Cambium 450 Platform User Guide

System Release 16.0

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About This User Guide

This guide describes the planning, installation, configuration and operation of the Cambium point-to-point and point-to-multipoint wireless Ethernet bridges. It covers PMP/PTP 450, 450i, 450b, 450d and PMP 450m platform Series. It is intended for use by the system designer, system installer and system administrator.

For radio network design, refer to the following chapters:

- Chapter 1: Product description
- Chapter 2: System hardware
- Chapter 3: System planning
- Chapter 4: Legal and regulatory information
- Chapter 5: Preparing for installation
- Chapter 6: Installation

For system configuration, tools and troubleshooting, refer to the following chapters:

- Chapter 7: Configuration
- Chapter 8: Tools
- Chapter 9: Operation
- Chapter 10: Reference information
- Chapter 11: Troubleshooting

Contacting Cambium Networks

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Purpose

Cambium Networks Point-to-Multi-Point (PMP)/Point-To-Point (PTP) 450 documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Cambium PMP/PTP equipment and ancillary devices of 450 Platform Family. It is recommended that all personnel engaged in such activities be properly trained.

Cambium disclaims all liability whatsoever, implied or express, 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.

Product notation conventions in document

This document covers Cambium 450 Series, 450i Series and 450m Series products. The following notation conventions are followed while referring to product series and product family:

Product notation	Description
• 450 Platform Family	Refers to the complete 450 Series family, which includes 450 Series, 450i Series, 450b Series and 450m Series
• 450 Series	Refers to 450 Series devices in the following configurations: - PMP 450 - AP [2.4GHz/3.5 GHz/3.65 GHz /5 GHz] - Connectorized - SM [900 MHz/2.4GHz/3.5 GHz/3.65 GHz /5 GHz] - Connectorized/ Integrated - PTP 450 BHM/ BHS [900 MHz/3.5 GHz/3.65 GHz/5 GHz] - Connectorized/ Integrated - PMP 450d SM [5 GHz]
• 450i Series	Refers to 450i Series devices in the following configurations: - PMP 450i - AP [900 MHz/3 GHz/5 GHz] - Connectorized/ Integrated - SM [3 GHz/5 GHz] - Connectorized/ Integrated - PTP 450i BHM/ BHS [3 GHz/5 GHz] - Connectorized/ Integrated
• 450b Series	Refers to 450b Series devices in the following configurations: - PMP 450b Mid-Gain - SM [5 GHz] - Integrated - PMP 450b High Gain - SM [5 GHz] - Dish

Product notation	Description
• 450m Series	Refers to 450m Series device configuration: - PMP 450m AP 5 GHz - Integrated - PMP 450m AP 3 GHz - Integrated

Cross references

References to external publications are shown in italics. Other cross references, emphasized in blue text in electronic versions, are active links to the references.

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

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents. To provide feedback, visit our support website.https://support.cambiumnetworks.com.

Important regulatory information

The 450 Platform Family products are 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).

Application software

Download the latest 450 Platform Family software and install it in the Outdoor Units (ODUs) before deploying the equipment. Instructions for installing software are provided in Upgrading the software version and using CNUT on page 7-67.

USA specific information

Caution

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

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation

The USA Federal Communications Commission (FCC) requires 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.

Cambium supplies variants of the 5GHz 450, 450i, 450b, and 450m Series specifically for operation in the USA to comply with FCC requirements (KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02). These variants are only allowed to operate with license keys that comply with FCC rules.

To ensure compliance when using PMP 450 Series and PTP 450 Series, follow the recommendation in Avoidance of weather radars (USA only).

External antennas

When using a connectorized version of the product, the conducted transmit power may need to 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 feeder cable losses.

The range of permissible values for maximum antenna gain and feeder cable losses are included in this user guide together with a sample calculation. 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 and feeder cable losses are entered into the GUI.

Avoidance of weather radars (USA only)

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. If interference is not eliminated, a distance limitation based on line-of-sight from TDWR will need to be used. 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 PTP 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.

The 450 Platform Family AP must be configured to not operate on the affected channels.

Canada specific information

Caution

This device complies with ISEDC ’s license-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

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

ISEDC requires 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 ISEDC rules; specifically it must not be possible to disable or modify the radar protection functions that have been demonstrated to ISEDC .

In order to comply with these ISEDC requirements, Cambium supplies variants of the 450 Platform Family for operation in Canada. These variants are only allowed to operate with license keys that comply with ISEDC rules. In particular, operation of radio channels overlapping the band 5600 MHz to 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.

Other variants of the 450 Platform Family are available for use in the rest of the world, but these variants are not supplied to Canada except under strict controls, when they are needed for export and deployment outside Canada.

Renseignements specifiques au Canada

Attention

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

ISEDC a demandé aux fabricants de mettre en œuvre des mécanismes spécifiques pour éviter d'interférer avec des systèmes radar fonctionnant dans la bande 5600 MHz à 5650 MHz. Ces mécanismes doivent être mis en œuvre dans tous les produits capables de fonctionner à l'extérieur dans la bande 5470 MHz à 5725 MHz.

Les fabricants doivent s'assurer que les produits de radiocommunications ne peuvent pas être configurés pour fonctionner en dehors des règles ISEDC , en particulier, il ne doit pas être possible de désactiver ou modifier les fonctions de protection des radars qui ont été démontrés à ISEDC .

Afin de se conformer à ces exigences de ISEDC , Cambium fournit des variantes du 450 Platform Family exclusivement pour le Canada. Ces variantes ne permettent pas à l'équipement de fonctionner en dehors des règles de ISEDC . En particulier, le fonctionnement des canaux de radio qui chevauchent la bande 5600-5650 MHz est interdite et ces canaux sont définitivement exclus.

ISEDC Approved Antennas

The list of antennas used to obtain ISEDC approvals is provided in section Country specific radio regulations, Innovation Science and Economic Development Canada (ISEDC) , Table 331.

Antennas externes

Lorsque vous utilisez une version du produit sans antenne intégrée, il peut être nécessaire de réduire la puissance d'émission pour garantir que la limite réglementaire de puissance isotrope rayonnée équivalente (PIRE) n'est pas dépassée. L'installateur doit avoir une bonne compréhension de la façon de calculer le gain de l'antenne réelle et les pertes dans les câbles de connections.

La plage de valeurs admissibles pour un gain maximal de l'antenne et des pertes de câbles de connections sont inclus dans ce guide d'utilisation avec un exemple de calcul. L'interface utilisateur du produit applique automatiquement la limite de puissance menée correct afin de s'assurer qu'il ne soit pas possible pour l'installation de dépasser la limite PIRE, lorsque les valeurs appropriées pour le gain d'antenne et les pertes de câbles d'alimentation sont entrées dans l'interface utilisateur.

Antennes approuvées par ISEDC

La liste des antennas approveés pour l'operation au Canada est founie dans le chapitre Country specific radio regulations, Innovation Science and Economic Development Canada (ISEDC) tableaux Table 331.

EU Declaration of Conformity

Hereby, Cambium Networks declares that the Cambium 450 Series, 450i Series and 450m Series Wireless Ethernet Bridge complies with the essential requirements and other relevant provisions of the Radio Equipment Directive 2014/53/EU. The declaration of conformity may be consulted at:

https://www.cambiumnetworks.com/eu_dofc

Specific expertise and training for professional installers

To ensure that the 450 Platform Family products – PMP/PTP 450 Series, PMP/PTP 450i Series, PMP 450m Series are installed and configured in compliance with the requirements of ISEDC and the FCC, installers must have the radio engineering skills and training described in this section.

The Cambium Networks technical training program details can be accessed from below link:

https://www.cambiumnetworks.com/training/

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 450 Platform Family can be found in Chapter 2: System hardware and Chapter 3: System planning.

Training

The installer needs to have basic competence in radio and IP network installation. The specific requirements applicable to the 450 Platform should be gained by reading Chapter 5: Preparing for installation, Chapter 6: Installation, Chapter 7: Configuration, Chapter 8: Tools and Chapter 9: Operation; and by performing sample set ups at base workshop before live deployments.

The Cambium Networks technical training program details can be accessed from below link:

https://www.cambiumnetworks.com/training/

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.
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.

Repair and service

If unit failure is suspected, obtain details of the Return Material Authorization (RMA) process from the support website (http://www.cambiumnetworks.com/support).

Hardware warranty

Cambium's standard hardware warranty is for one (1) year from date of shipment from Cambium Networks or a Cambium distributor. Cambium Networks warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Cambium 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 and PTP products or activate warranties, visit the support website. For warranty assistance, contact the reseller or distributor. The removal of the tamper-evident seal will void the warranty.

Caution

Using non-Cambium parts for repair could damage the equipment or void warranty. Contact Cambium for service and repair instructions.

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.

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, refer to https://www.cambiumnetworks.com/support/compliance/

Disposal of surplus packaging

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

In non-EU countries

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

Chapter 1: Product description

This chapter provides a high level description of 450 Platform Family products. It describes in general terms the function of the product, the main product variants and the main hardware components. The following topics are described in this chapter:

- Overview of the 450 Platform Family on page 1-2 introduces the key features, typical uses, product variants and components of the 450 Platform Family.
- Wireless operation on page 1-16 describes how the 450 Platform Family wireless link is operated, including modulation modes and spectrum management.
- System management on page 1-21 introduces the 450 Platform Family management system, including the web interface, configuration, security, alerts and recovery.

Overview of the 450 Platform Family

This section introduces the key features, typical uses, product variants and components of the 450 Platform Family.

Purpose

Cambium 450 Platform Family products are designed for Ethernet bridging over point-to-point and point-to-multipoint microwave links in unlicensed and lightly-licensed frequency bands 900MHz, 2.4 GHz, 3.5/3.65 GHz and 4.9 to 5.925 GHz.

Users must ensure that the 450 Platform Family complies with local operating regulations.

The 450 Platform Family acts as a transparent bridge between two or more segments of the operator's network. In this sense, it can be treated as a virtual wired connection among points. The 450 Series platform forwards 802.3 Ethernet frames destined for the other part of the network and filters frames it does not need to forward.

450 Platform Family

The 450 Series platform supports following:

- PMP 450m Series
- PMP/PTP 450i Series
- PMP 450b Series
- PMP/PTP 450 Series

PMP 450m Series

The PMP 450m Series AP is a revolutionary product which is based on Multi-User Multiple-Input and Multiple-Output (MU-MIMO) technology. By combining a sophisticated beam forming antenna array with multiple transceivers, Cambium Networks is using leading edge technology to provide a substantial shift upward in capacity per sector.

Key features

The Cambium PMP 450m Series AP offers the following benefits:

- MU-MIMO Access Point is a technologically cutting-edge device providing more than 500 Mbps in 20 MHz Channel bandwidth using 2.5 ms frame size and a 5GHz channel, depending upon SMs position within sector. Even higher data rates are possible using 5 ms frame sizes or using 30 MHz or 40 MHz bandwidths.
- Releases 16.0 and beyond support 3GHz AP, as well as MU-MIMO in the UL direction.

- PMP 450m AP is compatible with existing PMP 450/450i Series Subscriber Modules(SM), providing an easy network upgrade path. This benefits to re-use existing SMs (i.e. capital investment). With releases 15.1.3 and beyond, 5GHz PMP 450m also provides basic sector mode support for 430 SMs.
- 3x higher throughput packet rate compare 450 Series
- 5GHz Integrated with 14x14 MU-MIMO antenna; 3GHz Integrated with 8x8 MU-MIMO antenna
- **5GHz ports-**
  - Gigabit copper/power port combined, 100BaseT port with power out and SFP port, 2.5G Copper SFP
  - **3GHz ports-**Gigabit copper Ethernet port without Power, Ethernet, 100/1000BaseT Auxiliary with power out, SFP1, SFP2.
- More than 20 bps/Hz spectral efficiency and over 40 bps/Hz when deployed in frequency re-use configuration

Table 1 gives a summary of the main PMP 450m Series AP characteristics.

Table 1 Main characteristics of the PMP 450m Series AP

Characteristic	Value
Topology	PMP
Wireless link condition	LOS, near LOS or non-LOS
Range	PMP: Up to 40 mi (or 64 km)
Duplexing	TDD (symmetric and asymmetric)
Connectivity	1000Base-T Ethernet Main port with PoE input
Operating frequencies	5.150 to 5.925 GHz 3.65 to 3.70 GHz
Tx Power	5GHz 42 dBm EIRP 3GHz 55 dBm EIRP
Channel bandwidth	5, 7, 10, 15, 20, 30, and 40 MHz
High spectral efficiency	More than 60 bps/Hz[1]
Timing synchronization	CMM5 or UGPS
Data rate	More than 500 Mbps with 20 MHz channel bandwidth and 2.5ms frame size. Additional data rate improvements are available by using 30 MHz and 40 MHz channel bandwidths, or 5 ms frame size.

[1] This is achieved in an ABAB frequency reuse AP deployment model.

Frequency bands

The PMP 450m Series AP operates from

- 5150 to 5925 MHz.
- 3300 to 3900 MHz

Hardware components

The ODU (Outdoor unit) is a self-contained transceiver unit that houses both radio and networking electronics.

The **PMP 450m Series** is supplied in the following configurations:

Table 2 PMP 450m Series hardware configurations

ODU	Frequency	ODU type	
5 GHz PMP 450m AP	5150 to 5925 MHz	Integrated	14 dBi, 90° MU-MIMO sector antenna
3 GHz PMP 450m AP	3300 to 3900 MHz	Integrated	16 dBi, 90° MU-MIMO sector antenna

PMP/PTP 450i Series

The PMP/PTP 450i Series is a high performance wireless bridge for Ethernet traffic. It is capable of operating in line-of-sight (LOS), near-LOS and non-LOS propagation conditions. It supports 900 MHz, 3 GHz, and 4.9 to 5.925 GHz frequency band.

Key features

The PMP/PTP 450i Series has extensive quality of service (QoS) involving traffic classification, traffic policy and shaping capability.

The Cambium PMP/PTP 450i Series offers the following benefits:

- Cambium's high performing point-to-multipoint solution, with up to 310 Mbps (40 MHz Channel Bandwidth and 5 ms Frame Period) usable throughput for PMP and PTP
- State-of-the-art MIMO (Multi In Multi Out) technology
- Upto 7.5 bps/Hz spectral efficiency
- Increased Packet Processing rate
- Efficient GPS synchronized, scheduled TDD operation for easy AP/BHM site deployment and performance that is consistent regardless of SM/BHS loading
- A range of cost-effective subscriber device solutions to meet the business case of any network application

- MIMO B Mode: This technique provides for the ability to double the throughput of a radio transmission under proper RF conditions. Different data streams are transmitted simultaneously on two different antennas
- MIMO-A mode: This mode of operation has same modulation levels as the MIMO-B mode, namely: QPSK, 16-QAM, 64-QAM and 256-QAM. This mode increases system reliability in the links.
- GPS synchronization via CMM4, CMM5, or UGPS

Table 3 gives a summary of the main PMP/PTP 450i Series characteristics.

Table 3 Main characteristics of the PMP/PTP 450i Series

Characteristic	Value
Topology	PMP/PTP
Wireless link condition	LOS, near LOS or non-LOS
Range	PTP: Up to 186 mi (or 299 km) depending on configuration for all bands PMP: Up to 40 mi (or 64 km) for 5 GHz band PMP: Up to 120 mi (or 193 km) for 900 MHz band
Duplexing	TDD (symmetric and asymmetric)
Connectivity	1000Base-T Ethernet Main port with PoE input
Operating frequencies	902 to 928 MHz 3.3 to 3.9 GHz 4.9 to 5.925 GHz
Tx Power - conducted	Max 25 dBm (3 GHz) Max 27 dBm (5 GHz) Max 25 dBm (900 MHz)
Channel bandwidth	5, 7, 10, 15, 20, 30, and 40 MHz **Note** All bands do not support all channel bandwidths. For more information, refer to this link.
Spectral efficiency	Up to 7.5 bps/Hz
Timing synchronization	CMM4, CMM5, or UGPS
Data rate	Up to 310 Mbps (40 MHz channel BW) for PMP/PTP

Frequency bands

The PMP/PTP 450i Series ODU can operate in the following bands:

- 900 MHz band: 902 to 928 MHz
- 3 GHz band: 3300 to 3900 MHz
- 5 GHz band: 4900 to 5925 MHz

Note

900 MHz, 3 GHz, and 5 GHz bands with different frequencies require different hardware components.

Hardware components

The ODU (Outdoor unit) is a self-contained transceiver unit that houses both radio and networking electronics. The main hardware components of the PMP/PTP 450i Series are as follows:

- PMP 450i AP
- PMP 450i SM
- PTP 450i BH (BHM/BHS)

The **PMP/PTP 450i** Series is supplied in the following configurations:

Table 4 PMP/PTP 450i Series hardware configurations

ODU	Frequency	ODU type	
PMP 450i AP	902 to 928 MHz	Connectorized	Use with an external antenna
	3.3 to 3.9 GHz	Integrated	17 dBi, 90° sector dual slant antenna
		Connectorized	Use with an external antenna
	4.9 to 5.925 GHz (support 4.9, 5.1, 5.2, 5.4 and 5.8 GHz)	Integrated	16 dBi, 90° sector antenna
		Connectorized	Use with an external antenna
PMP 450i SM	3.3 to 3.9 GHz	Integrated	19 dBi, SM/BH with MARS antenna
		Connectorized	Use with an external antenna
	4.9 to 5.925 GHz (support 4.9, 5.1, 5.2, 5.4 and 5.8 GHz)	Integrated	23 dBi flat panel antenna
		Connectorized	Use with an external antenna
PTP 450i BH	3.3 to 3.9 GHz	Integrated	19 dBi, SM/BH with MARS antenna
		Connectorized	Use with an external antenna
	4.9 to 5.925 GHz	Integrated	23 dBi flat panel antenna
		Connectorized	Use with an external antenna

	(support 4.9, 5.1, 5.2, 5.4 and 5.8 GHz)

Note

The BH ODU can be configured as a BHM or a BHS in PTP mode.

