

Session Count	<p>This field displays how many sessions the SM (or BHS) has had with the AP (or BHM). Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum.</p> <p>In the case of a multipoint link, if the number of sessions is significantly greater than the number for other SMs, then this may indicate a link problem or an interference problem.</p>
NoLUIDs	<p>This field indicates how many times the AP has needed to reject a registration request from a SM because its capacity to make LUID assignments is full. This then locks the SM out of making any valid attempt for the next 15 minutes. It is extremely unlikely that a non-zero number would be displayed here.</p>
OutOfRange	<p>This field indicates how many times the AP has rejected a registration request from a SM because the SM is a further distance away than the range that is currently configured in the AP. This then locks the SM out of making any valid attempt for the next 15 minutes.</p>
AuthFail	<p>This field displays how many times authentication attempts from this SM have failed in the AP.</p>
EncryptFail	<p>This field displays how many times an encryption mismatch has occurred between the SM and the AP.</p>
Rescan Req	<p>This field displays how many times a re-range request has occurred for the BHM that is being evaluated in the AP Eval page of a BHS.</p>
SMLimitReached	<p>This field displays 0 if additional SMs may be registered to the AP. If a 1 is displayed, the AP will not accept additional SM registrations.</p>
NoVC's	<p>This counter is incremented when the SM is registering to an AP which determines that no VC resources are available for allocation. This could be a primary data VC or a high priority data VC.</p>
VCRsvFail	<p>This counter is incremented when the SM is registering to an AP which has a VC resource available for allocation but cannot reserve the resource for allocation.</p>
VCActFail	<p>This counter is incremented when the SM is registering to an AP which has a VC resource available for allocation and has reserved the VC, but cannot activate the resource for allocation.</p>
AP Gain	<p>This field displays the total external gain (antenna) used by the AP.</p>
RcvT	<p>This field displays the AP's configured receive target for receiving SM transmissions (this field affects automatic SM power adjust).</p>
Sector ID	<p>This field displays the value of the Sector ID field that is provisioned for the AP.</p>

Color Code	<p>This field displays a value from 0 to 254 indicating the AP's configured color code. For registration to occur, the color code of the SM and the AP <i>must</i> match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.</p> <p>Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (<i>not</i> all 255 color codes).</p>
BeaconVersion	This field indicates that the beacon is OFDM (value of 1).
Sector User Count	This field displays how many SMs are registered on the AP.
NumULHalfSlots	This is the number of uplink slots in the frame for this AP.
NumDLHalfSlots	This is the number of downlink slots in the frame for this.
NumULContSlots	This field displays how many Contention Slots are being used in the uplink portion of the frame.
WhiteSched	Flag to display if schedule whitening is supported via FPGA
ICC	This field lists the SMs that have registered to the AP with their Installation Color Code (ICC), Primary CC, Secondary CC or Tertiary CC.
SM PPPoE	This field provides information to the user whether the SM is supporting PPPoE or not.
Frame Period	This field displays the configured Frame Period of the radio.

Using BHM Evaluation tool

The **BHM Evaluation** tab on **Tools** web page of the BHS provides information about the BHM that the BHS sees.

BHM Evaluation page of BHS

The BHM Evaluation page of BHS is explained in [Table 188](#).

Table 188 BHM Evaluation tab attributes - BHS



Attribute	Meaning
Index	This field displays the index value that the system assigns (for only this page) to the BHM where this BHS is registered.
Frequency	This field displays the frequency that the BHM transmits.
Channel Bandwidth	The channel size used by the radio for RF transmission. The setting for the channel bandwidth must match between the BHM and the BHS.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multipathing to settle before receiving the desired data. A 1/16 cyclic prefixes mean that for every 16 bits of throughput data transmitted, an additional bit is used.

ESN	This field displays the MAC address (electronic serial number) of the BHM. For operator convenience during BHS aiming, this tab retains each detected ESN for up to 15 minutes. If the broadcast frequency of a detected BHM changes during a 15-minute interval in the aiming operation, then a multiple instance of the same ESN is possible in the list. Eventually, the earlier instance expires and disappears and the later instance remains to the end of its interval, but you can ignore the early instance(s) whenever two or more are present.
Region	This field displays the BHM's configured Country Code setting.
Power Level	This field displays the BHS's combined received power level from the BHM's transmission.
Beacon Count	A count of the beacons seen in a given time period.
FECEn	<p>This field contains the SNMP value from the BHM that indicates whether the Forward Error Correction feature is enabled.</p> <p>0: FEC is disabled 1: FEC is enabled</p>
Type	Multipoint indicates that the listing is for a BHM.
Age	This is a counter for the number of minutes that the BHM has been inactive. At 15 minutes of inactivity for the BHS, this field is removed from the BHM Evaluation tab in the BHS.
Lockout	This field displays how many times the BHS has been temporarily locked out of making registration attempts.
RegFail	This field displays how many registration attempts by this BHS failed.
Range	This field displays the distance in feet for this link. To derive the distance in meters, multiply the value of this parameter by 0.3048.
MaxRange	This field indicates the configured value for the AP's Max Range parameter.
TxBER	A 1 in this field indicates the BHM is sending Radio BER.
EBcast	A 1 in this field indicates the BHM is encrypting broadcast packets. A 0 indicates it is not.
Session Count	<p>This field displays how many sessions the BHS has had with the BHM. Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum.</p> <p>In the case of a multipoint link, if the number of sessions is significantly greater than the number for other BHS's, then this may indicate a link problem or an interference problem.</p>

NoLUIDs	This field indicates how many times the BHM has needed to reject a registration request from a BHS because its capacity to make LUID assignments is full. This then locks the BHS out of making any valid attempt for the next 15 minutes. It is extremely unlikely that a non-zero number would be displayed here.
OutOfRange	This field indicates how many times the BHM has rejected a registration request from a BHS because the BHS is a further distance away than the range that is currently configured in the BHM. This then locks the BHS out of making any valid attempt for the next 15 minutes.
AuthFail	This field displays how many times authentication attempts from this SM have failed in the BHM.
EncryptFail	This field displays how many times an encryption mismatch has occurred between the BHS and the BHM.
Rescan Req	This field displays how many times a re-range request has occurred for the BHM that is being evaluated in the BHM Eval page of a BHM.
SMLimitReached	This field displays 0 if additional BHSs may be registered to the BHM. If a 1 is displayed, the BHM will not accept additional BHS registrations.
NoVC's	This counter is incremented when the BHS is registering to a BHM which determines that no VC resources are available for allocation. This could be a primary data VC or a high priority data VC.
VCRsvFail	This counter is incremented when the BHS is registering to a BHM which has a VC resource available for allocation but cannot reserve the resource for allocation.
VCActFail	This counter is incremented when the BHS is registering to a BHM which has a VC resource available for allocation and has reserved the VC, but cannot activate the resource for allocation.
AP Gain	This field displays the total external gain (antenna) used by the BHM.
RcvT	This field displays the AP's configured receive target for receiving BHS transmissions (this field affects automatic BHS power adjust).
Sector ID	This field displays the value of the Sector ID field that is provisioned for the BHM.
Color Code	<p>This field displays a value from 0 to 254 indicating the BHM's configured color code. For registration to occur, the color code of the BHS and the BHM <i>must</i> match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.</p> <p>Color code allows you to force a BHS to register to only a specific BHM, even where the BHS can communicate with multiple BHMs. The default setting for the color code value is 0. This value matches only the color code of 0 (<i>not</i> all 255 color codes).</p>

BeaconVersion	This field indicates that the beacon is OFDM (value of 1).
Sector User Count	This field displays how many BHS's are registered on the BHM.
NumULHalfSlots	This is the number of uplink slots in the frame for this BHM.
NumDLHalfSlots	This is the number of downlink slots in the frame for this.
NumULContSlots	This field displays how many Contention Slots are being used in the uplink portion of the frame.
WhiteSched	Flag to display if schedule whitening is supported via FPGA
ICC	This field lists the BHSs that have registered to the BHM with their Installation Color Code (ICC), Primary CC, Secondary CC or Tertiary CC.
SM PPPoE	This field provides information to the user whether the BHS is supporting PPPoE or not.
Frame Period	This field displays the configured Frame Period of the radio.

Using the OFDM Frame Calculator tool

The first step to avoid interference in wireless systems is to set all APs/BHMs to receive timing from a synchronization source (Cluster Management Module, or Universal Global Positioning System). This ensures that the modules are in sync and start transmitting at the same time each frame.

The second step to avoid interference is to configure parameters on all APs/BHMs of the same frequency band in proximity such that they have compatible transmit/receive ratios (all stop transmitting each frame before any start receiving). This avoids the problem of one AP/BHM attempting to receive the signal from a distant SM/BHS while a nearby AP transmits, which could overpower that signal.

The following parameters on the AP determine the transmit/receive ratio:

- Max Range
- Frame Period
- Downlink Data percentage
- (reserved) Contention Slots

If OFDM (PMP 430, PMP 450, PTP 230) and FSK (PMP 1x0) APs/BHMs of the same frequency band are in proximity, or if APs/BHMs set to different parameters (differing in their Max Range values, for example), then operator must use the Frame Calculator to identify compatible settings.

The frame calculator is available on the Frame Calculator tab of the Tools web page. To use the Frame Calculator, type various configurable parameter values into the calculator for each proximal AP and then record the resulting AP/BHM Receive Start value. Next vary the Downlink Data percentage in each calculation and iterate until the calculated AP/BHM Receive Start for all collocated AP/BHMs where the transmit end does not come before the receive start.

The calculator does not use values in the module or populate its parameters. It is merely a convenience application that runs on a module. For this reason, you can use any FSK module (AP, SM, BHM, BHS) to perform FSK frame calculations for setting the parameters on an FSK AP and any OFDM module (AP, SM, BHM, BHS) to perform OFDM frame calculations for setting the parameters on an OFDM AP/BHM.

For more information on PMP/PTP 450 Platform co-location, see

<http://www.cambiumnetworks.com/solution-papers>

The co-location is also supported for 900 MHz PMP 450i APs (OFDM) and PMP 100 APs (FSK).

Please refer *Co-location of PMP 450 and PMP 100 systems in the 900 MHz band and migration recommendations* document for details.

**Caution**

APs/BHMs that have slightly mismatched transmit-to-receive ratios and low levels of data traffic may see little effect on throughput. A system that was not tuned for co-location may work fine at low traffic levels, but encounter problems at higher traffic levels. The conservative practice is to tune for co-location before traffic ultimately increases. This prevents problems that occur as sectors are built.

The OFDM Frame Calculator page is explained in [Table 189](#).

Table 189 OFDM Frame Calculator page attributes

OFDM Frame Calculator Parameters	
Link Mode :	<input type="radio"/> Point-To-Point Link <input checked="" type="radio"/> Multipoint Link
Platform Type AP/BHM :	PMP/PTP 450/450i/450m ▾
Platform Type SM/BHS :	PMP/PTP 450/450i ▾
Channel Bandwidth :	10.0 MHz ▾
Cyclic Prefix :	One Sixteenth ▾
Frame Period :	<input type="radio"/> 5.0 ms <input checked="" type="radio"/> 2.5 ms
Max Range :	2 Miles (Range: 1 - 40 miles)
Downlink Data :	75 %
Contention Slots :	3 (Range: 0 — 15)
SM/BHS One Way Air Delay :	0 ns
<input type="button" value="Calculate"/>	

Calculated Frame Results	
CANOPY 15.0 AP-None	
Modulation:OFDM	
Total Frame Bits : 25000	
Frame Period : 2.5 ms	
AP Details :	
Data Slots (Down/Up) : 27 /9	
Contention Slots: 3	
Air Delay for Max Range: 10800 ns, 108 bits	
Approximate distance for Max Range: 2.010 miles (10616 feet)	
AP Antenna Transmit End : 15733, 1.573362 ms	
AP Antenna Receive Start : 16587, 1.658743 ms	
AP Antenna Receive End : 24195	
SM Details :	
SM Receive End : 16296	
SM Transmit Start : 16587	
SM One Way Air Delay : 0 ns	
SM Approximate distance : 0.000 miles (0 feet)	

Attribute	Meaning
Link Mode	For AP to SM frame calculations, select Multipoint Link For BHM to BHS frame calculations, select Point-To-Point Link
Platform Type AP/BHM	Use the drop-down list to select the hardware series (board type) of the AP/BHM.

Platform Type SM/BHS	Use the drop-down list to select the hardware series (board type) of the SM/BHS.
Channel Bandwidth	Set this to the channel bandwidth used in the AP/BHM.
Cyclic Prefix	Set this to the cyclic prefix used in the AP/BHM.
Max Range	Set to the same value as the Max Range parameter is set in the AP(s) or BHM(s).
Frame Period	Set to the same value as the Frame Period parameter is set in the AP(s) or BHM(s).
Downlink Data	<p>Initially set this parameter to the same value that the AP/BHM has for its Downlink Data parameter (percentage). Then, use the Frame Calculator tool procedure as described in Using the Frame Calculator on page 8-45, you will vary the value in this parameter to find the proper value to write into the Downlink Data parameter of all APs or BHMs in the cluster.</p> <p>PMP 450 Platform Family APs or BHMs offer a range of 15% to 85% and default to 75%. The value that you set in this parameter has the following interaction with the value of the Max Range parameter (above):</p> <p>The default Max Range value is 5 miles and, at that distance, the maximum Downlink Data value (85% in PMP 450 Platform) is functional.</p>
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. Set this parameter to the value of the Contention Slot parameter is set in the APs or BHMs.
SM/BHS One Way Air Delay	This field displays the time in <i>ns</i> (nano seconds), that a SM/BHS is away from the AP/BHM.

The Calculated Frame Results display several items of interest:

Table 190 OFDM Calculated Frame Results attributes

Attribute	Meaning
Modulation	The type of radio modulation used in the calculation (OFDM for 450 Platform Family)
Total Frame Bits	The total number of bits used in the calculated frames
Data Slots (Down/Up)	This field is based on the Downlink Data setting. For example, a result within the typical range for a Downlink Data setting of 75% is 61/21, meaning 61 data slots down and 21 data slots up.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator.
Air Delay for Max Range	This is the roundtrip air delay in bit times for the Max Range value set in the calculator

Approximate distance for Max Range	The Max Range value used for frame calculation
AP Transmit End	In bit times, this is the frame position at which the AP/BHM ceases transmission.
AP Receive Start	In bit times, this is the frame position at which the AP/BHM is ready to receive transmission from the SM/BHS.
AP Receive End	In bit times, this is the frame position at which the AP/BHM will cease receiving transmission from the SM/BHS.
SM Receive End	In bit times, this is the frame position at which the SM/BHS will cease receiving transmission from the AP/BHM.
SM Transmit Start	In bit times, this is the frame position at which the SM/BHS starts the transmission.
SM One Way Air Delay	This field displays the time in <i>ns</i> , that SM/BHS is away from the AP/BHM.
SM Approximate distance	This field displays an approximate distance in miles (feet) that the SM/BHS is away from the AP/BHM.

To use the Frame Calculator to ensure that all APs or BHMs are configured to transmit and receive at the same time, follow the procedure below:

Procedure 33 Using the Frame Calculator

- 1 Populate the OFDM Frame Calculator parameters with appropriate values as described above.
 - 2 Click the **Calculate** button.
 - 3 Scroll down the tab to the Calculated Frame Results section
 - 4 Record the value of the **AP Receive Start** field
 - 5 Enter a parameter set from another AP in the system – for example, an AP in the same cluster that has a higher **Max Range** value configured.
 - 6 Click the **Calculate** button.
 - 7 Scroll down the tab to the Calculated Frame Results section
 - 8 If the recorded values of the **AP Receive Start** fields are within 150 bit times of each other, skip to step 10.
- If the recorded values of the **AP Receive Start** fields are not within 150 bit times of each other, modify the **Downlink Data** parameter until the calculated results for **AP Receive Start** are within 300 bit time of each other, if possible, 150 bit time.

- 10 Access the Radio tab in the Configuration web page of each AP in the cluster and change its **Downlink Data** parameter (percentage) to the last value that was used in the Frame Calculator.

Using the Subscriber Configuration tool

The **Subscriber Configuration** page in the Tools page of the AP displays:

- The current values whose control may be subject to the setting in the **Configuration Source** parameter.
- An indicator of the source for each value.

This page may be referenced for information on how the link is behaving based on where the SM is retrieving certain QoS and VLAN parameters.

Figure 175 SM Configuration page of AP

Subscriber Configuration Information

LUID: 002 - [0a-00-3e-bb-01-04] State: IN SESSION (Encrypt Disabled)

Site Name : No Site Name

Software Version : .SVM;14.SVm;0.SVB;25.SVW;F.IT;SOC110.SVT;01:58.SVD;08/20/2015.

Software Boot Version : CANOPYBOOT 1.0

FPGA Version : 080715 (DES, Sched, US/ETSI) P13

Sustained Uplink Data Rate(SM): 65000 Uplink Burst Allocation(SM): 2500000 Sustained Downlink Data Rate (SM): 65000 Downlink Burst Allocation (SM): 2500000 (kbit)

Sustained Broadcast Data Rate (SM): 0, units: (SM): kbps

Max Burst Uplink Rate (SM): 0 (kbit)

Max Burst Downlink Rate (SM): 0 (kbit)

HiPriChan(SM): 0 VCChannel: 2

Low Priority Uplink CIR (SM): 0 Low Priority Downlink CIR (SM): 0 High Priority Uplink CIR (SM): 0 High Priority Downlink CIR (SM): 0 (kbps)

Low Priority Uplink (SM): 3 Low Downlink Priority (SM): 3 High Uplink Priority (SM): 5 High Downlink Priority (SM): 5

APBerLevel(AP): 2 Level HiPriTCPAck(AP): 1

AllowVLANLearning(SM): 1 AllowVLANFrameType(SM): 0 VLANAgeTmout(SM): 25

SMMManageVIDDis(SM): 0

IngressVID(SM): 1 ManageVID(SM): 1

MemberSet(SM):

Empty Set

The AP displays one of the following for the configuration source:

- (SM) – QoS/VLAN parameters are derived from the SM's settings
- (APCAP) – QoS/VLAN parameters are derived from the AP's settings, including any keyed capping (for radios capped at 4 Mbps, 10 Mbps, or 20 Mbps)
- (D) – QoS/VLAN parameters are retrieved from the device, due to failed retrieval from the AAA or WM server.
- (AAA) – QoS/VLAN parameters are retrieved from the RADIUS server
- (BAM) – QoS/VLAN parameters are retrieved from a WM BAM server

Using the Link Status tool

The Link Status Tool displays information about the most-recent Link Test initiated on the SM or BHS. Link Tests initiated from the AP or BHM are not included in the Link Status table. This table is useful for monitoring link test results for all SMs or BHS in the system.

The Link Status table is color coded to display health of link between AP/BHM and SM/BHS. The current Modulation Level Uplink/Downlink is chosen to determine link health and color coded accordingly.

Uplink/Downlink Rate Column will be color coded using current Rate as per the table below:

Table 191 Color code versus uplink/downlink rate column

Actual Rate	1x	2x	3x	4x	6x	8x
SISO	RED	ORANGE	GREEN	BLUE	NA	NA
MIMO-A	RED	ORANGE	GREEN	BLUE	NA	NA
MIMO B	NA	RED	NA	ORANGE	GREEN	BLUE

Link Status – AP/BHM

The current Uplink Rate (both low and high VC) for each SM or BHS in Session is now available on AP or BHM Link Status Page.

