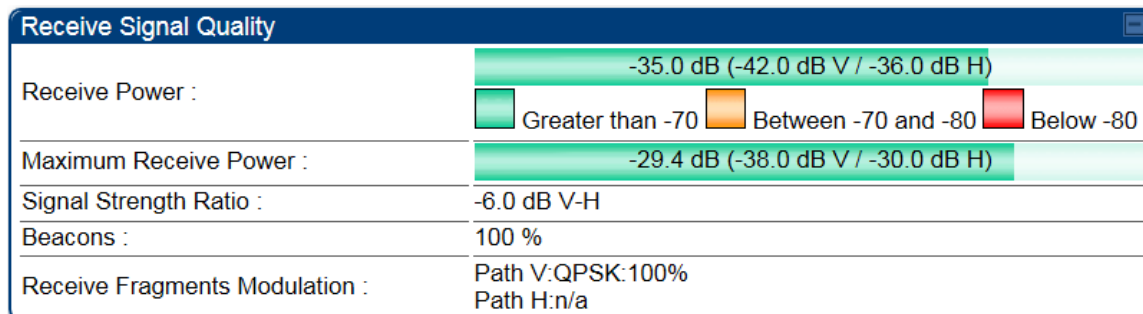


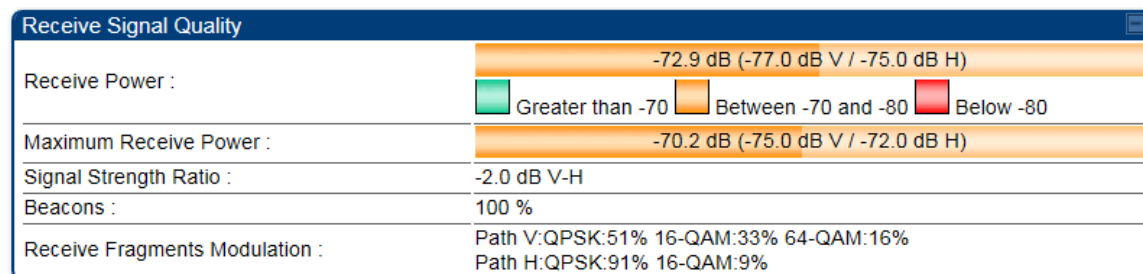
## Using the Alignment Tool

The SM's or BHS's Alignment Tool may be used to maximize Receive Power Level, Signal Strength Ratio and Signal to Noise Ratio to ensure a stable link. The Tool provides color coded readings to facilitate in judging link quality.

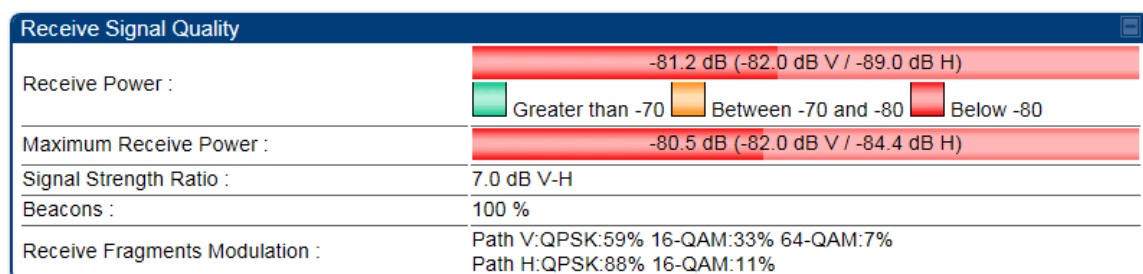
**Figure 69 Alignment Tool tab of SM - Receive Power Level > -70 dBm**



**Figure 70 Alignment Tool tab of SM - Receive Power Level between -70 to -80 dBm**



**Figure 71 Alignment Tool tab of SM - Receive Power Level < -80 dBm**



## Aiming page and Diagnostic LED – SM/BHS

The SM's/BHS's Alignment Tool (located in GUI **Tools -> Aiming**) may be used to configure the SM's/BHS's LED panel to indicate received signal strength and to display decoded beacon information/power levels. The SM/BHS LEDs provide different status based on the mode of the SM/BHS. A SM/BHS in "operating" mode will register and pass traffic normally. A SM/BHS in "aiming" mode will not register or pass traffic, but will display (via LED panel) the strength of received radio signals (based on radio channel selected via **Tools ->Aiming**). See SM/BHS LEDs in Planning and Installation Guide.