PMP/ PTP 450b Series

The PMP/ PTP 450b Series is a high performance wireless Subscriber Module. It supports 4.9 to 5.925 GHz frequency band.

Key features

The Cambium PMP/ PTP 450b Series offers the following benefits:

- Ultra-wide band radios support the entire band from 4.9 to 5.925 GHz.
- Gigabit Ethernet Interface provides the maximum transfer rates to the device.
- 3.5 mm audio jack allows direct connection of headphones without any adapters.
- Updated FPGA enhances Packet Processing Power more than 4 times that of the 450 SM.
- Capable of up to 300 Mbps aggregate in a 40 MHz channel.

Table 5 gives a summary of the main PMP 450b Series characteristics.

Table 5 Main characteristics of the PMP/ PTP 450b Series

Characteristic	Value
Topology	PMP
Wireless link condition	LOS, near LOS or non-LOS
Range	PMP: Up to 40 mi (or 64 km)
Duplexing	TDD (symmetric and asymmetric)
Connectivity	100/1000Base-T Ethernet Main port with PoE input
Operating frequencies	4.9 to 5.925 GHz
Tx Power - conducted	Max 27 dBm
Channel bandwidth	5, 10, 15, 20, 30, and 40 MHz
Spectral efficiency	Up to 7.5 bps/Hz
Timing synchronization	CMM4, CMM5, or UGPS
Data rate	Up to 300 Mbps (40 MHz channel BW) for PMP

Frequency bands

The PMP 450b Series ODU can operate in the following band:

- 5 GHz band: 4900 to 5925 MHz

Hardware components

The ODU (Outdoor unit) is a self-contained transceiver unit that houses both radio and networking electronics. The main hardware components of the PMP/ PTP 450b Series are as follows:

- PMP 450b SM

The **PMP/ PTP 450b** Series is supplied in the following configurations:

Table 6 PMP/ PTP 450b Series hardware configurations

ODU	Frequency	ODU type	
PMP/ PTP 450b SM	4.9 to 5.925 GHz (support 4.9, 5.1, 5.2, 5.4 and 5.8 GHz)	Integrated	16 dBi integrated antenna (Mid-Gain)
		Dish	23 dBi integrated antenna (High Gain)

PMP/PTP 450 Series

Cambium PMP/PTP 450 Series networks are designed for wireless point-to-multipoint and point-to-point links in the unlicensed/licensed 900 MHz, 2.4 GHz, 3.5 GHz, 3.65 GHz, 5.4 GHz and 5.8 GHz bands. Users must ensure that the PMP/PTP 450 Series complies with local operating regulations.

The PMP/PTP 450 Series enables network operators to grow their business by offering more capacity for data, voice and video applications.

Key features

The Cambium PMP/PTP 450 Series offers the following benefits:

- Cambium's point-to-multipoint and point-to-point solution, with up to 310 Mbps usable throughput
- State-of-the-art MIMO (Multi In Multi Out) technology
- Efficient GPS synchronized, scheduled TDD operation for easy Access Point site deployment and performance that is consistent regardless of subscriber loading
- A range of cost-effective subscriber device solutions to meet the business case of a network application
- MIMO-B Mode: This technique provides for the ability to double the throughput of a radio transmission under proper RF conditions. Different data streams are transmitted simultaneously on two different antennas.
- MIMO-A Mode: This mode of operation using the same modulation levels as the MIMO-B mode, namely: QPSK, 16-QAM, 64-QAM and 256-QAM but it provides an additional combining gain.

Table 7 gives a summary of PMP/PTP 450 Series products main characteristics.

Table 7 Main characteristics of the PMP/PTP 450 Series

Characteristic	Value
Topology	PMP/PTP
Wireless link condition	LOS, near LOS or non-LOS
Range	Up to 40 mi (or 64 km) for PMP Up to 186 mi (or 299 km) for PTP
Duplexing	TDD (symmetric and asymmetric)
Connectivity	100Base-T Ethernet Main port with PoE input
Operating frequencies	900 MHz, 2.4 GHz, 3.5 GHz, 3.65 GHz and 5 GHz
Tx Power - conducted	max 22 dBm (2.4 GHz and 5 GHz) max 25 dBm (3.5 GHz and 3.65 GHz) max 25 dBm (900 MHz - PMP 450 SM and BH)
Channel bandwidth	5, 7, 10, 15, 20, 30, and 40 MHz NOTE All bands do not support all channel bandwidths. For more information, refer to this link.
High spectral efficiency	Up to 7.5 bps/Hz
Timing synchronization	CMM4 or UGPS
Data rate	Up to 310 Mbps (40 MHz channel BW) for PMP/PTP

Frequency bands

The PMP/PTP 450 Series ODU can operate in the following bands:

- 900 MHz band: 902 to 928 MHz (SM and BH)
- 2.4 GHz band: 2400 to 2483 MHz
- 3.5 GHz band: 3300 to 3600 MHz
- 3.65 GHz band: 3500 to 3850 MHz
- 5 GHz band: 5470 to 5875 MHz

Hardware components

The main hardware components of the PMP/PTP 450 are as follows:

- PMP 450 AP
- PMP 450 SM
- PTP 450 BH (BHM/BHS)

The **PMP/PTP 450** is supplied in the following configurations:

Table 8 PMP/PTP 450 Series hardware configurations

ODU	Frequency	ODU type	
PMP 450 AP	2.4 GHz	Connectorized	Use with an external antenna
		Integrated	18 dBi Dual Slant
	3.5/3.65 GHz	Connectorized	Use with an external antenna
		Integrated	16 dBi Dual Slant
	5 GHz (5.4 and 5.8 GHz)	Connectorized	Use with an external antenna
PMP 450 SM	900 MHz	Connectorized	Use with an external antenna
	2.4 GHz	Connectorized	Use with an external antenna
		Integrated	7 dBi Dual Slant, integrated patch
	3.5/3.65 GHz	Connectorized	Use with an external antenna
		Integrated	8 dBi Dual Slant, integrated patch
		Integrated	19 dBi Flat Plate, integrated patch
	5 GHz (5.4 and 5.8 GHz)	Connectorized	Use with an external antenna
		Integrated	9 dBi H+V, integrated patch
		Integrated	25 dBi H+V, Integrated dish
PTP 450 BH	902 to 928 MHz	Connectorized	Use with an external antenna
	3.5/3.65 GHz	Connectorized	Use with an external antenna
		Integrated	8 dBi Dual Slant
	5 GHz (5.4 and 5.8 GHz)	Connectorized	Use with an external antenna
		Integrated	9 dBi H+V

Note

The BH ODU can be configured as a BHM or a BHS in PTP mode

Supported interoperability for 450m/450i/450b/450 Series

The supported interoperability among various 450m/450i/450 Series hardwares are listed below:

Table 9 Supported Interoperability for PMP

Band	AP	SM
5.1, 5.2 and 5.9 GHz	PMP 450m AP	PMP 450i SM, PMP 450b SM
4.9, 5.1, 5.2 and 5.9 GHz	PMP 450i AP	PMP 450i SM, PMP 450b SM
5.4 and 5.8 GHz	PMP 450m AP	PMP 450i SM, PMP 450 SM, PMP 450d SM, and PMP 450b SM
	PMP 450i AP	
	PMP 450 AP	
3.5 and 3.65 GHz	PMP 450 AP	PMP 450 SM, PMP 450i SM
	PMP 450i AP	PMP 450i SM, PMP 450 SM
	PMP 450m AP	PMP 450i SM, PMP 450 SM
2.4 GHz	PMP 450 AP	PMP 450 SM
900 MHz	PMP 450i AP	PMP 450 SM

Table 10 Supported Interoperability for PTP

Band	BH
900 MHz	PTP 450 BHM and BHS
3.5 and 3.65 GHz	PTP 450/450i BHM and BHS
4.9, 5.1, 5.2, 5.4 and 5.8 GHz	PTP 450i BHM and BHS
5.4 and 5.8 GHz	PTP 450/450i BHM and BHS

Typical deployment

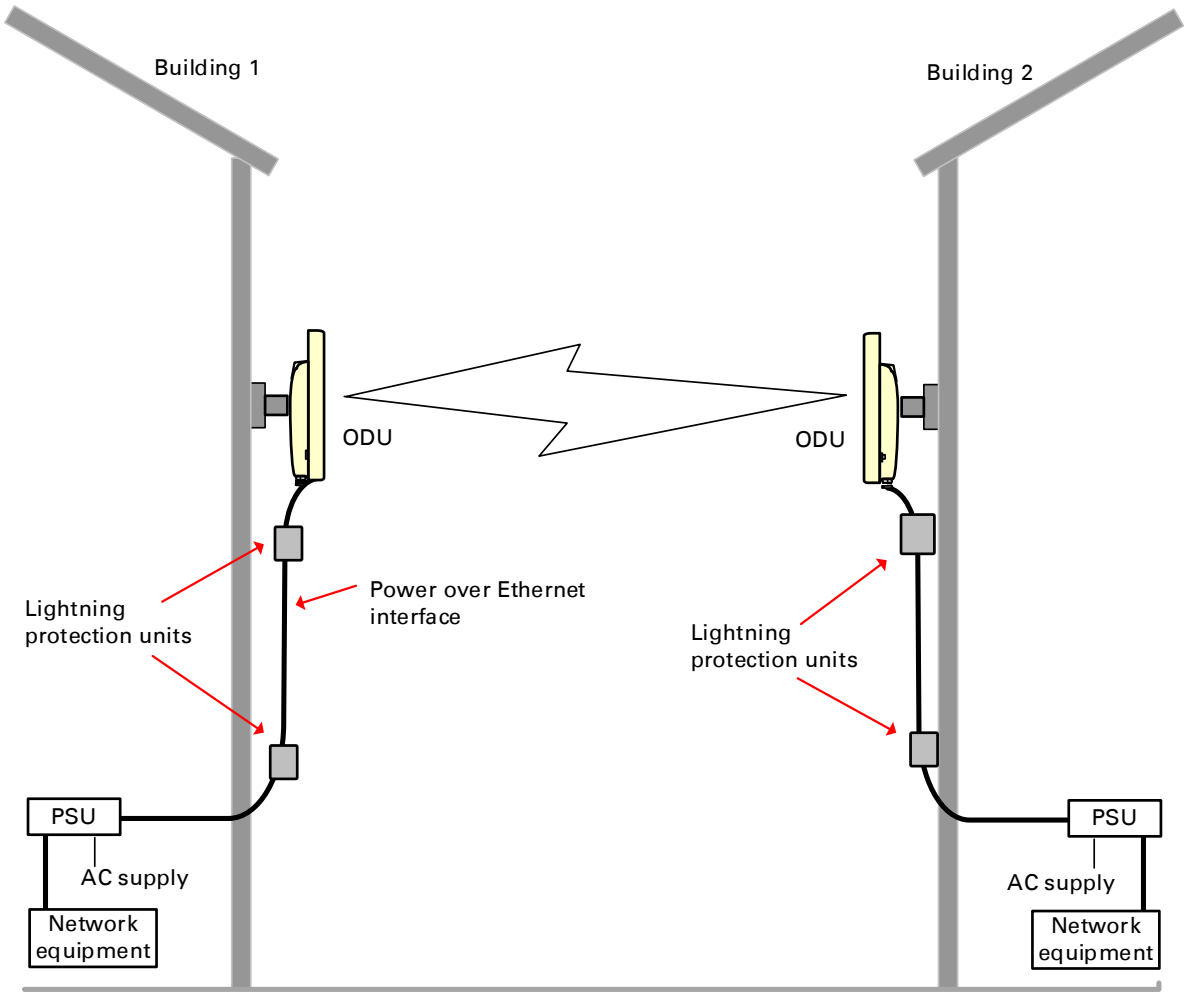
The 450 Platform Family is an "all outdoor" solution consisting of a wireless bridge across sites. Each site installation consists of an Integrated or Connectorized outdoor unit (ODU) and a power supply (PSU) (see Figure 1). The ODU provides the following interfaces:

- Ethernet port: This provides proprietary power over Ethernet and connection to the management and/or data networks.

Note

PMP 450M 3GHz has a separate power and data interface.

Figure 1 PMP/PTP 450 Platform Family typical bridge deployment



Note

Lightning Protection and Power supply differs on 3GHz model.

Point-to-Multipoint

The PMP configuration of 450 Platform Family consists of Access Point (AP) and Subscriber Module (SM) ODU. The radio link operates on a single frequency channel in each direction using Time Division Duplex (TDD). The AP operates in TDMA mode to service multiple SMs.

Applications for the PMP Series include:

- High throughput enterprise applications
- nLOS video surveillance in metro areas
- Urban area network extension
- Network extension into areas with foliage

Point-to-Point (Backhaul)

The PTP configuration of 450 Platform Family consists of two BH (Backhaul) ODUs. The customer can decide, via software configuration, if this unit is a BHM (Backhaul Master) or a BHS (Backhaul Slave). The radio link operates on a single frequency channel using Time Division Duplex (TDD). The BHM operates in TDMA mode to service the BHS.

Applications for the PTP Series include:

- Enterprise Access
- nLOS video surveillance
- Leased line replacements and backup solutions
- Network extension

Product variants

The 450 Platform Family is available in the following product variants:

- The ODU is supplied in the following regional variants:
  - FCC, intended for deployment in the USA
  - EU, intended for deployment in countries of the European Union or other countries following ETSI regulations
  - Rest of the World (RoW), intended for deployment in countries other than USA and EU countries.
  - IC, intended for deployment in Canada
- A ruggedized ODU Subscriber Module designed to meet IP-66 and IP-67 standards to withstand harsh environments
- An integrated Dish ODU Subscriber Module in a new, rugged and high gain design for 5 GHz band
- An indoor power supply module providing Power-over-Ethernet (PoE) supply to ODU (AP/SM/BH)
- 240 W DC power supply unit (PSU) to ODU (3GHz model)
- Antennas and antenna cabling: Connectorized ODUs require external antennas connected using RF cable
- Ethernet cabling: All configurations require a copper Ethernet Cat5e connection from the ODU (Ethernet port) to the PoE
- Lightning protection unit (LPU): LPUs are installed in the ports copper drop cables to provide transient voltage surge suppression
- DC lightning protection unit (LPU) to provide transient voltage surge suppression for 3GHz PMP 450.
- Surge Suppression: The Gigabit Surge Suppressor provides a path to ground (Protective Earth) that protects connected radio equipment from near-miss lightning strikes.
- Ground cables: ODU, LPUs and outdoor copper Ethernet cables are bonded to the site grounding system using ground cables.

For more information about these components, including interfaces, specifications and Cambium part numbers, refer to Chapter 2: System hardware.

Wireless operation

This section describes how the 450 Platform Family wireless link is operated, including modulation modes, power control and security.

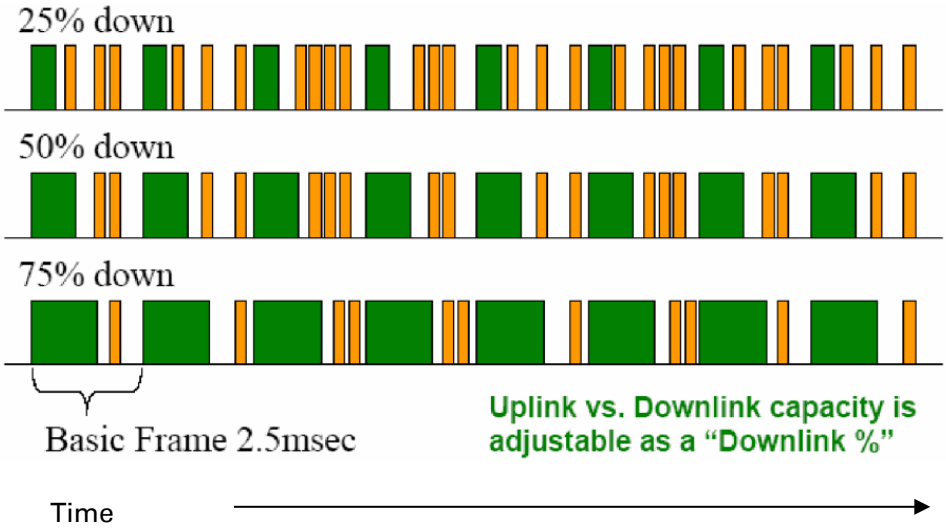
Time division duplexing

The system uses Time Division Duplexing (TDD) – one channel alternately transmits and receives rather than using one channel for transmitting and a second channel for receiving. The radio link operates on a single frequency channel in each direction using TDD. The AP operates in TDMA mode to service multiple SMs. To accomplish TDD, the AP/BHM must provide sync to its SM/BHS. Furthermore, collocated APs/BHMs must be synced together – an unsynchronized AP/BHM that transmits during the receive cycle of a collocated AP/BHM can prevent a second AP/BHM from being able to decode the signals from its APs/BHSs. In addition, across a geographical area, APs/BHMs that can "hear" each other benefit from using a common sync to further reduce self-interference within the network.

Modules use TDD on a common frequency to divide frames for uplink (orange) and downlink (green) usage, as shown in the figure below.

For more information on synchronization configuration options, see GPS synchronization on page 2-55.

Figure 2 TDD frame division



TDD frame parameters

The TDD burst duration varies depending on the following:

- Channel Bandwidth
- Cyclic Prefix
- Frame Period
- Frame configuration - Downlink Data
- Link operation – Dynamic Rate Adaptation

OFDM and channel bandwidth

The PMP/PTP 450 Platform Family 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 the sub-carriers is high. OFDM works exceptionally over a Non-Line-of-Sight (NLoS) channel.

The channel bandwidth of the OFDM signal is configurable to one of the following values: 5, 7, 10, 15, 20, 30, and 40 MHz. Higher bandwidths provide greater link capacity at the expense of using more bandwidth. Systems configured for a narrower channel bandwidth provide better receiver sensitivity and can also be an appropriate choice in deployments where the amount of free spectrum is limited.

Note

The channel bandwidth must be configured to the same value at both ends of the link. Not all channel bandwidths are available in all regulatory bands.

