Attribute	Meaning
Current Uplink Bucket Size	This field displays the number of bits in the bucket to be potentially consumed at above-MIR rates, up to Max Burst MIR rate.
Uplink MIR	This field displays the active MIR rate per second. This is the rate that the bucket is filled with bits.
Uplink MIR Per 100ms Interval	This field displays the rate that the bucket is filled with bits at every 100 ms interval.
Uplink Max Bucket Size	This field displays the maximum bucket size, which is the maximum number of bits that can be in the bucket. The bucket fills at MIR rate and can hold this number of bits, which is a configuration value.
Current Max Burst Bucket Size	If Max Burst is enabled, there is a secondary "bucket" that controls the maximum rate of bit consumption. If Max Burst is not enabled (which means not limited), this will be 0 as the bucket is not used.
Uplink Max Burst MIR	This field displays the configured value of the Max Burst rate. This is the maximum rate at which bits can be consumed above MIR. Once excess (> MIR) bits have been consumed, the link will be throttled to MIR.
Uplink Max Burst MIR per 100ms Interval	This field displays the configured value of the Max Burst rate at every 100 ms interval.
Uplink Broadcast Credit	This field displays the broadcast credit.
Uplink Broadcast MIR	This field displays the broadcast MIR rate per second.
Uplink Broadcast MIR Type	This field displays the type of the broadcast MIR.
Downlink MIR	This field displays the active configured MIR rate per second. This is the rate that the bucket is filled with bits.
Downlink Max Bucket Size	This field displays the configured maximum bucket size, which is the maximum number of bits that can be in the bucket. The bucket fills at MIR rate and can hold this number of bits, which is a configuration value.
Downlink Max Burst MIR	This field displays the configured value of the Max Burst rate. This is the maximum rate at which bits can be consumed above MIR. Once excess (> MIR) bits have been consumed, the link will be throttled to MIR.

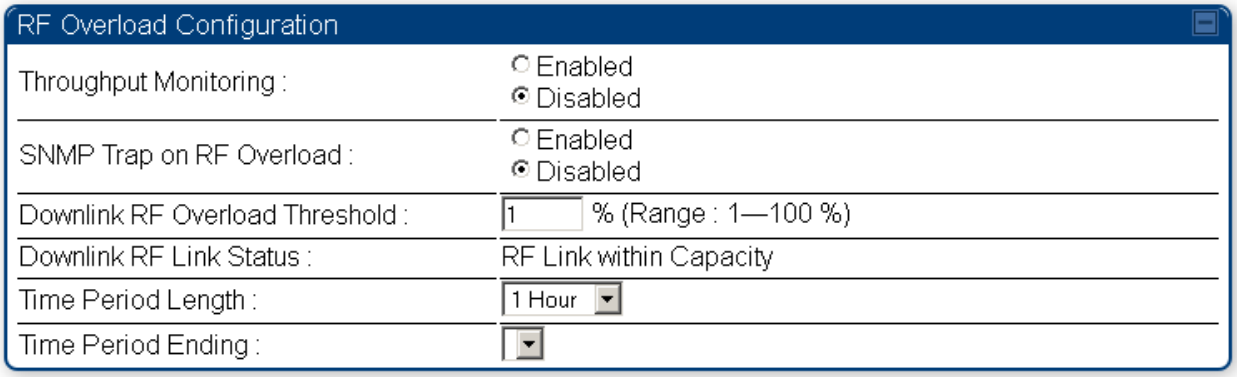
Interpreting Throughput statistics

The 450 Platform Family has a Statistics > Throughput page which shows historical information about sector or backhaul throughput and packet discards. This page is applicable for AP and BHM modules. This information can be useful to identify an overloaded sector or heavy bandwidth users. This page also shows the user throughput in terms of data rate (kbps) and packet rate (packets per second, or PPS), as well as the average packet size during the sample period.

Operators may set the AP/BHM to send an SNMP trap when it detects an RF overload condition based on a configurable threshold.

The following configuration parameters are available on the Throughput tab GUI pane and a radio reboot is not required when configuring these parameters:

Table 140: RF overload Configuration attributes – AP/BHM



Attribute	Meaning
Throughput Monitoring	This enables or disables the monitoring of sector throughput and packet discards. This parameter is disabled by default.
SNMP Trap on RF Overload	This enables or disables the sending of an SNMP trap when an AP/BHM overload condition is reached (based on Downlink RF Overload Threshold).
Downlink RF Overload Threshold	This parameter determines the overload threshold in percent of packets discarded that triggers the generation of an SNMP trap.
Downlink RF Link Status	This field displays the status of the capacity of the RF link.
Time Period Length Time Period Ending	These two configuration parameters determine what set of collection samples to show on the GUI display. The Time Period Length can be set from one to three hours. Time Period Ending allows the operator to set the end time for the set of collection samples to display.

Following configuration settings are three tables that display the statistics that are collected.

Board Performance statistics

This table contains a row that corresponds to each 1 minute statistics collection interval. Each row contains the following data aggregated for the entire AP/BHM:

- Ethernet Throughput - Statistics collected at the Ethernet port:
    - kbps in – average throughput over the collection interval in Kbps into the AP/BHM on the Ethernet Interface
    - kbps out – average throughput over the collection interval in Kbps out of the AP/BHM on the Ethernet Interface

    - PPS in – average packets per second over the collection interval into the AP/BHM on the Ethernet Interface
    - PPS out – average packets per second over the collection interval out of the AP/BHM on the Ethernet Interface
- RF Throughput - Statistics collected at the RF Interface:
    - kbps in – average throughput over the collection interval in Kbps into the AP/BHM on the RF Interface
    - kbps out – average throughput over the collection interval in Kbps out of the AP/BHM on the RF Interface
    - PPS in – average packets per second over the collection interval into the AP/BHM on the RF Interface
    - PPS out – average packets per second over the collection interval out of the AP/BHM on the RF Interface
- Aggregate Through Board – Sum of bidirectional data transferred through (not originating or terminating at) the AP/BHM:
    - kbps – average bidirectional throughput over the collection interval in Kbps
    - PPS – average bidirectional packets per second over the collection interval
    - Ave Pkt Size – Average Packet size over the collection interval of bidirectional data transferred

Board Throughput statistics

This table contains a row that corresponds to each one minute statistics collection interval. This table may be used to determine if there are problems with any of the interfaces. For example, if the Ethernet in packets is much higher than the RF out packets it could indicate a denial of service (DoS) attack on the AP/BHM. Each row contains the following data aggregated for the entire AP/BHM:

- Ethernet Statistics- Statistics collected at the Ethernet port:
    - inOctets – Number of octets (bytes) received by the AP/BHM at the Ethernet Interface over the collection interval
    - outOctets – Number of octets (bytes) sent by the AP/BHM at the Ethernet Interface over the collection interval
    - inPkts – Number of packets received by the AP/BHM at the Ethernet Interface over the collection interval
    - outPkts – Number of packets sent by the AP/BHM at the Ethernet Interface over the collection interval
    - Discards (in/out) – Number of packets that had to be discarded by the AP/BHM at the respective Ethernet Interface Queue

- RF Statistics - Statistics collected at the RF Interface:
    - inOctets – Number of octets (bytes) received by the AP/BHM at the RF Interface over the collection interval
    - outOctets – Number of octets (bytes) sent by the AP/BHM at the RF Interface over the collection interval
    - inPkts – Number of packets received by the AP/BHM at the RF Interface over the collection interval
    - outPkts – Number of packets sent by the AP/BHM at the RF Interface over the collection interval
    - Discards (in/out) – Number of packets that had to be discarded by the AP/BHM at the respective RF Interface Queue during the collection interval
    - Discards % (in/out) – Percent of the total packets received / transmitted that had to be discarded during the collection interval

LUID RF Throughput statistics

This table contains a row that corresponds to each active LUID served by the AP/BHM. Note that an LUID may be assigned 1 or 2 VCs. If the LUID is assigned 2 VCs, then the data in the table is the sum of the activity for both VCs. This table may be used to determine which LUIDs are experiencing overload so that corrective action can be taken (i.e. fixing a poor RF link or moving a heavily loaded link to a less congested AP/BHM). Each row contains counters and statistics related to the RF Interface that are updated once per minute:

- Inbound Statistics - Statistics collected at the RF Interface for the Uplink:
- octets – Number of octets (bytes) received by the AP/BHM at the RF Interface for this LUID over the collection interval
- pkts – Number of packets received by the AP/BHM at the RF Interface for this LUID over the collection interval
- Ave Pkt Size – Average size of the packets received by the AP/BHM at the RF Interface for this LUID over the collection interval
- discards – Number of packets received by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF In Queue was full
- discards % – Percent of the total packets received by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF In Queue was full
- Outbound Statistics - Statistics collected at the RF Interface for the Downlink:
- octets – Number of octets (bytes) transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval
- pkts – Number of packets transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval

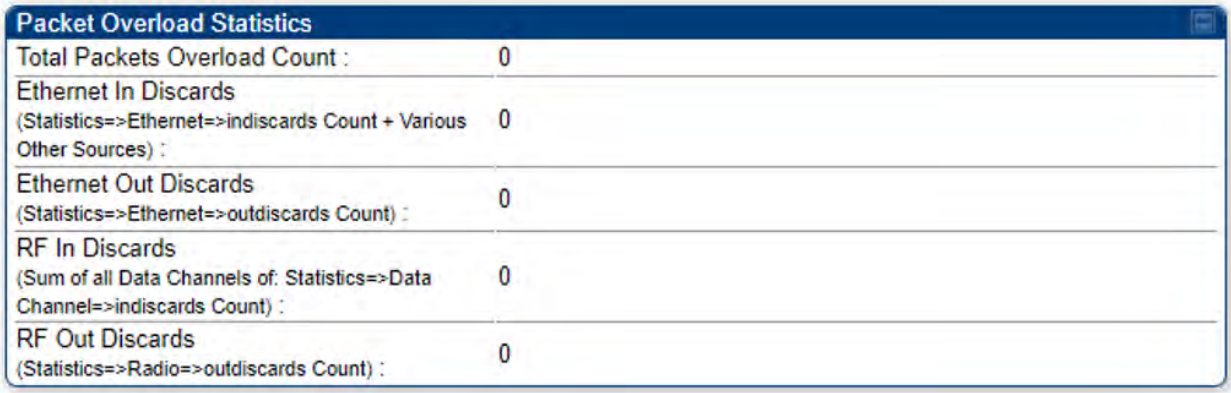
- Ave Pkt Size – Average size of the packets transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval
- discards – Number of packets to be transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF Out Queue was full
- discards % – Percent of the total packets to be transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF Out Queue was full.

Interpreting Overload statistics

The Statistics > Overload page displays statistics on packet overload and resultant packet discards. Unlike the other fields, the Total Packets Overload Count is expressed in only this page. It is not a count of how many packets have been lost, but rather of how many discard events (packet loss bursts) have been detected due to overload condition.

This statistics page is applicable for all modules (AP/SM/BHM/BHS) and explained in below table.

Table 141: Overload page attributes – AP/SM/BHM/BHS



Packet Overload Statistics	
Total Packets Overload Count :	0
Ethernet In Discards (Statistics=>Ethernet=>indiscards Count + Various Other Sources) :	0
Ethernet Out Discards (Statistics=>Ethernet=>outdiscards Count) :	0
RF In Discards (Sum of all Data Channels of: Statistics=>Data Channel=>indiscards Count) :	0
RF Out Discards (Statistics=>Radio=>outdiscards Count) :	0

Attribute	Meaning
Total Packets Overload Count	This field represents the sum of all RF and Ethernet in/out discards.
Ethernet In Discards	This field represents the number of packets tossed due to the Ethernet queue being full. If a climb in this stat accompanies a climb in RF Out Discards stat, then most likely the board is at RF capacity either due to traffic exceeding the RF pipe, or interference temporarily limiting the RF throughput. If this stat climbs without the RF Out Discards stat climbing, then the radio is most likely PPS limited.
Ethernet Out Discards	This field represents the number of packets tossed due to an Ethernet out overload. This stat must not climb in normal operation because the Ethernet link is much higher capacity than the RF link. If this stat is incrementing, then either the Ethernet link is established at a low speed (i.e. 10Mbps – half duplex), or there is a problem with cabling/Ethernet hardware.

Attribute	Meaning
RF In Discards	This field indicates the number of packets tossed due to no resources available within the radio to process them. This stat also must not be increasing because the system is designed to shed packets on the RF Out interface. If this stat is incrementing the board, it is most likely congested due to high PPS rate in combination with an Ethernet Out problem, which limits packet flow off the device.
RF Out Discards	This field indicates the number of packets tossed due to RF link at capacity. This stat will increase whenever the RF link is at capacity. When the internal FPGA RF input queue overflows, this stat is incremented. If this stat is seen to be incrementing at the AP, then the sector is congested. If seen at the SM, the number of Contention Slots must be looked at to ensure that enough Contention Slots are allocated to allow for bandwidth requests to be seen at the AP.

Note

PMP 450m overload:

The 450m Series AP is designed to handle high load in terms of high throughput and high PPS. In terms of throughput, PMP 450m is designed to achieve 3x or more throughput improvement over PMP 450 and PMP 450i Series products. In terms of packets per second (PPS), PMP 450m is designed to handle more than 100k PPS.

Overload occurs when the offered load exceeds the above limits. When overload occurs, PMP 450m will start discarding packets and TCP throughput will degrade due to packet loss.

It's worth noting that Frame Utilization statistics (Statistics > Frame Utilization tab: Frame Utilization: Downlink and Uplink) are not necessarily indicative of overload condition. They show how much the TDD frame is utilized. High frame utilization depends on:

- High traffic during busy periods: those statistics will be close to 100% and almost all slots will be utilized. In this case if the Overload statistics show that packets are discarded then this is an indication of overload condition.
- High percentage of VCs with low modulation with moderate traffic. Those VCs will require more slots to service them (due to low modulation) and the frame utilization will be high. In this case the TDD frame is fully utilized but the system is at low capacity and is not in an overload condition.

PMP 450m has higher PPS than PMP 450 and PMP 450i and supports higher throughput through spatial multiplexing, therefore when a PMP 450m replaces an overloaded PMP 450 or PMP 450i AP the PMP 450m will not be overloaded under the same conditions but the frame utilization may still show close to 100%; this should not alarm the customer. The overload statistics shall be monitored on PMP 450m to see if it is overloaded or not.

Interpreting Power Adjust History

The **Statistics > Power Adjust History** tab provides a chronological record of power adjustment events for the selected SM. It logs changes in received power levels (Rx power) over time, detailing adjustments made to the module's power settings. Each entry includes timestamps, received power levels, adjustment values, number of samples, receiver temperature compensation, temperature readings, and historical power values. Adjustments are segmented by component carrier, with separate entries for each carrier.

This feature facilitates monitoring and analysis of system-driven power adjustments to optimize performance.

This statistics page is applicable for all modules (AP/SM/BHM/BHS) and explained in below table.

Table 142: Power Adjust History page attributes – AP/SM/BHM/BHS

Select Subscriber

Current Subscriber Module : SM1 - Canopy V Setup 4 [02045600d1f1] Luid: 2

Power Adjustment Configuration

SM Receive Target Level : -52 dBm (Range: -77 — -37 dBm) combined power

Power Adjustment History

Component Carrier:1 Carrier:1

Time (CST)	Rx power (dBm)	Adjust SM (dB)	Samples	Rx Temp Comp (dB)	Temp (°C)	History (dBm)							
05/08/2024 19:27:21	-52	-1	Multiple	+0	37	-52.2	-51.9	-52.5	-51.9	-52.2	-52.2	-55.9	-55.9
05/08/2024 19:26:21	-53	+1	Multiple	+0	37	-53.9	-52.9	-53.5	-53.2	-53.2			
05/08/2024 19:18:21	-52	-1	Multiple	+0	37	-51.9	-51.9	-51.9	-51.9	-52.5	-51.9	-51.9	
05/08/2024 19:17:21	-53	+1	Multiple	+0	37	-53.2	-52.9	-53.2	-53.2	-53.9	-53.9	-53.9	
05/08/2024 19:12:21	-52	-1	Multiple	+0	37	-52.2	-52.2	-51.9	-51.9	-51.9	-52.2	-52.2	-51.9
05/08/2024 19:10:21	-53	+1	Multiple	+0	37	-53.9	-53.2	-52.9	-52.9	-52.9	-53.9	-53.9	
05/08/2024 19:07:21	-52	-1	Multiple	+0	37	-51.9	-52.9	-52.9	-51.9	-52.5	-51.9	-51.9	-51.9
05/08/2024 19:06:21	-54	+1	Multiple	+0	37	-53.5	-53.9	-53.5	-52.9	-53.5			
05/08/2024 19:05:21	-52	-1	Multiple	+0	37	-52.5	-51.9	-51.9	-51.9	-51.9	-52.5	-52.2	-52.9
05/08/2024 19:03:21	-54	+1	Multiple	+0	37	-53.5	-53.9	-53.5	-53.5	-53.5	-53.2	-52.2	-57.9
05/08/2024 19:01:21	-52	-1	Multiple	+0	37	-51.9	-51.9	-51.9	-52.2	-51.9	-51.9	-51.9	-51.9
05/08/2024 19:00:21	-54	+1	Multiple	+0	37	-53.2	-53.5	-52.9	-53.9	-53.9	-52.9	-53.5	-53.5
05/08/2024 18:57:21	-52	-1	Multiple	+0	37	-52.9	-51.9	-51.9	-51.9	-52.5	-51.9		
05/08/2024 18:56:21	-53	+1	Multiple	+0	37	-53.2	-52.9	-53.5	-53.2	-52.9	-53.2	-53.2	
05/08/2024 18:55:21	-52	-1	Multiple	+0	37	-52.5	-51.9	-52.2	-51.9	-52.5	-51.9	-51.9	-51.9
05/08/2024 18:54:21	-54	+1	Multiple	+0	37	-53.5	-52.9	-53.5	-53.9	-53.9	-52.9	-52.9	-53.5
05/08/2024 18:46:21	-52	-1	Multiple	+0	37	-51.9	-51.9	-51.9	-51.9	-51.9	-51.9		
05/08/2024 18:45:21	-54	+1	Multiple	+0	37	-53.9	-53.2	-53.9	-52.9	-53.5	-53.5	-53.9	-53.9
05/08/2024 18:43:21	-52	-1	Multiple	+0	37	-51.9	-51.9	-52.9	-51.9	-52.9	-51.9	-51.9	-51.9
05/08/2024 18:42:21	-54	+1	Multiple	+0	37	-53.2	-53.9	-53.5	-52.9	-52.9	-53.9	-53.9	

Component Carrier:2 Carrier:2

Time (CST)	Rx power (dBm)	Adjust SM (dB)	Samples	Rx Temp Comp (dB)	Temp (°C)	History (dBm)							
05/08/2024 19:29:21	-51	-2	Multiple	+0	37	-50.5	-51.5	-51.5	-52.5	-51.5	-51.5	-52.2	-52.5
05/08/2024 19:28:21	-54	+2	Single	+0	37	-53.5	-53.5	-46.5	-53.5	-53.5	-53.5	-53.2	-53.2
05/08/2024 19:27:21	-54	+1	Multiple	+0	37	-53.5	-53.5	-53.5					
05/08/2024 19:25:21	-52	-1	Multiple	+0	37	-51.8	-49.5	-49.5	-49.2	-49.2	-49.2	-53.2	-53.2
05/08/2024 19:24:21	-54	+1	Multiple	+0	37	-53.5	-53.2	-53.5	-53.2	-53.5	-53.5		
05/08/2024 19:22:21	-52	-1	Multiple	+0	37	-51.8	-51.5	-46.8	-46.8				
05/08/2024 19:16:21	-53	+1	Multiple	+0	37	-53.2	-53.2	-49.5	-49.5				
05/08/2024 19:14:21	-51	-2	Multiple	+0	37	-50.5	-50.8	-51.5	-51.5	-48.5	-48.5		
05/08/2024 19:13:21	-53	+1	Single	+0	37	-49.5	-49.5	-52.5	-52.5				
05/08/2024 19:12:21	-54	+1	Multiple	+0	37	-52.8	-53.5	-53.5					
05/08/2024 19:11:21	-50	-3	Multiple	+0	37	-50.2	-49.5	-48.5	-48.2				
05/08/2024 19:10:21	-54	+2	Single	+0	37	-52.5	-51.5	-51.8	-51.5				
05/08/2024 19:09:21	-54	+1	Multiple	+0	37	-53.5	-53.5	-53.2	-52.8	-52.8			
05/08/2024 19:08:21	-51	-2	Multiple	+0	37	-50.5	-51.5	-51.5	-51.5	-51.5			
05/08/2024 19:07:21	-53	+1	Single	+0	37	-53.5	-45.5	-45.5	-48.5				
05/08/2024 19:05:21	-53	+1	Multiple	+0	37	-53.2	-51.8	-51.8					
05/08/2024 19:04:21	-52	-1	Multiple	+0	37	-51.8	-49.5	-51.5	-51.5	-51.5			
05/08/2024 19:03:21	-54	+1	Multiple	+0	37	-53.5	-52.8	-53.5	-53.5	-52.2	-51.5	-51.5	-51.8
05/08/2024 19:02:21	-52	-1	Multiple	+0	37	-52.2	-51.8	-52.5	-53.5	-53.5	-53.5	-53.5	-52.8
05/08/2024 19:00:21	-53	+1	Multiple	+0	37	-53.2	-50.8	-50.5	-51.2	-50.8	-51.2	-51.2	-50.5

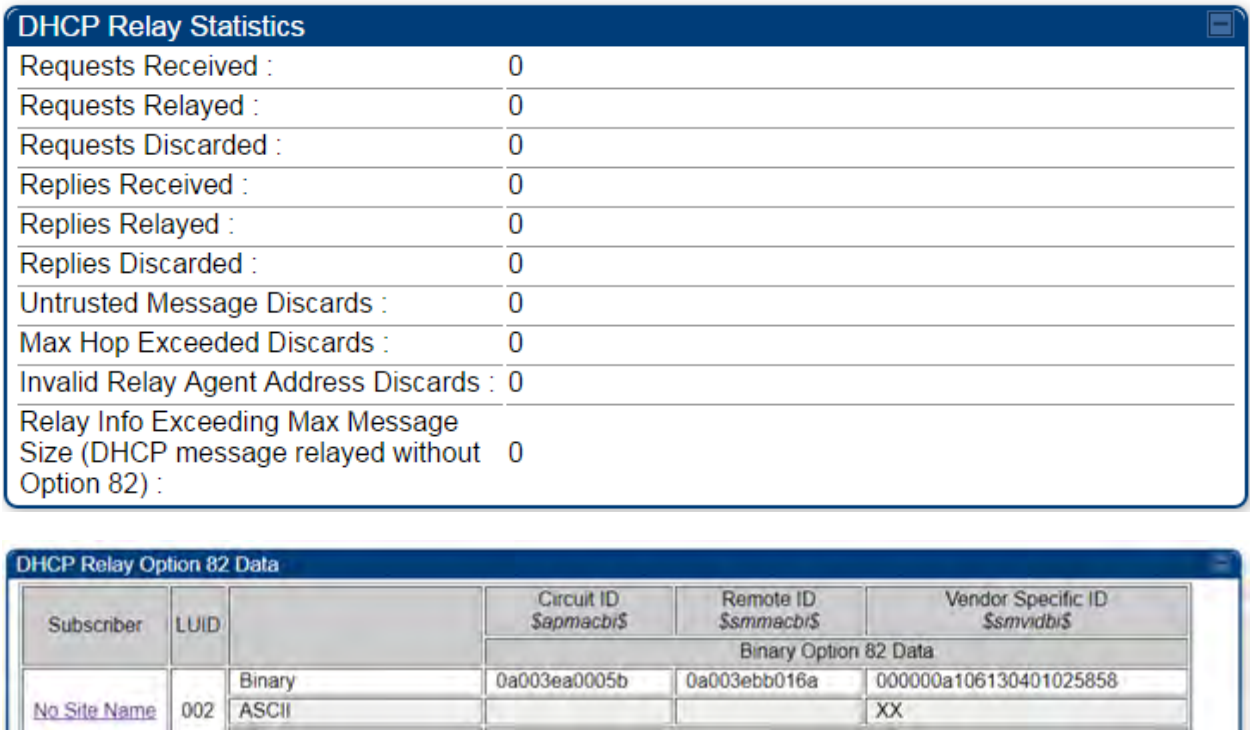
Attribute	Meaning
Current Subscriber Module	Identifies the subscriber module that is currently active and being observed.
SM Receive Target Level	Shows the desired level for receiving signals, indicating the ideal strength of the incoming signals.

Attribute	Meaning
Time (CST)	Displays the current time in Central Standard Time (CST) for each recorded event.
Rx power (dBm)	Shows the strength of the received signal at the subscriber module, measured in decibels (dB).
Adjust SM (dB)	Indicates the adjustment made to the subscriber module's power settings, measured in decibels (dB).
Samples	Displays the number of samples taken to calculate the received signal strength and adjustments.
Rx Temp Comp (dB)	Shows the adjustment made to the received signal strength to account for changes in temperature, measured in decibels (dB).
Temp (°C)	Displays the current temperature recorded by the subscriber module in degrees Celsius (°C).
History (dBm)	Provides a record of past signal strengths at the subscriber module, aiding in understanding signal fluctuations over time.

Interpreting DHCP Relay statistics

The Statistics > DHCP Relay page displays requests and replies received, relayed and discarded when the AP is configured as a DHCP relay. Typically, in a working DHCP relay configuration a one-to-one ratio is established between requests and replies that are received and relayed. This statistics page is only applicable for PMP (AP and SM modules) and it is explained in below figure.

Figure 118: *DHCP Relay page attributes – AP/SM*



DHCP Relay Statistics

Requests Received :	0
Requests Relayed :	0
Requests Discarded :	0
Replies Received :	0
Replies Relayed :	0
Replies Discarded :	0
Untrusted Message Discards :	0
Max Hop Exceeded Discards :	0
Invalid Relay Agent Address Discards :	0
Relay Info Exceeding Max Message Size (DHCP message relayed without Option 82) :	0

DHCP Relay Option 82 Data

Subscriber	LUID		Circuit ID $apmacbi$	Remote ID $smmacbi$	Vendor Specific ID $smvidbi$
			Binary Option 82 Data		
No Site Name	002	Binary	0a003ea0005b	0a003ebb016a	000000a106130401025858
		ASCII			XX

Attribute	Meaning
Requests Received	This field represents the number of DHCP relay requests received by the AP.
Requests Relayed	This field represents the number of DHCP relay requests relayed by the AP.
Requests Discarded	This field represents the number of DHCP relay requests discarded by the AP due to errors in the request.
Replies Received	This field represents the number of DHCP relay replies received by the AP.
Replies Relayed	This field represents the number of DHCP relay replies relayed by the AP.
Replies Discarded	This field represents the number of DHCP relay replies discarded by the AP due to errors in the reply.
Untrusted Message Discards	This field indicates messages that were discarded because the message already contained Option 82 information with no Relay Agent specified.
Max Hop Exceeded Discards	This field indicates messages that have been relayed too many times, exceeding the max hop count (16).
Invalid Relay Agent Address Discards	This field indicates messages that have been discarded because the message relay agent address is already in place (relay agent address does not equal address of the AP).
Relay Info Exceeding Max Message Size (DHCP message relayed without Option 82)	This field indicates DHCP messages too large to fit Option 82 data. These messages are sent on without Option 82 information.
Subscriber	See Device tab attributes
LUID	
Circuit ID	This field displays the option 82 data of the SM in binary and ASCII formats.
Remote ID	
Vendor Specific ID	

Interpreting Filter statistics

The Statistics > Filter page displays statistics on packets that have been filtered (dropped) due to the filters set on the Protocol Filtering page. The filter page of SM is explained in below table.

Table 143: Filter page attributes - SM

Packet Filter Statistics	
PPPoE Count :	0
All IPv4 Count :	0
All Other IPv4 Count :	0
SMB Count :	0
SNMP Count :	0
Bootp Client Count :	0
Bootp Server Count :	0
IPv4 Multicast Count :	0
All IPv6 Count :	0
All Other IPv6 Count :	0
IPv6 SMB Count :	0
IPv6 SNMP Count :	0
IPv6 Bootp Client Count :	0
IPv6 Bootp Server Count :	0
IPv6 Multicast Count :	0
ARP Count :	0
All Others Count :	0
User Defined Port1 Count :	0
User Defined Port2 Count :	0
User Defined Port3 Count :	0

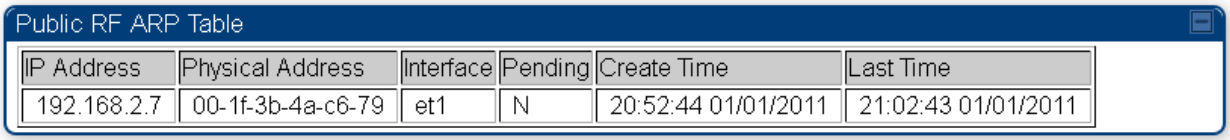
Attribute	Meaning
PPPoE Count	Number of PPPoE packets filtered.
All IPv4 Count	Number of IPv4 packets filtered.
All Other IPv4 Count	Any IPv4 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out.
SMB Count	Number of IPv4 Server Message Block (file sharing) packets filtered.
SNMP Count	Number of IPv4 SNMP packets filtered.
Bootp Client Count	Total number of IPv4 DHCP requests filtered.
Bootp Server Count	Total number of IPv4 DHCP replies filtered.
IPv4 Multicast Count	Number of IPv4 Multicast messages filtered.
All IPv6 Count	Number of IPv6 messages filtered.
All Other IPv6 Count	Any IPv6 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out.
IPv6 SMB Count	Number of IPv6 Server Message Block (file sharing) packets filtered
IPv6 SNMP Count	Number of IPv6 SNMP messages filtered
IPv6 Bootp Client Count	Total number of IPv6 DHCP replies filtered
IPv6 Bootp Server Count	Total number of IPv6 DHCP replies filtered

Attribute	Meaning
IPv6 Multicast Count	Number of IPv6 Multicast messages filtered
ARP Count	Total number of ARP packets filtered.
All other Count	The count of any messages that did not fit above that were filtered out
User Defined Port1 Count	Number of packets defined by the user port1 that were filtered.
User Defined Port2 Count	Number of packets defined by the user port2 that were filtered.
User Defined Port3 Count	Number of packets defined by the user port3 that were filtered.

Viewing ARP statistics

The Statistics > ARP page in a SM module correlated the IP address of the Ethernet-connected device to its MAC address and provides data about the connection.

Figure 119: *ARP page of the SM*



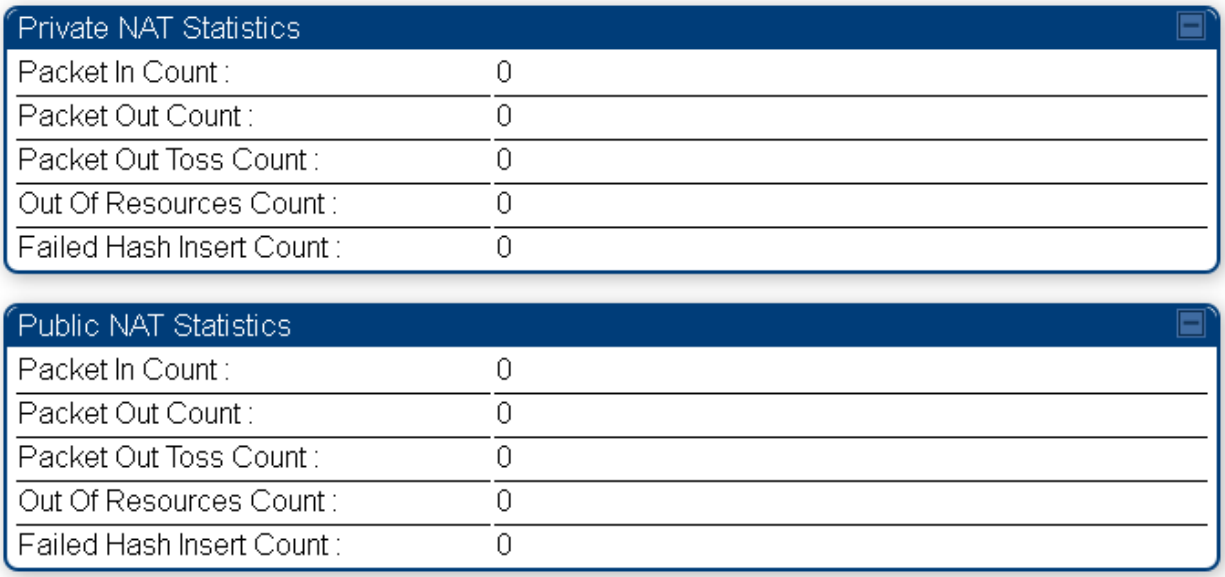
Public RF ARP Table

IP Address	Physical Address	Interface	Pending	Create Time	Last Time
192.168.2.7	00-1f-3b-4a-c6-79	et1	N	20:52:44 01/01/2011	21:02:43 01/01/2011

Viewing NAT statistics

When NAT is enabled on a SM, statistics are kept on the Public and Private (WAN and LAN) sides of the NAT and displayed on the **Statistics > NAT Stats** page. The NAT page of SM is explained in below table.

Table 144: NAT page attributes - SM



Private NAT Statistics	
Packet In Count :	0
Packet Out Count :	0
Packet Out Toss Count :	0
Out Of Resources Count :	0
Failed Hash Insert Count :	0

Public NAT Statistics	
Packet In Count :	0
Packet Out Count :	0
Packet Out Toss Count :	0
Out Of Resources Count :	0
Failed Hash Insert Count :	0

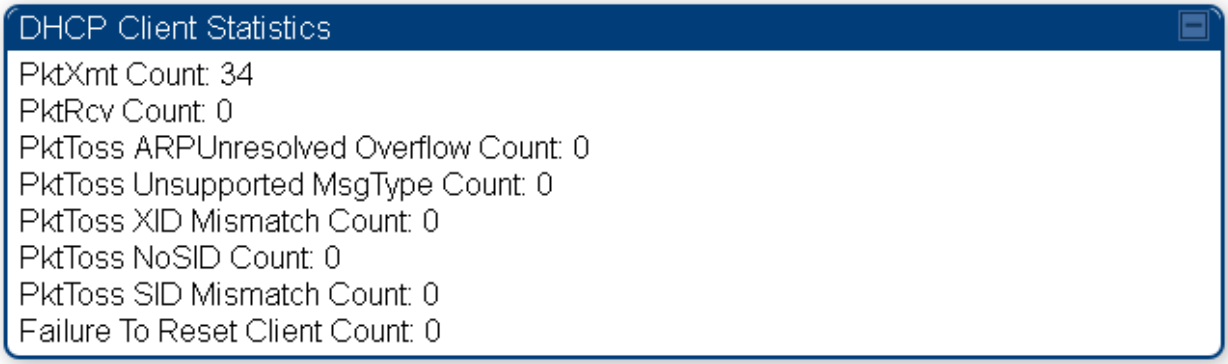
Attribute	Meaning
Private NAT Statistics, Packet In Count	This field represents the number of packets received on the SM's LAN/Ethernet interface
Private NAT Statistics, Packet Out Count	This field represents the number of packets sent from the SM's LAN/Ethernet interface
Private NAT Statistics, Packet Out Toss Count	This field represents the number of packets that we not sent from the SM's LAN/Ethernet interface due to addressing issues.
Private NAT Statistics, Out of Resources Count	This field represents the number of times the NAT table for the SM's LAN/Ethernet interfaces has been filled.
Private NAT Statistics, Failed Hash Insert Count	This field represents the number of times that the device failed to insert an address binding into the NAT hash table.
Public NAT Statistics, Packet In Count	This field represents the number of packets received on the SM's WAN/wireless interface
Public NAT Statistics, Packet Out Count	This field represents the number of packets sent from the SM's WAN/wireless interface
Public NAT Statistics, Out of Resources Count	This field represents the number of packets that we not sent from the SM's WAN/wireless interface due to addressing issues.
Public NAT Statistics, Failed Hash Insert Count	This field represents the number of times the NAT table for the SM's WAN/wireless interfaces has been filled.

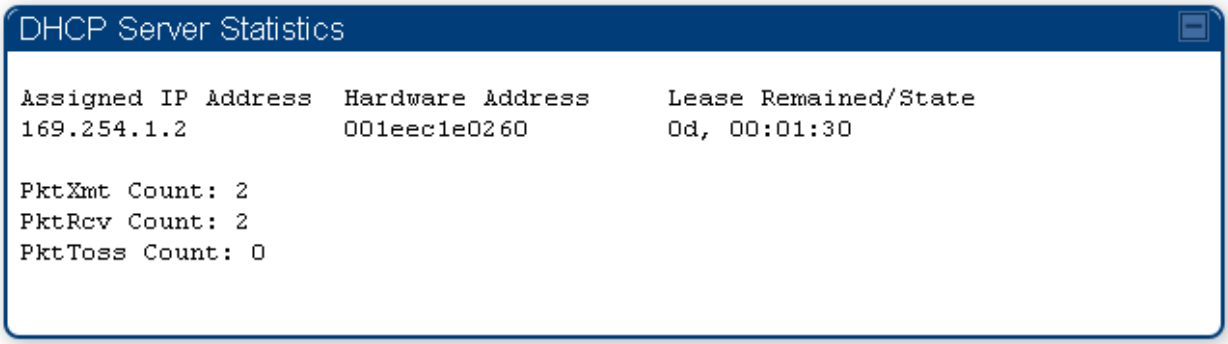
Viewing NAT DHCP Statistics

The Statistics > NAT DHCP page displays NAT enabled DHCP client statistics. This is statistics page is applicable for SM only.

When NAT is enabled on a SM with DHCP client (DHCP selected as the Connection Type of the WAN interface) and/or DHCP Server, statistics are kept for packets transmitted, received and tossed, as well as a table of lease information for the DHCP server (Assigned IP Address, Hardware Address and Lease Remained/State).

Table 145: NAT DHCP Statistics page attributes - SM





Attribute	Meaning
PktXmt Count	Represents the number of DHCP packets transmitted from the client
PktRcv Count	This field represents the number of DHCP packets received by the client
PktToss ARPUnresolved Overflow Count	This field represents the number of packets tossed due to failed attempts to resolve an IP address into a physical MAC address
PktToss Unsupported MsgType Count	This field represents the number of packets tossed due to the receipt of an unsupported message type (cannot be interpreted by DHCP client)
PktToss XID Mismatch Count	The field represents the number of packets that were tossed due to a transaction ID mismatch
PktToss NoSID Count	This field represents the number of packets that were tossed due to lack of a DHCP session ID
PktToss SID Mismatch Count	Represents the number of packets tossed due to a session ID mismatch
Failure to Reset Client Count	This field represents the number of times the DHCP client was unable to be reset (resulting in no IP address being served).

Interpreting Sync Status statistics

The Statistics > Sync Status page of AP is only displayed when the Sync Input is set to AutoSync or AutoSync+Free Run.

The Sync Status page is explained in below table.

Table 146: Sync Status page attributes - AP

Sync Status	
Sync Pulse Source :	Power Port
Sync Pulse Status :	Receiving Sync
Sync Pulse Status - Timing Port/UGPS :	No Sync
Sync Pulse Status - Power Port :	Receiving Sync
UGPS Power Status :	Power Off

Attribute	Meaning
Sync Pulse Source	This field indicates the status of the synchronization source: • Searching indicates that the unit is searching for a GPS fix • Timing Port/UGPS indicates that the module is receiving sync via the timing AUX/SYNC timing port • Power Port indicates that the module is receiving sync via the power port (Ethernet port).
Sync Pulse Status	This field indicates synchronization source pulse status.
Sync Pulse Status - Timing Port/UGPS	This field indicates synchronization pulse status over Timing Port/UGPS port.
Sync Pulse Status - Power Port	This field indicates synchronization pulse status over power port.
UGPS Power Status	This field indicates UGPS power up status (on or off).

This information may be helpful in a decision of whether to climb a tower to diagnose a perceived antenna problem.

Interpreting PPPoE Statistics for Customer Activities

The page can be access under Statistics > PPPoE of SM GUI.

When the PPPoE feature is enabled on the SM, PPPoE statistics provide data about activities of the customer.

The PPPoE Statistics of SM is explained in below table.

Table 147: PPPoE Statistics page attributes - SM

PPPoE Statistics	
IP address :	0.0.0.0
PPPoE Session Status :	Connecting
PPPoE AC Name :	
PPPoE Service Name :	
PPPoE Session ID :	0
PPPoE Session Uptime :	00:00:00
PPPoE Session Idle Time :	00:00:00
PPPoE Session MTU :	0
Primary DNS Address :	0.0.0.0
Secondary DNS Address :	0.0.0.0
PPPoE Control Bytes Sent :	168
PPPoE Control Bytes Received :	0
PPPoE Data Session Bytes Sent :	0
PPPoE Data Session Bytes Received :	0

Attribute	Meaning
IP address	This field displays the IP address of the PPPoE session initiator (situated below the SM)
PPPoE Session Status	This field displays the operational status of the PPPoE Session
PPPoE AC Name	This field displays access concentrator name used in the PPPoE session
PPPoE Service Name	This field displays the PPPoE service name associated with the PPPoE server in use
PPPoE Session ID	This field displays the current PPPoE session ID
PPPoE Session Uptime	This field displays the total session uptime for the PPPoE session
PPPoE Session Idle Time	This field displays the total idle time for the PPPoE session
PPPoE Session MTU	This field displays Maximum Transmission Unit configured for the PPPoE session
Primary DNS Address	This field displays the primary DNS server used by the PPPoE session
Secondary DNS Address	This field displays the secondary DNS server used by the PPPoE session
PPPoE Control Bytes Sent	Displays the total number of PPPoE session control bytes sent from SM
PPPoE Control Bytes Received	This field displays the total number of PPPoE session control bytes received by the SM
PPPoE Data Session Bytes Sent	This field displays the total number of PPPoE data session (non-control/non-session management user data) sent by the SM
PPPoE Data Session Bytes Received	This field displays the total number of PPPoE data session (non-control/non-session management user data)

Interpreting Bridge Control Block statistics

The Statistics > Bridge Control Block page displays statistics of Bridge FEC, Bridge ratio and Bridge error. The page is applicable for all modules (AP/SM/BHM/BHS). The Bridge Control Block Statistics page is explained in below table.