**Note**

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

---

Refer SM/BHS LED description in Planning and Installation Guide for SM/BHS LED details.

### Aiming page of SM

The Aiming page is similar to Spectrum Analyzer where it scans the spectrum but it does not establish any session with any APs. It has two modes – Single Frequency Only and Normal Frequency Scan List. The Aiming page of SM is explained in [Table 102](#).

Table 102 Aiming page attributes – SM

| Tools → Aiming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.4/5.7GHz MIMO OFDM - Subscriber Module - 0a-00-3e-a0-a0-66                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                     |
| Alignment mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                     |
| <div> <div> <div>Aiming Configuration</div> <div> <div> <div>Aiming Mode :</div> <div> <input type="radio"/> Single Frequency Only<br/> <input checked="" type="radio"/> Normal Frequency Scan List </div> </div> <div>Note: No beacon information is decoded for 'Single Frequency Only' mode</div> <div> <div>Single Frequency :</div> <div>None ▾</div> </div> <div> <div>Enable Aiming Mode</div> <div>Disable Aiming Mode</div> </div> </div> <div>Aiming Mode will be enabled for 15 minutes or until disabled.</div> </div> </div>                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                     |
| <div> <div>Aiming Status</div> <div>Current Status : SM is in Alignment Mode for selected frequencies</div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                     |
| <div> <div>Aiming Results</div> <div> <div>Current entry:</div> <div> <b>Frequency:</b> 5745.000 MHz<br/> <b>Power:</b> -31.9 (-50.0 V / -32.0 H) dBm<br/> <b>Users:</b> 1<br/> <b>ESN:</b> 0a-00-3e-a1-35-75<br/> <b>Color Code:</b> 0<br/> <b>Multipoint</b> </div> </div> <div>Other entries:</div> <div> <b>Frequency:</b> 5680.000 MHz<br/> <b>Power:</b> -36.5 (-42.0 V / -38.0 H) dBm<br/> <b>ESN:</b> 0a-00-3e-a0-aa-9a<br/> <b>Color Code:</b> 5<br/> <b>Backhaul</b> </div> <div> <b>Frequency:</b> 5740.000 MHz<br/> <b>Power:</b> -77.8 (-91.0 V / -78.0 H) dBm<br/> <b>Users:</b> 2<br/> <b>ESN:</b> 0a-00-3e-a0-08-08<br/> <b>Color Code:</b> 0<br/> <b>Multipoint</b> </div> </div> |                                                                                                                                                                                                                                                                                                                                     |
| Attribute                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Meaning                                                                                                                                                                                                                                                                                                                             |
| Aiming Mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Single Frequency Only:</b> scans only selected single frequency.<br><b>Normal Frequency Scan List: scans:</b> scans all frequency of scan list.                                                                                                                                                                                  |
| Single Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Select a particular frequency from drop-down menu for scanning.                                                                                                                                                                                                                                                                     |
| Scan Radio Frequency Only Mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Enabled:</b> the radio is configured to “aiming” or “alignment” mode, wherein the LED panel displays an indication of receive power level. See SM/BHS LED description in Planning and Installation Guide.<br><b>Disabled:</b> the radio is configured to “operating” mode, wherein the SM registers and passes traffic normally. |
| Aiming Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The Aiming Results are displayed in two sections – Current entry and Other entries.<br><b>Frequency:</b> this field indicates the frequency of the AP which is transmitting the beacon information.                                                                                                                                 |

---

**Power:** This field indicates the current receive power level (vertical channel) for the frequency configured in parameter **Radio Frequency**.

**Users:** This field indicates the number of SMs currently registered to the AP which is transmitting the beacon information.

**ESN:** This field indicates the MAC, or hardware address of the AP/BHM which is transmitting the beacon information.

**Color Code:** 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 *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.

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 (*not* all 255 color codes).