Cyclic Prefix

OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol (slot) to allow multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used. For your convenience, the 450 Platform Family ODUs have been locked to a 1/16 CP.

Frame Period

The frame period or frame duration is the time between the beginning of a frame and the end of the frame. The 450 Platform Family supports two frame periods: 2.5 ms and 5 ms.

The 5ms frame period configuration provides higher throughput as a result of reduced frame overhead during transmission. In turn, the 2.5 ms frame period configuration affords reduced latency in the system, half of that introduced by the 5 ms frame configuration.

Frame configuration - Downlink Data

The percentage of frame assigned to transport downlink data. The downlink data specifies the percentage of the aggregate throughput for the downlink (frames transmitted from the AP/BHM to the subscriber). The configurable range is 15% to 85%.

Note

For all 450 platform APs, the maximum configurable range is 34% to 66% for 40 MHz with 5 ms frame.

Link operation – Dynamic Rate Adapt

The 450 Platform Family ODUs offer eight levels or speeds of operation – 2X MIMO-B and 1X MIMO-A (QPSK), 4X MIMO-B and 2X MIMO-A (16-QAM), 6x MIMO-B and 3X MIMO-A (64-QAM) and 8X MIMO-B and 4X MIMO-A (256-QAM). If received power varies due to distance between the AP/BHM and the SM/BHS or due to obstructions, or if interference affects the RF environment, the system automatically and dynamically adjusts the links to the best operation level.

The system chooses its modulation rate dynamically, based on an internal ARQ (Automatic Repeat reQuest) error control method. With ARQ, every data slot of every frame sent over the air (except downlink broadcast) is expected to be acknowledged by the receiver, and if acknowledgement is not received, the data is resent. The sending unit monitors these re-sends and adjusts the modulation rate accordingly. It is normal to have links that change levels of operation as the RF environment changes. Furthermore, the uplink or downlink portions of TDD duty cycle operate independently.

The various modulation levels used by 450 Platform Family are shown in Table 11.

Table 11 Modulation levels

Rate	MIMO-B	MIMO-A
QPSK	2X MIMO-B	1X MIMO-A
16-QAM	4X MIMO-B	2X MIMO-A
64-QAM	6X MIMO-B	3X MIMO-A
256-QAM	8X MIMO-B	4X MIMO-A

Note

MIMO-A achieves half the throughput of MIMO-B but adds a combining diversity (gain) which enhances the link budget or availability.

Encryption

The 450 Platform Family supports optional encryption for data transmitted over the wireless link. The 450 Platform Family supports the following form of encryption for security of the wireless link:

AES (Advanced Encryption Standard): An over-the-air link encryption option that uses the Rijndael algorithm and 128-bit keys and 256-bit key size to establish a higher level of security than DES. AES products are certified as compliant with the Federal Information Processing Standards (FIPS 197) in the U.S.A.

The default setting on an AP is "Disabled".

MIMO

Multiple-Input Multiple-Output (MIMO) techniques provide protection against fading and increase the probability that the receiver decodes a usable signal. When the effects of MIMO are combined with those of OFDM techniques and a high link budget, there is a high probability of a robust connection over a non-line-of-sight path.

The sub-features that comprises the MIMO techniques utilized in the 450 Platform Family ODUs are:

- MIMO-A: This technique enables 450 Platform Family radio to use a scheme that optimizes coverage by transmitting the same data over both antennas. This redundancy improves the signal to noise ratio at the receiver making it more robust.
- MIMO-B: This technique provides the ability to double the throughput of a radio transmission under proper RF conditions. Different data streams are transmitted simultaneously on two different antennas.

MU-MIMO

Multiple-input multiple-output, or MIMO, is a range of technologies used to multiply the capacity of a wireless connection without requiring more spectrum.

Although traditional MIMO techniques are focused on increasing the bandwidth available between two wireless nodes, multi-user MIMO (MU-MIMO) applies these technologies to increase overall wireless network capacity by allowing an access point to communicate wirelessly with more than one wireless node at once.

A MU-MIMO access point features an array of antennas. When the AP decides to communicate with multiple nodes at the same time, it creates or receives multiple simultaneous beams between each node.

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

A MU-MIMO access point estimates and measures what a transmission from each wireless node ‘sounds like’, by applying knowledge of the wireless path characteristics between the access point and node. Known as channel estimation, this process is of vital importance; without it, the access point cannot distinguish properly between wireless nodes, affecting performance.

Channel estimation is achieved at the access point in the downlink direction by sending a specific signal to a wireless node, which the node then reports back. The uplink channel estimates are made in a similar manner at the access point, by measuring the normal uplink communication to each node. These measurements between the access point and the nodes provide a measure of the wireless conditions and can be applied to other communications to/from the node and is known as channel sounding.

Channel estimation and sounding must be regularly repeated to ensure wireless network performance remains high; the speed at which a system is able to accurately estimate the channel has a large impact on performance.

Once channel estimation is completed for a wireless node, the MU-MIMO access point can electrically tune each antenna to provide the highest performance for that node. The access point uses beamforming to create a radio beam to that node which is tuned for optimum performance and avoids beams directed to other nodes, reducing interference and helping to improve overall wireless network capacity.

A MU-MIMO access point can communicate to multiple wireless nodes simultaneously using this process. As the majority of nodes are unable to make full use of the whole access point capacity at once, communicating with several nodes simultaneously can greatly improve the overall capacity achieved in the wireless network.

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System management

This section introduces the 450 Platform Family management system, including the web interface, installation, configuration, alerts and upgrades.

Management agent

The 450 Platform Family radios are 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/BHS)

The management agent supports the following interfaces:

- Hypertext transfer protocol (HTTP)
- Hypertext transfer protocol secure (HTTPS)
- RADIUS authentication
- Simple network management protocol (SNMP) – v2c and v3
- Network time protocol (NTP)
- System logging (Syslog)
- Wireless Manager (WM) software
- Canopy Network Updater Tool (CNUT) software
- cnMaestro™

Web server

The 450 Platform Family management agent contains a web server. The web server supports access via the HTTP/HTTPS interface.

Web-based management offers a convenient way to manage the 450 Platform Family radios from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web and SNMP are the interfaces supported for installation of 450 Platform Family radios and for the majority of configuration management tasks.

Web pages

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

Access Point or Backhaul Master:

- Home
- Configuration
- Statistics
- Tools
- Logs
- Accounts
- Quick Start
- Copyright

Subscriber Module or Backhaul Slave

- Home
- Configuration
- Statistics
- Tools
- Logs
- Accounts
- PDA
- Copyright

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, who has full read and write permissions. This is the level of the root and admin users, as well as any other administrator accounts that one of them creates.
- INSTALLER, who has permissions identical to those of ADMINISTRATOR except that the installer cannot add or delete users or change the password of any other user.
- TECHNICIAN, who has permissions to modify basic radio parameters and view informational web pages
- GUEST, who has no write permissions and only a limited view of General Status tab
- Admin, Installer and Tech accounts can be configured as READ-ONLY. This will allow the account to only see the items.

See Managing module access by passwords for detailed information on account permissions.

Remote Authentication Dial-in User Service (RADIUS)

The PMP configuration of 450 Platform Family includes support for RADIUS (Remote Authentication Dial In User Service) protocol functionality including:

- SM Authentication: Allows only known SMs onto the network (blocking "rogue" SMs), and can be configured to ensure SMs are connecting to a known network (preventing SMs from connecting to "rogue" APs). RADIUS authentication is used for SMs, but not used for APs.
- SM Configuration: Configures authenticated SMs with MIR (Maximum Information Rate), High Priority, and VLAN (Virtual LAN) parameters from the RADIUS server when a SM registers to an AP.
- **User Authentication** allows users to configure a separate User authentication server along with the SM authentication server. If firmware is upgraded while using this functionality and no User authentication servers are configured, then AP continues to use the SM authentication server for User authentication
- SM Accounting provides support for RADIUS accounting messages for usage-based billing. This accounting includes indications for subscriber session establishment, subscriber session disconnection, and bandwidth usage per session for each SM that connects to the AP.
- Centralized AP and SM user name and password management: Allows AP and SM usernames and access levels (Administrator, Installer, Technician and Read-Only) to be centrally administered in the RADIUS server instead of on each radio and tracks access events (logon/logoff) for each username on the RADIUS server. This accounting does not track and report specific configuration actions performed on radios or pull statistics such as bit counts from the radios. Such functions require an Element Management System (EMS) such as Cambium Wireless Manager. This accounting is not the ability to perform accounting functions on the subscriber/end user/customer account.
- Framed-IP-Address: Operators may use a RADIUS server to assign management IP addressing to SM modules. SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v2c and SNMP v3 using Management Information Base (MIB) files which are available for download from the Cambium Networks Support website:

https://support.cambiumnetworks.com/files/ptp450

https://support.cambiumnetworks.com/files/pmp450

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. The 450 Platform Family radios may receive NTP data from a CMM4 module or an NTP server configured in the system's management network.

The Time Zone option is configurable on the AP's/BHM's Time Configuration page, and may be used to offset the received NTP time to match the operator's local time zone. When set on the AP/BHM, the offset is set for the entire sector (AP/BHSs is notified of the current Time Zone upon initial registration). If a Time Zone change is applied, the AP/BHSs are notified of the change in a best effort fashion, meaning some AP/BHSs may not pick up the change until the next re-registration. Time Zone changes are noted in the Event Log.

An AP/BHM which is receiving NTP date and time information from an NTP server or from a GPS synchronization source may be used as an NTP server. Any client which has IP connectivity to the BHM may request NTP date and time information from the AP/BHM. No additional configuration (other than the AP/BHM receiving valid NTP data) is required to use the AP/BHM as an NTP server.

Wireless Manager (WM)

Cambium Networks Wireless Manager 4.0 is recommended for managing 450 Platform Family networks. You can achieve better uptime through better visibility of your network with the Cambium Wireless Manager. This network management software tool offers breakthrough map-based visualization capabilities using embedded Google maps, and combined with advanced configuration, provisioning, alerting and reporting features you can control your entire outdoor wireless network including Point-to-Multipoint and Point-to-Point solutions as well as other SNMP enabled devices. With its powerful user interface, you can not only be able to control your network's access, distribution and backhaul layers, but can also have visibility to WLAN sites and be able to quickly launch indoor network management systems. Some key features of Wireless Manager are:

- **Template-Based Configuration**: With Wireless Manager's user-defined templates you can accelerate the process for the configuration of the devices you add to your network resulting in quicker and easier deployments. The template-based functionality provides an automated way to configure large numbers of network devices with just a few mouse clicks and can be scheduled to occur at any time via Wireless Manager's Task Scheduler.
- **Ultralight Thin Client**: With the growing mobile workforce it is important to have access to the status of your network at any time. With Wireless Manager you can view the status and performance of your entire wireless network via a compact web interface accessible by your smart phone.
- **Map-Based Visualization**: Wireless Manager overlays sophisticated real-time information about your network elements onto building layouts and dynamic Google maps. Visuals can be scaled to view an entire city or building or a specific area, floor or link.
- **High Availability Architecture Support**: Wireless Manager offers a high availability option, providing a highly reliable and redundant network management solution that ensures you always have management access to your network.
- **High Scalability**: The enhanced Wireless Manager offers you server scalability with support for up to 10,000 nodes as well as support for distributed server architecture.

Cambium's Wireless Manager 4.0 available for download at:

https://www.cambiumnetworks.com/products/software-tools/wireless-manager/

Canopy Network Updater Tool (CNUT)

CNUT (Canopy Network Updater Tool) is the stand-alone software update tool for 450 Platform Family ODUs. The CNUT 4.11.2 should be used for 450 Platform Family ODUs.

The Canopy Network Updater Tool has the following features:

- Automatically discovers all network elements
- HTTP and HTTPS
- Executes UDP command that initiates and terminates the Auto-update mode within APs/BHMs. This command is both secure and convenient:
  - For security, the AP/BHM accepts this command from only the IP address that specified in the Configuration page of ODU.
  - For convenience, Network Updater automatically sets this Configuration parameter in the AP/BHM to the IP address of the Network Updater server when the server performs any of the update commands.
- Allows you to choose among updating:
  - Entire network.
  - Only elements that you select.
  - Only network branches that you select.
- Provides a Script Engine that you can use with any script which:
  - The user can define.
  - Cambium supplies.

CNUT is available at:

https://www.cambiumnetworks.com/products/management/cambium-network-updater-tool/

cnMaestro™

cnMaestro™ is a cloud-based or on-premises platform specialized for secure, end-to-end network lifecycle management: inventory management, device onboarding, daily operations, and maintenance. The cnMaestro wireless network manager simplifies device management by offering full network visibility. Network operators can have a real-time view of their complete end-to-end network and perform a full suite of wireless network management functions to optimize system availability, maximize throughput, and meet emerging needs of business and residential customers. In addition, the cnMaestro wireless network manager collects and displays compliance with service level agreements.

To learn about cnMaestro™, please visit http://www.cambiumnetworks.com/products/software-tools/cnmaestro/

See Configuring cnMaestroTM Connectivity on 7-265 for details.

Radio recovery mode

The 450 Platform Family recovery mode provides a means to recover from serious configuration errors including lost or forgotten passwords and unknown IP addresses.

The recovery procedure for 450m/450i/450b series and 450 series ODUs differ due to difference in hardware. This procedure for 450i/450m Series is known as Radio Recovery Console and for 450 Series is known as Default mode (or Default/Override Plug).

Radio Recovery Console – 450i, 450b and 450m Series

The Radio Recovery Console mode supports:

- Restoring factory default IP address 169.254.1.1 and password
- Boot with factory default Canopy system software settings
- Load previously installed SW images

See Radio Recovery Console– PMP/PTP 450i/450b and PMP 450m on page 9-42.

Default Mode (or Default Plug) – 450 Series

A default plug is available to provide access to a module whose password and/or IP address have been forgotten.

This plug allows the 450 Series ODUs to be accessed using IP address 169.254.1.1 and no password. During the override session, you can assign any new IP address and set either or both user passwords (display-only and/or full access) as well as make other parameter changes.

See Default Mode (or Default/Override Plug) - PMP/PTP 450 on page 9-44.

Chapter 2: System hardware

This chapter describes the hardware components of a 450 Platform link.

The following topics are described in this chapter:

- System Components on page 2-2 describes system components of PTP and PMP including its accessories
- Cabling on page 2-38 describes about various cables.
- Lightning protection unit (LPU) and grounding kit on page 2-47 describes about lightning protection and grounding kit
- Antennas and antenna cabling on page 2-52 describes supported antennas and its accessories
- GPS synchronization on page 2-55 describes UGPS and CMM4.
- Ordering the components on page 2-71 specifies Cambium part numbers for 450 Platform Family components

System Components

Point-to-Multipoint (PMP)

The PMP radio is a transceiver device. It is a connectorized or radiated outdoor unit containing all the radio, networking, and surge suppression electronics. It can be purchased as:

- Access Point Module (AP)
- Subscriber Module (SM)

PMP 450 Platform Family Integrated or Connectorized ODU

The PMP 450i Series and PMP 450 Series ODUs are supplied in Integrated or Connectorized configurations. The PMP 450m Series AP is supplied in Integrated configuration only.

See Table 2 PMP 450m Series hardware configurations on page 1-4

See Table 4 PMP/PTP 450i Series hardware configurations on page 1-6

See Table 6 PMP/ PTP 450b Series hardware configurations on page 1-9

See Table 8 PMP/PTP 450 Series hardware configurations on page 1-11

Product variants

Table 12 PMP 450m Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max EIRP
5 GHz PMP 450m AP	FCC	90° integrated sector array, 14x14 MIMO system,	5150 – 5925 MHz	5, 10, 15, 20, 30, 40 MHz	42 dBm
	RoW				
	EU				
	IC				
3 GHz PMP 450m AP	Global Global (No Encryption)	90° integrated sector array, 8x8 MIMO system,	3300 – 3900 MHz	5, 7, 10, 15, 20, 30, 40 MHz	55 dBm

Table 13 PMP 450i Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max Tx Power
900 MHz PMP 450i AP	FCC	Connectorized	902 - 928 MHz	5, 7, 10, 15, 20 MHz	25 dBm
3 GHz PMP 450i AP	FCC, RoW, Canada, RoW DES, Europe	Connectorized Integrated 16 dBi	3300 – 3900 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
5 GHz PMP 450i AP	FCC, RoW, Canada, RoW DES, Europe	Connectorized Integrated 16 dBi 90 degree	4900 – 5925 MHz	5, 10, 15, 20, 30, 40 MHz	27 dBm

Table 14 PMP 450b Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max Tx Power
5 GHz PMP 450b SM	FCC, RoW, Canada, RoW DES, Europe	16 dBi integrated 23 dBi dish	4900 – 5925 MHz	5, 10, 15, 20, 30, 40 MHz	27 dBm

Note

The Transmit power is limited based on regional setting.

Table 15 PMP 450 Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max Tx Power
900 MHz PMP 450 SM	FCC	Connectorized	902 - 928 MHz	5, 7, 10, 15, 20 MHz	25 dBm
2.4 GHz PMP 450 AP	FCC ISM	Connectorized	2400 – 2483.5 MHz	5, 10, 15, 20 MHz	22 dBm
		Integrated 18 dBi			
2.4 GHz PMP 450 SM	FCC ISM	Connectorized	2400 – 2483.5 MHz	5, 10, 15, 20 MHz	22 dBm
		Integrated 7 dBi			
3.5 GHz PMP 450 AP	FCC ISM	Connectorized	3300 – 3600 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 16 dBi			
3.5 GHz PMP 450 SM	FCC ISM	Connectorized	3300 – 3600 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 8 dBi			
		Integrated 19 dBi			
3.65 GHz PMP 450 AP	FCC ISM	Connectorized	3500 – 3850 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 16 dBi			
3.65 GHz PMP 450 SM	FCC ISM	Connectorized	3500 – 3850 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 8 dBi			
		Integrated 19 dBi			
5.4/5.8 GHz PMP 450 AP	FCC, RoW, RoW DES	Connectorized	5470 – 5875 MHz	5, 10, 15, 20, 30, 40 MHz (5, 15 and 30 MHz not available in DFS regions)	22 dBm
		Integrated 17 dBi			
5.4/5.8 GHz PMP 450 SM	FCC, ROW, RoW DES	Connectorized	5470 – 5875 MHz	5, 10, 15, 20, 30, 40 MHz (5, 15 and 30 MHz not available in DFS regions)	22 dBm
		Integrated 9 dBi			
		Integrated 25 dBi			

Note

The Transmit power is limited based on regional setting.