Table 148: Bridge Control Block page attributes – AP/SM/BHM/BHS

Bridge FEC Stats	
FEC bin :	437
FEC bout :	24
FEC btoss :	0
FEC btosscap :	0
FEC uin :	3915
FEC uout :	5745
FEC utoss :	0
FEC utosscap :	0

Bridge Eth Aux Stats	
Eth Aux bin :	0
Eth Aux bout :	0
Eth Aux btoss :	0
Eth Aux btosscap :	0
Eth Aux uin :	0
Eth Aux uout :	0
Eth Aux utoss :	0
Eth Aux utosscap :	0

Bridge Radio Stats	
RF bin :	3
RF bout :	441
RF unknown ucast floods :	0
RF btoss :	0
RF btosscap :	0
RF uin :	331
RF uout :	9
RF utoss :	0
RF utosscap :	0

Bridge Error Stats	
ErrNI1QSend :	0
ErrNI2QSend :	0
ErrBridgeFull :	0
ErrSendMsg :	0
ErrApFecQSend :	0
ErrApRfQSend :	0

Attribute	Meaning
Bridge FEC Stats	
FEC bin	This field indicates the number of broadcast packets received by the bridge control block on the Main Ethernet interface
FEC bout	This field indicates the number of broadcast packets sent by the bridge control block on the Main Ethernet interface
FEC btoss	This field indicates the number of broadcast packets tossed out by the bridge control block on the Main Ethernet interface

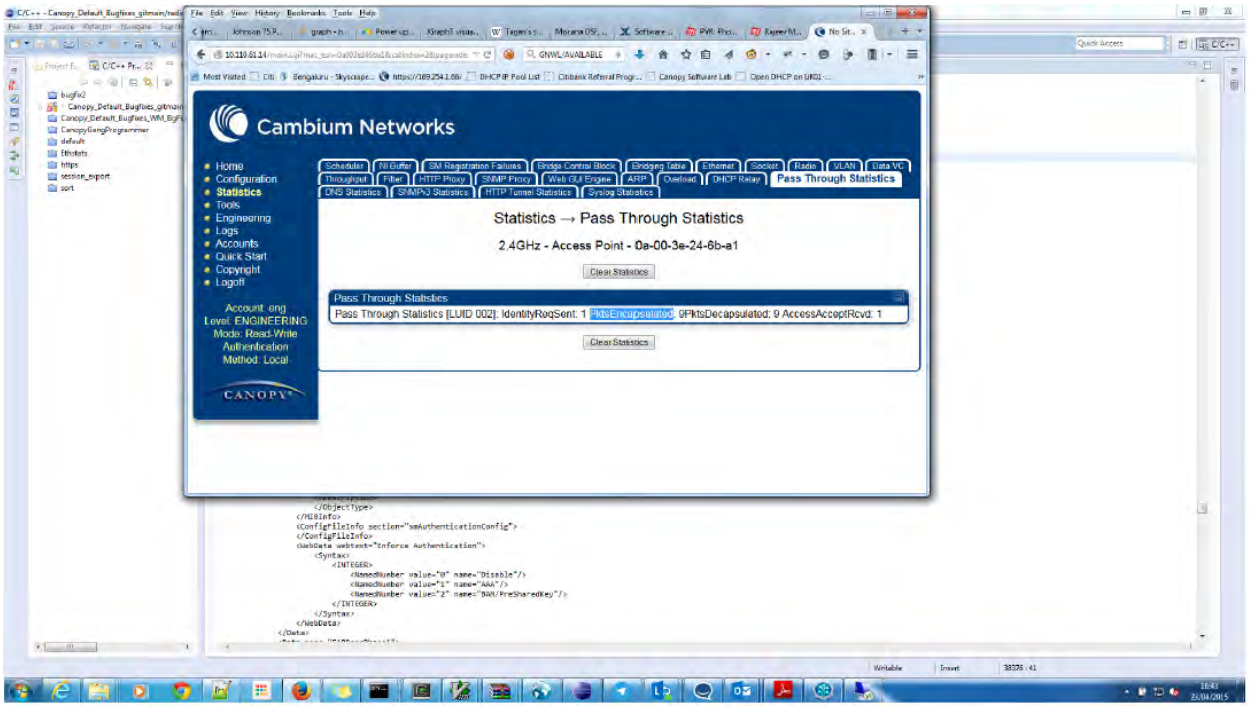
Attribute	Meaning
FEC btosscap	This field indicates the number of broadcast packets tossed out at the Main Ethernet interface due to MIR cap being exceeded.
FEC uin	This field indicates the number of unicast packets received by the bridge control block on the Main Ethernet interface
FEC uout	This field indicates the number of unicast packets sent by the bridge control block on the Main Ethernet interface
FEC utoss	This field indicates the number of unicast packets tossed by the bridge control block on the Main Ethernet interface
FEC utosscap	This field indicates the number of unicast packets tossed out at the Main Ethernet interface due to MIR cap being exceeded.
Bridge Eth Aux Stats	
FEC bin	This field indicates the number of broadcast packets received by the bridge control block on the Aux Ethernet interface
FEC bout	This field indicates the number of broadcast packets sent by the bridge control block on the Aux Ethernet interface
FEC btoss	This field indicates the number of broadcast packets tossed out by the bridge control block on the Aux Ethernet interface
FEC btosscap	This field indicates the number of broadcast packets tossed out at the Aux Ethernet interface due to MIR cap being exceeded.
FEC uin	This field indicates the number of unicast packets received by the bridge control block on the Aux Ethernet interface
FEC uout	This field indicates the number of unicast packets sent by the bridge control block on the Aux Ethernet interface
FEC utoss	This field indicates the number of unicast packets tossed by the bridge control block on the Aux Ethernet interface
FEC utosscap	This field indicates the number of unicast packets tossed out at the Aux Ethernet interface due to MIR cap being exceeded.
Bridge Radio Stats	
RF bin	This field indicates the number of broadcast packets received by the bridge control block on the radio interface
RF bout	This field indicates the number of broadcast packets sent by the bridge control block on the radio interface
RF btoss	This field indicates the number of broadcast packets tossed by the bridge control block on the radio interface
RF btosscap	This field indicates the number of broadcast packets tossed out at the radio interface due to MIR cap being exceeded.

Attribute	Meaning
RF uin	This field indicates the number of unicast packets received by the bridge control block on the radio interface
RF uout	This field indicates the number of unicast packets sent by the bridge control block on the radio interface
RF utoss	This field indicates the number of unicast packets tossed by the bridge control block on the radio interface
RF utosscap	This field indicates the number of unicast packets tossed out at the radio interface due to MIR cap being exceeded.
Bridge Error Stats	
ErrNI1QSend	This field indicates that a packet which was sourced from the radio network stack interface 1 (Ethernet interface) could not be sent because the radio bridge queue was full. The packet was tossed out.
ErrNI2QSend	This field indicates that a packet which was sourced from the radio network stack interface 2 (RF interface) could not be sent because the radio bridge queue was full. The packet was tossed out.
ErrBridgeFull	This field indicates the total number of times the bridging table was full and could not accept new entries.
ErrSendMsg	This field displays the error message from bridge core call back routine.
ErrApFecQSend	This field indicates that a packet which was received on the Ethernet interface could not be processed because the radio bridge queue was full and packet was tossed out.
ErrApRfQSend	This field indicates that a packet which was received on the RF interface could not be processed because the radio bridge queue was full. The packet was tossed out.

Interpreting Pass Through Statistics

The Statistics > Pass Through Statistics page displays radius related statistics. The page is applicable for PMP 450 Platform Family - AP only. The Pass Through Statistics page is explained in below table.

Table 149: Pass Through Statistics page attributes – AP



Attribute	Meaning
IdentityReqSent	This field indicates the number of EAP Identity requests sent through the AP with respect to an SM.
PktsEncapsulated	This field indicates no of packets received from the SM which are encapsulated by the AP.
PktsDecasulated	This field indicates no of packets received from the radius server and are decapsulated by the AP with respect to an SM
AccessAcceptRcvd	This field indicates no of RADIUS Access Accept message received by the AP with respect to an SM.

Interpreting SNMPv3 Statistics

The Statistics > SNMPv3 Statistics page displays all SNMPv3 related statistics. The page is applicable for all type of ODUs of PMP 450 Platform. The SNMPv3 Statistics page is explained in below table.

Table 150: SNMPv3 Statistics page attributes – AP

```
SNMPv3 Statistics
Statistics for snmpMPDStats group
 snmpUnknownSecurityModels = 0
 snmpInvalidMsgs = 0
 snmpUnknownPDUHandlers = 0
Statistics for usmStats group
 usmStatsUnsupportedSecLevels = 0
 usmStatsNotInTimeWindows = 0
 usmStatsUnknownUserNames = 0
 usmStatsUnknownEngineIDs = 0
 usmStatsWrongDigests = 0
 usmStatsDecryptionErrors = 0
Statistics for snmpTargetObjects group
 snmpTargetSpinLock = 0
 snmpUnavailableContexts = 0
 snmpUnknownContexts = 0
Statistics for usmUser group
 usmUserSpinLock = 0
Statistics for vacmMIBViews group
 vacmViewSpinLock = 0
Value of Globals
 engine id = 80 00 00 a1 03 0a 00 3e a0 2b c8
 engineId length = 11
 number of engine boots = 237
 time since engine is up = 54598
 next saltId = 0
 next messageId = 100
 next localPortNum = 2000
 max msg size = 1460
 default context =
 authoritative = YES
 localize keys = YES
Misc. statistics
 assertsfailed = 0
 lenassertsfailed = 0
 oidlenassertsfailed = 0
 delfailed = 0
Compile time options
 Authentication = enabled
 Privacy = enabled
 CipherEngine = disabled
 SNMP over IPv6 = disabled
```

Attribute	Meaning
Statistics for snmpMPDStats group	SNMP Message Processing and Dispatching RFC 3412
snmpUnknownSecurityModels	The total number of packets received by the SNMP engine which were dropped because they referenced a securityModel that was not known to or supported by the SNMP engine.
snmpInvalidMsgs	The total number of packets received by the SNMP engine which were dropped because there were invalid or inconsistent components in the SNMP message.

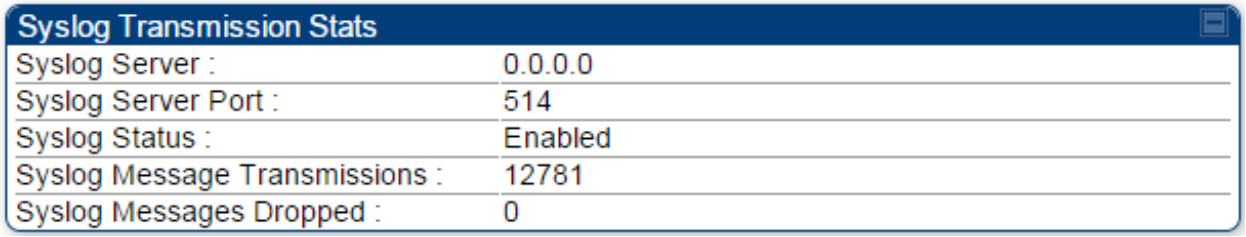
Attribute	Meaning
snmpUnknownPDUHandlers	The total number of packets received by the SNMP engine which were dropped because the PDU contained in the packet could not be passed to an application responsible for handling the pduType, e.g. no SNMP application had registered for the proper combination of the contextEngineID and the pduType.
usmStatsUnsupportedSecLevels	The total number of packets received by the SNMP engine which were dropped because they requested a securityLevel that was unknown to the SNMP engine or otherwise unavailable.
usmStatsNotInTimeWindows	The total number of packets received by the SNMP engine which were dropped because they appeared outside of the authoritative SNMP engine's window.
usmStatsUnknownUserNames	The total number of packets received by the SNMP engine which were dropped because they referenced a user that was not known to the SNMP engine.
usmStatsUnknownEngineIDs	The total number of packets received by the SNMP engine which were dropped because they referenced a snmpEngineID that was not known to the SNMP engine.
usmStatsWrongDigests	The total number of packets received by the SNMP engine which were dropped because they didn't contain the expected digest value.
usmStatsDecryptionErrors	The total number of packets received by the SNMP engine which were dropped because they could not be decrypted.
snmpTargetSpinLock	This object is used to facilitate modification of table entries in the SNMP-TARGET-MIB module by multiple managers.
snmpUnavailableContexts	The total number of packets received by the SNMP engine which were dropped because the context contained in the message was unavailable.
snmpUnknownContexts	The total number of packets received by the SNMP engine which were dropped because the context contained in the message was unknown.
usmUserSpinLock	The use of usmUserSpinlock is to avoid conflicts with another SNMP command generator application which may also be acting on the usmUserTable.

Attribute	Meaning
vacmViewSpinLock	An advisory lock used to allow cooperating SNMP Command Generator applications to coordinate their use of the Set operation in creating or modifying views.
snmpEngineBoots	It is a count of the number of times the SNMP engine has re-booted/re-initialized since snmpEngineID was last configured
snmpEngineTime time since engine is up	which is the number of seconds since the snmpEngineBoots counter was last incremented

Interpreting syslog statistics

The Statistics > Syslog Statistics page displays statistics of syslog messages. The page is applicable for all modules (AP/SM/BHM/BHS). The Syslog Statistics page is explained in below table.

Table 151: Syslog statistics page attributes – AP/SM/BH



Syslog Transmission Stats	
Syslog Server :	0.0.0.0
Syslog Server Port :	514
Syslog Status :	Enabled
Syslog Message Transmissions :	12781
Syslog Messages Dropped :	0

Attribute	Meaning
Syslog Server	This displays dotted decimal or DNS name (if the DNS is enabled) of the syslog server address.
Syslog Server Port	The syslog server port (default 514) to which syslog messaging is sent.
Syslog Status	This indicates status of syslog messaging. It can be Enable or Disabled based on configuration
Syslog Message Transmissions	This field indicates the count of syslog messages sent to UDP layer.
Syslog Message Dropped	This field indicates the count of dropped syslog messages.

CBRS Statistics for AP/SM

The **Statistics > CBRS** page displays CBRS heart beat statistics and CBRS EIRP Change History. This page is visible only on the AP/BHM. Statistics for the SMs can also be seen on this page, viewed on the AP/BHM Radio. The CBRS statistics for AP/SM page is explained in Table 1.

Figure 120: *CBRS statistics for AP*

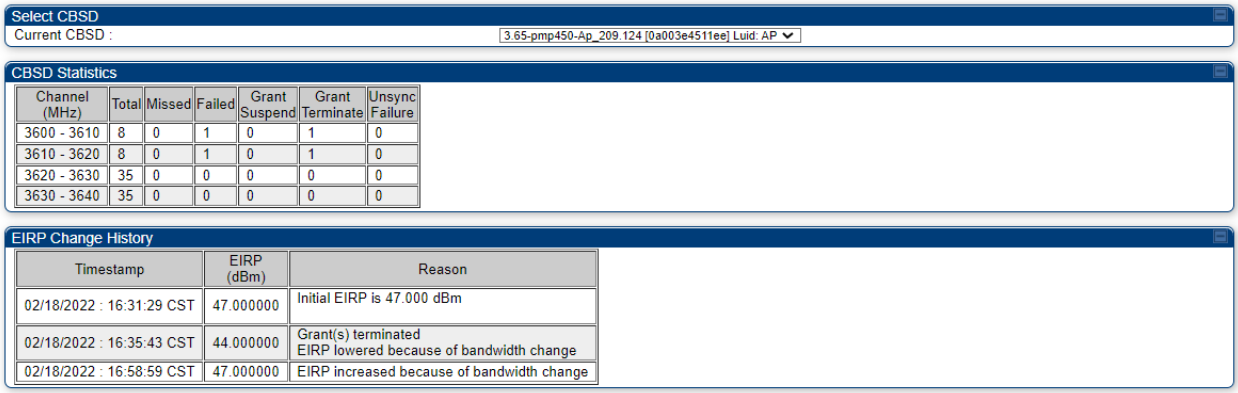
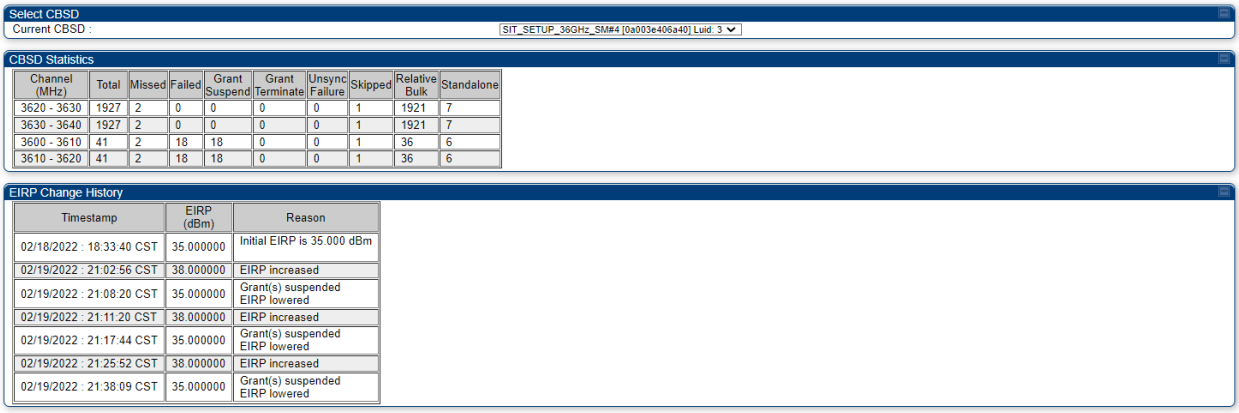


Table 152: CBRS statistics for AP

Attribute	Meaning
Select CBSD	
Current CBSD	Allows an operator to select the statistics for a particular AP/BHM.
CBSD Statistics	
Channel	The low frequency and high frequency range of a CBRS grant. Each row in the CBSD Statistics table represents a channel range for a currently active CBRS grant. Note that the statistics per row represent all the counts for all the grants in a particular channel range since the statistics were last cleared, assuming a grant is currently held for that channel range.
Total	The total count of the heartbeat requests sent, per frequency range, since the statistics were last cleared.
Missed	The AP sent a heartbeat request but did not receive a heartbeat response.
Failed	The AP received a heartbeat response with a failure code.
Grant Suspend	The total number of heartbeat responses received from the SAS, per frequency range, with reason code **suspended grant**.
Grant Terminate	The total number of heartbeat responses received from the SAS with reason code 500 – **terminated grant**. Note that as of System Release 21.0, terminated grants will immediately be removed from the table. But as mentioned previously in the **Channel** field description, the statistics show all the counts for all grants held in every channel range since the statistics were last cleared. If at any time after a grant termination, an operator moves the radio's back to the previously terminated channel range and is successful in obtaining a new grant, these counts will include the counts for the previously terminated grant as well as the newly obtained grant.
Unsync failure	The total number of heartbeat responses received from the SAS with reason code 502 – unsync failure.
EIRP Change History	

Attribute	Meaning
Timestamps	Each row in the EIRP Change History table represents a point in the time when the total EIRP for a particular CBSD was changed. The events are listed in chronological order.
EIRP	The total transmit EIRP the CBSD moved to at this point in time.
Reason	The detailed reason for that EIRP change.

Figure 121: *CBRS Statistics for SM*



Channel (MHz)	Total	Missed	Failed	Grant Suspend	Grant Terminate	Unsync Failure	Skipped	Relative Bulk	Standalone
3620 - 3630	1927	2	0	0	0	0	1	1921	7
3630 - 3640	1927	2	0	0	0	0	1	1921	7
3600 - 3610	41	2	18	18	0	0	1	36	6
3610 - 3620	41	2	18	18	0	0	1	36	6

Timestamp	EIRP (dBm)	Reason
02/18/2022 : 18:33:40 CST	35.000000	Initial EIRP is 35.000 dBm
02/19/2022 : 21:02:56 CST	38.000000	EIRP increased
02/19/2022 : 21:08:20 CST	35.000000	Grant(s) suspended EIRP lowered
02/19/2022 : 21:11:20 CST	38.000000	EIRP increased
02/19/2022 : 21:17:44 CST	35.000000	Grant(s) suspended EIRP lowered
02/19/2022 : 21:25:52 CST	38.000000	EIRP increased
02/19/2022 : 21:38:09 CST	35.000000	Grant(s) suspended EIRP lowered

Table 153: CBRS Statistics for SM

Attribute	Meaning
Select CBSD	
Current CBSD	Allows an operator to select to view statistics for a particular SM.
CBSD Statistics	
Channel	The low frequency and high frequency range of a CBRS grant. Each row in the CBSD Statistics table represents a channel range for a currently active CBRS grant. Note that the statistics per row represent all the counts for all the grants in a particular channel range since the statistics were last cleared, assuming a grant is currently held for that channel range.
Total	The total count of the heartbeat requests sent, per frequency range, since the statistics were last cleared.
Missed	The heartbeat request was sent but no response was received.
Failed	The heartbeat response was received with a failure code.
Grant Suspend	The total number of heartbeat responses received from the SAS, per frequency range, with reason code **suspended grant**.
Grant Terminate	The total number of heartbeat responses received from the SAS with reason code 500 – **terminated grant**. Note that as of PMP System Release 21.0, terminated grants will immediately be removed from the table. But as mentioned previously in the **Channel**

Attribute	Meaning
	field description, the statistics show all the counts for all grants held in every channel range since the statistics were last cleared. If at any time after a grant termination, an operator moves the Radio's back to the previously terminated channel range and is successful in obtaining a new grant, these counts will include the counts for the previously terminated grant as well as the newly obtained grant.
Unsync failure	The total number of heartbeat responses received from the SAS with reason code 502 – unsync failure.
Skipped	The AP did not include this SM in the heartbeat exchange.
Relative bulk	The total number of heartbeat requests sent for this particular SM that was included in a bulk heartbeat request with other SMs.
Standalone	The total number of heartbeat requests sent for this particular SM that was sent standalone – not part of a bulk heartbeat request with other SMs.
EIRP Change History	
Timestamps	Each row in the EIRP Change History table represents a point in the time when the total EIRP for a particular CBSD was changed. The events are listed in chronological order.
EIRP	The total transmit EIRP the CBSD moved to at this point in time.
Reason	The detailed reason for that EIRP change. Note that an "EIRP lowered" or an "EIRP increased" reason that does not mention grants is typically a user-initiated change.

Interpreting Frame Utilization statistics

The Frame Utilization Statistics is a feature helps user to understand how effectively the RF channel is being utilized. This feature allows to check Time Division Duplex (TDD) frame utilization pattern and diagnose for any excessive usage in uplink or downlink direction.

This forms the first step of identifying the TDD frame utilization information. If the user finds excessive utilization based on these stats, the second step would be to take several actions like sectorization, tuning the uplink/downlink ratio etc. to improve RF channel utilization. Efficient use of the TDD frame will help to achieve optimum performance of link.

Note

The backhauls (BHM and BHS) contain only the downlink scheduler-based statistics.

Table 154: Frame utilization statistics for 450m

MU-MIMO Utilization

Slot Grouping

Group Size	% Downlink Distribution	% Uplink Distribution
1 (ungrouped)	27.5	7.2
2	0.1	0.5
3	1.6	0.0
4	70.9	92.2

Group Forming Statistics

Number of Groups Per Frame	Downlink	Uplink
0 (ungrouped)	80.8%	77.7%
1	5.3%	22.3%
2	9.5%	N/A
3	4.5%	N/A

Additional Statistics

	Downlink	Uplink
Average MU-MIMO Group Size - Data	4.0	4.0
Multiplexing Gain	3.0	3.6

Sector Utilization

	Downlink	Uplink
SU-MIMO	7%	2%
MU-MIMO	19%	20%
ACK	1%	2%
MU-MIMO ACK		1%
Broadcast & Multicast	0%	
Total Utilization	27%	24%

Slot Counts

Uplink and Downlink Slot Counts

	Downlink		Uplink	
	Slots	%	Slots	%
Per Frame Average	7		7	
Low Priority	170082	17.7	161228	16.4
Medium Priority	0	0.0	0	0.0
High Priority	0	0.0	0	0.0
Ultra High Priority	8	0.0	163	0.0
Broadcast & Multicast	153	0.0		
Authentication and Configuration	0	0.0	0	0.0
Registration and Control	1	0.0	167	0.0
MAC Acknowledgements	8330	0.9	4579	0.5
Contention Slots Average Per Frame			37	
Bandwidth Requests Received			10487	
Bandwidth Requests Missed			9745	
Total	178574	18.6	166137	16.9

Frame Utilization

Downlink :	19 %
Uplink :	17 %
Bandwidth Request Success :	52 %

Maximum Possible Counts

Downlink :	960000
Uplink :	984000
Contention :	1056000

Packet Discard Counts

Ethernet indiscards :	0
Ethernet outdiscards :	0
Radio indiscards :	0
Radio outdiscards :	0

Attribute	Meaning
Frame Utilization Interval	
Statistics Display interval	This allows to configure timer interval to monitor and display the frame utilization statistics. It can be configured for 1 minute (low interval), 5 minutes (medium interval) or 15 minutes (high interval) based on requirement.
Next Update	This field displays when the next update will occur.
MU-MIMO Utilization	
Slot Grouping - Group Size	This specifies the distribution of group size for the past 1/5/15 minutes. For each group size, from 1 to 7, the table shows the percentage of slots using that group size. • A group size of 1 corresponds to beamformed transmissions. • A group size of 2 to 7 corresponds to MU-MIMO transmissions. Note that for 30 MHz and 40 MHz bandwidths, the UL group size is limited to 3 or smaller.
Group Forming Statistics	

Attribute	Meaning
Number of Groups Per Frame	Indicates what percentage of frames in this measurement window had the corresponding number of MU-MIMO groups per frame, and per direction. In the example shown, 5.3% of the frames had 3 different MU-MIMO groups formed. Note that this frame could also contain SU-MIMO scheduled data. The "0 ungrouped" shows the percentage of frames that had non-MUMIMO scheduled traffic at all. This frame would have only SU-MIMO scheduled traffic, and/or unused symbols. The "2" and "3" rows always show N/A in the Uplink direction because current PMP software only supports a single MU-MIMO group per frame in the Uplink direction.
Additional Statistics	
Average MU-MIMO Group Size - Data	This specifies the average number of users in the MU-MIMO groups formed in the last 1/5/15 minutes for data traffic only.
Total Utilization	This is a percentage of available timeslots used in the past 1/5/15 minutes.
Multiplexing Gain	This specifies the ratio between the number of logical slots and the number of physical slots used. A physical slot is an OFDM symbol. In non MU-MIMO mode, each logical slot is sent during one physical slot. In MU-MIMO mode a number of logical slots are sent during a physical slot, equal to the number of VCs in the group. A logical slot carries new information; if data is repeated in a group, because some VCs have more data to send then others, then the repeated transmissions are not counted as a logical slots. Without MU-MIMO operation, the multiplexing gain would always be equal to 1. With MU-MIMO operation, this number accounts for parallel transmissions to multiple users in the MU-MIMO group. The difference between the Average MU-MIMO Group Size and the Multiplexing Gain is that the Average MU-MIMO Group Size only considers the MU-MIMO groups, and it averages the number of VCs in the Group. The Multiplexing Gain also considers non MU-MIMO transmissions, which are counted as groups of size 1.
Sector Utilization	
SU-MIMO	This specifies the portion of the Total Utilization used for SU-MIMO transmissions.
MU-MIMO	This specifies the portion of the Total Utilization used for MU-MIMO transmissions.
ACK	This specifies the portion of the Total Utilization used for acknowledgments transmission.
MU-MIMO ACK	This specifies the portion of the Total Utilization used for acknowledgements transmissions that are MU-MIMO scheduled. Currently only the UL direction supports MU-MIMO scheduling of ACK's.

Attribute	Meaning
Broadcast & Multicast	This specifies the portion of the Total Utilization used for broadcast and multicast transmissions.
Slots Counts - Uplink and Downlink Slot Counts	
Per Frame Average	This indicates the average data per frame in the downlink traffic.
Low Priority	The number of downlink data slots used for low priority downlink traffic.
Medium Priority	The number of downlink data slots used for medium priority downlink traffic.
High Priority	The number of downlink data slots used for high priority downlink traffic.
Ultra High Priority	The number of downlink data slots used for ultra high priority downlink traffic.
Note: The above Low, Medium, High, and Ultra High Priority Counts are physical slot transmissions. For MU-MIMO scheduling, some transmissions can contain data from more than 1 data channel priority. In those cases, the highest data channel used is "counted" in these statistics, and the other data channels are not, to avoid overcounting.	
Broadcast & Multicast	The number of downlink data slots used for broadcast and multicast traffic.
Authentication and Configuration	The number of slots used for registration and control message transmissions
Registration and control	The number of slots used for Authentication and Configuration transmissions.
MAC Acknowledgements	The number of downlink data slots used as ACKs.
Contention Slots Average Per Frame	It is the average number of contention slots in a frame for the last duration. Duration is 1/5/15 mins.
Bandwidth Requests Received	This indicates the number of Bandwidth Requests received from SMs.
Bandwidth Requests Missed	This indicates how many of Bandwidth Requests are colliding.
Total	This indicates the sum of all downlink data slots used in the configured interval.
Frame Utilization	
Downlink	This indicates the percentage of downlink data slots used against the maximum number of slots possible in the configured interval.
Uplink	This indicates the percentage of uplink data slots used against the maximum number of uplink slots possible in the configured interval.

Attribute	Meaning
Bandwidth Request Success	The "Bandwidth Request Success" is a message sent from the SM to the AP asking to be scheduled for bandwidth to send in the uplink. This gets transmitted in the unscheduled portion of the uplink. Unscheduled uplink is defined as Contention Slots + unscheduled uplink slots. Since this is sent in the unscheduled portion of the uplink, it will result in collisions when SMs randomly pick the same slot. The "Bandwidth Request Missed" metrics are to add data to know how many of requests are colliding. If it is near 100%, then near all of the SM's bandwidth requests are getting through to the AP, so this a is near perfect scenario. If it is significantly less than that, you may be experiencing uplink latency as your SMs are attempting to request bandwidth and are unable to do so. Also note that if it is consistently at 100% the AP may be able to reduce its contention slots to a lower value and gain more data slots.
Maximum possible counts	
Downlink	This indicates the maximum possible downlink data slots in the configured interval. This is based on the configuration of Channel Bandwidth, Frame period, uplink/downlink allocation, contention slots and configured Statistics Display interval.
Uplink	This indicates the maximum possible uplink data slots in the configured interval. This is based on the configuration of Channel Bandwidth, Frame period, uplink/downlink allocation, contention slots and configured Statistics Display interval.
Contention	This indicates the maximum possible contention slots.
Packet Discard counts	
Ethernet indiscards	This indicates the number of Ethernet packets discarded in the IN queue.
Ethernet outdiscards	This indicates the number of Ethernet packets discarded in the OUT queue.
Radio indiscards	This indicates the number of packets discarded over radio in the IN queue.
Radio outdiscards	This indicates the number of packets discarded over radio in the OUT queue.

Table 155: Frame utilization statistics for 450, 450i

Frame Utilization Interval

Statistics Display Interval :	1 minute
Next Update :	23 seconds

Frame Utilization Summary

Utilization

Direction	Percentage
Downlink	0.4%
Uplink	0.5%

Spectral Efficiency (user data bits per second per hertz)

Direction	Extrapolated	8X Max	7X Max	6X Max	5X Max	4X Max	3X Max	2X Max	1X Max
Downlink	1.38	3.52	3.08	2.64	2.20	1.76	1.32	0.88	0.44
Uplink	1.53	3.60	3.15	2.70	2.25	1.80	1.35	0.90	0.45

Data to Overhead Percentage

Direction	Data	Overhead (Ack)
Downlink	60.5%	39.4%
Uplink	83.1%	16.8%

Data Per Modulation Percentage

Direction	1X	2X	3X	4X	5X	6X	7X	8X
Downlink	40.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	59.1%
Uplink	0.0%	0.0%	0.0%	98.4%	0.0%	0.0%	0.0%	1.5%

Data Per QoS Percentage

Direction	BCast	Low	Medium	High	Ultra High	AAA	Ctl
Downlink	40.8%	59.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Uplink	NA	99.7%	0.0%	0.0%	0.2%	0.0%	NA

Bandwidth Request Receive Efficiency

Percentage Received	Received	Missed	Urgent
100.0%	684	0	0

Interval Slot Count Summary

Used

Direction	Total	Data	Acknowledgements	Frame Average
Downlink	2265	1394	871	0
Uplink	2984	2483	501	0

Modulation (1X : count of slots containing 1 fragment of user data. 2X : count of slots containing 2 fragments of user data...)

Direction	Total	1X	2X	3X	4X	5X	6X	7X	8X	Average
Downlink	1394	586	0	0	0	0	0	0	808	5.0X
Uplink	2483	0	0	0	2430	23	0	0	30	4.0X

Quality of Service

Direction	Total	BCast	Low	Medium	High	Ultra High	AAA	Ctl
Downlink	1394	586	807	0	0	1	0	0
Uplink	2483	NA	2478	0	0	5	0	NA

Acknowledgements

Direction	Total	Partial
Downlink	871	0
Uplink	501	0

Contention

Total	Average Per Frame	Average Reserved	Average Effective
561016	47	3	3

Packet Discard Counts

Ethernet indiscards :	0
Ethernet outdiscards :	0
Radio indiscards :	0
Radio outdiscards :	0

Attribute	Meaning
Frame Utilization Interval	
Statistics Display interval	This allows to configure timer interval to monitor and display the frame utilization statistics. It can be configured for 1 minute (low interval), 5 minutes (medium interval) or 15 minutes (high interval) based on requirement.
Next Update	This field displays when the next update will occur.
Frame Utilization Summary	
Utilization	Total percentage used in the time interval.
Spectral Efficeincy (user data bits per second per hertz)	Provides an actual measure of how many bits per hertz per second achieved for user data in the most recent frame utilization interval.
Data to Overhead Percentage	Provides a breakdown of user data to overhead data.
Data Per Modulation Percentage	Provides a breakdown of data slots used per modulation.
Data Per QoS Percentage	Provides what percentage of used slots were due to which QoS levels. Note that “AAA” QoS refers to slots used for authentication/authorization/accounting. “Ctl” QoS refers to slots used for

Attribute	Meaning
	system level messages (registration, encryption).
Bandwidth Request Receive Efficiency	How efficient the SM's Bandwidth Request messages are getting to the AP.
Interval Slot Count Summary-Used	Provides a summary of actual slot counts rather than the percentages provided in the Frame Utilization Summary.
Used	Provides a breakdown of total slots used in each direction. It further breaks down the total between data and acks. Finally, it provides an average slots used per TDD frame.
Modulation (1X : Count of slot containing 1 fragment of user data. 2X: Count of slot containing 2 fragments of user data...)	Provides a breakdown of the number of slots used at each modulation.
Quality of Service	Provides a breakdown of the number of slots used at each QoS level.
Aknowledgements	Provides the number of slots used for acks. It also provides a new count called **Partial.**
Contention	
Total	The total number of slots available for contention in this statistics time interval. This includes both slots reserved for contention and unused uplink data slots.
Average Per Frame	The average number of total slots available for contention. This includes both slots reserved for contention and unused uplink data slots. This is calculated by dividing the total count by the number of frames in the statistics time interval.
Average Reserved	The average number of slots reserved for contention per frame. These slots cannot be used for uplink data. This statistic is only applicable when auto-contention is enabled.
Average Effective	In addition to adjusting the number of slots available for contention, contention space collisions can also be controlled by adjusting the timing of when bandwidth requests can be sent by the SM. This effective statistic takes into account both the timing backoff and the number of slots reserved for contention. This statistic is only applicable when auto-contention is enabled.
Packet Discard counts	
Ethernet indiscards	This indicates the number of Ethernet packets discarded in the IN queue.
Ethernet outdiscards	This indicates the number of Ethernet packets discarded in the OUT queue.
Radio indiscards	This indicates the number of packets discarded over radio in the IN queue.
Radio outdiscards	This indicates the number of packets discarded over radio in the OUT queue.

Interpreting Channel Change History statistics

The Channel Change History statistics are available for all PMP AP and BHM products. For non-CBRS deployments, the Authorized Grants column is not be visible, and only user-triggered channel change reasons are displayed.

Figure 122: *The Channel Change History statistics for AP and BHM*

Channel Change History

Center Frequency (MHz)	Bandwidth (MHz)	Timestamp	Reason
5165.000	5.0	04/26/2024 : 11:15:25 CST	Channel change triggered by user
5167.500	5.0	04/26/2024 : 11:15:42 CST	Channel change triggered by user
5170.000	5.0	04/26/2024 : 11:15:59 CST	Channel change triggered by user
5172.500	5.0	04/26/2024 : 11:16:15 CST	Channel change triggered by user
5175.000	5.0	04/26/2024 : 11:16:33 CST	Channel change triggered by user
5177.500	5.0	04/26/2024 : 11:16:50 CST	Channel change triggered by user
5180.000	5.0	04/26/2024 : 11:17:06 CST	Channel change triggered by user
5182.500	5.0	04/26/2024 : 11:17:22 CST	Channel change triggered by user
5185.000	5.0	04/26/2024 : 11:17:40 CST	Channel change triggered by user
5187.500	5.0	04/26/2024 : 11:17:56 CST	Channel change triggered by user
5190.000	5.0	04/26/2024 : 11:18:13 CST	Channel change triggered by user
5192.500	5.0	04/26/2024 : 11:18:29 CST	Channel change triggered by user
5880.000	5.0	05/01/2024 : 15:54:23 CST	Channel change triggered by user
5880.000	20.0	05/02/2024 : 16:14:21 CST	Channel change triggered by user

Table 156: The Channel Change History statistics for AP and BHM

Attribute	Meaning
Center frequency	The center frequency of the operating channel for the sector. For example, if a CBRS AP holds four 10 MHz multigrants ranging in frequency from 3580 through 3620, the first, second, and fourth 10 MHz channels are authorized while the third channel was suspended, 3590 would be the center frequency displayed here.
Bandwidth	The bandwidth of the operating channel for the sector. For example, if a CBRS AP holds four 10 MHz multigrants ranging in frequency from 3580 through 3620, the first, second, and fourth 10 MHz channels are authorized while the third channel was suspended, 20 MHz would be the bandwidth displayed here.
Timestamp	The time that the AP/BHM switch to the Center Frequency and Bandwidth displayed in this row. The channel changes are displayed in chronological order, with the newest changes at the bottom of the table.
Reason	The particular reason for the channel change. For example, CBRS grant termination.

Interpreting Spatial Utilization statistics

Figure 123: *Spatial Utilization statistics*

Spatial Utilization

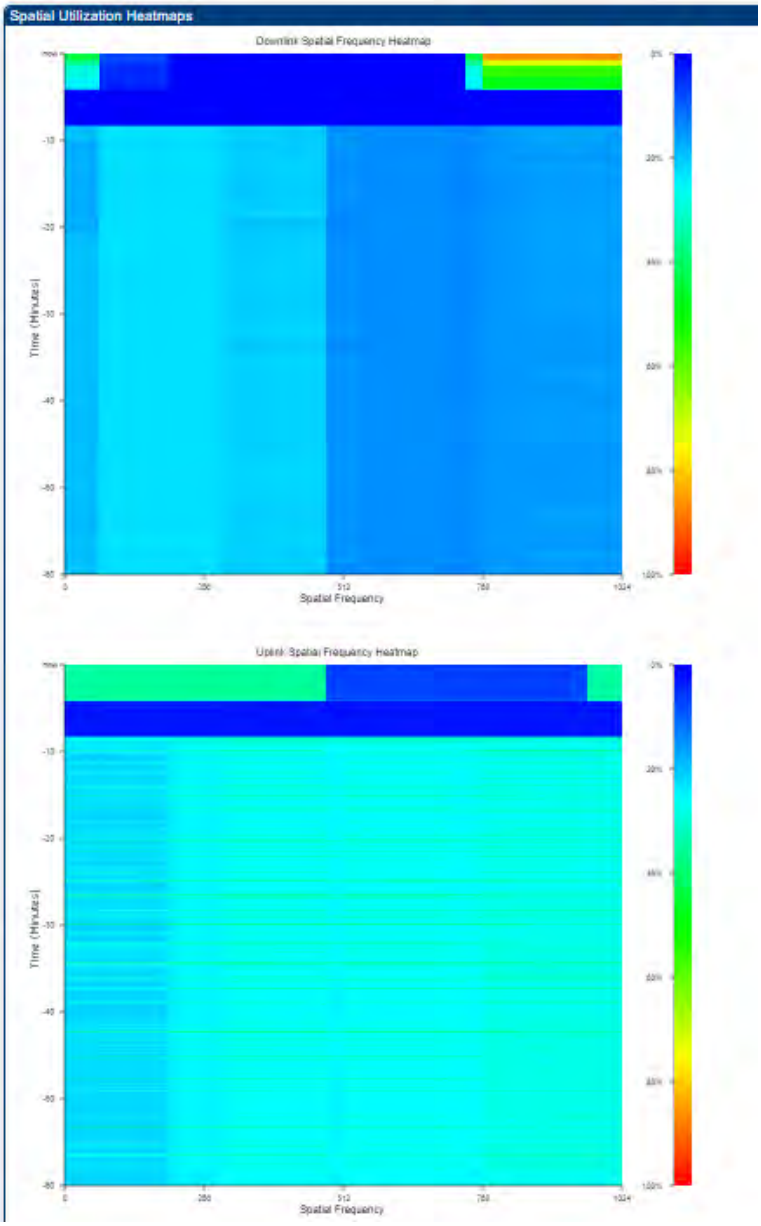
Instantaneous Distribution

Group	Downlink	
	Median Slot Count	LUIDs in Group
Top LUID	3584	19
Top 2 LUIDs	3584	18
Top 4 LUIDs	3584	15, 16
Top 8 LUIDs	3584	4, 5, 7, 9
Top 16 LUIDs	3428	2, 3, 6, 8, 10, 12, 21, 22
Top 32 LUIDs	3368	11, 13, 14, 17, 20
Top 64 LUIDs	0	
Top 128 LUIDs	0	
Top 256 LUIDs	0	

Spatial Utilization

Spatial Frequency	LUIDs in Range	Downlink				Azimuth (degrees)
		Instantaneous (%)	Total (%)	Max (%)	Min (%)	
0 - 31	2	100	100	100	99	(-50.7 - -49.3) , (0.0 - 1.4) , (50.7 - 52.0)
32 - 63	5	100	100	100	99	(-49.3 - -47.9) , (1.4 - 2.8) , (52.0 - 53.4)
64 - 95	9	100	100	100	99	(-47.9 - -46.5) , (2.8 - 4.2) , (53.4 - 54.8)
96 - 127		100	100	100	99	(-46.5 - -45.1) , (4.2 - 5.5) , (54.8 - 56.2)
128 - 159	14	100	100	100	99	(-45.1 - -43.7) , (5.5 - 6.9) , (56.2 - 57.6)
160 - 191		100	100	100	99	(-43.7 - -42.3) , (6.9 - 8.3) , (57.6 - 59.0)
192 - 223	8	100	100	100	99	(-42.3 - -40.9) , (8.3 - 9.7) , (59.0 - 60.0)
224 - 255	19	100	100	100	99	(-40.9 - -39.5) , (9.7 - 11.1)
256 - 287	11	100	100	100	99	(-39.5 - -38.1) , (11.1 - 12.6)
288 - 319		100	100	100	99	(-38.1 - -36.7) , (12.6 - 14.0)
320 - 351	22	100	100	100	99	(-36.7 - -35.2) , (14.0 - 15.4)
352 - 383	18	100	100	100	99	(-35.2 - -33.8) , (15.4 - 16.9)
384 - 415		100	100	100	99	(-33.8 - -32.3) , (16.9 - 18.3)
416 - 447	3	100	100	100	99	(-32.3 - -30.9) , (18.3 - 19.8)
448 - 479	6	100	100	100	99	(-30.9 - -29.4) , (19.8 - 21.3)
480 - 511		100	100	100	99	(-29.4 - -27.9) , (21.3 - 22.7)
512 - 543	4	100	100	100	99	(-27.9 - -26.4) , (22.7 - 24.3)
544 - 575		100	100	100	99	(-26.4 - -24.9) , (24.3 - 25.8)
576 - 607	17	100	100	100	99	(-24.9 - -23.3) , (25.8 - 27.3)
608 - 639	10	100	100	100	99	(-23.3 - -21.8) , (27.3 - 28.9)
640 - 671		100	100	100	99	(-21.8 - -20.2) , (28.9 - 30.5)
672 - 703	7	100	100	100	99	(-20.2 - -18.5) , (30.5 - 32.1)
704 - 735	20	100	100	100	99	(-18.5 - -16.9) , (32.1 - 33.8)
736 - 767		100	100	100	99	(-16.9 - -15.2) , (33.8 - 35.5)
768 - 799	12	100	100	100	99	(-15.2 - -13.5) , (35.5 - 37.2)
800 - 831		100	100	100	99	(-13.5 - -11.7) , (37.2 - 38.9)
832 - 863	16	100	100	100	99	(-11.7 - -9.9) , (38.9 - 40.7)
864 - 895	13	100	100	100	99	(-60.0 - -58.7) , (-9.9 - -8.1) , (40.7 - 42.6)
896 - 927	21	100	100	100	99	(-58.7 - -56.8) , (-8.1 - -6.2) , (42.6 - 44.5)
928 - 959		100	100	100	99	(-56.8 - -54.8) , (-6.2 - -4.2) , (44.5 - 46.5)
960 - 991	15	100	100	100	99	(-54.8 - -52.8) , (-4.2 - -2.1) , (46.5 - 48.5)
992 - 1023		100	100	100	99	(-52.8 - -50.7) , (-2.1 - 0.0) , (48.5 - 50.7)

Spatial Frequency Heatmap



Attribute	Meaning
Instantaneous Distribution	This table is updated every 500 ms and displays the following: • Group: Each row corresponds to the top (most active) 1, 2, 8, 16, 32, 64, 128 and 256 VCs. • Median Slot Count: Median value of the average number of slots scheduled for the VCs in each group in the past 500 ms.
	• LUIDs in Group: List of LUIDs belonging to each bin.

