	
Wireless Security	Select the type of authentication preferred, whether RADIUS , WPA2 , Open or a combination of the three.
WPA2	
WPA2 Pre-shared Key	Configure this key on the AP and then configure each of the network SMs with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.
RADIUS	
EAP-TTLS Username	Configure the EAP-TTLS Username to match the credentials on the RADIUS server being used for the network.
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”.
Default Root Certificate	Default EAP-TTLS root certificate that must match the certificate on the RADIUS server.
Default Canopy Root Certificate	PMP 450 default EAP-TTLS root certificate to match the certificate on the RADIUS server used with current PMP 450 deployments.
User Provisioned Root Certificate 1	Import a user certificate if a certificate different from the default certificates is needed.
User Provisioned Root Certificate 2	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 3 Firewall	<p>Enabled: Modifications to the Layer 3 Firewall Table are allowed and rules are enforced.</p> <p>Disabled: Modifications to the Layer 3 Firewall Table are not allowed and rules are not enforced.</p>

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.

The **Monitor** menu contains the following pages:

- **SM Performance page** on page **178**
- **SM System page** on page **181**
- **SM Wireless page** on page **183**
- **SM Network page** on page **186**
- **SM System Log page** on page **193**

SM Performance page

Use the Performance page to monitor system status and statistics to analyze and troubleshoot network performance and operation.

Figure 48 SM Performance page

Quick Search...

Cambium Networks ePMP 1000 5GHz-Station1 Subscriber Module Administrator

Monitor > Performance Time Since Last Reset 0000:00:00:10 Reset Stats

Ethernet Statistics - Transmitted	
Total Traffic	0 kbits
Total Packets	0
Packet Errors	0
Packet Drops	0
Multicast / Broadcast Traffic	0 kbits
Broadcast Packets	0
Multicast Packets	0

Ethernet Statistics - Received	
Total Traffic	0 kbits
Total Packets	0
Packet Errors	0
Packet Drops	0
Multicast / Broadcast Traffic	0 kbits
Broadcast Packets	0
Multicast Packets	0

Wireless Statistics - Downlink	
Total Traffic	33 Kbits
Total Packets	16
Error Drop Packets	0
Multicast / Broadcast Traffic	7 Kbits
Broadcast Packets	18
Multicast Packets	7

Wireless Statistics - Uplink	
Total Traffic	115 Kbits
Total Packets	24
Error Drop Packets	0
Retransmission Packets	0
Multicast / Broadcast Traffic	4 Kbits
Broadcast Packets	12
Multicast Packets	0
Link Quality (Uplink)	100 %
Link Capacity (Uplink)	100 %

System Statistics	
Session Drops	0
Device Reboots	0
Radar (DFS) Detections	0

Downlink Packets per MCS	
MCS 0	0 (0%)
MCS 1	25 (61%)
MCS 2	0 (0%)
MCS 3	0 (0%)
MCS 4	0 (0%)
MCS 5	0 (0%)
MCS 6	0 (0%)
MCS 7	0 (0%)
MCS 8	0 (0%)
MCS 9	0 (0%)
MCS 10	0 (0%)
MCS 11	0 (0%)
MCS 12	0 (0%)
MCS 13	0 (0%)
MCS 14	0 (0%)
MCS 15	16 (39%)

Uplink Packets per MCS	
MCS 0	0 (0%)
MCS 1	0 (0%)
MCS 2	0 (0%)
MCS 3	0 (0%)
MCS 4	0 (0%)
MCS 5	0 (0%)
MCS 6	0 (0%)
MCS 7	0 (0%)
MCS 8	0 (0%)
MCS 9	0 (0%)
MCS 10	0 (0%)
MCS 11	0 (0%)
MCS 12	0 (0%)
MCS 13	0 (0%)
MCS 14	0 (0%)
MCS 15	36 (100%)

Table 73 SM Performance attributes

Attribute	Meaning
Time Since Last Reset	Time since the stats were last reset.
Reset Stats	Resets all statistics for both Ethernet and Wireless.
Ethernet Statistics - Transmitted	
Total Traffic	Total amount of traffic in Kbits transferred from the SM's Ethernet interface.
Total Packets	Total number of packets transferred from the SM's Ethernet interface.
Packet Errors	Total number of packets transmitted out of the SM's 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 SM's Ethernet interface due to Ethernet setup or filtering issues.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits sent via the SM's Ethernet interface.
Broadcast Packets	Total number of broadcast packets sent via the SM's Ethernet interface.
Multicast Packets	Total number of multicast packets sent via the SM's Ethernet interface.
Ethernet Statistics - Received	
Total Traffic	Total amount of traffic in Kbits received by the SM's Ethernet interface.
Total Packets	Total number of packets received by the SM's Ethernet interface.
Packet Errors	Total number of packets received by the SM's 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 SM's wireless interface due to Ethernet setup or filtering issues.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits received by the SM's Ethernet interface.
Broadcast Packets	Total number of broadcast packets received via the SM's Ethernet interface.
Multicast Packets	Total number of multicast packets received via the SM's Ethernet interface.
Wireless Statistics - Downlink	
Total Traffic	Total amount of traffic received via the SM's wireless interface in Kbits.
Total Packets	Total number of packets received via the SM's wireless interface.
Error Drop Packets	Total number of packets dropped prior to sending out of the SM's Ethernet interface due to RF errors (packet integrity error and other RF related packet error).
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic transmitted out of the SM's wireless interface in Kbits.
Broadcast Packets	Total number of broadcast packets transmitted out of the SM's wireless interface.

Attribute	Meaning
Multicast Packets	Total number of multicast packets transmitted out of the SM's wireless interface.
Wireless Statistics - Uplink	
Total Traffic	Total amount of traffic transmitted out of the SM's wireless interface in Kbits.
Total Packets	Total number of packets transmitted out of the SM's wireless interface.
Error Drop Packets	Total number of packets dropped after transmitting out of the SM's Wireless interface due to RF errors (No acknowledgement and other RF related packet error).
Capacity Drop Packets	Total number of packets dropped after transmitting out of the SM's Wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Retransmission Packets	Total number of packets re-transmitted after transmitting out of the SM's Wireless interface due to the packets not being received by the AP.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic received on the SM's wireless interface in Kbits.
Broadcast Packets	Total number of broadcast packets transmitted on the SM's wireless interface.
Multicast Packets	Total number of multicast packets transmitted on the SM's wireless interface.
Link Quality (Uplink)	The Uplink quality based on the current MCS and PER.
Link Capacity (Uplink)	The uplink capacity based on the current MCS with respect to the highest supported MCS (MCS15).
Session Drops	Total number of sessions dropped by the SM.
Device Reboots	Total number of reboots of the SM.
Radar (DFS) Detections	Total number of DFS events that were detected by the SM.
Downlink Packets Per MCS	Number of packets (and percentage of total packets) received on the SM's wireless interface for every modulation mode, based on radio conditions.
Uplink Packets Per MCS	Number of packets (and percentage of total packets) transmitted out of the SM's wireless interface for every modulation mode used by the SM's transmitter, based on radio conditions.

SM System page

Use the **System** page to reference key system information.