Backhaul (PTP)

The Backhaul radio is a transceiver device. It is a connectorized or integrated outdoor unit containing all the radio, networking, and surge suppression electronics. It can be configured as:

- Backhaul Master (BHM)
- Backhaul Slave (BHS)

PTP 450 Platform Family Integrated or Connectorized ODU

See Table 4 PMP/PTP 450i Series hardware configurations on page 1-6

See Table 8 PMP/PTP 450 Series hardware configurations on page 1-11

Product variants

Table 16 PTP 450i Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max Tx Power	Notes
3 GHz PTP 450i	FCC, RoW, Canada, Row DES, Europe	Connectorized Integrated 23 dBi	3300 - 3900 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm	Transmit power limited based on regional setting
5 GHz PTP 450i	FCC, RoW, Canada, Row DES, Europe	Connectorized Integrated 23 dBi	4900 – 5925 MHz	5, 10, 15, 20, 30, 40 MHz	27 dBm	Transmit power limited based on regional setting

Table 17 PTP 450 Series variants

Variant	Region	Antenna	Frequency Range	Channel Bandwidth	Max Tx Power
900 MHz PTP 450 BH	FCC	Connectorized	902 – 928 MHz	5, 7, 10, 15, 20 MHz	25 dBm
3.5 GHz PTP 450 BH	ROW	Connectorized	3300 – 3600 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 16 dBi			
		Integrated 19 dBi			
3.65 GHz PTP 450 BH	ROW	Connectorized	3500 – 3850 MHz	5, 7, 10, 15, 20, 30, 40 MHz	25 dBm
		Integrated 16 dBi			
		Integrated 19 dBi			
5.4/5.8 GHz PTP 450 BH	FCC, RoW, RoW DES	Connectorized	5470 – 5875 MHz	5, 10, 15, 20, 30, 40 MHz	22 dBm
		Integrated 9 dBi			
		Integrated 25 dBi			

Note

The Transmit power is limited based on regional setting.

450 Platform Family interfaces

PMP 450m Series interfaces – AP – 3GHz

The 3 GHz 450m Series AP interfaces is illustrated below.

Figure 3 3GHz PMP 450m Series interfaces

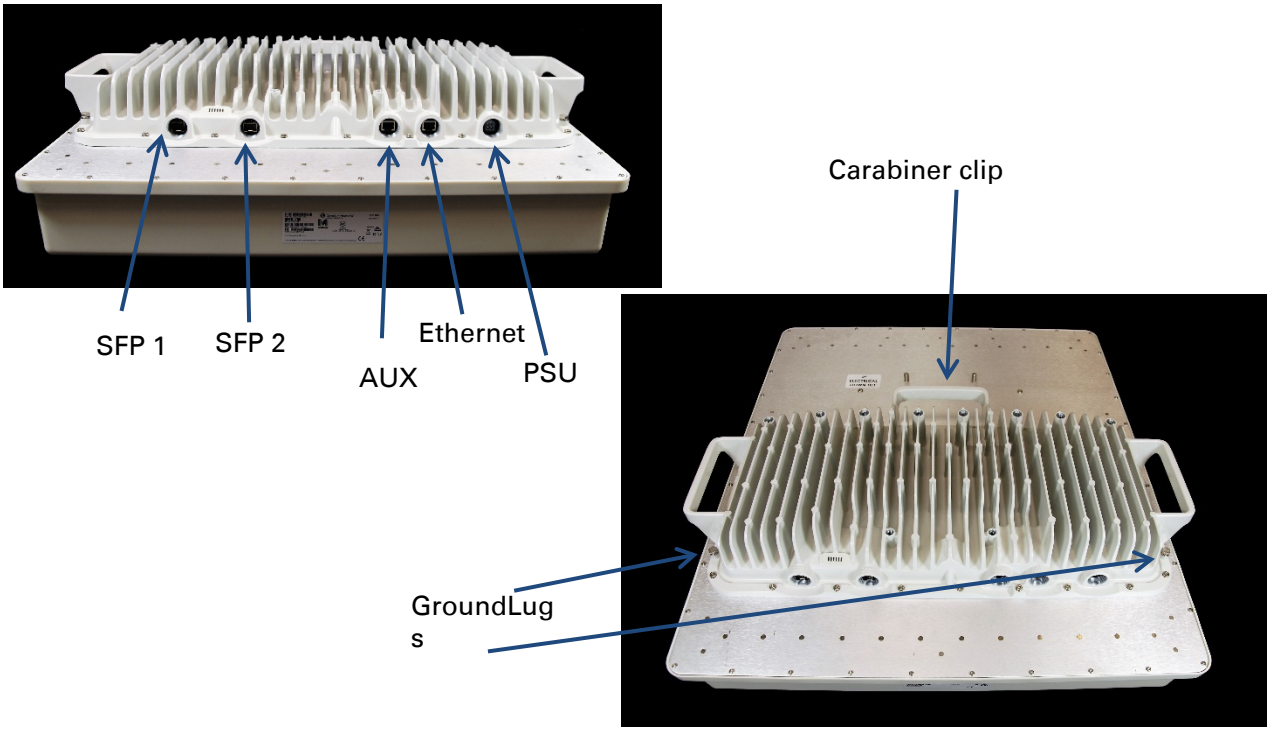


Table 18 PMP 3GHz 450m Series AP interface descriptions and cabling

Interface	Function	Cabling
PSU	DC power input, 40 V – 60 V, plus Cambium Sync-over-power	4-core (2 twisted pairs)
Ethernet	10/100/1000Base-T Ethernet, plus Cambium Sync-over-data	CAT5e
AUX	10/100Base-T Ethernet with PoE out	CAT5e
	UGPS synchronization port	
	Audio tones	
SFP 1	SFP module	Fibre or copper
SFP 2	SFP module (single or dual)	Fibre or copper
Ground Lugs	For grounding the unit	10 AWG copper wire

PMP 450m Series interfaces – AP – 5GHz

The 5GHz 450m Series AP interfaces is illustrated below.

Figure 4 5GHz PMP 450m Series interfaces

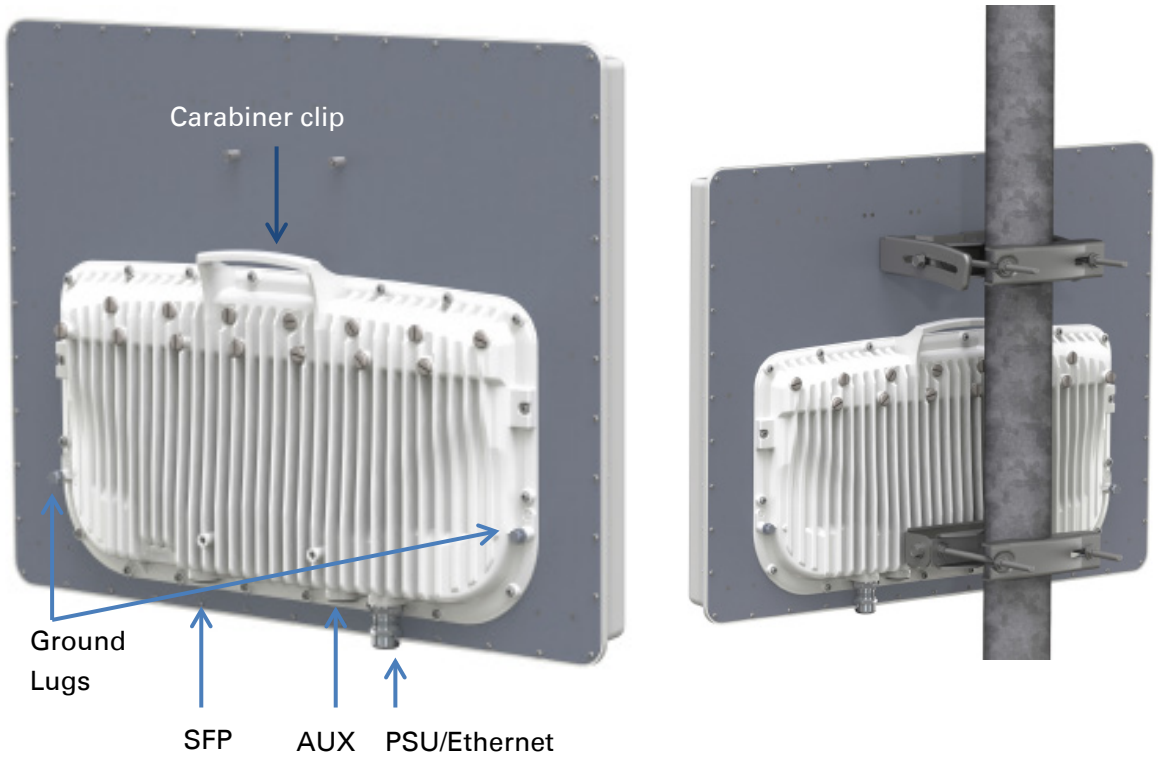


Table 19 PMP 5GHz 450m Series AP interface descriptions and cabling

Interface	Function	Cabling
PSU/Ethernet	Power-over-Ethernet, Ethernet communications (management and data), CMM5 sync-over-power synchronization input	RJ45 Cable See Table 106 on page 5-12
Aux/Sync	GPS synchronization input and output, UGPS power output	RJ 45 Cable See Table 107 on page 5-12
	Audio tones	
	Data	
SFP	Read Ethernet communications (management and data)	
Ground Lugs	For grounding the unit	10 AWG copper wire

Note

For PMP 450m AP, the Sync-Over-Power is supported with CMM5 only.

For PMP 450m AP, the Sync-Over-Power will not work with CMM4 like PMP 450/450i Series.

Note

SFP kits (Single Mode Optical SFP Interface per ODU (part number C000065L008A), Multi-mode Optical SFP Interface per ODU (part number C000065L009A), and 2.5GBASE-T Copper SFP Interface per ODU (part number C000065L011A)) are required for SFP port connectivity.

PMP/PTP 450i Series interfaces – AP/SM/BH

The AP/SM/BH interfaces are illustrated below.

Figure 5 PMP/PTP 450i interfaces

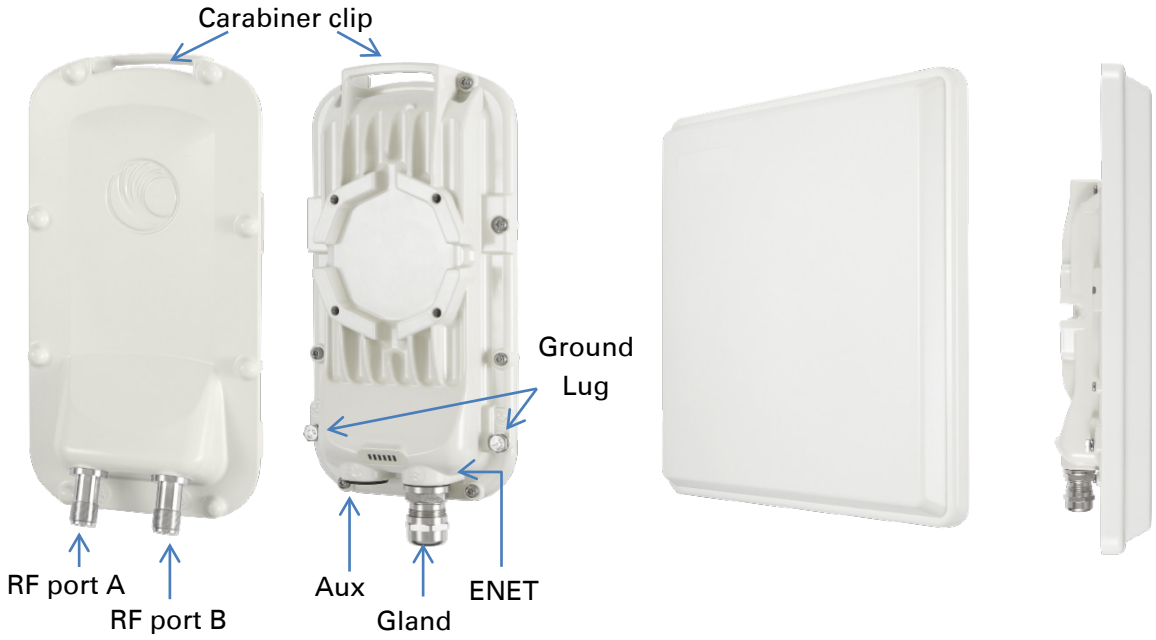


Table 20 PMP/PTP 450i Series - AP/SM/BH interface descriptions and cabling

Interface	Function	Cabling
PSU/Ethernet	Power-over-Ethernet, Ethernet communications (management and data), CMM sync-over-power synchronization input	RJ45 Cable See Table 106 on page 5-12
Aux/Sync	GPS synchronization input and output, UGPS power output	RJ 45 Cable See Table 107 on page 5-12
	Audio tones	
	Data	
RF Port A	Vertical RF connection to antenna	50 ohm RF cable, N-type
RF Port B	Horizontal RF connection to antenna	50 ohm RF cable, N-type
Ground Lugs	For grounding the unit	10 AWG copper wire

Note

If the Aux port will be used, a second Ethernet Gland will need to be ordered (Part Number: N000065L033A).

PMP 450b Mid-Gain Series interfaces - SM

The **PMP 450b Series - SM** interfaces are illustrated below.

Figure 6 PMP 450b Mid-Gain Series - SM interfaces

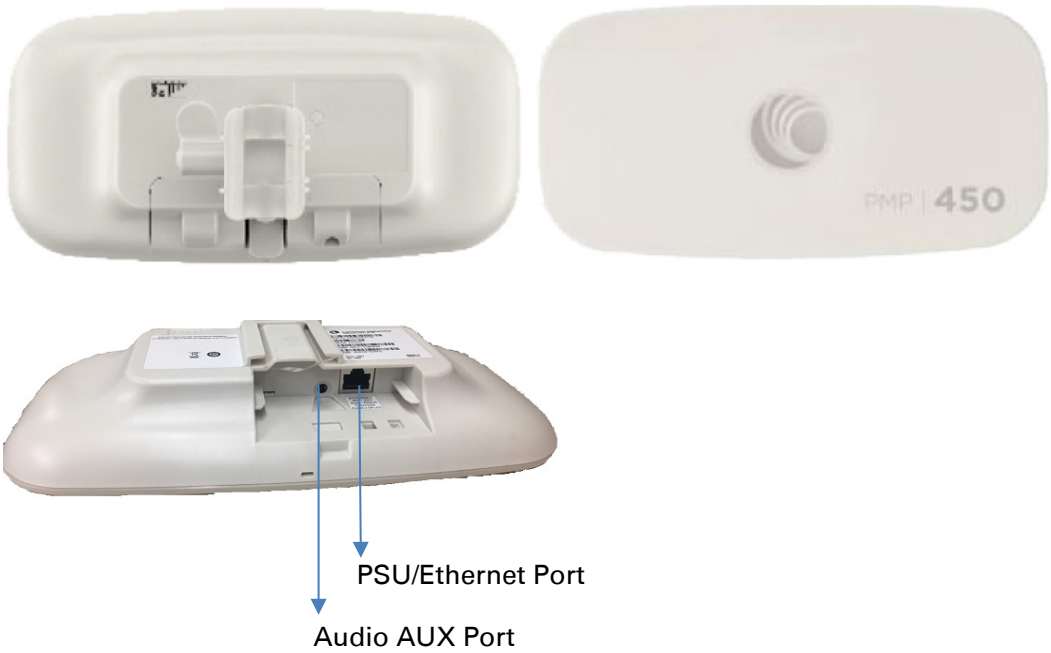


Table 21 PMP 450b Series - SM (Mid-Gain) interface descriptions and cabling

Interface	Function	Cabling
PSU/Ethernet	Power-over-Ethernet, Ethernet communications (management and data)	RJ45 Cable
Audio AUX Port	3.5 mm audio jack for alignment tone	Standard 3.5 mm TRRS headphones

PMP 450b High Gain Series interfaces - SM

The **PMP 450b Series - SM** interfaces are illustrated below.

Figure 7 PMP 450b Series - SM interfaces (High Gain)

Table 22 PMP 450b Series - SM (High Gain) interface descriptions and cabling

Interface	Function	Cabling
PSU/Ethernet	Power-over-Ethernet, Ethernet communications (management and data)	RJ45 Cable
Audio AUX Port	3.5 mm audio jack for alignment tone	Standard 3.5 mm TRRS headphones

PMP/PTP 450 Series interfaces - AP

The **PMP 450 Series - AP** interfaces are illustrated below.