Attribute	Meaning
Spatial Utilization	This is a table (32 rows) that lists frame utilization for each spatial frequency (SF) range with following information: • Spatial Frequency: Range of spatial frequency for each bin. Each bin includes 32 consecutive spatial frequency values. • Azimuth (degrees): Azimuth range in degrees corresponding to the spatial frequencies of the bin. The zero-degree Azimuth is boresight. Note Some SF ranges correspond to multiple azimuth ranges. This is because for some spatial frequencies the AP generates beams in multiple azimuth directions. The SM can be physically located in any of the azimuth ranges.
Spatial Utilization (Contd.)	1. **Instantaneous (%)**: Frame utilization for the SF bin, updated every 500 ms. The frame utilization percentage accounts for all traffic, sector mode, beamforming mode, and MU-MIMO mode. 2. **Total (%)**: Average utilization in the SF bin for the past 1/5/15 minutes, as selected in the Statistics Display interval. 3. **Max (%)**: Maximum instantaneous utilization in the 1/5/15 minute interval. 4. **Min (%)**: Minimum instantaneous utilization in the 1/5/15 minute interval. 5. **VCs in Range**: List of VCs with spatial frequency falling in the bin. 6. **LUIDs in Range**: List of LUIDs with spatial frequency falling in the bin. **Note** The size of each SF bin is smaller than the beam generated by the AP during a MU-MIMO transmission. This means that when a VC in a bin is scheduled for a MU-MIMO transmission, the adjacent bins also receive the signal, and the transmission is counted towards their utilization as well. Bins with consistent low utilization indicate the areas of the sector where more SMs could be installed, or the cutomers that could be offered higher data plans.
Spacial Frequency Heatmap	The spatial frequency heatmap allow the operator to see how the 450m spatial frequency have been occupied (utilised) over the previous hour of operation. There are two heatmaps the first displays downlink utilisation and the lower the uplink utilisation. The heatmaps are useful when operators are identifying: • congested spatial directions • spare capacity in spatial directions The heatmap uses a graduated colour scale to represent the percentage utilisation. The graphic to the right-hand side of the heatmap should be used as a key to interpret the GUI. Where dark blue represents zero percent utilisation and red represents 100% utilisation.

Radio Recovery

This section describes:

- How to recover a PMP/PTP 450i and PMP 450m Series ODUs from configuration errors or software image corruption
- How to override a PMP/PTP 450 Series ODUs from forgotten IP address and password to factory default

Radio Recovery Console– PMP/PTP 450i/450b and PMP 450m

Recovery mode allows to restore IP address and password. Also, it allows new main application software to be loaded even when the integrity of the existing main application software image has been compromised. The most likely cause of an integrity problem with the installed main application software is where the power supply has been interrupted during a software upgrade.

> **Note**
>
> When Recovery has been entered through a power on/off/on cycle, the ODU will revert to normal operation if no web access has been made to the unit within 30 seconds. This prevents the unit remaining inadvertently in recovery following a power outage.

Options in recovery mode are:

- Boot with normal operation
- Boot with default Canopy system software settings
- Load a previous SW image

The last most recent software images loaded to the board are retained. However the factory image is not retained.

Boot with default Canopy system software settings (similar to the hardware Default Plug based on 450 Platforms Family).

> **Note**
>
> The unit may enter recovery console automatically, in response to some failures.

> **Note**
>
> Once the unit has entered recovery, it will switch back to normal operation if no access has been made to the recovery web page within 30 seconds.

Use below procedure to enter in recovery console manually.

Procedure 27 Radio Recovery Console:

1	Apply power to PSU for at least 10 seconds.
2	Remove power from the PSU, and then re-apply it as soon as the power indicator light goes out (about 1 - 2 seconds).
3	When the unit is in recovery mode, access the web interface by entering the default IP address 169.254.1.1. The Recovery Image Warning page is displayed.
4	Review the Boot Selection (Recovery Options attributes).
5	Select a recovery option

Figure 124: *Recovery Options page*

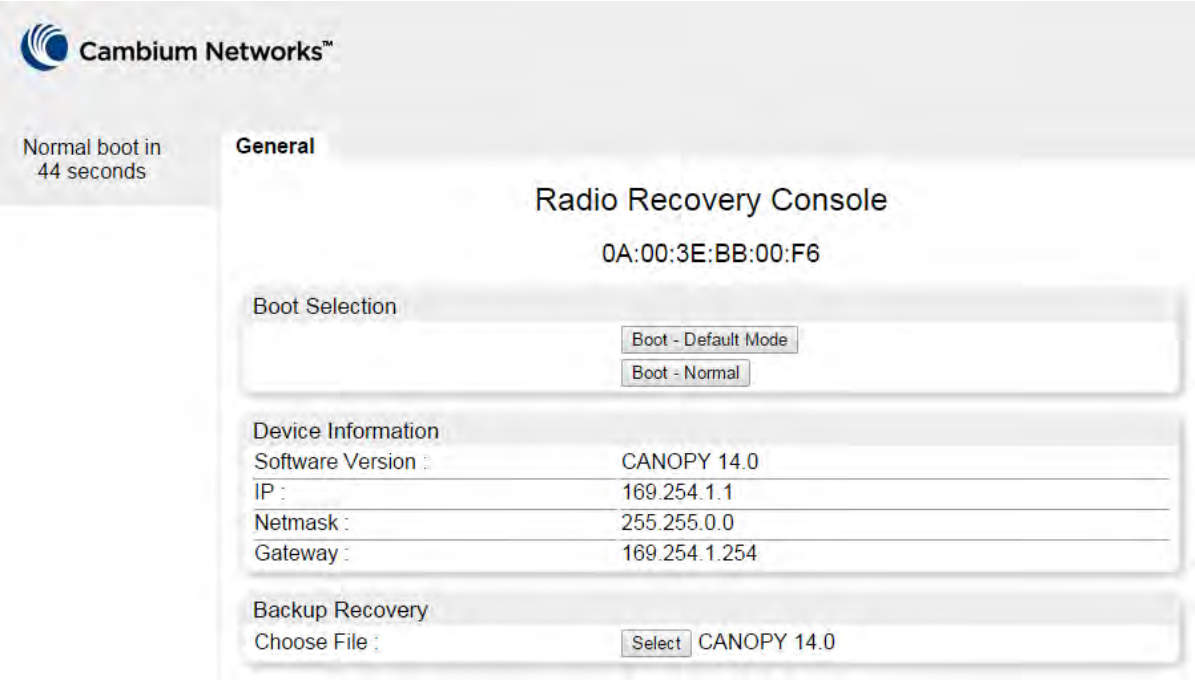


Table 157: Recovery Options attributes

Attribute	Meaning
Boot Selection	Boot – Default Mode: Use this option to temporarily set the IP and Ethernet attributes to factory defaults until the next reboot. Boot – Normal: Use this option to reboot the unit.
IP address, Netmask, Gateway	These fields display IP address, Netmask and Gateway of the radio while it is in recovery or default mode.

Note

The radio enters recovery mode when a short power cycle is used. The radio will boot normally if power has been removed for a longer period (typically 5 - 10 seconds).

Default Mode (or Default/Override Plug) - PMP/PTP 450 Series

The default mode allows to temporarily override some PMP/PTP 450 Series ODU settings and thereby regain control of the module by powering the module on with the Default Plug inserted into the unit's synchronization (RJ11) port.

This override plug is needed for access to the module in any of the following cases:

- You have forgotten either

- the IP address assigned to the ODU.
- the password that provides access to the ODU.
- The ODU has been locked by the No Remote Access feature.
- You want local access to a module that has had the 802.3 link disabled in the Configuration page.

You can configure the module such that, when it senses the override plug, it responds by either

- resetting the LAN1 IP address to 169.254.1.1, allowing access through the default configuration without changing the configuration, whereupon you will be able to view and reset any non-default values as you wish.
- resetting all configurable parameters to their factory default values.

Note

The Default Plug is available from Best-Tronics Manufacturing, Inc.
See https://btpa.com/Cambium-Products/ as Part BT-0583 (RJ-11 Default Plug).
Alternatively, you can fabricate an override plug. See Override plug cable in Planning and Installation Guide for pinout.

Using the Default/Override Plug

The following section details usage of the override plug to regain access to PMP/PTP 450 Series ODU.

Note

While the override plug is connected to a PMP/PTP 450 Series ODU, the ODU can neither register nor allow registration of another ODU.

Note

Since the 900 MHz SM is based on the 450 Series, it only supports the "Default Plug" mode of overriding.

Use below procedure to enter in default mode manually.

Procedure 28 Default mode

1	Insert the override plug into the RJ-11 GPS utility port of the module.
2	Power cycle by removing, then re-inserting, the Ethernet cable. RESULT: The module boots with the default IP address of 169.254.1.1, password fields blank, and all other configuration values as previously set.
3	Wait approximately 30 seconds for the boot to complete.
4	Remove the override plug.
5	Set passwords and IP address as desired.
6	Change configuration values if desired.
7	Click the Save Changes button.
8	Click the Reboot button.

Chapter 4: Reference information

This chapter contains reference information and regulatory notices that apply to the 450 Platform Family ODUs.

The following topics are described in this chapter:

- Equipment specifications contains specifications of the 450 Platform Family, ODU specifications including RF bands, channel width and link loss.
- Data network specifications shows the 450 Platform Family Ethernet interface specifications.
- Wireless specifications lists the safety specifications against which 450 Platform Family ODU has been tested and certified. It also describes how to keep RF exposure within safe limits.
- Country specific radio regulations describes how the 450 Platform Family complies with the radio regulations that are enforced in various countries.
- Equipment Disposal describes the Equipment Disposal system for Electronic and Electric Equipment.

Equipment specifications

This section contains specifications of the AP, SM, BHM and BHS associated supplies required for 450 Platform Family installations.

Specifications for 5/6 GHz 450v Series - AP

The 5/6 GHz 450v AP conforms to the specifications listed in below table.

Table 158: 5/6 GHz 450v Series - AP specifications

Category	Specification
Model Number	450v AP
Channel Spacing	Configurable on 2.5 MHz increments
Frequency Range	5125 to 7125 MHz
Channel Bandwidth	5, 10, 15, 20, 30, and 40 MHz
Interface	
MAC (Media Access Control) Layer	Cambium Proprietary
Physical Layer	2x2 MIMO OFDM
Ethernet Interface	100/1000BASE-T, full duplex, rate auto negotiated (802.3 compliant)
Protocols Used	IPv4, IPv6, UDP, TCP/IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management	IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestro

Category		Specification
MTU		1700 bytes
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	5.1 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.2 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.4 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.8 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	U-NII-5	1x = -88.2 dBm, 2x = -85.5 dBm, 3x = -81.6 dBm, 4x = -79.0 dBm, 5x = -75.7 dBm, 6x = -72.8 dBm, 7x = -69.0 dBm, 8x = -64.0 dBm
	U-NII-7	1x = -88.3 dBm, 2x = -84.8 dBm, 3x = -80.8 dBm, 4x = -78.4 dBm, 5x = -75.1 dBm, 6x = -72.3 dBm, 7x = -69.1 dBm, 8x = -64.8 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	5.1 GHz	1x = -85.0 dBm, 2x = -81.0 dBm, 3x = -76.9 dBm, 4x = -75.0 dBm, 5x = -72.3 dBm, 6x = -69.0 dBm, 7x = -66.4 dBm, 8x = -62.0 dBm
	5.2 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.6 dBm, 4x = -76.2 dBm, 5x = -73.0 dBm, 6x = -70.0 dBm, 7x = -67.0 dBm, 8x = -63.0 dBm
	5.4 GHz	1x = -86.5 dBm, 2x = -82.5 dBm, 3x = -78.5 dBm, 4x = -76.2 dBm, 5x = -73.1 dBm, 6x = -70.4 dBm, 7x = -66.6 dBm, 8x = -63.4 dBm
	5.8 GHz	1x = -86.5 dBm, 2x = -82.5 dBm, 3x = -78.5 dBm, 4x = -76.2 dBm, 5x = -73.1 dBm, 6x = -70.4 dBm, 7x = -66.6 dBm, 8x = -63.4 dBm
	U-NII-5	1x = -87.7 dBm, 2x = -82.5 dBm, 3x = -78.3 dBm, 4x = -75.8 dBm, 5x = -73.0 dBm, 6x = -69.7 dBm, 7x = -66.7 dBm, 8x = -62.8 dBm
	U-NII-7	1x = -86.4 dBm, 2x = -82.3 dBm, 3x = -77.6 dBm, 4x = -75.5 dBm, 5x = -72.2 dBm, 6x = -69.3 dBm, 7x = -65.4 dBm, 8x = -61.3 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	5.1 GHz	1x = -82.0 dBm, 2x = -78.0 dBm, 3x = -73.6 dBm, 4x = -72.0 dBm, 5x = -69.5 dBm, 6x = -67.0 dBm, 7x = -64.0 dBm, 8x = -59.0 dBm		
	5.2 GHz	1x = -81.0 dBm, 2x = -78.0 dBm, 3x = -75.4 dBm, 4x = -73.0 dBm, 5x = -69.5 dBm, 6x = -67.0 dBm, 7x = -63.7 dBm, 8x = -59.0 dBm		
	5.4 GHz			
	5.8 GHz	1x = -81.0 dBm, 2x = -78.0 dBm, 3x = -75.4 dBm, 4x = -73.0 dBm, 5x = -69.5 dBm, 6x = -67.0 dBm, 7x = -63.7 dBm, 8x = -59.0 dBm		
	U-NII-5	1x = -82.0 dBm, 2x = -79.3 dBm, 3x = -75.2 dBm, 4x = -73.0 dBm, 5x = -69.9 dBm, 6x = -66.9 dBm, 7x = -63.4 dBm, 8x = -59.0 dBm		
	U-NII-7	1x = -82.0 dBm, 2x = -78.0 dBm, 3x = -74.6 dBm, 4x = -72.5 dBm, 5x = -68.9 dBm, 6x = -66.0 dBm, 7x = -62.8 dBm, 8x = -58.4 dBm		
Performance				
Subscriber Per Sector		Up to 238		
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms, 5 ms		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		3x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	20
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3-5 ms, typical		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via embedded GPS, or Cambium Sync		
Quality of Service		Diffserv QoS		
Link Budget				

Category	Specification
Antenna Beam Width	90° integrated sector (Dual polarity, H+V)
Antenna Gain	+16 dBi
Maximum EIRP	+48 dBm
Physical	
Ports	• Main PoE: 1 GbE • Aux: 1 GbE • SFP optical: 10 GbE • GPS • Reset
Antenna Connection	Integrated Sector antenna
Surge Suppression (with LPU)	EN 61000-4-5: 10x700 µs, 6 kV, EN 61000-4-2: ESD 8 kV contact / 15 kV air Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure	> 40 Years
Environmental	IP66, IP67
Temperature / Humidity	-40°C to +60°C (-40°F to +140°F) 0-100% condensing
Wind Survival	200 kph (124 mph)
Weight	6.3 kg (13.9 lbs), 9.1 kg (20 lbs) with bracket
Wind Loading – Front Facing	@90 mph / 144 kph 376 N
	@110 mph /177 kph 562 N
Dimension (HxWxD)	673 x 222 x 134 mm (26.5 x 8.75 x 5.3 in.)
Power Consumption	45W Typical, 55W Max, Using Aux port PoE for another device will increase power draw
Input Voltage	48-59 VDC, 802.3bt type 4 class 8 (also accepting passive PoE)
Mounting	Pole mount with included brackets
Security	
Encryption	FIPS-197 128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for 5 GHz PMP 450m Series - AP

The 5 GHz PMP 450m AP conforms to the specifications listed in below table.

Table 159: 5 GHz PMP 450m Series - AP specifications

Category		Specification
Model Number		PMP 450m AP
Spectrum		
Channel Spacing		Configurable on 2.5 MHz increments
Frequency Range		4900 to 5925 MHz
Channel Bandwidth		5, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		14x14 Multi-User MIMO OFDM
Ethernet Interface		100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -99.4 dBm, 2x = -96.9 dBm, 4x = -90.5 dBm, 6x = -84.3 dBm, 8x = -76.9 dBm
	5.1 GHz	1x = -100.6 dBm, 2x = -97 dBm, 4x = -90.5 dBm, 6x = -84 dBm, 8x = -76.3 dBm
	5.2 GHz	1x = -100.5 dBm, 2x = -96.7 dBm, 4x = -90.1 dBm, 6x = -83.7 dBm, 8x = -76.1 dBm
	5.4 GHz	1x = -101.2 dBm, 2x = -96.2 dBm, 4x = -90.3 dBm, 6x = -83.9 dBm, 8x = -76.5 dBm
	5.8 GHz	1x = -100.8 dBm, 2x = -96.5 dBm, 4x = -90.3 dBm, 6x = -84 dBm, 8x = -76.3 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -97.5 dBm, 2x = -94.8 dBm, 4x = -88.4 dBm, 6x = -82.3 dBm, 8x = -75.1 dBm
	5.1 GHz	1x = -97.9 dBm, 2x = -94.3 dBm, 4x = -87.8 dBm, 6x = -81.5 dBm, 8x = -74.2 dBm
	5.2 GHz	1x = -97.9 dBm, 2x = -93.9 dBm, 4x = -87.4 dBm, 6x = -81.1 dBm, 8x = -73.9 dBm
	5.4 GHz	1x = -98.1 dBm, 2x = -94.1 dBm, 4x = -87.5 dBm, 6x = -81.3 dBm, 8x = -74.2 dBm
	5.8 GHz	1x = -98.4 dBm, 2x = -94.3 dBm, 4x = -87.8 dBm, 6x = -81.5 dBm, 8x = -74.4 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -96 dBm, 2x = -93.2 dBm, 4x = -86.7 dBm, 6x = -80.3 dBm, 8x = -73.5 dBm
	5.1 GHz	1x = -96.5 dBm, 2x = -92.8 dBm, 4x = -86.4 dBm, 6x = -80 dBm, 8x = -72.8 dBm
	5.2 GHz	1x = -96.4 dBm, 2x = -92.2 dBm, 4x = -85.4 dBm, 6x = -79.1 dBm, 8x = -72.2 dBm
	5.4 GHz	1x = -96.7 dBm, 2x = -92.4 dBm, 4x = -85.7 dBm, 6x = -79.4 dBm, 8x = -72.6 dBm
	5.8 GHz	1x = -97.4 dBm, 2x = -92.8 dBm, 4x = -86.2 dBm, 6x = -80 dBm, 8x = -73 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -94.7 dBm, 2x = -92.1 dBm, 4x = -85.5 dBm, 6x = -79.2 dBm, 8x = -72.5 dBm
	5.1 GHz	1x = -95.2 dBm, 2x = -91.5 dBm, 4x = -85.1 dBm, 6x = -78.7 dBm, 8x = -71.7 dBm
	5.2 GHz	1x = -95.2 dBm, 2x = -91.3 dBm, 4x = -84.8 dBm, 6x = -78.5 dBm, 8x = -71.5 dBm
	5.4 GHz	1x = -95.6 dBm, 2x = -90.8 dBm, 4x = -84.8 dBm, 6x = -78.5 dBm, 8x = -71.5 dBm
	5.8 GHz	1x = -96.3 dBm, 2x = -91.3 dBm, 4x = -85.2 dBm, 6x = -78.8 dBm, 8x = -71.6 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -92.6 dBm, 2x = -89.9 dBm, 4x = -83.6 dBm, 6x = -77.4 dBm, 8x = -70.9 dBm		
	5.1 GHz	1x = -93.1 dBm, 2x = -89.0 dBm, 4x = -83.0 dBm, 6x = -76.7 dBm, 8x = -69.8 dBm		
	5.2 GHz	1x = -93.1 dBm, 2x = -88.7 dBm, 4x = -82.5 dBm, 6x = -76.2 dBm, 8x = -69.4 dBm		
	5.4 GHz	1x = -93.6 dBm, 2x = -89.1 dBm, 4x = -82.9 dBm, 6x = -76.5 dBm, 8x = -69.7 dBm		
	5.8 GHz	1x = -94.1 dBm, 2x = -89.4 dBm, 4x = -83.2 dBm, 6x = -76.8 dBm, 8x = -69.9 dBm		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	4.9 GHz	1x = -91.5 dBm, 2x = -88.8 dBm, 4x = -82.5 dBm, 6x = -76.3 dBm, 8x = -69.7 dBm		
	5.1 GHz	1x = -92.1 dBm, 2x = -88.1 dBm, 4x = -82.0 dBm, 6x = -75.5 dBm, 8x = -68.2 dBm		
	5.2 GHz	1x = -92.0 dBm, 2x = -87.7 dBm, 4x = -81.7 dBm, 6x = -75.3 dBm, 8x = -67.9 dBm		
	5.4 GHz	1x = -92.7 dBm, 2x = -87.4 dBm, 4x = -81.8 dBm, 6x = -75.4 dBm, 8x = -68.2 dBm		
	5.8 GHz	1x = -93.0 dBm, 2x = -87.9 dBm, 4x = -82.1 dBm, 6x = -75.6 dBm, 8x = -68.1 dBm		
Performance				
Subscriber Per Sector		Up to 238		
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms, 5 ms		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		4x	16-QAM	17
		6x	64-QAM	24
		8x	256-QAM	32
Latency		10 ms, typical (MU-MIMO introduces additional latency for the traffic that is MU-MIMO scheduled.)		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (UGPS)		

Category		Specification
Quality of Service		Diffserv QoS
Link Budget		
Antenna Beam Width	5 GHz	90° integrated sector (Dual polarity, H+V)
Antenna Gain		+14 dBi
Maximum EIRP		+48 dBm
Physical		
Data, Sync/AUX and SFP port	RJ45	• 1000BASE-T Ethernet Data • AUX port for UGPS or PoE out to 802.3at
Antenna Connection		Integrated Sector Array
Surge Suppression (with LPU)		EN61000-4-5: 1.2 us/50 us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000065L007B
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F) 0-95% non-condensing
Weight	Integrated	Approx. 14.2 kg (31 bs)
Wind Loading – Front Facing		@90 mph / 144 kph 376 N
		@110 mph /177 kph 562 N
Dimension (HxWxD)	Integrated	52 x 65 x 11 cm (20.3” x 25.7” x 4.4”)
Power Consumption		70 W typical, 80 W peak (up to 110 W max with AUX port PoE enabled)
Input Voltage		58 V, 1.7 A
Mounting		Pole mount with included brackets
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for 3 GHz PMP 450m Series - AP

The 3 GHz PMP 450m AP conforms to the specifications listed in below table.

Table 160: 3 GHz PMP 450m Series - AP specifications

Category		Specification
Model Number		3 GHz PMP 450m AP
Spectrum		
Channel Spacing		Customizable channel selection to 50kHz raster
Frequency Range		3300 – 3980 MHz
Channel Bandwidth		5, 7, 10, 15, 20, 30 and 40MHz
Interface		
MAC (Media Access Control) Layer		Cambium Networks Proprietary
Physical Layer		8x8 Multi-User MIMO OFDM
Ethernet Interface		100/1000BaseT, full duplex, rate auto negotiated (802.3 compliant), dual SFP support for 1 Gbps optical
Protocols Used		IPv4, IPv6, UDP, TCP/IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestroTM
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	3.5 GHz	1x = -97.6 dBm, 2x = -95 dBm, 4x = -88.7 dBm, 6x = -82.5 dBm, 8x = -75 dBm
	3.6 GHz	1x = -96.9 dBm, 2x = -94.4 dBm, 4x = -88.1 dBm, 6x = -81.7 dBm, 8x = -74 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	1x = -96.1 dBm, 2x = -93.4 dBm, 4x = -87.1 dBm, 6x = -81.1 dBm, 8x = -74.7 dBm
	3.6 GHz	1x = -96 dBm, 2x = -92.9 dBm, 4x = -86.6 dBm, 6x = -80.6 dBm, 8x = -73.6 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	3.5 GHz	1x = -95.2 dBm, 2x = -92.8 dBm, 4x = -86.4 dBm, 6x = -80.3 dBm, 8x = -73.2 dBm
	3.6 GHz	1x = -94.6 dBm, 2x = -92.5 dBm, 4x = -86 dBm, 6x = -79.6 dBm, 8x = -72.8 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	3.5 GHz	1x = -93.6 dBm, 2x = -91.1 dBm, 4x = -84.6 dBm, 6x = -78.4 dBm, 8x = -71.8 dBm		
	3.6 GHz	1x = -92.8 dBm, 2x = -90.4 dBm, 4x = -84 dBm, 6x = -78 dBm, 8x = -71.1 dBm		
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	3.5 GHz	1x = -92.3 dBm, 2x = -89.8 dBm, 4x = -83.4 dBm, 6x = -77.2 dBm, 8x = -70.7 dBm		
	3.6 GHz	1x = -91.5 dBm, 2x = -89.3 dBm, 4x = -82.9 dBm, 6x = -76.5 dBm, 8x = -70 dBm		
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -89.7 dBm, 2x = -87.2 dBm, 4x = -81.1 dBm, 6x = -74.8 dBm, 8x = -68.7 dBm		
	3.6 GHz	1x = -89 dBm, 2x = -86.6 dBm, 4x = -80.7 dBm, 6x = -74.4 dBm, 8x = -68.1 dBm		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -88.7 dBm, 2x = -86.3 dBm, 4x = -80.1 dBm, 6x = -73.7 dBm, 8x = -67.4 dBm		
	3.6 GHz	1x = -88 dBm, 2x = -85.5 dBm, 4x = -79.5 dBm, 6x = -73.3 dBm, 8x = -66.7 dBm		
Performance				
Subscriber Per Sector		Up to 238		
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms, 5 ms		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		4x	16-QAM	17
		6x	64-QAM	24
		8x	256-QAM	32
Latency		10 ms, typical		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (UGPS, CMM5 (GPS only, no power))		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width (Azimuth)		90° integrated sector (3dB rolloff), 120° (6dB rolloff), (dual slant polarity, ±45°		

Category		Specification	
Antenna Beam Width (Elevation)		2° Electrical Downtilt, 8° Elevation (with Null Fill)	
Antenna Gain		+16 dBi	
Maximum EIRP		+58 dBm (or up to maximum allowed by regulation)	
Physical			
Data ports Main port Aux port SFP port 1 SFP port 2	RJ45 RJ45 SFP SFP	1000BASE-T Ethernet Data 100BASE-T with 802.3at PoE out; UGPS power/sync Single channel SFP, 1 Gbps Dual channel SFP, 1 Gbps	
Power	4-pin	DC power input	
Antenna Connection		Integrated Sector Array	
Surge Suppression (with LPU)		MAIN and AUX ports: EN61000-4-5: 10/700us, 4 kV voltage waveform. Recommended external surge suppressor: Model # C000065L007B DC IN port: EN61000-4-5: 1.2/50us, 2 kV/4 kV. Recommended external surge suppressor: Model # C000000L114A	
Mean Time Between Failure		> 40 Years	
Environmental		IP66, IP67	
Temperature / Humidity		-40°C to +76°C (-40°F to +169°F) / 100% condensing	
Weight	Integrated	Without Mounting Brackets: 20.4 kg (45 lbs) With Mounting Brackets: 22.6 kg (49.8 lbs)	
Wind Loading – Front Facing		@90 mph / 144 kph	521 N
		@110 mph /177 kph	787 N
		@124 mph/ 200kph	986 N
Dimension (HxWxD)	Integrated	69 x 61 x 17.5 cm (27.2” x 24” x 7”)	
Power Consumption		140 W typical, 150 W peak (up to 180 W max with AUX port PoE enabled)	
Input Voltage		40 - 60 V DC	
Mounting		Pole mount with included brackets (1.25″ to 4″ pole diameter)	

Category		Specification
Security		
Encryption		FIPS-197 128-bit AES, Optional 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450i Series - AP

The PMP 450i AP conforms to the specifications listed in below table.

Table 161: PMP 450i Series - AP specifications

Category		Specification
Model Number		PMP 450i AP
Spectrum		
Channel Spacing		5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		902 to 928 MHz
		3300 - 3900 MHz
		4900 - 5925 MHz
Channel Bandwidth	902 – 928 MHz	5, 7, 10, 15, and 20 MHz
	3300 - 3900 MHz	5, 7, 10, 15, 20, 30, and 40 MHz
	4900 – 5925 MHz	5, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz	1x = -91.9 dBm, 2x = -87.29 dBm, 3x = -83.38 dBm, 4x = -81.34 dBm, 5x = -78.41 dBm, 6x = -75.42 dBm, 7x = -72.46 dBm, 8x = -68.58 dBm
	3.5 GHz	1x = -93 dBm, 2x = -89.3 dBm, 3x = -84.9 dBm, 4x = -82.6 dBm, 5x = -79.2 dBm, 6x = -76.1 dBm, 7x = -72.3 dBm, 8x = -68.2 dBm
	3.6 GHz	1x = -92.4 dBm, 2x = -87.5 dBm, 3x = -83.6 dBm, 4x = -81.0 dBm, 5x = -78.2 dBm, 6x = -75.0 dBm, 7x = -72.0 dBm, 8x = -67.2 dBm
	4.9 GHz	1x = -91.6 dBm, 2x = -87.6 dBm, 3x = -83.0 dBm,4x = -80.4 dBm, 5x = -77.2 dBm, 6x = -74.3 dBm, 7x = -71.0 dBm, 8x = -66.3 dBm
	5.1 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66 dBm
	5.2 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66.0 dBm
	5.4 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66.0 dBm
	5.8 GHz	1x = -90.5 dBm, 2x = -86.0 dBm, 3x = -82.0 dBm, 4x = -80.0 dBm, 5x = -76.3 dBm, 6x = -73.6 dBm, 7x = -70.0 dBm, 8x = -66.1 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 MHz	1x = -89.31 dBm, 2x = -85.32 dBm, 3x = -82.35 dBm, 4x = -80.35 dBm, 5x = -77.43 dBm, 6x = -74.36 dBm, 7x = -71.53 dBm, 8x = -67.47 dBm
	3.5 GHz	1x = -92.0 dBm, 2x = -87.7 dBm, 3x = -82.6 dBm, 4x = -80.4 dBm, 5x = -77.5 dBm, 6x = -74.5 dBm, 7x = -71.1 dBm, 8x = -66.2 dBm
	3.6 GHz	1x = -90.6 dBm, 2x = -87.0 dBm, 3x = -82.1 dBm, 4x = -80.0 dBm, 5x = -77.0 dBm, 6x = -73.5 dBm, 7x = -70.0 dBm, 8x = -66.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -89.47 dBm, 2x = -84.61 dBm, 3x = -81.71 dBm, 4x = -78.77 dBm, 5x = -75.82 dBm, 6x = -73.69 dBm, 7x = -70.78 dBm, 8x = -66.76 dBm
	3.5 GHz	1x = -90.2 dBm, 2x = -86.2 dBm, 3x = -82.0 dBm, 4x = -79.9 dBm, 5x = -76.3 dBm, 6x = -73.2 dBm, 7x = -70.0 dBm, 8x = -65.2 dBm
	3.6 GHz	1x = -90.0 dBm, 2x = -85.0 dBm, 3x = -81.0 dBm, 4x = -78.8 dBm, 5x = -75.3 dBm, 6x = -72.8 dBm, 7x = -69.0 dBm, 8x = -65.0 dBm
	4.9 GHz	1x = -88.8 dBm, 2x = -84.2 dBm, 3x = -80.0 dBm, 4x = -77.9 dBm, 5x = -74.3 dBm, 6x = -71.4 dBm, 7x = -68.3 dBm, 8x = -64.0 dBm
	5.1 GHz	1x = -88.6 dBm, 2x = -84.7 dBm, 3x = -79.7 dBm, 4x = -78.0 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -67.6 dBm, 8x = -64.6 dBm
	5.2 GHz	1x = -88.6 dBm, 2x = -84.7 dBm, 3x = -79.7 dBm, 4x = -78.0 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -67.6 dBm, 8x = -64.6 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.6 dBm, 4x = -77.8 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -68.0 dBm, 8x = -63.8 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.6 dBm, 4x = -77.8 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -68.0 dBm, 8x = -63.8 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	900 MHz	1x = -88.5 dBm, 2x = -83.56 dBm, 3x = -79.67 dBm, 4x = -75.58 dBm, 5x = -74.66 dBm, 6x = -71.57 dBm, 7x = -68.64 dBm, 8x = -65.61 dBm
	3.5 GHz	1x = -89.0 dBm, 2x = -84.4 dBm, 3x = -80.2 dBm, 4x = -78.0 dBm, 5x = -74.9 dBm, 6x = -72.0 dBm, 7x = -68.1 dBm, 8x = -63.8 dBm
	3.6 GHz	1x = -88.0 dBm, 2x = -83.6 dBm, 3x = -79.0 dBm, 4x = -77.0 dBm, 5x = -74.0 dBm, 6x = -71.1 dBm, 7x = -67.1 dBm, 8x = -63.1 dBm
	4.9 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -78.2 dBm, 4x = -76.2 dBm, 5x = -73.0 dBm, 6x = -69.6 dBm, 7x = -66.3 dBm, 8x = -62.6 dBm
	5.1 GHz	1x = -87.5 dBm, 2x = -82.9 dBm, 3x = -78.5 dBm, 4x = -76.5 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.8 dBm, 8x = -62.8 dBm
	5.2 GHz	1x = -87.5 dBm, 2x = -82.9 dBm, 3x = -78.5 dBm, 4x = -76.5 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.8 dBm, 8x = -62.8 dBm
	5.4 GHz	1x = -85.6 dBm, 2x = -82.4 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.5 dBm, 6x = -69.5 dBm, 7x = -66.2 dBm, 8x = -62.2 dBm
	5.8 GHz	1x = -86.0 dBm, 2x = -81.5 dBm, 3x = -77.5 dBm, 4x = -75.5 dBm, 5x = -72.4 dBm, 6x = -69.2 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -86.51 dBm, 2x = -82.51 dBm, 3x = -78.56 dBm, 4x = -75.58 dBm, 5x = -72.61 dBm, 6x = -70.55 dBm, 7x = -67.64 dBm, 8x = -63.54 dBm
	3.5 GHz	1x = -87.4 dBm, 2x = -83.0 dBm, 3x = -78.8 dBm, 4x = -76.9 dBm, 5x = -73.2 dBm, 6x = -69.9 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm
	3.6 GHz	1x = -86.8 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.9 dBm, 8x = -61.6 dBm
	4.9 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.1 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.2 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.4 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.8 GHz	1x = -85.8 dBm, 2x = -80.7 dBm, 3x = -77.2 dBm, 4x = -74.6 dBm, 5x = -71.5 dBm, 6x = -68.7 dBm, 7x = -64.9 dBm, 8x = -61.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -86.0 dBm, 2x = -81.4 dBm, 3x = -77.0 dBm, 4x = -74.9 dBm, 5x = -71.9 dBm, 6x = -68.0 dBm, 7x = -64.3 dBm, 8x = -60.0 dBm
	3.6 GHz	1x = -84.8 dBm, 2x = -80.5 dBm, 3x = -75.8 dBm, 4x = -73.9 dBm, 5x = -70.8 dBm, 6x = -68.0 dBm, 7x = -64.1 dBm, 8x = -60.0 dBm
	4.9 GHz	1x = -84.1 dBm, 2x = -80.0 dBm, 3x = -76.0 dBm, 4x = -73.0 dBm, 5x = -70.2 dBm, 6x = -66.4 dBm, 7x = -63.2 dBm, 8x = -59.6 dBm
	5.1 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.2 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.8 GHz	1x = -83.2 dBm, 2x = -79.2 dBm, 3x = -74.1 dBm, 4x = -73.0 dBm, 5x = -69.3 dBm, 6x = -66.2 dBm, 7x = -63.0 dBm, 8x = -59.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -83.9 dBm, 2x = -79.5 dBm, 3x = -75.0 dBm, 4x = -73.0 dBm, 5x = -70.0 dBm, 6x = -67.0 dBm, 7x = -63.0 dBm, 8x = -58.5 dBm
	3.6 GHz	1x = -83.4 dBm, 2x = -79.0 dBm, 3x = -74.6 dBm, 4x = -72.4 dBm, 5x = -69.0 dBm, 6x = -66.0 dBm, 7x = -63.0 dBm, 8x = -58.0 dBm
	4.9 GHz	1x = -83.0 dBm, 2x = -78.9 dBm, 3x = -74.2 dBm, 4x = -72.0 dBm, 5x = -69.2 dBm, 6x = -66.0 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.1 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.2 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.4 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.8 GHz	1x = -81.8 dBm, 2x = -78.4 dBm, 3x = -73.6 dBm, 4x = -71.6 dBm, 5x = -68.2 dBm, 6x = -65.2 dBm, 7x = -61.7 dBm, 8x = -57.0 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms
Modulation Levels (Adaptive)		Modulation Levels / SNR (in dB)
		2x / QPSK / 10
		3x / 8-QAM / 14
		4x / 16-QAM / 17
		5x / 32-QAM / 21
		6x / 64-QAM / 24
		7x / 128-QAM / 28
		8x / 256-QAM / 32
Latency		2.5 - 5 ms
Maximum Deployment Range		Up to 40 miles (64 km) Up to 120 miles (190 km) for 900 MHz

Category		Specification
GPS Synchronization		Yes, via Autosync (CMM4), via UGPS
Quality of Service		Diffserv QoS
Link Budget		
Antenna Beam Width	900 MHz	65° sector antenna (Dual Slant)
	3 GHz	90° sector for integrated (Dual polarity, slant +45° and -45°)
	5 GHz	90° (3 dB roll off) sector for integrated (Dual polarity, H+V)
Antenna Gain (Does not include cable loss, ~1dB)	900 MHz	13 dBi
	3 GHz	17 dBi integrated 90° sector or external
	5 GHz	17 dBi integrated 90° sector or external
Transmit Power Range		-27 dB dynamic range (to EIRP limit by region) (1 dB step)
Maximum Transmit Power		+27 dBm combined output (for 5 GHz) +25 dBm combined output (for 3 GHz) +25 dBm combined output (for 900MHz)
Physical		
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output (planned for future release) • Sync input or output (Connection and powering of UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2 us/50 us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)

Category		Specification
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension (HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.3” x 5.3” x 3.3”)
	Integrated	37.0 x 37.0 x 6.3 cm (14.5” x 14.5” x 3.2”)
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450 MicroPoP - AP

The PMP 450 MicroPoP conforms to the specifications listed in below table.

Table 162: PMP 450 MicroPoP Series - AP specifications

Category	Specification
Model Number	PMP 450 MicroPoP AP
Spectrum	
Channel Spacing	5, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range	4900 – 5925 MHz
Channel Bandwidth	5, 10, 15, 20, 30, and 40 MHz
Interface	
MAC (Media Access Control) Layer	Cambium Proprietary
Physical Layer	2x2 MIMO OFDM
Ethernet Interface	10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used	IPv4, IPv6, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management	IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestro

Category		Specification
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz	1x = -91.9 dBm, 2x = -87.29 dBm, 3x = -83.38 dBm, 4x = -81.34 dBm, 5x = -78.41 dBm, 6x = -75.42 dBm, 7x = -72.46 dBm, 8x = -68.58 dBm
	3.5 GHz	1x = -93 dBm, 2x = -89.3 dBm, 3x = -84.9 dBm, 4x = -82.6 dBm, 5x = -79.2 dBm, 6x = -76.1 dBm, 7x = -72.3 dBm, 8x = -68.2 dBm
	3.6 GHz	1x = -92.4 dBm, 2x = -87.5 dBm, 3x = -83.6 dBm, 4x = -81.0 dBm, 5x = -78.2 dBm, 6x = -75.0 dBm, 7x = -72.0 dBm, 8x = -67.2 dBm
	4.9 GHz	1x = -91.6 dBm, 2x = -87.6 dBm, 3x = -83.0 dBm,4x = -80.4 dBm, 5x = -77.2 dBm, 6x = -74.3 dBm, 7x = -71.0 dBm, 8x = -66.3 dBm
	5.1 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66 dBm
	5.2 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66.0 dBm
	5.4 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.0 dBm, 4x = -80.3 dBm, 5x = -76.6 dBm, 6x = -73.5 dBm, 7x = -70.6 dBm, 8x = -66.0 dBm
	5.8 GHz	1x = -90.5 dBm, 2x = -86.0 dBm, 3x = -82.0 dBm, 4x = -80.0 dBm, 5x = -76.3 dBm, 6x = -73.6 dBm, 7x = -70.0 dBm, 8x = -66.1 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -89.47 dBm, 2x = -84.61 dBm, 3x = -81.71 dBm, 4x = -78.77 dBm, 5x = -75.82 dBm, 6x = -73.69 dBm, 7x = -70.78 dBm, 8x = -66.76 dBm
	3.5 GHz	1x = -90.2 dBm, 2x = -86.2 dBm, 3x = -82.0 dBm, 4x = -79.9 dBm, 5x = -76.3 dBm, 6x = -73.2 dBm, 7x = -70.0 dBm, 8x = -65.2 dBm
	3.6 GHz	1x = -90.0 dBm, 2x = -85.0 dBm, 3x = -81.0 dBm, 4x = -78.8 dBm, 5x = -75.3 dBm, 6x = -72.8 dBm, 7x = -69.0 dBm, 8x = -65.0 dBm
	4.9 GHz	1x = -88.8 dBm, 2x = -84.2 dBm, 3x = -80.0 dBm, 4x = -77.9 dBm, 5x = -74.3 dBm, 6x = -71.4 dBm, 7x = -68.3 dBm, 8x = -64.0 dBm
	5.1 GHz	1x = -88.6 dBm, 2x = -84.7 dBm, 3x = -79.7 dBm, 4x = -78.0 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -67.6 dBm, 8x = -64.6 dBm
	5.2 GHz	1x = -88.6 dBm, 2x = -84.7 dBm, 3x = -79.7 dBm, 4x = -78.0 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -67.6 dBm, 8x = -64.6 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.6 dBm, 4x = -77.8 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -68.0 dBm, 8x = -63.8 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.6 dBm, 4x = -77.8 dBm, 5x = -74.6 dBm, 6x = -71.5 dBm, 7x = -68.0 dBm, 8x = -63.8 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	900 MHz	1x = -88.5 dBm, 2x = -83.56 dBm, 3x = -79.67 dBm, 4x = -75.58 dBm, 5x = -74.66 dBm, 6x = -71.57 dBm, 7x = -68.64 dBm, 8x = -65.61 dBm
	3.5 GHz	1x = -89.0 dBm, 2x = -84.4 dBm, 3x = -80.2 dBm, 4x = -78.0 dBm, 5x = -74.9 dBm, 6x = -72.0 dBm, 7x = -68.1 dBm, 8x = -63.8 dBm
	3.6 GHz	1x = -88.0 dBm, 2x = -83.6 dBm, 3x = -79.0 dBm, 4x = -77.0 dBm, 5x = -74.0 dBm, 6x = -71.1 dBm, 7x = -67.1 dBm, 8x = -63.1 dBm
	4.9 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -78.2 dBm, 4x = -76.2 dBm, 5x = -73.0 dBm, 6x = -69.6 dBm, 7x = -66.3 dBm, 8x = -62.6 dBm
	5.1 GHz	1x = -87.5 dBm, 2x = -82.9 dBm, 3x = -78.5 dBm, 4x = -76.5 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.8 dBm, 8x = -62.8 dBm
	5.2 GHz	1x = -87.5 dBm, 2x = -82.9 dBm, 3x = -78.5 dBm, 4x = -76.5 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.8 dBm, 8x = -62.8 dBm
	5.4 GHz	1x = -85.6 dBm, 2x = -82.4 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.5 dBm, 6x = -69.5 dBm, 7x = -66.2 dBm, 8x = -62.2 dBm
	5.8 GHz	1x = -86.0 dBm, 2x = -81.5 dBm, 3x = -77.5 dBm, 4x = -75.5 dBm, 5x = -72.4 dBm, 6x = -69.2 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -86.51 dBm, 2x = -82.51 dBm, 3x = -78.56 dBm, 4x = -75.58 dBm, 5x = -72.61 dBm, 6x = -70.55 dBm, 7x = -67.64 dBm, 8x = -63.54 dBm
	3.5 GHz	1x = -87.4 dBm, 2x = -83.0 dBm, 3x = -78.8 dBm, 4x = -76.9 dBm, 5x = -73.2 dBm, 6x = -69.9 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm
	3.6 GHz	1x = -86.8 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.7 dBm, 6x = -69.5 dBm, 7x = -65.9 dBm, 8x = -61.6 dBm
	4.9 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.1 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.2 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.4 GHz	1x = -85.5 dBm, 2x = -81.6 dBm, 3x = -77.3 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.6 dBm, 7x = -64.8 dBm, 8x = -61.0 dBm
	5.8 GHz	1x = -85.8 dBm, 2x = -80.7 dBm, 3x = -77.2 dBm, 4x = -74.6 dBm, 5x = -71.5 dBm, 6x = -68.7 dBm, 7x = -64.9 dBm, 8x = -61.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -86.0 dBm, 2x = -81.4 dBm, 3x = -77.0 dBm, 4x = -74.9 dBm, 5x = -71.9 dBm, 6x = -68.0 dBm, 7x = -64.3 dBm, 8x = -60.0 dBm
	3.6 GHz	1x = -84.8 dBm, 2x = -80.5 dBm, 3x = -75.8 dBm, 4x = -73.9 dBm, 5x = -70.8 dBm, 6x = -68.0 dBm, 7x = -64.1 dBm, 8x = -60.0 dBm
	4.9 GHz	1x = -84.1 dBm, 2x = -80.0 dBm, 3x = -76.0 dBm, 4x = -73.0 dBm, 5x = -70.2 dBm, 6x = -66.4 dBm, 7x = -63.2 dBm, 8x = -59.6 dBm
	5.1 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.2 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -83.0 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.5 dBm, 5x = -70.0 dBm, 6x = -66.6 dBm, 7x = -63.6 dBm, 8x = -59.0 dBm
	5.8 GHz	1x = -83.2 dBm, 2x = -79.2 dBm, 3x = -74.1 dBm, 4x = -73.0 dBm, 5x = -69.3 dBm, 6x = -66.2 dBm, 7x = -63.0 dBm, 8x = -59.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -83.9 dBm, 2x = -79.5 dBm, 3x = -75.0 dBm, 4x = -73.0 dBm, 5x = -70.0 dBm, 6x = -67.0 dBm, 7x = -63.0 dBm, 8x = -58.5 dBm
	3.6 GHz	1x = -83.4 dBm, 2x = -79.0 dBm, 3x = -74.6 dBm, 4x = -72.4 dBm, 5x = -69.0 dBm, 6x = -66.0 dBm, 7x = -63.0 dBm, 8x = -58.0 dBm
	4.9 GHz	1x = -83.0 dBm, 2x = -78.9 dBm, 3x = -74.2 dBm, 4x = -72.0 dBm, 5x = -69.2 dBm, 6x = -66.0 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.1 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.2 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.4 GHz	1x = -82.0 dBm, 2x = -78.5 dBm, 3x = -74.0 dBm, 4x = -72.4 dBm, 5x = -68.6 dBm, 6x = -65.3 dBm, 7x = -62.3 dBm, 8x = -57.0 dBm
	5.8 GHz	1x = -81.8 dBm, 2x = -78.4 dBm, 3x = -73.6 dBm, 4x = -71.6 dBm, 5x = -68.2 dBm, 6x = -65.2 dBm, 7x = -61.7 dBm, 8x = -57.0 dBm

Category		Specification		
Performance				
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3-5 ms with 2.5 ms frame, 7-10 ms with 5 ms frame		
Maximum Deployment Range		Up to 2 miles (3.2 k) With license key up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4), via UGPS		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width	Omni	360-degree integrated omni (dual polarity, vertical and horizontal)		
	Sector	90-degree integrated (dual polarity, vertical and horizontal)		
	Connectorized	Gain of external antenna		
Antenna Gain	Omni	9 dBi		
	Sector	13 dBi		
	Connectorized	Gain of external antenna		
Transmit Power Range		54 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm		
Physical				
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output (planned for future release)		

Category		Specification
		• Sync input or output (Connection and powering of UGPS Sync input)
Surge Suppression		EN61000-4-5: 10x700us, 4kV, EN 61000-4-2: ESD 30 kV contact / 30 kV air
Mean Time Between Failure		> 40 Years
Environmental		IP67
Temperature / Humidity	Omni	-40C to +60C (-40F to +140F) 0-95% non-condensing
	Sector	-40C to +60C (-40F to +140F) 0-100% condensings
Weight	Omni	1.2 kg (includes mounting bracket)
	Sector	2 kg (includes mounting bracket)
	Connectorized	0.9 kg (includes mounting bracket)
Wind Survival	Omni	200 km/Hr
	Sector	200 km/Hr
	Connectorized	200 km/Hr
Dimension (HxWxD)	Omni	56 x 9 x 9 cm (22'' x 3.5'' x 3.5''), mount standoff 11 cm (4.3'')
	Sector	31 x 17 x 10 cm (12'' x 6.7'' x 3.7''), mount standoff 11 cm (4.3'')
	Connectorized	24 x 4 x 9 cm (9.5"x1.5"x3.5")
Power Consumption		9 W typical, 12 W peak
Input Voltage		48-59 V DC, 802.3at compatible
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		128-bit AES and 256-bit AES **Note** AES-256 requires a license key.