The Link Status tool results include values for the following fields for AP/BHM.

Table 192 Link Status page attributes – AP/BHM

Link Status															
Due to current system load, Downlink Statistics will only be updated at most every 5 seconds.															
Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.															
 MIMO-B:2X MIMO-A/SISO:1X  MIMO-B:4X MIMO-A/SISO:2X  MIMO-B:6X MIMO-A/SISO:3X  MIMO-B:8X MIMO-A/SISO:4X															
Subscriber	Uplink Statistics						Downlink Statistics						BER Results	Reg	ReReg
	Power Level dBm: Signal Strength Ratio (dB V - H)	Fragments Modulation	Signal to Noise Ratio (dB)	Link Test Efficiency	Rate	Power Level dBm: Signal Strength Ratio (dB V - H)	Signal to Noise Ratio (dB)	Link Test Efficiency	Rate						
Site Name - LUID: 002	-52.5 (-55.3 V / -55.7 H):0.4	Path V:QPSK:37% 16-QAM:21% 64-QAM:20% 256-QAM:20% Path H:QPSK:39% 16-QAM:23% 64-QAM:23% 256-QAM:14%	44 V / 42 H	NA	8X/8X MIMO-B	-42.2 (-44.0 V / -47.0 H):4.0	43 V / 43 H	NA	8X/8X MIMO-B	2.065307e-07	3	0			

Link Status															
Due to current system load, Downlink Statistics will only be updated at most every 5 seconds.															
Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.															
 MIMO-B:2X MIMO-A/SISO:1X  MIMO-B:4X MIMO-A/SISO:2X  MIMO-B:6X MIMO-A/SISO:3X  MIMO-B:8X MIMO-A/SISO:4X															
Subscriber	Uplink Statistics						Downlink Statistics						BER Results	Reg	ReReg
	Power Level dBm: Signal Strength Ratio (dB V - H)	Fragments Modulation	Signal to Noise Ratio (dB)	Link Test Efficiency	Rate	Beacon % Received Curr/Min /Avg/Max	Power Level dBm: Signal Strength Ratio (dB V - H)	Signal to Noise Ratio (dB)	Link Test Efficiency	Rate	SU-MIMO	MU-MIMO			
No Site Name - LUID: 011	-56.6 (-60.0 V / -59.2 H):-0.8	Path V:QPSK:100% Path H:QPSK:100%	14 V / 14 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	100	-47.5 (-49.0 V / -53.0 H):4.0	12 V / 12 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	1.639318e-05	1	0		
SM11 - LUID: 007	-57.5 (-60.0 V / -61.0 H):1.0	Path V:QPSK:94% 16-QAM:6% Path H:QPSK:98% 16-QAM:1%	23 V / 23 H	NA	8X/2X MIMO-B	100	-49.5 (-51.0 V / -55.0 H):4.0	12 V / 12 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	1.621768e-05	1	0		
SM12 - LUID: 005	-57.0 (-60.0 V / -60.0 H):0.0	Path V:QPSK:100% Path H:QPSK:100%	14 V / 14 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	100	-48.5 (-50.0 V / -54.0 H):4.0	12 V / 12 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	1.635075e-05	1	0		
SM13 - LUID: 010	-58.2 (-60.5 V / -62.0 H):1.5	Path V:QPSK:100% Path H:QPSK:100%	14 V / 14 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	100	-49.0 (-50.0 V / -56.0 H):6.0	12 V / 12 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	1.652222e-05	1	0		
SM21 - LUID: 006	-57.5 (-61.0 V / -60.0 H):-1.0	Path V:QPSK:100% Path H:QPSK:100%	14 V / 14 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	100	-46.2 (-48.0 V / -51.0 H):3.0	12 V / 12 H	NA	8X/2X MIMO-B 8X/1X MIMO-A	2.307317e-05	1	0		

Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM. As each SM registers to the AP, the system assigns an LUID of 2 or a higher unique number to the SM. If a SM loses registration with the AP and then regains registration, the SM will retain the same LUID.

**Note**

The LUID associated is lost when a power cycle of the AP occurs.

Both the LUID and the MAC are hot links to open the interface to the SM. In some instances, depending on network activity and network design, this route to the interface yields a blank web page. If this occurs, refresh your browser view.

	Site Name indicates the name of the SM. You can assign or change this name on the Configuration web page of the SM. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.
Uplink Statistics - Power Level: Signal Strength Ratio	This field represents the combined received power level at the AP/BHM as well as the ratio of horizontal path signal strength to vertical path signal strength.
Uplink Statistics – Fragments Modulation	This field represents the percentage of fragments received at each modulation state, per path (polarization).
Uplink Statistics – Signal to Noise Ratio	This field represents the signal to noise ratio for the uplink (displayed when parameter Signal to Noise Ratio Calculation during Link Test is enabled) expressed for both the horizontal and vertical channels.
Uplink Statistics – Link Test Efficiency	This field displays the efficiency of the radio link, expressed as a percentage, for the radio uplink.
<u>Downlink Statistics – Beacon % Received</u> <u>Curr/Min/Max/Avg</u>	<u>This field displays a count of beacons received by the SM in percentage.</u> <u>This value must be between 99-100%. If it is lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.</u>
Downlink Statistics – Power Level: Signal Strength Ratio	This field represents the received power level at the SM/BHS as well as the ratio of horizontal path signal strength to vertical path signal strength at the SM/BHS.
Downlink Statistics – Signal to Noise Ratio	This field represents the signal to noise ratio for the downlink (displayed when parameter Signal to Noise Ratio Calculation during Link Test is enabled) expressed for both the horizontal and vertical channels.
Downlink Statistics – Link Test Efficiency	This field displays the efficiency of the radio link, expressed as a percentage, for the radio downlink.
<u>Downlink Statistics – SU-MIMO Rate</u>	<u>The SU-MIMO rate applies to all AP platforms.</u> <u>For 450m, this field indicates the rate being used for symbols where this particular VC is not being MU-MIMO grouped with other SM's.</u> <u>For 450 and 450i platforms, there is no grouping and this field indicates the modulation rate for all symbols.</u>
<u>Downlink Statistics – MU-MIMO Rate</u>	<u>The MU-MIMO rate applies only to the 450m AP. This field indicates the modulation rate used for symbols where this particular low priority VC is MU-MIMO scheduled by grouping it in the same slot with other low priority VC's.</u>

BER Results	<p>This field displays the over-the-air Bit Error Rates for each downlink. (The ARQ [Automatic Resend reQuest] ensures that the transport BER [the BER seen end-to-end through a network] is essentially zero.) The level of acceptable over-the-air BER varies, based on operating requirements, but a reasonable value for a good link is a BER of 1e-4 (1×10^{-4}) or better, approximately a packet resend rate of 5%.</p> <p>BER is generated using unused bits in the downlink. During periods of peak load, BER data is not updated as often, because the system puts priority on transport rather than on BER calculation.</p>
Reg Requests	<p>A Reg Requests count is the number of times the SM/BHS registered after the AP/BHM determined that the link had been down.</p> <p>If the number of sessions is significantly greater than the number for other SMs/BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).</p>
ReReg Requests	<p>A ReReg Requests count is the number of times the AP/BHM received a SM/BHS registration request while the AP/BHM considered the link to be still up (and therefore did not expect registration requests).</p> <p>If the number of sessions is significantly greater than the number for other SMs/BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).</p>

Link Status – SM/BHS

The Link Status tool of SM/BHS displays Downlink Status and Uplink Status information.

Table 193 Link Status page attributes – SM/BHS

Downlink Status	
Receive Power :	-48.2 dBm (-53.0 dBm V / -50.0 dBm H)
Signal Strength Ratio :	-3.0dB V - H
Signal to Noise Ratio :	43 V / 39 H dB
Beacons :	100 %
Receive Fragments Modulation :	Path V:QPSK:37% 16-QAM:33% 64-QAM:15% 256-QAM:15% Path H:QPSK:25% 16-QAM:25% 64-QAM:25% 256-QAM:25%
Latest Remote Link Test Efficiency Percentage :	NA %
BER Total Avg Results :	0.000000e+00
Beacons Received Last 15 minutes :	0/0/0 (min/avg/max) Note: The SM needs to be in session for at least 15 minutes.
Uplink Status	
Transmit Power :	20 dBm
Max Transmit Power :	22 dBm
Power Level :	-37.5 (-41.0 V / -40.0 H) dBm
Signal Strength Ratio :	-1.0dB V - H
Signal to Noise Ratio :	879 36 dB V / 32 dB H
Latest Remote Link Test Efficiency Percentage :	NA %
Local Status	
Session Status :	REGISTERED VC 18 Rate 8X6X MIMO-B VC 255 Rate 8X1X MIMO-B
Spatial Frequency :	879
Latest Local Link Test Results	
No test results available.	
Run Link Test	

Attribute	Meaning
Downlink Status	
Receive Power	This field lists the current combined receive power level, in dBm.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power for downlink.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor for downlink.
Beacons	Displays a count of beacons received by the SM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Received Fragments Modulation	This field represents the percentage of fragments received at each modulation state, per path (polarization)
Latest Remote Link Test Efficiency Percentage	This field is not applicable.
BER Total Avg Results	This field displays the over-the-air average Bit Error Rates (BER) for downlink.
Beacons Received Last 15 minutes	The beacon count on the SM can be used to estimate the interference in the channel. The min/avg/max beacon percentage displayed based on this value for the last 15 mins.

Uplink Status

Transmit Power	This field displays the current combined transmit power level, in dBm.
Max Transmit Power	This field displays the maximum transmit power of SM.
Power Level	This field indicates the combined power level at which the SM is set to transmit, based on the Country Code and Antenna Gain settings.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power for uplink.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor for uplink.
Latest Remote Link Test Efficiency Percentage	This field is not applicable.
Session Status	This field displays the current state, Virtual channel, high-priority/ low priority channel rate adaptation and MIMO-A/MIMO-B/SISO status of SM.
Spatial Frequency	This field displays the spatial frequency value of the VC or SM.
Run Link Test	Run Link Test

See Exploratory Test section of [Performing Extrapolated Link Test](#) on page [8-29](#)

Using BER Results tool

Radio BER data represents bit errors at the RF link level. Due to CRC checks on fragments and packets and ARQ (Automatic Repeat reQuest), the BER of customer data is essentially zero. Radio BER gives one indication of link quality. Other important indications to consider includes the received power level, signal to noise ratio and link tests.

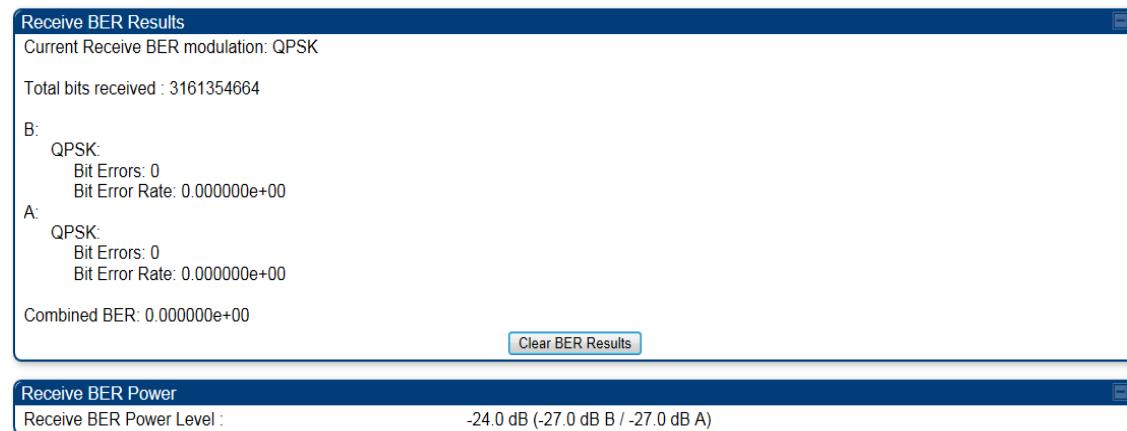
BER is only instrumented on the downlink and is displayed on the BER Results tab of the Tools page in any SM. Each time the tab is clicked, the current results are read and counters are reset to zero.

The BER Results tab can be helpful in troubleshooting poor link performance.

The link is acceptable if the value of this field is less than 10^{-4} . If the BER is greater than 10^{-4} , re-evaluate the installation of both modules in the link.

The BER test signal is broadcast by the AP/BHM (and compared to the expected test signal by the SM/BHS) only when capacity in the sector allows it. This signal is the lowest priority for AP/BHM transmissions.

Figure 176 BER Results tab of the SM



Using the Sessions tool

The PMP 450 Platform Family AP has a tab **Sessions** under the Tools category which allows operators to drop one or all selected SM sessions and force a SM re-registration. This operation is useful to force QoS changes for SMs without losing AP logs or statistics. This operation may take 5 minutes to regain all SM registrations.

Figure 177 Sessions tab of the AP



Chapter 9: Operation

This chapter provides instructions for operators of the 450 Platform Family wireless Ethernet Bridge. The following topics are described in this chapter:

- [System information](#) on page 9-2
 - [Viewing General Status](#) on page 9-2
 - [Viewing Session Status](#) on page 9-22
 - [Viewing Remote Subscribers](#) on page 9-29
 - [Interpreting messages in the Event Log](#) on page 9-29
 - [Viewing the Network Interface](#) on page 9-32
 - [Viewing the Layer 2 Neighbors](#) on page 9-33
- [System statistics](#) on page 9-34
 - [Viewing the Scheduler statistics](#) on page 9-34
 - [Viewing list of Registration Failures statistics](#) on page 9-36
 - [Interpreting Bridging Table statistics](#) on page 9-37
 - [Interpreting Translation Table statistics](#) on page 9-38
 - [Interpreting Ethernet statistics](#) on page 9-39
 - [Interpreting RF Control Block statistics](#) on page 9-42
 - [Interpreting VLAN statistics](#) on page 9-45
 - [Interpreting Data VC statistics](#) on page 9-47
 - [Interpreting Throughput statistics](#) on page 9-49
 - [Interpreting Overload statistics](#) on page 9-52
 - [Interpreting DHCP Relay statistics](#) on page 9-54
 - [Interpreting Filter statistics](#) on page 9-56
 - [Viewing ARP statistics](#) on page 9-57
 - [Viewing NAT statistics](#) on page 9-57
 - [Viewing NAT DHCP Statistics](#) on page 9-59
 - [Interpreting Sync Status statistics](#) on page 9-60
 - [Interpreting PPPoE Statistics for Customer Activities](#) on page 9-61
 - [Interpreting Bridge Control Block statistics](#) on page 9-63
 - [Interpreting Pass Through Statistics](#) on page 9-66
 - [Interpreting SNMPv3 Statistics](#) on page 9-67
 - [Interpreting syslog statistics](#) on page 9-69
 - [Interpreting Frame Utilization statistics](#) on page 9-69
- [Radio Recovery](#) on page 9-74

System information

This section describes how to use the summary and status pages to monitor the status of the Ethernet ports and wireless link.

- [Viewing General Status](#) on page 9-2
- [Viewing Session Status](#) on page 9-22
- [Viewing Remote Subscribers](#) on page 9-29
- [Interpreting messages in the Event Log](#) on page 9-29
- [Viewing the Network Interface](#) on page 9-32
- [Viewing the Layer 2 Neighbors](#) on page 9-33

Viewing General Status

The **General Status** tab provides information on the operation of this AP/BHM and SM/BHS. This is the page that opens by default when you access the GUI of the radio.

General Status page of AP

The **General Status** page of PMP 450m AP is explained in [Table 194](#)

The **General Status** page of PMP 450/450i AP is explained in [Table 195](#).

Table 194 General Status page attributes – PMP 450m AP

Device Information	
Device Type :	5.7GHz MU-MIMO OFDM - Access Point - 0a-00-3e-60-31-af Radio not calibrated
Board Type :	P14
Product Type :	PMP 450m
Software Version :	CANOPY 15.0.3 (Build DEV-48) AP-None
Bootloader Version :	BOOTLOADER 15.0.3/48 2017-02-07 11:29:44 -0600
Board MSN :	0A003E280B8E
FPGA Version :	020175
Uptime :	08:04:16
System Time :	08:04:15 01/01/2016 UTC
SFP Ethernet Interface :	1000Base-X Full Duplex
SFP Part Details :	SOLID-OPTICS GLC-LH-SMD-SO, serial number SOS131L_S0679, date code 17012300
Region Code :	Other
Regulatory :	Passed
Channel Frequency :	5790.0 MHz
Channel Bandwidth :	20.0 MHz
Cyclic Prefix :	1/16
Color Code :	23
Max Range :	6 Miles
EIRP :	30 dBm
Temperature :	44 °C / 112 °F
Access Point Stats	
Registered SM Count :	0 (0 Data VCs)
Sync Pulse Status :	Generating Sync
Sync Pulse Source :	Self Generate
Maximum Count of Registered SMs :	0
Frame Configuration Information	
Data Slots Down :	70
Data Slots Up :	12
Contention Slots :	2
Site Information	
Site Name :	No Site Name :
Site Contact :	No Site Contact
Site Location :	No Site Location
Key Features Information	
MU-MIMO Mode :	MU-MIMO
Time Updated and Location Code :	11/10/2016 10:01:03 - INTL

Device Information	
Device Type :	5.4GHz MU-MIMO OFDM - Access Point - 0a-00-3e-60-31-22
Board Type :	P14
Product Type :	PMP 450m
Software Version :	CANOPY 15.0.1 AP-None
Software Boot Version :	CANOPYBOOT 1.0
Board MSN :	Medusa
FPGA Version :	0b0874
Uptime :	01:01:59
System Time :	11:04:30 11/10/2016 UTC
Main Ethernet Interface :	100Base-TX Full Duplex
Region Code :	Other
Regulatory :	Passed
Channel Frequency :	5520.0 MHz
Channel Bandwidth :	20.0 MHz
Cyclic Prefix :	1/16
Color Code :	250
Max Range :	2 Miles
EIRP :	37 dBm
Temperature :	64 °C / 146 °F

Access Point Stats	
Registered SM Count :	0 (0 Data VCs)
Sync Pulse Status :	Generating Sync
Sync Pulse Source :	Self Generate
Maximum Count of Registered SMs :	0

Frame Configuration Information	
Data Slots Down :	70
Data Slots Up :	12
Contention Slots :	2

Site Information	
Site Name :	No Site Name :
Site Contact :	No Site Contact
Site Location :	No Site Location

Key Features Information	
MU-MIMO Mode :	MU-MIMO
Time Updated and Location Code :	11/10/2016 10:01:03 - INTL

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the device, its module type and its MAC address.
Board Type	This field indicates the series of hardware.