Figure 49 SM System page

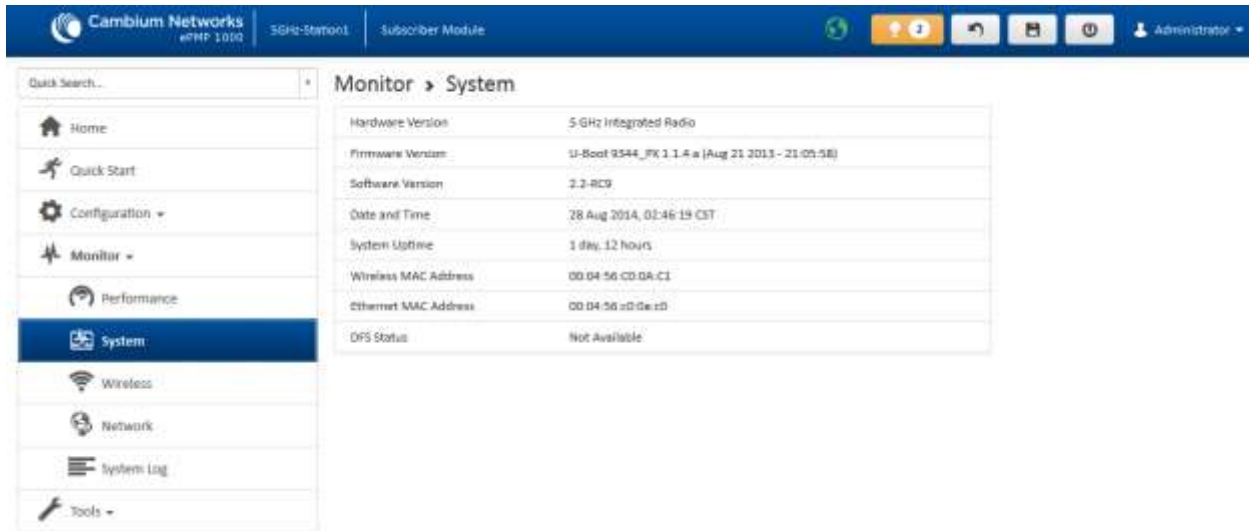


Table 74 SM System page attributes

Attribute	Meaning
Hardware Version	Board hardware version information.
Firmware Version	U-Boot version information.
Software Version	Current operating version of software on the device. This listing is also present on the GUI footer bar (which contains a hyperlink to download new system software).
Date and Time	Current date and time, subject to time zone offsets introduced by the configuration of the device Time Zone parameter. This shows a factory-configured time until a valid NTP server is configured.
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 Ethernet interface.

Attribute	Meaning
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>

SM Wireless page

Use the **Wireless** page to reference key information about the radio's wireless interface.

Figure 50 SM Wireless page

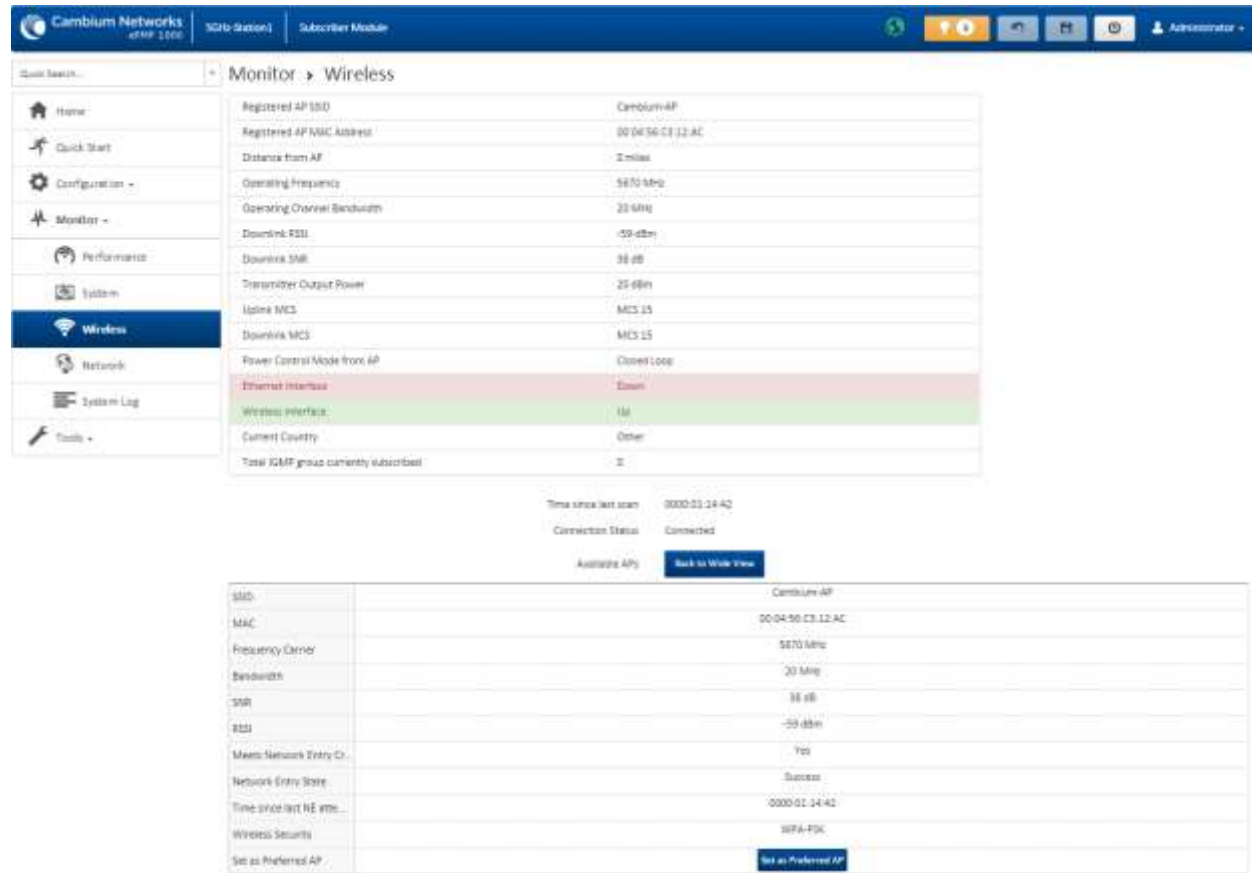



Table 75 SM Wireless page attributes

Attribute	Meaning
Registered AP SSID	SSID of the AP to which the SM is registered.
Registered AP MAC address	Wireless MAC address of the AP to which the SM is registered.
Distance from AP	The distance from the AP, determined by radio signal propagation delay.
Operating Frequency	The current frequency at which the SM is transmitting and receiving.
Operating Channel Bandwidth	The current channel size at which the SM is transmitting and receiving.
Downlink RSSI	The Received Signal Strength Indicator, which is a measurement of the power level being received by the SM's antenna.
Downlink SNR	The Signal to Noise Ratio, which is an expression of the carrier signal quality with respect to signal noise.
Transmitter Output Power	The current power level at which the SM is transmitting.
Uplink MCS	Modulation and Coding Scheme – indicates the modulation mode used for the radio uplink, based on radio conditions (MCS 1-7, 9-15).