Specifications for PMP/PTP 450b Retro - SM

The PMP/PTP 450b Retro conforms to the specifications listed in below table.

Table 163: PMP/PTP 450b Retro Series - SM specifications

Category		Specification
Model Number		PMP 450b Retro SM
Spectrum		
Channel Spacing		5, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		4900 – 5925 MHz
Channel Bandwidth		5, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, IPv6, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestro
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -89.7 dBm, 2x = -84.8 dBm, 3x = -80.7 dBm, 4x = -78.4 dBm, 5x = -75.7 dBm, 6x = -72.0 dBm, 7x = -68.8 dBm, 8x = -64.2 dBm
	5.2 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -83.4 dBm, 4x = -80.8 dBm, 5x = -77.6 dBm, 6x = -74.2 dBm, 7x = -71.6 dBm, 8x = -67.0 dBm
	5.4 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -84.0 dBm, 4x = -82.3 dBm, 5x = -79.0 dBm, 6x = -75.9 dBm, 7x = -72.3 dBm, 8x = -68.0 dBm
	5.8 GHz	1x = -92.1 dBm, 2x = -87.9 dBm, 3x = -84.3 dBm, 4x = -82.1 dBm, 5x = -79.0 dBm, 6x = -75.4 dBm, 7x = -72.0 dBm, 8x = -68.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel		
	4.9 GHz	1x = -89.7 dBm, 2x = -84.8 dBm, 3x = -80.7 dBm, 4x = -78.4 dBm, 5x = -75.7 dBm, 6x = -72.0 dBm, 7x = -68.8 dBm, 8x = -64.2 dBm
	5.1 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.2 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.4 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm
	5.8 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -88.0 dBm, 2x = -83.7 dBm, 3x = -78.9 dBm, 4x = -76.6 dBm, 5x = -74.0 dBm, 6x = -70.4 dBm, 7x = -67.8 dBm, 8x = -63.0 dBm
	5.1 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.2 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -86.3 dBm, 2x = -81.3 dBm, 3x = -77.2 dBm, 4x = -75.4 dBm, 5x = -72.2 dBm, 6x = -69.0 dBm, 7x = -66.0 dBm, 8x = -61.4 dBm
	5.1 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.2 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.4 GHz	1x = -86.5 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -75.6 dBm, 5x = -72.6 dBm, 6x = -69.1 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm
	5.8 GHz	1x = -86.5 dBm, 2x = -82.2 dBm, 3x = -77.9 dBm, 4x = -75.9 dBm, 5x = -72.8 dBm, 6x = -69.2 dBm, 7x = -66.2 dBm, 8x = -62.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -84.5 dBm, 2x = -80.0 dBm, 3x = -76.2 dBm, 4x = -74.1 dBm, 5x = -70.8 dBm, 6x = -67.7 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.1 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.2 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm
	5.8 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	4.9 GHz	1x = -82.9 dBm, 2x = -79.0 dBm, 3x = -75.0 dBm, 4x = -72.4 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -63.0 dBm, 8x = -56.4 dBm		
	5.1 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm		
	5.2 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm		
	5.4 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm		
	5.8 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm		
Performance				
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		4x	16-QAM	17
		6x	64-QAM	24
		8x	256-QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		PMP mode: up to 40 miles (64 km)		
GPS Synchronization		Yes, synchronized by Access Point		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		60 degrees		
Antenna Gain		9 dBi		
Transmit Power Range		54 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm		
Physical				

Category		Specification
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output (planned for future release) • Sync input or output (Connection and powering of UGPS Sync input)
Surge Suppression		EN61000-4-5: 10x700us, 4kV, EN 61000-4-2: ESD 30 kV contact / 30 kV air
Mean Time Between Failure		> 40 Years
Environmental		IP55
Temperature / Humidity		-40C to +60C (-40F to +140F) 0-95% non-condensing
Weight		0.4 kg (1 lb.) (includes mounting bracket)
Wind Survival		200 km/hour (124 mi/hour)
Dimension (HxWxD)		28.6 x 8.9 x 8.9 cm (11.25'' x 3.5'' x 3.5'')
Power Consumption		9 W typical, 12 W peak
Input Voltage		48-59 V DC, 802.3at compatible
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for 450v Series - SM

The 450v SM conforms to the specifications listed in below table.

Table 164: 450v Series - SM specifications

Category	Specification
Model Number	450v SM
Spectrum	
Channel Spacing	Configurable on 2.5 MHz increments
Frequency Range	5.150 GHz - 7.125 GHz
Channel Bandwidth	5, 10, 15, 20, 30, and 40 MHz
Interface	

Category		Specification
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		100/1000BASE-T, full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, IPv6, UDP, TCP/IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestro
MTU		1700 bytes
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/FEC) @ 10 MHz Channel	5.1 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.2 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.4 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	5.8 GHz	1x = -89.0 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -79.3 dBm, 5x = -76.2 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	U-NII-5	1x = -87.0 dBm, 2x = -85.9 dBm, 3x = -81.7 dBm, 4x = -79.0 dBm, 5x = -75.9 dBm, 6x = -72.8 dBm, 7x = -69.8 dBm, 8x = -64.8 dBm
	U-NII-7	1x = -87.7 dBm, 2x = -84.8 dBm, 3x = -80.7 dBm, 4x = -78.5 dBm, 5x = -75.0 dBm, 6x = -72.0 dBm, 7x = -68.5 dBm, 8x = -64.0 dBm
Nominal Receive Sensitivity (w/FEC) @ 20 MHz Channel	5.1 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.0 dBm, 4x = -75.6 dBm, 5x = -72.6 dBm, 6x = -69.5 dBm, 7x = -66.6 dBm, 8x = -62.6 dBm
	5.2 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.0 dBm, 4x = -76.1 dBm, 5x = -73.0 dBm, 6x = -69.7 dBm, 7x = -66.8 dBm, 8x = -63.0 dBm
	5.4 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -76.4 dBm, 5x = -73.3 dBm, 6x = -70.0 dBm, 7x = -66.7 dBm, 8x = -63.5 dBm
	5.8 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.0 dBm, 4x = -75.6 dBm, 5x = -72.6 dBm, 6x = -69.5 dBm, 7x = -66.6 dBm, 8x = -62.6 dBm
	U-NII-5	1x = -87.1 dBm, 2x = -82.4 dBm, 3x = -78.1 dBm, 4x = -76.0 dBm, 5x = -73.0 dBm, 6x = -70.0 dBm, 7x = -66.9 dBm, 8x = -62.0 dBm
	U-NII-7	1x = -86.9 dBm, 2x = -82.1 dBm, 3x = -78.0 dBm, 4x = -75.6 dBm, 5x = -72.4 dBm, 6x = -69.7 dBm, 7x = -66.0 dBm, 8x = -61.4 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	5.1 GHz	1x = -82.0 dBm, 2x = -78.0 dBm, 3x = -74.0 dBm, 4x = -72.6 dBm, 5x = -69.6 dBm, 6x = -66.5 dBm, 7x = -63.6 dBm, 8x = -59.6 dBm		
	5.2 GHz	1x = -82.0 dBm, 2x = -78.7 dBm, 3x = -75.6 dBm, 4x = -72.4 dBm, 5x = -69.6 dBm, 6x = -66.7 dBm, 7x = -63.5 dBm, 8x = -59.5 dBm		
	5.4 GHz			
	5.8 GHz	1x = -82.0 dBm, 2x = -78.7 dBm, 3x = -75.6 dBm, 4x = -72.4 dBm, 5x = -69.6 dBm, 6x = -66.7 dBm, 7x = -63.5 dBm, 8x = -59.5 dBm		
	U-NII-5	1x = -82.0 dBm, 2x = -78.3 dBm, 3x = -75.1 dBm, 4x = -72.5 dBm, 5x = -69.7 dBm, 6x = -66.5 dBm, 7x = -62.5 dBm, 8x = -58.0 dBm		
	U-NII-7	1x = -82.5 dBm, 2x = -77.8 dBm, 3x = -74.8 dBm, 4x = -72.4 dBm, 5x = -69.2 dBm, 6x = -66.2 dBm, 7x = -62.7 dBm, 8x = -58.0 dBm		
Performance				
ARQ		Yes		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	13
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3-5 ms, typical		
Maximum Deployment Range		Up to 40 miles (64 km), in PMP mode, up to 124 miles (200 km) in PTP mode		
GPS Synchronization		Yes, via embedded GPS		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		7° azimuth		
Antenna Gain	5 GHz	+22 dBi H+V, integrated		
	6 GHz	+24 dBi H+V, integrated		
Transmit Power Range		55 dB dynamic range (to EIRP limit by region) (1 dB step)		

Category		Specification
Maximum Transmit Power	5 GHz	+28 dBm combined output
	6 GHz	+20 dBm combined output
Physical		
Ports		• Main PoE: 1 GbE • SFP optical: 10 GbE • Audio jack • SMA connector: for GPS antenna
Antenna Connection		N/A - Integrated Dish antenna
Surge Suppression EN61000-4-5		EN 61000-4-5: 10x700 µs, 6 kV, EN 61000-4-2: ESD 8 kV contact / 15 kV air Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Dust and Water Ingress Protection Rating		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-100% condensing
Weight		4.5 kg (9.9 lbs), 6.5 kg (14.3 lbs) with bracket
Wind Survival		200 kph (124 mph)
Vibration		NEMA TS2 Section 2.1.9 and Section 2.2.3
Shock		NEMA TS2 Section 2.1.10 and Section 2.2.4
External Icing		NEMA 250-2003 Section 5.6
Dimensions (Dia x Depth)		462 mm (diameter) x 264 mm (18.1″ diameter x 10.4″ depth)
Power Consumption		45W Typical, 55W Maximum
Input Voltage		48-59 VDC, 802.3bt type 4 class 8 (also accepting passive PoE)
Mounting		Pole mount with brackets
Security		
Encryption		FIPS-197 128-bit AES, and 256-bit AES **Note** AES-256 requires a license key.

Specifications for PMP 450i Series - SM

The PMP 450i SM conforms to the specifications listed in below table.

Table 165: PMP 450i Series - SM specifications

Category		Specification
Model Number		PMP 450i SM
Spectrum		
Channel Spacing		5, 7, 10, 15, 20, 30, and 40 Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		3300 – 3900 MHz
		4900 - 5925 MHz
Channel Bandwidth	3300 – 3900 MHz	5, 7, 10, 15, 20, 30, and 40 MHz
	4900 – 5925 MHz	5, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	3.5 GHz	1x = -93.0 dBm, 2x = -89.2 dBm, 3x = -85.3 dBm, 4x = -82.9 dBm, 5x = -79.4 dBm, 6x = -76.2 dBm, 7x = -72.4 dBm, 8x = -68.5 dBm
	3.6 GHz	1x = -92.0 dBm, 2x = -88.0 dBm, 3x = -84.0 dBm, 4x = -82.0 dBm, 5x = -78.6 dBm, 6x = -75.6 dBm, 7x = -71.7 dBm, 8x = -68.6 dBm
	4.9 GHz	1x = -92.5 dBm, 2x = -88.3 dBm, 3x = -83.8 dBm, 4x = -81.4 dBm, 5x = -78.4 dBm, 6x = -75.4 dBm, 7x = -71.4 dBm, 8x = -67.0 dBm
	5.1 GHz	1x = -92.0 dBm, 2x = -87.5 dBm, 3x = -83.0 dBm, 4x = -81.0 dBm, 5x = -78.0 dBm, 6x = -75.0 dBm, 7x = -72.0 dBm, 8x = -67.4 dBm
	5.2 GHz	1x = -92.0 dBm, 2x = -87.5 dBm, 3x = -83.0 dBm, 4x = -81.0 dBm, 5x = -78.0 dBm, 6x = -75.0 dBm, 7x = -72.0 dBm, 8x = -67.4 dBm
	5.4 GHz	1x = -92.0 dBm, 2x = -87.5 dBm, 3x = -83.0 dBm, 4x = -81.0 dBm, 5x = -78.0 dBm, 6x = -75.0 dBm, 7x = -72.0 dBm, 8x = -67.4 dBm
	5.8 GHz	1x = -91.3 dBm, 2x = -87.3 dBm, 3x = -83.3 dBm, 4x = -81.3 dBm, 5x = -78.0 dBm, 6x = -75.0 dBm, 7x = -71.0 dBm, 8x = -67.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	1x = -92.3 dBm, 2x = -87.9 dBm, 3x = -83.0 dBm, 4x = -81.0 dBm, 5x = -78.8 dBm, 6x = -75.0 dBm, 7x = -71.0 dBm, 8x = -67.8 dBm
	3.6 GHz	1x = -91.0 dBm, 2x = -87.9 dBm, 3x = -82.6 dBm, 4x = -81.4 dBm, 5x = -76.7 dBm, 6x = -73.7 dBm, 7x = -70.3 dBm, 8x = -67.8 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	3.5 GHz	1x = -90.3 dBm, 2x = -86.3 dBm, 3x = -81.8 dBm, 4x = -80.2 dBm, 5x = -76.4 dBm, 6x = -73.5 dBm, 7x = -69.8 dBm, 8x = -66.3 dBm
	3.6 GHz	1x = -89.6 dBm, 2x = -85.4 dBm, 3x = -80.9 dBm, 4x = -78.6 dBm, 5x = -75.7 dBm, 6x = -72.7 dBm, 7x = -69.1 dBm, 8x = -65.8 dBm
	4.9 GHz	1x = -89.6 dBm, 2x = -84.9 dBm, 3x = -81.0 dBm, 4x = -78.8 dBm, 5x = -75.0 dBm, 6x = -72.0 dBm, 7x = -69.0 dBm, 8x = -64.5 dBm
	5.1 GHz	1x = -89.8 dBm, 2x = -85.5 dBm, 3x = -80.6 dBm, 4x = -79.0 dBm, 5x = -75.4 dBm, 6x = -71.8 dBm, 7x = -69.7 dBm, 8x = -64.5 dBm
	5.2 GHz	1x = -89.8 dBm, 2x = -85.5 dBm, 3x = -80.6 dBm, 4x = -79.0 dBm, 5x = -75.4 dBm, 6x = -71.8 dBm, 7x = -69.7 dBm, 8x = -64.5 dBm
	5.4 GHz	1x = -89.0 dBm, 2x = -84.7 dBm, 3x = -80.7 dBm, 4x = -78.7 dBm, 5x = -75.6 dBm, 6x = -72.2 dBm, 7x = -68.7 dBm, 8x = -64.8 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -84.7 dBm, 3x = -80.7 dBm, 4x = -78.7 dBm, 5x = -75.6 dBm, 6x = -72.2 dBm, 7x = -68.7 dBm, 8x = -64.8 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	3.5 GHz	1x = -89.0 dBm, 2x = -84.5 dBm, 3x = -80.2 dBm, 4x = -77.9 dBm, 5x = -74.5 dBm, 6x = -71.5 dBm, 7x = -68.4 dBm, 8x = -64.8 dBm
	3.6 GHz	1x = -88.3 dBm, 2x = -83.8 dBm, 3x = -79.5 dBm, 4x = -76.8 dBm, 5x = -73.7 dBm, 6x = -70.4 dBm, 7x = -67.7 dBm, 8x = -64.4 dBm
	4.9 GHz	1x = -87.8 dBm, 2x = -83.1 dBm, 3x = 79.0 dBm, 4x = -76.9 dBm, 5x = -74.0 dBm, 6x = -70.4 dBm, 7x = -67.0 dBm, 8x = -62.3 dBm
	5.1 GHz	1x = -88.6 dBm, 2x = -83.6 dBm, 3x = -79.7 dBm, 4x = -77.5 dBm, 5x = -73.7 dBm, 6x = -70.2 dBm, 7x = -67.7 dBm, 8x = -62.9 dBm
	5.2 GHz	1x = -88.6 dBm, 2x = -83.6 dBm, 3x = -79.7 dBm, 4x = -77.5 dBm, 5x = -73.7 dBm, 6x = -70.2 dBm, 7x = -67.7 dBm, 8x = -62.9 dBm
	5.4 GHz	1x = -87.0 dBm, 2x = -83.5 dBm, 3x = -78.8 dBm, 4x = -76.6 dBm, 5x = -73.7 dBm, 6x = -70.4 dBm, 7x = -66.7 dBm, 8x = -62.6 dBm
	5.8 GHz	1x = -86.9 dBm, 2x = -82.9 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -73.0 dBm, 6x = -70.0 dBm, 7x = -67.1 dBm, 8x = -62.3 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	3.5 GHz	1x = -87.0 dBm, 2x = -83.5 dBm, 3x = -78.8 dBm, 4x = -76.3 dBm, 5x = -73.1 dBm, 6x = -70.3 dBm, 7x = -67.0 dBm, 8x = -63.2 dBm
	3.6 GHz	1x = -86.7 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -75.7 dBm, 5x = -72.6 dBm, 6x = -69.8 dBm, 7x = -65.8 dBm, 8x = -62.8 dBm
	4.9 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -77.9 dBm, 4x = -75.4 dBm, 5x = -72.9 dBm, 6x = -69.1 dBm, 7x = -65.9 dBm, 8x = -61.8 dBm
	5.1 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -77.9 dBm, 4x = -75.4 dBm, 5x = -72.9 dBm, 6x = -69.1 dBm, 7x = -65.9 dBm, 8x = -61.8 dBm
	5.2 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -77.9 dBm, 4x = -75.4 dBm, 5x = -72.9 dBm, 6x = -69.1 dBm, 7x = -65.9 dBm, 8x = -61.8 dBm
	5.4 GHz	1x = -87.0 dBm, 2x = -82.6 dBm, 3x = -77.9 dBm, 4x = -75.4 dBm, 5x = -72.9 dBm, 6x = -69.1 dBm, 7x = -65.9 dBm, 8x = -61.8 dBm
	5.8 GHz	1x = -85.9 dBm, 2x = -81.5 dBm, 3x = -77.9 dBm, 4x = -74.8 dBm, 5x = -72.1 dBm, 6x = -68.7 dBm, 7x = -65.2 dBm, 8x = -61.2 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -85.5 dBm, 2x = -81.2 dBm, 3x = -76.7 dBm, 4x = -74.6 dBm, 5x = -71.3 dBm, 6x = -68.8 dBm, 7x = -65.3 dBm, 8x = -61.1 dBm
	3.6 GHz	1x = -85.0 dBm, 2x = -80.4 dBm, 3x = -76.2 dBm, 4x = -73.6 dBm, 5x = -70.7 dBm, 6x = -67.5 dBm, 7x = -64.4 dBm, 8x = -61.0 dBm
	4.9 GHz	1x = -84.9 dBm, 2x = -80.9 dBm, 3x = -75.8 dBm, 4x = -73.2 dBm, 5x = -70.8 dBm, 6x = -66.4 dBm, 7x = -63.2 dBm, 8x = -59.6 dBm
	5.1 GHz	1x = -84.6 dBm, 2x = -80.2 dBm, 3x = -75.4 dBm, 4x = -73.8 dBm, 5x = -70.6 dBm, 6x = -67.0 dBm, 7x = -63.6 dBm, 8x = -59.6 dBm
	5.2 GHz	1x = -84.6 dBm, 2x = -80.2 dBm, 3x = -75.4 dBm, 4x = -73.8 dBm, 5x = -70.6 dBm, 6x = -67.0 dBm, 7x = -63.6 dBm, 8x = -59.6 dBm
	5.4 GHz	1x = -84.6 dBm, 2x = -80.2 dBm, 3x = -75.4 dBm, 4x = -73.8 dBm, 5x = -70.6 dBm, 6x = -67.0 dBm, 7x = -63.6 dBm, 8x = -59.6 dBm
	5.8 GHz	1x = -84.0 dBm, 2x = -80.0 dBm, 3x = -74.8 dBm, 4x = -73.9 dBm, 5x = -69.9 dBm, 6x = -66.8 dBm, 7x = -63.8 dBm, 8x = -59.1 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -83.5 dBm, 2x = -79.6 dBm, 3x = -75.0 dBm, 4x = -73.0 dBm, 5x = -70.0 dBm, 6x = -67.0 dBm, 7x = -64.0 dBm, 8x = -60.0 dBm
	3.6 GHz	1x = -82.9 dBm, 2x = -78.9 dBm, 3x = -74.0 dBm, 4x = -72.0 dBm, 5x = -69.1 dBm, 6x = -66.0 dBm, 7x = -62.9 dBm, 8x = -59.0 dBm
	4.9 GHz	1x = -83.7 dBm, 2x = -79.6 dBm, 3x = -74.7 dBm, 4x = -72.7 dBm, 5x = -69.7 dBm, 6x = -66.0 dBm, 7x = -62.7 dBm, 8x = -56.8 dBm
	5.1 GHz	1x = -83.6 dBm, 2x = -79.1 dBm, 3x = -74.5 dBm, 4x = -72.5 dBm, 5x = -69.5 dBm, 6x = -66.0 dBm, 7x = -62.4 dBm, 8x = -56.9 dBm
	5.2 GHz	1x = -83.6 dBm, 2x = -79.1 dBm, 3x = -74.5 dBm, 4x = -72.5 dBm, 5x = -69.5 dBm, 6x = -66.0 dBm, 7x = -62.4 dBm, 8x = -56.9 dBm
	5.4 GHz	1x = -83.6 dBm, 2x = -79.1 dBm, 3x = -74.5 dBm, 4x = -72.5 dBm, 5x = -69.5 dBm, 6x = -66.0 dBm, 7x = -62.4 dBm, 8x = -56.9 dBm
	5.8 GHz	1x = -82.7 dBm, 2x = -78.7 dBm, 3x = -74.0 dBm, 4x = -72.7 dBm, 5x = -68.6 dBm, 6x = -65.6 dBm, 7x = -61.7 dBm, 8x = -56.3 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		10° azimuth for 23 dBi integrated antenna		
Antenna Gain (Does not include cable loss, ~1dB)	5 GHz	+23 dBi H+V, integrated or external		
	3 GHz	+19 dBi dual slant, integrated or external		
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm combined output (for 5 GHz)		
		+25 dBm combined output (for 3 GHz)		
Physical				
Sync/AUX port	RJ45	10/100/1000BASE-T Ethernet Data PoE output (planned for future release) Sync input or output (Connection and powering of UGPS Sync input)		
Antenna Connection		50 ohm, N-type (Connectorized version only)		
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A		

Category		Specification
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension (HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.3” x 5.3” x 3.3”)
	Integrated	31.0 x 31.0 x 6.4 cm (12” x 12” x 2.5”)
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PTP 450i Series - BH

The PTP 450i BH conforms to the specifications listed in below table.

Table 166: PTP 450i Series - BH specifications

Category		Specification
Model Number		PTP 450i BH
Spectrum		
Channel Spacing		5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		4900 - 5925 MHz
Channel Bandwidth	4900 – 5925 MHz	5, 10, 15, 20, 30, and 40 MHz

Category		Specification
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	3.5 GHz	1x = -93.0 dBm, 2x = -89.3 dBm, 3x = -85.0 dBm, 4x = -82.2 dBm, 5x = -79.2 dBm, 6x = -76.3 dBm, 7x = -72.6 dBm, 8x = -69.1 dBm
	3.6 GHz	1x = -93.0 dBm, 2x = -88.1 dBm, 3x = -84.0 dBm, 4x = -82.3 dBm, 5x = -78.8 dBm, 6x = -75.9 dBm, 7x = -72.1 dBm, 8x = -68.6 dBm
	4.9 GHz	1x = -92.6 dBm, 2x = -88.3 dBm, 3x = -84.0 dBm, 4x = -81.6 dBm, 5x = -78.4 dBm, 6x = -75.4 dBm, 7x = -72.3 dBm, 8x = -68.0 dBm
	5.1 GHz	1x = -93.0 dBm, 2x = -88.5 dBm, 3x = -84.3 dBm, 4x = -82.0 dBm, 5x = -78.3 dBm, 6x = -75.1 dBm, 7x = -72.4 dBm, 8x = -68.0 dBm
	5.2 GHz	1x = -93.0 dBm, 2x = -88.5 dBm, 3x = -84.3 dBm, 4x = -82.0 dBm, 5x = -78.3 dBm, 6x = -75.1 dBm, 7x = -72.4 dBm, 8x = -68.0 dBm
	5.4 GHz	1x = -93.0 dBm, 2x = -88.6 dBm, 3x = -84.2 dBm, 4x = -81.3 dBm, 5x = -78.8 dBm, 6x = -75.0 dBm, 7x = -72.2 dBm, 8x = -68.0 dBm
	5.8 GHz	1x = -92.4 dBm, 2x = -88.4 dBm, 3x = -82.6 dBm, 4x = -81.2 dBm, 5x = -78.0 dBm, 6x = -75.1 dBm, 7x = -71.4 dBm, 8x = -67.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	1x = -92.0 dBm, 2x = -87.9 dBm, 3x = -83.0 dBm, 4x = -81.2 dBm, 5x = -77.8 dBm, 6x = -75.0 dBm, 7x = -71.0 dBm, 8x = -68.1 dBm
	3.6 GHz	1x = -91.0 dBm, 2x = -86.9 dBm, 3x = -82.0 dBm, 4x = -80.8 dBm, 5x = -76.2 dBm, 6x = -73.8 dBm, 7x = -70.4 dBm, 8x = -67.3 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	3.5 GHz	1x = -90.3 dBm, 2x = -86.5 dBm, 3x = -81.6 dBm, 4x = -79.4 dBm, 5x = -76.5 dBm, 6x = -73.4 dBm, 7x = -70.0 dBm, 8x = -66.3 dBm
	3.6 GHz	1x = -89.8 dBm, 2x = -86.0 dBm, 3x = -80.5 dBm, 4x = -78.9 dBm, 5x = -75.7 dBm, 6x = -72.5 dBm, 7x = -69.0 dBm, 8x = -66.0 dBm
	4.9 GHz	1x = 90.0 dBm, 2x = -85.6 dBm, 3x = -81.2 dBm, 4x = -78.8 dBm, 5x = -76.0 dBm, 6x = -72.8 dBm, 7x = -69.0 dBm, 8x = -65.0 dBm
	5.1 GHz	1x = 90.0 dBm, 2x = -85.6 dBm, 3x = -81.2 dBm, 4x = -78.8 dBm, 5x = -76.0 dBm, 6x = -72.8 dBm, 7x = -69.0 dBm, 8x = -65.0 dBm
	5.2 GHz	1x = 90.0 dBm, 2x = -85.6 dBm, 3x = -81.5 dBm, 4x = -78.4 dBm, 5x = -75.9 dBm, 6x = -72.2 dBm, 7x = -68.9 dBm, 8x = -65.0 dBm
	5.4 GHz	1x = 89.6 dBm, 2x = -85.2 dBm, 3x = -81.2 dBm, 4x = -78.6 dBm, 5x = -75.5 dBm, 6x = -72.4 dBm, 7x = -69.2 dBm, 8x = -64.7 dBm
	5.8 GHz	1x = 89.6 dBm, 2x = -84.8 dBm, 3x = -80.0 dBm, 4x = -78.5 dBm, 5x = -74.8 dBm, 6x = -71.6 dBm, 7x = -68.7 dBm, 8x = -64.3 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	3.5 GHz	1x = 88.6 dBm, 2x = -84.5 dBm, 3x = -79.8 dBm, 4x = -77.6 dBm, 5x = -74.7 dBm, 6x = -71.6 dBm, 7x = -68.5 dBm, 8x = -65.2 dBm
	3.6 GHz	1x = 88.0 dBm, 2x = -83.6 dBm, 3x = -78.9 dBm, 4x = -76.7 dBm, 5x = -73.9 dBm, 6x = -70.8 dBm, 7x = -67.8 dBm, 8x = -64.0 dBm
	4.9 GHz	1x = 88.0 dBm, 2x = -83.6 dBm, 3x = -79.2 dBm, 4x = -77.0 dBm, 5x = -74.0 dBm, 6x = -71.0 dBm, 7x = -67.2 dBm, 8x = -63.1 dBm
	5.1 GHz	1x = 88.0 dBm, 2x = -83.6 dBm, 3x = -79.2 dBm, 4x = -77.0 dBm, 5x = -74.0 dBm, 6x = -71.0 dBm, 7x = -67.2 dBm, 8x = -63.1 dBm
	5.2 GHz	1x = 88.1 dBm, 2x = -83.9 dBm, 3x = -79.5 dBm, 4x = -76.6 dBm, 5x = -74.0 dBm, 6x = -70.4 dBm, 7x = -67.7 dBm, 8x = -62.8 dBm
	5.4 GHz	1x = 88.0 dBm, 2x = -83.9 dBm, 3x = -79.3 dBm, 4x = -77.1 dBm, 5x = -73.6 dBm, 6x = -70.7 dBm, 7x = -67.4 dBm, 8x = -63.4 dBm
	5.8 GHz	1x = 87.9 dBm, 2x = -83.0 dBm, 3x = -78.4 dBm, 4x = -76.7 dBm, 5x = -73.4 dBm, 6x = -70.0 dBm, 7x = -66.7 dBm, 8x = -62.5 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel’	3.5 GHz	1x = 87.0 dBm, 2x = -82.6 dBm, 3x = -78.4 dBm, 4x = -76.6 dBm, 5x = -73.2 dBm, 6x = -70.2 dBm, 7x = -67.3 dBm, 8x = -63.2 dBm
	3.6 GHz	1x = 87.0 dBm, 2x = -82.4 dBm, 3x = -77.8 dBm, 4x = -75.8 dBm, 5x = -72.6 dBm, 6x = -69.0 dBm, 7x = -66.0 dBm, 8x = -63.2 dBm
	4.9 GHz	1x = 87.0 dBm, 2x = -82.4 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.9 dBm, 6x = -69.5 dBm, 7x = -66.1 dBm, 8x = -62.4 dBm
	5.1 GHz	1x = 87.0 dBm, 2x = -82.4 dBm, 3x = -78.0 dBm, 4x = -76.0 dBm, 5x = -72.9 dBm, 6x = -69.5 dBm, 7x = -66.1 dBm, 8x = -62.4 dBm
	5.2 GHz	1x = 87.0 dBm, 2x = -82.5 dBm, 3x = -77.7 dBm, 4x = -76.0 dBm, 5x = -72.8 dBm, 6x = -69.5 dBm, 7x = -66.8 dBm, 8x = -61.9 dBm
	5.4 GHz	1x = 86.7 dBm, 2x = -82.8 dBm, 3x = -78.0 dBm, 4x = -75.7 dBm, 5x = -72.4 dBm, 6x = -69.6 dBm, 7x = -66.2 dBm, 8x = -61.3 dBm
	5.8 GHz	1x = 85.9 dBm, 2x = -81.6 dBm, 3x = -77.6 dBm, 4x = -75.5 dBm, 5x = -71.7 dBm, 6x = -68.6 dBm, 7x = -65.8 dBm, 8x = -60.8 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = 86.0 dBm, 2x = -81.0 dBm, 3x = -76.0 dBm, 4x = -75.0 dBm, 5x = -71.3 dBm, 6x = -68.2 dBm, 7x = -65.3 dBm, 8x = -61.1 dBm
	3.6 GHz	1x = 85.2 dBm, 2x = -80.5 dBm, 3x = -76.0 dBm, 4x = -74.0 dBm, 5x = -70.4 dBm, 6x = -67.5 dBm, 7x = -64.6 dBm, 8x = -61.0 dBm
	4.9 GHz	1x = -84.9 dBm, 2x= -80.5 dBm, 3x = -76.0 dBm, 4x = -74.0 dBm, 5x = -71.0 dBm, 6x = -68.0 dBm, 7x = -63.9 dBm, 8x = -59.8 dBm
	5.1 GHz	1x = -84.9 dBm, 2x= -80.5 dBm, 3x = -76.0 dBm, 4x = -74.0 dBm, 5x = -71.0 dBm, 6x = -68.0 dBm, 7x = -63.9 dBm, 8x = -59.8 dBm
	5.2 GHz	1x = 85.0 dBm, 2x = -80.5 dBm, 3x = -75.9 dBm, 4x = -74.2 dBm, 5x = -71.0 dBm, 6x = -67.9 dBm, 7x = -64.9 dBm, 8x = -59.4 dBm
	5.4 GHz	1x = 85.0 dBm, 2x = -80.4 dBm, 3x = -76.0 dBm, 4x = -74.2 dBm, 5x = -71.0 dBm, 6x = -67.6 dBm, 7x = -64.2 dBm, 8x = -60.0 dBm
	5.8 GHz	1x = 84.7 dBm, 2x = -79.9 dBm, 3x = -75.5 dBm, 4x = -73.3 dBm, 5x = -70.5 dBm, 6x = -66.4 dBm, 7x = -63.8 dBm, 8x = -59.0 dBm

Category		Specification		
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = 84.0 dBm, 2x = -79.0 dBm, 3x = -75.0 dBm, 4x = -73.4 dBm, 5x = -70.0 dBm, 6x = -67.0 dBm, 7x = -64.0 dBm, 8x = -59.0 dBm		
	3.6 GHz	1x = 84.0 dBm, 2x = -79.0 dBm, 3x = -74.0 dBm, 4x = -72.0 dBm, 5x = -69.0 dBm, 6x = -65.5 dBm, 7x = -63.1 dBm, 8x = -58.9 dBm		
	4.9 GHz	1x = 83.6 dBm, 2x = -79.5 dBm, 3x = -74.6 dBm, 4x = -72.0 dBm, 5x = -69.4 dBm, 6x = -66.4 dBm, 7x = -63.7 dBm, 8x = -58.7 dBm		
	5.1 GHz	1x = 83.6 dBm, 2x = -79.5 dBm, 3x = -74.6 dBm, 4x = -72.0 dBm, 5x = -69.4 dBm, 6x = -66.4 dBm, 7x = -63.7 dBm, 8x = -58.7 dBm		
	5.2 GHz	1x = 83.7 dBm, 2x = -79.5 dBm, 3x = -74.9 dBm, 4x = -72.6 dBm, 5x = -69.5 dBm, 6x = -66.4 dBm, 7x = -63.6 dBm, 8x = -58.6 dBm		
	5.4 GHz	1x = 83.6 dBm, 2x = -79.1 dBm, 3x = -75.0 dBm, 4x = -72.8 dBm, 5x = -69.4 dBm, 6x = -66.9 dBm, 7x = -62.8 dBm, 8x = -58.4 dBm		
	5.8 GHz	1x = 83.3 dBm, 2x = -78.5 dBm, 3x = -74.2 dBm, 4x = -72.7 dBm, 5x = -69.0 dBm, 6x = -66.0 dBm, 7x = -62.3 dBm, 8x = -58.0 dBm		
Performance				
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3 - 5 ms		

Category		Specification
Maximum Deployment Range		Up to 40 miles (64 km)
GPS Synchronization		Yes, via Autosync (CMM4)
Quality of Service		Diffserv QoS
Link Budget		
Antenna Beam Width	900 MHz	37° azimuth for 12 dBi Yagi antenna
	5 GHz	10° azimuth for 23 dBi integrated antenna
Antenna Gain (Does not include cable loss, ~1dB)	900 MHz	12 dBi Yagi antenna
	5 GHz	+23 dBi H+V, integrated or external
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)
Maximum Transmit Power		+27 dBm combined output
Physical		
Sync/AUX port	RJ45	• 10/100/1000BASE-T Ethernet Data • PoE output • Sync input or output (Connection and powering of UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2 us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension (HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.25” x 5.25” x 3.25”)
	Integrated	31.0 x 31.0 x 6.4 cm (12” x 12” x 2.5”)

Category		Specification
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model #N000045L002A
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450b 5 GHz Mid-Gain Series - SM

The PMP 450b 5 GHz Mid-Gain conforms to the specifications listed in below table.

Table 167: PMP 450b 5 GHz Mid-Gain Series - SM specifications

Category	Specification
Model Number	5 GHz PMP 450b Mid-Gain
Spectrum	
Channel Spacing	Configurable in 2.5 MHz increments
Frequency Range	4900 - 5925 MHz
Channel Bandwidth	5, 10, 15, 20, 30, and 40 MHz
Interface	
MAC (Media Access Control) Layer	Cambium Proprietary
Physical Layer	2x2 MIMO OFDM
Ethernet Interface	100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used	IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management	HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN	802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity	

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -92.0 dBm, 2x = -88.0 dBm, 3x = -84.0 dBm, 4x = -82.0 dBm, 5x = -78.0 dBm, 6x = -75.1 dBm, 7x = -72.5 dBm, 8x = -68.0 dBm
	5.1 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -82.6 dBm, 4x = -80.8 dBm, 5x = -77.6 dBm, 6x = -74.2 dBm, 7x = -71.6 dBm, 8x = -66.8 dBm
	5.2 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -83.4 dBm, 4x = -80.8 dBm, 5x = -77.6 dBm, 6x = -74.2 dBm, 7x = -71.6 dBm, 8x = -67.0 dBm
	5.4 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -84.0 dBm, 4x = -82.3 dBm, 5x = -79.0 dBm, 6x = -75.9 dBm, 7x = -72.3 dBm, 8x = -68.0 dBm
	5.8 GHz	1x = -92.1 dBm, 2x = -87.9 dBm, 3x = -84.3 dBm, 4x = -82.1 dBm, 5x = -79.0 dBm, 6x = -75.4 dBm, 7x = -72.0 dBm, 8x = -68.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -89.7 dBm, 2x = -84.8 dBm, 3x = -80.7 dBm, 4x = -78.4 dBm, 5x = -75.7 dBm, 6x = -72.0 dBm, 7x = -68.8 dBm, 8x = -64.2 dBm
	5.1 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.2 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.4 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm
	5.8 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -88.0 dBm, 2x = -83.7 dBm, 3x = -78.9 dBm, 4x = -76.6 dBm, 5x = -74.0 dBm, 6x = -70.4 dBm, 7x = -67.8 dBm, 8x = -63.0 dBm
	5.1 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.2 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -86.3 dBm, 2x = -81.3 dBm, 3x = -77.2 dBm, 4x = -75.4 dBm, 5x = -72.2 dBm, 6x = -69.0 dBm, 7x = -66.0 dBm, 8x = -61.4 dBm
	5.1 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.2 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.4 GHz	1x = -86.5 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -75.6 dBm, 5x = -72.6 dBm, 6x = -69.1 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm
	5.8 GHz	1x = -86.5 dBm, 2x = -82.2 dBm, 3x = -77.9 dBm, 4x = -75.9 dBm, 5x = -72.8 dBm, 6x = -69.2 dBm, 7x = -66.2 dBm, 8x = -62.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -84.5 dBm, 2x = -80.0 dBm, 3x = -76.2 dBm, 4x = -74.1 dBm, 5x = -70.8 dBm, 6x = -67.7 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.1 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.2 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm
	5.8 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm
Nominal Receive Sensitivity (w/ FEC) @40 MHz Channel	4.9 GHz	1x = -82.9 dBm, 2x = -79.0 dBm, 3x = -75.0 dBm, 4x = -72.4 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -63.0 dBm, 8x = -56.4 dBm
	5.1 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm
	5.2 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm
	5.4 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm
	5.8 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		15° azimuth for 16 dBi integrated antenna 30° elevation for 16 dBi integrated antenna		
Antenna Gain	5 GHz	+16 dBi H+V, integrated		
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm combined output		
Physical				
Sync/AUX port	RJ45	• 100/1000BASE-T Ethernet Data • PoE output (planned for future release) • Sync input or output (Connection and powering of UGPS Sync input)		
Antenna Connection		50 ohm, N-type (Connectorized version only)		
Surge Suppression EN61000-4-5		EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform Recommended surge suppressor: Cambium Networks Model # C000000L065A		
Mean Time Between Failure		> 40 Years		
Environmental		IP55		
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing		

Category		Specification
Weight	Integrated	Approx. 0.5 kg (1.1 lb. including mounting bracket)
Wind Survival	Integrated	190 km/h (118 mi/h)
Dimension (HxWxD)	Integrated	12.4 x 25.1 x 11.9 cm (4.9” x 9.9” x 4.7”)
Power Consumption		9 W nominal, 12 W peak
Input Voltage		20 - 32 V DC,
Mounting		Wall or Pole mount
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450b 5 GHz High Gain Series – SM

The PMP 450b High Gain SM conforms to the specifications listed in below table.