Figure 8 PMP/PTP 450 Series - AP interfaces

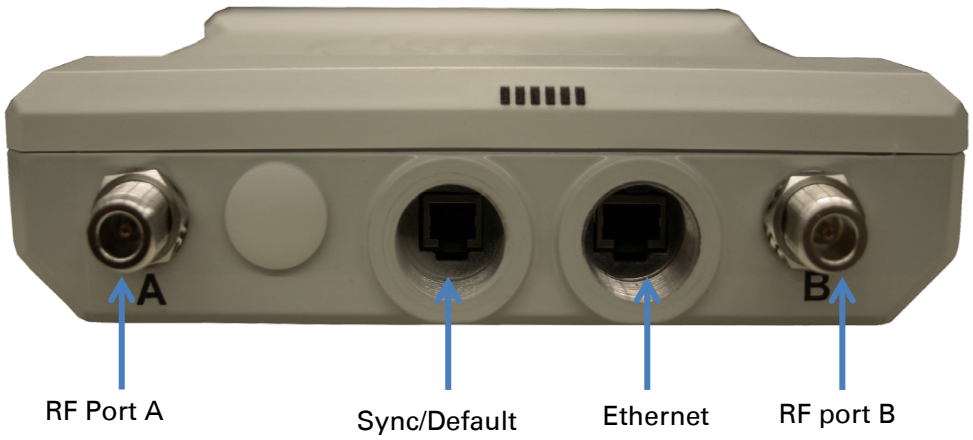


Table 23 PMP/PTP 450 Series - AP interface descriptions and cabling – 2.4 GHz and 5 GHz

Interface		Function	Cabling
PSU/Ethernet		Power-over-Ethernet, Ethernet communications (management and data)	RJ45 Cable
Sync/Default		GPS synchronization signaling, provides power to UGPS module. Default plug port.	RJ11 cable, default plug.
RF Port A	2.4 GHz	-45 degree RF connection to AP antenna	50 ohm RF cable, N-type
	5 GHz	Vertical RF connection to AP antenna	
RF Port B	2.4 GHz	+45 degree RF connection to AP antenna	50 ohm RF cable, N-type
	5 GHz	Horizontal RF connection to AP antenna	
Ground Lugs		For grounding the unit	10 AWG copper wire

PMP/PTP 450 Series interfaces – SM/BH

The **PMP 450 Series SM/BH** interfaces are illustrated below.

Figure 9 PMP/PTP 450 Series – SM/BH interfaces

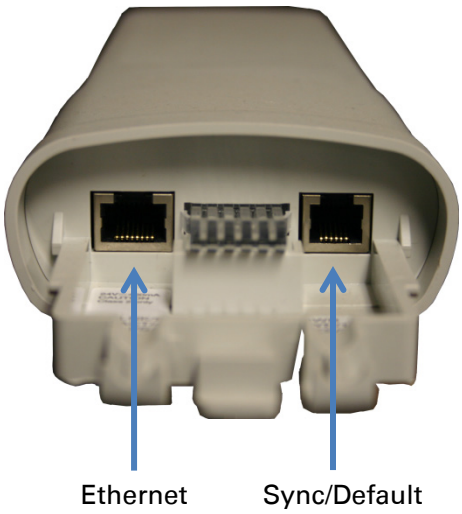


Figure 10 PMP/PTP 450 Series – SM/BH Connectorized interfaces

Note

As per Underwriters Laboratory (UL) guidelines, the Ground Lug on the radiated SM is not required.

Figure 11 PMP 450d Series - SM Integrated Dish

Figure 12 PMP 450 Series – SM 3 GHz Integrated

Figure 13 PTP 450 Series – BHM/BHS

ATEX/HAZLOC variants

PTP/PMP 450i series products are available in ATEX/Hazloc variants for operation in locations where explosive gas hazards exist, as defined by Hazloc (USA) and ATEX (Europe). ATEX/HAZLOC variants are similar to the standard product except that:

- ODUs are supplied with the Full capacity license
- The frequency range is restricted to 4940 MHz to 5850 MHz
- The maximum EIRP generated by ODU is restricted to comply with the ATEX and HAZLOC standards

In order to meet specific radio regulations in the USA, Canada and the EU, Cambium supplies products approved for USA, Canada, EU and the rest of the world under different models and part numbers. These models and part numbers are shown in

Table 68 and Table 69.

Diagnostic LEDs

The diagnostic LEDs of 450 Platform Family ODUs are as shown below.

Note

The colors shown in the diagram may differ from the actual color displayed by the AP/BHM, depending on its current status.

AP/BHM LEDs

The diagnostic LEDs report the information about the status of the AP/BHM.

Figure 14 AP/BHM diagnostic LEDs, viewed from unit front

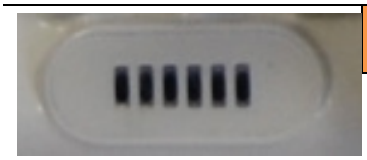
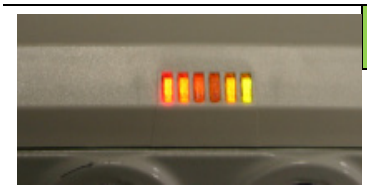
ODU LED Display	LED Labels					
PMP 450m Series - AP						
	MAIN LNK+ACT/5	AUX LNK+ACT/4	GPS/3	SES/2	SYN/1	PWR
PMP/PTP 450i Series - AP/BHM						
	MAIN LNK/5	ACT/4	GPS/3	SES/2	SYN/1	PWR
PMP/PTP 450 Series - AP/BHM						
	MAIN LNK/5	ACT/4	GPS/3	SES/2	SYN/1	PWR

Table 24 AP/BHM LED descriptions

LED	Color when active	Status information provided	Notes
PWR	Red	DC power	Always lit after 10-20 seconds of power on.
SYN/1	Yellow	Presence of sync	-
SES/2	Green	Unused	-
GPS/3	Red	Pulse of sync	Lit when the AP/BHM is getting a sync pulse from a GPS source goes along with SYN/1
ACT/4	**For 450 and 450i Series** Yellow	Presence of data activity on the Ethernet link	Flashes during data transfer. Frequency of flash is not a diagnostic indication.
AUX LNK + ACT/4	**For 450m Series** Red/ Green (bi-colored for 10/100)	Aux port link speed and activity	Flashes to indicate Ethernet activity on Aux port. Indicates speed based on the following colors: 10Base-T : Red 100Base-T : Green
MAIN LNK/5	**For 450i Series** Red/ Green/Orange (bi-colored for 10/100/1000)	Activity on Main port link	Continuously lit when link is present. Indicates speed based on the following colors: 10Base-T : Red 100Base-T : Green 1000Base-T : Orange
	For 450 AP Orange/Green/Yellow (10/100/1000)	Ethernet link	Continuously lit when link is present. 10Base-T : Orange 100Base-T : Green 1000Base-T : Yellow
	For 450 BHM Green		Continuously lit when link is present. 10Base-T : Green 100Base-T : Green
MAIN LNK + ACT/5	**For 450m Series** Red/ Green/Orange (bi-colored for 10/100/1000)	Main port link speed and activity	Flashes to indicate data transfer speed and activity.

SM/BHS LEDs

The SM/BHS LEDs provide different status of radio based on the operating modes. A SM/BHS in "operating" mode registers and passes traffic normally. A SM/BHS in "aiming" mode does not register or pass the traffic, but displays (via LED panel) the strength of received radio signals (based on radio channel selected via **Tools -> Alignment**).

Figure 15 AP/BH diagnostic LEDs, viewed from unit front

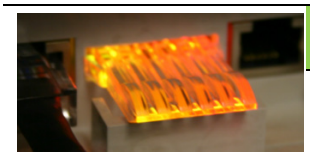
ODU LED Display	LED Labels					
PMP/PTP 450i Series - SM/BHS						
	MAIN LNK/5	ACT/4	GPS/3	SES/2	SYN/1	PWR
PMP 450b Mid-Gain Series - SM						
	LNK/SPD/ ACT/4	GPS/3	SES/2	SYN/1	STDBY/ PWR	
PMP 450b High Gain Series - SM						
	LNK/SPD/ ACT/4	GPS/3	SES/2	SYN/1	STDBY/ PWR	
PMP/PTP 450 Series - SM/BHS						
	MAIN LNK/5	ACT/4	GPS/3	SES/2	SYN/1	PWR

Table 25 SM/BHS LED descriptions

		Status information provided		
LED	**Color when active**	**SM / BHS in "Operating" Mode**	**SM / BHS in "Aiming" Mode**	**Notes**
PWR	Red	DC power	DC power	Always lit after 10-20 seconds of power on.
STDBY/ PWR	Yellow/Blue			Flashes Yellow during boot-up. Flashes Blue when operating.
SYN/1	Yellow	Presence of sync	These three LEDs act as a bar graph to indicate the relative quality of alignment. As power level improves during alignment, more of these LEDs are lit.	Lit when SM/BHS is in sync with an AP/BHM.
SES/2	Green	Session Indicator		Lit when SM/BHS is in session.
GPS/3	Red	Unused		Unused
ACT/4	Yellow	Presence of data activity on the Ethernet link	Presence of data activity on the Ethernet link	Flashes during data transfer. Frequency of flash is not a diagnostic indication.
LNK/SP D/ACT/4	**For 450b Series** Red/Green/Ora nge (10/100/1000)	Ethernet Link	Ethernet Link	Flashes during data transfer. Frequency of flash is not a diagnostic indication. 10Base-T : Red 100Base-T : Green 1000Base-T : Orange
MAIN LNK/5	**For 450i Series** Red/ Green/ Orange (bi-colored for 10/100/1000)	Ethernet link	Ethernet link	Flashes during data transfer. 10Base-T : Red 100Base-T : Green 1000Base-T : Orange
	For 450 Series Green	Ethernet link	Ethernet link	Continuously lit when link is present.

Operating Mode

- Scanning: If the SM/BHS is not registered to AP/BHM, then these three LEDs cycle on and off from left to right (SYN/1, SES/2 and GPS/3).
- Ethernet Link:
  - For 450m AP, the MAIN LNK + ACT/5 LED is active when the Main port link is present and the AUX LNK + ACT/4 LED is active when the Aux port link is present.
  - For 450/450i AP/BHM, the MAIN LNK/5 LED is lit continuously when the link is present.
  - For 450/450i SM/BHS, the MAIN LNK/5 LED is lit continuously when the link is present.
- Data Transfer:
  - For 450m AP, the MAIN LNK + ACT/5 LED flashes to indicate data transfer speed and activity on the Main port and the AUX LNK + ACT/4 LED flashes to indicate data transfer speed and activity on the Aux port.
  - For 450/450i AP/BHM, the ACT/4 LED flashes during data transfer.
  - For 450/450i SM/BHS, the ACT/4 LED flashes during data transfer.
  - For 450b SM, the LNK/SPD/ACT/4 LED flashes during data transfer.

Aiming Mode

The 3 LEDs (SYN/1, SES/2, and GPS/3) are turned into a 3-position bar graph. The more LEDs that are lit, the better the received power the module is seeing. The colors of the LEDS have no particular meaning other than to assist is distinguishing one position from the next.

Power supply options

The 450 Platform Family ODUs are powered over its Main Ethernet cable using Power Over Ethernet (POE). The power injector is connected to the ODU and network terminating equipment using Cat5e cable with RJ45 connectors.

Power supply – PMP 450m Series

The PMP 450m 5GHz - AP supports powering from AC+DC Enhanced Power Injector (see AC+DC Enhanced Power Injector on page 2-25)

- **PSU part numbers**

Table 26 PSU part numbers for PMP 450m AP (5/ 3GHz)

AP- Model	Cambium description	Cambium part number
5GHz	AC+DC Enhanced Power Injector	C000065L002C
3GHz	Power Supply, AC, 54V 240W	N000000L054B

Power supply – PMP/PTP 450i Series

The PMP/PTP 450i Series supports powering from the following powering sources:

- Power Supply, 60 W, 56 V with 1000BASE-T or GigE
- AC+DC Enhanced Power Injector
- Power over Ethernet midspan, 60 W, -48 VDC Input
- CMM4 with external 56 V power supply and CMM4 to 450i Series ODU cable (Dongle)
- IEEE802.3at power injector

Note

The 900 MHz SM is based off of the 450 Series , please see Power supply – PMP/PTP 450 Series on page 2-29.

Warning

Always use an appropriately rated and approved AC supply cord-set in accordance with the regulations of the country of use.

Warning

The PMP 450 Ruggedized High Gain Integrated Subscriber Module (Cambium part numbers C035045C014A and C036045C014A), while encapsulated in a 450i-type enclosure, contains 450 circuitry which must be powered via 30 VDC. Powering these SMs with a 56 VDC will damage the device.

Please refer to Cabling on Page 2-38 for details on maximum cable lengths between power injector and PMP/PTP 450i.

PSU part numbers

Table 27 PSU part numbers for PMP/PTP 450i Series

Cambium description	Cambium part number
Power supply, 60 W, 56 V with Gbps support	N000065L001B
AC+DC Enhanced Power Injector	C000065L002C
Line Cord, Fig 8 – US	N000065L003A
Line Cord, Fig 8 – UK	N000065L004A
Line Cord, Fig 8 – EU	N000065L005A
Power over Ethernet midspan, 60 W, -48 VDC Input	N000000L036A
Power supply, 30 W, 56 V – Gbps support	N000000L034A

○ AC Power Injector N000065L001B

The AC Power Injector interfaces are shown in Figure 16 and described in Table 28.

Figure 16 AC Power Injector interfaces

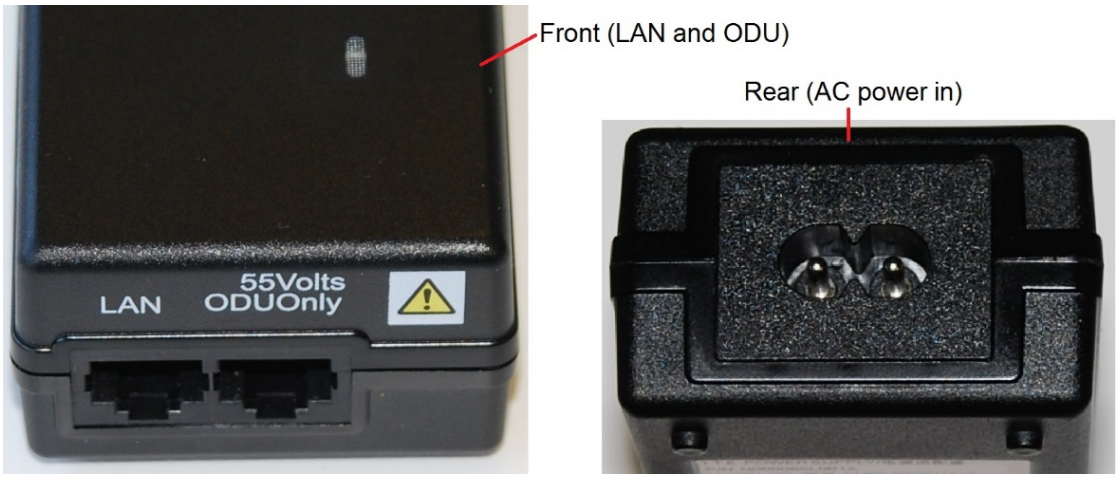


Table 28 AC Power Injector interface functions

Interface	Function
AC power in	AC power input (main supply)
ODU	RJ45 socket for connecting Cat5e cable to ODU
LAN	RJ45 socket for connecting Cat5e cable to network
Power (green) LED	Power supply detection

○ AC+DC Enhanced Power Injector C000065L002C

The AC+DC Enhanced Power Injector interfaces are shown in Figure 17 and described in Table 29.

Figure 17 AC+DC Enhanced Power Injector interfaces

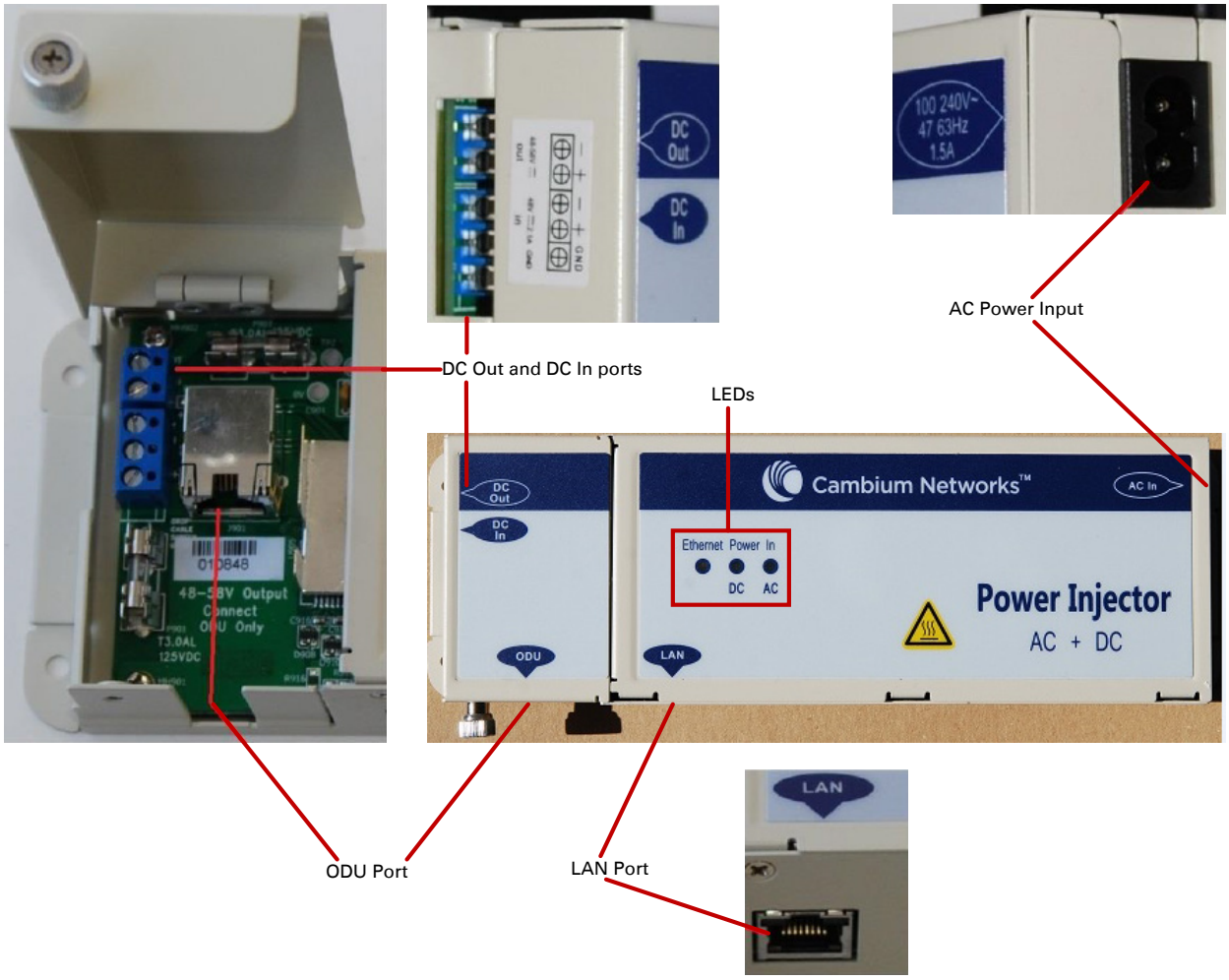


Table 29 AC+DC Enhanced Power Injector interface functions

Interface	Function
100-240V 47-63Hz 1.7A	AC power input (main supply)
DC In	Alternative DC power supply input
DC Out	DC power output to a second PSU (for power supply redundancy) or to a NIDU
ODU	RJ45 socket for connecting Cat5e cable to ODU
LAN	RJ45 socket for connecting Cat5e cable to network
Power - AC (green) LED	Indicates power is applied at the AC power input
Power - DC (green) LED	Indicates power is applied at the DC In port
Ethernet (yellow) LED	Detects Ethernet traffic and it is used with PTP650 and PTP700 families only. It does not operate with the 450 platform products.