Software Version	This field indicates the system release, the time and date of the release and whether communications involving the module are secured by DES or AES encryption. If you request technical support, provide the information from this field.
<u>Bootloader Version</u>	<u>This field indicates the version of Uboot running on the 450m AP platform.</u>
Product Type	<p>The field indicates model number of 450m device. The 450m Series has two model variants.</p> <ul style="list-style-type: none"> • PMP 450m: This model works in SU-MIMO mode which is default “limited” mode. The MU-MIMO license can be purchased from Cambium Networks and applied. • MU-MIMO: This model works in MU-MIMO mode.
Board MSN	This field indicates the Manufacture's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control.
FPGA Version	This field indicates the version of the field-programmable gate array (FPGA) on the module. If you request technical support, provide the value of this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. If the AP is connected to a CMM4, then this field provides GMT (Greenwich Mean Time). Any SM that registers to the AP inherits the system time.
Last NTP Time Update	This field displays when the AP last used time sent from an NTP server. If the AP has not been configured in the Time tab of the Configuration page to request time from an NTP server, then this field is populated by 00:00:00 00/00/00.
Main Ethernet Interface	This field indicates the speed and duplex state of the Ethernet interface to the AP.
Aux Ethernet Interface	This field displays Aux Ethernet Data and PoE-out interface enable/disable status. It is not supported in current release of PMP 450m Seriea AP.
Region Code	A parameter that offers multiple fixed selections, each of which automatically implements frequency band range for the selected region. Units shipped to regions other than restrictions the United States must be configured with the corresponding Region Code to comply with local regulatory requirements.

Regulatory	This field indicates whether the configured Country Code and radio frequency are compliant with respect to their compatibility. 450 Platform Family products shipped to the United States is locked to a Country Code setting of "United States". Units shipped to regions other than the United States must be configured with the corresponding Country Code to comply with local regulatory requirements.
Channel Frequency	This field indicates the current operating center frequency, in MHz.
Channel Bandwidth	This field indicates the current size of the channel band used for radio transmission.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multipathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.
Frame Period	This field indicates the current Frame Period setting of the radio in ms.
Color Code	<p>This field displays a value from 0 to 254 indicating the AP's configured color code. For registration to occur, the color code of the SM and the AP <i>must</i> match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.</p> <p>Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (<i>not</i> all 255 color codes).</p>
Max Range	This field indicates the setting of the Max Range parameter, which contributes to the way the radio transmits. 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.
EIRP	This field indicates the combined power level at which the AP will transmit, based on the Country Code.
Temperature	This field indicates the current operating temperature of the device board.
Registered SM Count	This field indicates how many SMs are registered to the AP.
Sync Pulse Status	<p>This field indicates the status of synchronization as follows:</p> <p>Generating Sync indicates that the module is set to <i>generate</i> the sync pulse.</p> <p>Receiving Sync indicates that the module is set to <i>receive</i> a sync pulse from an outside source and is receiving the pulse.</p>

No Sync Since Boot up / ERROR: No Sync Pulse indicates that the module is set to *receive* a sync pulse from an outside source and is not receiving the pulse.



Note

When this message is displayed, the AP transmitter is turned off to avoid self-interference within the system.

Sync Pulse Source	<p>This field indicates the status of the synchronization source:</p> <p>Searching indicates that the unit is searching for a GPS fix</p> <p>Timing Port/UGPS indicates that the module is receiving sync via the timing AUX/SYNC timing port</p> <p>Power Port indicates that the module is receiving sync via the power port (Ethernet port).</p> <p>On-board GPS indicates that the module is receiving sync via the unit's internal GPS module</p>
Maximum Count of Registered SMs	This field displays the largest number of SMs that have been simultaneously registered in the AP since it was last rebooted. This count can provide some insight into sector history and provide comparison between current and maximum SM counts at a glance.
Data Slots Down	This field indicates the number of frame slots that are designated for use by data traffic in the downlink (sent from the AP to the SM). The AP calculates the number of data slots based on the Max Range, Downlink Data and (reserved) Contention Slots configured by the operator.
Data Slots Up	This field indicates the number of frame slots that are designated for use by data traffic in the uplink (sent from the SM to the AP). The AP calculates the number of data slots based on the Max Range, Downlink Data and (reserved) Contention Slots configured by the operator.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. See Contention slots on page 7-168.
Connection Status	This field indicates the device connectivity to cnMaestro (Cambium's cloud-based network management system).
Account ID	This field shows Account ID which is registered with Cambium Networks and it allows operator to manage devices using cnMaestro.
Site Name	This field indicates the name of the physical module. You can assign or change this name in the SNMP tab of the AP Configuration page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.
Site Contact	This field indicates contact information for the physical module. You can provide or change this information in the SNMP tab of the AP Configuration page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.

Site Location	This field indicates site information for the physical module. You can provide or change this information in the SNMP tab of the AP Configuration page.
MU-MIMO Mode	This field displays information about MU-MIMO mode. If AP is keyed as MU-MIMO, it will display "MU-MIMO"(Multi User - MIMO) otherwise it will display "SU-MIMO"(Single User - MIMO).
Time Updated and Location Code	This field displays information about the keying of the radio.

Table 195 General Status page attributes – PMP 450/450i AP

Device Information	
Device Type :	5.7GHz MIMO OFDM - Access Point - 0a-00-3e-a1-35-49
Board Type :	P12
Product Type :	PMP 450
Software Version :	CANOPY 15.0.1 (Build 70) AP-None
Board MSN :	6069PU00EZ
FPGA Version :	061716
PLD Version :	16
Uptime :	01:57:27
System Time :	10:43:54 11/10/2016 UTC
Main Ethernet Interface :	100Base-TX Full Duplex
Region Code :	United States
Regulatory :	Passed
Antenna Type :	External
Channel Frequency :	5760.0 MHz
Channel Bandwidth :	20.0 MHz
Cyclic Prefix :	1/16
Frame Period :	2.5 ms
Color Code :	87
Max Range :	40 Miles
Transmit Power :	19 dBm
Total Antenna Gain :	8 dBi (8 dBi external + 0 dBi internal)
Temperature :	36 °C / 96 °F
Access Point Stats	
Registered SM Count :	1 (2 Data VCs)
Sync Pulse Status :	Generating Sync
Sync Pulse Source :	Self Generate
Maximum Count of Registered SMs :	1
Frame Configuration Information	
Data Slots Down :	48
Data Slots Up :	16
Contention Slots :	3
cnMaestro Connection Stats	
Connection Status :	Connected (qa.cloud.cambiumnetworks.com)
AccountID :	CAMNWK
Site Information	
Site Name :	No Site Name
Site Contact :	No Site Contact
Site Location :	No Site Location
Key Features Information	
Time Updated and Location Code :	08/23/2016 11:58:35 - INTL
Attribute	Meaning
Device Type	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
Software Version	

Board Type	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
Product Type	This indicates model of the device.
FPGA Version	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
PLD Version	
Uptime	
System Time	
Main Ethernet Interface	
Aux Ethernet Interface	It is not supported for PMP 450 Series devices. See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
Region Code	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
Regulatory	
Antenna Type	
Channel Center Frequency	
Channel Bandwidth	
Cyclic Prefix	
Frame Period	
Color Code	
Max Range	
Transmitter Output Power	This field indicates the combined power level at which the AP is set to transmit, based on the Country Code and Antenna Gain settings.
Temperature	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
802.3at Type 2 PoE Status	The field displays whether PoE Classification functionality is enabled or disabled. It is only applicable for 450i Series devices.
Registered SM Count	See Table 194 General Status page attributes – PMP 450m AP on page 9-3 for details
Sync Pulse Status	
Sync Pulse Source	
Maximum Count of Registered SMs	
Data Slots Down	

Data Slots Up

Contention Slots

Connection Status

Account ID See [Table 194 General Status page attributes – PMP 450m AP](#) on page [9-3](#) for details

Site Name

Site Contact

Site Location

Time Updated and
Location Code

General Status page - SM

The SM's **General Status** page is explained in [Table 196](#).



Note

In order for accurate power level readings to be displayed, traffic must be present on the radio link.

Table 196 General Status page attributes - SM

Device Information	
Device Type :	5.4/5.7GHz MIMO OFDM - Subscriber Module - 0a-00-3e-a2-d9-2f
Board Type :	P11 C120
Product Type :	PMP 450
Software Version :	CANOPY 15.0 SM-DES
Board MSN :	6069QQ0FE7
FPGA Version :	061716
Uptime :	00:11:12
System Time :	05:59:12 01/02/2011 UTC
Main Ethernet Interface :	100Base-TX Full Duplex
Region Code :	Other
DFS :	Idle
Antenna Type :	External
Frame Period :	2.5 ms
Temperature :	55 °C / 131 °F

Subscriber Module Stats	
Session Status :	REGISTERED VC 18 Rate 8X/6X MIMO-B VC 255 Rate 8X/6X MIMO-B
PPPoE Session Status :	In Session
Registered AP :	0a-00-3e-a1-35-49 No Site Name
Color Code :	87 (Primary)
Channel Frequency :	5850.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Air Delay :	50 ns, approximately 0.004 miles (24 feet)
Receive Power :	-52.2 dBm
Signal Strength Ratio :	3.0dB V - H
Signal to Noise Ratio :	34 V / 35 H dB
Beacons :	100 %
Transmit Power :	22 dBm (target power [25 dBm] exceeded maximum)
Total Antenna Gain :	0 dBi (0 dBi external + 0 dBi internal)

cnMaestro Connection Stats	
Connection Status :	Connecting (cloud.cambiumnetworks.com - Default Cloud URL)
AccountID :	0a-00-3e-a1-35-49

Site Information	
Site Name :	No Site Name
Site Contact :	No Site Contact
Site Location :	No Site Location

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the SM, its module type and its MAC address.

Board Type	This field indicates the series of hardware.
Product Type	This indicates model of the device.
Software Version	This field indicates the system release, the time and date of the release. If you request technical support, provide the information from this field.
FPGA Version	This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.
PLD Version	This field indicates the version of the programmable logic device (PLD) on the module. If you request technical support, provide the value of this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. Any SM that registers to an AP inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).
Ethernet Interface	This field indicates the speed and duplex state of Ethernet interface to the SM.
Regional 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 Country Code to comply with local regulatory requirements.
DFS	This field indicates that DFS operation is enabled based on the configured region code, if applicable.
Antenna Type	The current antenna type that has been selected.
Frame Period	This field indicates the current Frame Period setting of the radio in ms.
Temperature	The current operating temperature of the board.
Session Status	This field displays the following information about the current session: Scanning indicates that this SM currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page. Syncing indicates that this SM currently attempts to receive sync. Registering indicates that this SM has sent a registration request message to the AP and has not yet received a response. Registered indicates that this SM is both: <ul style="list-style-type: none">• registered to an AP.• ready to transmit and receive data packets.
Session Uptime	This field displays the duration of the current link. The syntax of the displayed time is <i>hh:mm:ss</i> .

Registered AP	Displays the MAC address and site name of the AP to which the SM is registered to. This parameter provides click-through proxy access to the AP's management interface.
Color Code	<p>This field displays a value from 0 to 254 indicating the SM's configured color code. For registration to occur, the color code of the SM and the AP <i>must</i> match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.</p> <p>Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (<i>not</i> all 255 color codes).</p>
Channel Frequency	This field lists the current operating frequency of the radio.
Channel Bandwidth	The size in MHz of the operating channel.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multipathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.
Air Delay	This field displays the distance in feet between this SM and the AP. To derive the distance in meters, multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.
Receive Power	This field lists the current combined receive power level, in dBm.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.
Beacons	Displays a count of beacons received by the SM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Transmit Power	This field lists the current combined transmit power level, in dBm.



Note

The red SM message "target power exceeded maximum" does not necessarily indicate a problem.

7 dBm (target power [24 dBm] exceeded maximum)

In this case, the AP is requesting the SM to transmit at a higher power level, but the SM is restricted due to EIRP limits or hardware capabilities. This message can be an indication that the SM is deployed further from the AP than optimal, causing the AP to adjust the SM to maximum transmit power.

Data Slots Down	This field lists the number of slots used for downlink data transmission.
Data Slots Up	This field lists the number of slots used for uplink data transmission.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. See Contention slots on page7-168.
Site Name	This field indicates the name of the physical module. You can assign or change this name in the SNMP tab of the SM Configuration page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.
Site Contact	This field indicates contact information for the physical module. You can provide or change this information in the SNMP tab of the SM Configuration page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.
Site Location	This field indicates site information for the physical module. You can provide or change this information in the SNMP tab of the SM Configuration page.
Maximum Throughput	This field indicates the limit of aggregate throughput for the SM and is based on the default (factory) limit of the SM and any floating license that is currently assigned to it.
Time Updated and Location Code	This field displays information about the keying of the radio.



Note

For PMP 450 SM 900 MHz, there is additional parameter Path Info (under Subscriber Module Stats) which displays polarization path(A & B) information.

Path Info :

Path A = -45° Path B = +45°

General Status page of BHM

The BHM's **General Status** page is explained in [Table 197](#).

Table 197 General Status page attributes - BHM

Device Information	
Device Type :	5.7GHz MIMO OFDM - Backhaul - Timing Master - 0a-00-3e-bb-42-7e
Board Type :	P13
Product Type :	PTP 450i
Software Version :	CANOPY 15.0 BHUL450-None
Board MSN :	6069SJ0FWL
Board Model :	C050045A001A
FPGA Version :	080216
Uptime :	00:10:31
System Time :	00:26:54 01/01/2011 UTC
Main Ethernet Interface :	100Base-TX Full Duplex
Aux Ethernet Interface :	Disabled (PoE Disabled)
Region Code :	Other
Regulatory :	Passed
Antenna Type :	External
Channel Frequency :	5775.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Frame Period :	2.5 ms
Color Code :	0
Transmit Power :	0 dBm
Total Antenna Gain :	11 dBi (11 dBi external + 0 dBi internal)
Temperature :	39 °C / 102 °F
802.3at Type 2 PoE Status :	Not Present (Ignored)

Backhaul Stats	
Timing Slave Status :	Connected
Sync Pulse Status :	Generating Sync
Sync Pulse Source :	Self Generate

Frame Configuration Information	
Data Slots Down :	29
Data Slots Up :	10

cnMaestro Connection Stats	
Connection Status :	Cambium-ID Not Configured
AccountID :	

Site Information	
Site Name :	AP2
Site Contact :	No Site Contact
Site Location :	No Site Location

Key Features Information	
Time Updated and Location Code :	09/26/2016 13:46:16 - INTL

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the BHM, its module type and its MAC address.
Board Type	This field indicates the series of hardware.
Product Type	This indicates model of the device.

Software Version	This field indicates the system release, the time and date of the release. If you request technical support, provide the information from this field.
Board MSN	This field indicates the Manufacture's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control.
FPGA Version	This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. Any BHS that registers to a BHM inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).
Ethernet Interface	This field indicates the speed and duplex state of Ethernet interface to the BHM.
Antenna Type	The current antenna type that has been selected.
Temperature	The current operating temperature of the board.
Session Status	This field displays the following information about the current session: Scanning indicates that this BHS currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page. Syncing indicates that this BHM currently attempts to receive sync. Registering indicates that this BHM has sent a registration request message to the BHM and has not yet received a response. Registered indicates that this BHM is both: <ul style="list-style-type: none">• Registered to a BHM.• Ready to transmit and receive data packets.
Session Uptime	This field displays the duration of the current link. The syntax of the displayed time is <i>hh:mm:ss</i> .
Registered Backhaul	Displays the MAC address and site name of the BHM to which the BHS is registered to. This parameter provides click-through proxy access to the BHM's management interface.
Channel Frequency	This field lists the current operating frequency of the radio.
Receive Power	This field lists the current combined receive power level, in dBm.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power.
Transmit Power	This field lists the current combined transmit power level, in dBm.

Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.
Beacons	Displays a count of beacons received by the BHM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Air Delay	This field displays the distance in feet between this BHS and the BHM. To derive the distance in meters, multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.
Data Slots Down	This field lists the number of slots used for downlink data transmission.
Data Slots Up	This field lists the number of slots used for uplink data transmission.
Regional 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 Country Code to comply with local regulatory requirements.
Site Name	This field indicates the name of the physical module. Assign or change this name in the Configuration > SNMP page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.

General Status page of BHS

The BHS's **General Status** page is explained in [Table 198](#).

Table 198 General Status page attributes - BHS

Device Information	
Device Type :	4.9/5.9GHz MIMO OFDM - Backhaul - Timing Slave - 0a-00-3e-bb-41-a3
Board Type :	P13
Product Type :	PTP 450i
Software Version :	CANOPY 15.0 BHUL450-DES
Board MSN :	6069SJ0EXU
Board Model :	C050045A001A
FPGA Version :	080216
Uptime :	00:03:14
System Time :	00:23:15 01/01/2011 UTC
Main Ethernet Interface :	100Base-TX Full Duplex
Aux Ethernet Interface :	Disabled (PoE Disabled)
Region Code :	Other
DFS :	Idle
Antenna Type :	External
Frame Period :	2.5 ms
Temperature :	37 °C / 99 °F
802.3at Type 2 PoE Status :	Not Present (Ignored)
Timing Slave Stats	
Session Status :	REGISTERED VC 18 Rate 8X/8X MIMO-B VC 255 Rate 8X/1X MIMO-B
Session Uptime :	00:02:32
Registered Backhaul :	0a-00-3e-bb-42-7e AP2
Channel Frequency :	5775.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Air Delay :	25 ns, approximately 0.002 miles (12 feet)
Receive Power :	-61.0 dBm
Signal Strength Ratio :	6.0dB V - H
Signal to Noise Ratio :	35 V / 22 H dB
Transmit Power :	16 dBm
Total Antenna Gain :	0 dBi (0 dBi external + 0 dBi internal)
Beacons :	100 %
Frame Configuration Information	
Data Slots Down :	29
Data Slots Up :	10
Region Specific Information	
Region Code :	Other
cnMaestro Connection Stats	
Connection Status :	Not enough credentials, trying to get zero touch token
AccountID :	
Site Information	
Site Name :	No Site Name
Site Contact :	No Site Contact
Site Location :	No Site Location
Key Features Information	
Time Updated and Location Code :	09/26/2016 11:47:20 - INTL

Attribute	Meaning
Device Type	
Board Type	
Software Version	See Table 198 on page 9-20
Board MSN	
FPGA Version	
Uptime	
System Time	
Ethernet Interface	
Antenna Type	
Temperature	
Session Status	
Session Uptime	
Registered Backhaul	
Channel Frequency	
Receive Power	
Signal Strength	
Ratio	
Transmit Power	See Table 198 on page 9-20
Signal to Noise Ratio	
Beacons	
Air Delay	
Data Slots Down	
Data Slots Up	
Regional Code	
Site Name	
Site Contact	
Site Location	
Time Updated and Location Code	

Viewing Session Status

The **Session Status** page in the Home page provides information about each SM or BHS that has registered to the AP or BHM. This information is useful for managing and troubleshooting a system. This page also includes the current active values on each SM or BHS for MIR and VLAN, as well as the source of these values, representing the SM/BHS itself, Authentication Server, or the Authentication Server and SM/BHS.



Note

In order for accurate power level readings to be displayed, traffic must be present on the radio link.

The Session Status List has four tab: Device, Session, Power and Configuration.

The SessionStatus.xml hyper link allows user to export session status page from web management interface of AP or BHM. The session status page will be exported in xml file.

Device tab

The Device tab provides information on the Subscriber's LUID and MAC, Hardware, Software, FPGA versions and the state of the SM/BHS (Registered and/or encrypted).

Table 199 Device tab attributes

Session Status List				
Data : SessionStatus.xml				
	Device	Session	Power	Configuration
Subscriber	Hardware	Software Version	FPGA Version	State
LUID: 002 - [0a-00-3e-a1-32-62] P1 SM connectorized	PMP 450	CANOPY 15.0	061716 (DES, Sched, US/ETSI) P11	IN SESSION (Encrypt Active)

Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM, the system assigns an LUID of 2 or a higher unique number to the SM/BHS. If a SM/BHS loses registration with the AP/BHS and then regains registration, the SM/BHS will retain the same LUID.