Table 168: PMP 450b High Gain Series – SM specifications

Category		Specification
Model Number		PMP 450b High Gain SM
Spectrum		
Channel Spacing		Configurable in 2.5 MHz increments
Frequency Range		4900 - 5925 MHz
Channel Bandwidth		5, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID

Category		Specification
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -92.0 dBm, 2x = -88.0 dBm, 3x = -84.0 dBm, 4x = -82.0 dBm, 5x = -78.0 dBm, 6x = -75.1 dBm, 7x = -72.5 dBm, 8x = -68.0 dBm
	5.1 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -82.6 dBm, 4x = -80.8 dBm, 5x = -77.6 dBm, 6x = -74.2 dBm, 7x = -71.6 dBm, 8x = -66.8 dBm
	5.2 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -83.4 dBm, 4x = -80.8 dBm, 5x = -77.6 dBm, 6x = -74.2 dBm, 7x = -71.6 dBm, 8x = -67.0 dBm
	5.4 GHz	1x = -92.6 dBm, 2x = -88.5 dBm, 3x = -84.0 dBm, 4x = -82.3 dBm, 5x = -79.0 dBm, 6x = -75.9 dBm, 7x = -72.3 dBm, 8x = -68.0 dBm
	5.8 GHz	1x = -92.1 dBm, 2x = -87.9 dBm, 3x = -84.3 dBm, 4x = -82.1 dBm, 5x = -79.0 dBm, 6x = -75.4 dBm, 7x = -72.0 dBm, 8x = -68.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -89.7 dBm, 2x = -84.8 dBm, 3x = -80.7 dBm, 4x = -78.4 dBm, 5x = -75.7 dBm, 6x = -72.0 dBm, 7x = -68.8 dBm, 8x = -64.2 dBm
	5.1 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.2 GHz	1x = -90.0 dBm, 2x = -85.3 dBm, 3x = -80.0 dBm, 4x = -78.8 dBm, 5x = -75.2 dBm, 6x = -71.6 dBm, 7x = -69.2 dBm, 8x = -64.8 dBm
	5.4 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm
	5.8 GHz	1x = -89.6 dBm, 2x = -85.6 dBm, 3x = -81.0 dBm, 4x = -78.2 dBm, 5x = -75.9 dBm, 6x = -72.4 dBm, 7x = -69.4 dBm, 8x = -65.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -88.0 dBm, 2x = -83.7 dBm, 3x = -78.9 dBm, 4x = -76.6 dBm, 5x = -74.0 dBm, 6x = -70.4 dBm, 7x = -67.8 dBm, 8x = -63.0 dBm
	5.1 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.2 GHz	1x = -87.8 dBm, 2x = -83.7 dBm, 3x = -78.3 dBm, 4x = -76.6 dBm, 5x = -73.5 dBm, 6x = -70.0 dBm, 7x = -67.5 dBm, 8x = -63.2 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -83.5 dBm, 3x = -79.4 dBm, 4x = -76.5 dBm, 5x = -74.0 dBm, 6x = -70.5 dBm, 7x = -67.7 dBm, 8x = -63.0 dBm

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -86.3 dBm, 2x = -81.3 dBm, 3x = -77.2 dBm, 4x = -75.4 dBm, 5x = -72.2 dBm, 6x = -69.0 dBm, 7x = -66.0 dBm, 8x = -61.4 dBm
	5.1 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.2 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -78.2 dBm, 4x = -75.4 dBm, 5x = -72.5 dBm, 6x = -69.3 dBm, 7x = -65.5 dBm, 8x = -61.4 dBm
	5.4 GHz	1x = -86.5 dBm, 2x = -82.0 dBm, 3x = -78.0 dBm, 4x = -75.6 dBm, 5x = -72.6 dBm, 6x = -69.1 dBm, 7x = -66.0 dBm, 8x = -62.0 dBm
	5.8 GHz	1x = -86.5 dBm, 2x = -82.2 dBm, 3x = -77.9 dBm, 4x = -75.9 dBm, 5x = -72.8 dBm, 6x = -69.2 dBm, 7x = -66.2 dBm, 8x = -62.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -84.5 dBm, 2x = -80.0 dBm, 3x = -76.2 dBm, 4x = -74.1 dBm, 5x = -70.8 dBm, 6x = -67.7 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.1 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.2 GHz	1x = -84.6 dBm, 2x = -79.8 dBm, 3x = -75.2 dBm, 4x = -73.3 dBm, 5x = -70.2 dBm, 6x = -67.4 dBm, 7x = -64.2 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm
	5.8 GHz	1x = -84.8 dBm, 2x = -79.8 dBm, 3x = -76.0 dBm, 4x = -73.6 dBm, 5x = -71.0 dBm, 6x = -67.5 dBm, 7x = -64.7 dBm, 8x = -59.5 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	4.9 GHz	1x = -82.9 dBm, 2x = -79.0 dBm, 3x = -75.0 dBm, 4x = -72.4 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -63.0 dBm, 8x = -56.4 dBm
	5.1 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm
	5.2 GHz	1x = -83.2 dBm, 2x = -79.3 dBm, 3x = -74.5 dBm, 4x = -72.1 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.0 dBm, 8x = -57.0 dBm
	5.4 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm
	5.8 GHz	1x = -83.6 dBm, 2x = -78.6 dBm, 3x = -75.4 dBm, 4x = -72.4 dBm, 5x = -69.4 dBm, 6x = -66.0 dBm, 7x = -63.5 dBm, 8x = -57.0 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels	MCS	SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		7° azimuth for 23 dBi integrated antenna 7° elevation for 23 dBi integrated antenna		
Antenna Gain	5 GHz	+23 dBi H+V, integrated		
Transmit Power Range		22 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm combined output (+22 dBm @ 256QAM)		
Physical				
Sync/AUX port	RJ45	• 100/1000BASE-T Ethernet Data • PoE output (planned for future release) • Sync input or output (Connection and powering of UGPS Sync input)		
Antenna Connection		50 ohm, N-type (Connectorized version only)		
Surge Suppression EN61000-4-5		EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform Recommended surge suppressor: Cambium Networks Model # C000000L065A		
Mean Time Between Failure		> 40 Years		
Environmental		IP67		

Category		Specification
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Integrated	Approx. 3.1 kg (7 lb. including mounting bracket)
Wind Survival	Integrated	145 km/h (90 mi/h)
Dimension (HxWxD)	Integrated	47 cm diameter x 28 cm (18.5” diameter x 11.2”)
Power Consumption		9 W nominal, 12 W peak
Input Voltage		20 - 32 V DC,
Mounting		Wall or Pole mount
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP/PTP 450b 3 GHz High Gain Series – SM/BHS

The PMP/PTP 450b 3 GHz High Gain – SM/BHS conforms to the specifications listed in below table.

Table 169: PMP/PTP 450b 3 GHz High Gain Series specifications

Category		Specification
Model Number		PMP/PTP 450b 3 GHz High Gain – SM/BHS
Spectrum		
Channel Spacing		Customizable channel selection to 50 kHz raster
Frequency Range		3300 – 3980 MHz
Channel Bandwidth		5, 7, 10, 15, 20, 30, and 40 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Networks Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3

Category		Specification
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	3.5 GHz	1x = -93.0 dBm, 2x = -90.1 dBm, 3x = -86.2 dBm, 4x = -83.8 dBm, 5x = -80.3 dBm, 6x = -77.6 dBm, 7x = -73.9 dBm, 8x = -70.1 dBm
	3.6 GHz	1x = -93.0 dBm, 2x = -89.7 dBm, 3x = -85.6 dBm, 4x = -83.0 dBm, 5x = -80.0 dBm, 6x = -76.8 dBm, 7x = -73.0 dBm, 8x = -69.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	1x = -92.0 dBm, 2x = -88.2 dBm, 3x = -84.5 dBm, 4x = -82.2 dBm, 5x = -79.4 dBm, 6x = -76.0 dBm, 7x = -73.0 dBm, 8x = -68.4 dBm
	3.6 GHz	1x = -92.0 dBm, 2x = -87.9 dBm, 3x = -83.6 dBm, 4x = -81.4 dBm, 5x = -78.2 dBm, 6x = -75.4 dBm, 7x = -71.6 dBm, 8x = -67.8 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	3.5 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -83.0 dBm, 4x = -80.4 dBm, 5x = -77.6 dBm, 6x = -74.4 dBm, 7x = -71.2 dBm, 8x = -67.4 dBm
	3.6 GHz	1x = -90.0 dBm, 2x = -86.0 dBm, 3x = -82.1 dBm, 4x = -80.0 dBm, 5x = -77.0 dBm, 6x = -74.0 dBm, 7x = -70.8 dBm, 8x = -66.7 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	3.5 GHz	1x = -89.0 dBm, 2x = -85.1 dBm, 3x = -81.0 dBm, 4x = -79.0 dBm, 5x = -75.6 dBm, 6x = -72.7 dBm, 7x = -69.4 dBm, 8x = -65.9 dBm
	3.6 GHz	1x = -89.0 dBm, 2x = -84.9 dBm, 3x = -80.2 dBm, 4x = -78.1 dBm, 5x = -75.0 dBm, 6x = -71.9 dBm, 7x = -69.0 dBm, 8x = -64.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	3.5 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -80.0 dBm, 4x = -77.8 dBm, 5x = -74.6 dBm, 6x = -71.6 dBm, 7x = -68.5 dBm, 8x = -64.5 dBm
	3.6 GHz	1x = -87.9 dBm, 2x = -83.0 dBm, 3x = -79.0 dBm, 4x = -76.8 dBm, 5x = -74.0 dBm, 6x = -70.2 dBm, 7x = -67.5 dBm, 8x = -63.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -86.5 dBm, 2x = -82.0 dBm, 3x = -78.2 dBm, 4x = -75.8 dBm, 5x = -72.7 dBm, 6x = -69.6 dBm, 7x = -66.4 dBm, 8x = -62.0 dBm
	3.6 GHz	1x = -86.0 dBm, 2x = -80.8 dBm, 3x = -77.6 dBm, 4x = -74.7 dBm, 5x = -72.0 dBm, 6x = -68.5 dBm, 7x = -65.9 dBm, 8x = -61.5 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -85.0 dBm, 2x = -80.7 dBm, 3x = -76.4 dBm, 4x = -74.4 dBm, 5x = -71.6 dBm, 6x = -68.0 dBm, 7x = -65.4 dBm, 8x = -60.0 dBm
	3.6 GHz	1x = -84.2 dBm, 2x = -80.2 dBm, 3x = -76.2 dBm, 4x = -73.4 dBm, 5x = -70.4 dBm, 6x = -67.5 dBm, 7x = -64.5 dBm, 8x = -60.0 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8-QAM	14
		4x	16-QAM	17
		5x	32-QAM	21
		6x	64-QAM	24
		7x	128-QAM	28
		8x	256-QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		12° azimuth for 20 dBi integrated antenna 12° elevation for 20 dBi integrated antenna		
Antenna Gain		+20 dBi H+V, integrated		
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		29 dBm combined output (23 dBm @ 256-QAM)		
Physical				
Sync/AUX port	RJ45	• 100/1000BASE-T Ethernet Data • PoE output (planned for future release) • Sync input or output (Connection and powering of UGPS Sync input)		
Antenna Connection		50 ohm, N-type (Connectorized version only)		
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform		
Mean Time Between Failure		> 40 Years		
Environmental		IP67		

Category		Specification
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Integrated	Approx. 3.1 kg (7 lb. including mounting bracket)
Wind Survival	Integrated	145 km/h (90 mi/h)
Dimension (HxWxD)	Integrated	47 cm diameter x 28 cm (18.5” diameter x 11.2”)
Power Consumption		9 W nominal, 12 W peak
Input Voltage		20 - 32 V DC,
Mounting		Wall or Pole mount
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450 Series - AP

The PMP 450 AP conforms to the specifications listed in below table.

Table 170: PMP 450 Series - AP specifications

Category		Specification
Model Number		PMP 450 AP
Spectrum		
Channel Spacing		5, 7, 10, 15, 20 and 30 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range	2.4 GHz	2400 – 2483.5 MHz
	3.5 GHz	3300 – 3600 MHz
	3.65 GHz	3500 – 3850 MHz
	5 GHz	5470 – 5875 MHz
Channel Bandwidth	3.5 and 3.65 GHz	5, 7, 10, 15, 20 and 30 MHz
	2.4 and 5 GHz	5, 10, 15, 20 and 30 MHz
OFDM Subcarriers		512 FFT
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary

Category		Specification
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP, TFTP, RADIUS
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v3, TFTP, Syslog
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 GHz	1x = -91.9 dBm, 2x = -87.29 dBm, 3x = -83.38 dBm, 4x = -81.34 dBm, 5x = -78.41 dBm, 6x = -75.42 dBm, 7x = -72.46 dBm, 8x = -68.58 dBm
	2.4 GHz	1x = -88.7 dBm, 2x = -85.62 dBm, 3x = -81.14 dBm, 4x = -78.87 dBm, 5x = -75.71 dBm, 6x = -72.71 dBm, 7x = -69.0 dBm, 8x = -65.02 dBm
	3.5 GHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.3 dBm, 4x = -79.7 dBm, 5x = -76.7 dBm, 6x = -73.3 dBm, 7x = -70.0 dBm, 8x = -65.8 dBm
	3.65 GHz	1x = -91.0 dBm, 2x = -86.1 dBm, 3x = -82.0 dBm, 4x = -80.0 dBm, 5x = -75.2 dBm, 6x = -72.0 dBm, 7x = -68.8 dBm, 8x = -65.0 dBm
	5.4 GHz	1x = -88.7 dBm, 2x = -84.0 dBm, 3x = -79.0 dBm, 4x = -77.0 dBm, 5x = -74.0 dBm, 6x = -70.9 dBm, 7x = -67.0 dBm, 8x = -63.0 dBm
	5.8 GHz	1x = -88.5 dBm, 2x = -84.0 dBm, 3x = -78.7 dBm, 4x = -76.6 dBm, 5x = -73.7 dBm, 6x = -69.7 dBm, 7x = -66.7 dBm, 8x = -63.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 GHz	1x = -89.31 dBm, 2x = -85.32 dBm, 3x = -82.35 dBm, 4x = -80.35 dBm, 5x = -77.43 dBm, 6x = -74.36 dBm, 7x = -71.53 dBm, 8x = -67.47 dBm
	3.5 GHz	1x = -89.0 dBm, 2x = -86.0 dBm, 3x = -80.8 dBm, 4x = -78.8 dBm, 5x = -75.4 dBm, 6x = -72.0 dBm, 7x = -68.6 dBm, 8x = -64.3 dBm
	3.65 GHz	1x = -89.0 dBm, 2x = -85.0 dBm, 3x = -80.0 dBm, 4x = -78.0 dBm, 5x = -74.5 dBm, 6x = -71.0 dBm, 7x = -67.5 dBm, 8x = -64.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 GHz	1x = -89.47 dBm, 2x = -84.61 dBm, 3x = -81.71 dBm, 4x = -78.77dBm, 5x = -75.82 dBm, 6x = -73.69 dBm, 7x = -70.78 dBm, 8x = -66.76 dBm

Category		Specification
	2.4 GHz	1x = -87.27 dBm, 2x = -83.62 dBm, 3x = -80.36 dBm, 4x = -77.81dBm, 5x = -74.76 dBm, 6x = -71.73 dBm, 7x = -68.79 dBm, 8x = -64.82 dBm
	3.5 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.8 dBm, 4x = -77.8 dBm, 5x = -74.4 dBm, 6x = -71.0 dBm, 7x = -67.4 dBm, 8x = -63.2 dBm
	3.65 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -79.0 dBm, 4x = -77.0 dBm, 5x = -72.8 dBm, 6x = -69.8 dBm, 7x = -66.4 dBm, 8x = -62.0 dBm
	5.4 GHz	1x = -86.1 dBm, 2x = -82.2 dBm, 3x = -76.3 dBm, 4x = -74.6 dBm, 5x = -71.3 dBm, 6x = -68.0 dBm, 7x = -64.3 dBm, 8x = -60.5 dBm
	5.8 GHz	1x = -86.0 dBm, 2x = -82.2 dBm, 3x = -76.0 dBm, 4x = -74.6 dBm, 5x = -71.0 dBm, 6x = -68.0 dBm, 7x = -64.0 dBm, 8x = -60.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	900 GHz	1x = -88.5 dBm, 2x = -83.56 dBm, 3x = -79.67 dBm, 4x = -75.58 dBm, 5x = -74.66 dBm, 6x = -71.57 dBm, 7x = -68.64 dBm, 8x = -65.61 dBm
	2.4 GHz	1x = -85.39 dBm, 2x = -82.86 dBm, 3x = -77.91 dBm, 4x = -74.87 dBm, 5x = -72.9 dBm, 6x = -69.81 dBm, 7x = -66.94 dBm, 8x = -63.67 dBm
	3.5 GHz	1x = -87.0 dBm, 2x = -82.8 dBm, 3x = -78.7 dBm, 4x = -76.3 dBm, 5x = -72.7 dBm, 6x = -69.8 dBm, 7x = -66.5 dBm, 8x = -62.6 dBm
	3.65 GHz	1x = -86.4 dBm, 2x = -82.6 dBm, 3x = -77.0 dBm, 4x = -76.0 dBm, 5x = -71.5 dBm, 6x = -68.9 dBm, 7x = -65.5 dBm, 8x = -61.5 dBm
	5.4 GHz	1x = -84.2 dBm, 2x = -80.2 dBm, 3x = -75.0 dBm, 4x = -72.9 dBm, 5x = -69.9 dBm, 6x = -66.9 dBm, 7x = -62.9 dBm, 8x = -59.0 dBm
	5.8 GHz	1x = -85.0 dBm, 2x = -80.0 dBm, 3x = -74.6 dBm, 4x = -73.0 dBm, 5x = -69.1 dBm, 6x = -66.4 dBm, 7x = -62.1 dBm, 8x = -58.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 GHz	1x = -86.51 dBm, 2x = -82.51 dBm, 3x = -78.56 dBm, 4x = -75.58 dBm, 5x = -72.61 dBm, 6x = -70.55 dBm, 7x = -67.64 dBm, 8x = -63.54 dBm
	2.4 GHz	1x = -84.22 dBm, 2x = -81.27 dBm, 3x = -77.27 dBm, 4x = -74.73 dBm, 5x = -71.3 dBm, 6x = -68.86 dBm, 7x = -65.29 dBm, 8x = -62.2 dBm
	3.5 GHz	1x = -85.8 dBm, 2x = -81.8 dBm, 3x = -77.4 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -68.8 dBm, 7x = -65.5

Category		Specification
		dBm, 8x = -61.2 dBm
	3.65 GHz	1x = -85.0 dBm, 2x = -81.5 dBm, 3x = -76.9 dBm, 4x = -75.2 dBm, 5x = -70.5 dBm, 6x = -67.0 dBm, 7x = -64.0 dBm, 8x = -61.2 dBm
	5.4 GHz	1x = -83.1 dBm, 2x = -78.9 dBm, 3x = -74.0 dBm, 4x = -72.0 dBm, 5x = -68.7 dBm, 6x = -66.0 dBm, 7x = -62.0 dBm, 8x = -56.8 dBm
	5.8 GHz	1x = -83.0 dBm, 2x = -78.8 dBm, 3x = -73.7 dBm, 4x = -71.8 dBm, 5x = -67.8 dBm, 6x = -64.7 dBm, 7x = -62.8 dBm, 8x = -56.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	2.4 GHz	1x = -82.16 dBm, 2x = -79.77 dBm, 3x = -75.72 dBm, 4x = -73.31 dBm, 5x = -70.31 dBm, 6x = -67.29 dBm, 7x = -64.31 dBm, 8x = -59.18 dBm
	3.5 GHz	1x = -85.0 dBm, 2x = -80.0 dBm, 3x = -75.8 dBm, 4x = -73.6 dBm, 5x = -69.8 dBm, 6x = -67.0 dBm, 7x = -63.6 dBm, 8x = -59.4 dBm
	3.65 GHz	1x = -83.7 dBm, 2x = -79.5 dBm, 3x = -75.0 dBm, 4x = -73.0 dBm, 5x = -69.0 dBm, 6x = -65.9 dBm, 7x = -62.5 dBm, 8x = -58.0 dBm
	5.4 GHz	1x = -81.0 dBm, 2x = -76.9 dBm, 3x = -72.0 dBm, 4x = -70.1 dBm, 5x = -66.1 dBm, 6x = -64.0 dBm, 7x = -60.1 dBm, 8x = -55.8 dBm
	5.8 GHz	1x = -80.9 dBm, 2x = -76.8 dBm, 3x = -71.8 dBm, 4x = -69.7 dBm, 5x = -66.0 dBm, 6x = -63.5 dBm, 7x = -59.0 dBm, 8x = -55.0 dBm
Performance		
Subscribers Per Sector		Up to 238
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8QAM	14
		4x	16QAM	17
		5x	32QAM	21
		6x	64QAM	24
		7x	128QAM	28
		8x	256QAM	32
Latency		3 - 5 ms for 2.5 ms Frame Period 6-10 ms for 5.0 ms Frame Period		
Maximum Deployment Range		Up to 40 miles (64 km)		
Packets Per Second		12,500		
GPS Synchronization		Yes, via CMM3, CMM4 or UGPS		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Gain (Does not include cable loss, ~1dB)	2.4 GHz	18 dBi Dual Slant		
	3.5 GHz	16 dBi Dual Slant		
	3.65 GHz	16 dBi Dual Slant		
	5 GHz	17 dBi Horizontal and Vertical		
Combined Transmit Power		-30 to +22 dBm (to EIRP limit by region) in 1 dB-configurable intervals (2.4 GHz, 5 GHz) -30 to +25 dBm (to EIRP limit by region) in 1 dB-configurable intervals (3.5 GHz) -30 to +25 dBm (to EIRP limit by region and channel bandwidth) in 1 dB-configurable intervals (3.6 GHz)		
Maximum Transmit Power		• 22 dBm combined OFDM (2.4 GHz, 5 GHz) (dependent upon Region Code setting) • 25 dBm combined OFDM (3.5 GHz, 3.6 GHz), (dependent upon Region Code setting)		
Physical				
Wind Survival		200 mph (322 kph)		
Antenna Connection		50 ohm, N-type (Connectorized version only)		

Category		Specification
Surge Suppression EN61000-4-5		EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform Recommended surge suppressor: Cambium Networks Model # C000000L065A
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F) / 0-95% non-condensing
Weight	2.4 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
	3.5 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
	3.6 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
	5 GHz	5.9 kg (13 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
Dimension (HxWxD)	2.4 GHz	Radio: 27 x 21 x 7 cm (10.6” x 8.3” x 2.8”) Antenna: 112.2 x 24.5 x 11.7 cm (44.2” x 9.6” x 4.6”)
	3.5 GHz	Radio: 27 x 21 x 7 cm (10.6” x 8.3” x 2.8”)
	3.6 GHz	Radio: 27 x 21 x 7 cm (10.6” x 8.3” x 2.8”)
	5 GHz	Radio: 27 x 21 x 7 cm (10.6” x 8.3” x 2.8”) Antenna: 51 x 13 x 7.3 cm (20.2” x 5.1” x 2.9”)
Power Consumption		14 W
Input Voltage		22 to 32 VDC
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PMP 450 Series - SM

The PMP 450 SM conforms to the specifications listed in below table.

Table 171: PMP 450 Series - SM specifications

Category		Specification
Model Number		PMP 450 SM
Spectrum		
Channel Spacing		5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range	900 MHz	902 – 928 MHz
	2.4 GHz	2400 – 2483.5 MHz
	3.5 GHz	3300 – 3600 MHz
	3.65 GHz	3500 – 3850 MHz
	5 GHz	5470 – 5875 MHz
Channel Bandwidth	900 MHz,	5, 7, 10, 15, and 20 MHz
	2.4 GHz, 3.5 GHz, 3.65 GHz and 5 GHz	5, 10, 15, 20, 30, and 40 MHz Note: 2.4 GHz band does not support 40 MHz.
OFDM Subcarriers		512 FFT
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100 BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v3
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		

Category		Specification
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz	1x = -93.66 dBm, 2x = -89.6 dBm, 3x = -85.65 dBm, 4x = -83.58 dBm, 5x = -80.65 dBm, 6x = -77.59 dBm, 7x = -74.24 dBm, 8x = -70.59 dBm
	2.4 GHz	1x = -92.18 dBm, 2x = -87.5 dBm, 3x = -84.19 dBm, 4x = -81.15 dBm, 5x = -78.2 dBm, 6x = -74.15 dBm, 7x = -70.21 dBm, 8x = -65.18 dBm
	3.5 GHz	1x = -92.0 dBm, 2x = -89.4 dBm, 3x = -85.6 dBm, 4x = -83.5 dBm, 5x = -79.0 dBm, 6x = -76.4 dBm, 7x = -73.0 dBm, 8x = -67.0 dBm
	3.65 GHz	1x = -91.3 dBm, 2x = -89.1 dBm, 3x = -85.0 dBm, 4x = -82.2 dBm, 5x = -79.0 dBm, 6x = -76.0 dBm, 7x = -72.0 dBm, 8x = -67.3 dBm
	5.4 GHz	1x = -91.2 dBm, 2x = -88.0 dBm, 3x = -83.2 dBm, 4x = -81.1 dBm, 5x = -78.0 dBm, 6x = -75.1 dBm, 7x = -71.1 dBm, 8x = -66.3 dBm
	5.8 GHz	1x = -89.0 dBm, 2x = -87.0 dBm, 3x = -84.0 dBm, 4x = -82.0 dBm, 5x = -79.0 dBm, 6x = -76.0 dBm, 7x = -72.0 dBm, 8x = -64.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 MHz	1x = -92.08 dBm, 2x = -88.71 dBm, 3x = -84.71 dBm, 4x = -81.71 dBm, 5x = -78.76 dBm, 6x = -75.7 dBm, 7x = -72.78 dBm, 8x = -68.73 dBm
	3.5 GHz	1x = -91.0 dBm, 2x = -88.0 dBm, 3x = -83.0, 4x = -81.4 dBm, 5x = -78.0 dBm, 6x = -74.5 dBm, 7x = -71.0 dBm, 8x = -66.0 dBm
	3.65 GHz	1x = -90.4 dBm, 2x = -87.3 dBm, 3x = -82.4, 4x = -81.0 dBm, 5x = -78.0 dBm, 6x = -74.0 dBm, 7x = -71.0 dBm, 8x = -66.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -90.1 dBm, 2x = -86.89 dBm, 3x = -82.95, 4x = -80.73 dBm, 5x = -77.95 dBm, 6x = -74.67 dBm, 7x = -70.96 dBm, 8x = -67.88 dBm
	2.4 GHz	1x = -89.78 dBm, 2x = -84.77 dBm, 3x = -80.8, 4x = -78.85 dBm, 5x = -74.81 dBm, 6x = -71.75 dBm, 7x = -68.91 dBm, 8x = -64.77 dBm
	3.5 GHz	1x = -90.5 dBm, 2x = -86.5 dBm, 3x = -82.0, 4x = -80.5 dBm, 5x = -76.5 dBm, 6x = -73.5 dBm, 7x = -70.0 dBm, 8x = -65.0 dBm
	3.65 GHz	1x = -89.3 dBm, 2x = -86.3 dBm, 3x = -81.6, 4x = -79.0 dBm, 5x = -75.6 dBm, 6x = -72.5 dBm, 7x = -68.5 dBm, 8x = -65.0 dBm
	5.4 GHz	1x = -88.0 dBm, 2x = -84.8 dBm, 3x = -80.4, 4x = -78.6 dBm, 5x = -74.8 dBm, 6x = -71.7 dBm, 7x = -67.7 dBm, 8x = -62.0 dBm
	5.8 GHz	1x = -88.9 dBm, 2x = -85.0 dBm, 3x = -80.5, 4x = -78.8 dBm, 5x = -75.0 dBm, 6x = -72.0 dBm, 7x = -68.0 dBm, 8x = -61.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	900 MHz	1x = -87.0 dBm, 2x = -84.82 dBm, 3x = -80.98, 4x = -78.79 dBm, 5x = -74.98 dBm, 6x = -71.9 dBm, 7x = -68.99 dBm, 8x = -64.92 dBm
	2.4 GHz	1x = -87.81 dBm, 2x = -82.8 dBm, 3x = -78.81, 4x = -76.35 dBm, 5x = -72.42 dBm, 6x = -69.77 dBm, 7x = -67.45 dBm, 8x = -62.78 dBm
	3.5 GHz	1x = -89.5 dBm, 2x = -84.5 dBm, 3x = -81.0, 4x = -78.5 dBm, 5x = -75.0 dBm, 6x = -71.0 dBm, 7x = -68.4 dBm, 8x = -64.0 dBm
	3.65 GHz	1x = -87.5 dBm, 2x = -84.3 dBm, 3x = -80.0, 4x = -79.9 dBm, 5x = -74.4 dBm, 6x = -71.0 dBm, 7x = -68.0 dBm, 8x = -63.0 dBm

Category		Specification
	5.4 GHz	1x = -86.0 dBm, 2x = -82.7 dBm, 3x = -78.7, 4x = -76.6 dBm, 5x = -73.7 dBm, 6x = -69.5 dBm, 7x = -65.7 dBm, 8x = -59.5 dBm
	5.8 GHz	1x = -86.9 dBm, 2x = -83.0 dBm, 3x = -78.9, 4x = -77.1 dBm, 5x = -73.9 dBm, 6x = -70.0 dBm, 7x = -65.9 dBm, 8x = -58.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -86.92 dBm, 2x = -83.9 dBm, 3x = -79.92, 4x = -77.0 dBm, 5x = -73.93 dBm, 6x = -70.85 dBm, 7x = -67.97 dBm, 8x = -64.89 dBm
	2.4 GHz	1x = -86.73 dBm, 2x = -81.71 dBm, 3x = -76.69, 4x = -74.69 dBm, 5x = -70.76 dBm, 6x = -67.68 dBm, 7x = -64.77 dBm, 8x = -61.69 dBm
	3.5 GHz	1x = -87.7 dBm, 2x = -84.0 dBm, 3x = -78.6, 4x = -77.6 dBm, 5x = -74.0 dBm, 6x = -70.0 dBm, 7x = -67.4 dBm, 8x = -62.0 dBm
	3.65 GHz	1x = -86.0 dBm, 2x = -83.0 dBm, 3x = -79.0, 4x = -77.0 dBm, 5x = -73.0 dBm, 6x = -68.5 dBm, 7x = -66.0 dBm, 8x = -61.0 dBm
	5.4 GHz	1x = -85.0 dBm, 2x = -81.7 dBm, 3x = -77.0, 4x = -75.6 dBm, 5x = -71.7 dBm, 6x = -68.0 dBm, 7x = -63.7 dBm, 8x = -57.3 dBm
	5.8 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.0, 4x = -75.0 dBm, 5x = -72.0 dBm, 6x = -68.0 dBm, 7x = -63.9 dBm, 8x = -56.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	2.4 GHz	1x = -84.72 dBm, 2x = -80.4 dBm, 3x = -75.74, 4x = -72.68 dBm, 5x = -69.75 dBm, 6x = -66.66 dBm, 7x = -63.76 dBm, 8x = -59.67 dBm
	3.5 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.0, 4x = -75.6 dBm, 5x = -72.0 dBm, 6x = -68.6 dBm, 7x = -65.9 dBm, 8x = -60.1 dBm
	3.65 GHz	1x = -84.3 dBm, 2x = -80.3 dBm, 3x = -76.0, 4x = -74.3 dBm, 5x = -71.4 dBm, 6x = -67.0 dBm, 7x = -64.8 dBm, 8x = -58.5 dBm
	5.4 GHz	1x = -83.0 dBm, 2x = -80.7 dBm, 3x = -75.5, 4x = -73.7 dBm, 5x = -69.0 dBm, 6x = -65.5 dBm, 7x = -60.6 dBm, 8x = -55.0 dBm
	5.8 GHz	1x = -83.8 dBm, 2x = -80.7 dBm, 3x = -75.8, 4x = -73.8 dBm, 5x = -70.0 dBm, 6x = -65.0 dBm, 7x = -60.8 dBm, 8x = -54.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	3.5 GHz	1x = -83.1 dBm, 2x = -79.3 dBm, 3x = -75.0, 4x = -72.9 dBm, 5x = -70.0 dBm, 6x = -66.0 dBm, 7x = -64.0 dBm, 8x = -56.3 dBm
	3.65 GHz	1x = -83.6 dBm, 2x = -79.6 dBm, 3x = -74.5, 4x = -72.3 dBm, 5x = -69.6 dBm, 6x = -65.3 dBm, 7x = -63.0 dBm, 8x = -54.4 dBm
	5.4 GHz	1x = -83.0 dBm, 2x = -78.4 dBm, 3x = -73.6, 4x = -72.0 dBm, 5x = -68.6 dBm, 6x = -64.6 dBm, 7x = -59.4 dBm, 8x = -54.0 dBm
	5.8 GHz	1x = -82.6 dBm, 2x = -78.6 dBm, 3x = -73.6, 4x = -72.6 dBm, 5x = -68.7 dBm, 6x = -64.0 dBm, 7x = -59.6 dBm, 8x = -52.0 dBm
Performance		
Subscribers Per Sector		Up to 238

Category		Specification		
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8QAM	14
		4x	16QAM	17
		5x	32QAM	21
		6x	64QAM	24
		7x	128QAM	28
		8x	256QAM	32
Latency		• 3 - 5 ms for 2.5 ms Frame Period • 6-10 ms for 5.0 ms Frame Period		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Gain (Does not include cable loss, ~1dB)	900 MHz	12 dBi Yagi antenna		
	2.4 GHz	7 dBi Dual Slant, integrated patch		
	3.5 GHz	8 dBi Dual Slant, integrated patch		
		19 dBi Flat Plate, integrated patch		
	3.65 GHz	8 dBi Dual Slant, integrated patch		
		19 dBi Flat Plate, integrated patch		
	5 GHz	9 dBi H+V, integrate d patch		
		25 dBi H+V, integrated dish		
Combined Transmit Power		-30 to +22 dBm (to EIRP limit by region) – 2.4, 5 GHz -30 to +25 dBm (to EIRP limit by region) – 3.5, 3.6 GHz 25 dBm - 3 GHz		
Maximum Transmit Power		• 22 dBm combined OFDM (2.4 GHz, 5 GHz) (dependent upon Region Code setting) • 25 dBm combined OFDM (900 MHz, 3.5 GHz, 3.6 GHz),		

Category		Specification
		(dependent upon Region Code setting)
Reflector antenna gain	2.4 GHz	+12 dBi
	3.5 GHz	+11 dBi
	3.65 GHz	+11 dBi
	5 GHz	+15 dBi
Other antenna (5 GHz only)	CLIP Gain	+8 dBi
	LENS Gain	+5.5 dBi
Physical		
Wind Survival		200 mph (322 kph)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform Recommended surge suppressor: Cambium Networks Model # 600SSH
Environmental		IP55
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F) / 0-95% non-condensing
Weight	2.4 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
	3.5 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna 2.5 kg (5.5 lbs) for 450 ruggedized
	3.6 GHz	15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna 2.5 kg (5.5 lbs) for 450 ruggedized
	5 GHz	5.9 kg (13 lbs) with antenna 2.5 kg (5.5 lbs) without antenna 3.5 kg (7.7 lbs) for 450d
Dimensions (H x W x D)		30 x 9 x 9 cm (11.75” x 3.4” x 3.4”) 50 x 50 x 38 cm (19.69” x 19.69” x 14.96”) for 450d 31.0 x 31.0 x 6.4 cm (12” x 12” x 2.5”) for 450 ruggedized

Category		Specification
Power Consumption		12 W
Input Voltage		20 to 32 VDC
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

Specifications for PTP 450 Series - BH

The PTP 450 BH conforms to the specifications listed in below table.

Table 172: PTP 450 Series - BH specifications

Category		Specification
Model Number		PTP 450 BH
Spectrum		
Channel Spacing		5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		902 to 928 MHz
		3300 – 3600 MHz
		3500 – 3850 MHz
		5470 – 5875 MHz
Channel Bandwidth	900 MHz	5, 7, 10, 15, and 20 MHz
	3.5 GHz, 3.6 GHz, and 5 GHz	5, 7, 10, 15, 20, 30 , and 40 MHz 7 MHz Channel bandwidth configurable for 3.5 GHz and 3.65 GHz band only.
OFDM Subcarriers		512 FFT
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100 BaseT, half/full duplex, rate auto negotiated (802.3 compliant)

Category		Specification
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP, TFTP, RADIUS
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3, TFTP, Syslog
VLAN		802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz	1x = -94.0 dBm, 2x = -90.7 dBm, 3x = -85.6 dBm, 4x = -83.8 dBm, 5x = -80.6 dBm, 6x = -77.5 dBm, 7x = -73.8 dBm, 8x = -69.8 dBm
	3.5 GHz	1x = -94.0 dBm, 2x = -89.6 dBm, 3x = -85.4 dBm, 4x = -83.0 dBm, 5x = -80.0 dBm, 6x = -76.5 dBm, 7x = -72.3 dBm, 8x = -68.2 dBm
	3.6 GHz	1x = -94.0 dBm, 2x = -90.0 dBm, 3x = -85.0 dBm, 4x = -82.7 dBm, 5x = -79.6 dBm, 6x = -75.0 dBm, 7x = -71.9 dBm, 8x = -66.7 dBm
	5.4 GHz	1x = -90.9 dBm, 2x = -86.8 dBm, 3x = -83.7 dBm, 4x = -80.8 dBm, 5x = -78.0 dBm, 6x = -74.8 dBm, 7x = -70.0 dBm, 8x = -66.0 dBm
	5.8 GHz	1x = -91.5 dBm, 2x = -87.0 dBm, 3x = -83.0 dBm, 4x = -81.0 dBm, 5x = -77.8 dBm, 6x = -74.0 dBm, 7x = -70.0 dBm, 8x = -66.4 dBm
Nominal Receive Sensitivity (w/ FEC) @7 MHz Channel	900 MHz	1x = -92.4 dBm, 2x = -88.3 dBm, 3x = -83.9 dBm, 4x = -81.8 dBm, 5x = -78.9 dBm, 6x = -75.9 dBm, 7x = -72.9 dBm, 8x = -68.9 dBm
	3.5 GHz	1x = -92.4 dBm, 2x = -88.0 dBm, 3x = -83.5 dBm, 4x = -81.0 dBm, 5x = -78.1 dBm, 6x = -75.1 dBm, 7x = -70.9 dBm, 8x = -67.0 dBm
	3.6 GHz	1x = -92.0 dBm, 2x = -87.7 dBm, 3x = -83.6 dBm, 4x = -80.7 dBm, 5x = -78.1 dBm, 6x = -74.0 dBm, 7x = -70.8 dBm, 8x = -66.0 dBm
Nominal Receive Sensitivity (w/ FEC) @10 MHz Channel	900 MHz	1x = -91.0 dBm, 2x = -87.0 dBm, 3x = -82.8 dBm, 4x = -80.9 dBm, 5x = -77.7 dBm, 6x = -74.6 dBm, 7x = -71.0 dBm, 8x = -66.9 dBm
	3.5 GHz	1x = -91.5 dBm, 2x = -86.5 dBm, 3x = -82.0 dBm, 4x = -80.1 dBm, 5x = -76.5 dBm, 6x = -73.2 dBm, 7x = -70.0 dBm, 8x = -65.7 dBm
	3.6 GHz	1x = -90.7 dBm, 2x = -86.0 dBm, 3x = -82.1 dBm, 4x = -80.0 dBm, 5x = -76.5 dBm, 6x = -72.7 dBm, 7x = -69.1 dBm, 8x = -64.0 dBm
	5.4 GHz	1x = -87.5 dBm, 2x = -84.1 dBm, 3x = -80.0 dBm, 4x = -77.9 dBm, 5x = -75.0 dBm, 6x = -71.5 dBm, 7x = -67.0 dBm, 8x = -58.0 dBm
	5.8 GHz	1x = -88.0 dBm, 2x = -84.0 dBm, 3x = -80.0 dBm, 4x = -78.0 dBm, 5x = -75.0 dBm, 6x = -71.0 dBm, 7x = -66.0 dBm, 8x = -61.7 dBm
Nominal Receive Sensitivity (w/ FEC) @15 MHz Channel	900 MHz	1x = -89.8 dBm, 2x = -85.7 dBm, 3x = -80.9 dBm, 4x = -78.7 dBm, 5x = -75.8 dBm, 6x = -72.9 dBm, 7x = -69.1 dBm, 8x = -65.0 dBm
	3.5 GHz	1x = -89.0 dBm, 2x = -85.0 dBm, 3x = -80.0 dBm, 4x = -78.0 dBm, 5x = -75.2 dBm, 6x = -71.0 dBm, 7x = -68.3 dBm, 8x = -64.0 dBm
	3.6 GHz	1x = -88.7 dBm, 2x = -84.7 dBm, 3x = -80.7 dBm, 4x = -77.7 dBm, 5x = -74.5 dBm, 6x = -70.7 dBm, 7x = -67.8 dBm, 8x = -62.3 dBm

Category		Specification
	5.4 GHz	1x = -85.3 dBm, 2x = -83.0 dBm, 3x = -79.1 dBm, 4x = -76.0 dBm, 5x = -73.0 dBm, 6x = -70.0 dBm, 7x = -66.0 dBm, 8x = -58.0 dBm
	5.8 GHz	1x = -87.4 dBm, 2x = -83.0 dBm, 3x = -78.5 dBm, 4x = -76.5 dBm, 5x = -73.5 dBm, 6x = -69.7 dBm, 7x = -64.5 dBm, 8x = -58.0 dBm
Nominal Receive Sensitivity (w/ FEC) @20 MHz Channel	900 MHz	1x = -88.1 dBm, 2x = -84.0 dBm, 3x = -79.3 dBm, 4x = -77.0 dBm, 5x = -74.3 dBm, 6x = -71.0 dBm, 7x = -67.4 dBm, 8x = -63.0 dBm
	3.5 GHz	1x = -88.0 dBm, 2x = -83.3 dBm, 3x = -79.5 dBm, 4x = -77.1 dBm, 5x = -73.5 dBm, 6x = -70.3 dBm, 7x = -67.0 dBm, 8x = -63.0 dBm
	3.6 GHz	1x = -87.7 dBm, 2x = -82.7 dBm, 3x = -79.0 dBm, 4x = -76.0 dBm, 5x = -73.0 dBm, 6x = -68.6 dBm, 7x = -66.8 dBm, 8x = -61.5 dBm
	5.4 GHz	1x = -84.4 dBm, 2x = -81.0 dBm, 3x = -77.0 dBm, 4x = -74.9 dBm, 5x = -71.9 dBm, 6x = -67.8 dBm, 7x = -64.0 dBm, 8x = -56.0 dBm
	5.8 GHz	1x = -85.0 dBm, 2x = -81.0 dBm, 3x = -77.2 dBm, 4x = -75.0 dBm, 5x = -71.8 dBm, 6x = -67.5 dBm, 7x = -63.0 dBm, 8x = -56.0 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	1x = -86.0 dBm, 2x = -82.0 dBm, 3x = -77.5 dBm, 4x = -75.0 dBm, 5x = -71.5 dBm, 6x = -68.0 dBm, 7x = -65.4 dBm, 8x = -61.0 dBm
	3.6 GHz	1x = -86.2 dBm, 2x = -81.7 dBm, 3x = -77.7 dBm, 4x = -75.0 dBm, 5x = -71.4 dBm, 6x = -67.4 dBm, 7x = -64.5 dBm, 8x = -59.0 dBm
	5.4 GHz	1x = -82.4 dBm, 2x = -80.0 dBm, 3x = -75.9 dBm, 4x = -73.0 dBm, 5x = -69.9 dBm, 6x = -66.0 dBm, 7x = -60.0 dBm, 8x = -54.0 dBm
	5.8 GHz	1x = -84.0 dBm, 2x = -79.0 dBm, 3x = -75.0 dBm, 4x = -72.5 dBm, 5x = -70.0 dBm, 6x = -65.0 dBm, 7x = -59.2 dBm, 8x = -53.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel	5.4 GHz	1x = -82.4 dBm, 2x = -78.0 dBm, 3x = -74.5 dBm, 4x = -71.3 dBm, 5x = -68.5 dBm, 6x = -63.3 dBm, 7x = -58.0 dBm, 8x = -53.0 dBm
	5.8 GHz	1x = -82.0 dBm, 2x = -78.6 dBm, 3x = -74.0 dBm, 4x = -72.0 dBm, 5x = -68.5 dBm, 6x = -64.0 dBm, 7x = -58.0 dBm, 8x = -50.0 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms

Category		Specification		
Modulation Levels (Adaptive)		Modulation Levels		SNR (in dB)
		2x	QPSK	10
		3x	8QAM	14
		4x	16QAM	17
		5x	32QAM	21
		6x	64QAM	24
		5x	128QAM	28
		8x	256QAM	32
Latency		• 3 - 5 ms for 2.5 ms frame period • 6 - 10 ms for 5.0 ms frame period		
Packets Per Second		12,500		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Combined Transmit Power	-	• 30 to +22 dBm (to EIRP limit by region) in 1 dB-configurable intervals (5 GHz) • -30 to +25 dBm (to EIRP limit by region) in 1 dB-configurable intervals (3.5 GHz) • -30 to +25 dBm (to EIRP limit by region and channel bandwidth) in 1 dB-configurable intervals (3.6 GHz)		
Antenna Gain (Does not include cable loss, ~1dB)	3.5 GHz	8 dBi Dual Slant, integrated patch		
		19 dBi Flat Plate, integrated patch		
	3.65 GHz	8 dBi Dual Slant, integrated patch		
		19 dBi Flat Plate, integrated patch		
	5 GHz	9 dBi H+V, integrated patch		
		25 dBi H+V, integrated dish		
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		• 22 dBm combined OFDM (5 GHz) (dependent upon Region Code setting) • 25 dBm combined OFDM (3.5 GHz, 3.6 GHz), (dependent upon Region Code setting)		

Category		Specification
Reflector antenna gain	3.5 GHz	+11 dBi
	3.65 GHz	+11 dBi
	5 GHz	+15 dBi
Other antenna (5 GHz only)	CLIP Gain	+8 dBi
	LENS Gain	+5.5 dBi
Physical		
Sync/AUX port	RJ45	• 10/100/1000BASE-T Ethernet Data • PoE output • Sync input or output (Connection and powering of UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight		15 kg (33 lbs) with antenna 2.5 kg (5.5 lbs) without antenna
Wind Survival		200 mph (322 kph)
Dimension (HxWxD)		30 x 9 x 9 cm (11.75” x 3.4” x 3.4”)
Maximum Power Consumption		14 W
Input Voltage		22 to 32 VDC
Security		
Encryption		128-bit AES and 256-bit AES Note AES-256 requires a license key.