Note

The earlier power injector models only had a single power LED that combined the AC+DC indications.

○ -48 VDC Power Injector N000000L036A

The DC Power Injector interfaces are shown in Figure 18 and described in Table 30.

Figure 18 -48 V DC Power Injector interfaces

Table 30 -48V DC Power Injector interfaces

Interface	Function
DC input	36 to 60V, 2A
RJ 45 Sockets	Two (Data In and Data & Power Out)
LEDs	Two (AC and Port)

Power supply – PMP 450b Series

The PMP 450b Series support powering from the following powering sources:

- Gigabit Enet Capable Power Supply – 20 to 32 V DC, 15W
- CMM4 with external 29 V power supply

Figure 19 -20 to 32 VDC Power Injector interfaces

Table 31 -Power Injector interfaces

Interface	Function
PSU/Ethernet	20 to 32 VDC, 2A

o PSU part numbers

Table 32 PSU part numbers for PMP 450b SM

Cambium description	Cambium part number
Gigabit Enet Capable Power Supply - 20 - 32VDC, 15W	N000900L001C

Power supply – PMP/PTP 450 Series

The PMP/PTP 450 Series support powering from the following powering sources:

- Gigabit Enet Capable Power Supply – 30 VDC, 15W
- CMM4 with external 29 V power supply

Warning

The PMP 450 Ruggedized High Gain Integrated Subscriber Module (Cambium part numbers C035045C014A and C036045C014A), while encapsulated in a 450i-type enclosure, contains 450 circuitry which must be powered via 30VDC. Powering these SMs with a 56 VDC will damage the device.

PSU part numbers

Table 33 PSU part numbers for PMP/PTP 450 Series

Cambium description	Cambium part number
Gigabit Enet Capable Power Supply - 30VDC, 15W	N000900L001C
Cable, UL Power Supply Cord Set, US	N000900L007A
Cable, UL Power Supply Cord Set, EU	N000900L008A
Cable, UL Power Supply Cord Set, UK	N000900L009A
Cable, UL Power Supply Cord Set, Brazil	N000900L010A

Gigabit Enet Capable Power Supply

The Gigabit Enet Capable power supply interfaces are described in Table 34. This power supply requires procurement of an AC line cord that connects the outlet of the same (using IEC-60320 Type 5 connector). A list of available power supply cord options from Cambium Networks are given in Table 33.

Table 34 –Gigabit Enet Capable power supply

Interface	Function
AC Input	90-264 VAC, 0.5A rms @120VAC/ 0.25A rms @240VAC, 47 to 63 Hz
DC Output	30.0 Vdc +/-5%, 15W, 500 mA max
RJ 45 Sockets	Two (Data In and Data & Power Out)
LEDs	Green, :LED Intensity determined by Level 5 efficiency

Figure 20 Gigabit Enet Capable power supply

ODU mounting brackets & accessories

The list of supported brackets is provided in Table 35.

- The "Tilt bracket assembly" is the recommended bracket for the AP, SM or BH integrated units.
- The "Mounting Bracket (Connectorized)" can be used where a low profile and ease of assembly of Connectorized AP, SM or BH is required.
- The "Mounting Bracket (Integrated)" provide a wider range of adjustment for AP, SM and BH integrated devices.

Table 35 Accessories part numbers

Cambium description	Cambium part number
Mounting brackets	
Tilt Bracket Assembly	N000045L002A
Mounting Bracket (Integrated)	N000065L031A
Mounting Bracket (Connectorized)	N000065L032A
Miscellaneous	
Ethernet cable adapter for CMM4 (Dongle)	N000045L001A
RJ-45 Gland Spare – PG16 style (QTY 10)	N000065L033A
Blanking Plug Pack (Qty 10)	N000065L036A

Lightning protection

The 450 Platform Family supports the lightning protection units listed in Table 36.

The LPU offers the highest level of protection and is the recommended device. Where low cost deployment is essential, for example for SM in residential application, the Gigabit Surge Suppressor may be used instead.

Table 36 Lightning protection part numbers

Cambium description	Cambium part number
450 Series (Including 450b and 450d)	
Surge Suppressor (30 VDC)	600SSH
450i and 450m Series	
LPU and Grounding Kit (1 kit per ODU)	C000065L007B
Gigabit Surge Suppressor (56 VDC)	C000000L033A
DC-LPU and Grounding Kit (1 kit per ODU)	C000000L114A

ODU interfaces

PMP 450m Series 5GHz AP

These interfaces are described in Table 37.

Figure 21 PMP 450m Series - AP rear interfaces

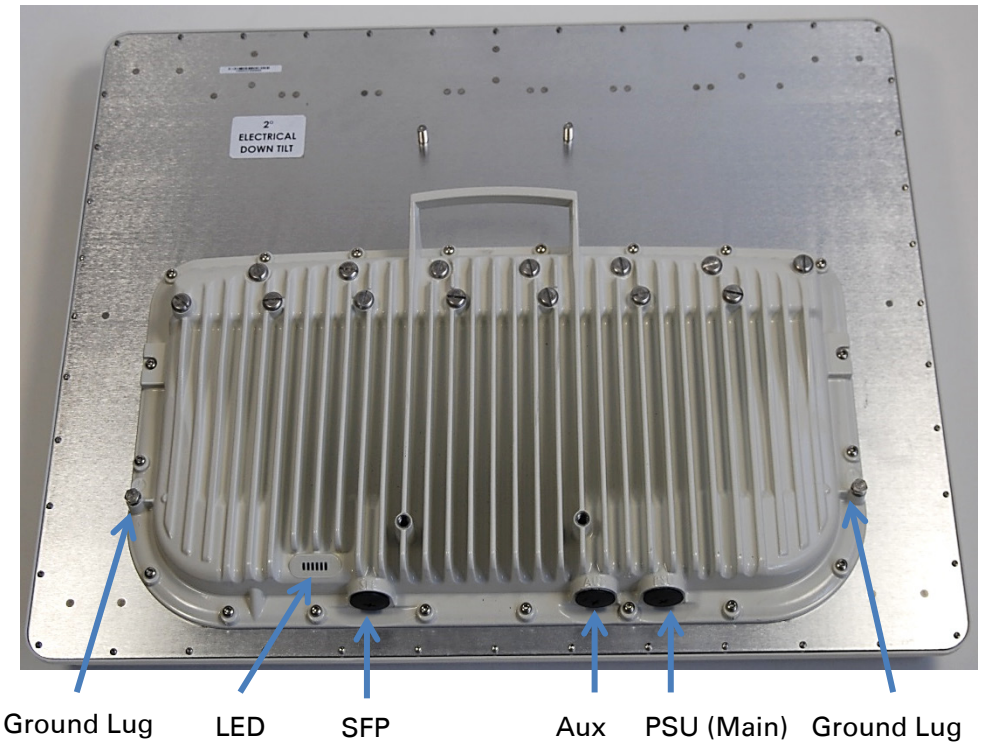


Table 37 PMP 450m Series – AP rear interfaces

Port name	Connector	Interface	Description
PSU (Main)	RJ45	PoE input	Power over Ethernet (PoE).
		10/100/1000 BaseT Ethernet	Data
Aux	RJ45	10/100 BaseT Ethernet	Data
		PoE output	Standard IEEE802.3at PoE.
		Sync input/output	Connection and powering of UGPS Sync input
SFP	SFP	2.5 Gbps Copper and 1 Gbps Fiber Ethernet	Data and Management Services. Plug-in SFP module must be purchased separately.

Ground Lugs	10 AWG copper wire	For grounding the unit

PMP 450m Series 3GHz AP

These interfaces are described in Table 38.

Figure 22 PMP 450m 3GHz - AP rear interfaces

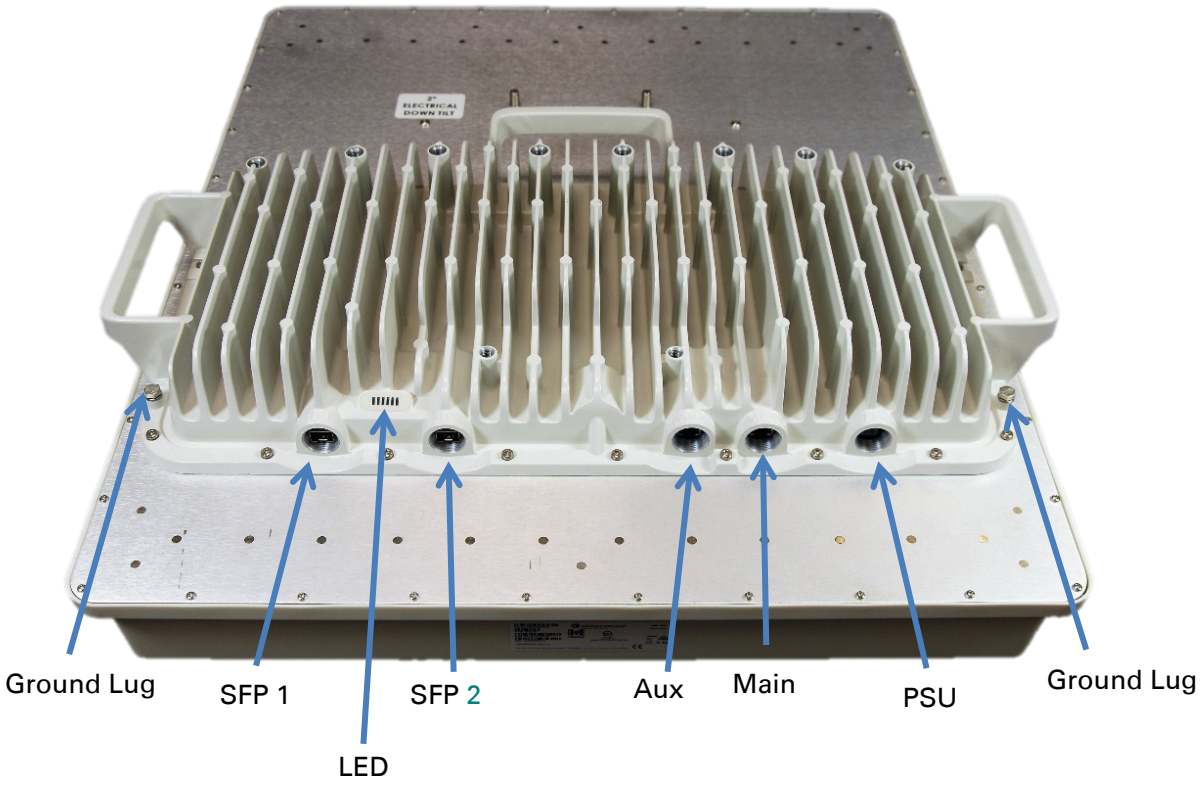


Table 38 PMP 450m 3GHz – AP rear interfaces

Port name	Connector	Interface	Description
PSU	4-pin	DC power input	DC power input, 40 V – 60 V, plus Cambium Sync-over-power
Main	RJ45	Ethernet	10/100/1000Base-T Ethernet, plus Cambium Sync-over-data
Aux	RJ45	Ethernet	10/100Base-T Ethernet with PoE out
		Synchronization	UGPS synchronization port
		Alignment	Audio tones
SFP 1	SFP	Ethernet	SFP module

SFP 2	SFP	Ethernet	SFP module (single or dual)
Ground Lugs		10 AWG copper wire	For grounding the unit

PMP/PTP 450i

The Ethernet and Sync/AUX ports are on the rear of the integrated and connectorized ODUs (Figure 23). These interfaces are described in Table 39.

Figure 23 PMP/PTP 450i Series - ODU rear interfaces

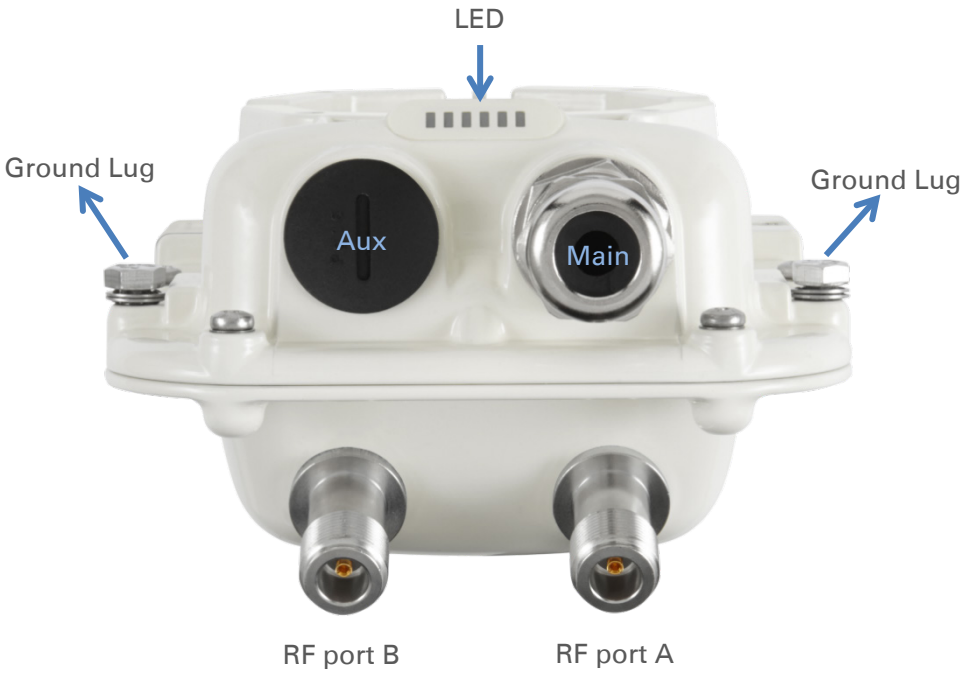


Table 39 PMP/PTP 450i Series – ODU rear interfaces

Port name	Connector	Interface	Description
Main PSU	RJ45	PoE input	Power over Ethernet (PoE).
		10/100/1000BASE-T Ethernet	Data
Sync/AUX	RJ45	10/100/1000BASE-T Ethernet	Data (see Note below)
		PoE output	Standard IEEE802.3at PoE.
		Sync input/output	Connection and powering of UGPS Sync input

The front of the connectorized ODU (Figure 24 PMP/PTP 450i Series **– Connectorized ODU antenna interfaces**) provides N type female connectors for RF cable interfaces to antennas with ports A and B for vertical and horizontal polarization respectively.

Figure 24 PMP/PTP 450i Series – Connectorized ODU antenna interfaces

PMP 450b Mid-Gain SM

The Ethernet and AUX ports are on the rear of the integrated and connectorized ODUs (Figure 25). These interfaces are described in Table 40.

Figure 25 PMP 450b Mid-Gain SM - ODU rear interfaces

Table 40 PMP 450b Mid-Gain SM – ODU rear interfaces

Port name	Connector	Interface	Description
PSU/Ethernet Port	RJ45	PoE input	Power over Ethernet (PoE).
		10/100/1000BASE-T Ethernet	Data
Audio AUX Port	Standard 3.5 mm headphones	Alignment tone input	3.5 mm audio jack for alignment tone

PMP 450b High Gain SM

The Ethernet and AUX ports are on the rear of the integrated and connectorized ODUs (Figure 25). These interfaces are described in Table 40.

Figure 26 PMP 450b High Gain SM - ODU rear interfaces

Table 41 PMP 450b High Gain SM – ODU rear interfaces

Port name	Connector	Interface	Description
PSU/Ethernet Port	RJ45	PoE input	Power over Ethernet (PoE).
		10/100/1000BASE-T Ethernet	Data
Audio AUX Port	Standard 3.5 mm headphones	Alignment tone input	3.5 mm audio jack for alignment tone

Cabling

Ethernet standards and cable lengths

All configurations require a copper Ethernet connection from the ODU (Main PSU port) to the Power supply.

Table 42 PSU drop cable length restrictions

System configuration		Maximum cable length (m/ft)	
Power supply	**PoE powered device on AUX/SYNC port**	**From power supply to ODU**	**From ODU to PoE device on AUX/SYNC port**
Power supply (30W)	None	100 m	N/A
	IEEE 802.3at Type 2	Not supported	
AC Power Injector (60W)	None	100 m	N/A
	IEEE 802.3at Type 2	100 m in total	
AC+DC enhanced Power Injector	None	100 m	N/A
	IEEE 802.3at Type 2	100 m in total	
-48 V DC power injector	None	100 m	N/A
	IEEE 802.3at Type 2	100 m in total	
CMM4 with 56 V supply	None	100 m	N/A
	IEEE 802.3at Type 2	Not supported	
IEEE802.3at compliant supply	None	100 m	N/A
	IEEE 802.3at Type 2	Not supported	

Note

The Ethernet connectivity for CMM4 requires the part “Ethernet cable adapter for CMM4 – N000045L001A”.