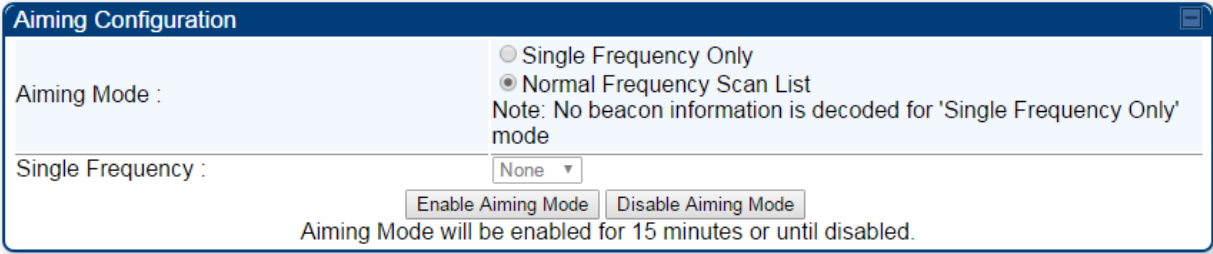
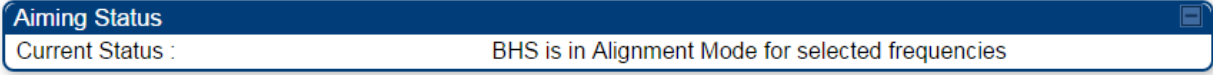
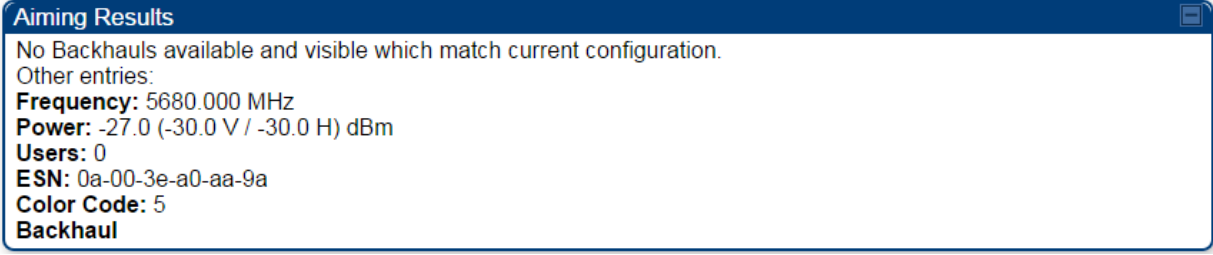
**Multipoint or Backhaul:** this field indicates type of configuration - point-Multipoint (PMP) or Backhaul (PTP).

---

## Aiming page of BHS

The Alignment page of BHS is explained in [Table 103](#).

**Table 103 Aiming page attributes - BHS**

| Alignment mode                                                                      |         |
|-------------------------------------------------------------------------------------|---------|
|   |         |
|   |         |
|  |         |
| Attribute                                                                           | Meaning |
| Refer                                                                               |         |
| Refer <a href="#">Table 102 Aiming page attributes – SM</a> for attribute details.  |         |



### Note

The Alignment Tone cable for a 450i Series uses an RJ-45 to headset cable whereas the 450 Series alignment tone cable uses an RJ-12 to headset cable.

## Alignment Tone

For coarse alignment of the SM/BHS, use the Alignment Tool located at **Tools -> Alignment Tool**. Optionally, connect a headset alignment tone kit to the AUX/SYNC port of the SM/BHS and listen to the alignment tone, which indicates greater SM/BHS receive signal power by pitch. By adjusting the SM's/BHS's position until the highest frequency pitch is obtained operators and installers can be confident that the SM/BHS is properly positioned. For information on device GUI tools available for alignment, see sections [Aiming page](#) and [Diagnostic LED - SM/BHS](#) on page 2-332, [Using the Link Capacity Test tool](#) on page 2-338 and [Using AP Evaluation tool](#) on page 2-347.