Note

The LUID associated is lost when a power cycle of the AP/BHM occurs.

Both the LUID and the MAC are hot links to open the interface to the SM/BHS. In some instances, depending on network activity and network design, this route to the interface yields a blank web page. If this occurs, refresh your browser view.

Site Name indicates the name of the SM/BHS. Change this name on the Configuration web page of the SM/BHS. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Hardware	This field displays the SMs or BHS hardware type.
Software Version	This field displays the software release that operates on the SM/BHS, the release date and time of the software.
FPGA Version	This field displays the version of FPGA that runs on the SM/BHS
State	<p>This field displays the current status of the SM/BHS as either</p> <ul style="list-style-type: none"> • IN SESSION to indicate that the SM/BHS is currently registered to the AP/BHM. • IDLE to indicate that the SM/BHS was registered to the AP/BHM at one time, but now is not. <p>This field also indicates whether the encryption scheme in the module is enabled.</p>

Session tab

The Session tab provides information on the SMs or BHS Session Count, Reg Count, Re-Reg Count, Uptime, Air delay, PPPoE State and Timeouts.

Table 200 Session tab attributes

Session Status List													
Data : SessionStatus.xml													
Device		Session		Power		Configuration		Air Delay				PPPoE State	Time
▼	Subscriber	Count	Reg Count	Re-Reg Count	Uptime	CC Priority	Distance	ns	bits	PPPoE State	Time		
	LUID: 002 - [0a-00-3e-a0-a6-80]	1	1	0	00:03:31	Secondary	0.000 miles (0 feet)	0	0	NA	0		
	LUID: 003 - [0a-00-3e-a0-a0-66] No Site Name	1	1	0	00:00:09	ICC	0.002 miles (12 feet)	25	0	NA	0		

Attribute	Meaning
Subscriber	See Table 199 on page 9-22.

Count	<p>This field displays how many sessions the SM/BHS has had with the AP/BHM. Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum.</p> <p>If the number of sessions is significantly greater than the number for other SMs or BHS, then this may indicate a link problem or an interference problem.</p>
Reg Count	<p>When a SM/BHS makes a Registration Request, the AP/BHM checks its local session database to see whether it was registered earlier. If the AP/BHM concludes that the SM/BHS is not currently in session database and it is valid Registration Request, then the request increments the value of this field.</p> <p>In ideal situation, the Reg Count indicates total number of connected SMs to an AP.</p>
<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>Note</p> <p>The user can clear Reg Count by dropping all current sessions of SM (or BHS) from Configuration > Tools > Sessions menu.</p> </div> </div>	
Re-Reg Count	<p>When a SM/BHS makes a Registration Request, the AP/BHM checks its local session database to see whether it was registered earlier. If the AP/BHM concludes that the SM/BHS is currently in session database, then the request increments the value of this field.</p> <p>Typically, a Re-Reg is the case where both:</p> <ul style="list-style-type: none"> • SM/BHS attempts to reregister for having lost communication with the AP/BHM. • AP/BHM has not yet observed the link to the SM/BHS as being down. <p>It is possible for a small period of time if there is no downlink traffic and AP/BHM still assumes the session is up, but the SM/BHS, loses session and quickly re-connects before the AP/BHM knew the session had dropped. This is how a re-registration happens.</p> <p>If the number of sessions is significantly greater than the number for other SMs or BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).</p>
Uptime	Once a SM/BHS successfully registers to an AP/BHM, this timer is started. If a session drops or is interrupted, this timer is reactivated once re-registration is complete.
CC Priority	The field displays Color Code Priority (ICC, Primary, Secondary or Tertiary) of all connected SM.

AirDelay	This field displays the distance of the SM/BHS from the AP/BHM in meters, nanoseconds and bits. At close distances, the value in this field is unreliable.
PPPoE state	This field displays the current PPPoE state (whether configured) of the SM/BHS.
Timeout	This field displays the timeout in seconds for management sessions via HTTP, ftp access to the SM/BHS. 0 indicates that no limit is imposed.

Power tab

Table 201 Power tab attributes

The screenshot shows the 'Session Status List' application with the 'Power' tab selected. The main table displays the following data:

Subscriber	Hardware	Downlink Rate	AP Rx Power (dBm)	Signal Strength Ratio (dB)	Signal to Noise Ratio (dB)
LUID: 002 - [0a-00-3e-bb-01-04]	PMP 450i	VC 18 Rate 8X/8X MIMO-B	-51.7	1.0dB V - H	44 V / 44 H

Below this, a detailed view of the Power tab shows data for multiple subscribers:

Subscriber	Hardware	Downlink Rate		AP Rx Power (dBm)	Signal Strength Ratio (dB)	Signal to Noise Ratio (dB)
		SU-MIMO	MU-MIMO			
LUID: 002 - [0a-00-3e-b4-c2-65] SM26	PMP 450 MIMO	VC 18 Rate 8X/1X MIMO-A	VC 18 Rate 8X/1X MIMO-A	-57.9	-2.0dB V - H	14 V / 14 H
LUID: 003 - [0a-00-3e-b4-d2-fe] SM24	PMP 450 MIMO	VC 19 Rate 8X/1X MIMO-A	VC 19 Rate 8X/1X MIMO-A	-57.0	0.0dB V - H	14 V / 14 H
LUID: 004 - [0a-00-3e-b4-d3-1c] SM25	PMP 450 MIMO	VC 20 Rate 8X/1X MIMO-A	VC 20 Rate 8X/1X MIMO-A	-57.5	-1.0dB V - H	14 MIMO-A
LUID: 005 - [0a-00-3e-b4-24-08] SM12	PMP 450 MIMO	VC 21 Rate 8X/1X MIMO-A VC 255 Rate 8X/1X MIMO-B	VC 21 Rate 8X/1X MIMO-A	-57.0	0.0dB V - H	14 MIMO-A
LUID: 006 - [0a-00-3e-b4-d3-36] SM21	PMP 450 MIMO	VC 22 Rate 8X/1X MIMO-A VC 254 Rate 8X/1X MIMO-B	VC 22 Rate N/A	-57.5	-1.0dB V - H	14 V / 14 H
LUID: 007 - [0a-00-3e-b4-24-1a] SM11	PMP 450 MIMO	VC 23 Rate 8X/1X MIMO-A	VC 23 Rate 8X/1X MIMO-A	-57.5	1.0dB V - H	14 MIMO-A
LUID: 008 - [0a-00-3e-b4-c2-5c] SM23	PMP 450 MIMO	VC 24 Rate 8X/1X MIMO-A	VC 24 Rate 8X/1X MIMO-A	-57.0	0.0dB V - H	14 MIMO-A
LUID: 009 - [0a-00-3e-b4-d2-ff] SM22	PMP 450 MIMO	VC 25 Rate 8X/1X MIMO-A VC 253 Rate 8X/1X MIMO-B	VC 25 Rate 8X/1X MIMO-A	-57.0	0.0dB V - H	14 MIMO-A
LUID: 010 - [0a-00-3e-b4-d2-e0] SM13	PMP 450 MIMO	VC 26 Rate 8X/1X MIMO-A VC 252 Rate 8X/1X MIMO-B	VC 26 Rate 8X/1X MIMO-A	-58.0	1.8dB V - H	14 MIMO-A
LUID: 011 - [0a-00-3e-b1-be-77] No Site Name	PMP 450 MIMO	VC 27 Rate 8X/1X MIMO-A VC 251 Rate 8X/1X MIMO-B	VC 27 Rate 8X/1X MIMO-A	-56.8	-0.3dB V - H	14 MIMO-A

Attribute	Meaning
Subscriber	See Table 199 on page 9-22.
Hardware	This field displays the SMs or BHS hardware type.

<u>Downlink Rate SU-MIMO</u>	<p>This field displays whether the high-priority channel is enabled in the SM/BHS and the status of rate adapt. For example, if “8X/4X” is listed, the radio is capable of operating at 8X but is currently operating at 4X, due to RF conditions.</p> <p>This field also states whether it is MIMO-A or MIMO-B radio e.g. “8X/8X MIMO-B” indicates MIMO-B and “8X/4X MIMO-A” indicates MIMO-A.</p> <p>A VC starts at its lowest modulation and slowly rate adapts up, as traffic is successfully transmitted over the VC. It is normal for one VC to have a different modulation rate than another VC, if only one VC has traffic on it. For example if High Priority VC is enabled, but only low priority VC has traffic the reading will show:</p> <p>REGISTERED VC 18 Rate 8X/8X MIMO-B VC 255 Rate 8X/1X MIMO-B</p> <p><u>Note: The SU-MIMO rate applies to all AP platforms. For 450m, this field indicates the rate being used for symbols where this particular VC is not being MU-MIMO grouped with other SM's.</u></p>
<u>Downlink Rate MU-MIMO</u>	<u>The MU-MIMO rate applies only to the 450m AP. This rate indicates the modulation used for symbols where this particular low priority VC is MU-MIMO scheduled, by grouping it in the same slot with other low priority VC's</u>
AP Rx Power (dBm)	This field indicates the AP's or BHM's combined receive power level for the listed SM/BHS.
Signal Strength Ratio (dB)	This field displays the ratio of the Vertical path received signal power to the Horizontal path received signal power. This ratio can be useful for determining multipathing conditions (high vertical to horizontal ratio) for Uplink.
Signal to Noise Ratio (dB)	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor. In other words, it indicates signal to noise ratio for Uplink.

Configuration tab

The **Configuration** tab provides information on the SMs or BHS Uplink or Downlink (UL/DL) Sustained Data Rate, UL/DL Burst Allocation, UL/DL Burst Rate, UL/DL Low Priority CIR, UL/DL High CIR, UL/DL High Priority Queue Information and the UL/DL Broadcast or Multicast Allocation. This data is refreshed based on the Web Page Auto Update setting on the AP's or BHS's General Configuration page.

Table 202 Configuration tab attributes

Session Status List									
Data : SessionStatus.xml									
Device	Session	Power	Configuration						
Subscriber		Sustained Data Rate (kbps)	Burst Allocation (kbit)	Max Burst Rate (kbit)	Low Priority CIR (kbps)	High CIR (kbps)	Broadcast/Multicast Allocation	RADIUS Authentication Reply	RADIUS Authentication Server
LUID: 002 - [0a-00-3e-a0-e8-60] No Site Name	Uplink	65000(SM)	2500000(SM)	0(SM)	0(SM)	0(SM)	0(SM)	Hello from freeradius	10.110.61.7
	Downlink	65000(SM)	2500000(SM)	0(SM)	0(SM)	0(SM)			
LUID: 003 - [0a-00-3e-a2-cf-8d] No Site Name	Uplink	2000(SM)	2500000(SM)	0(SM)	0(SM)	NA	0(SM)	Hello from Microsoft	10.120.133.1
	Downlink	2000(SM)	2500000(SM)	0(SM)	0(SM)	NA			

Attribute	Meaning
Subscriber	See Table 199 on page 9-22 .
Sustained Data Rate (kbps) - Uplink	This field displays the value that is currently in effect for the SM/BHS, with the source of that value in parentheses. This is the specified rate at which each SM/BHS registered to this AP/BHM is replenished with credits for transmission. The configuration source of the value is indicated in parentheses. See Maximum Information Rate (MIR) Parameters on page 7-189 .
Sustained Data Rate (kbps) - Downlink	This field displays the value that is currently in effect for the SM/BHS, with the source of that value in parentheses. This is the specified the rate at which the AP/BHM should be replenished with credits (tokens) for transmission to each of the SMs/BHS's in its sector. The configuration source of the value is indicated in parentheses. See Maximum Information Rate (MIR) Parameters on page 7-189 .
Burst Allocation (kbit) - Uplink	This field displays the value that is currently in effect for the SM/BHS, with the source of that value in parentheses. This is the specified maximum amount of data that each SM/BHS is allowed to transmit before being recharged at the Sustained Uplink Data Rate with credits to transmit more. The configuration source of the value is indicated in parentheses. See Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-191
Burst Allocation (kbit) - Downlink	This field displays the value that is currently in effect for the SM/BHS, with the source of that value in parentheses. This is the specified the rate at which the AP/BHM should be replenished with credits (tokens) for transmission to each of the SMs/BHS's in its sector. The configuration source of the value is indicated in parentheses. See Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-191

Max Burst Rate (kbit) - Uplink	The data rate at which an SM/BHS is allowed to burst (until burst allocation limit is reached) before being recharged at the Sustained Uplink Data Rate with credits to transit more. When set to 0 (default), the burst rate is unlimited. See Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-191
Max Burst Rate (kbit) - Downlink	The data rate at which an SM/BHS is allowed to burst (until burst allocation limit is reached) before being recharged at the Sustained Downlink Data Rate with credits to transit more. When set to 0 (default), the burst rate is unlimited. See Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-191
Low Priority CIR	This field indicates the minimum rate at which low priority traffic is sent over the uplink and downlink (unless CIR is oversubscribed or RF link quality is degraded).
High CIR	This field indicates the minimum rate at which high priority traffic is sent over the uplink and downlink (unless CIR is oversubscribed or RF link quality is degraded).
Broadcast/Multicast Allocation	This field displays the data rate at which Broadcast and Multicast traffic is sent via the radio link.
RADIUS Authentication Reply	This field displays whether RADIUS server is reachable or not.
RADIUS Authentication Server	This field displays the associated RADIUS Authentication Server for each SM where it was authenticated. This information is useful when there are multiple RADIUS servers (maximum three servers supported by Cambium). If one server is not reachable, other configured servers are tried in sequential order as a fall-back. In this scenario, the Session Status is useful to identify associate RADIUS Authentication Server for all connected SMs.

Table 203 Session Status > Configuration CIR configuration denotations

Attribute	Meaning
(SM)	QoS/VLAN parameters are derived from the SM's/BHS's settings
(APCAP)	QoS/VLAN parameters are derived from the AP's settings, including any keyed capping (for radios capped at 4 Mbps, 10 Mbps, or 20 Mbps)
(D)	QoS/VLAN parameters are retrieved from the device, due to failed retrieval from the AAA or WM server.
(AAA)	QoS/VLAN parameters are retrieved from the RADIUS server

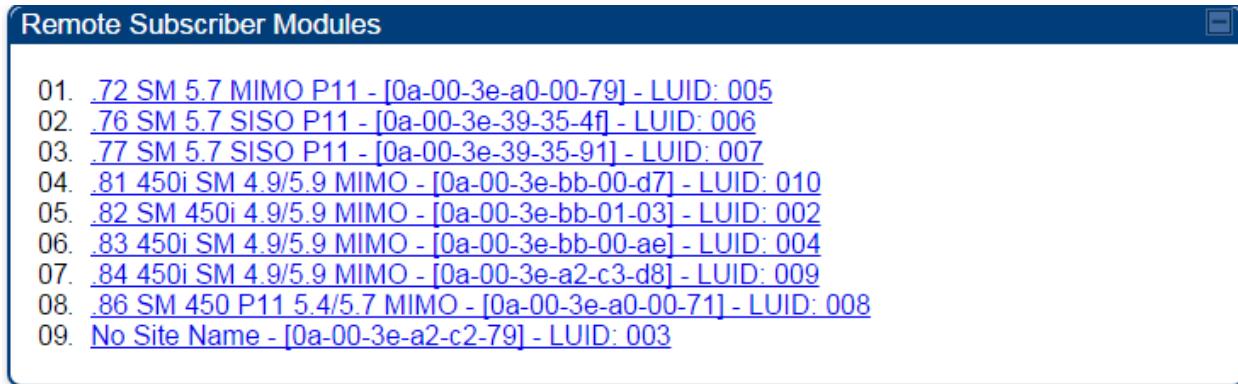
(BAM)

QoS/VLAN parameters are retrieved from a WM BAM server

Viewing Remote Subscribers

This page allows to view the web pages of registered SMs or BHS over the RF link. To view the pages for a selected SM/BHS, click its link. The **General Status** page of the SM opens.

Figure 178 Remote Subscribers page of AP



Interpreting messages in the Event Log

Each line in the Event Log of a module Home page begins with a time and date stamp. However, some of these lines wrap as a combined result of window width, browser preferences and line length. You may find this tab easiest to use if you expand the window till all lines are shown beginning with time and date stamp.

Time and Date Stamp

The time and date stamp reflect one of the following:

- GPS time and date directly or indirectly received from the CMM4.
- NTP time and date from a NTP server (CMM4 may serve as an NTP server)
- The running time and date that you have set in the Time & Date web page.

**Note**

In the Time & Date web page, if you have left any time field or date field unset and clicked the **Set Time and Date** button, then the time and date default to **00:00:00 UTC : 01/01/00**.

A reboot causes the preset time to pause or, in some cases, to run in reverse. Additionally, a power cycle resets the running time and date to the default **00:00:00 UTC : 01/01/00**. Thus, whenever either a reboot or a power cycle has occurred, must reset the time and date in the Time & Date web page of any module that is not set to receive sync.

Event Log Data Collection

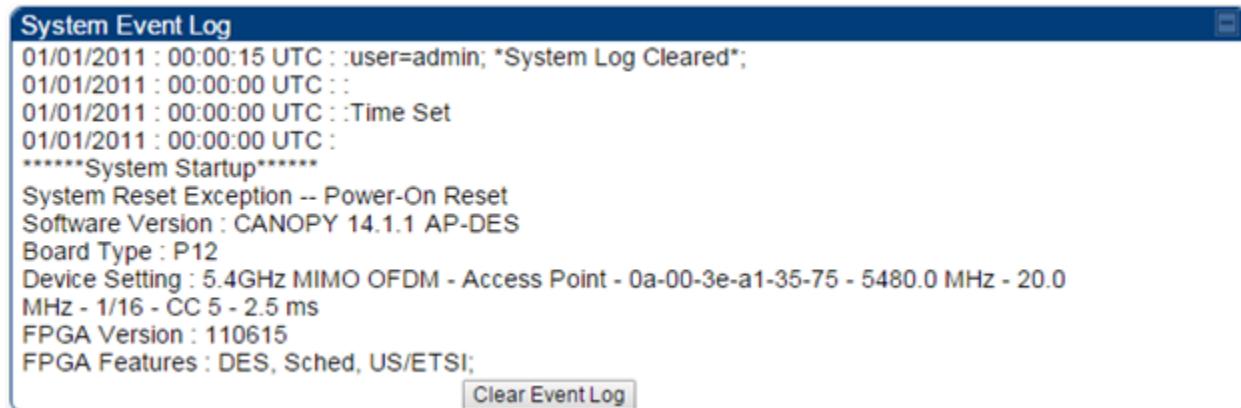
The collection of event data continues through reboots and power cycles. When the buffer allowance for event log data is reached, the system adds new data into the log and discards an identical amount of the oldest data.

Each line that contains the expression WatchDog flags an event that was both:

- considered by the system software to have been an exception
- recorded in the preceding line.

Conversely, a Fatal Error () message flags an event that is recorded in the next line. Some exceptions and fatal errors may be significant and require either operator action or technical support.