PSU specifications

The PMP/PTP 450i AC+DC Enhanced Power Injector conforms to the specifications listed in below table.

Table 173: PMP/PTP 450i AC power Injector specifications

Category	Specification
Dimensions	137 mm (5.4 in) x 56 mm (2.2 in) x 38 mm (1.5 in)
Weight	0.240 Kg (0.5 lbs)
Temperature	-40°C to +60°C
Humidity	90% non-condensing
Waterproofing	Not waterproof
Altitude	Sea level to 5000 meters (16000 ft)
AC Input	Min 90 V AC, 57 – 63 Hz, max 264 V AC, 47 – 53 Hz.
DC output voltage to the ODU	58V +2V/- 0V
AC connector	IEC-320-C8
Efficiency	Better than 85%, efficiency level 'VI'
Over Current Protection	Hiccup current limiting, trip point set between 120% to 150% of full load current
Hold up time	At least 10 milliseconds

Warning

Use the above PSU to only power up 450i and 450m products.

The PMP/PTP 450 power supply conforms to the specifications listed in below table.

Table 174: PMP/PTP 450 power supply specifications (part number: N000900L001A)

Category	Specification
Dimensions	118 mm (4.66 in) x 45 mm (1.75 in) x 32 mm (1.25 in)
Weight	0.240 Kg (0.5 lbs)
Temperature	0°C to +40°C
Humidity	20 to 90%
AC Input	90-264 VAC, 47 – 63 Hz, 0.5 A rms at 120 VAC, 0.25 A rms at 240 VAC.
DC output voltage to the ODU	30 V ± 5%
AC connector	IEC-320-C8
Efficiency	Better than 85%, efficiency level 'V'

Category	Specification
Over Current Protection	Short circuit, with auto recovery; Should restart between every 0.5 to 2 sec.
Hold up time	10mS min at max load, 120VAC

Note

The 30bV PSU (part number: #N000900L001A) has to be used for PMP 450 900 MHz SM.

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 56 VDC will damage the device.

Data network specifications

This section contains specifications of the PMP/PTP 450 platform Ethernet interface.

Ethernet interface

450m/450i Series

The 450m/450i Series Ethernet port conforms to the specifications listed in below table.

Table 175: 450m/450i Series Main and Aux Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	IEEE 802.3 compatible
QoS	IEEE 802.1p, IEEE 802.1Q, IEEE 802.1ad, DSCP IPv4
Main Ethernet port	10/100/1000 BaseT, half/full duplex, rate auto negotiated
Aux Ethernet port	10/100 BaseT, half/full duplex, rate auto negotiated
Maximum Ethernet Frame Size	1700 Bytes

450/450b Series

Table 176: 450 Series Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	IEEE 802.3 compatible
QoS	IEEE 802.1p, IEEE 802.1Q, IEEE 802.1ad, DSCP IPv4

Ethernet Bridging	Specification
Interface	10/100/1000* BaseT, half/full duplex, rate auto negotiated
Maximum Ethernet Frame Size	1700 Bytes
* 450 SM does not support 1000 BaseT. * 450 AP supports 1000 BaseT, but with known CRC errors and it is not recommended to use.	

Note

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

Over the air throughput is restricted to the rate of the Ethernet interface at the receiving end of the link.

Wireless specifications

This section contains specifications of the 450 Platform Family wireless interface. These specifications include RF bands, channel bandwidth, spectrum settings, maximum power and link loss.

General wireless specifications

The wireless specifications that apply to all 450 Platform variants are listed under below table.

Table 177: 450 Platform Family - wireless specifications

Item	Specification
Channel selection	Manual selection (fixed frequency).
Manual power control	To avoid interference to other users of the band, maximum power can be set lower than the default power limit.
Duplex scheme	Adaptive TDD

Item	Specification		
Range	Band	Platform	Range
	900 MHz	PMP 450i Series - AP and PMP 450 Series - SM	120 mi / 193 km
	2.4 GHz	PMP 450 Series	40 mi / 64 km
	3.5 GHz	PMP/PTP 450/450b Series	40 mi / 64 km (PMP) 186 mi/ 299 km (PTP)
	3.65 GHz	PMP/PTP 450/450b Series	40 mi / 64 km (PMP) 186 mi/ 299 km (PTP)
	5 GHz	PMP/PTP 450/450i/450b Series and PMP 450m Series AP	40 mi / 64 km (PMP) 186 mi/ 299 km (PTP)
Over-the-air encryption	128-bit AES and 256-bit AES		
Error Correction	Rate 3/4 RS coder		

Link Range and Throughput

Link range and throughput estimates are based on site-specific attributes and configuration parameters. For the most up-to-date information on link range and throughput for your equipment see the Capacity Planner and LINKPlanner software tools:

- For average-deployment link range and throughput planning information, see:
  - https://support.cambiumnetworks.com/files/capacityplanner/
- For site-specific link range and throughput planning information, see:
  - https://support.cambiumnetworks.com/files/linkplanner

Country specific radio regulations

This section describes how the 450 Platform Family complies with the radio regulations that are enforced in various countries.

Caution

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

Type approvals

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

The radio specification type approvals that have been granted for 450 Platform frequency variants are listed in below table.

Table 178: Radio certifications

Variant	Region	Specification (Type Approvals)
900 MHz PMP 450i	Canada	RSS Gen and RSS 210
	USA	FCC Part 15.247
	Mexico	NOM-121-SCT1-2009
2.4 GHz PMP 450	Canada	RSS Gen and RSS 210
	USA	FCC Part 15 Class B
3.5 GHz PMP/PTP 450	Canada	RSS Gen and RSS 192
	Europe	ETSI EN 302 326-2 V1.2.2
3.6 GHz PMP/PTP 450	Canada	RSS Gen and RSS 197
	USA	FCC Part 15 Class B
3.5 GHz PMP 450m	Canada	RSS Gen and RSS 192
	Europe	ETSI EN 302 326-2 V1.2.2
3.6 GHz PMP 450m	Canada	RSS Gen, RSS 197 and RSS 198
	USA	FCC Part 90Z and Part 15 Class B
	Europe	ETSI EN 302 326-2 V1.2.2
3.5 GHz PMP 450b	Canada	RSS Gen, RSS 197 and RSS 198
	USA	FCC Part 90Z and Part 15 Class B
	Canada	ETSI EN 302 326-2 V1.2.2
4.9 GHz PMP/PTP 450i/450b/450m/450 MicroPoP/450b Retro	USA	FCC Part 90 Subpart Y
	Canada	RSS Gen and RSS 111
5.1 GHz PMP/PTP 450i/450b/450 MicroPoP/450b Retro	USA	FCC Part 15 Class B
5.1 GHz PMP 450m	USA	FCC Part 15E and Part 15B
	Europe	ETSI EN 302 625 V1.1.1
5.2 GHz PMP 450m	USA	FCC Part 15E and Part 15B
5.2 GHz PMP/PTP 450i/450b/450 MicroPoP/450b Retro	USA	FCC Part 15 Class B
	Canada	RSS Gen and RSS 247
5.4 GHz PMP/PTP 450 and 450i/450 MicroPoP/450b Retro	Europe	ETSI EN 301 893 v1.6.1
	USA	FCC Part 15 Class B

Variant	Region	Specification (Type Approvals)
5.4 GHz PMP 450m	USA	FCC Part 15E and Part 15B
	Canada	RSS Gen and RSS 247
	Europe	ETSI EN 301 893 v1.8.1 ETSI EN 301 893 v2.1.1 Clause 4.8
5.8 GHz PMP/PTP 450 and 450i/450 MicroPoP/450b Retro	Canada	RSS Gen and RSS 210
	USA	FCC Part 15 Class B
	Europe	ETSI EN 302 502 v1.2.1
5.8 GHz PMP 450m	USA	FCC Part 15E and Part 15B
	Canada	RSS Gen and RSS 247
	Europe	ETSI EN 302 502 v2.1.1

DFS for 2.4 and 5 GHz Radios

Dynamic Frequency Selection (DFS) is a requirement in several countries and regions for 2.4 and 5 GHz unlicensed systems to detect radar systems and avoid co-channel operation.

The details of DFS operation and channels available for each Country Code, including whether DFS is active on the AP, SM, which DFS regulation apply, and any channel restrictions are shown in below table.

Table 179: Country & Bands DFS setting

Region Code	Country Code	Band	AP	SM	Weather Radar Notch-Out
North America	USA	2.4 GHz	No effect	No effect	No
		5.2 GHz	FCC DFS	No effect	No
		5.4 GHz	FCC DFS	No effect	No
		5.8 GHz	No effect	No effect	No
	Canada	2.4 GHz	No effect	No effect	No
		5.2 GHz	RSS-247 Iss2 DFS	No effect	No
		5.4 GHz	RSS-247 Iss2 DFS	No effect	Yes
		5.8 GHz	No effect	No effect	No
	Mexico	2.4 GHz	No effect	No effect	No
		5.2 GHz	ANATEL Res506-2008	No effect	No
		5.4 GHz	ANATEL Res506-2008	No effect	No
		5.8 GHz	No effect	No effect	No
South America	Brazil	5.4 GHz	ETSI EN 301 893 v2.1.1DFS	No effect	No
		5.8 GHz	No effect	No effect	No
Europe	ETSI	5.4 GHz	ETSI EN 301 893 v2.1.1 DFS	ETSI EN 301 893 v2.1.1 DFS	Yes
		5.8 GHz	ETSI EN 302 502 v2.1.1 DFS	ETSI EN 302 502 v2.1.1 DFS	Yes

Region Code	Country Code	Band	AP	SM	Weather Radar Notch-Out
Other-Regulatory	Other-FCC	2.4 GHz	No effect	No effect	No
		5.2 GHz	FCC DFS	No effect	No
		5.4 GHz	FCC DFS	No effect	No
		5.8-GHz	No effect	No effect	No
	Other-ETSI	5.4 GHz	ETSI EN 301 893 v2.1.1 DFS	ETSI EN 301 893 v1.7.1 DFS	No
		5.8 GHz	ETSI EN 302 502 v2.1.1 DFS	ETSI EN 302 502 v1.2.1 DFS	No

Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment

	Please do not dispose of Electronic and Electric Equipment or Electronic and Electric Accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment. In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

Country specific band range maximum transmit power

Maximum transmit power 900 MHz band

Table 180: Frequency range and Maximum transmit power – 900 MHz band PMP 450i Series

Region	Country	Band Range		Device Type	Antenna Type	EIRP Limit /Conducted Power Limit (dBm)							
		Lower	Upper				5 MHz	7 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40MHz
North America	Other FCC, USA, Canada, Mexico, Puerto, Rico	902	928	Any	Any	EIRP	36	36	36	36	36	-	-
						CPL							
Oceania	Australia	915	928	Any	Any	EIRP	30	30	30	30	-	-	-
						CPL	19	19	19	19	-	-	-
		915	928	Any	Any	EIRP	30	30	30	36	-	-	-
						CPL	19	19	19	19	-	-	-

Region	Country	Band Range		Device Type	Antenna Type	EIRP Limit /Conducted Power Limit (dBm)							
		Lower	Upper				5 MHz	7 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40MHz
South America	New Zealand Brazil Ecuador	920.5 (MHz)	924.5 (MHz)	Any	Any	EIRP	30	30	30	36	-	-	-
						CPL	19	19	19	19	-	-	-
		919.5 (5MHz)	925.5 (MHz)	Any	Any	EIRP	30	30	30	36	-	-	-
						CPL	19	19	19	19	-	-	-
		902	907.5	Any	Any	EIRP	36	36	36	36	-	-	-
						CPL							
		915	928	Any	Any	EIRP	36	36	36	36	-	-	-
						CPL					-	-	-
		902	928	Any	Any	EIRP						-	-
						CPL	27	27	27	27	27	-	-
	Colombia, Panama, Venezuela	902	928	Any	Any	EIRP	36	36	36	36	36	-	-
						CPL						-	-
Others	Others	902	928	Any	Any	EIRP						-	-
						CPL						-	-

CPL= Conducted Power Limit

Maximum transmit power 2.4 GHz band

Table 181: Frequency range and Maximum transmit power – 2.4 GHz band PMP/PTP 450 Series

Country	Band Range		Device Type	Antenna Type		EIRP Limit /Conducted Power Limit (dBm)					
	Lower	Upper				5 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40 MHz
Other FCC, USA, Canada and Indonesia	2400	2483.5	AP	Sector	EIRP	36	36	36	36	-	-
					CPL	18	18	18	18	-	-
			SM, BH	Integrated	EIRP	36	36	36	36	-	-
					CPL					-	-
				Reflector	EIRP	36	36	36	36	-	-
					CPL	24	24	24	24	-	-
				Integrated Dish (450d)	EIRP	36	36	36	36	-	-
					CPL	11	11	11	11	-	-
Others	2400	2483.5	Any	Any	EIRP						
					CPL	30	30	30	30	30	30

CPL= Conducted Power Limit

Maximum transmit power 3 GHz band

Table 182: Frequency range and Maximum transmit power – 3 GHz band PMP/PTP 450 Series

Country	Band Range		Device Type	Antenna Type		EIRP Limit /Conducted Power Limit (dBm)						
	Lower	Upper				5 MHz	7 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40 MHz
Other	3300 (1)	3850 (1)	Any	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
FCC	3650	3700	Any	Any	EIRP	37	38.5	40	41.7	43	44.7	46
					CPL	19	20.5	22	23.7	25	26.7	28
ETSI	3410 (2)	3800 (2)	Any (5)	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
India	3300 (3)	3800 (3)	Any	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
Indonesia	3600	3800	Any	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
China	3300	3400	Any	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
Canada	3450	3650	Any	Any	EIRP	62	62	62	62	62	62	62
					CPL	*	*	*	*	*	*	*
	3650	3700	Any	Any	EIRP	37	38.5	40	41.7	43	44.7	46
					CPL	19	20.5	22	23.7	25	26.7	28
USA	3550 (4)	3700 (4)	Any	Any	EIRP	44	45.5	47	48.7	50	51.7	53
					CPL	24	25.5	27	28.1	30	30	30
	3650	3700	Any	Any	EIRP	37	38.5	40	41.7	43	44.7	46
					CPL	19	20.5	22	23.7	25	26.7	28

Country	Band Range		Device Type	Antenna Type		EIRP Limit /Conducted Power Limit (dBm)						
	Lower	Upper				5 MHz	7 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40 MHz
Mexico	3300	3750	Any	Any	EIRP	*	*	*	*	*	*	*
					CPL	*	*	*	*	*	*	*
Australia	3300	3800	Any	Any	EIRP	57	58.9	60	61.7	63	63	X
					CPL	*	*	*	*	*	X	X
Brazil	3400	3600	Any	Any	EIRP	*	*	*	*	*	X	X
					CPL	*	*	*	*	*	X	X

(*) = No limit

(X) = Not allowed

CPL= Conducted Power Limit

1. = Frequencies between 3850 and 3900 can also be selected, but performance is not guaranteed in this portion of the band. For example, sensitivity is degraded
2. = No PTP support in ETSi region
3. = Either ETSI or FCCC
4. = This band follows the CBRS rules (devices need to connect to a SAS to be granted a channel)
5. The lack of power limits applies only to Category C ETSI countries. ETSI Categories A and B have limits that are captured in Table 206.

Maximum transmit power 4.9 GHz band

Table 183: Default combined transmit power per country – 4.9 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Canada, Other FCC	AP	Sector	5 MHz	16	24	40
			10 MHz	16	24	40
			15 MHz	16	24	40
			20 MHz	16	24	40
		Omni	5 MHz	12	24	36
			10 MHz	12	24	36
			15 MHz	12	24	36
			20 MHz	12	24	36
	SM, BH	Flate plate	5 MHz	27	24	51
			10 MHz	27	24	51
			15 MHz	27	24	51
			20 MHz	27	24	51
		4ft parabolic	5 MHz	32	24	56
			10 MHz	32	24	56
			15 MHz	32	24	56
			20 MHz	32	23	52
		6ft parabolic	5 MHz	36	24	60
			10 MHz	36	24	60
			15 MHz	36	24	60
			20 MHz	36	24	60
Brazil	AP	Sector	5 MHz	16	27	43
			10 MHz	16	27	43
			15 MHz	16	27	43
			20 MHz	16	27	43

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Mexico	AP	Sector	5 MHz	16	22	38
			10 MHz	16	22	38
			15 MHz	16	22	38
			20 MHz	16	22	38
			30 MHz	16	22	38
			40 MHz	16	22	38
Other	Any	Any	Any	-	27	-

Table 184: Default combined transmit power per country – 4.9 GHz band PMP 450b Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
FCC	SM	16 dBi Mid-Gain	5 MHz	16	26	42
			10 MHz	16	26	42
			15 MHz	16	26	42
			20 MHz	16	26	42
		23 dBi High Gain	5 MHz	23	26	49
			10 MHz	23	26	49
			15 MHz	23	26	49
			20 MHz	23	26	49

Table 185: Default combined transmit power per country – 4.9 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
USA, Canada, Other FCC	AP	Sector	5 MHz	42 dBm (in sector mode)/ 48 dBm (in beamforming mode)
			10 MHz	
			15 MHz	
			20 MHz	
Brazil	AP	Sector	5 MHz	
			10 MHz	
			15 MHz	
			20 MHz	
Mexico	AP	Sector	5 MHz	
			10 MHz	
			15 MHz	
			20 MHz	
			30 MHz	
			40 MHz	
Other	AP	Sector	Any	

Maximum transmit power 5.1 GHz band

Table 186: Default combined transmit power per Country – 5.1 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC and Canada	AP	Sector	5 MHz	16	14	30
			10 MHz	16	17	33
			15 MHz	16	18	34
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
		Omni	5 MHz	12	16	28
			10 MHz	12	19	31
			15 MHz	12	22	34
			20 MHz	12	24	36
			30 MHz	12	24	36
			40 MHz	12	24	36
	SM, BH	Flat plate	5 MHz	23	24	47
			10 MHz	23	27	50
			15 MHz	23	27	50
			20 MHz	23	27	50
			30 MHz	23	27	50
			40 MHz	23	27	50
		4ft parabolic	5 MHz	33	14	47
			10 MHz	33	17	50
			15 MHz	33	18	51
			20 MHz	33	20	53
			30 MHz	33	20	53
			40 MHz	33	20	53

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
		6ft parabolic	5 MHz	36	11	47
			10 MHz	36	14	50
			15 MHz	36	15	51
			20 MHz	36	17	53
			30 MHz	36	17	53
			40 MHz	36	17	53

Table 187: Default combined transmit power per country – 5.1 GHz band PMP 450b Mid-Gain and High Gain

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
FCC	SM	16 dBi Mid-Gain	5 MHz	16	9	47
			10 MHz	16	6	50
			15 MHz	16	6	51
			20 MHz	16	6	53
			30 MHz	16	6	53
			40 MHz	16	6	53
		23 dBi High Gain	5 MHz	23	9	47
			10 MHz	23	6	50
			15 MHz	23	6	51.7
			20 MHz	23	6	53
			30 MHz	23	6	53
			40 MHz	23	6	53

(1) Last channel at full power is 5325. Channel centers 5327.5 and 5330 need a backoff of 7 dB.

(2) First channel at full power is 5495. Channel centers 5490 and 5492.5 need a backoff of 5 dB.

(3) FCC Tx power limits need to be captured in the user guide

(4) Channel center 5170 needs a 4 dB backoff.

Table 188: Default combined transmit power per Country – 5.1 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
USA	AP	Sector	5 MHz	30
			10 MHz	33
			15 MHz	34
			20 MHz	36
			30 MHz	36
			40 MHz	36

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
ETSI	AP	Sector	5 MHz	33
			10 MHz	36
			15 MHz	37.7
			20 MHz	39
Mexico	AP	Sector	20 MHz	23
			30 MHz	23
			40 MHz	23
Other	Any	Any	5 MHz	42
			10 MHz	42
			15 MHz	42
			20 MHz	42
			30 MHz	42
			40 MHz	42

Note

For releases 16.0 and later, although sector transmission mode EIRP is limited to 42 dBm, ROW GUI configuration limit allows a setting of up to 48 dBm. This allows the software to transmit as high as 48 dBm for ROW regions, depending on the modulation mode and transmission mode in use. For a detailed explanation, see the Release 16.0 training slides available at:

https://learning.cambiumnetworks.com/learn/course/121/PMP450SoftwareRelease16

Maximum transmit power 5.2 GHz band

Note

The selection of 5 MHz channel is not available for the PMP 450 AP and the PTP 450 BHM. It is available for the PMP/PTP 450i AP/SM and the PMP 450m AP.

Table 189: Default combined transmit power per country – 5.2 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
USA, Other FCC	SM, BH	Omni	5 MHz	12	12	24
			10 MHz	12	15	27
			15 MHz	12	16	28
			20 MHz	12	18	30
			30 MHz	12	18	30
			40 MHz	12	18	30
USA, Other FCC	SM, BH	Flat plate	5 MHz	23	27	50
			10 MHz	23	27	50
			15 MHz	23	27	50
			20 MHz	23	27	50
			30 MHz	23	27	50
			40 MHz	23	27	50
USA, Other FCC	SM, BH	4ft parabolic	5 MHz	32	27	59
			10 MHz	32	27	59
			15 MHz	32	27	59
			20 MHz	32	27	59
			30 MHz	32	27	59
			40 MHz	32	27	59

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	SM, BH	6ft parabolic	5 MHz	36	27	63
			10 MHz	36	27	27
			15 MHz	36	27	27
			20 MHz	36	27	27
			30 MHz	36	27	27
			40 MHz	36	27	27
Mexico	Any	Any	5 MHz	-	-	24
			10 MHz	-	-	27
			15 MHz	-	-	28
			20 MHz	-	-	30
			30 MHz	-	-	30
			40 MHz	-	-	30
Other	Any	Any	Any	-	-	-

Table 190: Default combined transmit power per country – 5.2 GHz band PMP 450b Mid-Gain and High Gain

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
FCC	SM	16 dBi Mid-Gain	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
		23 dBi High Gain	5 MHz	23	1	24
			10 MHz	23	4	27
			15 MHz	23	5	28
			20 MHz	23	7	30
			30 MHz	23	7	30
			40 MHz	23	7	30

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Other	SM	16 dBi Mid-Gain	5 MHz	16	27	43
			10 MHz	16	27	43
			15 MHz	16	27	43
			20 MHz	16	27	43
			30 MHz	16	27	43
			40 MHz	16	27	43
		23 dBi High Gain	5 MHz	16	27	43
			10 MHz	16	27	43
			15 MHz	16	27	43
			20 MHz	16	27	43
			30 MHz	16	27	43
			40 MHz	16	27	43

Table 191: Default combined transmit power per Country – 5.2 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	24
			10 MHz	27
			15 MHz	28
			20 MHz	30
			30 MHz	30
			40 MHz	30
Mexico	AP	Sector	5 MHz	24
			10 MHz	27
			15 MHz	28
			20 MHz	30
			30 MHz	30
			40 MHz	30

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
Other	Any	Any	5 MHz	42
			10 MHz	42
			15 MHz	42
			20 MHz	42
			30 MHz	42
			40 MHz	42

Note

For releases 16.0 and later, although sector transmission mode EIRP is limited to 42 dBm, ROW GUI configuration limit allows a setting of up to 48 dBm. This allows the software to transmit as high as 48 dBm for ROW regions, depending on the modulation mode and transmission mode in use. For a detailed explanation, see the Release 16.0 training slides available at:

https://learning.cambiumnetworks.com/learn/course/121/PMP450SoftwareRelease16

Maximum transmit power 5.4 GHz band

Table 192: Default combined transmit power per country – 5.4 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
FCC	AP	Sector	5 MHz	24
			10 MHz	27
			15 MHz	28
			20 MHz	29
			30 MHz	30
			40 MHz	30
ETSI	AP	Sector	5 MHz	24
			10 MHz	27
			15 MHz	28
			20 MHz	30
			30 MHz	30
			40 MHz	30

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
RoW	AP	Sector	5 MHz	42
			10 MHz	42
			15 MHz	42
			20 MHz	42
			30 MHz	42
			40 MHz	42
RoW Other	AP	Sector	-	42

Note

- The selection of 5 MHz channel is not available for the PMP 450 AP and the PTP 450 BHM. It is available for PMP/PTP 450i AP/SM, PMP 40b SM, and PMP 450m AP.
- Power reduction at the band edges is required in some cases.

Table 193: Default combined transmit power per country – 5.4 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
		Omni	5 MHz	12	12	24
			10 MHz	12	15	27
			15 MHz	12	16	28
			20 MHz	12	18	30
			30 MHz	12	18	30
			40 MHz	12	18	30
	SM, BH	Flat plate	5 MHz	27	27	54
			10 MHz	27	27	54
			15 MHz	27	27	54
			20 MHz	27	27	54
			30 MHz	27	27	54
			40 MHz	27	27	54
		4ft parabolic	5 MHz	32	27	59
			10 MHz	32	27	59
			15 MHz	32	27	59
			20 MHz	32	27	59
			30 MHz	32	27	59
			40 MHz	32	27	59

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Brazil, Mexico, Australia, ETSI	Any	Any	5 MHz	36	27	63
			10 MHz	36	27	63
			15 MHz	36	27	63
			20 MHz	36	27	63
			30 MHz	36	27	63
			40 MHz	36	27	63
Other	Any	Any	Any	-	27	-

Table 194: Default combined transmit power per country – 5.4 GHz band PMP 450b Mid-Gain and High Gain

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
FCC, ETSI	SM	16 dBi Mid-Gain	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
		23 dBi High Gain	5 MHz	23	1	24
			10 MHz	23	4	27
			15 MHz	23	5	28
			20 MHz	23	9	30
			30 MHz	23	9	30
			40 MHz	23	9	30

Table 195: Default combined transmit power per country – 5.4 GHz band PMP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
United States, Canada, Brazil, Australia, Denmark, Finland, Germany, Greece, Liechtenstein, Norway, Portugal, Spain, UK, Vietnam	AP	Sector	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
	SM,BH	Flat plate (Gain: 27), 4ft parabolic (Gain: 32), 6ftparabolic (Gain: 36)	5 MHz	-	27	-
			10 MHz	-	27	-
			15 MHz	-	27	-
			20 MHz	-	27	-
			30 MHz	-	27	-
			40 MHz	-	27	-
Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden	AP	Sector	5 MHz	16	8	24
			10 MHz	16	11	27*
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
Algeria	AP	Sector	5 MHz	16	14	30
			10 MHz	16	14	30
			15 MHz	16	14	30
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MH	16	14	30

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Other	AP	Sector	5 MHz	16	-	No EIRP limit
			10 MHz	16	19	
			15 MHz	16	-	
			20 MHz	16	19	
			30 MHz	16	-	
			40 MHz	16	-	

(*) At 5.4 GHz, EU regulations are harmonized. 5600 – 5650 MHz excluded, as ten-minute Channel Availability Check (CAC) is required.

Note

For releases 16.0 and later, although sector transmission mode EIRP is limited to 42 dBm, ROW GUI configuration limit allows a setting of up to 48 dBm. This allows the software to transmit as high as 48 dBm for ROW regions, depending on the modulation mode and transmission mode in use. For a detailed explanation, see the Release 16.0 training slides available at: https://learning.cambiumnetworks.com/learn/course/121/PMP450SoftwareRelease16

Maximum transmit power 5.8 GHz band

Table 196: Default combined transmit power per Country – 5.8 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	36
			10 MHz	36
			15 MHz	36
			20 MHz	36
			30 MHz	36
			40 MHz	36
Mexico	AP	Sector	5 MHz	30
			10 MHz	33
			15 MHz	34
			20 MHz	36
			30 MHz	36
			40 MHz	36

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
ETSI	AP	Sector	5 MHz	30
			10 MHz	33
			15 MHz	34
			20 MHz	36
			30 MHz	36
			40 MHz	36
Other	AP	Sector	5 MHz	42
			10 MHz	42
			15 MHz	42
			20 MHz	42
			30 MHz	42
			40 MHz	42

Table 197: Default combined transmit power per country – 5.8 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Canada, Brazil, Other FCC	AP	Sector, Omni	5 MHz	16	20	36
			10 MHz	16	20	36
			15 MHz	16	20	36
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
	SM, BH	Flat plate, 4ft parabolic, 6ft parabolic	5 MHz	-	27	-
			10 MHz	-	27 (26 for 5733 MHz and below)	-
			15 MHz	-	27	-
	Note Canada is limited to 4ft parabolic Antenna type.		20 MHz	-	27	-
			30 MHz	-	27	-
			40 MHz	-	27	-
Mexico	Any	Any	5 MHz	-	-	30
			10 MHz	-	-	33
			15 MHz	-	-	34
			20 MHz	-	-	36
			30 MHz	-	-	36
			40 MHz	-	-	36
Other	Any	Any	5 MHz	-	27	-

Table 198: Default combined transmit power per country – 5.8 GHz band PMP 450b Mid-Gain and High Gain

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
FCC	SM	16 dBi Mid-Gain	5 MHz	16	20	36
			10 MHz	16	20	36
			15 MHz	16	20	36
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
		23 dBi High Gain	5 MHz	23	13	36
			10 MHz	23	13	36
			15 MHz	23	13	36
			20 MHz	23	13	36
			30 MHz	23	13	36
			40 MHz	23	13	36
ETSI/Other ETSI	SM	16 dBi Mid-Gain	5 MHz	16	14	30
			10 MHz	16	17	33
			15 MHz	16	18	34
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
		23 dBi High Gain	5 MHz	23	7	30
			10 MHz	23	10	33
			15 MHz	23	11	34
			20 MHz	23	13	36
			30 MHz	23	13	36
			40 MHz	23	13	36

Table 199: Default combined transmit power per country – 5.8 GHz band PMP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Australia, India, United States	AP	Sector	5 MHz	16	20	36
			10 MHz	16	20	36
			15 MHz	16	20	36
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
Vietnam	AP	Sector	5 MHz	16	8	24
			10 MHz	16	11	27
			15 MHz	16	12	28
			20 MHz	16	14	30
			30 MHz	16	14	30
			40 MHz	16	14	30
Brazil	AP	Sector	5 MHz	16	20	36
			10 MHz	16	20	36
			15 MHz	16	20	36
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
Canada	AP	Sector	5 MHz	16	10	26
			10 MHz	16	20	36
			15 MHz	16	20	36
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36

Countries	Device Type	Antenna Type	Channel BW	Antenna Gain (dBi)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Denmark, Finland, Germany, Greece, Iceland, Ireland, Liechtenstein, Norway, Portugal, Serbia, Spain, Switzerland, United Kingdom,	AP	Sector	5 MHz	16	14	30
			10 MHz	16	17	33
			15 MHz	16	18	34
			20 MHz	16	20	36
			30 MHz	16	20	36
			40 MHz	16	20	36
Indonesia	AP	Sector	5 MHz	16	14	30
			10 MHz	16	17	33
			15 MHz	16	18	34
			20 MHz	16	20	36

Table 200: Extrapolated EIRP and Tx power limits for PMP 450 MicroPoP Series

	5/10 MHz				20/40 MHz			
	Rounded EIRP	MicroPoP Omni Tx power	MicroPoP Sector Tx power	MicroPoP Connectorized	Rounded EIRP	MicroPoP Omni Tx power	MicroPoP Sector Tx powe	MicroPoP Connectorized
4.9 GHz		26 dBm	26 dBm	26 dBm		24 dBm	24 dBm	24 dBm
5.1 GHz	26 dBm	17 dBm	13 dBm	EIRP – Antenna Gain	32 dBm	23 dBm	19 dBm	EIRP – Antenna Gain
5.2 GHz	25 dBm	16 dBm	12 dBm	EIRP – Antenna Gain	25 dBm	16 dBm	12 dBm	EIRP – Antenna Gain
5.4 GHz	25 dBm	16 dBm	12 dBm	EIRP – Antenna Gain	25 dBm	16 dBm	12 dBm	EIRP – Antenna Gain
5.8 GHz	32 dBm	23 dBm	19 dBm	EIRP – Antenna Gain	31 dBm	22 dBm	18 dBm	EIRP – Antenna Gain

Note

For releases 16.0 and later, although sector transmission mode EIRP is limited to 42 dBm, ROW GUI configuration limit allows a setting of up to 48 dBm. This allows the software to transmit as high as 48 dBm for ROW regions, depending on the modulation mode and transmission mode in use. For a detailed explanation, see the Release 16.0 training slides available at: https://learning.cambiumnetworks.com/learn/course/121/PMP450SoftwareRelease16

Maximum transmit power 6 GHz band

Table 201: Default combined transmit power per Country – 6 GHz band 450v Series -AP/SM

Countries	Device Type	Antenna Type	Channel BW	EIRP Limit (dBm)
USA, Other FCC	AP/SM	Sector/Integrated	5 MHz	30
			10 MHz	33
			15 MHz	35
			20 MHz	36
			30 MHz	36
			40 MHz	36
Canada	AP/SM	Sector/Integrated	5 MHz	30
			10 MHz	33
			15 MHz	35
			20 MHz	36
			30 MHz	36
			40 MHz	36
Other	AP/SM	Sector/Integrated	5 MHz	
			10 MHz	
			15 MHz	
			20 MHz	
			30 MHz	
			40 MHz	

Note

450v SMs operating without AFC authorization are restricted to an EIRP 6 dB lower than the EIRP of the serving AP.

Country specific frequency range

Frequency range 900 MHz band

Table 202: Frequency range per country – 900 MHz band

Region	Country	Channel center Frequency limits (MHz)		Notes
		Lower	Upper	
Other	Other	902	928	
	Other-FCC	902	928	
North America	Canada	902	928	
	United States	902	928	
	Mexico	902	928	
	Puerto Rico	902	928	
Oceania	Australia	915	928	HW limits: • Max Tx power 19 dBm 1 x 10 MHz channel on 923 or 922 MH • 1 x 7 MHz channel between 920.5 and 924.5 MHz inclusive • 2 x adjacent 5 MHz channels between 919.5 and 925.5 inclusive
	New Zealand	915 920.5 (7 MHz) 919.5 (5 MHz)	928 924.5 (7 MHz) 925.5 (5 MHz)	EIRP is 36 dBm between 915 and 920, and 30 above 920. HW limits: • Max Tx power 19 dBm across the entire band 1 x 10 MHz channel on 923 or 922 MHz • 1 x 7 MHz channel between 920.5 and 924.5 MHz inclusive • 2 x adjacent 5 MHz channels between 919.5 and 925.5 inclusive
South America	Brazil	902 915	907.5 928	

Region	Country	Channel center Frequency limits (MHz)		Notes
		Lower	Upper	
	Ecuador	902	928	
	Colombia	902	928	
	Panama	902	928	
	Venezuela	902	928	

Frequency range 2.4 GHz band

Table 203: Frequency range per country – 2.4 GHz band PMP/PTP 450 Series

Countries	Antenna Typ	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Canada, United States, Other, Other-FCC and Indonesia *	Any	5 MHz	2402.5	2481
		10 MHz	2405	2478.5
		15 MHz	2407.5	2476
		20 MHz	2410	2473.5

(*) Usable frequency range 2402-2482 MHz

Frequency range 3.5 GHz band

Table 204: Frequency range per country – 3.5 GHz band PMP/PTP 450/450i/450b/450m Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Brazil, Other-ETSI	Any	5 MHz	3402.5	3597.5
		7 MHz	3403.5	3596.5
		10 MHz	3405	3595
		20 MHz	3410	3590
China	Any	5 MHz	3302.5	3397.5
		7 MHz	3303.5	3396.5
		10 MHz	3305	3395
		20 MHz	3310	3390

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Others	Any	5 MHz	3302.5	3847.5
		7 MHz	3303.5	3846.5
		10 MHz	3305	3845
		15 MHz	3307.5	3842.5
		20 MHz	3310	3840
		30 MHz	3315	3835
		40 MHz	3320	3830
Canada	Any	5 MHz	3452.5	3597.5
		7 MHz	3453.5	3596.5
		10 MHz	3455	3595
		15 MHz	3457.5	3592.5
		20 MHz	3460	3590
		30 MHz	3465	3585
		40 MHz	3470	3580
Mexico	Any	5 MHz	3302.5	3597.5
		7 MHz	3303.5	3596.5
		10 MHz	3305	3595
		15 MHz	3307.5	3592.5
		20 MHz	3310	3590
		30 MHz	3315	3585
		40 MHz	3320	3580
Australia	Any	5 MHz	3302.5	3597.5
		7 MHz	3303.5	3596.5
		10 MHz	3305	3595
		15 MHz	3307.5	3592.5
		20 MHz	3310	3590
		30 MHz	3315	3580

Frequency range 3.65 GHz band

Table 205: Frequency range per country – 3.65 GHz band PMP/PTP 450/450i/450b/450m Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Australia and India	Any	5 MHz	3302.5	3797.5
		7 MHz	3303.5	3796.5
		10 MHz	3305	3795
		15 MHz	3307.5	3792.5
		20 MHz	3310	3790
		30 MHz	3315	3785
		40 MHz*	3320	3780
		Note Australia does not support 40 MHz channel bandwidth.		
Other	Any	5 MHz	3302.5	3897.5
		7 MHz	3303.5	3896.5
		10 MHz	3305	3895
		15 MHz	3307.5	3892.5
		20 MHz	3310	3890
		30 MHz	3315	3885
		40 MHz	3320	3880
Other – ETSI	Any	5 MHz	3412.5	3797.5
		10 MHz	3415	3795
		15 MHz	3417.5	3792.5
		20 MHz	3420	3790
		30 MHz	3425	3785
		40 MHz	3430	3780
Indonesia	Any	5 MHz	3602.5	3797.5
		7 MHz	3603.5	3796.5
		10 MHz	3605	3795
		20 MHz	3610	3790
		40 MHz	3620	3780

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Mexico	Any	5 MHz	3302.5	3747.5
		10 MHz	3305	3745
		20 MHz	3310	3740
		40 MHz	3320	3730

Table 206: Power and EIRP Limits to meet EU requirements

Product	450b				450m	
State Category	A		B		A and B	
Baseline power limit	-59 dBm/MHz/antenna		-50 dBm/MHz/antenna		-52 dBm/MHz/sector	
Channel Bandwidth	20 MHz	40 MHz	20 MHz	40 MHz	20 MHz	40 MHz
Band Edge Center Frequency	3420 MHz	3430 MHz	3420 MHz	3430 MHz	3420 MHz	3430 MHz
Max Tx power (combined) at Band Edge Frequency	7 dBm	-13 dBm	17 dBm	-1 dBm		
Max EIRP at Band Edge Frequency					38 dBm	37 dBm
Lowest center frequency at full power	3466 MHz	3542 MHz	3449 MHz	3491 MHz	3445 MHz	3475 MHz
Full power	Tx power = 27 dBm				EIRP = 52 dBm	

Note

- The baseline power requirement is the maximum power spectral density the out-of-band transmission can be.
- Each European country falls into one of these categories: A, B, or C. Category C does not have additional restrictions for emissions below or above the band, but Categories A and B do. The operator needs to apply the right limit to the device according to the country the device is deployed in.

  For example, an operator in a Category A country using a 450m AP with 450b SMs, 20MHz bandwidth, and operating at center frequency 3420 needs to enable their Max Tx Power setting on every 450b via radio GUI or SNMP, then set that limit to 7 dBm. Additionally, the EIRP setting on the 450m AP must be configured to 38 dBm or lower.
- For center frequencies below the lowest center frequency at max power and other channel bandwidths, the user can interpolate the values in the table.

For example, an operator in a Category B country using a 450m AP with 450b SMs, 20 MHz bandwidth, and operating at a center frequency 3440 needs to enable the Max Tx Power setting on every 450b via radio GUI or SNMP, then set that limit to 17+(27-17)/(3449-3420)*(3440-3420) = 24 dBm. Additionally, the EIRP setting on the PMP 450m AP must be configured to 38+(52-38)/(3445-3420)* (3440-3420) = 49 dBm or lower.