**Figure 72 PMP/PTP 450i Series link alignment tone**



Alignment Tool Headset and alignment tone adapters can be ordered from Cambium and Best-Tronics (<http://btpa.com/Cambium-Products/>) respectively using the following part numbers:

**Table 104 Alignment Tool Headsets and Alignment tone adapter third party product details**

| Reference  | Product description                                                 |
|------------|---------------------------------------------------------------------|
| ACATHS-01A | Alignment tool headset for the PMP/PTP 450 and 450i Series products |

|                |                                                                             |
|----------------|-----------------------------------------------------------------------------|
| <b>BT-1277</b> | <b>Headset alignment cable (RJ-45) for the PMP/PTP 450i Series products</b> |
| <b>BT-0674</b> | <b>Headset alignment cable (RJ-12) for the PMP/PTP 450 Series products.</b> |

## Using the Link Capacity Test tool

The **Link Capacity Test** tab allows you to measure the throughput and efficiency of the RF link between two modules. Many factors, including packet length, affect throughput.

The Link Capacity Test tool has following modes:

- **Link Test with Multiple VCs:** Tests radio-to-radio communication across selected or all registered VCs, but does not bridge traffic (PMP 450m Series AP only).
- **Link Test without Bridging:** Tests radio-to-radio communication, but does not bridge traffic.
- **Link Test with Bridging:** Bridges traffic to “simulated” Ethernet ports, providing a status of the bridged link.
- **Link Test with Bridging and MIR:** Bridges the traffic during test and also adheres to any MIR (Maximum Information Rate) settings for the link.
- **Extrapolated Link Test:** Estimates the link capacity by sending few packets and measuring link quality.

The **Link Capacity Test** tab contains the settable parameter **Packet Length** with a range of 64 to 1714 bytes. This allows you to compare throughput levels that result from various packet sizes.

The **Current Results Status** also displayed date and time of last performed Link Capacity Test. If there is any change in time zone, the date and time will be adjusted accordingly.

**Note**

The Extrapolated Link Test can be run by Read-Only login also.

---

## Performing Link Test

The link test is a tool that allows the user to test the performance of the RF link. Packets are added to one or more queues in the AP in order to fill the frame. Throughput and efficiency are then calculated during the test. The 450 and 450i APs offer link test options to one SM at a time. The 450m AP offers the option of a link test to multiple VCs at the same time. This allows the user to test throughput in MU-MIMO mode, in which multiple SMs are served at the same time.

This new link test can be found under **Tools > Link Capacity Test**

## Link Test with Multiple LUIDs



### Note

The “Link Test with Multiple LUIDs” Link Capacity Test is supported for PMP 450m Series AP only.

**Figure 73** Link Capacity Test - PMP 450m Series AP

**Link Test Configurations**

Link Test Mode: **Link Test with Multiple LUIDs**

Link Test with Multiple Data Channels: **Link Test Low Priority Data Channels**

MU-MIMO: **Enabled**

Ignore Configured CIR: **Enabled**

User Traffic During Link Test: **Block User Traffic**

**Link Test Settings**

LUID List: **(reg 2 — 22,24,32) Empty field or 0 will flood all registered LUIDs for duration of test**

Duration: **2** Seconds (2 — 10)

Direction: **Downlink Only**

Number of Packets: **0** (0 — 64) Zero will flood the link for duration of test

Packet Length: **1714** Bytes (64 — 1714 bytes)