Attribute	Meaning
Downlink MCS	Modulation and Coding Scheme – indicates the modulation mode used for the radio downlink, based on radio conditions (MCS 1-7, 9-15).
Power Control Mode from AP	<p>Open Loop: In this mode, the SM will not receive any power change information in the Group Poll Frame. SM calculates the UL transmit power based on path loss calculations only.</p> <p>Closed Loop: In closed loop UL power control, Subscriber Module will get the AP actual transmit power of beacon frame and SM Target Received Power Level in the beacon. Based on these two values, SM calculates the path loss. Based on path loss and TRL values it calculates it's transmit power such that the signal from SM arrives at AP at the configured target level. Path loss calculation will be updated by SM every time there is a change in values of AP actual TX power or TRL in the Beacon.</p>
Ethernet Interface	<p>Up: The radio (LAN) interface is functioning properly.</p> <p>Down: The radio (LAN) interface has encountered an error and is not servicing traffic.</p>
Wireless Interface	<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>
Current Country	The current code the SM is operating under.
Total IGMP groups currently subscribed	Number of IGMP groups the SM has identified from IGMP capable devices connected to it.
Time since last scan	Amount of time elapsed since the last scan was completed by the SM for available APs.
Connection Status	The current registration status of the SM.
Available APs	The Available AP List may be referenced to view which APs are available for SM network entry, and also to view the status of the current AP to SM radio link.
SSID	The SSID of the visible AP.
MAC	The MAC address of the visible AP.
Frequency Carrier	The current operating frequency of the visible AP.
Bandwidth	The current operating channel bandwidth of the visible AP.
SNR	The current measured Signal-to-Noise Ratio of the SM to AP link.
RSSI	The current measured Received Signal Strength Indicator at the AP.

Attribute	Meaning
Meets Network Entry Criteria	<p>Yes: The scanned AP meets the Network Entry criteria defined by the internal Network Algorithm.</p> <p>No: The scanned AP does not meet the Network Entry criteria defined by the internal Network Algorithm.</p>
Network Entry State	<p>The indication of the result of the SM's network entry attempt:</p> <p>Successful: SM registration is successful</p> <p>Failed: Out of Range: The SM is out of the AP's configured maximum range (Max Range parameter)</p> <p>Failed: Capacity limit reached at AP: The AP is no longer allowing SM network entry due to capacity reached</p> <p>Failed: No Allocation on AP: The SM to AP handshaking failed due to a misconfigured pre-shared key between the SM and AP</p> <p>Failed: SW Version Incompatibility: The version of software resident on the AP is older than the software version on the SM</p> <p>Failed: PTP Mode: ACL Policy: The AP is configured with PTP Access set to MAC Limited and the SM's MAC address is not configured in the AP's PTP MAC Address field</p> <p>Failed: Other: The AP does not have the required available memory to allow network entry</p>
Time since last NE attempt	This timer indicates the last time that the SM attempted network entry to the AP.
Wireless Security	This field indicates the security state of the AP to SM link.
Set as Preferred AP	Click the  button to add the AP to the Preferred AP List under Configuration=>Radio.

SM Network page

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

Figure 51 SM Network page, Bridge Mode

The screenshot displays the Cambium Networks ePMP 1000 web interface. The top navigation bar includes the logo, device name (5GHz-Station1), and user role (Administrator). The left sidebar contains navigation links: Home, Quick Start, Configuration, Monitor (selected), Performance, System, Wireless, Network (highlighted), System Log, and Tools.

The main content area is titled "Monitor > Network". It features several status panels:

- Ethernet Status:**

IP Assignment	static
Ethernet Interface	Up
IP Address	10.120.204.2
Subnet Mask	255.255.255.0
MTU Size	1500 bytes
Port Speed	N/A
Port Duplex Mode	N/A
- Wireless Status:**

Wireless Interface	Up
IP Address	--
Subnet Mask	--
Default Gateway	10.120.204.254
- Network Status:**

Network Mode	Bridge
DNS Server IP	10.120.12.30,10.120.12.31
DHCP Lease Time	24 hours
- Multicast Status:**

Multicast Group Limit	5
-----------------------	---

Below these panels are two tables:

ARP Table (Compact View):

MAC Address	IP Address	Interface
00:00:00:00:00:00	10.120.204.70	Bridge
00:22:BE:6E:40:00	10.120.204.254	Bridge
00:00:00:00:00:00	10.120.204.72	Bridge
00:00:00:00:00:00	10.120.204.73	Bridge
00:00:00:00:00:00	10.120.204.71	Bridge

Bridge Table (Compact View):

MAC Address	Port	Aging Timer (secs)
00:04:56:C0:0A:C0	Own	0

Table 76 SM Network page attributes, Bridge Mode

Attribute	Meaning
Ethernet Status	

Attribute	Meaning
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 unused.</p>
Ethernet Interface	<p>Up: The device Ethernet interface is functioning and passing data</p> <p>Down: The device Ethernet interface has encountered an error disallowing full operation. Reset the device to reinitiate the Ethernet interface.</p>
IP Address	The current IP Address mode of the device (static or DHCP).
Subnet Mask	The currently configured device IP subnet mask.
MTU Size	The currently configured Maximum Transmission Unit for the AP's 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.
Port Speed	The current speed of the SMs LAN port.
Port Duplex Mode	The current duplex mode of the SMs LAN port.
Wireless Status	
Wireless 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 unused.</p>
Wireless Interface	<p>Up: The device wireless interface is functioning and passing data</p> <p>Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface.</p>
IP address	The IP address for the wireless interface is displayed only when the SM is in NAT Mode.
Subnet Mask	The subnet for the wireless interface is displayed only when the SM is in NAT Mode.
Network Status	

Attribute	Meaning
Network Mode	<p>Bridge: The SM acts as a switch, and packets are forwarded or filtered based on their MAC destination address.</p> <p>NAT: The SM acts as a router, and packets are forwarded or filtered based on their IP header (source or destination) which can be grouped into subnets for finer granularity.</p>
Default Gateway	IP address that is currently assigned.
DNS Server IP	Represents the IP address of the DNS Server.
PPPoE Mode	<p>Disabled: If this is left blank the STA will accept the first service option that comes back from the Access Concentrator specified below, if any. PPPoE is 'Disabled' by default.</p> <p>Enabled: An optional entry is 'Enabled' to set a specific service name to connect to the PPPoE session. This is limited to 32 characters.</p>
DHCP Lease Time	Current configured time for which a DHCP IP address is leased. When the lease time expires, the DHCP client must renew IP addressing via DHCP request.
Multicast Status	
Multicast Group Limit	The maximum number of simultaneous multicast groups that will be allowed through the SM.
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 SM identified the devices on.
Bridge Table	
MAC Address	MAC Address of the SM connected to the AP.
Port	The port to which the device is connected.
Aging Timer (secs)	Time set for the MAC addresses in the Bridge table.