Frequency range 4.9 GHz band

Table 207: Frequency range per country – 4.9 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
USA, Mexico, Canada, Other FCC	Any	5 MHz	4942.5	4987.5
		10 MHz	4945	4985
		15 MHz	4947.5	4982.5
		20 MHz	4950	4980
Brazil	Any	5 MHz	4912.5	4987.5
		10 MHz	4915	4985
		15 MHz	4917.5	4982.5
		20 MHz	4920	4980
Other	Any	5 MHz	4902.5	5147.5
		10 MHz	4905	5145
		15 MHz	4907.5	5142.5
		20 MHz	4910	5140
		30 MHz	4915	5135
		40 MHz	4920	5130

Table 208: Frequency range per country – 4.9 GHz band PMP 450b Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		EIRP (dBm)
			Lower	Upper	
FCC	16 dBi Mid-Gain 23 dBi High Gain	5 MHz	4942.5	4987.5	26
		10 MHz	4945	4985	26
		15 MHz	4947.5	4982.5	26
		20 MHz	4950	4980	24

Table 209: Frequency range per country – 4.9 GHz band PMP 450m Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
USA,Mexico, Canada,Other FCC	Any	5 MHz	4942.5	4987.5
		10 MHz	4945	4985
		15 MHz	4947.5	4982.5
		20 MHz	4950	4980
Brazil	Any	5 MHz	4912.5	4987.5
		10 MHz	4915	4985
		15 MHz	4917.5	4982.5
		20 MHz	4920	4980
Other	Any	5 MHz	4902.5	5147.5
		10 MHz	4905	5145
		15 MHz	4907.5	5142.5
		20 MHz	4910	5140
		30 MHz	4915	5135
		40 MHz	4920	5130

Frequency range 5.1 GHz band

Table 210: Frequency range per country – 5.1 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
United States, FCC	Any	5 MHz	5157.5[1]	5247.5
		10 MHz	5160[2]	5245
		15 MHz	5165[3]	5242.5
		20 MHz	5170[4]	5240
		30 MHz	5180[5]	5235
		40 MHz	5180[6]	5230
ETSI	Any	5 MHz	5155	5245
		10 MHz	5155	5245
		15 MHz	5157.5	5242.5
		20 MHz	5160	5240
Other	Any	5 MHz	5152.5	5247.5
		10 MHz	5155	5245
		15 MHz	5157.5	5242.5
		20 MHz	5160	5240
		30 MHz	5165	5235
		40 MHz	5170	5230

[1]Center frequency 5160 is the lowest allowed at full power. Max power for edge frequency is 20.6 dBm.

[2]Center frequency 5165 is the lowest allowed at full power. Max power for edge frequencies is 22.8 dBm.

[3]Center frequency 5170 is the lowest allowed at full power. Max power for edge frequencies is 23 dBm.

[4]Center frequency 5177.5 is the lowest allowed at full power. Max power for edge frequency is 23 dBm.

[5]Center frequency 5190 is the lowest allowed at full power. Max power for edge frequency is 22.9 dBm.

[6]Center frequency 5205 is the lowest allowed at full power. Max power for edge frequency is 22.9 dBm.

Table 211: Frequency range per country – 5.1 GHz band PMP 450b Mid-Gain Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	16 dBi	5 MHz	5155	5247.5	9
		10 MHz	5155	5245	6
		15 MHz	5157.5	5242.5	6
		20 MHz	5160	5240	6
		30 MHz	5165	5235	6
		40 MHz*	5170	5230	6
		* Channel center 5170 needs a 4 dB backoff.			

Table 212: Frequency range per country – 5.1 GHz band PMP 450 MicroPoP Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	16 dBi	5 MHz	5155	5247.5	26
		10 MHz	5155	5245	26
		15 MHz	5157.5	5242.5	32
		20 MHz	5160	5240	32
		30 MHz	5165	5235	32
		40 MHz	5170	5230	32

Table 213: Frequency range per country – 5.1 GHz band PMP 450b High Gain Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	23 dBi	5 MHz	5155[1]	5245[2]	10
		10 MHz	5155	5245	8
		15 MHz	5157.5	5242.5	8
		20 MHz	5160	5235	8
		30 MHz	5165	5235	8
		40 MHz	5170[3]	5230[4]	8

[1] Center frequency 5155 needs a 9 dB backoff

[2] Center frequency 5245 needs a 2 dB backoff

[3] Center frequencies 5170 and 5172.5 need a 9 dB backoff

[4] The FCC grant allows up to 5250

Table 214: Frequency range per country – 5.1 GHz band PMP 450m Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted[6] Power (dBm)
			Lower	Upper	
United States, Canada and FCC[4]	Any	5 MHz	5162.5	5247.5	30
		10 MHz	5160	5197.5	26
			5200	5245	33
		15 MHz	5165	5197.5	26
			5200	5242.5	34
		20 MHz	5170	5197.5	26
			5200	5240	36
		30 MHz	5165	5180	30
			5182.5	5192.5	33
			5195	5235	36
		40 MHz	5170[5]	5185	30
			5187.5	5197.5	33
			5200	5230	36
ETSI	Any	5 MHz	5152.5 [1]	5247.5[1]	33
		10 MHz	5155	5245	36
		15 MHz	5157.5	5242.5	36[2]
		20 MHz	5160	5240	36[3]
Other	Any	5 MHz	5152.5	5247.5	48
		10 MHz	5155	5245	48
		15 MHz	5157.5	5242.5	48
		20 MHz	5160	5240	48
		30 MHz	5165	5235	48
		40 MHz	5170	5230	48

[1] Frequencies 5152.5 and 5247.5 are supported by the PMP 450m AP, but not by the PMP 450i SM. As this is the only SM the AP can communicate with in this band, these frequencies should not be available at the AP until there is an SM that supports them as well.

[2] The regulatory EIRP limit is 37 dBm, but the hardware supports up to 36 dBm.

[3] The regulatory EIRP limit is 39 dBm, but the hardware supports up to 36 dBm.

[4] The split EIRP limits are currently applied to all FCC regions. They are needed for US and Canada.

Note that center frequencies from 5165 to 5175 are not supported by the SM, and therefore are not allowed in the 450m SW.

[5] Note that center frequencies from 5170 to 5177.5 are not supported by the SM, and therefore are not allowed in the 450m SW.

However, the 450m has a grant for these frequencies, and could be enabled in the future if any SM supports them.

[6] This EIRP value is the limit of the parameter configured in the PMP 450m GUI. Note that not all operating modes achieve the same EIRP.

The limits are as follows:

Sector mode	42 dBm
Beamforming mode QPSK	48 dBm
Beamforming mode 16-QAM	48 dBm
Beamforming mode 64-QAM	46 dBm
Beamforming mode 256-QAM	44 dBm
MU-MIMO mode	44 dBm

Table 215: Frequency range per country – 5.1 GHz band PMP 450v AP

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
United States, Canada and FCC	Any	5 MHz	5156	5156	14
		10 MHz	5155	5155	1
			5157.5	5245	17
		15 MHz	5158	5158	2
			5160	5242	18
		20 MHz	5170	5197.5	0
			5200	5240	20
		30 MHz	5165	5180	17
			5182.5	5192.5	18
			5195	5235	20
		40 MHz	5170	5185	3
			5187.5	5197.5	20
Other	Any	5 MHz	5152.5	5247.5	
		10 MHz	5155	5245	
		15 MHz	5157.5	5242.5	
		20 MHz	5160	5240	
		30 MHz	5165	5235	
		40 MHz	5170	5230	

Table 216: Frequency range per country – 5.1 GHz band PMP 450v SM

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
United States, Canada and FCC	Any	5 MHz	5156	5156	11
			5157.5	5242.5	23
			5244	5244	19
		10 MHz	5155	5155	-8
			5157.5	5242.5	15
			5245	5245	13
		15 MHz	5158	5158	7
			5160	5240	20
			5242	5242	16
		20 MHz	5160	5160	-8
			5162.5	5237.5	22
			5240	5240	19
		30 MHz	5165	5165	8
			5167.5	5232.5	19
			5235	5235	17
		40 MHz	5170	5170	4
			5172.5	5227.5	19
			5230	5230	20
Other	Any	5 MHz	5152.5	5247.5	
		10 MHz	5155	5245	
		15 MHz	5157.5	5242.5	
		20 MHz	5160	5240	
		30 MHz	5165	5235	
		40 MHz	5170	5230	

Frequency range 5.2 GHz band

Table 217: Frequency range per country – 5.2 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
United States, FCC	Any	10 MHz	5255	5340
		15 MHz	5257.5	5337.5
		20 MHz	5260	5332.5[2]
		30 MHz	5265	5332.5[3]
		40 MHz	5270	5325[4]
Other	Any	10 MHz	5255	5345
		15 MHz	5257.5	5342.5
		20 MHz	5260	5340
		30 MHz	5265	5335
		40 MHz	5270	5330

[2] Center frequency 5330 is the highest allowed at full power. Maximum power for edge frequency is 20.4 dBm.

[3] Center frequency 5317.5 is the lowest allowed at full power. Maximum power for edge frequency is 20.8 dBm.

[4] Center frequency 5310 is the lowest allowed at full power. Maximum power for edge frequencies is 20.5 dBm.

Table 218: Frequency range per country – 5.2 GHz band PMP 450b Mid-Gain Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	16 dBi	10 MHz	5255	5340	3
		15 MHz	5257.5	5337.5	6
		20 MHz	5260	5337.5	6
		30 MHz	5265	5330	6
		40 MHz	5270	5330 (*)	6
(*) Last channel at full power is 5325. Channel centers 5327.5 and 5330 need a power back off of 5 dB.					

Table 219: Frequency range per country – 5.2 GHz band PMP 450b High Gain Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	23 dBi	10 MHz	5255[1]	5340	2
		15 MHz	5257.5	5337.5	3
		20 MHz	5260	5335	3
		30 MHz	5265	5332.5	3
		40 MHz	5270[2]	5330[3]	3

[1] The FCC grant allows down to 5250

[2] Center frequency 5270 can have power increased by 2 dB.

[3] Center frequencies 5325, 5327.5 and 5330 need a 6 dB backoff

Table 220: Frequency range per country – 5.2 GHz band PMP 450m Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)[5]
			Lower	Upper	
United States, FCC	Any	5 MHz	5252.5	5347.5[1]	24
		10 MHz	5255	5300	27
			5302.5	5340	25
		15 MHz	5257.5	5300	28[2]
			5302.5	5335	25
		20 MHz	5260	5300	30
			5302.5	5340[3]	25
		30 MHz	5265	5335	30
		40 MHz	5270	5330[4]	30
Other	Any	5 MHz	5252.5	5347.5	48
		10 MHz	5255	5345	48
		15 MHz	5257.5	5342.5	48
		20 MHz	5260	5340	48
		30 MHz	5265	5335	48
		40 MHz	5270	5330	48

[1] Frequencies 5345 and 5347.5 are supported by the PMP 450m AP, but not by the PMP 450i SM. As this is the only SM the AP can communicate with in this band, these frequencies should not be available at the AP until there is an SM that supports them as well.

[2] PMP 450m is certified for up to 29 dBm, but the regulatory limit is 28.7 dBm, and the GUI only allows integer inputs.

[3] Frequency above 5332.5 are not supported by the PMP 450i SM. As this is the only SM available in this band, the PMP 450m AP should also not offer these frequencies until there is an SM able to support them.

[4] Max frequency supported by 450i SM is 5325 MHz. This is also the SW limit for 450m until there is an SM that supports the additional frequencies.

[5] This EIRP value is the limit of the parameter configured in the PMP 450m GUI. Note that not all operating modes achieve the same EIRP.

The limits are as follows:

Sector mode	42 dBm
Beamforming mode QPSK	48 dBm
Beamforming mode 16-QAM	48 dBm

Beamforming mode 64-QAM	46 dBm
Beamforming mode 256-QAM	44 dBm
MU-MIMO mode	44 dBm

Frequency range 5.4 GHz band

Table 221: Frequency range per country – 5.4 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Mexico	Any	5 MHz	5472.5	5722.5
		10 MHz	5475	5720
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5685
Other	Any	5 MHz	5472.5	5722.5
		10 MHz	5475	5720
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5705
Other	FCC[12]	5 MHz	5475[3]	5720[1 4]
		10 MHz	5475[5]	5717.5[6]
		15 MHz	5480	5717.5
		20 MHz	5482.5[8]	5715[1]
		30 MHz	5487.5[9]	5710
		40 MHz	5497.5[10]	5705

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Other	ETSI	5 MHz	5472[2]	5597.5
			5652.5[7]	5720[8]
		10 MHz	5475	5595
			5655	5720
		15 MHz	5477.5	5592.5
			5657.5	5717.5
		20 MHz	5480	5590
			5660	5715
Other	ETSI	30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705

[1] Beyond highest full power channel. SW does not reduce max power.

[2] Center frequency 5487.5 is the lowest allowed at full power

[3] Center frequency 5477.5 is the lowest allowed at full power. Maximum power for edge frequency is 7 dBm. PMP 450 SM supports down to 5472.5

[4] PMP 450 SM supports up to 5722.5

[5] Center frequency 5477.5 is the lowest allowed at full power. Maximum power for edge frequency is 12.1 dBm. PMP 450 SM supports down to 5475

[6] PMP 450 SM supports up to 5720

[7] 5 MHz channel not available in DFS regions for PMP 450b.

[8] Center frequency 5495 is the lowest allowed at full power. Maximum power for edge frequency is 16.5 dBm

[9] Center frequency 5495 is the lowest allowed at full power. Maximum power for edge frequency is 22.8 dBm.

[10] Center frequency 5507.5 is the lowest allowed at full power. Maximum power for edge frequency is 22.4 dBm

[11] PMP 450 AP needs the 5600-5650 MHz exclusion, as it was never re-certified with the new rules.

All other products do not need this notch.

Table 222: Frequency range per country – 5.4 GHz band PMP 450b Mid-Gain Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	16 dBi	10 MHz	5477.5	5720	3
		15 MHz	5480	5717.5	8
		20 MHz	5482.5	5715	8
		30 MHz	5487.5	5710	8
		40 MHz	5490 (*)	5705	8
(*) First channel at full power is 5495. Channel centers 5490 and 5492.5 need a power backoff of 5 dB.					

Table 223: Frequency range per country – 5.4 GHz band PMP 450b High Gain Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	23 dBi	10 MHz	5480[1]	5720[2]	3
		15 MHz	5487.5	5717.5	6
		20 MHz	5490	5715	6
		30 MHz	5495	5710	6
		40 MHz	5490[2]	5705[4]	6

[1] Center frequency 5480 and below needs a 1 dB backoff

[2] The FCC grant allows up to 5725

Center frequencies from 5715 and above need a 1 dB backoff

[3] Center frequencies 5495 and below need a 5 dB backoff

[4] Center frequencies 5700 and above need a 6 dB backoff

Table 224: Frequency range per country – 5.4 GHz band PMP/PTP 450 Series

Region code	Country Code	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Other	Any	5 MHz	5472.5	5722.5
		10 MHz	5475	5720
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5705
	Other-FCC	5 MHz	5475	5720
		10 MHz	5477.5	5717.5
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5705
	Other-ETSI	5 MHz	5472.5	5597.5
			5652.5	5722.5
		10 MHz	5475	5595
			5655	5720
		15 MHz	5477.5	5592.5
			5657.5	5717.5
		20 MHz	5460	5590
			5640	5715
		30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705
Oceania	Australia	5 MHz	5472.5	5597.5
			5652.5	5722.5
		10 MHz	5475	5595
			5645	5720

Region code	Country Code	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Oceania	Australia	15 MHz	5477.5	5592.5
			5657.5	5717.5
		20 MHz	5465	5490
			5640	5715
		30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705
North America	Canada	10 MHz	5475	5597.5
			5655	5722.5
		15 MHz	5477.5	5592.5
			5657.5	5717.5
		20 MHz	5480	5590
			5660	5715
		30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705
South America	Brazil	10 MHz	5475	5720
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5705
Asia	Vietnam	10 MHz	5475	5720
		15 MHz	5477.5	5717.5
		20 MHz	5480	5715
		30 MHz	5485	5710
		40 MHz	5490	5705

Region code	Country Code	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Africa	Algeria	5 MHz	5472.5	5667.5
		10 MHz	5475	5665
		15 MHz	5477.5	5662.5
		20 MHz	5480	5660
		30 MHz	5485	5655
		40 MHz	5490	5650
Europe	Europe (Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Norway, Portugal, Serbia, Spain, Switzerland, United Kingdom)	10 MHz	5475	5595
			5655	5720
		15 MHz	5477.5	5592.5
			5657.5	5717.5
		20 MHz	5465	5490
			5660	5715
		30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705

Table 225: Frequency range per country – 5.4 GHz band PMP 450m Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		EIRP (dBm)[4]
			Lower	Upper	
United States, FCC	Any	5 MHz	5475	5720	24
		10 MHz	5475[3]	5477.5	22
			5480	5720[3]	27
		15 MHz	5477.5	5482.5	22
			5485	5717.5	28[1]
		20 MHz	5480	5487.5	22
			5490	5715	29
		30 MHz	5485	5710	30
		40 MHz	5490	5705	30
ETSI	Any	5 MHz	5472.5[2]	5597.5	24
			5652.5	5722.5	24
		10 MHz	5475	5595	27
			5655	5720	27
		15 MHz	5477.5	5592.5	28
			5657.5	5717.5	28
		20 MHz	5480	5590	30
			5660	5715	30
		30 MHz	5485	5585	30
			5665	5710	30
		40 MHz	5490	5585	30
			5670	5705	30
Other	Any	5 MHz	5472.5	5722.5	48
		10 MHz	5475	5720	48
		15 MHz	5477.5	5717.5	48
		20 MHz	5480	5715	48
		30 MHz	5485	5710	48
		40 MHz	5490	5705	48

[1] PMP 450m is certified for up to 29 dBm, but the regulatory limit is 28.7 dBm, and the GUI only allows integer inputs.

[2] 5472.5 can be used only with PMP 450 SMs. PMP 450i SMs do not support this center frequency.

[3] Edge frequencies are not supported by PMP 450i SMs, but they are supported by PMP 450 SMs. They can be selected with the 450m AP as long as there are no PMP 450i SMs in the sector.

[4] This EIRP value is the limit of the parameter configured in the PMP 450m GUI. Note that not all operating modes achieve the same EIRP.

The limits are as follows:

Sector mode	42 dBm
Beamforming mode QPSK	48 dBm
Beamforming mode 16-QAM	48 dBm
Beamforming mode 64-QAM	46 dBm
Beamforming mode 256-QAM	44 dBm
MU-MIMO mode	44 dBm

Frequency range 5.8 GHz band

Table 226: Frequency range per country – 5.8 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
USA, Canada, Brazil, Other FCC	Any	5 MHz	5730[1]	5845[2]
		10 MHz	5730[3]	5845
		15 MHz	5732.5[4]	5842.5[5]
		20 MHz	5735[6]	5840
		30 MHz	5740	5835
		40 MHz	5745[7]	5830[7]
Mexico	Any	5 MHz	5727.5	5847.5
		10 MHz	5730	5845
		15 MHz	5732.5	5842.5
		20 MHz	5735	5840
		30 MHz	5740	5835
		40 MHz	5745	5830

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
Other	Any	5 MHz	5727.5	5922.5
		10 MHz	5730	5920
		15 MHz	5732.5	5917.5
		20 MHz	5735	5915
		30 MHz	5740	5910
		40 MHz	5745	5905
ETSI	Any	5 MHz	5727.5	5872.5
		10 MHz	5730	5870
		15 MHz	5735	5867.5
		20 MHz	5737.5	5865
		30 MHz	5740	5860
		40 MHz	5745	5855

[1] PMP 450 SM supports down to 5727.5

[2] PMP 450 SM supports up to 5847.5

[3] At 5730 and 5732.5 Tx power limited to 26 dBm

[4] At 5732.5 and 5735 Tx power limited to 26 dBm

[5] At 5842.5, 5840, 5837.5 Tx power limited to 26 dBm

[6] At 5735 and 5737.5 Tx power limited to 26 dBm

[7] At all frequencies, power limited to 26 dBm

Table 227: Frequency range per country – 5.8 GHz band PMP 450b Mid-GainSeries

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	16 dBi Mid-Gain	5 MHz	5730	5845	19
		10 MHz	5730	5845	19
		15 MHz	5732.5	5842.5	19
		20 MHz	5735	5840	19
		30 MHz	5740	5835	19
		40 MHz	5745	5830	19

Table 228: Frequency range per country – 5.8 GHz band PMP 450b High Gain Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)		Conducted Power (dBm)
			Lower	Upper	
FCC	23 dBi High Gain	5 MHz	5730	5845	21
		10 MHz	5730	5845	21
		15 MHz	5732.5	5842.5	21
		20 MHz	5735	5840	21
		30 MHz	5740	5835	21
		40 MHz	5745	5830	21

Table 229: Frequency range per country – 5.8 GHz band PMP/PTP 450 Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
Denmark, Norway, United Kingdom, Finland	Any	10 MHz	5730	5790
			5820	5845
		15 MHz	5732.5	5787.5
			5822.5	5842.5
		20 MHz	5735	5785
			5825	5840
		30 MHz	5740	5780
			5830	5835
		40 MHz	5745	5775
			5835	5830
Germany	Any	10 MHz	5760	5870
		15 MHz	5762.5	5867.5
		20 MHz	5765	5865
		30 MHz	5770	5860
		40 MHz	5775	5855

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
Spain	Any	10 MHz	5730	5790
			5820	5850
		15 MHz	5732.5	5787.5
			5822.5	5847.5
		20 MHz	5735	5785
			5825	5845
		30 MHz	5740	5780
			5830	5840
		40 MHz	5745	5775
			5835	5835
Greece	Any	10 MHz	5730	5790
		15 MHz	5732.5	5787.5
		20 MHz	5735	5785
		30 MHz	5740	5780
		40 MHz	5745	5775
Portugal, Iceland, Serbia	Any	10 MHz	5730	5870
		15 MHz	5732.5	5867.5
		20 MHz	5735	5865
		30 MHz	5740	5860
		40 MHz	5745	5855

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
Switzerland, Liechtenstein	Any	10 MHz	5730	5790
			5820	5870
		15 MHz	5732.5	5787.5
			5822.5	5867.5
		20 MHz	5735	5785
			5825	5865
		30 MHz	5740	5780
			5830	5860
		40 MHz	5745	5775
			5835	5855
Australia	Any	5 MHz	5727.5	5847.5
		10 MHz	5730	5845
		15 MHz	5732.5	5842.5
		20 MHz	5735	5840
		30 MHz	5740	5835
		40 MHz	5745	5830
Canada, United States	Any	5 MHz	5727.5	5847.5
		10 MHz	5730	5845
		15 MHz	5732.5	5842.5
		20 MHz	5735	5840
		30 MHz	5740	5835
		40 MHz	5745	5830
India	Any	5 MHz	5727.5	5872.5
		10 MHz	5730	5870
		15 MHz	5832.5	5867.5
		20 MHz	5735	5865
		30 MHz	5840	5860
		40 MHz	5845	5855

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)	
			Lower	Upper
Brazil, Vietnam	Any	5 MHz	5727.5	5847.5
		10 MHz	5730	5845
		15 MHz	5732.5	5842.5
		20 MHz	5735	5840
		30 MHz	5740	5835
		40 MHz	5745	5830
Indonesia	Any	5 MHz	5727.5	5822.5
		10 MHz	5730	5820
		15 MHz	5732.5	5817.5
		20 MHz	5735	5815
Malaysia	Any	5 MHz	5727.5	5872.5
		10 MHz	5830	5870
		20 MHz	5835	5865

Table 230: Frequency range per country – 5.8 GHz band PMP 450m Series

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		EIRP (dBm)[1]
			Lower	Upper	
United States, FCC	Any	5 MHz	5730	5845	36
		10 MHz	5730	5845	36
		15 MHz	5732.5	5842.5	36
		20 MHz	5735	5840	36
		30 MHz	5740	5835	36
		40 MHz	5745	5830	36
ETSI	Any	5 MHz	5727.5	5872.5	30
		10 MHz	5730	5870	33
		15 MHz	5735	5867.5	34
		20 MHz	5737.5	5865	36
		30 MHz	5740	5860	36
		40 MHz	5745	5855	36
Other	Any	5 MHz	5727.5	5922.5	48
		10 MHz	5730	5920	48
		15 MHz	5732.5	5917.5	48
		20 MHz	5735	5915	48
		30 MHz	5740	5910	48
		40 MHz	5745	5905	48

[1] This EIRP value is the limit of the parameter configured in the PMP 450m GUI. Note that not all operating modes achieve the same EIRP.

The limits are as follows:

Sector mode	42 dBm
Beamforming mode QPSK	48 dBm
Beamforming mode 16-QAM	48 dBm
Beamforming mode 64-QAM	46 dBm
Beamforming mode 256-QAM	44 dBm
MU-MIMO mode	44 dBm

Table 231: Frequency range per country – 5.8 GHz band 450v AP

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		EIRP (dBm)
			Lower	Upper	
United States, FCC	Any	5 MHz	5731	5844	20
		10 MHz	5730	5845	20
		15 MHz	5733	5842	20
		20 MHz	5735	5840	20
		30 MHz	5740	5835	20
		40 MHz	5745	5830	20
Other	Any	5 MHz	5731	5844	
		10 MHz	5730	5845	
		15 MHz	5733	5842	
		20 MHz	5735	5840	
		30 MHz	5740	5835	
		40 MHz	5745	5830	

Table 232: Frequency range per country – 5.8 GHz band 450v SM

Countries	Antenna Type	Channel Bandwidth	Channel center Frequency limits (MHz)		EIRP (dBm)
			Lower	Upper	
United States, FCC	Any	5 MHz	5731	5842.5	18
			5744	5744	17
		10 MHz	5730	5730	18
			5732.5	5842.5	22
			5845	5845	8
		15 MHz	5733	5840	16
			5842	5842	14
		20 MHz	5782.5	5782.5	24
			5785	5837.5	18
			5840	5840	15
		30 MHz	5740	5785	16
			5787.5	5832.5	15
			5835	5835	14
		40 MHz	5745	5772.5	20
			5775	5775	18
			5777.5	5830	22
Other	Any	5 MHz	5731	5844	
		10 MHz	5730	5845	
		15 MHz	5733	5842	
		20 MHz	5735	5840	
		30 MHz	5740	5835	
		40 MHz	5745	5830	

Federal Communication Commission (FCC) specific information

FCC compliance testing

With GPS synchronization installed, the system has been tested for compliance to US (FCC) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA. These limits have been designed to provide reasonable protection against harmful interference. However, the equipment can radiate radio

frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference does not occur in a particular installation.

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

> Note
>
> Notwithstanding that Cambium has designed (and qualified) the 450 Platform Family ODUs to generally meet the Class B requirement to minimize the potential for interference, the 450 Platform Family ODU range is not marketed for use in a residential environment.

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

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

FCC Interference Statement

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

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

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

> Note
>
> FCC Radiation Exposure Statement:
>
> This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 183 cm between the radiator and your body.

Industry Canada (IC)

Note

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 93 cm between the radiator and your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 93 cm de distance entre la source de rayonnement et votre corps.

FCC IDs

Table 233: US FCC IDs

FCC ID	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum Combined Tx Output Power
Z8H 89FT0083	450v 2X2 SM	5.8 GHz	5 MHz	5727.5 – 5847.5 MHz	25.68 dBm
			10 MHz	5730.0 – 5845.0 MHz	25.51 dBm
			15 MHz	5732.5 – 5842.5 MHz	26.55 dBm
			20 MHz	5735 – 5840 MHz	26.27 dBm
			30 MHz	5740 – 5835 MHz	26.95 dBm
			40 MHz	5745 – 5830 MHz	26.58 dBm
			40 + 40 MHz	5755 - 5795.5 MHz	20 dBm
				5744.5 - 5829.5 MHz	20 dBm

FCC approved antenna list for 450i

The lists of antennas which have been approved for operation by the FCC are provided in:

- USA approved antenna list 4.9 GHz for 4.9 GHz
- USA approved antenna list 5.1 and 5.2 GHz for 5.1 and 5.2 GHz
- USA approved antenna list 5.4 GHz for 5.4 GHz
- USA approved antenna list 5.8 GHz for 5.8 GHz

> Note
>
> Any antenna of the same type and of gain equal or lower than the one approved by the FCC can be used in the countries following the FCC rules.

Table 234: USA approved antenna list 4.9 GHz

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Directional	Integrated flat plate	Cambium Networks	N/A	23.0
	2 ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.0
	4 ft parabolic dual polarised	Gabriel Antennas	Dual QuickFire QFD4-49-N	33.7
	6 ft parabolic dual polarised	Gabriel Antennas	QuickFire QF6-49-N	37.2
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16.0
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0
	90° sectorised	Cambium Networks	85009324001	17.0
	60° sectorised	Cambium Networks	85009325001	17.0
Omni-directional	Dual polar omni-directional	KP	KPPA-5.7-DPOMA	13.0

Table 235: USA approved antenna list 5.1 and 5.2 GHz

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Directional	Integrated flat plate	Cambium Networks	N/A	23.0
	2ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.5
	4ft parabolic dual polarised	Gabriel Antennas	PX4F-52-N7A/A	34.5
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16.0
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0
	90° sectorised	Cambium Networks	85009324001	17.0
	60° sectorised	Cambium Networks	85009325001	17.0
Omni-directional	Dual polar omni-directional	KP	KPPA-5.7-DPOMA	13.0
	Dual polar omni-directional	Mars Antennas	MA-WO56-DP10	10.0

Table 236: USA approved antenna list 5.4 GHz

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Directional	Integrated flat plate	Cambium Networks	N/A	23.0
	2 ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.5
	2 ft dual polarised parabolic	MTI	MT-486013-NVH	28.5
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16.0
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0
	90° sectorised	Cambium Networks	85009324001	17.0
	60° sectorised	Cambium Networks	85009325001	17.0
Omni-directional	Dual polar omni-directional	KP	KPPA-5.7-DPOMA	13.0
	Dual polar omni-directional	Mars Antennas	MA-WO56-DP10	10.0

Table 237: USA approved antenna list 5.8 GHz

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Directional	Integrated flat plate	Cambium Networks	N/A	23.0
	2 ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.0
	4 ft parabolic dual polarised	Gabriel Antennas	PX4F-52-N7A/A	35.3
	6 ft Parabolic dual polarised	Gabriel Antennas	PX6F-52/A	38.1
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16.0
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0
	90° sectorised	Cambium Networks	85009324001	17.0
	60° sectorised	Cambium Networks	85009325001	17.0
Omni-directional	Dual polar omni-directional	KP	KPPA-5.7-DPOMA	13.0

FCC approved antenna list for 450b Connectorized and 450 MicroPoP

Antennas with a maximum gain of 24 dBi were included in the approval.

Innovation Science and Economic Development Canada (ISEDC) specific information

900 MHz ISEDC notification

Radio Standards Specification RSS-247, Issue 1, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, is a new standard to replace annexes 8 and 9 of RSS-210, Issue 8.

4.9 GHz ISEDC notification

The system has been approved under ISEDC RSS-111 for Public Safety Agency usage. The installer or operator is responsible for obtaining the appropriate site licenses before installing or using the system.

Utilisation de la bande 4.9 GHz FCC et ISEDC

Le système a été approuvé en vertu d' ISEDC RSS-111 pour l'utilisation par l'Agence de la Sécurité publique. L'installateur ou l'exploitant est responsable de l'obtention des licences de appropriées avant

d'installer ou d'utiliser le système.

5.2 GHz and 5.4 GHz ISEDC notification

This device complies with ISEDC RSS-247. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. Users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted by the regulations. The transmitted power must be reduced to achieve this requirement.

Utilisation de la bande 5.2 and 5.4 GHz ISEDC

Cet appareil est conforme à ISEDC RSS-247. Son fonctionnement est soumis aux deux conditions suivantes: (1) Ce dispositif ne doit pas causer d'interférences nuisibles, et (2) Cet appareil doit tolérer toute interférence reçue, y compris les interférences pouvant entraîner un fonctionnement indésirable. Les utilisateurs doivent prendre garde au fait que les radars à haute puissance sont considères comme les utilisateurs prioritaires de 5250 à 5350 MHz et 5650 à 5850 MHz et ces radars peuvent causer des interférences et / ou interférer avec un réseau local ne nécessitant pas de licence.

Pour la version du produit avec antenne externe et afin de réduire le risque d'interférence avec d'autres utilisateurs, le type d'antenne et son gain doivent être choisis afin que la puissance isotrope rayonnée équivalente (PIRE) ne soit pas supérieure à celle permise par la règlementation. Il peut être nécessaire de réduire la puissance transmise doit être réduite pour satisfaire cette exigence.

ISEDC notification 5.8 GHz

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

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

In Canada, high power radars are allocated as primary users (meaning they have priority) of the 5600 – 5650 MHz spectrum. These radars could cause interference or damage to license-exempt local area network (LE-LAN) devices.

Utilisation de la bande 5.8 GHz ISEDC

RSS-GEN issue 3 (7.1.3) appareil utilisant la bande sans licence:

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.

Au Canada, les radars à haute puissance sont désignés comme utilisateurs principaux (ils ont la priorité) dans la bande 5600 à 5650 MHz. Ces radars peuvent causer des interférences et / ou interférer avec un réseau local ne nécessitant pas de licence.

ISEDC certification numbers

Table 238: ISEDC Certification Numbers – PMP 450v 2x2 SM

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum combined Tx output power
109W-0083	450v 2 x2 SM	5.8 GHz	5 MHz	5727.5 – 5847.5 MHz	27 dBm
			10 MHz	5730.0 – 5845.0 MHz	27 dBm
			15 MHz	5732.5 – 5842.5 MHz	27 dBm
			20 MHz	5735 – 5840 MHz	27 dBm
			30 MHz	5740 – 5835 MHz	27 dBm
			40 MHz	5745 – 5830 MHz	27 dBm
			40 + 40 MHz	5765 - 5810 MHz	20 dBm

Table 239: ISEDC Certification Numbers – PMP 450i

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum combined Tx output power
109W-0028	3 GHz AP, SM & BH	3.45 GHz	5 MHz	3452.5 – 3647.5 MHz	46 dBm
			20 MHz	3460.0 – 3640.0 MHz	45 dBm
			40 MHz	3470.0 – 3630.0 MHz	46 dBm
		3.65 GHz	5 MHz	3652.5 – 3697.5 MHz	36 dBm
			20 MHz	3660.0 – 3690.0 MHz	42 dBm
			40 MHz	3670.0 – 3680.0 MHz	41 dBm

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum combined Tx output power
109AO-50450I	5 GHz AP, SM & BH	4.9 GHz	5 MHz	4942.5 – 4987.5 MHz	24 dBm
			10 MHz	4945.0 – 4985.0 MHz	24 dBm
			15 MHz	4952.5 - 4982.5 MHz	24 dBm
			20 MHz	4950.0 – 4980.0 MHz	24 dBm
109AO-50450I	5 GHz AP, SM & BH	5.2 GHz	5 MHz	5252.5 – 5342.5 MHz	11 dBm
			10 MHz	5255.0 – 5340.0 MHz	11 dBm
			15 MHz	5257.5 – 5337.5 MHz	11 dBm
			20 MHz	5260.0 – 5332.5 MHz	11 dBm
			30 MHz	5265.0 – 5332.5 MHz	11 dBm
			40 MHz	5270.0 – 5325.0 MHz	11 dBm
109AO-50450I	5 GHz AP, SM & BH	5.4 GHz	5 MHz	5472.5 – 5722.5 MHz	11 dBm
			10 MHz	5475.0 – 5720.0 MHz	14 dBm
			15 MHz	5477.5 – 5717.5 MHz	14 dBm
			20 MHz	5480.0 – 5715.0 MHz	16 dBm
			30 MHz	5485.0 – 5710.0 MHz	16 dBm
			40 MHz	5490.0 – 5705.0 MHz	16 dBm

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum combined Tx output power
109AO-50450I	5 GH AP, SM & BH	5.8 GHz	5 MHz	5730.0 – 5845.0 MHz	28 dBm
			10 MHz	5730.0 – 5845.0 MHz	28 dBm
			15 MHz	5732.5 – 5842.5 MHz	28 dBm
			20 MHz	5735.0 – 5840.0 MHz	28 dBm
			30 MHz	5740.0 – 5825.0 MHz	28 dBm
			40 MHz	5745.0 – 5820.MHz	28dBm

Table 240: ISEDC Certification Numbers – PMP 450m

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum EIRP
109AO-30450m	3 GHz PMP 450m AP	3.45 GHz	5 MHz	3452.5 – 3647.5 MHz	57 dBm
			20 MHz	3460.0 – 3640.0 MHz	57 dBm
			40 MHz	3470.0 – 3630.0 MHz	57 dBm
		3.65 GHz	5 MHz	3652.5 – 3697.5 MHz	57dBm
			20 MHz	3660.0 – 3690.0 MHz	57 dBm
			40 MHz	3670.0 – 3680.0 MHz	57dBm
		3.95 GHz	5 MHz		
			20 MHz		
			40 MHz		

ISEDC Cert.	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum EIRP
109A0-50450M	5 GHz PMP 450m AP	4.9 GHz	5 MHz	4942.5 – 4987.5 MHz	48 dBm
			10 MHz	4945.0 – 4985.0 MHz	48 dBm
			15 MHz	4952.5 - 4982.5 MHz	48 dBm
			20 MHz	4950.0 – 4980.0 MHz	48 dBm
109A0-50450M	5 GHz PMP 450m AP	5.4 GHz	5 MHz	5472.5 – 5722.5 MHz	23.5 dBm
			10 MHz	5475.0 – 5720.0 MHz	27 dBm
			15 MHz	5477.5 – 5717.5 MHz	29 dBm
			20 MHz	5480.0 – 5715.0 MHz	30 dBm
			30 MHz	5485.0 – 5710.0 MHz	30 dBm
			40 MHz	5490.0 – 5705.0 MHz	30 dBm
109A0-50450M	5 GHz PMP 450m AP	5.8 GHz	5 MHz	5730.0 – 5845.0 MHz	36 dBm
			10 MHz	5730.0 – 5845.0 MHz	36 dBm
			15 MHz	5732.5 – 5842.5 MHz	36 dBm
			20 MHz	5735.0 – 5840.0 MHz	36 dBm
			30 MHz	5265.0 – 5332.5 MHz	36 dBm
			40 MHz	5270.0 – 5325.0 MHz	36 dBm

Table 241: ISEDC Certification Numbers – PMP 450b 6

ISEDC Cert.	Model Number	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum EIRP
109W-0084	6091HH	PMP 450b 6	5.8 GHz	5 MHz	5725 - 5850 MHz	44 dBm

ISEDC Cert.	Model Number	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum EIRP
				10 MHz	5725 - 5850 MHz	44 dBm
				15 MHz	5725 - 5850 MHz	44 dBm
				20 MHz	5725 - 5850 MHz	44 dBm
				30 MHz	5725 - 5850 MHz	44 dBm
				40 MHz	5725 - 5850 MHz	44 dBm

Canada approved antenna list

Under ISEDC regulations, this radio transmitter may only operate using dedicated external antenna of a type and maximum (or lesser) gain approved for the transmitter by ISEDC . To reduce potential radio interference to other users, the antenna type and its gain must be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, cet émetteur radio peut fonctionner avec une antenne externe dédiée d'un type et un gain maximal (ou moins) approuvé pour l'émetteur par Industrie Canada. Afin de réduire le risque d'interférence radio pour les autres utilisateurs, le type d'antenne et son gain doivent être choisis afin que la puissance irradiée isotrope équivalente (EIRP) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This radio transmitter (identify the device by certification number) has been approved by ISEDC to operate with the antenna types listed in Country specific radio regulations, Innovation Science and Economic Development Canada (ISEDC) specific information, Canada approved dedicated external antenna list 4.9 and 5.8 GHz with the maximum permissible gain and required antenna impedance for each dedicated external antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet émetteur radio (identifier l'appareil par son numéro de certification) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenneexterne dédiée énumérées dans les règlements radiophoniques spécifiques au pays, Country specific radio regulations, Innovation Science and Economic Development Canada (ISEDC) specific information, Canada approved dedicated external antenna list 4.9 and 5.8 GHz et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne s'ils ne sont pas inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour le fonctionnement de l'émetteur.

Table 242: Canada approved dedicated external antenna list 4.9 and 5.8 GHz

Antenna type	Description	Manufacturer	Reference	Gain (dBi)	
				4.9 GHz	5.8 GHz
Directional	Integrated flat plate	Cambium Networks	N/A	23	23
	2 ft dual polarised flat plate	MARS Antennas	MA-WA56-DP-28N	28.5	28
	4 ft parabolic dual polarised	Andrews Antennas	PX4F-52-N7A/A	N/A	35.3
	6 ft Parabolic dual polarised	Gabriel Antennas	QF6-49-N	37.2	N/A
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16	16
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0	
	90°sector	Cambium Networks	85009324001	17	17
	60° sectorised	Cambium Networks	85009325001	16	16
Omni-directional	Omni-directional	KP Antennas	KPPA-5.7-DPOMA	13	13
	Omni-directional	MARS Antennas	MA-WO56-DP10	10	10

Table 243: Canada approved dedicated external antenna list 5.2 and 5.4 GHz

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Directional	Integrated flat plate	Cambium Networks	N/A	23.0
	2ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.5
	2ft dual polarised parabolic	MTI	MT-486013-NVH	28.5

Directivity	Type	Manufacturer	Reference	Stated Gain (dBi)
Sector	Integrated 90° sector flat plate	Cambium Networks	A005240	16.0
	Integrated 90° PMP 450i AP	Cambium Networks	N/A	17.0
	90° sectorised	Cambium Networks	85009324001	17.0
	60° sectorised	Cambium Networks	85009325001	17.0
Omni-directional	Dual polar omni-directional	KP	KPPA-5.7-DPOMA	13.0
	Dual polar omni-directional	Mars Antennas	MA-WO56-DP10	10.0

Chapter 5: Troubleshooting

This chapter contains procedures for identifying and correcting faults in a 450 Platform Family link. These procedures can be performed either on a newly installed link, or on an operational link if communication is lost, or after a lightning strike.

The following topics are described in this chapter:

- General troubleshooting procedure
- Troubleshooting procedures
- Power-up troubleshooting
- Power-up troubleshooting
- Logs

General troubleshooting procedure

General planning for troubleshooting

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

- Identify troubleshooting tools that are available at your site (such as a protocol analyzer).
- Identify commands and other sources that can capture baseline data for the site. These may include:
    - Ping
    - Tracert or traceroute
    - Link Capacity Test results
    - Throughput data
    - Configuration tab captures
    - Status tab captures
    - Session logs
    - Web browser used
- Start a log for the site.
- Include the following information in the log:
    - Types of hardware deployed
    - Site-specific troubleshooting processes

    - Escalation procedures
    - Operating procedures
    - Site-specific configuration records
    - Network topology

General fault isolation process

Effective troubleshooting also requires an effective fault isolation methodology that includes the following:

- Attempting to isolate the problem to the level of a system, subsystem, or link, such as
    - AP to SM
    - AP to CMM4
    - AP to GPS
    - Backhaul (BH)
    - Backhaul (BH) to CMM4
    - Power
- Researching Event Logs of the involved equipment
- Interpreting messages in the Event Log
- Answering the questions listed in the following sections.
- Reversing the last previous corrective attempt before proceeding to the next.
- Performing only one corrective attempt at a time.

Questions to help isolate the problem

When a problem occurs, attempt to answer the following questions:

- What is the history of the problem?
    - Have we changed something recently?
    - Have we seen other symptoms before this?
- How wide-spread is the symptom?
    - Is the problem on only a single SM? (If so, focus on that SM.)
    - Is the problem on multiple SMs? If so

        - is the problem on one AP in the cluster? (If so, focus on that AP)
        - is the problem on multiple, but not all, APs in the cluster? (If so, focus on those APs)
        - is the problem on all APs in the cluster? (If so, focus on the CMM4 and the GPS signal.)
- Based on data in the Event Log
    - does the problem correlate to External Hard Resets with no WatchDog timers? (If so, this indicates a loss of power. Correct your power problem.)
    - is intermittent connectivity indicated? (If so, verify your configuration, power level, cables and connections and the speed duplex of both ends of the link).
    - does the problem correlate to loss-of-sync events?
- Are connections made via shielded cables?
- Does the GPS antenna have an unobstructed view of the entire horizon?
- Has the site grounding been verified?