**Start Test**

### Procedure 24 Performing a Link Capacity Test - Link Test with Multiple LUIDs

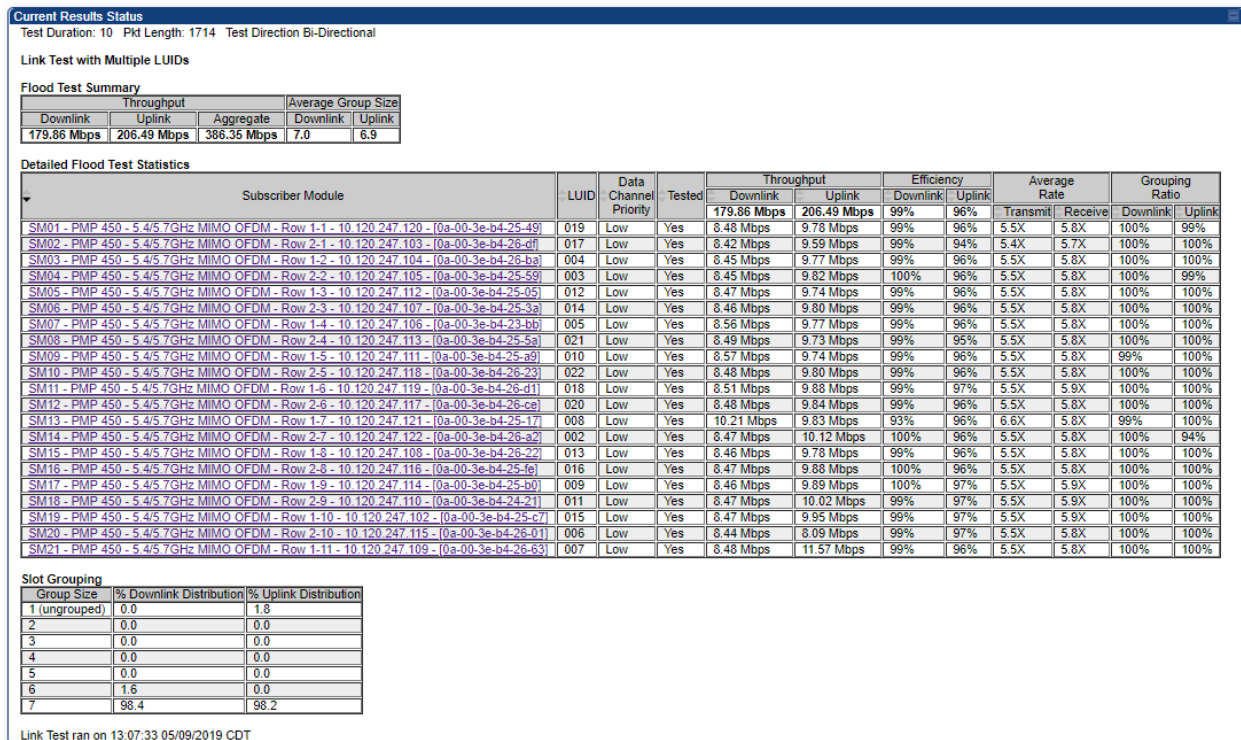
#### Link Test Configurations parameters

- 1 Access the Link Capacity Test tab in the Tools web page of the module.
- 2 Set **Link with Multiple Data Channels** attribute to **Link Test Low Priority Data Channels**, **Link Test Low and Medium Priority Data Channels**, **Link Test Low, Medium and High Priority Data Channels**, or **Link Test All Data Channels**.
- 3 Set the **MU-MIMO** attribute to **Enabled** or **Disabled**.  
**Note:** The MU-MIMO feature is enabled on the Low Priority Data Channel only
- 4 Set the **Ignore Configured CIR** attribute to **Enabled** or **Disabled**.
- 5 Set the **User Traffic During Link Test** attribute to **Block User Traffic** or **Allow User Traffic**.

#### Link Test Settings parameters

- 6 Enter **LUID List** (applicable for PMP 450m AP only)  
The Current Subscriber Module and LUID List are valid only when selecting Link Test with Multiple LUIDs.
  - Current Subscriber Module: select the LUID to perform the link test with
  - LUID list: select a list or range of LUIDs to include in the link test with multiple LUIDs  
If left blank, all LUIDs will be included in the link test
- 7 Type into the **Duration** field how long (in seconds) the RF link must be tested.
- 8 Select the **Direction** attribute to **Bi-directional**, **Uplink Only**, or **Downlink Only**.
- 9 Type into the **Number of Packets** field a value of **0** to flood the link for the duration of the test.
- 10 Type into the **Packet Length** field a value of **1714** to send 1714-byte packets during the test.
- 11 Click the **Start Test** button.

Figure 74 Link Test with Multiple LUIDs



## Link Test without Bridging, Link Test with Bridging or Link Test with Bridging and MIR

Figure 75 Link Test without Bridging

**Link Test Configurations**

Link Test Mode : Link Test without Bridging ▼

Signal to Noise Ratio Calculation during Link Test :   
☒ Enabled  
☐ Disabled

Link Test with All Available Data Channels :   
☐ All Available Data Channels  
☒ Low Priority Channel only  
 Note: All Available Data Channels option requires that the SM already has at least one additional data channel enabled

**Link Test Settings**

Current Subscriber Module : SM4\_21 [0a003eb4d338] Luid: 2 ▼

Duration : 10 Seconds (2 — 10)