Outdoor copper Cat5e Ethernet cable

Outdoor Cat5e cable is used for all connections that terminate outside the building. For example, connections between the ODU, surge suppressors (if installed), UGPS receivers (if installed) and the power supply injector. This is known as a "drop cable" (Figure 27).

The following practices are essential to the reliability and longevity of cabled connections:

- Use only shielded cables and connectors to resist interference and corrosion.
- For vertical runs, provide cable support and strain relief.
- Include a 2 ft (0.6 m) service loop on each end of the cable to allow for thermal expansion and contraction and to facilitate terminating the cable again when needed.
- Include a drip loop to shed water so that most of the water does not reach the connector at the device.
- Properly crimp all connectors.
- Use dielectric grease on all connectors to resist corrosion.

Order Superior Essex type BBDGe cable from Cambium Networks (Table 43). Other lengths of this cable are available from Superior Essex.

Figure 27 Outdoor drop cable

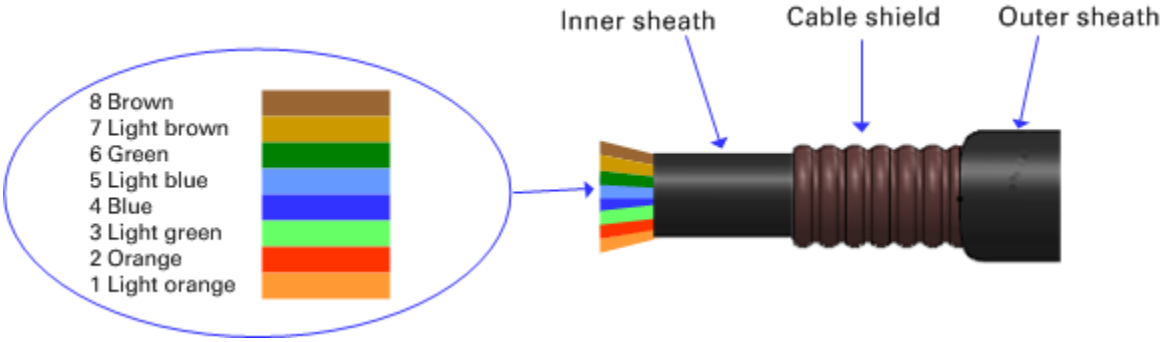


Table 43 Drop cable part numbers

Cambium description	Cambium part number
1000 ft Reel Outdoor Copper Clad CAT5E	WB3175
328 ft (100 m) Reel Outdoor Copper Clad CAT5E	WB3176

SFP module kits

SFP module kits allow connection of a PMP 450 Series ODU to a network over an Optical Gigabit Ethernet interface (1000BASE-LX or 1000BASE-SX) full-duplex mode.

Note

PMP 450m supports Fiber SFPs from system release 15.0.3.

Order SFP module kits from Cambium Networks (Table 44).

Table 44 SFP module kit part numbers

Cambium description	Cambium part number
Single Mode Optical SFP Interface per ODU	C000065L008A
Multi-mode Optical SFP Interface per ODU	C000065L009A
2.5GBASE-T Copper SFP Interface per ODU	C000065L011A

To compare the capabilities of the two optical SFP modules, refer to Table 45 and Table 46.

Table 45 Single Mode Optical SFP Interface per ODU (part number C000065L008)

Core/ cladding (microns)	Mode	Bandwidth at 1310 nm (MHz/km)	Maximum length of optical interface	Insertion loss (dB)
62.5/125	Multi	500	550 m (1800 ft)	1.67
50/125	Multi	400	550 m (1800 ft)	0.07
50/125	Multi	500	550 m (1800 ft)	1.19
10/125	Single	N/A	5000 m (16400 ft)	0.16

Table 46 Multi-mode Optical SFP Interface per ODU (part number C000065L009)

Core/ cladding (microns)	Mode	Bandwidth at 850 nm (MHz/km)	Maximum length of optical interface	Insertion loss (dB)
62.5/125	Multi	160	220 m (720 ft)	2.38
62.5/125	Multi	200	275 m (900 ft)	2.6
50/125	Multi	400	500 m (1640 ft)	3.37
50/125	Multi	500	550 m (1800 ft)	3.56

The upgrade kits contain the following components:

- Optical SFP transceiver module (Figure 28)
- Long EMC strain relief cable gland (Figure 29)
- The *Ethernet SFP Module Installation Guide*
- License key instructions and an entitlement key

Figure 28 Optical SFP transceiver module

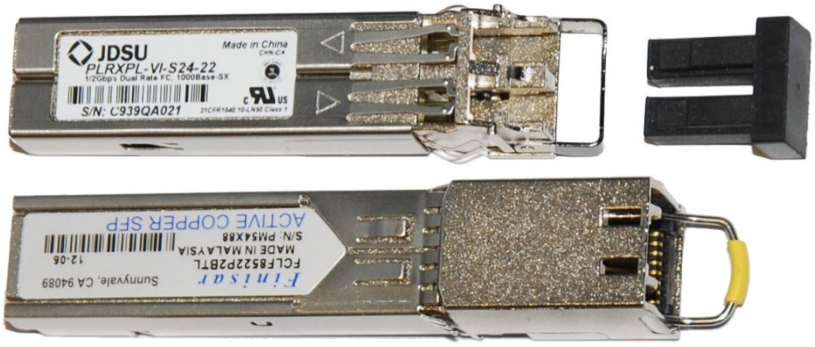


Figure 29 Long cable gland

Main Ethernet port

The PoE cable pinout diagram for Main port is given below.

Table 47 Main port PoE cable pinout

RJ45 pin	Interface	Ethernet description	PoE input description
1	1000 BaseT Ethernet with PoE In	+TxRx0	+Ve or -Ve
2		–TxRx0	
3		+TxRx1	+Ve or –Ve
6		–TxRx1	
4		+TxRx2	+Ve or –Ve
5		–TxRx2	
7		+TxRx3	+Ve or –Ve
8		–TxRx3	

Note

The PoE input on the Main port accepts any polarity.

Aux port

Table 48 Aux port PoE cable pinout

RJ45 pin	Interface	Signal description	PoE output description
1	100 BaseT Ethernet with PoE Out (see note below)	+TxRx0	-Ve
2		–TxRx0	
3		+TxRx1	+Ve
6		–TxRx1	
4	GPS and alignment tone	GPS power out, Alignment tone out, GPS data out	N/A
5		GPS data in	
7		GPS 0v	
8		GPS Sync in	

Note

If the Aux port will be used, a second Ethernet gland will need to be ordered (Part Number: N000065L033A).

Aux port to alignment tone headset wiring

A standard 32 ohms stereo headset can be connected to the AUX port to use the audio alignment tool. The diagrams of the adapters for RJ45 and RJ12 are provided in Figure 30 and Figure 31 respectively. The recommended values for both resistors are 220 ohm, 0.25W. Different resistor values can be used to optimize the level of the audio signal depending on the headset characteristics and the level of ambient noise.

Figure 30 Alignment Tone Cable

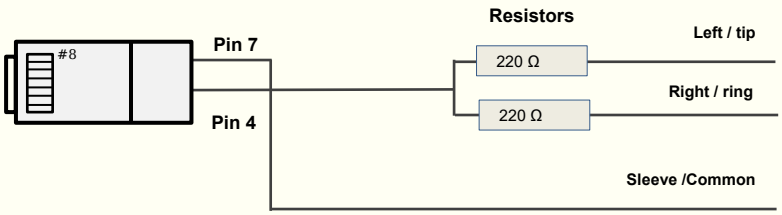


Table 49 Aux port PoE cable pinout

RJ45 pin (AUX port)	Signal description	Serial component	Jack socket (to jack plug of headset)
4	Alignment tone out	220 ohms resistor	Ring
		220 ohm resistor	Tip
7	GPS 0v	None	Sleeve

Figure 31 RJ12 Alignment Tone Cable

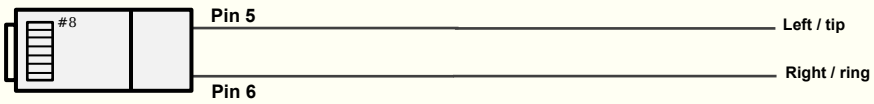


Table 50 RJ12 Aux port PoE cable pinout

RJ12 pin (AUX port)	Signal description	Jack socket (to jack plug of headset)
5	Alignment tone out	Tip
6	Alignment tone out	Ring

Alternatively, a readymade headset adapter can be ordered from Best-Tronics (http://btpa.com/Cambium-Products/) with the following part number:

Table 51 Alignment tone adapter third party product details

Reference	Product description
BT-1277	Headset alignment cable (RJ-45) for the PMP/PTP 450i Series products
BT-0674	Headset alignment cable (RJ-12) for the PMP/PTP 450 Series products.

RJ45 connectors and spare glands

RJ45 connectors are required for plugging Cat5e cables into ODUs, LPUs, PSUs and other devices. Order RJ45 connectors and crimp tool from Cambium Networks (Table 52).

The ODU is supplied with one environmental sealing gland for the drop cable. This gland is suitable for cable diameters from 5 mm to 9 mm.

Figure 32 Cable gland (part number #N000065L033)

Table 52 RJ45 connector and spare gland part numbers

Cambium description	Cambium part number
Tyco/AMP, Mod Plug RJ45, 100 pack	WB3177
Tyco/AMP Crimp Tool	WB3211
RJ-45 Spare Grounding Gland - PG16 size (Qty. 10)	N000065L033

Ethernet cable testing

This section describes a procedure for testing the RJ45 Ethernet cables used for Main and AUX port connectivity on 450i and 450m radios.

To test a cable, perform the following instructions:

1. Check the resistances of the cable and radio installation using a digital multimeter (DMM).
2. Disconnect the drop cable from the power source (EPI or mains adapter) first; keep the radio connected and test the resistances looking towards the radio. Test access can be made via any of the following:
   - Directly onto the pins of the RJ45 plug.
   - Using a commercially available RJ45 breakout board.

Measure between	Approximate resistance	Example
Wire 1 and wire 2 Wire 3 and wire 6 Wire 4 and wire 5 Wire 7 and wire 8	1 ohm + 2 ohms per 10m of cable Maximum difference between any two readings 0.3 ohms + 0.3 ohms per 10m of cable A cable with a single LPU but no radio will read about 3,600 ohms. A cable with a single 1000SS but no radio will read about 7,200 ohms.	For a 20m cable: Approximate resistance = 1 ohm + 2x 2 ohms = 5 ohms Maximum difference between readings = 0.3 ohms + 2x 0.3 ohms = 0.9 ohms
Wire 1 and wire 3 Wire 1 and wire 4 Wire 1 and wire 7 Wire 3 and wire 4 Wire 3 and wire 7 Wire 4 and wire 7	> 20 Kohms	

Note

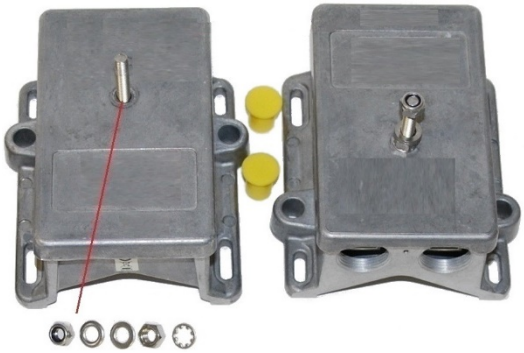
These figures should be indicative only rather than hard limits. The measurement must be done with a low-voltage DMM, not a high-voltage insulation tester.

Lightning protection unit (LPU) and grounding kit

450i and 450m Series LPUs provide transient voltage surge suppression for ODU installations. Each cable requires two LPUs, one near the ODU and the other near the linked device, usually at the building entry point (Table 53).

Table 53 LPU and grounding kit contents

Lightning protection units (LPUs)
LPU grounding point nuts and washers



ODU to top LPU drop cable (600 mm)
EMC strain relief cable glands

U-bolts, nuts and washers for mounting LPUs

ODU to top LPU ground cable (M6-M6)

Bottom LPU ground cable (M6-M10)

ODU to ground cable (M6-M10

One LPU and grounding kit (Table 53) is required for the PSU drop cable connection to the ODU. If the ODU is to be connected to an auxiliary device, one additional LPU and grounding kit is required for the Aux drop cable. Order the kits from Cambium Networks (Table 54).

Table 54 LPU and grounding kit part number

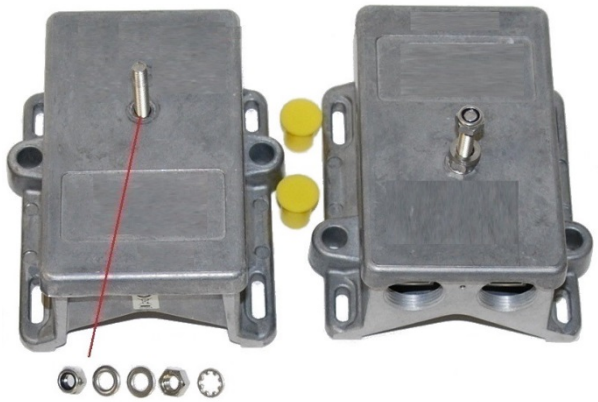
Cambium description	Cambium part number
Aux ports LPU and Grounding Kit (One Kit Per End)	C000065L007B

DC LPU and Grounding Kit

450m 3GHz LPUs provide transient voltage surge suppression for ODU installations. Each cable requires two LPUs, one near the ODU and the other near the linked device, usually at the building entry point.

Table 55 DC LPU and grounding kit contents

Lightning protection units (LPUs)
LPU grounding point nuts and washers



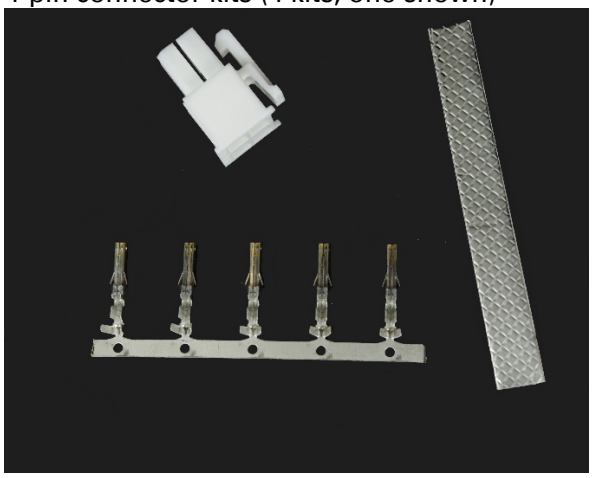
EMC strain relief cable glands

U-bolts, nuts and washers for mounting LPUs

ODU to top LPU ground cable (M6-M6), bolt and washers

ODU to grounding system ground cable, bottom LPU ground cable (2pcs, M6 and M10 lugs), bolt and washers

4-pin connector kits (4 kits, one shown)



One LPU and grounding kit (Table 53) is required for the PSU drop cable connection to the ODU. If the ODU is to be connected to an auxiliary device, one additional LPU and grounding kit is required for the Aux drop cable. Order the kits from Cambium Networks (Table 56)

Note

When installing LPUs, use only EMC cable glands supplied in the ODU and LPU kits (with black caps). Do not use the non-EMC cable glands supplied in other kits (with silver caps), as these may only be used in ODU installations without LPUs.

Table 56 DC LPU and grounding kit part number

Cambium description	Cambium part number
DC LPU and Grounding Kit	C000000L114A

Cable grounding kit

Copper drop cable shields must be bonded to the grounding system in order to prevent lightning-strike arcing (resulting in fire risk and damage to equipment).

One grounding kit (Figure 33) is required for each grounding point on the cable. Order cable grounding kits from Cambium Networks (Table 54, Table 56).

Caution

To provide adequate protection, all grounding cables must be a minimum size of 10 mm^2 csa (8AWG), preferably 16 mm^2 csa (6AWG), or 25 mm^2 csa (4AWG).

Figure 33 Cable grounding kit

Table 57 Cable grounding kit part numbers

Cambium description	Cambium part number
Cable Grounding Kits For 1/4" And 3/8" Cable	01010419001

Antennas and antenna cabling

Antenna requirements

Each connectorized ODU requires one external antenna (normally dual-polar).

For connectorized units operating in the USA or Canada 900 MHz, 4.9 GHz, 5.1 GHz, 5.2 GHz, 5.4 GHz or 5.8 GHz bands, choose external antennas which are recommended by Cambium Networks. Do not install any other antennas.

Supported external AP antennas

The recommended AP external antennas are listed in Table 58.

Table 58 List of AP external antennas

Cambium description	Cambium part number
900 MHz 13 dBi 65 degree Sector Antenna (Dual Slant)	N009045D001A
5 GHz Horizontal and Vertical Polarization Antenna for 90 Degree Sector	85009324001
5 GHz Horizontal and Vertical Polarization Antenna for 60 Degree Sector	85009325001

Note

LINKPlanner, Cambium Networks, planning tool, contains an up-to-date, exhaustive list of antennas that can be used with Cambium Products.

Supported external BH/SM antenna

The recommended PTP 450i Series BH or PMP 450/450i Series SM external antenna is listed in Table 59.

Table 59 PTP 450i Series BH or PMP 450/450i Series SM external antenna

Cambium description	Cambium part number
900 MHz 12 dBi gain directional antenna (Dual Slant)	N009045D003A

RF cable and connectors

RF cable of generic type LMR-400 is required for connecting the ODU to the antenna. N type male connectors are required for connecting the RF cables to the connectorized ODU. Two connectors are required per ODU. Use weatherproof connectors, preferably ones that are supplied with adhesive lined heat shrink sleeves that are fitted over the interface between the cable and connector. Order CNT-400 RF cable and N type male connectors from Cambium Networks (Table 60).

Table 60 RF cable and connector part numbers

Cambium description	Cambium part number
50 Ohm Braided Coaxial Cable - 75 meter	30010194001
50 Ohm Braided Coaxial Cable - 500 meter	30010195001
RF Connector, N, Male, Straight for CNT-400 Cable	09010091001

Antenna accessories

Connectorized ODUs require the following additional components:

- Cable grounding kits: Order one cable grounding kit for each grounding point on the antenna cables. Refer to Ethernet cable testing
- This section describes a procedure for testing the RJ45 Ethernet cables used for Main and AUX port connectivity on 450i and 450m radios.