Figure 179 Event log data



System Event Log

```
01/01/2011 : 00:00:15 UTC ::user=admin; *System Log Cleared*;
01/01/2011 : 00:00:00 UTC ::Time Set
01/01/2011 : 00:00:00 UTC :
*****System Startup*****
System Reset Exception -- Power-On Reset
Software Version : CANOPY 14.1.1 AP-DES
Board Type : P12
Device Setting : 5.4GHz MIMO OFDM - Access Point - 0a-00-3e-a1-35-75 - 5480.0 MHz - 20.0
MHz - 1/16 - CC 5 - 2.5 ms
FPGA Version : 110615
FPGA Features : DES, Sched, US/ETSI;
```

Clear Event Log

Messages that Flag Abnormal Events

The messages listed below flag abnormal events and, case by case, may signal the need for corrective action or technical support.

Table 204 Event Log messages for abnormal events

Event Message	Meaning
Expected LUID = 6 Actual LUID = 7	Something is interfering with the control messaging of the module. Also ensure that you are using shielded cables to minimize interference. Consider trying different frequency options to eliminate or reduce interference.
FatalError()	The event recorded on the line immediately beneath this message triggered the Fatal Error ()�.
Loss of GPS Sync Pulse	Module has lost GPS sync signal.
Machine Check Exception	This is a symptom of a possible hardware failure. If this is a recurring message, begin the RMA process for the module.
RcvFrmNum = 0x00066d ExpFrmNum = 0x000799	Something is interfering with the control messaging of the module. Also ensure that you are using shielded cables to minimize interference. Consider trying different frequency options to eliminate or reduce interference.
System Reset Exception -- External Hard Reset	The unit lost power or was power cycled.
System Reset Exception -- External Hard Reset WatchDog	The event recorded on the preceding line triggered this WatchDog message.

Messages that Flag Normal Events

The messages listed below record normal events and typically *do not* signal a need for any corrective action or technical support.

Table 205 Event Log messages for normal events

Event Message	Meaning
Acquired GPS Sync Pulse.	Module has acquired GPS sync signal.
FPGA Features	Type of encryption.
FPGA Version	FPGA (JBC) version in the module.

GPS Date/Time Set	Module is now on GPS time.
Reboot from Webpage	Module was rebooted from management interface.
Software Boot Version	Boot version in the module.
Software Version	The software release and authentication method for the unit.
System Log Cleared	Event log was manually cleared.

Viewing the Network Interface

In any module, the LAN1 Network Interface section of this tab displays the defined Internet Protocol scheme for the Ethernet interface to the module. In SM/BHS devices, this page also provides an RF Public Network Interface section, which displays the Internet Protocol scheme defined for network access through the master device (AP/BHM).

Figure 180 Network Interface tab of the AP

LAN1 Network Interface	
Ethernet Interface :	1000Base-TX Full Duplex
IP address :	10.120.226.64
Subnet Mask :	255.255.254.0
Gateway IP address :	10.120.226.254
Preferred DNS Server :	10.120.12.31
Alternate DNS Server :	10.120.12.30
DHCP status :	DHCP not enabled

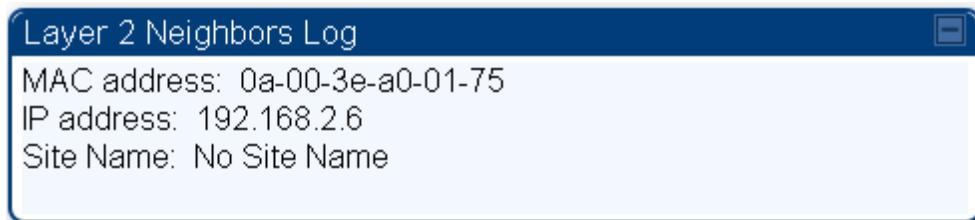
Figure 181 Network Interface tab of the SM

LAN1 Network Interface	
Ethernet Interface :	1000Base-TX Full Duplex
IP address :	10.120.216.220
Subnet Mask :	255.255.255.0
Gateway IP address :	10.120.216.254
Preferred DNS Server :	0.0.0.0
Alternate DNS Server :	0.0.0.0
DHCP status :	DHCP not enabled

Viewing the Layer 2 Neighbors

In the Layer 2 Neighbors tab, a module reports any device from which it has received a message in Link Layer Discovery Protocol within the previous two minutes. Given the frequency of LLDP messaging, this means that the connected device will appear in this tab 30 seconds after it is booted and remain until two minutes after its shutdown.

Figure 182 Layer 2 Neighbors page



System statistics

This section describes how to use the system statistics pages to manage the performance of the PMP/PTP 450 Platform Family link.

Viewing the Scheduler statistics

The **Statistics > Scheduler** page is applicable for all modules (AP/SM/BHM/BHS) and the parameters are displayed as shown below:

Table 206 Scheduler tab attributes

Radio Statistics	
Transmit Unicast Data Count :	0
Transmit Broadcast Data Count :	176
Transmit Multicast Data Count :	0
Receive Unicast Data Count :	0
Receive Broadcast Data Count :	0
Receive Multicast Data Count :	0
Transmit Control Count :	0
Receive Control Count :	0
In Sync Count :	0
Out of Sync Count :	0
Overrun Count :	0
Underrun Count :	0
Receive Corrupt Data Count :	0
Receive Corrupt Control Data Count :	0
Receive Bad Broadcast Control Count :	0
Bad In Sync ID Received :	0
Rcv LT Start :	0
Rcv LT Start HS :	0
Rcv LT Result :	0
Xmt LT Result :	0
Frame Too Big :	0
Bad Acknowledgment :	0
Bad Fragment :	0

Attribute	Meaning
Transmit Unicast Data Count	Total amount of unicast packets transmitted from the radio
Transmit Broadcast Data Count	Total amount of broadcast packets transmitted from the radio
Transmit Multicast Data Count	Total amount of multicast packets transmitted by the radio
Receive Unicast Data Count	Total amount of unicast packets received by the radio

Receive Broadcast Data Count	Total amount of broadcast packets received by the radio
Receive Multicast Data Count	Total amount of multicast packets received by the radio
Transmit Control Count	Amount of radio control type messages transmitted (registration requests and grants, power adjust, etc.)
Receive Control Count	Amount of radio control type messages received (registration requests and grants, power adjust, etc.)
In Sync Count	Number of times the radio has acquired sync. When GPS synchronization is used it is number of times GPS sync acquired. For the SM, it is the number of times the SM successfully obtained sync with an AP.
Out of Sync Count	Number of times the radio lost same sync lock
Overrun Count	Number of times FPGA frame has overrun its TX Frame
Underrun Count	Number of times FPGAs TX Frame aborted prematurely
Receive Corrupt Data Count	Number of times a corrupt fragment has been received at the FPGA.
Receive Bad Broadcast Control Count	Number of times the radio has received an invalid control message via broadcast (SM only).
Bad In Sync ID Received	Currently unused
Rcv LT Start	Number of Link Test Start messages received. A remote radio has requested that this radio start a link test to it.
Rcv LT Start HS	Number of Link Test Start Handshake messages received. This radio requested that a remote radio start a link test and the remote radio has sent a handshake back acknowledging the start.
Rcv LT Result	This radio received Link Test results from the remote radio under test. When this radio initiates a link test, the remote radio will send its results to this radio for display.
Xmt LT Result	This radio transmitted its link test results to the remote radio under test. When the remote radio initiates a link test, this radio must send its results to the remote radio for display there.
Frame Too Big	This statistics indicates the number of packets received and processed by the radios which were greater than max packet size 1700 bytes.
Bad Acknowledgment	This statistics indicates the number of packets received as bad acknowledgment. It is for engineering use only.

Bad Fragment	This statistic indicates number of fragments tagged internally as bad. It is for engineering use only.
Rx No Buffer Count	Currently unused
Scheduler Error	This error is incremented when the scheduler cannot send or get scheduled to send a packet. It is also general called a "VC Error".

Viewing list of Registration Failures statistics

SM Registration Failures page of AP

The SM Registration Failures tab identifies SMs that have recently attempted and failed to register to this AP. With its time stamps, these instances may suggest that a new or transient source of interference exists.

Table 207 SM Registration Failures page attributes - AP

Registration Failures Statistics		
Number of Registration Grant Failures : 1		
Attribute		Meaning
Status 17 Flag 0		No response was received from the AAA server and hence SM is trying to send a session request again.

BHS Registration Failures page of BHM

Table 208 BHS Registration Failures page attributes - BHM

Registration Failures Statistics		
Number of Registration Grant Failures : 1		
Attribute		Meaning
Status 17 Flag 0		No response was received from the AAA server and hence SM is trying to send a session request again.

There is a list of flags from 0 to 20 as shown in [Table 209](#) and the "Flags" can be ignored.

Table 209 Flags status

Flag	Meaning	Flag	Meaning
0	Normal	11	AP Lite Limit Reached
1	Out of Range	12	Only Ver 9.5+ Allowed
2	No Luids	13	Temporary Data VC for AAA
3	BH ReRange	14	AAA Authentication Failure
4	Auth Fail	15	Registration Grant Reject
5	Encrypt Fail	16	Blank
6	Power Adjust	17	AAA Session Retry
7	No VCs	18	AAA Reauth Failure
8	Reserve VC Fail	19	RegReq at zero power
9	Activate VC Fail	20	RegReq no time ref
10	Hi VC Setup Fail	-	-

Interpreting Bridging Table statistics

If NAT (network address translation) is not active on the SM/BHS, then the Bridging Table page provides the MAC address of all devices that are attached to registered SMs/BHS (identified by LUIDs).

The SM/BHS management MAC addresses are also added in bridge table upon SMs/BHS registration. These entries will be removed automatically from the table once SMs/BHS is deregistered. This alleviates the arp cache > bridge cache timeout problems.

The bridging table allows data to be sent to the correct module as follows:

- For the AP/BHM, the uplink is from RF to Ethernet. Thus, when a packet arrives in the *RF* interface to the AP/BHM, the AP/BHM reads the MAC address from the inbound packet and creates a bridging table entry of the source MAC address on the other end of the *RF* interface.
- For the SM/BHS, the uplink is from Ethernet to RF. Thus, when a packet arrives in the Ethernet interface to one of these modules, the module reads the MAC address from the inbound packet and creates a bridging table entry of the source MAC address on the other end of the Ethernet interface.

Figure 183 Bridging Table page**Statistics → Bridging Table**

5.4GHz MIMO OFDM - Access Point - 0a-00-3e-bb-00-fb

Bridging Table				
Physical Address	Dest LUID	Age	Hash	Ent
0A003EBB00FB	258	-1	0576	02
0A003EBB0104	002	-1	0959	02
1A003EBB00FB	259	-1	0576	02
1A003EBB0104	002	-1	0959	02

Used: 4 BridgeFree: 4092 BridgeFullErr: 0

The Bridging Table supports up to 4096 entries.

Interpreting Translation Table statistics

When Translation Bridging is enabled in the AP, each SM keeps a table mapping MAC addresses of devices attached to the AP to IP addresses, as otherwise the mapping of end-user MAC addresses to IP addresses is lost. (When Translation Bridging is enabled, an AP modifies all uplink traffic originating from registered SMs such that the source MAC address of every packet is changed to that of the SM which bridged the packet in the uplink direction.)

Figure 184 Translation Table page of SM

Translation Table				
Mac:002275394384	IpAddress:192.168.2.1	Age:0		
Mac:001F3B4AC679	IpAddress:192.168.2.7	Age:0		
Mac:902155C788E8	IpAddress:192.168.2.2	Age:0		
Mac:000D4B76388B	IpAddress:192.168.2.4	Age:0		
Mac:AC81128BCCF4	IpAddress:192.168.2.3	Age:0		
Mac:0004236DA056	IpAddress:192.168.2.8	Age:3		
Mac:00265507A92B	IpAddress:192.168.2.5	Age:4		
Mac:902155C788E8	IpAddress:173.158.9.186	Age:68		
Mac:5CDAD4818A2F	IpAddress:192.168.2.9	Age:50		
Mac:001F3B4AC679	IpAddress:192.168.50.137	Age:26		

Interpreting Ethernet statistics

The **Statistics > Ethernet** page reports TCP throughput and error information for the Ethernet connection of the module. This page is applicable for all modules (AP/SM/BHM/BHS).

The **Ethernet** page displays the following fields.

Table 210 Ethernet tab attributes

Ethernet Control Block Statistics	
Ethernet Link Detected :	1
Ethernet Link Lost :	0
Undersized Toss Count :	0
inoctets Count :	139159
inuicastpkts Count :	420
Innucastpkts Count :	86
indiscards Count :	0
inerrors Count :	0
inunknownprotos Count :	0
outoctets Count :	56864
outuicastpktsCount :	184
outnuicastpkts Count :	3
outdiscards Count :	0
outerrors Count :	1
RxBabErr :	0
TxHbErr :	0
EthBusErr :	0
CRCError :	0
RcvFifoNoBuf :	0
RxOverrun :	0
LateCollision :	0
RetransLimitExp :	0
TxUnderrun :	0
CarSenseLost :	0
No Carrier :	1

Attribute	Meaning
Ethernet Link Detected	1 indicates that an Ethernet link is established to the radio, 0 indicates that no Ethernet link is established
Ethernet Link Lost	This field indicates a count of how many times the Ethernet link was lost.
Undersized Toss Count	This field indicates the number of packets that were too small to process and hence discarded.
inoctets Count	This field displays how many octets were received on the interface, including those that deliver framing information.
inuicastpkts Count	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
Innucastpkts Count	This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.

indiscards Count	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)
inerrors Count	This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.
inunknownprotos Count	This field displays how many inbound packets were discarded because of an unknown or unsupported protocol.
outoctets Count	This field displays how many octets were transmitted out of the interface, including those that deliver framing information.
outucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.
outnucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.
outdiscards Count	This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)
outerrors Count	This field displays how many outbound packets contained errors that prevented their transmission.
RxBabErr	This field displays how many receiver babble errors occurred.
TxHbErr	This field displays how many transmit heartbeat errors have occurred.
EthBusErr	This field displays how many Ethernet bus errors occurred on the Ethernet controller.
CRCError	This field displays how many CRC errors occurred on the Ethernet controller.
RcvFifoNoBuf	This field displays the number of times no FIFO buffer space was able to be allocated
RxOverrun	This field displays how many receiver overrun errors occurred on the Ethernet controller.
Late Collision	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.

**Caution**

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.

RetransLimitExp	This field displays how many times the retransmit limit has expired.
TxUnderrun	This field displays how many transmission-underrun errors occurred on the Ethernet controller.
CarSenseLost	This field displays how many carrier sense lost errors occurred on the Ethernet controller.
No Carrier	This field displays how many no carrier errors occurred on the Ethernet controller.

Interpreting RF Control Block statistics

The **Statistics > Radio** page is applicable for all module (AP/SM/BHM/BHS). The Radio page of the Statistics page displays the following fields.

Table 211 Radio (Statistics) page attributes – RF Control Block

RF Control Block Statistics	
inoctets Count:	653532396
inuicastpkts Count:	423096
Innucastpkts Count:	35848043
indiscards Count:	0
inerrors Count:	0
inunknownprotos Count:	0
outoctets Count:	138721214
outuicastpktsCount:	401826
outhuicastpkts Count:	13855
outdiscards Count:	120
outerrors Count:	0

Attribute	Meaning
inoctets Count	This field displays how many octets were received on the interface, including those that deliver framing information.
inuicastpkts Count	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
Innucastpkts Count	This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.
indiscards Count	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. This stat is pegged whenever corrupt data is received by software or whenever the RF Software Bridge queue is full. Corrupt data is a very unusual event because all packets are CRC checked by hardware before being passed into software. The likely case for indiscards is if the RF bridge queue is full. If this is the case the radio is most likely PPS limited due to excessive small packet traffic or a problem at the Ethernet interface. If there is a problem at the Ethernet interface there is likely to be discards at the Ethernet as well.
inerrors Count	This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.
inunknownprotos Count	This field displays how many inbound packets were discarded because of an unknown or unsupported protocol.

outoctets Count	This field displays how many octets were transmitted out of the interface, including those that deliver framing information.
outucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.
outnucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.
outdiscards Count	This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)
outerrors Count	This field displays how many outbound packets contained errors that prevented their transmission.

Interpreting Sounding statistics

In the SM GUI, sounding statistics can be found under **Statistics > Radio**.

The top section, RF Control Block Statistics, is applicable to the SM communicating to any AP (450, 450i, or 450m), and it is always visible. The bottom section, Sounding Statistics, is visible only if the SM is communicating with a 450m AP.

Table 212 Radio (Statistics) page attributes - Sounding

Sounding Statistics	
Attribute	Meaning
Total Requests :	0
Total Requests Ignored :	0
Total Requests Dropped :	0
Responses :	0
Responses Suppressed :	0
Errors :	0
Version Mismatch :	0
Max Request Interval :	0 ms
Avg Request Interval :	0 ms
Responses	Number of sounding responses (full VC assessments or condensed nulling) sent from the SM to the AP
Responses Suppressed	Number of sounding requests suppressed by the SM. The reason why a sounding response is suppressed is because the error calculated during the sounding process is lower than the threshold set by the AP. In this case, the SM does not need to transmit a sounding response to the AP
Errors	Number of errors in the sounding process at the SM Examples of events that count as errors: <ul style="list-style-type: none"> • Sounding type is not supported • IQ capture not enabled: for example, if sounding requested too soon after SM boot • IQ capture did not complete • Sounding processing took too long
Version Mismatch	Number of sounding requests with mismatched version numbers The Sounding Acquisition Command contains a version number. The SM checks its own version number and flags any mismatch. Currently, AP and SMs use V1.
Max Request Interval	Largest time between two sounding requests received from the 450m AP
Avg Request Interval	Average time between two sounding requests received from the 450m AP

The following attributes are applicable only for 450m:

Attribute	Meaning
mumimoVetoCount	If excessive channel distortion is observed during condensed nulling (tracking state) this count will increment and VC will transition back to assessing state.
channelDistortion	Channel distortion readings.
nullingSNR	Signal to noise ratio of condensed nulling error response.
cnResponseCountSM	The SM adds a counter to the CN (Condensed Nulling) response. This indicates how many responses were sent by that SM.
cnResponseCountAP	The AP increments a count for each CN response received.
missedTagCount	This is the number of CN responses transmitted by SM but not received at AP.

Interpreting VLAN statistics

The **Statistics > VLAN** page provides a list of the most recent packets that were filtered because of VLAN membership violations. It is applicable for all modules (AP/SM/BHM/BHS).

Table 213 VLAN page attributes

VLAN Statistics Configuration

VLAN Statistics Configuration : (Range : 1 — 4094 or 0 for Priority-tagged)

VLAN Statistics

VID : 1

VID Stats Frames Received : 1823

Bytes Received : 586624

Frames Transmitted : 1640

Bytes Transmitted : 585735

Most Recent Filtered Frames

No Ingress Filtered Frames

Ingress : Total Frames Filtered : 0 Total Bytes Filtered : 0

Egress : Total Frames Filtered : 0 Total Bytes Filtered : 0

Attribute	Meaning
Unknown	This must not occur. Contact Technical Support.
Only Tagged	The packet was filtered because the configuration is set to accept only packets that have an 802.1Q header and this packet did not.

Ingress	When the packet entered through the wired Ethernet interface, the packet was filtered because it indicated an incorrect VLAN membership.
Local Ingress	When the packet was received from the local TCP/IP stack, the packet was filtered because it indicated an incorrect VLAN membership. This must not occur. Contact Technical Support.
Egress	When the packet attempted to leave through the wired Ethernet interface, the packet was filtered because it indicated an incorrect VLAN membership.
Local Egress	When the packet attempted to reach the local TCP/IP stack, the packet was filtered because it indicated an incorrect VLAN membership.