Direction : Bi-directional ▼

Number of Packets : 0 (0 — 64) Zero will flood the link for duration of test

Packet Length : 1714 Bytes (64 — 1714 bytes)

Start Test

Figure 76 Link Test with Bridging and MIR

**Link Test Configurations**

Link Test Mode : Link Test with Bridging and MIR ▼

Signal to Noise Ratio Calculation during Link Test :   
☒ Enabled  
☐ Disabled

Link Test with All Available Data Channels :   
☐ All Available Data Channels  
☒ Low Priority Channel only  
 Note: All Available Data Channels option requires that the SM already has at least one additional data channel enabled.

**Link Test Settings**

Current Subscriber Module : SM4\_21 [0a003eb4d338] Luid: 2 ▼

Duration : 10 Seconds (2 — 10)

Direction : Bi-directional ▼

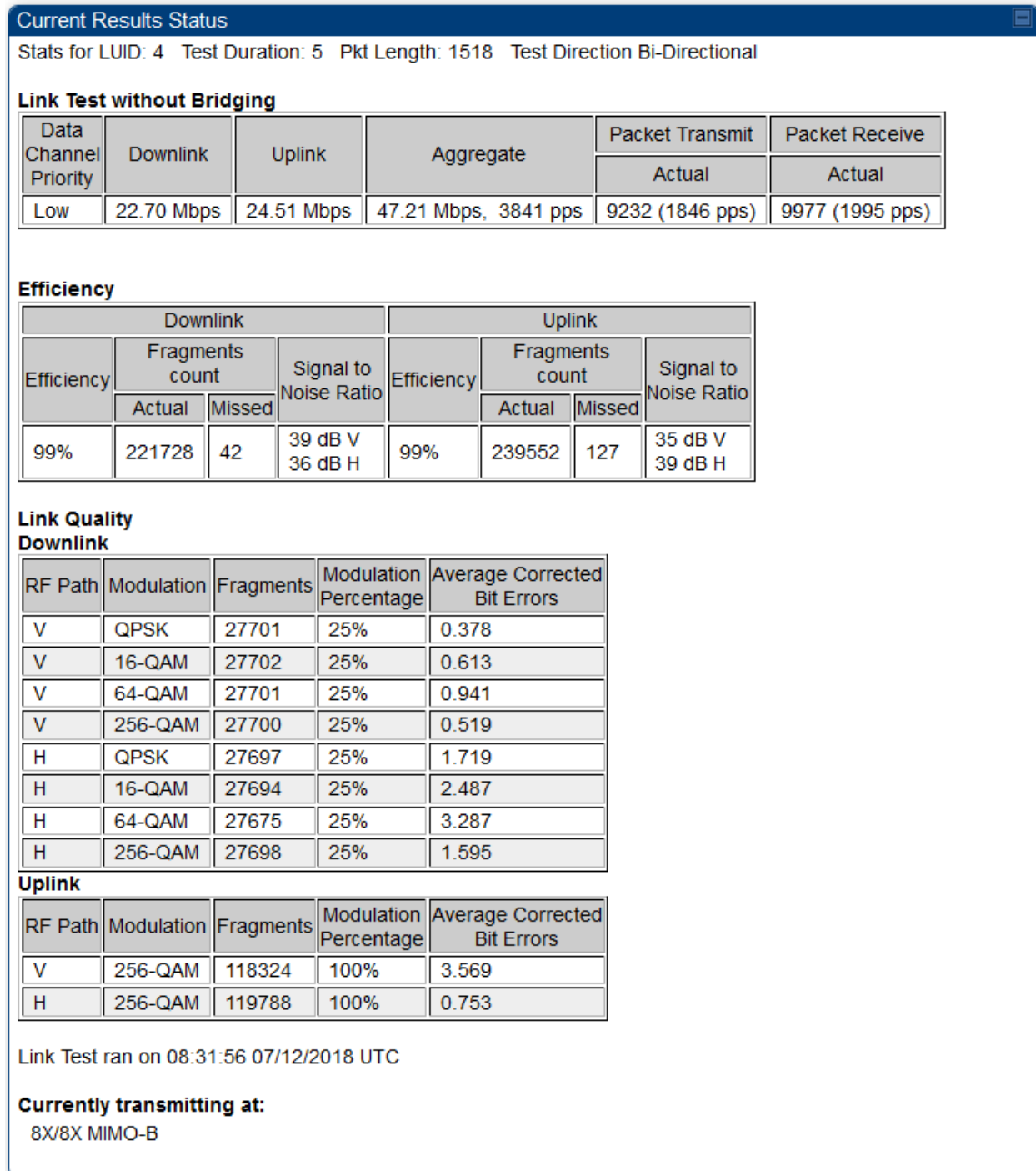
Number of Packets : 0 (0 — 64) Zero will flood the link for duration of test