Figure 52 SM Network page, NAT Mode

Ethernet Status

Ethernet Interface	Up
IP Address	10.1.1.100
Subnet Mask	255.255.255.0
MTU Size	1500 bytes
Port Speed	N/A
Port Duplex Mode	N/A

Wireless Status

Wireless IP Assignment	Static
Wireless Interface	Up
IP Address	10.120.204.4
Subnet Mask	255.255.255.0
Default Gateway	10.120.204.254

Separate Wireless Management IP

Separate Wireless Management IP	Enable
Separate Wireless Management IP Address Mode	Static
Separate Wireless Management IP Address	10.120.204.9
Separate Wireless Management IP Mask	255.255.255.0
Separate Wireless Default Gateway	10.120.204.254

Network Status

Network Mode	NAT
DNS Server IP	10.120.12.30, 10.120.12.31
PPPoE Mode	Disabled
DHCP Lease Time	24 hours

Multicast Status

Multicast Group Limit	0
-----------------------	---

ARP Table

Compact View

MAC Address	IP Address	Interface
00:22:BE:6E:40:00	10.120.204.254	WAN
00:00:00:00:00:00	10.120.204.71	
00:00:00:00:00:00	10.120.204.73	
00:00:00:00:00:00	10.120.204.72	
00:00:00:00:00:00	10.120.204.70	
00:04:56:C4:53:AE	10.120.204.20	

Local DHCP Server

DHCP Server Status: Enabled

DHCP Server IP Start Address: 10.1.1.1

DHCP Server IP End Address: 10.1.1.100

DHCP Gateway IP Address: 10.1.1.100

DHCP DNS IP Address: —

DHCP Static MAC to IP Configuration Table

Compact View

MAC Address	IP Address
-------------	------------

DHCP Assigned IP Address Table

Compact View

MAC Address	IP Address	Device Name
-------------	------------	-------------

Table 77 SM Network page attributes, NAT mode

Attribute	Meaning
Ethernet Status	

Attribute	Meaning
Ethernet Interface	<p>Up: The device Ethernet interface is functioning and passing data</p> <p>Down: The device Ethernet interface has encountered an error disallowing full operation. Reset the device to reinitiate the Ethernet interface.</p>
IP Address	The current IP Address mode of the device (static or DHCP).
Subnet Mask	The currently configured device IP subnet mask.
MTU Size	The currently configured Maximum Transmission Unit for the AP's 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.
Port Speed	The current speed of the SMs LAN port.
Port Duplex Mode	The current duplex mode of the SMs LAN port.
Separate Wireless Management IP	
Separate Wireless Management IP	<p>Disabled: A separate wireless management interface is not available.</p> <p>Enabled: A Separate Wireless Management IP has been configured and a management interface is available.</p>
Separate Wireless Management IP Address Mode	<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 unused.</p>
Separate Wireless Management IP Address	The IP address for the separate wireless management interface is displayed only when the SM is in NAT Mode and the Separate Wireless Management IP is enabled.
Separate Wireless Management IP Mask	The subnet for the separate wireless management interface is displayed only when the SM is in NAT Mode.
Separate Wireless Default Gateway	The default gateway for the separate wireless management interface is displayed only when the SM is in NAT Mode.
Wireless Status	
Wireless 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 unused.</p>

Attribute	Meaning
Wireless Interface	<p>Up: The device wireless interface is functioning and passing data</p> <p>Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface.</p>
IP address	The IP address for the wireless interface is displayed only when the SM is in NAT Mode.
Subnet Mask	The subnet for the wireless interface is displayed only when the SM is in NAT Mode.
Network Status	
Network Mode	<p>Bridge: The SM acts as a switch, and packets are forwarded or filtered based on their MAC destination address.</p> <p>NAT: The SM acts as a router, and packets are forwarded or filtered based on their IP header (source or destination) which can be grouped into subnets for finer granularity.</p>
DNS Server IP	Represents the IP address of the DNS Server.
PPPoE Mode	<p>Disabled: If this is left blank the STA will accept the first service option that comes back from the Access Concentrator specified below, if any. PPPoE is 'Disabled' by default.</p> <p>Enabled: An optional entry is 'Enabled' to set a specific service name to connect to the PPPoE session. This is limited to 32 characters.</p>
DHCP Lease Time	Current configured time for which a DHCP IP address is leased. When the lease time expires, the DHCP client must renew IP addressing via DHCP request.
Multicast Status	
Multicast Group Limit	The maximum number of simultaneous multicast groups that will be allowed through the SM.
ARP Table	
MAC Address	MAC Address of the devices in the SM's routing table.
IP Address	IP Address of the devices in the SMs routing table.
Interface	Interface on which the SM identified the devices on.
Local DHCP Server	
DHCP Server Status	Indicates if the local DHCP server on the SM in NAT mode is Enabled/Disabled.
DHCP Server IP Start Address	The first IP address in the DHCP pool 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 Server IP End Address	The last/highest address IP address in the DHCP pool of addresses which is issued to a DHCP client.

Attribute	Meaning
DHCP Gateway IP Address	The gateway of the local DHCP server
DHCP DNS IP Address	DNS Server IP address which will be used to configure DHCP clients (if Local DHCP Server is set to Enabled under Configuration=>Network).
DHCP Static MAC to IP Configuration Table	
MAC Address	MAC address of clients that were statically assigned an IP address in the DHCP Static MAC to IP Configuration Table under Configuration=>Network
IP Address	IP address of clients that were statically assigned an IP address in the DHCP Static MAC to IP Configuration Table under Configuration=>Network
DHCP Assigned IP Address Table	
MAC Address	MAC address of clients that were assigned a IP address through DHCP from the Local DHCP Server
IP Address	IP address of clients that were assigned a IP address through DHCP from the Local DHCP Server
Device Name	Device Name of clients that were assigned a IP address through DHCP from the Local DHCP Server

SM System Log page

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

Figure 53 SM System Log page

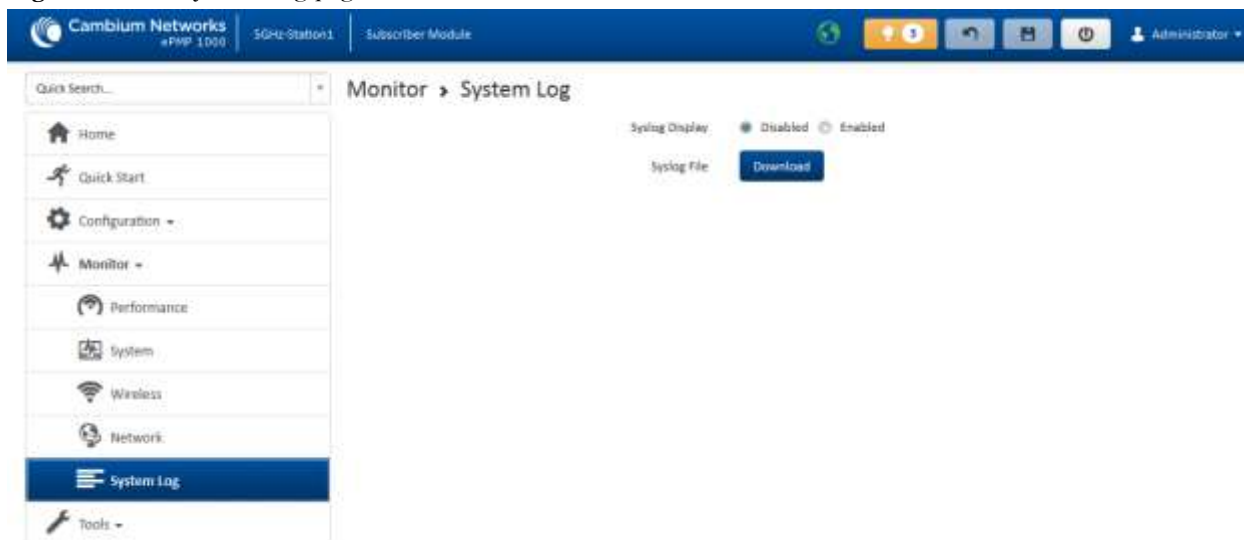


Table 78 SM System Log attributes

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.
Syslog file	Use this button to download the full system log file to a connected PC or device.