Interpreting Data VC statistics

The **Statistics > Data VC** page displays information about Virtual Channel (VC) used in data communications. This page is applicable for all modules (AP/SM/BHM/BHS).

The **Data VC** tab displays the fields as explained in [Table 214](#).

Table 214 Data VC page attributes

Data VC Statistics (CoS: 00 = Lowest Priority, 07 = Highest Priority)																		
Subscriber	VC	CoS	Inbound Statistics							Outbound Statistics							Queue Overflow	High Priority Queue
			octets	ucast pkts	nucast pkts	discards	errors	QPSK frgmts	16-QAM frgmts	64-QAM frgmts	256-QAM frgmts	octets	ucast pkts	nucast pkts	discards	errors		
LUID: 002	018	00	471342	1400	4	0	0	1082 365	298 166	268 114	246 112	513512	1405	7	0	0	0	889
Multicast	016	00	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA
Broadcast	012	00	NA	NA	NA	NA	NA	NA	NA	NA	NA	66936	1	940	0	0	NA	NA

Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM, the system assigns an LUID of 2 or a higher unique number to the SM/BHS. If a SM/BHS loses registration with the AP/BHM and then regains registration, the SM/BHS retains the same LUID.
VC	This field displays the virtual channel number. Low priority channels start at VC18 and count up. High priority channels start at VC255 and count down. If one VC is displayed, the high-priority channel is disabled. If two are displayed, the high-priority channel is enabled.
CoS	This field displays the Class of Service for the virtual channel. The low priority channel is a CoS of 00 and the high priority channel is a CoS of 01. CoS of 02 through 07 are not currently used.
Inbound Statistics, octets	This field displays how many octets were received on the interface, including those that deliver framing information.
Inbound Statistics, ucastpkts	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
Inbound Statistics, nucastpkts	This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.

Inbound Statistics, discards	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. Inbound discard statistics are incremented similar to the indiscards stat on the RF control block stats page. The sum of all data VC indiscards must be close to the RF control block in discards. If indiscards are evenly distributed across SMs, then the radio is PPS limited due to either excessive small packet transmissions, or a problem at the Ethernet link. If indiscards are contained to one or a few SMs, then there is likely a problem at or underneath the SM which is incrementing the count.
Inbound Statistics, errors	This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.
Inbound Statistics, QPSK frgmts	This field displays how many inbound fragments were received via the QPSK modulation scheme.
Inbound Statistics, 16-QAM frgmts	This field displays how many inbound fragments were received via the 16-QAM modulation scheme.
Inbound Statistics, 64-QAM frgmts	This field displays how many inbound fragments were received via the 64-QAM modulation scheme.
Inbound Statistics, 256-QAM frgmts	This field displays how many inbound fragments were received via the 256-QAM modulation scheme.
Outbound Statistics, octets	This field displays how many octets were transmitted out of the interface, including those that deliver framing information.
Outbound Statistics, ucastpkts	This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.
Outbound Statistics, nucastpkts	This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.
Outbound Statistics, discards	This field displays how many outbound packets were discarded without errors that would have prevented their transmission. Outbound discard statistics are incremented if a VC is not active when a packet is ready to send. This is a rare condition.
Outbound Statistics, errors	This field displays how many outbound packets contained errors that prevented their transmission.

Queue Overflow	This is a count of packets that were discarded because the queue for the VC was already full. If Queue Overflows are being seen across most or all SMs, then there is either an interferer local to the AP or the APs RF link is at capacity. If Queue Overflows are being seen at one or only a few SMs, then it is likely that there is a problem with those specific links whether it is insufficient signal strength, interferer, or a problem with the actual SM hardware.
High Priority Queue	This is a count of packets that were received on high priority queue.

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 215 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	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.
Time Period Ending	

Below the 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 [Table 216](#).

Table 216 Overload page attributes – AP/SM/BHM/BHS

Packet Overload Statistics	
Total Packets Overload Count :	0
Ethernet In Discards (Statistics=>Ethernet=>RxOverrun + Statistics=>Bridge Control Block=>ErrApFecQSend) :	0
Ethernet Out Discards (Statistics=>Ethernet=>outdiscards count)	0
RF In Discards (Sum of all VCs of: Statistics=>Data VC=>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.
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****450m Overload:**

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

Overload occurs when the offered load exceeds the above limits. When overload occurs, 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.

450m has higher PPS than 450 and 450i and supports higher throughput through spatial multiplexing, therefore when a 450m replaces an overloaded 450 or 450i AP the 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 450m to see if it is overloaded or not.

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 [Table 217](#).

Table 217 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

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.
--	---

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 [Table 218](#).

Table 218 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
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.

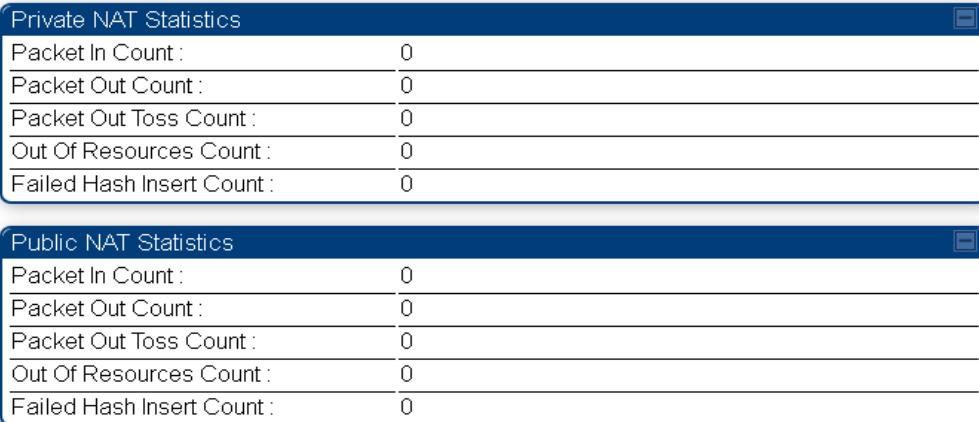
Figure 185 ARP page of the SM

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 [Table 219](#).

Table 219 NAT page attributes - SM



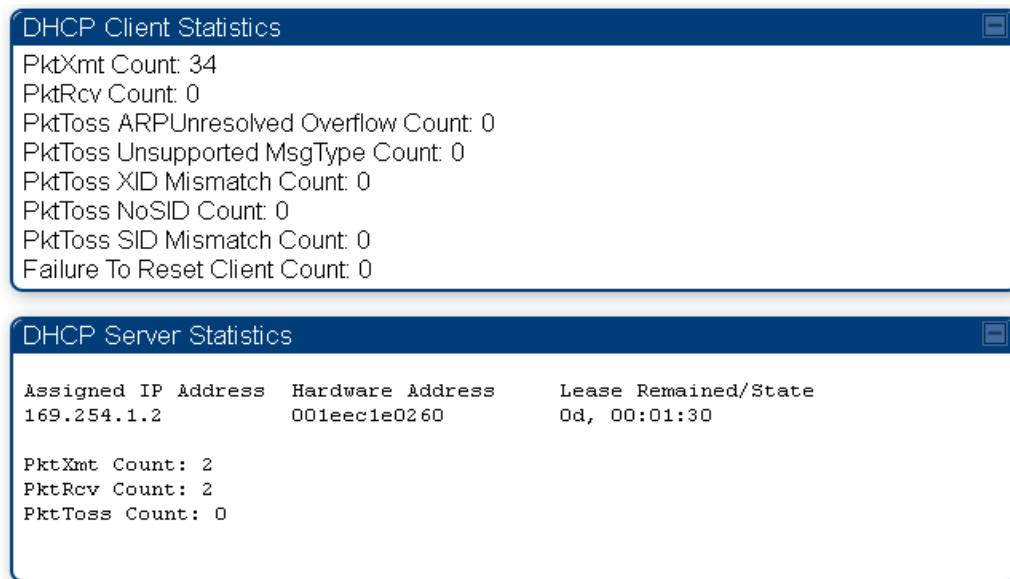
Attribute		Meaning
Private NAT Statistics, Packet In Count		This field represents the number of packets received on the SM's LAN/Ethernet interface
Private NAT Statistics, Packet Out Count		This field represents the number of packets sent from the SM's LAN/Ethernet interface
Private NAT Statistics, Packet 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 220 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	This field represents the number of times the DHCP client was unable to be reset (resulting in no IP address being served).
Client Count	

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 [Table 221](#).

Table 221 Sync Status page attributes - AP

Sync Status	
Attribute	Meaning
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

Sync Pulse Source	This field indicates the status of the synchronization source: <ul style="list-style-type: none"> 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 [Table 222](#).

Table 222 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 [Table 223](#).

Table 223 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
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
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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.
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.



Note:

PMP 450m Series AP does not support Aux port in current release of 15.0/15.0.0.1.

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 [Table 224](#).

Table 224 Pass Through Statistics page attributes – AP

Pass Through Statistics	
Pass Through Statistics [LUID 002]: IdentityReqSent: 1 PktsEncapsulated: 9PktsDecapsulated: 9 AccessAcceptRcvd: 1	
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.
PktsDecapsulated	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 [Table 225](#).

Table 225 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.
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.
usmStatsUnsupportedSecurityLevels	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.

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 rebooted/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 [Table 226](#).

Table 226 Syslog statistics page attributes – AP/SM/BH

Syslog Transmission Stats	
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.

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 this 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) will have only the downlink scheduler based statistics

Table 227 Frame utilization statistics

Frame Utilization Interval	
Statistics Display Interval :	1 minute
Next Update :	16 seconds
Frame Utilization	
Downlink :	0 %
Uplink :	0 %
Bandwidth Requests :	100 %
Downlink Counts	
Total :	1586
Per Frame Average :	0
Low Priority :	500
High Priority :	0
Broadcast/Multicast :	735
Canopy MAC Acknowledgments :	351
Registration Messages :	0
Uplink Counts	
Total :	781
Per Frame Average :	0
Low Priority :	426
High Priority :	0
Canopy MAC Acknowledgments :	355
Contention Slots :	455219
Contention Slots Average Per Frame :	18
Bandwidth Requests Received :	602
Bandwidth Requests Missed :	0
Maximum Possible Counts	
Downlink :	1152000
Uplink :	384000
Contention :	456000
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.
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.
Bandwidth Requests	<p>The "Bandwidth Request" 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.</p> <p>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 is a 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.</p> <p>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.</p>
Downlink Counts	
Total	This indicates the sum of all downlink data slots used in the configured interval.
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.
High Priority	The number of downlink data slots used for high priority downlink traffic.
Broadcast/Multicast	The number of downlink data slots used for broadcast and multicast traffic.

Canopy MAC Acknowledgements	The number of downlink data slots used as ACKs.
Registration Messages	The number of downlink data slots used for registration messages.
Uplink Counts	
Total	This indicates the sum of all uplink data slots used in configured interval.
Per Frame Average	This indicates the average data per frame in the uplink traffic.
Low Priority	The number of uplink data slots used for low priority uplink traffic.
High Priority	The number of uplink data slots used for high priority uplink traffic.
Canopy MAC Acknowledgements	The number of uplink data slots used as ACKs.
Contention Slots	The number of (reserved contention slots + unscheduled symbols that can be used as contention slots) Contention slots configured by the operator.
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.
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.

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 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 34 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 ([Table 228](#)).
- 5 Select a recovery option

Figure 186 Recovery Options page

The screenshot shows the Cambium Networks Radio Recovery Console interface. At the top, there is a message: "Normal boot in 44 seconds". Below this, a "General" tab is selected. The main title is "Radio Recovery Console" with the MAC address "0A:00:3E:BB:00:F6". Under "Boot Selection", there are two buttons: "Boot - Default Mode" and "Boot - Normal". Under "Device Information", the following details are listed:

Software Version :	CANOPY 14.0
IP :	169.254.1.1
Netmask :	255.255.0.0
Gateway :	169.254.1.254

Under "Backup Recovery", there is a "Choose File" input field with a "Select" button and the value "CANOPY 14.0".

Table 228 Recovery Options attributes

Attribute	Meaning
Boot Selection	<p>Boot – Default Mode: Use this option to temporarily set the IP and Ethernet attributes to factory defaults until the next reboot.</p> <p>Boot – Normal: Use this option to reboot the unit.</p>
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 <http://www.best-tronics.com/cambium.htm> as Part BT-0583 (RJ-11 Default Plug).

Alternatively, you can fabricate an override plug. See **Override plug cable** on page 5-16 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 35 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 10: 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](#) on page 10-2 contains specifications of the 450 Platform Family, ODU specifications including RF bands, channel width and link loss.
- [Data network specifications](#) on page 10-33 shows the 450 Platform Family Ethernet interface specifications.
- [Compliance with safety standards](#) on page 4-22 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](#) on page 10-36 describes how the 450 Platform Family complies with the radio regulations that are enforced in various countries.
- [Equipment Disposal](#) on page 10-38 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 PMP 450m Series - AP

The PMP 450m AP conforms to the specifications listed in [Table 229](#).

Table 229 PMP 450m Series - AP specifications

Category	Specification
Model Number	PMP 450m AP
Spectrum	
Channel Spacing	Configurable on 2.5 MHz increments
Frequency Range	5150 to 5925 MHz
Channel Bandwidth	20 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) @ 20 MHz Channel	5.8 GHz 5.4 GHz 1x = - 93.5 dBm, 2x = -88.6 dBm, 4x = -81.5 dBm, 6x = -75.9.0 dBm, 8x = -67.8 dBm 1x = - 93.0 dBm, 2x = -88.2 dBm, 4x = -82.1 dBm, 6x = -76.0 dBm, 8x = -68.2 dBm
Performance	

Subscriber Per Sector	Up to 238				
ARQ	Yes				
Cyclic Prefix	1/16				
Frame Period	2.5 ms				
Modulation Levels (Adaptive)	Modulation Levels	MCS	SNR (in dB)		
	2x	QPSK	10		
	4x	16QAM	17		
	6x	64QAM	24		
	8x	256QAM	32		
Latency	10 ms, typical (MU-MIMO introduces additional latency only for the low priority traffic)				
Maximum Deployment Range	Up to 40 miles (64 km)				
GPS Synchronization	Yes, via Autosync (uGPS)				
Quality of Service	Diffserv QoS				
Link Budget					
Antenna Beam Width	5 GHz	90° integrated sector (Dual polarity, H+V)			
Antenna Gain	+14 dBi				
Maximum Transmit Power	+24 dBm combined				
Physical					
Data, Sync/AUX and SFP port	RJ45	<ul style="list-style-type: none"> 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 # C000065L007A				
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 lbs)
Wind Loading – Front Facing	@90 mph / 144 kph	
	@110 mph / 177 kph	
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	56-bit DES, FIPS-197 128-bit AES	

(*) 5.1 and 5.2 bands are not supported in 15.0.1 release.

Specifications for PMP 450i Series - AP

The PMP 450i AP conforms to the specifications listed in [Table 230](#).

Table 230 PMP 450i Series - AP specifications

Category	Specification	
Model Number	PMP 450i AP	
Spectrum		
Channel Spacing	5, 7, 10, 15, 20 and 30 MHz Channel Bandwidth Configurable on 2.5 MHz increments	
Frequency Range	902 to 928 MHz <u>3300 - 3900 MHz</u> 4900 - 5925 MHz	
Channel Bandwidth	902 – 928 MHz	5, 7, 10 and 20 MHz <u>3300 - 3900 MHz</u> <u>5, 7, 10, 15, 20, and 30 MHz</u>
	4900 – 5925 MHz	5, 10, 15, 20 and 30 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		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz 4.9 GHz	1x = -91.9 dBm, 2x = -86.7 dBm, 4x = -80.9 dBm, 6x = -75 dBm, 8x = -68.8 dBm 1x = -91.6 dBm, 2x = -87.6 dBm, 4x = -80.4 dBm, 6x = -73.2 dBm, 8x = -66 dBm

	5.4 GHz	1x = -92 dBm, 2x = -87 dBm, 4x = -80.8 dBm, 6x = -73.7 dBm, 8x = -66.6 dBm
	5.8 GHz	1x = -91.5 dBm, 2x = -87 dBm, 4x = -80.2 dBm, 6x = -73.1 dBm, 8x = -66 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 MHz	1x = -90 dBm, 2x = -85.9 dBm, 4x = -79.8 dBm, 6x = -73.6 dBm, 8x = -67.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -90.6 dBm, 2x = -85.2 dBm, 4x = -79.1 dBm, 6x = -73.2 dBm, 8x = -66.2 dBm
	4.9 GHz	1x = -89.1 dBm, 2x = -85 dBm, 4x = -77.9 dBm, 6x = -71.8 dBm, 8x = -64.6 dBm
	5.4 GHz	1x = -89.5 dBm, 2x = -85.4 dBm, 4x = -78.2 dBm, 6x = -72.2 dBm, 8x = -64.8 dBm
	5.8 GHz	1x = -89.5 dBm, 2x = -84.7 dBm, 4x = -77.8 dBm, 6x = -71.6 dBm, 8x = -64 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -87.2 dBm, 2x = -83 dBm, 4x = -75.8 dBm, 6x = -69.6 dBm, 8x = -62.6 dBm
	5.4 GHz	1x = -87.2 dBm, 2x = -83.3 dBm, 4x = -76.2 dBm, 6x = -70.1 dBm, 8x = -63 dBm
	5.8 GHz	1x = -87.7 dBm, 2x = -82.7 dBm, 4x = -75.5 dBm, 6x = -69.6 dBm, 8x = -62.4 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -86.99 dBm, 2x = -82 dBm, 4x = -75.9 dBm, 6x = -69.9 dBm, 8x = -62.9 dBm
	4.9 GHz	1x = -86.1 dBm, 2x = -82.1 dBm, 4x = -74.8 dBm, 6x = -68.8 dBm, 8x = -61.7 dBm
	5.4 GHz	1x = -86.6 dBm, 2x = -81.3 dBm, 4x = -75.5 dBm, 6x = -68.6 dBm, 8x = -62 dBm
	5.8 GHz	1x = -85.8 dBm, 2x = -80.7 dBm, 4x = -74.6 dBm, 6x = -68.7 dBm, 8x = -61 dBm
	4.9 GHz	1x = -84.1 dBm, 2x = -80 dBm, 4x = -73 dBm, 6x = -66.4 dBm, 8x = -59.6 dBm

Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	5.4 GHz	1x = -84.5 dBm, 2x = -82 dBm, 4x = -75.3 dBm, 6x = -67.4 dBm, 8x = -60.2 dBm	
	5.8 GHz	1x = -84.1 dBm, 2x = -80 dBm, 4x = -73 dBm, 6x = -66.5 dBm, 8x = -59.4 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	16QAM	17
	6x	64QAM	24
	8x	256QAM	32
Latency	3 - 5 ms		
Maximum Deployment Range	Up to 40 miles (64 km)		
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)	
	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	
	5 GHz	17 dBi integrated 90° sector 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 900MHz)	
Physical			

Sync/AUX port	RJ45	<ul style="list-style-type: none"> • 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)
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		56-bit DES, FIPS-197 128-bit AES

Specifications for PMP 450i Series - SM

The PMP 450i SM conforms to the specifications listed in [Table 231](#).