Packet Length : 1714 Bytes (64 — 1714 bytes)

Start Test

Refer [Link Test with Multiple](#) on page 2-339 for Link Test procedure.

**Figure 77 Link Test without Bridging (1518-byte packet length)**



## Performing Extrapolated Link Test

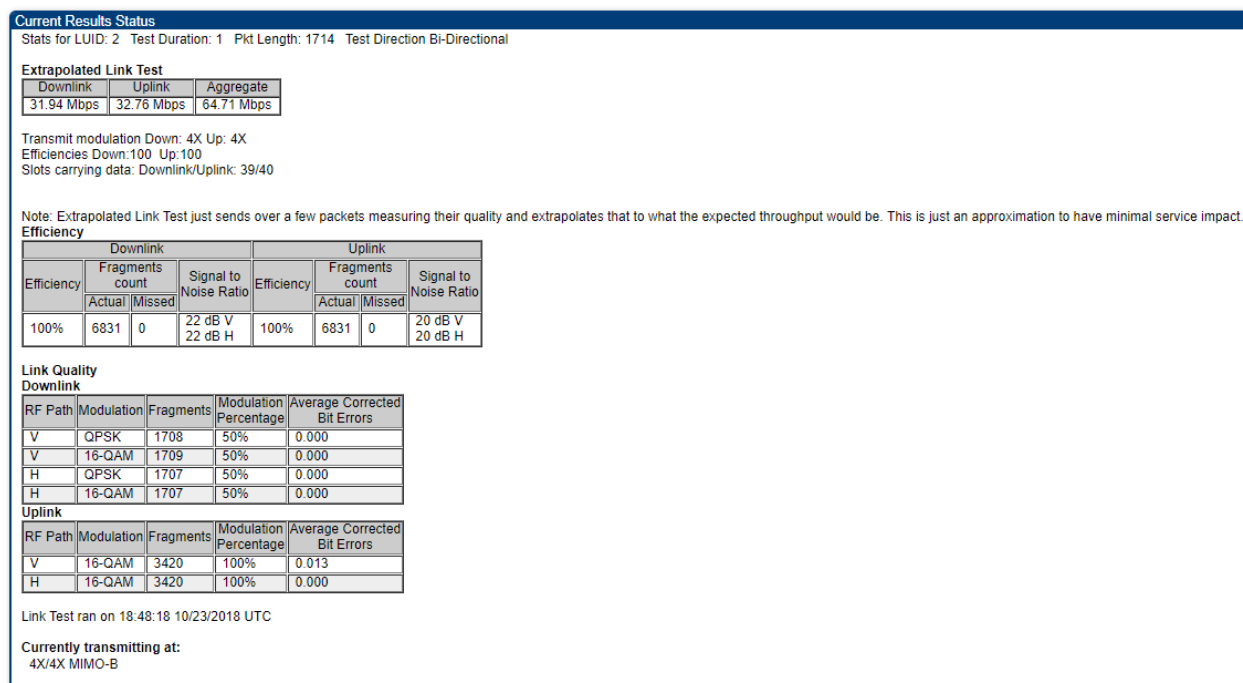
The Extrapolated Link Test estimates the link capacity by sending few packets and measuring link quality. Once the test is initiated, the radio starts session at the lower modulation, 1X, as traffic is passed successfully across the link, the radio decides to try the next modulation, 2X. This process repeats until it finds best throughput to estimate capacity of link.