SM TOOLS MENU

The **SM Tools** menu provides several options for upgrading device software, configuration backup/restore, analyzing RF spectrum, testing device throughput, running ping and traceroute tests.

- **SM Software Upgrade page** on page **195**
- **SM Backup / Restore page** on page **197**
- **SM eDetect page** on page **199**
- **SM Spectrum Analyzer page** on page **201**
- **SM eAlign page** on page **204**
- **SM Wireless Link Test page** on page **205**
- **SM Ping page** on page **206**
- **SM Traceroute page** on page **207**

SM Software Upgrade page

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



Caution

Read the *Release Notes* associated with each software release.

Figure 54 SM Software Upgrade page

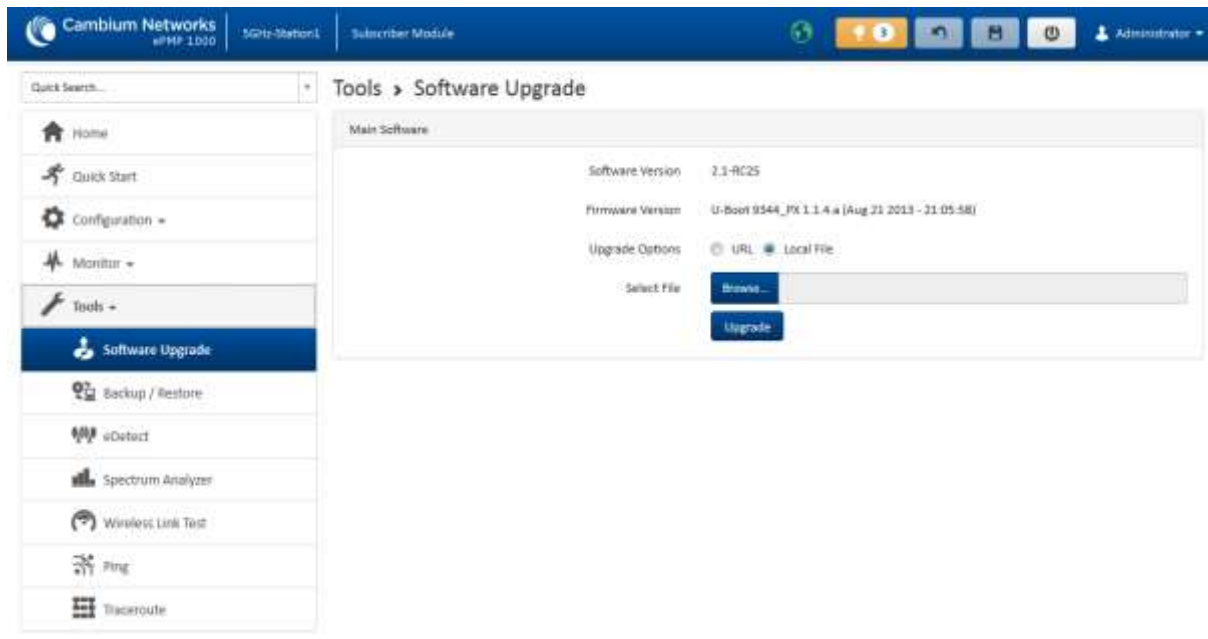


Table 79 SM Software Upgrade attributes

Attribute	Meaning
Software Version	The current operating software version.
Firmware Version	The current operating U-Boot version.
Upgrade Options	<p>From 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 Info field to http://192.168.2.1/<software_upgrade_package></p> <p>From 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.

To upgrade the device software, follow this:

Procedure:

- 1** Download the software upgrade packages from <https://support.cambiumnetworks.com/files/epmp>
- 2** Clear the cache of the accessing browser
- 3** On the device GUI, navigate to **Tools => Software Upgrade**
- 4** Select the **SW Upgrade Option** which represents the location of your software upgrade packages
- 5** Based on the configuration of **SW Upgrade Option**, enter either the **Software Upgrade Source Info** or click the **Browse** button and locate the software package
- 6** Click **Upgrade**
- 7** When the upgrade is completed successfully, click the **Reset** icon

SM Backup / Restore page

Use the **SM Backup / Restore** page to perform the following functions:

- Back up the configuration in either text (.json) format or binary (.bin) format.
- Restore the configuration of using a configuration file that was previously backed up.
- Reset the device to its factory default configuration. For more factory defaulting methods, see:
 - [Using the device external reset button](#) on page 227
 - [Resetting the ePMP to factory defaults by power cycling](#) on page 228

Figure 55 SM Backup / Restore page

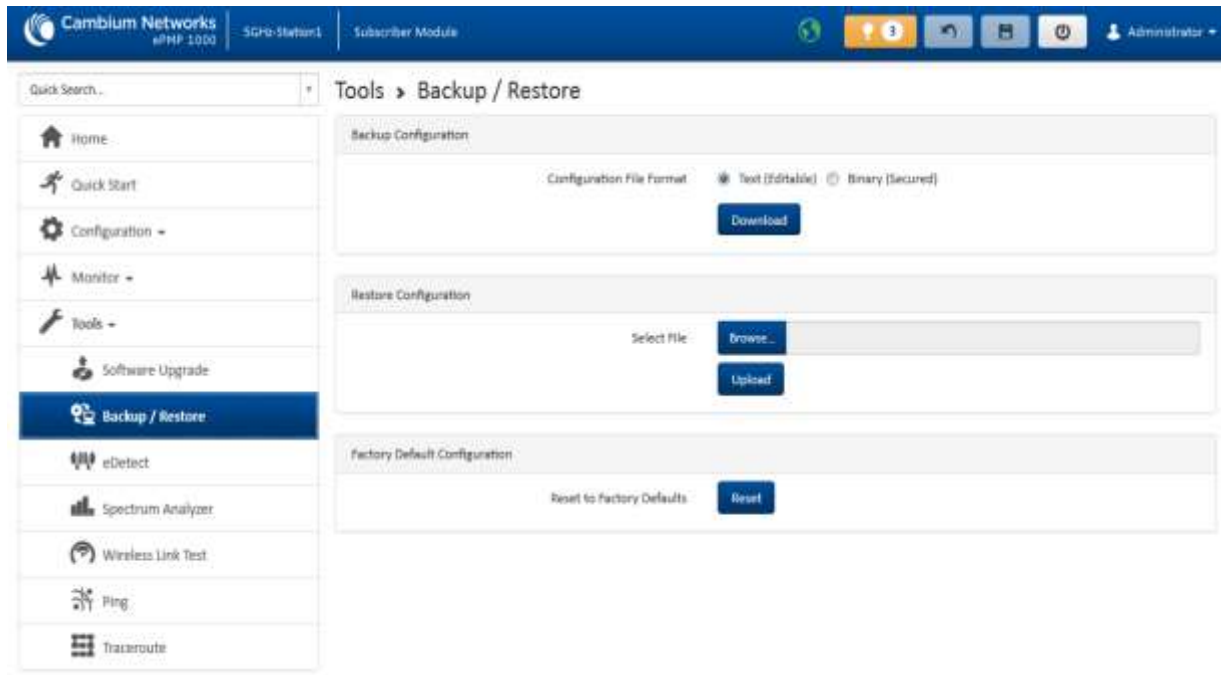


Table 80 SM Backup / Restore attributes

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.
Factory Default Configuration	
Reset to Factory Defaults	<p>Use this button to reset the device to its factory default configuration.</p> <div data-bbox="488 772 540 825" data-label="Image"> </div> <p>Caution</p> <p>A reset to factory default configuration resets all device parameters. With the SMs in default configuration it may not be able to register to an AP configured for your network.</p>

SM eDetect page

The **eDetect** tool (not available in ePTP Slave mode) is used to measure the 802.11 interference at the ePMP radio or system when run from the AP, on the current operating channel. When the tool is run, the ePMP device processes all frames received from devices not connected to the ePMP system and collects the interfering frame's information such as MAC Address, RSSI, and MCS. Use the SM eDetect page to collect information about interferers locally at the SM to display on the SM's GUI.