Table 231 PMP 450i Series - SM specifications

Category	Specification	
Model Number	PMP 450i SM	
Spectrum		
Channel Spacing	5, <u>7</u> , 10, 15, 20 and 30 Channel Bandwidth Configurable on 2.5 MHz increments	
Frequency Range	<u>3300 – 3900 MHz</u> 4900 - 5925 MHz	
Channel Bandwidth	3300 – 3900 MHz	5, 7, 10, 15, 20 and 30 MHz
	4900 – 5925 MHz	5, 10, 15, 20 and 30 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		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz 5.4 GHz 5.8 GHz	1x = -92.5 dBm, 2x = -88.5 dBm, 4x = -81 dBm, 6x = -74.2 dBm, 8x = -66 dBm 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm

Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -90.2 dBm, 2x = -85.2 dBm, 4x = -78.8 dBm, 6x = -71.4 dBm, 8x = -64.5 dBm
	5.4 GHz	1x = -90 dBm, 2x = -85.8 dBm, 4x = -78.5 dBm, 6x = -72.2 dBm, 8x = -65.8 dBm
	5.8 GHz	1x = -89.9 dBm, 2x = -84.9 dBm, 4x = -78.5 dBm, 6x = -71.2 dBm, 8x = -63.8 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -88.2 dBm, 2x = -83.1 dBm, 4x = -76.9 dBm, 6x = -70.5 dBm, 8x = -62.3 dBm
	5.4 GHz	1x = -87.7 dBm, 2x = -83.9 dBm, 4x = -76.6 dBm, 6x = -70.4 dBm, 8x = -63 dBm
	5.8 GHz	1x = -88 dBm, 2x = -82.9 dBm, 4x = -76.7 dBm, 6x = -69.4 dBm, 8x = -62.3 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -87 dBm, 2x = -81.8 dBm, 4x = -75.8 dBm, 6x = -68.5 dBm, 8x = -61.4 dBm
	5.4 GHz	1x = -87 dBm, 2x = -82.8 dBm, 4x = -75.6 dBm, 6x = -69.3 dBm, 8x = -61.6 dBm
	5.8 GHz	1x = -85.9 dBm, 2x = -81.5 dBm, 4x = -74.8 dBm, 6x = -68.7 dBm, 8x = -61.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -84.9 dBm, 2x = -80.9 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.3 dBm
	5.4 GHz	1x = -85.2 dBm, 2x = -80.2 dBm, 4x = -74.1 dBm, 6x = -67.9 dBm, 8x = -59.8 dBm
	5.8 GHz	1x = -84.9 dBm, 2x = -80 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.4 dBm
Performance		
ARQ	Yes	
Cyclic Prefix	1/16	
Frame Period	2.5 ms or 5.0 ms	
Modulation Levels (Adaptive)	Modulation Levels	MCS
	2x	QPSK
		10

	4x	16QAM	17		
	6x	64QAM	24		
	8x	256QAM	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			
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)				
Physical					
Sync/AUX port	RJ45	<ul style="list-style-type: none"> • 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				
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		56-bit DES, FIPS-197 128-bit AES

Specifications for PTP 450i Series - BH

The PTP 450i BH conforms to the specifications listed in [Table 232](#).

Table 232 PTP 450i Series - BH specifications

Category	Specification	
Model Number	PTP 450i BH	
Spectrum		
Channel Spacing	5, 10, 15, 20 and 30 MHz Channel Bandwidth Configurable on 2.5 MHz increments	
Frequency Range	902 to 928 MHz 4900 - 5925 MHz	
Channel Bandwidth	902 – 928 MHz	5, 7, 10 and 20 MHz
	4900 – 5925 MHz	5, 10, 15, 20 and 30 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		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	900 MHz 4.9 GHz 5.4 GHz 5.8 GHz	1x = -93 dBm, 2x = -88 dBm, 4x = -81 dBm, 6x = -75 dBm, 8x = -68 dBm 1x = -93 dBm, 2x = -88.3 dBm, 4x = -82 dBm, 6x = -74.4 dBm, 8x = -67.9 dBm 1x = -93 dBm, 2x = -88.4 dBm, 4x = -81.3 dBm, 6x = -75.5 dBm, 8x = -67.8 dBm 1x = -93.2 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74.3 dBm, 8x = -66.8 dBm

Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 MHz	1x = -91 dBm, 2x = -86 dBm, 4x = -80 dBm, 6x = -74 dBm, 8x = -67 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -90 dBm, 2x = -84 dBm, 4x = -79 dBm, 6x = -73 dBm, 8x = -66 dBm
	4.9 GHz	1x = -90 dBm, 2x = -85 dBm, 4x = -78.6 dBm, 6x = -72.5 dBm, 8x = -65 dBm
	5.4 GHz	1x = -87.6 dBm, 2x = -82.5 dBm, 4x = -76.5 dBm, 6x = -70.5 dBm, 8x = -61.5 dBm
	5.8 GHz	1x = -89.9 dBm, 2x = -84.8 dBm, 4x = -78.5 dBm, 6x = -71.4 dBm, 8x = -64 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	4.9 GHz	1x = -88 dBm, 2x = -83.9 dBm, 4x = -76.9 dBm, 6x = -70.7 dBm, 8x = -63.6 dBm
	5.4 GHz	1x = -88 dBm, 2x = -84.2 dBm, 4x = -76.9 dBm, 6x = -70.8 dBm, 8x = -62.7 dBm
	5.8 GHz	1x = -87.8 dBm, 2x = -82.8 dBm, 4x = -6.6 dBm, 6x = 69.3 dBm, 8x = -62.1 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -86 dBm, 2x = -82 dBm, 4x = -75 dBm, 6x = -69 dBm, 8x = -62 dBm
	4.9 GHz	1x = -86.9 dBm, 2x = -82.5 dBm, 4x = -75.7 dBm, 6x = -69.4 dBm, 8x = -62.3 dBm
	5.4 GHz	1x = -84.5 dBm, 2x = -80.5 dBm, 4x = -73.4 dBm, 6x = -66.4 dBm, 8x = -56.4 dBm
	5.8 GHz	1x = -85.8 dBm, 2x = -81.7 dBm, 4x = -75 dBm, 6x = -68.4 dBm, 8x = -61.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	4.9 GHz	1x = -85 dBm, 2x = -80.7 dBm, 4x = -73.7 dBm, 6x = -66.5 dBm, 8x = -60 dBm
	5.4 GHz	1x = -85.3 dBm, 2x = -80.5 dBm, 4x = -74.2 dBm, 6x = -67.2 dBm, 8x = -60 dBm
	5.8 GHz	1x = -84.6 dBm, 2x = -80 dBm, 4x = -73.3 dBm, 6x = -66.5 dBm, 8x = -59.1 dBm

Performance

ARQ	Yes	
Cyclic Prefix	1/16	
Frame Period	2.5 ms or 5.0 ms	
Modulation Levels (Adaptive)	Modulation Levels	MCS
	2x	QPSK
		SNR (in dB)
		10

	4x	16QAM	17		
	6x	64QAM	24		
	8x	256QAM	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	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	<ul style="list-style-type: none"> • 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	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")
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		56-bit DES, FIPS-197 128-bit AES

Specifications for PMP 450 Series - AP

The PMP 450 AP conforms to the specifications listed in [Table 233](#).

Table 233 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
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	2.4 GHz	1x = -92 dBm, 2x = -87.8 dBm, 4x = -80.4 dBm, 6x = -74.4 dBm, 8x = -66.5 dBm
	3.5 GHz	1x = -92.4 dBm, 2x = -88.3 dBm, 4x = -81.3 dBm, 6x = -75.3 dBm, 8x = -67.7 dBm

	3.65 GHz	1x = -10 dBm, 2x = -86.1 dBm, 4x = -80.2 dBm, 6x = -73.1 dBm, 8x = -66 dBm
	5.4 GHz	1x = -88.7 dBm, 2x = -84 dBm, 4x = -77.6 dBm, 6x = -71.6 dBm, 8x = -63.7 dBm
	5.8 GHz	1x = -91.5 dBm, 2x = -87 dBm, 4x = -80.2 dBm, 6x = -73.1 dBm, 8x = -66 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	1x = -90.5 dBm, 2x = -86.4 dBm, 4x = -80.3 dBm, 6x = -73.4 dBm, 8x = -66.9 dBm
	3.65 GHz	1x = -89.1 dBm, 2x = -85.1 dBm, 4x = -78.1 dBm, 6x = -72.1 dBm, 8x = -64.5 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	2.4 GHz	1x = -89.9 dBm, 2x = -85.6 dBm, 4x = -80 dBm, 6x = -73.5 dBm, 8x = -66.9 dBm
	3.5 GHz	1x = -89.8 dBm, 2x = -85.6 dBm, 4x = -80 dBm, 6x = -73 dBm, 8x = -66.3 dBm
	3.65 GHz	1x = -89 dBm, 2x = -85.2 dBm, 4x = -78.1 dBm, 6x = -72.1 dBm, 8x = -64.5 dBm
	5.4 GHz	1x = -86.1 dBm, 2x = -82.2 dBm, 4x = -75.3 dBm, 6x = -69.3 dBm, 8x = -61.3 dBm
	5.8 GHz	1x = -86 dBm, 2x = -82.2 dBm, 4x = -75.1 dBm, 6x = -69 dBm, 8x = -60 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	2.4 GHz	1x = -88.4 dBm, 2x = -84.1 dBm, 4x = -77.1 dBm, 6x = -71.4 dBm, 8x = -65 dBm
	3.5 GHz	1x = -88.5 dBm, 2x = -84.5 dBm, 4x = -77.5 dBm, 6x = -71.5 dBm, 8x = -64.3 dBm
	3.65 GHz	1x = -87.4 dBm, 2x = -83.7 dBm, 4x = -76.3 dBm, 6x = -69.7 dBm, 8x = -62.2 dBm
	5.4 GHz	1x = -84.2 dBm, 2x = -80.2 dBm, 4x = -73.2 dBm, 6x = -67.2 dBm, 8x = -60 dBm
	5.8 GHz	1x = -85 dBm, 2x = -80 dBm, 4x = -74.3 dBm, 6x = -67 dBm, 8x = -58 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	2.4 GHz	1x = -85 dBm, 2x = -85 dBm, 4x = -79 dBm, 6x = -72 dBm, 8x = -66 dBm
	3.5 GHz	1x = -85 dBm, 2x = -85 dBm, 4x = -79 dBm, 6x = -72 dBm, 8x = -65 dBm
	3.65 GHz	1x = -86 dBm, 2x = -86 dBm, 4x = -78 dBm, 6x = -71 dBm, 8x = -63 dBm

	5.4 GHz	1x = -81 dBm, 2x = -81 dBm, 4x = -75 dBm, 6x = -68 dBm, 8x = -59 dBm
	5.8 GHz	1x = -82 dBm, 2x = -82 dBm, 4x = -75 dBm, 6x = -69 dBm, 8x = -60 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	2.4 GHz	1x = -85.4 dBm, 2x = -80.4 dBm, 4x = -74 dBm, 6x = -68 dBm, 8x = -61 dBm
	3.5 GHz	1x = -85.5 dBm, 2x = -81.5 dBm, 4x = -74.5 dBm, 6x = -68.2 dBm, 8x = -61.3 dBm
	3.65 GHz	1x = -84 dBm, 2x = -79.5 dBm, 4x = -73.4 dBm, 6x = -66.4 dBm, 8x = -59.2 dBm
	5.4 GHz	1x = -81 dBm, 2x = -76.9 dBm, 4x = -70.9 dBm, 6x = -63.8 dBm, 8x = -55.8 dBm
	5.8 GHz	1x = -80.9 dBm, 2x = -76.8 dBm, 4x = -70 dBm, 6x = -63.8 dBm, 8x = -55 dBm

Performance

Subscribers Per Sector	Up to 238		
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	16QAM	17
	6x	64QAM	24
	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)
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	56-bit DES, AES

Specifications for PMP 450 Series - SM

The PMP 450 SM conforms to the specifications listed in [Table 234](#).

Table 234 PMP 450 Series - SM specifications

Category	Specification	
Model Number	PMP 450 SM	
Spectrum		
Channel Spacing	5, 7, 10, 15, 20 and 30 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, 2.4, 3.5 GHz, 3.65 GHz and 5 GHz	5, 7, 10 and 20 MHz 5, 10, 15, 20 and 30 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		
900 MHz	1x = -91 dBm, 2x = -91 dBm, 4x = -85 dBm, 6x = -78 dBm, 8x = -70 dBm	

Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	2.4 GHz	1x = -92.5 dBm, 2x = -89.9 dBm, 4x = -82.9 dBm, 6x = -75.9, dBm, 8x = -67.9 dBm
	3.5 GHz	1x = -93.5 dBm, 2x = -89.4 dBm, 4x = -83.5 dBm, 6x = -76.4 dBm, 8x = -68.3 dBm
	3.65 GHz	1x = -91.3 dBm, 2x = -89.1 dBm, 4x = -82.2 dBm, 6x = -75.2 dBm, 8x = -67.3 dBm
	5.4 GHz	1x = -89.3 dBm, 2x = -87.3 dBm, 4x = -80.3 dBm, 6x = -74.3 dBm, 8x = -66.3 dBm
	5.8 GHz	1x = -89 dBm, 2x = -87 dBm, 4x = -80 dBm, 6x = -73.9 dBm, 8x = -64.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	900 MHz	1x = -91 dBm, 2x = -84 dBm, 4x = -83 dBm, 6x = -77 dBm, 8x = -71 dBm
	3.5 GHz	1x = -92.2 dBm, 2x = -88.5 dBm, 4x = -81.4 dBm, 6x = -74.5 dBm, 8x = -67.6 dBm
	3.65 GHz	1x = -90.4 dBm, 2x = -87.3 dBm, 4x = -80.6 dBm, 6x = -73 dBm, 8x = -65.6 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	900 MHz	1x = -90 dBm, 2x = -83 dBm, 4x = -80 dBm, 6x = -74 dBm, 8x = -68 dBm
	2.4 GHz	1x = -88 dBm, 2x = -88 dBm, 4x = -81 dBm, 6x = -75 dBm, 8x = -69 dBm
	3.5 GHz	1x = -88 dBm, 2x = -88 dBm, 4x = -81 dBm, 6x = -76 dBm, 8x = -68 dBm
	3.65 GHz	1x = -86 dBm, 2x = -86 dBm, 4x = -80 dBm, 6x = -73 dBm, 8x = -66 dBm
	5.4 GHz	1x = -84 dBm, 2x = -84 dBm, 4x = -78 dBm, 6x = -72 dBm, 8x = -63 dBm
	5.8 GHz	1x = -84 dBm, 2x = -84 dBm, 4x = -77 dBm, 6x = -71 dBm, 8x = -63 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	2.4 GHz	1x = -88.5 dBm, 2x = -84.5 dBm, 4x = -77.5 dBm, 6x = -71.5 dBm, 8x = -64.5 dBm
	3.5 GHz	1x = -89.5 dBm, 2x = -84.5 dBm, 4x = -78.5 dBm, 6x = -71.5 dBm, 8x = -65.1 dBm
	3.65 GHz	1x = -87.3 dBm, 2x = -84.3 dBm, 4x = -77.3 dBm, 6x = -70.3 dBm, 8x = -62.2 dBm
	5.4 GHz	1x = -84.5 dBm, 2x = -82.5 dBm, 4x = -75.5 dBm, 6x = -69.5 dBm, 8x = -59.5 dBm

	5.8 GHz	1x = -84 dBm, 2x = -84 dBm, 4x = -77 dBm, 6x = -71 dBm, 8x = -63 dBm	
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	900 MHz	1x = -87 dBm, 2x = -80 dBm, 4x = -77 dBm, 6x = -72 dBm, 8x = -65 dBm	
	2.4 GHz	1x = -86.9 dBm, 2x = -82.9 dBm, 4x = -75.9 dBm, 6x = -69.9 dBm, 8x = -63.5 dBm	
	3.5 GHz	1x = -87.5 dBm, 2x = -83.5 dBm, 4x = -76.5 dBm, 6x = -69.5 dBm, 8x = -63.1 dBm	
	3.65 GHz	1x = -86 dBm, 2x = -83 dBm, 4x = -76.2 dBm, 6x = -68.2 dBm, 8x = -61 dBm	
	5.4 GHz	1x = -83.4 dBm, 2x = -81.7 dBm, 4x = -74.4 dBm, 6x = -67.2 dBm, 8x = -57.3 dBm	
	5.8 GHz	1x = -84 dBm, 2x = -80.5 dBm, 4x = -74 dBm, 6x = -66.9 dBm, 8x = -56 dBm	
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	2.4 GHz	1x = -85.9 dBm, 2x = -80.9 dBm, 4x = -73.9 dBm, 6x = -67.8 dBm, 8x = -60.9 dBm	
	3.5 GHz	1x = -86.5 dBm, 2x = -81.5 dBm, 4x = -74.5 dBm, 6x = -68.2 dBm, 8x = -61.3 dBm	
	3.65 GHz	1x = -84.3 dBm, 2x = -80.3 dBm, 4x = -74.3 dBm, 6x = -66.2 dBm, 8x = -58 dBm	
	5.4 GHz	1x = -82 dBm, 2x = -78.3 dBm, 4x = -72.3 dBm, 6x = -65.3 dBm, 8x = -55.3 dBm	
	5.8 GHz	1x = -81.7 dBm, 2x = -78.6 dBm, 4x = -71.6 dBm, 6x = -64.4 dBm, 8x = -54 dBm	
Performance			
Subscribers Per Sector	Up to 238		
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	16QAM	17
	6x	64QAM	24

	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, integrated 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				
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), (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)	
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	
Power Consumption	12 W	
Input Voltage	20 to 32 VDC	
Security		
Encryption	56-bit DES, AES	

Specifications for PTP 450 Series - BH

The PTP 450 BH conforms to the specifications listed in [Table 235](#).