Secondary Steps

After preliminary fault isolation is completed through the above steps, follow these:

- Check the Canopy knowledge base (http://community.cambiumnetworks.com/ to find whether other network operators have encountered a similar problem.
- Proceed to any appropriate set of diagnostic steps. These are organized as follows:
    - Module has lost or does not establish connectivity
    - NAT/DHCP-configured SM has lost or does not establish connectivity
    - SM Does Not Register to an AP
    - Module has lost or does not gain sync
    - Module does not establish Ethernet connectivity
    - CMM4 does not pass proper GPS sync to connected modules
    - Module Software Cannot be Upgraded
    - Module Functions Properly, Except Web Interface Became Inaccessible

Troubleshooting procedures

Proceed to any appropriate set of diagnostic steps. These are organized as follows:

- Module has lost or does not establish connectivity
- NAT/DHCP-configured SM has lost or does not establish connectivity
- SM Does Not Register to an AP

- Module has lost or does not gain sync
- Module does not establish Ethernet connectivity
- CMM4 does not pass proper GPS sync to connected modules
- Module Software Cannot be Upgraded
- Module Functions Properly, Except Web Interface Became Inaccessible

Module has lost or does not establish connectivity

To troubleshoot a loss of connectivity, perform the following steps:

Procedure 29 Troubleshooting loss of connectivity

1	Isolate the end user/SM from peripheral equipment and variables such as routers, switches and firewalls.
2	Set up the minimal amount of equipment.
3	On each end of the link: • Check the cables and connections. • Verify that the cable/connection scheme—straight-through or crossover—is correct. • Verify that the LED labeled LNK is green. • Access the General Status tab in the Home page of the module. • Verify that the SM is registered. • Verify that Received Power Level is -87 dBm or higher. • Access the IP tab in the Configuration page of the module. • Verify that IP addresses match and are in the same subnet. • If RADIUS authentication is configured, ensure that the RADIUS server is operational
4	On the SM end of the link: • Verify that the PC that is connected to the SM is correctly configured to obtain an IP address through DHCP. • Execute ipconfig (Windows) or ifconfig (linux) • Verify that the PC has an assigned IP address.
5	On each end of the link: • Access the General tab in the Configuration page of each module. • Verify that the setting for Link Speeds (or negotiation) matches that of the other module. • Access the Radio tab in the Configuration page of each module.

	• Verify that the Radio Frequency Carrier setting is checked in the Custom Radio Frequency Scan Selection List.
	• Verify that the Color Code setting matches that of the other module.
	• Access the browser LAN settings (for example, at Tools > Internet Options > Connections > LAN Settings in Internet Explorer).
	• Verify that none of the settings are selected.
	• Access the Link Capacity Test tab in the Tools page of the module.
	• Perform a link test
	• Verify that the link test results show efficiency greater than 90% in both the uplink and downlink
	• Execute ping.
	  ◦ Verify that no packet loss was experienced.
	  ◦ Verify that response times are not significantly greater than
	  ▪ 15 ms from SM to AP
	  ▪ 4 ms from AP to SM
	  ▪ Replace any cables that you suspect may be causing the problem.
	Note
	A ping size larger than 1494 Bytes to a module times out and fails. However, a ping of this size or larger to a system that is behind a Canopy module typically succeeds. It is generally advisable to ping such a system, since Canopy handles that ping with the same priority as is given all other transport traffic. The results are unaffected by ping size and by the load on the Canopy module that brokers this traffic.

6	After connectivity has been re-established, reinstall network elements and variables that you removed in Step 1.

NAT/DHCP-configured SM has lost or does not establish connectivity

Before troubleshooting this problem, identify the NAT/DHCP configuration from the following list:

- NAT with DHCP Client (DHCP selected as the Connection Type of the WAN interface) and DHCP Server
- NAT with DHCP Client (DHCP selected as the Connection Type of the WAN interface)
- NAT with DHCP Server
- NAT without DHCP

To troubleshoot a loss of connectivity for a SM configured for NAT/DHCP, perform the following steps.

Procedure 30 Troubleshooting loss of connectivity for NAT/DHCP-configured SM

1	Isolate the end user/SM from peripheral equipment and variables such as routers, switches and firewalls.
2	Set up the minimal amount of equipment.
3	On each end of the link: • Check the cables and connections. • Verify that the cable/connection scheme—straight-through or crossover—is correct. • Verify that the LED labeled LNK is green.
4	At the SM: • Access the NAT Table tab in the Logs web page. • Verify that the correct NAT translations are listed. RESULT: NAT is eliminated as a possible cause if these translations are correct.

5	If this SM is configured for NAT with DHCP, then at the SM:
	• Execute ipconfig (Windows) or ifconfig (Linux)
	• Verify that the PC has an assigned IP address.
	• If the PC does not have an assigned IP address, then
	  • enter ipconfig /release “Adapter Name”.
	  • enter ipconfig /renew “Adapter Name”.
	  • reboot the PC.
	  • after the PC has completed rebooting, execute ipconfig
	  • if the PC has an assigned IP address, then
	  • access the NAT DHCP Statistics tab in the Statistics web page of the SM.
	  • verify that DHCP is operating as configured.

6	After connectivity has been re-established, reinstall network elements and variables that you removed in Step 1.

SM Does Not Register to an AP

To troubleshoot a SM failing to register to an AP, perform the following steps.

Procedure 31 Troubleshooting SM failing to register to an AP

1	Access the Radio tab in the Configuration page of the SM.
2	Note the Color Code of the SM.
3	Access the Radio tab in the Configuration page of the AP.
4	Verify that the Color Code of the AP matches that of the SM.
5	Note the Radio Frequency Carrier of the AP.
6	Verify that the value of the RF Frequency Carrier of the AP is selected in the Custom Radio Frequency Scan Selection List parameter in the SM.

7	In the AP, verify that the Max Range parameter is set to a distance slightly greater than the distance between the AP and the furthest SM that must register to this AP.
8	Verify that no obstruction significantly penetrates the Fresnel zone of the attempted link.
9	Access the General Status tab in the Home page of each module.
10	Remove the bottom cover of the SM to expose the LEDs.
11	Power cycle the SM. RESULT: Approximately 25 seconds after the power cycle, the green LED labeled LNK must light to indicate that the link has been established. If the orange LED labeled SYN is lit instead, then the SM is in Alignment mode because the SM failed to establish the link.
12	If the AP is configured to require authentication, ensure proper configuration of RADIUS or Pre-shared AP key.
13	In this latter case and if the SM has encountered no customer-inflicted damage, then request an RMA for the SM.

Module has lost or does not gain sync

To troubleshoot a loss of sync, perform the following steps.

Procedure 32 Troubleshooting loss of sync

1	Access the Event Log tab in the Home page of the SM
2	Check for messages with the following format: RcvFrmNum = ExpFrmNum =
3	If these messages are present, check the Event Log tab of another SM that is registered to the same AP for messages of the same type.
4	If the Event Log of this second SM does not contain these messages, then the fault is isolated to the first SM. If the Event Log page of this second SM contains these messages, access the GPS Status page of the AP.
5	If the Satellites Tracked field in the GPS Status page of the AP indicates fewer than 4 or the Pulse Status field does not indicate Generating Sync, check the GPS Status page of another AP in the same AP cluster for these indicators. GPS signal acquisition must not take longer than 5 minutes from unit startup.
6	If these indicators are present in the second AP, then: • Verify that the GPS antenna still has an unobstructed view of the entire horizon. • Visually inspect the cable and connections between the GPS antenna and the CMM4. If this cable is not shielded, replace the cable with shielded cable.
7	If these indicators are not present in the second AP, visually inspect the cable and connections between the CMM4 and the AP antenna. If this cable is not shielded, replace the cable with shielded cable.

Module does not establish Ethernet connectivity

To troubleshoot a loss of Ethernet connectivity, perform the following steps:

Procedure 33 Troubleshooting loss of Ethernet connectivity

1	Verify that the connector crimps on the Ethernet cable are not loose.
2	Verify that the Ethernet cable is not damaged.
3	If the Ethernet cable connects the module to a network interface card (NIC), verify that the cable is pinned out as a straight-through cable.
4	If the Ethernet cable connects the module to a hub, switch, or router, verify that the cable is pinned out as a crossover cable.
5	Verify that the Ethernet port to which the cable connects the module is set to auto-negotiate speed.
6	Verify VLAN configuration in the network, which may cause loss of module access if the accessing device is on a separate VLAN from the radio.
7	Power cycle the module. RESULT: Approximately 25 seconds after the power cycle, the green LED labeled LNK must light up to indicate that the link has been established. If the orange LED labeled SYN is lit instead, then the module is in Alignment mode because the module failed to establish the link.
8	In this latter case and if the module has encountered no customer-inflicted damage, then request an RMA for the module.

CMM4 does not pass proper GPS sync to connected modules

If the Event Log tabs in all connected modules contain Loss of GPS Sync Pulse messages, perform the following steps.

Procedure 34 Troubleshooting CMM4 not passing sync

1	Verify that the GPS antenna has an unobstructed view of the entire horizon.
2	Verify that the GPS coaxial cable meets specifications.
3	Verify that the GPS sync cable meets specifications for wiring and length.

4	If the web pages of connected modules indicate any of the following, then find and eliminate the source of noise that is being coupled into the GPS sync cable:
	• In the GPS Status page:
	  ◦ anomalous number of Satellites Tracked (greater than 12, for example)
	  ◦ incorrect reported Latitude and/or Longitude of the antenna
	  ◦ In the Event Log page:
	  ◦ garbled GPS messages
	  ◦ large number of Acquired GPS Sync Pulse messages

	◦ GPS signal acquisition must not take longer than 5 minutes from unit startup.
5	If these efforts fail to resolve the problem, then request an RMA for the CMM4.

Module Software Cannot be Upgraded

If your attempt to upgrade the software of a module fails, perform the following steps.

Procedure 35 Troubleshooting an unsuccessful software upgrade

1	Download the latest issue of the target release and the associated release notes.
2	Verify that the latest version of CNUT is installed.
3	Compare the files used in the failed attempt to the newly downloaded software.
4	Compare the procedure used in the failed attempt to the procedure in the newly downloaded release notes.
5	If these comparisons reveal a difference, retry the upgrade, this time with the newer file or newer procedure.
6	If, during attempts to upgrade the FPGA firmware, the following message is repeatable, then request an RMA for the module: Error code 6, unrecognized device

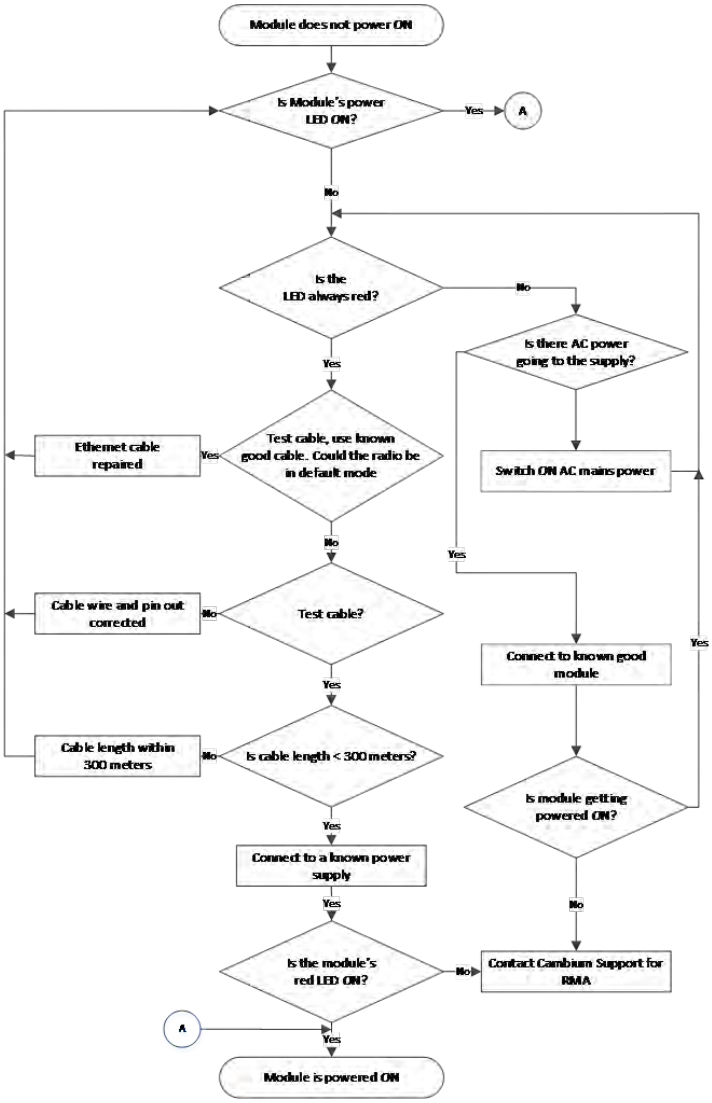
Module Functions Properly, Except Web Interface Became Inaccessible

If a module continues to pass traffic and the SNMP interface to the module continues to function, but the web interface to the module does not display, perform the following steps:

Procedure 36 Restoring web management GUI access

1	Enter telnet DottedIPAddress. RESULT: A telnet session to the module is invoked.
2	At the Login prompt, enter root.
3	At the Password prompt, enter PasswordIfConfigured.
4	At the Telnet +> prompt, enter reset. RESULT: The web interface is accessible again and this telnet connection is closed. **Note** The module may also be rebooted via an SNMP-based NMS (Wireless Manager, for example)
5	If the issue persists, turn off any SNMP-based network/radio monitoring software and repeat steps 1-4.

Power-up troubleshooting



Registration and connectivity troubleshooting

SM/BMS Registration

If no SMs are registered to this AP, then the Session Status tab displays the simple message No sessions. In this case, try the following steps.

1	More finely aim the SM or SMs toward the AP.
2	Recheck the Session Status tab of the AP for the presence of LUIDs.
3	If still no LUIDs are reported on the Session Status tab, click the Configuration button on the left side of the Home page. RESULT: The AP responds by opening the AP Configuration page.

4	Click the Radio tab.
5	Find the Color Code parameter and note the setting.
6	In the same sequence as you did for the AP directly under Configuration Link for Test in Planning and Installation Guide, connect the SM to a computing device and to power.
7	On the left side of the SM Home page, click the Configuration button. RESULT: The Configuration page of the SM opens.
8	Click the Radio tab.
9	If the transmit frequency of the AP is not selected in the Custom Radio Frequency Scan Selection List parameter, select the frequency that matches.
10	If the Color Code parameter on this page is not identical to the Color Code parameter you noted from the AP, change one of them so that they match.
11	At the bottom of the Radio tab for the SM, click the Save Changes button.
12	Click the Reboot button.
13	Allow several minutes for the SM to reboot and register to the AP.
14	Return to the computing device that is connected to the AP.
15	Recheck the Session Status tab of the AP for the presence of LUIDs.

Logs

Persistent Logging

PMP 450 SM supports logging information such as session logs, authentication logs, and authorization logs that are persistent through reboots and connectivity losses.

Navigate to Logs to view:

- SM Session
- SM Authentication
- SM Authorization

All the SM logs are saved to flash and displayed upon reboot.

Figure 125: *SM Logs*

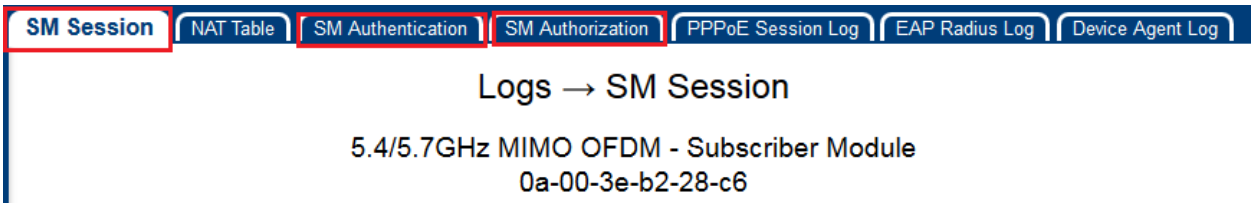


Figure 126: *SM Session log*

```
SM Session Log
06/15/2017 : 03:34:25 UTC : Event: SMAUTHORMSG, NewState: REGISTERED, Flag 0
repeated 2 times
06/15/2017 : 03:39:47 UTC : Event: SMSESFAIL, MsgType: OOS, NewState: OOSERVICE, Flag 0
06/15/2017 : 03:40:59 UTC : Event: SMSESACTIVATE, NewState: REGISTERING, Flag 0
06/15/2017 : 03:40:59 UTC : Event: SMSESINS, NewState: REGISTERED, Flag 0
06/15/2017 : 03:40:59 UTC : Event: SMAUTHORMSG, NewState: REGISTERED, Flag 0
repeated 2 times
```

Figure 127: *SM Authentication log*

```
SM Authentication Log
06/14/2017 : 11:03:02 UTC : Event: AUTHEN_RESET, NewState: IDLE, Flag 0
06/14/2017 : 11:04:17 UTC : Event: AUTHEN_REQ, NewState: AUTHENTICATING, Flag 0
06/14/2017 : 11:04:17 UTC : Event: AUTHEN_SUC, NewState: AUTHENTICATED, Flag 0
06/14/2017 : 16:07:56 UTC : Event: AUTHEN_RESET, NewState: IDLE, Flag 0
06/14/2017 : 16:09:10 UTC : Event: AUTHEN_REQ, NewState: AUTHENTICATING, Flag 0
06/14/2017 : 16:09:10 UTC : Event: AUTHEN_SUC, NewState: AUTHENTICATED, Flag 0
06/14/2017 : 16:20:03 UTC : Event: AUTHEN_RESET, NewState: IDLE, Flag 0
```

Figure 128: *SM Authorization log*

```
SM Authorization Log
06/15/2017 : 01:54:47 UTC : Event: AUTHOR_REQ, NewState: AUTHORIZING, Flag 0
06/15/2017 : 01:54:47 UTC : Event: AUTHOR_MSG, MsgType: BCASTKEY, NewState: AUTHORIZING, Flag 0
06/15/2017 : 01:54:47 UTC : Event: AUTHOR_REQPARAMS, NewState: AUTHORIZING, Flag 0
06/15/2017 : 01:54:47 UTC : Event: AUTHOR_CFGPARAMS, NewState: AUTHORIZED, Flag 0
06/15/2017 : 02:27:05 UTC : Event: AUTHOR_RESET, NewState: IDLE, Flag 0
06/15/2017 : 02:28:19 UTC : Event: AUTHOR_REQ, NewState: AUTHORIZING, Flag 0
06/15/2017 : 02:28:19 UTC : Event: AUTHOR_MSG, MsgType: BCASTKEY, NewState: AUTHORIZING, Flag 0
06/15/2017 : 02:28:19 UTC : Event: AUTHOR_REQPARAMS, NewState: AUTHORIZING, Flag 0
06/15/2017 : 02:28:19 UTC : Event: AUTHOR_CFGPARAMS, NewState: AUTHORIZED, Flag 0
06/15/2017 : 02:49:10 UTC : Event: AUTHOR_RESET, NewState: IDLE, Flag 0
```

Automated Frequency Coordination Logging

Detailed logging is available, including a graph and table, for 6 GHz AFC in the **Logs -> AFC Log** tab of the AP GUI. For details on how to read the table and graph on this page, see document **AFC operation for Cambium PMP products** available in the PMP section of the PMP 450 section of the Cambium Products page:

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

PMP 450m Reference information

A.1 Specifications

Please see the Specification sheets listed on the Cambium Networks website for the most up-to-date PMP 450m Series AP specifications:

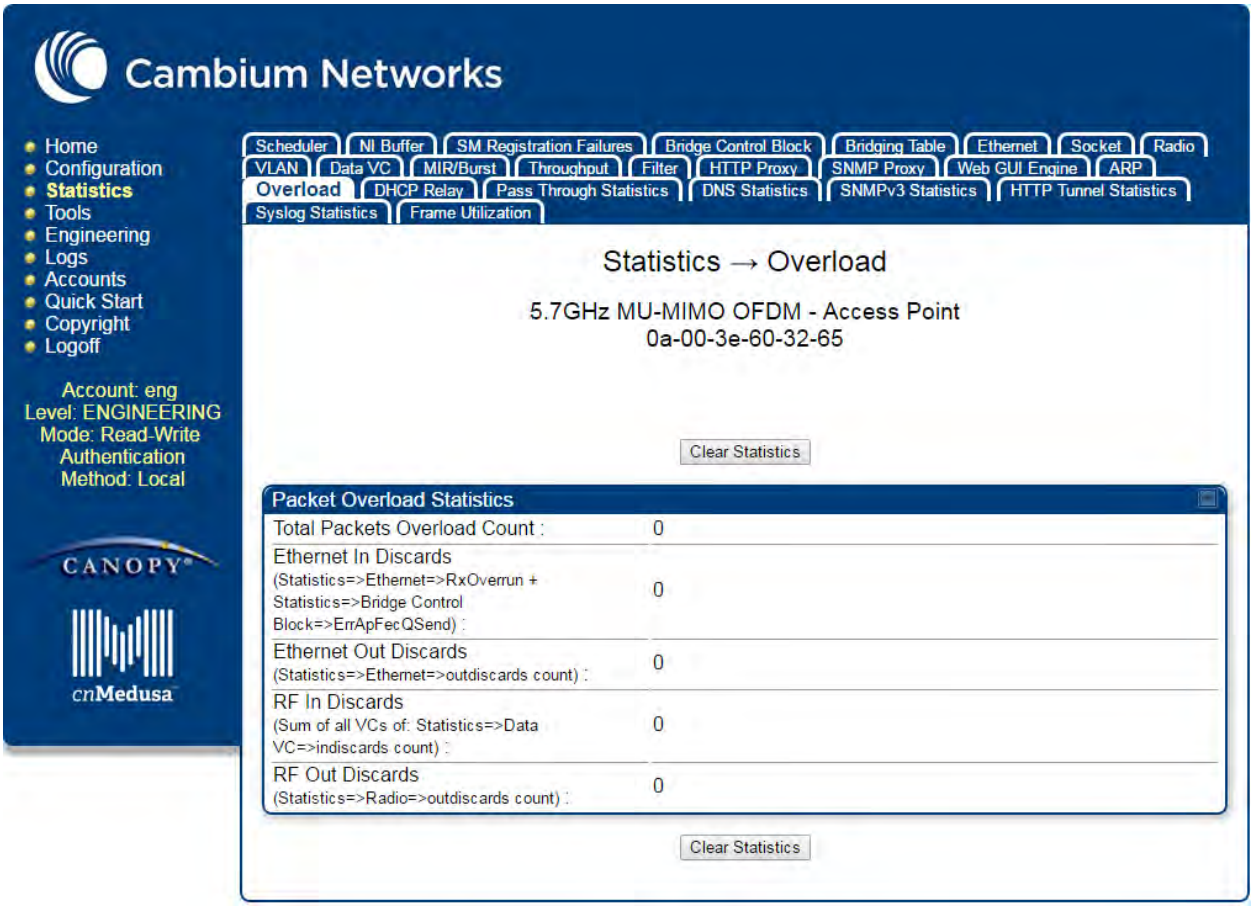
http://www.cambiumnetworks.com/resource/pmp-450m/

A.2 PMP 450m overload

The PMP 450m Series AP is designed to handle high load in terms of high throughput and high PPS. In terms of throughput, PMP 450m is designed to achieve 3x or more throughput improvement over PMP 450 and PMP 450i Series products. In terms of packets per second (PPS), PMP 450m is designed to handle more than 100K PPS.

Overload occurs when the offered load exceeds the above limits. When overload occurs, PMP 450m will start discarding packets and TCP throughput will degrade due to packet loss. The PMP 450 family of products have a set of overload statistics that can be used to monitor overload conditions (**Statistics** > **Overload** tab).

Figure 129: *Overload tab*



The above statistics shall be monitored over time for overload conditions over consecutive periods. Refer to Interpreting Overload statistics for description of those statistics.

It's worth noting that Frame Utilization statistics (**Statistics** > **Frame Utilization** tab: Frame Utilization: Downlink and Uplink) are not necessarily indicative of overload condition. They show how much the TDD frame is utilized. High frame utilization depends on:

1. High traffic during busy periods: those statistics will be close to 100% and almost all slots will be utilized. In this case if the Overload statistics show that packets are discarded then this is an indication of overload condition.
2. High percentage of VCs with low modulation with moderate traffic. Those VCs will require more slots to service them (due to low modulation) and the frame utilization will be high. In this case the TDD frame is fully utilized but the system is at low capacity and is not in an overload condition.

450m has higher PPS than PMP 450 and PMP 450i and supports higher throughput through spatial multiplexing, therefore when a PMP 450m replaces an overloaded 450 or PMP 450i AP the PMP 450m will not be overloaded under the same conditions but the frame utilization may still show close to 100%; this should not alarm the customer. The overload statistics shall be monitored on PMP 450m to see if it is overloaded or not.

Quality of Service (QoS) Glossary

Term	Definition
10Base-T	Technology in Ethernet communications that can deliver 10 Mb of data across 328 feet (100 meters) of CAT 5 cable.
169.254.0.0	Gateway IP address default in Cambium fixed wireless broadband IP network modules.
169.254.1.1	IP address default in Cambium fixed wireless broadband IP network modules.
255.255.0.0	Subnet mask default in Cambium fixed wireless broadband IP network modules and in Microsoft and Apple operating systems.
802.3	An IEEE standard that defines the contents of frames that are transferred through Ethernet connections. Each of these frames contains a preamble, the address to which the frame is sent, the address that sends the frame, the length of the data to expect, the data, and a checksum to validate that no contents were lost.
Access Point Cluster	Two to six Access Point Modules that together distribute network or Internet services to a community of subscribers. Each Access Point Module covers a 60° or 90° sector. This cluster covers as much as 360°. Also known as AP cluster.
Access Point Module	Also known as AP. One module that distributes network or Internet services in a 60° or 90° sector.
ACT/4	Second-from-left LED in the module. In the operating mode, this LED is lit when data activity is present on the Ethernet link.
Address Resolution Protocol	Protocol defined in RFC 826 to allow a network element to correlate a host IP address to the Ethernet address of the host. See http://www.faqs.org/rfcs/rfc826.html.
Aggregate Throughput	The sum of the throughputs in the uplink and the downlink.
AP	Access Point Module. One module that distributes network or Internet services to subscriber modules.
ARP	Address Resolution Protocol. A protocol defined in RFC 826 to allow a network element to correlate a host IP address to the Ethernet address of the host. See http://www.faqs.org/rfcs/rfc826.html.
APs MIB	Management Information Base file that defines objects that are specific to the Access Point Module. See also Management Information Base.
ASN.1	Abstract Syntax Notation One language. The format of the text files that compose the Management Information Base.

Term	Definition
Attenuation	Reduction of signal strength caused by the travel from the transmitter to the receiver, and caused by any object between. In the absence of objects between, a signal that has a short wavelength experiences a high degree of attenuation nevertheless.
BER	Bit Error Rate. The ratio of incorrect data received to correct data received.
BHM	Backhaul Timing Master (BHM)- a module that is used in a point to point link. This module controls the air protocol and configurations for the link..
BHS	Backhaul Timing Slave (BHS)- a module that is used in a point to point link. This module accepts configuration and timing from the master module.
Bit Error Rate	Ratio of incorrect data received to correct data received.
Box MIB	Management Information Base file that defines module-level objects. See also Management Information Base.
Bridge	Network element that uses the physical address (not the logical address) of another to pass data. The bridge passes the data to either the destination address, if found in the simple routing table, or to all network segments other than the one that transmitted the data. Modules are Layer 2 bridges except that, where NAT is enabled for an SM, the SM is a Layer 3 switch. Compare to Switch and Router, and see also NAT.
Buckets	Theoretical data repositories that can be filled at preset rates or emptied when preset conditions are experienced, such as when data is transferred.
Burst	Preset amount limit of data that may be continuously transferred.
CAT 5 Cable	Cable that delivers Ethernet communications from module to module. Later modules auto-sense whether this cable is wired in a straight-through or crossover scheme.
CIR	Committed Information Rate. For an SM or specified group of SMs, a level of bandwidth that can be guaranteed to never fall below a specified minimum (unless oversubscribed). In the Cambium implementation, this is controlled by the Low Priority Uplink CIR, Low Priority Downlink CIR, Medium Priority Uplink CIR, Medium Priority Downlink CIR parameters, High Priority Uplink CIR, High Priority Downlink CIR parameters, Ultra High Priority Uplink CIR, and Ultra High Priority Downlink CIR parameters.
Cluster Management Module	Module that provides power, GPS timing, and networking connections for an AP cluster. Also known as CMM4.
CMM	Cluster Management Module. A module that provides power, GPS timing, and networking connections for an Access Point cluster.
CodePoint	See DiffServ.
Color Code Field	Module parameter that identifies the other modules with which communication is allowed. The range of valid values is 0 to 255.
Community String Field	Control string that allows a network management station to access MIB information about the module.

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Connectorized</td><td>The 450 Platform Family Connectorized Radio solution provide RF port to connect external antenna. It gives flexibility to connect to a variety of external antennas.</td></tr>
<tr><td>Country Code</td><td>A parameter that offers multiple fixed selections, each of which automatically implements frequency band range restrictions for the selected country. Units shipped to countries other than the United States must be configured with the corresponding Region Code and Country Code to comply with local regulatory requirements.</td></tr>
<tr><td>CRCError Field</td><td>This field displays how many CRC errors occurred on the Ethernet controller.</td></tr>
<tr><td>Data Encryption Standard</td><td>Over-the-air link option that uses secret 56-bit keys and 8 parity bits. Data Encryption Standard (DES) performs a series of bit permutations, substitutions, and recombination operations on blocks of data.</td></tr>
<tr><td>Demilitarized Zone</td><td>Internet Protocol area outside of a firewall. Defined in RFC 2647. See http://www.faqs.org/rfcs/rfc2647.html.</td></tr>
<tr><td>DES</td><td>Data Encryption Standard. An over-the-air link option that uses secret 56-bit keys and 8 parity bits. DES performs a series of bit permutations, substitutions, and recombination operations on blocks of data.</td></tr>
<tr><td>DFS</td><td>See Dynamic Frequency Selection</td></tr>
<tr><td>DHCP</td><td>Dynamic Host Configuration Protocol, defined in RFC 2131. Protocol that enables a device to be assigned a new IP address and TCP/IP parameters, including a default gateway, whenever the device reboots. Thus DHCP reduces configuration time, conserves IP addresses, and allows modules to be moved to a different network within the system. See http://www.faqs.org/rfcs/rfc2131.html. See also Static IP Address Assignment.</td></tr>
<tr><td>DiffServ</td><td>Differentiated Services, consistent with RFC 2474. A byte in the type of service (TOS) field of packets whose values correlates to the channel on which the packet should be sent. The value is a numeric code point. The PMP 450 AP's support four levels of QoS. The mapping of these eight priority values to data channels is determined by the number of data channels configured per SM as shown in the table below:
<table>
<tr><th>Number of QoS levels →</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Level 1</td><td>0-7</td><td>0-3</td><td>0-1</td><td>0-1</td></tr>
<tr><td>Level 2</td><td>-</td><td>4-7</td><td>2-3</td><td>2-3</td></tr>
<tr><td>Level 3</td><td>-</td><td>-</td><td>4-7</td><td>4-5</td></tr>
<tr><td>Level 4</td><td>-</td><td>-</td><td>-</td><td>6-7</td></tr>
</table>
For example, for an AP that uses the default table shown above has configured 3 QoS levels per SM, would see codepoints 0 through 15 mapped to the Low Priority data channels, codepoint 16 would be mapped to the Medium Priority data channels, and so on.</td></tr>
</table>

Term	Definition
	Note that CodePoints 0, 8, 16, 24, 32, 48, and 56 are predefined to the fixed values shown in Table 22 DiffServ attributes – AP/BHM and are not user configurable. Operator cannot change any of these fixed priority values. Among the configurable parameters, the priority values (and therefore the handling of packets in the high or low priority channel) are set in the AP/BHM for all downlinks within the sector and in the SM/BHS for each uplink.
DMZ	Demilitarized Zone as defined in RFC 2647. An Internet Protocol area outside of a firewall. See http://www.faqs.org/rfcs/rfc2647.html.
Dynamic Frequency Selection	A requirement in certain countries and regions for systems to detect interference from other systems, notably radar systems, and to avoid co-channel operation with these systems.
Dynamic Host Configuration Protocol	See DHCP.
Electronic Serial Number	Hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number. Same as MAC Address.
ESN	Electronic Serial Number. The hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number. Same as MAC Address.
Ethernet Protocol	Any of several IEEE standards that define the contents of frames that are transferred from one network element to another through Ethernet connections.
ETSI	European Telecommunications Standards Institute
Fade Margin	The difference between strength of the received signal and the strength that the receiver requires for maintaining a reliable link. A higher fade margin is characteristic of a more reliable link. Standard operating margin.
FCC	Federal Communications Commission of the U.S.A.
Field-programmable Gate Array	Array of logic, relational data, and wiring data that is factory programmed and can be reprogrammed.
File Transfer Protocol	Utility that transfers of files through TCP (Transport Control Protocol) between computing devices that do not operate on the same platform. Defined in RFC 959. See http://www.faqs.org/rfcs/rfc959.html.
FPGA	Field-programmable Gate Array. An array of logic, relational data, and wiring data that is factory programmed and can be reprogrammed.
Free Space Path Loss	Signal attenuation that is naturally caused by atmospheric conditions and by the distance between the antenna and the receiver.
Fresnel Zone	Space in which no object should exist that can attenuate, diffract, or reflect a transmitted signal before the signal reaches the target receiver.

Term	Definition
FTP	File Transfer Protocol, defined in RFC 959. Utility that transfers of files through TCP (Transport Control Protocol) between computing devices that do not operate on the same platform. See http://www.faqs.org/rfcs/rfc959.html.
Global Positioning System	Network of satellites that provides absolute time to networks on earth, which use the time signal to synchronize transmission and reception cycles (to avoid interference) and to provide reference for troubleshooting activities.
GPS	Global Positioning System. A network of satellites that provides absolute time to networks on earth, which use the time signal to synchronize transmission and reception cycles (to avoid interference) and to provide reference for troubleshooting activities.
GPS/3	Third-from-left LED in the module. In the operating mode for an Access Point Module, this LED is continuously lit as the module receives sync pulse. In the operating mode for a Subscriber, this LED flashes on and off to indicate that the module is not registered.
GUI	Graphical user interface.
HTTP	Hypertext Transfer Protocol, used to make the Internet resources available on the World Wide Web. Defined in RFC 2068. See http://www.faqs.org/rfcs/rfc2068.html.
HTTPS	Hypertext Transfer Protocol Secure (HTTPS)
ICMP	Internet Control Message Protocols defined in RFC 792, used to identify Internet Protocol (IP)-level problems and to allow IP links to be tested. See http://www.faqs.org/rfcs/rfc792.html.
Integrated	The 450 Platform Family integrated Radio solution provides integrated antenna..
IP	Internet Protocol defined in RFC 791. The Network Layer in the TCP/IP protocol stack. This protocol is applied to addressing, routing, and delivering, and re-assembling data packets into the Data Link layer of the protocol stack. See http://www.faqs.org/rfcs/rfc791.html.
IP Address	32-bit binary number that identifies a network element by both network and host. See also Subnet Mask.
IPv4	Traditional version of Internet Protocol, which defines 32-bit fields for data transmission.
ISM	Industrial, Scientific, and Medical Equipment radio frequency band, in the 900 MHz, 2.4 GHz, and 5.8 GHz ranges.
L2TP over IPSec	Level 2 Tunneling Protocol over IP Security. One of several virtual private network (VPN) implementation schemes. Regardless of whether Subscriber Modules have the Network Address Translation feature (NAT) enabled, they support VPNs that are based on this protocol.

Term	Definition
Late Collision Field	This field displays how many late collisions occurred on the Ethernet controller. A normal collision occurs during the first 512 bits of the frame transmission. A collision that occurs after the first 512 bits is considered a late collision. A late collision is a serious network problem because the frame being transmitted is discarded. A late collision is most commonly caused by a mismatch between duplex configurations at the ends of a link segment.
Line of Sight	Wireless path (not simply visual path) direct from module to module. The path that results provides both ideal aim and an ideal Fresnel zone.
LNK/5	Furthest left LED in the module. In the operating mode, this LED is continuously lit when the Ethernet link is present. In the aiming mode for a Subscriber Module, this LED is part of a bar graph that indicates the quality of the RF link.
Logical Unit ID	Final octet of the 4-octet IP address of the module.
LOS	Line of sight. The wireless path (not simply visual path) direct from module to module. The path that results provides both ideal aim and an ideal Fresnel zone.
LUID	Logical Unit ID. The final octet of the 4-octet IP address of the module.
MAC Address	Media Access Control address. The hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number.
Management Information Base	Space that allows a program (agent) in the network to relay information to a network monitor about the status of defined variables (objects).
Maximum Information Rate (MIR)	The cap applied to the bandwidth of an SM or specified group of SMs. In the Cambium implementation, this is controlled by the Sustained Uplink Data Rate, Uplink Burst Allocation, Sustained Downlink Data Rate, and Downlink Burst Allocation parameters.
MIB	Management Information Base. Space that allows a program (agent) in the network to relay information to a network monitor about the status of defined variables (objects).
MIR	See Maximum Information Rate.
MU-MIMO	Multi User- Multiple Input Multiple Output
NAT	Network Address Translation defined in RFC 1631. A scheme that isolates Subscriber Modules from the Internet. See http://www.faqs.org/rfcs/rfc1631.html.
NEC	National Electrical Code. The set of national wiring standards that are enforced in the U.S.A.
NetBIOS	Protocol defined in RFC 1001 and RFC 1002 to support an applications programming interface in TCP/IP. This interface allows a computer to transmit and receive data with another host computer on the network. RFC 1001 defines the concepts and methods. RFC 1002 defines the detailed specifications. See http://www.faqs.org/rfcs/rfc1001.html and http://www.faqs.org/rfcs/rfc1002.html.

Term	Definition
Network Address Translation	Scheme that defines the Access Point Module as a proxy server to isolate registered Subscriber Modules from the Internet. Defined in RFC 1631. See http://www.faqs.org/rfcs/rfc1631.html.
Network Management Station	See NMS.
NMS	Network Management Station. A monitor device that uses Simple Network Management Protocol (SNMP) to control, gather, and report information about predefined network variables (objects). See also Simple Network Management Protocol.
Default Mode	Device that enables the operator to regain control of a module that has been locked by the No Remote Access feature, the 802.3 Link Disable feature, or a password or IP address that cannot be recalled. This device can be either fabricated on site or ordered.
PMP	See Point-to-Multipoint Protocol.
Point-to-Multipoint Protocol	Defined in RFC 2178, which specifies that data that originates from a central network element can be received by all other network elements, but data that originates from a non-central network element can be received by only the central network element. See http://www.faqs.org/rfcs/rfc2178.html. Also referenced as PMP.
PPPoE	Point to Point Protocol over Ethernet. Supported on SMs for operators who use PPPoE in other parts of their network operators who want to deploy PPPoE to realize per-subscriber authentication, metrics, and usage control.
PPS	Packet Per Second
PPTP	Point to Point Tunneling Protocol. One of several virtual private network implementations. Regardless of whether the Network Address Translation (NAT) feature enabled, Subscriber Modules support VPNs that are based on this protocol.
Protective Earth	Connection to earth (which has a charge of 0 volts). Also known as ground.
Proxy Server	Network computer that isolates another from the Internet. The proxy server communicates for the other computer, and sends replies to only the appropriate computer, which has an IP address that is not unique or not registered.
PTP	A Point-to-Point connection refers to a communications connection between two nodes or endpoints.
Radio Signal Strength Indicator	Relative measure of the strength of a received signal. An acceptable link displays a Radio Signal Strength Indicator (RSSI) value of greater than 700.

Term	Definition
Reflection	Change of direction and reduction of amplitude of a signal that encounters an object larger than the wavelength. Reflection may cause an additional copy of the wavelength to arrive after the original, unobstructed wavelength arrives. This causes partial cancellation of the signal and may render the link unacceptable. However, in some instances where the direct signal cannot be received, the reflected copy may be received and render an otherwise unacceptable link acceptable.
Region Code	A parameter that offers multiple fixed selections, each of which automatically implements frequency band range restrictions for the selected region. Units shipped to regions other than the United States must be configured with the corresponding Region Code to comply with local regulatory requirements.
RF	Radio frequency. How many times each second a cycle in the antenna occurs, from positive to negative and back to positive amplitude.
RJ-12	Standard cable that is typically used for telephone line or modem connection.
RJ-45	Standard cable that is typically used for Ethernet connection. This cable may be wired as straight-through or as crossover. Later modules auto-sense whether the cable is straight-through or crossover.
Router	Network element that uses the logical (IP) address of another to pass data to only the intended recipient. Compare to Switch and Bridge.
RSSI	Radio Signal Strength Indicator. A relative measure of the strength of a received signal. An acceptable link displays an RSSI value of greater than 700.
Self-interference	Interference with a module from another module in the same network.
SFP	Small Form-factor Pluggable
Simple Network Management Protocol	Standard that is used for communications between a program (agent) in the network and a network management station (monitor). Defined in RFC 1157. See http://www.faqs.org/rfcs/rfc1157.html.
SM	Customer premises equipment (CPE) device that extends network or Internet services by communication with an Access Point Module or an Access Point cluster.
SNMP	See Simple Network Management Protocol, defined in RFC 1157.
SNMPv3	SNMP version 3
SNMP Trap	Capture of information that informs the network monitor through Simple Network Management Protocol of a monitored occurrence in the module.
Spatial Frequency	Spatial Frequency is associated with an LUID or SM registered with an AP and it is visible on both AP and SM GUIs. It is grouped into bins where each bin includes 32 consecutive spatial frequency values.
Static IP Address Assignment	Assignment of Internet Protocol address that can be changed only manually. Thus, static IP address assignment requires more configuration time and consumes more of the available IP addresses than DHCP address assignment does. RFC 2050 provides guidelines for the static allocation of IP addresses. See http://www.faqs.org/rfcs/rfc2050.html. See also DHCP.

Term	Definition
Subnet Mask	32-bit binary number that filters an IP address to reveal what part identifies the network and what part identifies the host. The number of subnet mask bits that are set to 1 indicates how many leading bits of the IP address identify the network. The number of subnet mask bits that are set 0 indicate how many trailing bits of the IP address identify the host.
Subscriber Module	Customer premises equipment (CPE) device that extends network or Internet services by communication with an Access Point Module or an Access Point cluster.
Sustained Data Rate	Preset rate limit of data transfer.
Switch	Network element that uses the port that is associated with the physical address of another to pass data to only the intended recipient. Compare to Bridge and Router.
Sync	GPS (Global Positioning System) absolute time, which is passed from one module to another. Sync enables timing that prevents modules from transmitting or receiving interference. Sync also provides correlative time stamps for troubleshooting efforts.
TCP	Alternatively known as Transmission Control Protocol or Transport Control Protocol. The Transport Layer in the TCP/IP protocol stack. This protocol is applied to assure that data packets arrive at the target network element and to control the flow of data through the Internet. Defined in RFC 793. See http://www.faqs.org/rfcs/rfc793.html.
TDD	Time Division Duplexing. Synchronized data transmission with some time slots allocated to devices transmitting on the uplink and some to the device transmitting on the downlink.
telnet	Utility that allows a client computer to update a server. A firewall can prevent the use of the telnet utility to breach the security of the server. See http://www.faqs.org/rfcs/rfc818.html, http://www.faqs.org/rfcs/rfc854.html and http://www.faqs.org/rfcs/rfc855.html.
Tokens	Theoretical amounts of data. See also Buckets.
TxUnderrun Field	This field displays how many transmission-underrun errors occurred on the Ethernet controller.
UDP	User Datagram Protocol. A set of Network, Transport, and Session Layer protocols that RFC 768 defines. These protocols include checksum and address information but does not retransmit data or process any errors. See http://www.faqs.org/rfcs/rfc768.html.
udp	User-defined type of port.
U-NII	Unlicensed National Information Infrastructure radio frequency band, in the 5.1 GHz through 5.8 GHz ranges.
VID	VLAN identifier. See also VLAN.
VLAN	Virtual local area network. An association of devices through software that contains broadcast traffic, as routers would, but in the switch-level protocol.

Term	Definition
VPN	Virtual private network for communication over a public network. One typical use is to connect remote employees, who are at home or in a different city, to their corporate network over the Internet. Any of several VPN implementation schemes is possible. SMs support L2TP over IPSec (Level 2 Tunneling Protocol over IP Security) VPNs and PPTP (Point to Point Tunneling Protocol) VPNs, regardless of whether the Network Address Translation (NAT) feature enabled.

Cambium Networks

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