Figure 56 SM eDetect page

The screenshot displays the Cambium Networks ePMP 1000 web interface. The top navigation bar includes the Cambium Networks logo, "ePMP 1000", "5GHz Station", "Subscriber Module", and a user profile for "Administrator". A left sidebar contains a "Quick Search" bar and a list of navigation items: Home, Quick Start, Configuration, Monitor, Tools (selected), Software Upgrade, Backup / Restore, eDetect (highlighted), Spectrum Analyzer, Wireless Link Test, Ping, and Traceroute.


The main content area is titled "Tools > eDetect". It features a configuration section for the eDetect tool with the following controls:

- Detection Duration:** A text input field set to "30" with a unit dropdown menu showing "sec", "min", and "max". The range is indicated as "min: 1 | max: 120".
- Start/Stop:** Two buttons, "Start" and "Stop".
- Export to CSV:** An "Export" button.
- Status:** A label indicating the tool is "Stopped".

Below the configuration section is a "Detection Results" table. The table has three main sections: "Device Instance Health", "Detecting Device Info", and "Interferers' Info".

Device Instance Health	Detecting Device Info			Interferers' Info		
	Device MAC	Device RSSI (dBm)	Device MCS	Interferers' MAC	Interferers' RSSI (dBm)	Interferers' Max MCS

Table 81 SM eDetect attributes

Attribute	Meaning
eDetect	
Detection Duration	<p>Configure the duration for which the SM scans for interferers.</p>  <p>Caution</p> <p>During the scanning period, the SM must be connected to the AP and passing user traffic, and there cannot be any outage (unlike running a Spectrum Analyzer). There may be a negligible degradation in the SM's throughput.</p>
Start/Stop	Use to start or stop the interference detection.
Export to CSV	Choose this option to export the detection results to .csv format.
Status	Current status of the Interference Detection tool.
Detection Results	Use the Detection Results table to monitor interferers at the SM and their key RF parameters.
Device Instant Health	<p>This is an indicator of the device's health in terms of channel conditions in the presence of interferer(s).</p> <p>Green: Indicates that the channel is relatively clean and has good C/I levels (>25dB). The interference level is low.</p> <p>Yellow: Indicates that the channel has moderate or intermittent interference (C/I between 10dB and 25dB).</p> <p>Red: Indicates that the channel has high interference and poor C/I levels (<10dB).</p>
Device MAC	The MAC address of the SM's wireless interface.
Device RSSI (dBm)	The Received Signal Strength Indicator, which is a measurement of the power level being received by the device's antenna.
Device MCS	Modulation and Coding Scheme – indicates the modulation mode used for a radio's receiver side, based on radio conditions (MCS 1-7, 9-15).
Interferers' MAC	The MAC address of the interferer's wireless interface.
Interferers' RSSI (dBm)	The Received Signal Strength Indicator, which is a measurement of the interferer's power level being received by the device's antenna.
Interferers' MCS	Modulation and Coding Scheme – indicates the modulation mode used by the interferer, based on radio conditions (ex: MCS 1–15).

SM Spectrum Analyzer page

Use the **SM Spectrum Analyzer** page to configure SM spectrum analyzer parameters and to download the spectrum analyzer tool.

To download the spectrum analyzer tool, the AP **Device Mode** must be set to **Spectrum Analyzer**.

Java Runtime Environment is required to run the AP spectrum analyzer.



Caution

Conducting spectrum analysis causes the SM to enter scan mode and the SM drops all RF connections.

Vary the days and times when you analyze the spectrum in an area. The RF environment can change throughout the day or throughout the week.

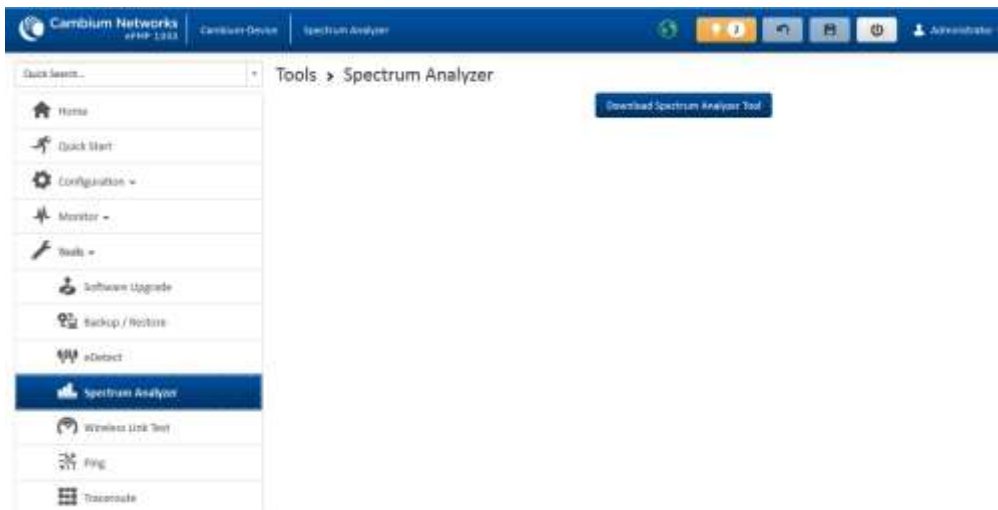
To conduct a spectrum analysis, follow these steps:

Required Software:

- Java Run-time Environment (JRE)

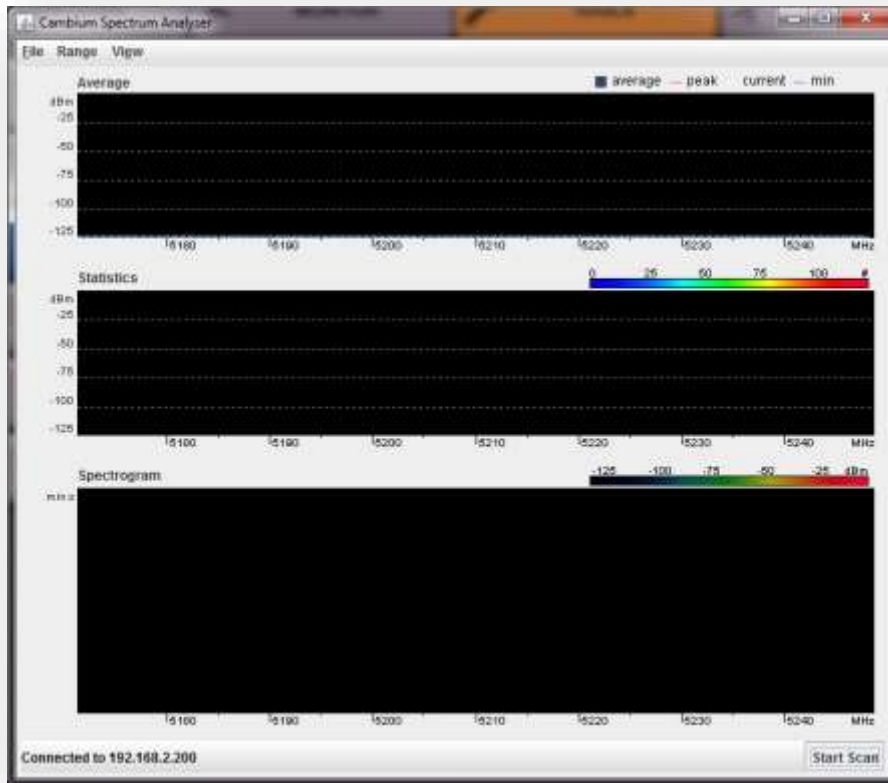
Procedure:

- 1 On the SM GUI, navigate to **Configure => System**
- 2 Configure **Device** mode to **Spectrum Analyzer**
- 3 Click the **Save** button
- 4 Click the **Reset** button
- 5 Login to the SM and navigate to **Tools => Spectrum Analyzer**. Following screen is displayed:



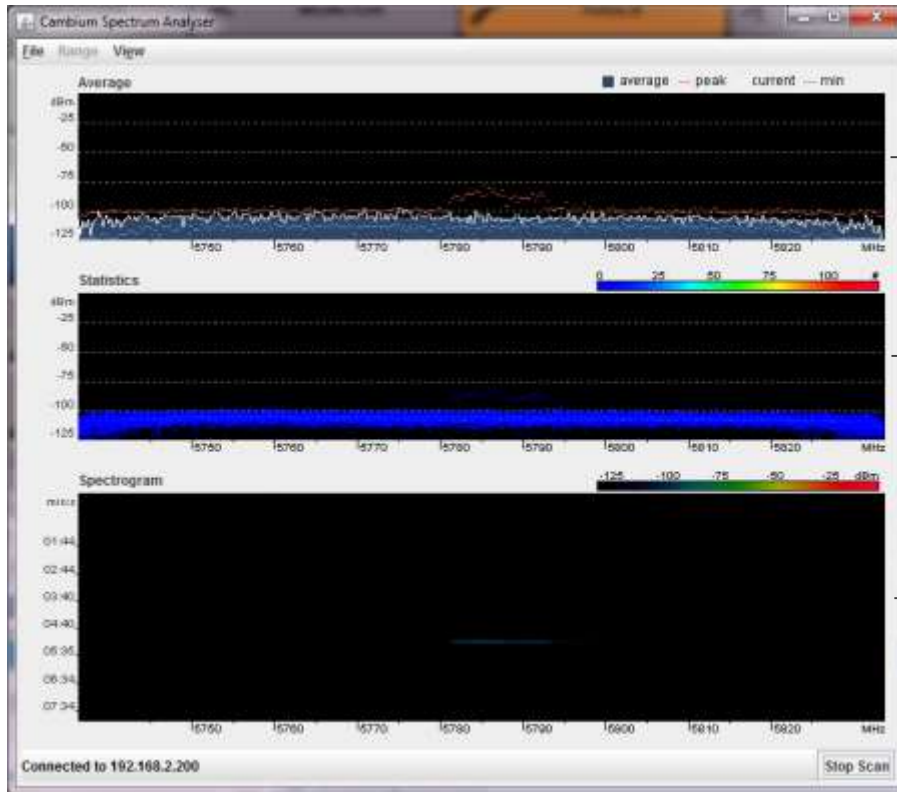
- 6 Click **Download Spectrum Analyzer Tool**
- 7 Locate the folder to which the spectrum analyzer tool was saved, and double-click on file `csa.jnlp` to launch the tool
- 8 If a security warning window is presented, tick the checkbox next to “*I accept the risk and want to run this application*”

- 9 In the security warning window, click **Run**
The spectrum analyzer interface is displayed



- 10 Click **Range** to configure the range of frequencies to scan.

- 11 Click **Start Scan** to begin scanning



Display of the average, peak, current, and minimum power levels for the configured range

Statistical display of the number of times each frequency in the range was scanned

Spectrogram display of the energy levels detected throughout the configured range, over time

When scanning is complete, follow these steps to return the device to AP operation:

Procedure:

- 1 In the spectrum analyzer application, click **Stop Scan**
- 2 Close the spectrum analyzer application by clicking **File => Exit**
- 3 On the SM GUI, navigate to **Configure => System**
- 4 Configure **Device Mode** to **SM**
- 5 Click the **Save** button
- 6 Click the **Reset** button

SM eAlign page

Use the eAlign page to aid with link alignment. A valid link to an AP is required for eAlign to provide meaningful measurements.

Figure 57 SM eAlign page



Table 82 SM eAlign attributes

Attribute	Meaning
Operating Frequency	The current frequency at which the SM is operating.
Registered AP SSID	The SSID of the AP to which the SM is registered.
Current RSSI	Current RSSI value measured on the uplink by the SM's receiver.
Peak RSSI	Peak RSSI value measured by the SM's receiver from the time the user navigated to the eAlign page.
Reset Measurements	Click this button to reset all current measurements.

SM Wireless Link Test page

Use the **SM Wireless Link Test** page to conduct a simple test of SM wireless throughput to the AP to which it is registered. This allows you to determine the throughput that can be expected on a particular link without having to use external tools.

Figure 58 SM Wireless Link Test page

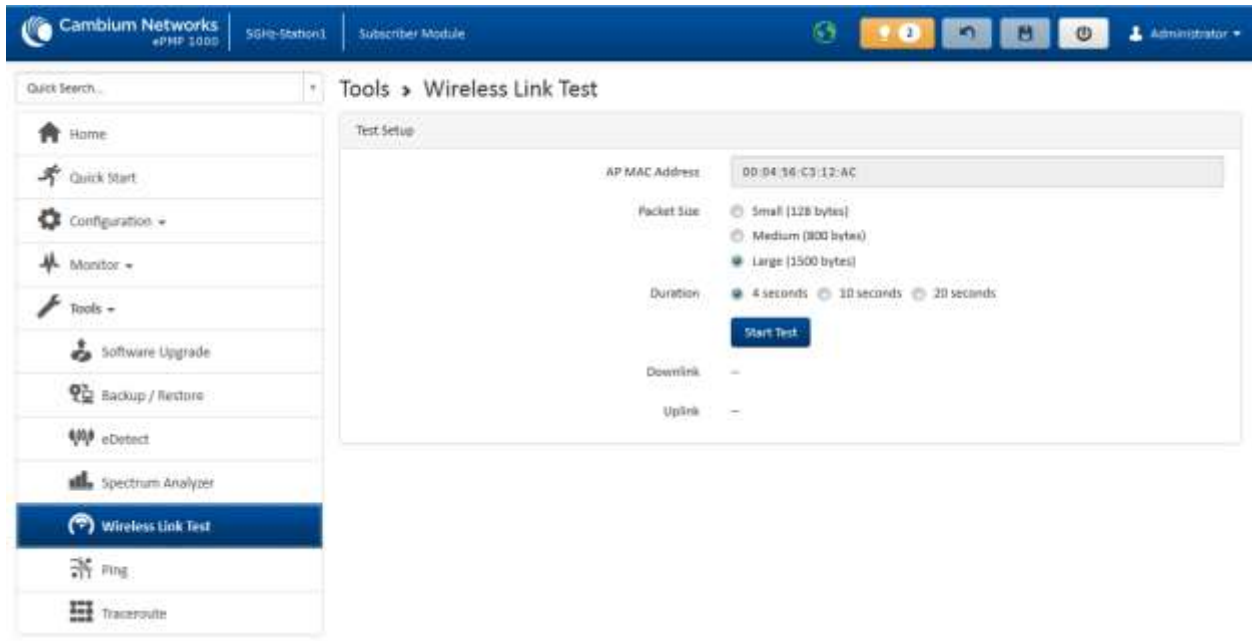


Table 83 SM Wireless Link Test attributes

Attribute	Meaning
Test Setup	
AP MAC Address	This is not an editable field. It is automatically populated with the wireless MAC address of the AP to which the SM is registered.
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.
Aggregate	This field indicates the result of the aggregate throughput on the link, in Mbps. Displayed only when Downlink/Uplink Ratio is set to 75/25, 50/50 or 30/70.