Table 235 PTP 450i Series - BH specifications

Category	Specification
Model Number	PTP 450 BH
Spectrum	
Channel Spacing	5, 7, 10, 15, 20 and 30 MHz Channel Bandwidth Configurable on 2.5 MHz increments

Frequency Range	3.5 GHz	3300 – 3600 MHz
	3.65 GHz	3500 – 3850 MHz
	5 GHz	5470 – 5875 MHz
Channel Bandwidth		5, 7, 10, 15, 20 and 30 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)	
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	3.5 GHz	OFDM: 1x = -92 dBm, 2x = -90 dBm, 4x = -83 dBm, 6x = -76 dBm, 8x = -69 dBm
	3.6 GHz	OFDM: 1x = -94 dBm, 2x = -89.3 dBm, 4x = -82.3 dBm, 6x = -75.2 dBm, 8x = -68.4 dBm
	5.4 GHz	OFDM: 1x = -90.4 dBm, 2x = -86 dBm, 4x = -79.4 dBm, 6x = -73.2 dBm, 8x = -65.4 dBm
	5.8 GHz	OFDM: 1x = -90 dBm, 2x = -85.4 dBm, 4x = -79.4 dBm, 6x = -73.4 dBm, 8x = -64.9 dBm
Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel	3.5 GHz	OFDM: 1x = -90 dBm, 2x = -88 dBm, 4x = -81 dBm, 6x = -74 dBm, 8x = -67 dBm
	3.6 GHz	OFDM: 1x = -92 dBm, 2x = -87.3 dBm, 4x = -81.3 dBm, 6x = -74.3 dBm, 8x = -66.4 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	3.5 GHz	OFDM: 1x = -91 dBm, 2x = -87.2 dBm, 4x = -80 dBm, 6x = -73 dBm, 8x = -65.6 dBm
	3.6 GHz	OFDM: 1x = -90.4 dBm, 2x = -86.3 dBm, 4x = -80 dBm, 6x = -73 dBm, 8x = -64.5 dBm

	5.4 GHz	OFDM: 1x =-87.6 dBm, 2x = -82.5 dBm, 4x = -76.5 dBm, 6x = -70.5 dBm, 8x = -61.5 dBm
	5.8 GHz	OFDM: 1x =-87.5 dBm, 2x = -82.7 dBm, 4x = -76.8 dBm, 6x = -70.5 dBm, 8x = -61.4 dBm
Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel	3.5 GHz	OFDM: 1x =-89 dBm, 2x = -85 dBm, 4x = -78 dBm, 6x = -71.1 dBm, 8x = -64.7 dBm
	3.6 GHz	OFDM: 1x =-89 dBm, 2x = -84.3 dBm, 4x = -78 dBm, 6x = -71 dBm, 8x = -63 dBm
	5.4 GHz	OFDM: 1x =-85.6 dBm, 2x = -81.6 dBm, 4x = -74.5 dBm, 6x = -68.5 dBm, 8x = -57.5 dBm
	5.8 GHz	OFDM: 1x =-85.6 dBm, 2x = -80.9 dBm, 4x = -75 dBm, 6x = -68 dBm, 8x = -58 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	3.5 GHz	OFDM: 1x =-88 dBm, 2x = -84 dBm, 4x = -77 dBm, 6x = -70 dBm, 8x = -62.2 dBm
	3.6 GHz	OFDM: 1x =-87.3 dBm, 2x = -83.3 dBm, 4x = -76.3 dBm, 6x = -69.3 dBm, 8x = -62 dBm
	5.4 GHz	OFDM: 1x =-84.5 dBm, 2x = -80.5 dBm, 4x = -73.4 dBm, 6x = -66.4 dBm, 8x = -56.4 dBm
	5.8 GHz	OFDM: 1x =-84.8 dBm, 2x = -80.8 dBm, 4x = -74.7 dBm, 6x = -66.4 dBm, 8x = -56 dBm
Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel	3.5 GHz	OFDM: 1x =-86 dBm, 2x = -82 dBm, 4x = -75 dBm, 6x = -68 dBm, 8x = -60 dBm
	3.6 GHz	OFDM: 1x =-86 dBm, 2x = -81.3 dBm, 4x = -74.3 dBm, 6x = -67.3 dBm, 8x = -59 dBm
	5.4 GHz	OFDM: 1x =-82.5 dBm, 2x = -78.5 dBm, 4x = -71.5 dBm, 6x = -64.4 dBm, 8x = -53.4 dBm
	5.8 GHz	OFDM: 1x =-82.5 dBm, 2x = -78.5 dBm, 4x = -71.5 dBm, 6x = -64.4 dBm, 8x = -54 dBm
Performance		
ARQ	Yes	
Cyclic Prefix	1/16	
Frame Period	2.5 ms or 5.0 ms	
Modulation Levels (Adaptive)	Modulation Levels 2x	MCS QPSK SNR (in dB) 10

	4x	16QAM	17
	6x	64QAM	24
	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	
Transmit Power Range	5 GHz	9 dBi H+V, integrated patch 25 dBi H+V, integrated dish	
		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)	
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	<ul style="list-style-type: none"> • 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	56-bit DES, AES	

PSU specifications

The PMP/PTP 450i AC+DC Enhanced Power Injector conforms to the specifications listed in [Table 236](#).

Table 236 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 [Table 237](#).

Table 237 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'
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 30V 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 [Table 238](#).

Table 238 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 Series

Table 239 450 Series Ethernet bridging specifications

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



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 [Table 240](#).

Table 240 450 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		
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 Series	40 mi / 64 km (PMP) 186 mi / 299 km (PTP)
	3.65 GHz	PMP/PTP 450 Series	40 mi / 64 km (PMP) 186 mi / 299 km (PTP)
	5 GHz	PMP/PTP 450/450i Series and PMP 450m Series AP	40 mi / 64 km (PMP) 186 mi / 299 km (PTP)
Over-the-air encryption	DES, 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/pmp450>
- 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 [Table 241](#).

Table 241 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 192
	USA	FCC Part 15 Class B
5.4 GHz PMP/PTP 450 and 450i	Europe	ETSI EN 301 893 v1.6.1
	USA	FCC Part 15 Class B
5.8 GHz PMP/PTP 450 and 450i	Canada	RSS Gen and RSS 210
	USA	FCC Part 15 Class B
	Europe	ETSI EN 302 502 v1.2.1

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 [Table 242 on page 10-37](#).

Table 242 Country & Bands DFS setting

Region Code	Country Code	Band	AP	SM	Weather Radar Notch-Out
North America	Mexico	2.4 GHz	No effect	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 v1.7.1 DFS	No effect	No
		5.8 GHz	No effect	No effect	No
Europe	ETSI	5.4 GHz	ETSI EN 301 893 v1.7.1 DFS	ETSI EN 301 893 v1.7.1 DFS	Yes
		5.8 GHz	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS	Yes
Other-Regulatory	Other-FCC	2.4 GHz	No effect	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 v1.7.1 DFS	ETSI EN 301 893 v1.7.1 DFS	No
		5.8 GHz	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS	No

Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment



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 maximum transmit power

Maximum transmit power 900 MHz band

Table 243 Default combined transmit power per country – 900 MHz band PMP 450i Series

Countries	Device Type (AP/SM/BH)	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Mexico, Canada, Other FCC	Any	Any	5 MHz	-	36
			7 MHz	-	36
			10 MHz	-	36
			20 MHz	-	36
Brazil	Any	Any	5 MHz	-	36
			7 MHz	-	36
			10 MHz	-	36
			20 MHz	-	36
Other	Any	Any	Any	-	-

Maximum transmit power 2.4 GHz band

Table 244 Default combined transmit power per country – 2.4 GHz band PMP/PTP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Canada, Other FCC	AP	Sector	Any	18	36
		Integrated	Any	-	36
	SM, BH	Reflector	Any	24	36
		Integrated Dish (450d)	Any	11	36
Other	Any	Any	Any	30	-

Maximum transmit power 3.5 GHz band

Table 245 Default combined transmit power per country – 3.5 GHz band PMP/PTP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Other-ETSI	AP	Sector	Any	-	66
	SM, BH	Any	Any	-	63
Brazil, China, India, Indonesia, Mexico, Other	Any	Any	Any	-	-
Canada	Any	Any	Any	-	62
Australia	Any	Any	Any	-	63

Maximum transmit power 3.65 GHz band

Table 246 Default combined transmit power per country – 3.65 GHz band PMP/PTP 450

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Australia, India, Indonesia, Mexico, Other	Any	Any	Any	-	-
Other-ETSI	AP SM, BH	Any	Any	-	66 63
Canada, USA, Other-FCC	SM, BH	AP Integrated Reflector Integrated Dish (450d)	Sector Any	25 - - 18	43

Maximum transmit power 4.9 GHz band

Table 247 Default combined transmit power per country – 4.9 GHz band PMP/PTP 450/450i Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Mexico, Canada, Other FCC	AP	Sector	5 MHz 10 MHz 20 MHz	24 24 23	40 40 39
		Omni	5 MHz 10 MHz 20 MHz	24 24 23	35 36 35
		Flat plate	5 MHz 10 MHz 20 MHz	24 24 23	51 51 50
	SM, BH	4ft parabolic	5 MHz 10 MHz	24 24	52 55

			20 MHz	23	56
			5 MHz	24	52
		6ft parabolic	10 MHz	24	55
			20 MHz	23	58
			5 MHz	23	54
Brazil	Any	Any	10 MHz	27	57
			20 MHz	27	60
Other	Any	Any	Any	27	-

Maximum transmit power 5.1 GHz band

Table 248 Default combined transmit power per Country – 5.1 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	12	28
			10 MHz	15	31
			20 MHz	16	32
	SM, BH	Omni	5 MHz	16	28
			10 MHz	19	31
			20 MHz	22	34
	Flat plate		5 MHz	-2	25
			10 MHz	1	28
			20 MHz	3	30
Mexico	Any	Any	4ft parabolic	5 MHz	6
				10 MHz	9
				20 MHz	9
					39
					42
					43
					-
					17
					20
Other	Any	Any		20 MHz	23
					-

Maximum transmit power 5.2 GHz band

Table 249 Default combined transmit power per country – 5.2 GHz band

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	6	22
			10 MHz	9	25
			20 MHz	12	28
	Omni	Omni	5 MHz	10	22
			10 MHz	13	25
			20 MHz	16	28
	SM, BH	Flat plate	5 MHz	-7	20
			10 MHz	-4	23
			20 MHz	-1	26
		4ft parabolic	5 MHz	-13	19
			10 MHz	-11	22
			20 MHz	-8	25
	Mexico	Any	5 MHz	-	24
			10 MHz	-	27
			20 MHz	-	30
Other	Any	Any	Any	27	-

Table 250 Default combined transmit power per Country – 5.2 GHz band PMP 450m Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	20 MHz	NA	32
Mexico	Any	Any	20 MHz	NA	32
Other	Any	Any	Any	NA	-

Maximum transmit power 5.4 GHz band

Table 251 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	20 MHz	29.6
ETSI	AP	Sector	20 MHz	30
RoW	AP	Sector	20 MHz	38

Table 252 Default combined transmit power per country – 5.4 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	6	22
			10 MHz	9	25
			20 MHz	12	28
	SM, BH	Omni	5 MHz	10	22
			10 MHz	13	25
			20 MHz	16	28
		Flat plate	5 MHz	-7	20
			10 MHz	-4	23
			20 MHz	-1	26
	4ft parabolic	Any	5 MHz	-6	21
			10 MHz	-3	24
			20 MHz	0	27
Brazil	Any	Any	10 MHz	19	27
			20 MHz	23	30
Mexico	Any	Any	10 MHz	-	27
			20 MHz	-	30
Other	Any	Any	Any	27	-
ETSI	Any	Any	5 MHz	-	24
			10 MHz	-	27
			20 MHz	-	30
Australia	Any	Any	10 MHz	-	30
			20 MHz	-	30

Table 253 Default combined transmit power per country – 5.4 GHz band PMP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
United States, Canada, Brazil, Australia, Denmark, Finland, Germany, Greece, Liechtenstein, Norway, Portugal, Spain, UK, Vietnam	AP	Sector (18 dBi – 1dB cable loss)	10 MHz	10	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 (18 dBi – 1dB cable loss)	10 MHz	10	27*
Algeria	AP	Sector (18 dBi – 1dB cable loss)	20 MHz	13	30
Other	AP	Sector (18 dBi – 1dB cable loss)	10 MHz	19	No EIRP limit
			20 MHz	19	No EIRP limit

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

Maximum transmit power 5.8 GHz band

Table 254 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	20 MHz	32
Mexico	AP	Sector	20 MHz	23
Other	AP	Sector	20 MHz	-

Table 255 Default combined transmit power per country – 5.8 GHz band PMP/PTP 450i Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Canada, Brazil, Other FCC	AP	Sector, Omni	5 MHz	-	36
			10 MHz	-	36
			20 MHz	-	36
	SM, BH	Flat plate, 4ft parabolic, 6ft parabolic	5 MHz	27	-
				27	-
			10 MHz	(26 for 5733 MHz and below)	
			20 MHz	27	-
Mexico	Any	Any	5 MHz	-	30
			10 MHz	-	33
			20 MHz	-	36
Other	Any	Any	5 MHz	27	-

Table 256 Default combined transmit power per country – 5.8 GHz band PMP 450 Series

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Australia, India, United States	AP	Sector (18 dBi – 1dB cable loss)	5 MHz	19	36
			10 MHz	19	36
			20 MHz	19	36
Brazil, Vietnam	AP	Sector (18 dBi – 1dB cable loss)	5 MHz	7	24
			10 MHz	10	27
			20 MHz	13	30
Canada	AP	Sector (18 dBi – 1dB cable loss)	5 MHz	9	26
			10 MHz	19	36
			20 MHz	19	36
Denmark, Finland, Germany, Greece, Iceland, Ireland, Liechtenstein, Norway, Portugal, Serbia, Spain, Switzerland, United Kingdom,	AP	Sector (18 dBi – 1dB cable loss)	5 MHz	-	-
			10 MHz	16	33
			20 MHz	19	36
Indonesia	AP	Sector (18 dBi – 1dB cable loss)	5 MHz	13	30
			10 MHz	19	36
			20 MHz	19	36

Country specific frequency range

Frequency range 900 MHz band

Table 257 Frequency range per country – 900 MHz band

Region	Country	Channel center Frequency limits (MHz)	
		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	918	926
	New Zealand	921 (7 MHz)	928 (7 MHz)
		921.5 (5 MHz)	928 (5 MHz)
	Brazil	902	907.5
		915	928
	Ecuador	902	928
	Colombia	902	928
	Venezuela	902	928

Frequency range 2.4 GHz band

Table 258 Frequency range per country – 2.4 GHz band PMP/PTP 450 Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Canada, United States, Other, Other- FCC	Any	5 MHz	2402.5	24 <u>8175</u>
		10 MHz	2405	24 <u>78.570</u>
		<u>15 MHz</u>	<u>2407.5</u>	<u>2476</u>
		20 MHz	241 <u>07.5</u>	24 <u>73.560</u>

Frequency range 3.5 GHz band

Table 259 Frequency range per country – 3.5 GHz band PMP/PTP 450 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, Indonesia	Any	5 MHz	3302.5	3397.5
		7 MHz	3303.5	3396.5
		10 MHz	3305	3395
		20 MHz	3310	3390

Frequency range 3.65 GHz band

Table 260 Frequency range per country – 3.65 GHz band PMP/PTP 450 Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
Australia, India, Other	Any	5 MHz	3302.53502.5	38473797.5-5
		10 MHz	35053305	38453795
		15 MHz	3307.5	3792.5
		20 MHz	35103310	38403790
		30 MHz	3315	3785
		40 MHz	3320	3780
Other – ETSI	Any	5 MHz	3402.53552.5	3847.53797.5
		10 MHz	34053555	38453795
		15 MHz	3407.5	3842.5
		20 MHz	34103560	38403790
		30 MHz	3415	3835
		40 MHz	3420	3830
Indonesia	Any	5 MHz	3602.5	3797.5
		10 MHz	3605	3795
		20 MHz	3610	3790
		40 MHz	3620	3780
Mexico	Any	5 MHz	3302.53552.5	3747.5
		10 MHz	33053555	3745
		20 MHz	33103560	3740
		40 MHz	3320	3730

Frequency range 4.9 GHz band

Table 261 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
		<u>15 MHz</u>	<u>4947.5</u>	<u>4982.5</u>
		20 MHz	4950	4980
		<u>30 MHz</u>	<u>4955</u>	<u>4975</u>
		<u>40 MHz</u>	<u>4960</u>	<u>4970</u>
Brazil	Any	5 MHz	4912.5	4987.5
		10 MHz	4915	4985
		<u>15 MHz</u>	<u>4917.5</u>	<u>4982.5</u>
		20 MHz	4920	4980
		<u>30 MHz</u>	<u>4925</u>	<u>4975</u>
		<u>40 MHz</u>	<u>4930</u>	<u>4970</u>
Other	Any	5 MHz	<u>4942.5</u> 4902.5	<u>4987.5</u> 4997.5
		10 MHz	<u>4945</u> 4905	<u>4985</u> 4995
		20 MHz	<u>4950</u> 4910	<u>4980</u> 4990
		<u>40 MHz</u>	<u>4960</u>	<u>4970</u>

Frequency range 5.4 GHz band

Table 262 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
		20 MHz	5480	5715
		40 MHz	5490	5705
Other	FCC	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	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	5480	5590
			5660	5715
		30 MHz	5485	5585
			5665	5710
		40 MHz	5490	5580
			5670	5705

Table 263 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
		20 MHz	5480	5715
	Other-FCC (Any non-US country that follows FCC rules)	10 MHz	5475	5595
			5645	5720
		20 MHz	5465	5490
			5640	5715
	Other-ETSI (Any country that follows ETSI rules)	10 MHz	5475	5595
			5645	5720
		20 MHz	5465	5490
			5640	5715
Oceania	Australia	10 MHz	5475	5595
			5645	5720
			5465	5490
			5640	5715
		20 MHz	5475	<u>5597.55595</u>
			<u>56555645</u>	<u>5722.55720</u>
			<u>15 MHz</u>	<u>5477.5</u>
			<u>5657.5</u>	<u>5717.5</u>
		30 MHz	<u>54805465</u>	<u>55905490</u>
			<u>56605640</u>	5715
			<u>5485</u>	<u>5585</u>
			<u>5665</u>	<u>5710</u>
			<u>5490</u>	<u>5580</u>
			<u>5670</u>	<u>5705</u>
South America	Brazil	10 MHz	5475	5720
			<u>15 MHz</u>	<u>5477.5</u>
		20 MHz	5480	5715
			<u>30 MHz</u>	<u>5485</u>
		40 MHz	<u>5490</u>	<u>5710</u>
			<u>5670</u>	<u>5705</u>
Asia	Vietnam	10 MHz	5475	5720
			<u>15 MHz</u>	<u>5477.5</u>

Africa	Algeria	20 MHz	5480	5715
		<u>30 MHz</u>	<u>5485</u>	<u>5710</u>
		<u>40 MHz</u>	<u>5490</u>	<u>5705</u>
		5 MHz	5472.5	<u>5667.55597.5</u>
		10 MHz	5475	<u>56655595</u>
		<u>15 MHz</u>	<u>5477.5</u>	<u>5662.5</u>
		20 MHz	<u>54805465</u>	<u>56605490</u>
		<u>30 MHz</u>	<u>5485</u>	<u>5655</u>
		<u>40 MHz</u>	<u>5490</u>	<u>5650</u>
		10 MHz	5475	5595
Europe	Europe (Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Norway, Portugal, Serbia, Spain, Switzerland, United Kingdom)		<u>56555645</u>	5720
		<u>15 MHz</u>	<u>5477.5</u>	<u>5592.5</u>
			<u>5657.5</u>	<u>5717.5</u>
		20 MHz	5465	5490
			<u>56605640</u>	5715
		<u>30 MHz</u>	<u>5485</u>	<u>5585</u>
			<u>5665</u>	<u>5710</u>
		<u>40 MHz</u>	<u>5490</u>	<u>5580</u>
			<u>5670</u>	<u>5705</u>

Frequency range 5.8 GHz band

Table 264 Frequency range per country – 5.8 GHz band PMP/PTP 450i Series

Countries	Antenna Type	Channel BW	Channel center Frequency limits (MHz)	
			Lower	Upper
USA, Canada, Brazil, Other FCC	Any	5 MHz	<u>5727.55730</u>	<u>5847.55845</u>
		10 MHz	5730	5845
		<u>15 MHz</u>	<u>5732.5</u>	<u>5842.5</u>
		20 MHz	5735	5840
		<u>30 MHz</u>	<u>5740</u>	<u>5835</u>
		<u>40 MHz</u>	<u>5745</u>	<u>5830</u>
Mexico	Any	5 MHz	5727.5	5847.5
		10 MHz	5730	5845