  To test a cable, perform the following instructions:

  3. Check the resistances of the cable and radio installation using a digital multimeter (DMM).
  4. Disconnect the drop cable from the power source (EPI or mains adapter) first; keep the radio connected and test the resistances looking towards the radio. Test access can be made via any of the following:
     - Directly onto the pins of the RJ45 plug.
     - Using a commercially available RJ45 breakout board.

Measure between	Approximate resistance	Example
Wire 1 and wire 2 Wire 3 and wire 6 Wire 4 and wire 5 Wire 7 and wire 8	1 ohm + 2 ohms per 10m of cable Maximum difference between any two readings 0.3 ohms + 0.3 ohms per 10m of cable A cable with a single LPU but no radio will read about 3,600 ohms.	For a 20m cable: Approximate resistance = 1 ohm + 2x 2 ohms = 5 ohms Maximum difference between readings

	A cable with a single 1000SS but no radio will read about 7,200 ohms.	= 0.3 ohms + 2x 0.3 ohms = 0.9 ohms
Wire 1 and wire 3 Wire 1 and wire 4 Wire 1 and wire 7 Wire 3 and wire 4 Wire 3 and wire 7 Wire 4 and wire 7	> 20 Kohms	

Note

These figures should be indicative only rather than hard limits. The measurement must be done with a low-voltage DMM, not a high-voltage insulation tester.

- Lightning protection unit (LPU) and grounding kit on 2-47
- Self-amalgamating and PVC tape: Order these items to weatherproof the RF connectors
- Lightning arrestors: When the connectorized ODU is mounted indoors, lightning arrestors (not LPUs) are required for protecting the antenna RF cables at building entry. One arrestor is required per antenna cable. One example of a compatible lightning arrestor is the Polyphaser LSXL-ME or LSXL (not supplied by Cambium Networks).

GPS synchronization

GPS synchronization description

Cambium offers GPS synchronization to limit the network's own self-interference. The Cluster Management CMM provides Global Positioning System (GPS) synchronization to the Access Point (AP) and all associated Subscriber Modules (SM). Network operators have a choice of UGPS and CMM solutions to select the option that works best for the environment.

Universal GPS (UGPS)

The UGPS provides network synchronization for smaller networks where a CMM may not be cost effective. The UGPS provides synchronization for one or two modules so that even remote areas at the edge of the network can operate with synchronization for improved performance. The UGPS works with all Cambium PMP radios. The UGPS has a small footprint and is easy to deploy.

Figure 34 UGPS

	Note PMP 450/450i/450m Series - APs can power up a UGPS via the Aux/Timing port.
	Note PMP 450i/450b/450m Series - If two units are to get sync from the UGPS, then an external power supply is required. If the GPS position information is required to be visible on the web GUI, then the UGPS power must be enabled on the AP; and it is safe to use both AP power and external power for a single UGPS unit.

CMM5

The CMM5 (Cluster Management Module) is the latest generation of solutions for the distribution of TDD Sync signals and "Power-over-Ethernet (PoE)" in the field. The CMM5 is a modular design with individual 4-port power injectors and an optional controller used for remote management.

Key features of the CMM5 include:

- Support for Gigabit Ethernet (1000BaseT)
- Modular and scalable from 4 ports to 32 ports
- Direct +/- 48VDC input (optional AC/DC power supplies are available from Cambium Networks)
- Uses Cambium Networks UGPS for a synchronization source
- Dual resilient power inputs
- Rack mountable
- Secure remote management when used with the optional CMM5 Controller Module
- Support for PMP 450m (cnMedusa™)
- Future support for integration into (cnMedusa™) for cloud or NOC-based management

It consists of four subsystems, described in the following sections:

- CMM5 Controller Module
- CMM5 Injector (29 volt and 56 volt versions)
- Power supply(s) (240/600 watt)
- UGPS

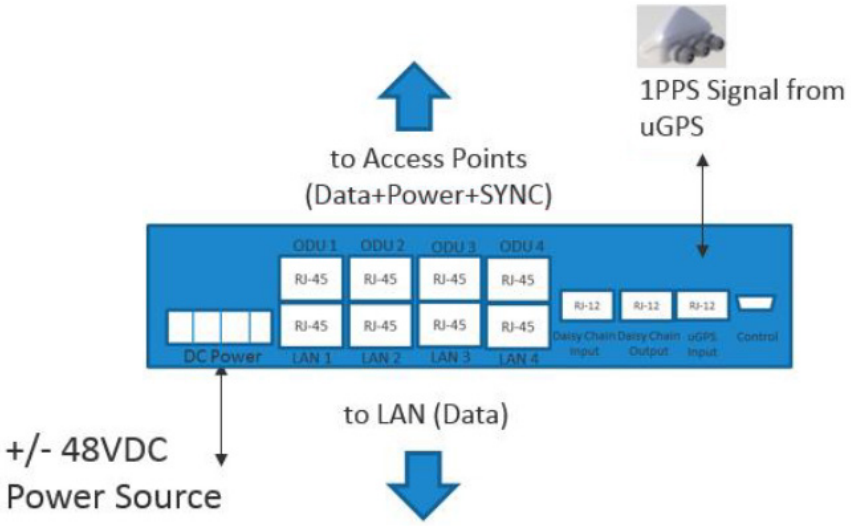
Cluster Management: Scenario 1

The following is a CMM5 Cluster Management scenario using four PMP 450i Access Points.

Table 61 CMM5 Cluster Management Scenario 1

Scenario	Equipment Needed	Features
Four PMP 450i Access Points	56 Volt Injector	• Gigabit Ethernet • Local Management Interface • +/- 48VDC Input • Broad Device Support • Rack Mountable
• 48 VDC Available • No management or resilience required	UGPS	-

Figure 35 Cluster Management: Scenario 1



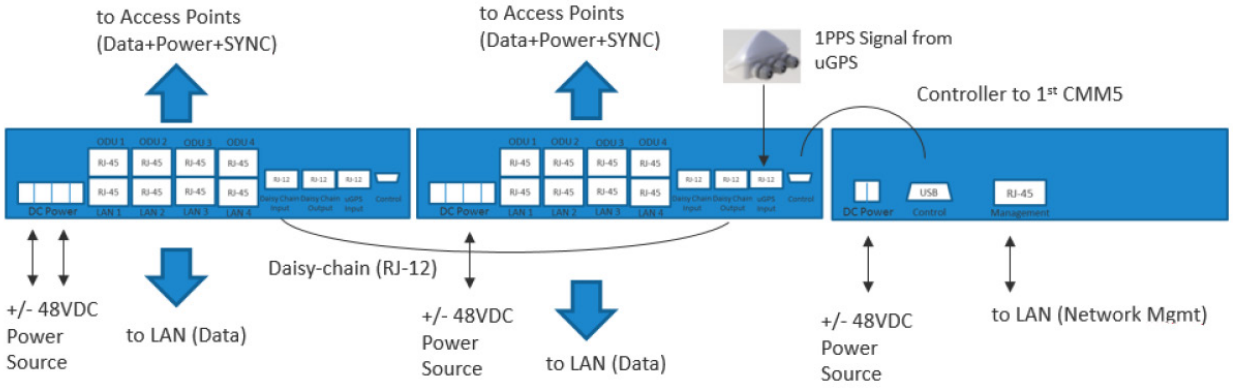
Cluster Management: Scenario 2

The following is a CMM5 Cluster Management scenario using four PMP 450i Access Points and four PMP 450 Access Points.

Table 62 CMM5 Cluster Management Scenario 2

Scenario	Equipment Needed	Features
Four PMP 450i Access Points Four PMP 450 Access Points	• 56 Volt Injector • 29 Volt Injector • 1 CMM5 Controller • One UGPS	• Gigabit Ethernet support • Local Management Interface • +/- 48VDC Input • Broad Device Support • Rack Mountable
AC only environments	Two UGPS AC-to-48 VDC Power Supplies	Resilient power sources
Management required Resilience required	-	Secure, Remote Management (https) Scalable to 32 devices

Figure 36 Cluster Management: Scenario 2

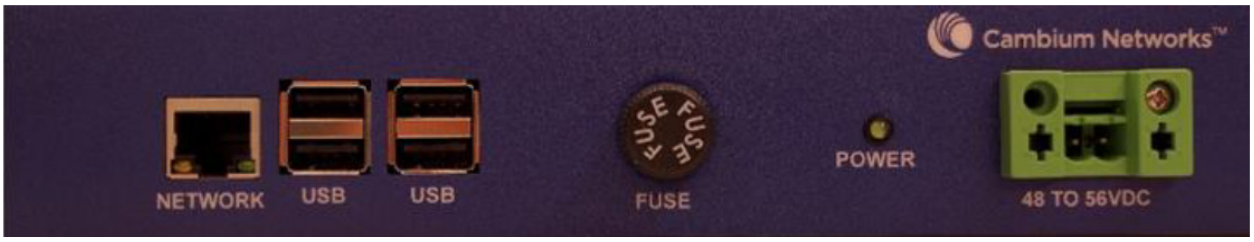


CMM5 Controller Module

The major features of the CMM5 Controller Module are:

- Auto-detect/control up to 8 Power Injectors
- Monitor SYNC/Power/GPS status
- Manage (up/down ports)
- Web (HTTPS) and SNMPv2/v3 management (SNMP on roadmap)
- 1U/ half-width rack-mount

Figure 37 Controller Module



CMM5 Injector Module

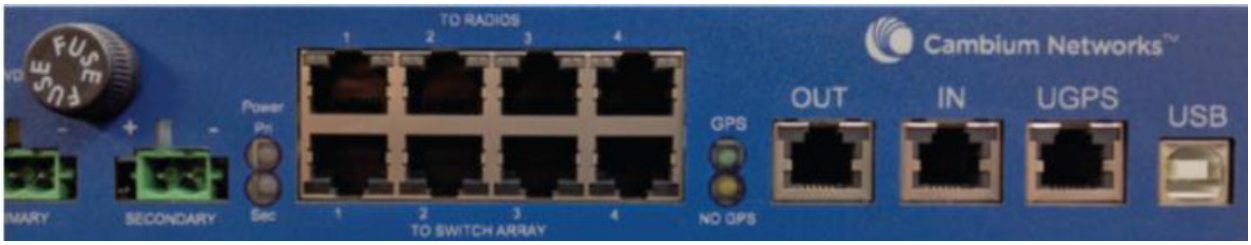
The CMM5 Injector Module has the following features:

- Stand-alone mode or used with controller for mgmt.
- +/- 48VDC input with green/amber LED's for status
- Injects SYNC pulse from UGPS
- 2U / half-width rack-mount

Note

There are two different versions of the injector module (56V and 29V). You must select the correct injector for the types of radios that you will be powering. In both cases, the injectors use the same input power supplies or can be powered with +/- 48VDC. The output power is different and the type of SYNC signal used is different between the two types of injectors. Systems can have 29V and 56V injectors deployed alongside each other.

Figure 38 Injector Module



CMM5 Injector Compatibility Matrix

The following table provides the Injector compatibility matrix.

Table 63 Injector Compatibility Matrix

Product	Power/Injector Module	Sync
PMP 450m	Yes/56V	Yes
PMP/PTP 450i	Yes/56V	Yes
PMP 450b	Yes/29V	Yes
PMP 450/PTP 450	Yes/29V	Yes
PMP 100/PTP 100	Yes/29V	Yes

CMM5 Specifications

The following table provides specifications for the CMM5 Power & Sync Injector (56 Volts).

Table 64 CMM5 Specifications

CMM5 Power and Sync Injector 56 Volts	
Model Number	C000000L556A
Data Interface	4 each RJ45 Gigabit Powered output ports "To Radios" 4 each RJ45 Gigabit Data input ports "To Switch Array" 1 each GPS timing port (RJ-12) 1 each CMM5 USB Serial port for local administration 1 each RJ12 Daisy Chain port "IN" 1 each RJ12 Daisy Chain port "OUT"
Surge Suppression	Lightning Suppression for each "To Radios" RJ45 Port
Power	Input Voltage: + or - 48 VDC Input Power Consumption: 400 watts Output Voltage: + or - 55 VDC Output Current: 0 - 1.8A per channel Output Power: 0 - 90 Watts per channel
Cabinet Temperature	-40° C to +55°C (-40° F to +131° F), 90% humidity, condensing
Physical	Max Distance from Managed Radios: 328 cable feet (100m) Max Distance to GPS Antenna: 100 cable feet (30.5m)
Dimensions	8.85" W x 15.75" D x 1.65" H (225mm x 400mm x 42mm)
Unit Weight	6.6 pounds (3kg)
Power Interface Terminals	2 Power input ports for 48 VDC Power (Power supplies sold separately)

Note

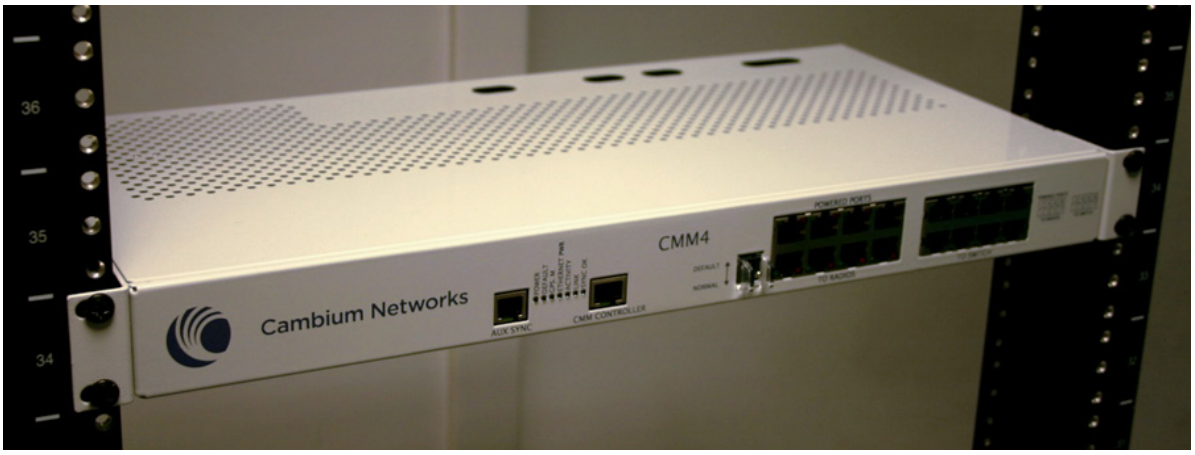
DC Power Input requirement is +/- 48VDC and must not exceed 100V surges. If surges above 100 VDC are expected, a suitable in-line DC surge suppressor with 48 VDC nominal voltage is required.

CMM4 (Rack Mount)

The Cluster Management Module (CMM) is the heart of the Cambium system's synchronization capability, which allows network operators to reuse frequencies and add capacity while ensuring consistency in the quality of service to customers.

For operators who prefer indoor CMM mounting, Cambium offers the Rack-Mounted Cluster Management Module 4. The unit is designed to be mounted onto a standard 19-inch telecommunications rack and to allow the Cambium CMM4 to be co-located with other telecommunications equipment.

Figure 39 CMM4 (Rack Mount)



The CMM4 has two DC power inputs, one 29 V and one 56V. It can be used to power and synchronize both 29 V legacy products such as the PMP 450 Series and 56V products such as the PMP 450i Series simultaneously.

If the 29 V legacy products are connected to the CMM4, a 29 V power supply needs to be connected.

If the 450i Series is connected to the CMM4, a 56 V power supply needs to be connected. The CMM4 supports having two of the 56 V and two of the 29 V supplies for redundancy.

Warning

PMP 450i Series requires different wiring between the CMM4 and device. If a PMP450 Series ODU is replaced by a PMP 450i Series and the existing drop cable needs to be re-used, the Ethernet cable adapter for CMM4 - N000045L001A" must be used between the CMM4 and the existing drop cable.

Figure 40 CMM4 56 V power adapter (dongle)

CMM4 56 V power adapter cable pinout

Figure 41 CMM4 power adapter cabling diagram

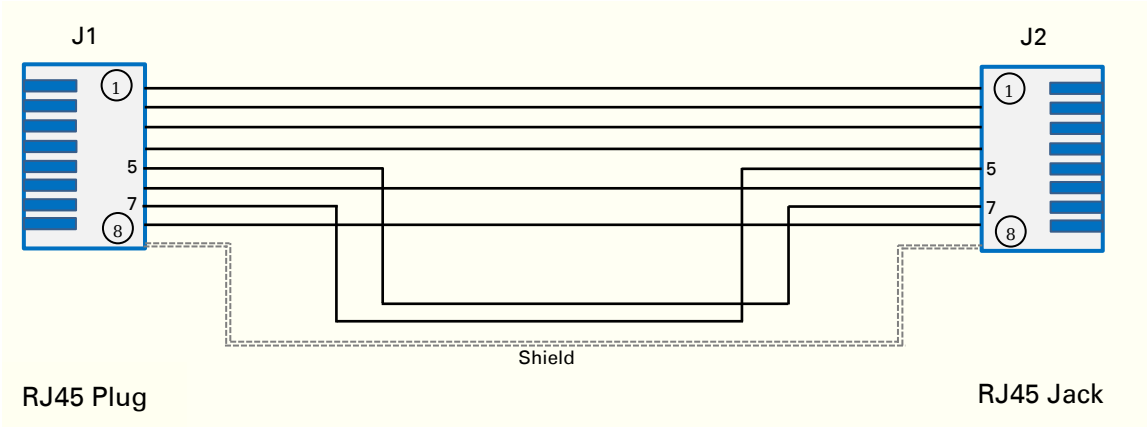


Table 65 CMM4 power adapter cable pinout

Plug J1 pin	Jack J2 pin
1	1
2	2
3	3
4	4
5	7
6	6
7	5
8	8
Screen	Screen

Note

Pins 5 and 7 are wired in a cross-over configuration.