SM Ping page

Use the SM **Ping** page to conduct a simple test of SM 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 SM, or there may be a failure in the network hardware (i.e. DNS server failure).

Figure 59 SM Ping page

Table 84 SM Ping attributes

Attribute	Meaning
Ping	
IP Address	Enter the IP address of the ping target.
Number of packets (-c)	Enter the total number of ping requests to send to the target.
Buffer size (-s)	Enter the number of data bytes to be sent.
TTL (-t)	Set the IP Time-To-Live (TTL) for multicast packets. This flag applies if the ping target is a multicast address.
Ping Results	Displays the ping test results.

SM Traceroute page

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

Figure 60 SM Traceroute page

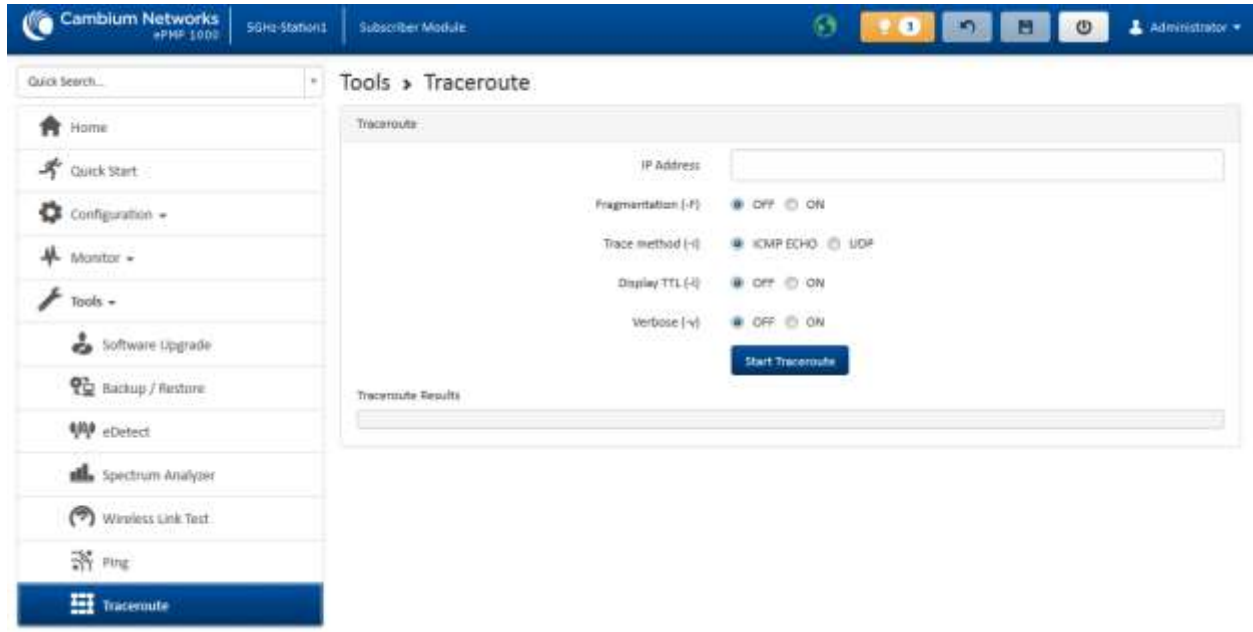


Table 85 SM Traceroute attributes

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 (-l)	ICMP ECHO: Use ICMP ECHO for traceroute probes. UDP: Use UDP for traceroute probes.
Display TTL (-l)	ON: Display TTL values for each hop on the route. OFF: Suppress display of TTL values for each hop on the route.
Verbose (-v)	ON: ICMP packets other than TIME_EXCEEDED and UNREACHABLE are displayed in the output. OFF: Suppress display of extraneous ICMP messaging.
Traceroute Results	Displays the results of the traceroute diagnostics.

Radius Server

INSTALLING FREE-RADIUS ON UBUNTU 12.04 LTS

To install the Radius server on Ubuntu 12.04 LTS, follow these instructions:

1. On the free-radius web page <http://freeradius.org>, download the latest package (currently 3.0.0), either from the main page or the download page.
2. Extract the archive file by using the command line as shown below:
 - To extract a tar.bz2 file, use the command (note the j option)


```
tar -jxvf freeradius-server-x.x.x.tar.bz2
```
 - To extract a tar.gz file, use the command (note the z option)


```
tar -zxvf freeradius-server-x.x.x.tar.gz
```
3. Once the files are extracted to a folder (cd freeradius-server-x.x.x), execute these commands:


```
sudo apt-get install libssl-dev
sudo apt-get install libtalloc-dev
./configure
make
make install
```

CONFIGURING FREE-RADIUS SERVER

To configure Free-Radius server, follow these steps:



Note

IP address or subnet of the client must be configured in the clients.conf file.

Ex. – For the examples listed in the document, the subnet of the external machine is 172.22.121.0 or 192.168.0.0.

1. For testing from external machines, edit /usr/local/etc/raddb/clients.conf and add an entry.
For example:

```
client 172.22.121.0/24 {
    ipaddr = 172.22.121.0
    netmask = 24
    secret = cambium
    proto = *
    shortname = epmp1
}
client 127.0.0.0/24 {
    ipaddr = 172.22.121.0
    netmask = 24
    secret = cambium
    proto = *
    shortname = epmp1
}
client 192.168.0.0/16 {
    ipaddr = 192.168.0.0
    netmask = 16
    secret = cambium
    proto = *
}
```

2. To add *EAP-TTLS Username* and *EAP-TTLS Password*, edit *usr/local/etc/raddb/user*.
For example put this string at the end of file:


```
cambium-SubscriberModule Cleartext-Password := "cambium",
```

where *cambium-SubscriberModule* - EAP-TTLS Username and "cambium" - EAP-TTLS Password.

3. To configure free-radius key and certificate, edit `/usr/local/etc/raddb/mods-available/eap` and add your certificates to folder `/usr/local/etc/raddb/certs`.

Locate a string such as `default_eap_type`, `private_key_file`, `certificate_file` in `eap` file and change the value to:

```
default_eap_type = ttls
private_key_password = *** - according to your certificate
private_key_file = ${certdir}/***.key
certificate_file = ${certdir}/***.crt
```

Under the `ttls` section, change the following:

```
copy_request_to_tunnel=yes
use_tunnel_reply=yes
```



Note

Once these steps are performed, free-radius in debug mode can be initiated: `$ radiusd -X`.