The procedure for performing Extrapolated Link Test is as follows:

### Procedure 25 Performing an Extrapolated Link Test

- 1 Access the Link Capacity Test tab in the Tools web page of the module.
- 2 Select Link Test Mode **Extrapolated Link Test**
- 3 Click the **Start Test** button.
- 4 In the Current Results Status block of this tab, view the results of the test.

**Figure 78 Extrapolated Link Test results**



## Link Capacity Test page of AP

The Link Capacity Test page of AP is explained in [Table 105](#).

**Table 105 Link Capacity Test page attributes – 450m AP**

| Link Test Configurations                             |                                                                                                                                                                                                                                                           |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Link Test Mode :                                     | Link Test with Bridging and MIR ▼                                                                                                                                                                                                                         |
| Signal to Noise Ratio Calculation during Link Test : | <input checked="" type="radio"/> Enabled<br><input type="radio"/> Disabled                                                                                                                                                                                |
| SM Link Test Mode Restriction :                      | <input checked="" type="radio"/> Enabled<br><input type="radio"/> Disabled                                                                                                                                                                                |
| Link Test with All Available Data Channels :         | <input type="radio"/> All Available Data Channels<br><input checked="" type="radio"/> Low Priority Channel only<br><small>Note: All Available Data Channels option requires that the SM already has at least one additional data channel enabled.</small> |
| MU-MIMO :                                            | <input checked="" type="radio"/> Enabled<br><input type="radio"/> Disabled                                                                                                                                                                                |
| Display results for untested Data Channels :         | <input type="radio"/> Enabled<br><input checked="" type="radio"/> Disabled                                                                                                                                                                                |
| Ignore Configured CIR :                              | <input type="radio"/> Enabled<br><input checked="" type="radio"/> Disabled                                                                                                                                                                                |

| Link Test Settings                        |                                                                                                               |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Current Subscriber Module :               | Idle [0a003ebb41d2] Luid: 2 ▼                                                                                 |
| LUID List :                               | <input type="text"/> (eg. 2 — 22,24,32) Empty field or 0 will flood all registered LUIDs for duration of test |
| Duration :                                | 2 Seconds (2 — 10)                                                                                            |
| Direction :                               | Bi-directional ▼                                                                                              |
| Number of Packets :                       | 0 (0 — 64) Zero will flood the link for duration of test                                                      |
| Packet Length :                           | 1714 Bytes (64 — 1714 bytes)                                                                                  |
| <input type="button" value="Start Test"/> |                                                                                                               |

| Attribute                                          | Meaning                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Link Test Mode                                     | <p>Select Link Test Mode from drop-down menu:</p> <ul style="list-style-type: none"> <li>Link Test with Multiple LUIDs (PMP 450m Series AP only)</li> <li>Link Test without Bridging</li> <li>Link Test with Bridging</li> <li>Link Test with Bridging and MIR</li> <li>Extrapolated Link Test</li> </ul> |
| Signal to Noise Ratio Calculation during Link Test | <p>Enable this attribute to display Signal-to-Noise information for the downlink and uplink when running the link test.</p>                                                                                                                                                                               |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SM Link Test Mode Restriction              | Enable this parameter to restrict SM link test mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Link Test with All Available Data Channels | This parameter is used to enable or disable usage of either all available data channels or low priority data channel only during the link test.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| MU-MIMO                                    | <p>This parameter determines whether the DL flood test packets use MU-MIMO grouping or not.</p> <p><b>Note:</b> This field is applicable only when the “Link Test Mode” field is set to “Link Test with Multiple VC’s” option.</p> <p><b>Note:</b> This field is applicable for PMP 450m APs only.</p>                                                                                                                                                                                                                                                                                                                                                         |
| Display results for untested Data Channels | <p>If “Link test with multiple VC’s” is run and a subset of registered VC’s enters into the VC List field, then enabling this field produces a table that displays results for VC’s with traffic which are in session; but not tested as part of the link test.</p> <p><b>Note:</b> This field is applicable for PMP 450m flood tests only.</p>                                                                                                                                                                                                                                                                                                                |
| Ignore Configured CIR                      | <p>Enable this parameter to schedule flood data regardless of the CIR configuration for each SM. For system release 16.1 and beyond, the exact impact of this setting depends on which scheduler “mode” has been configured by the operator on the AP’s QoS page.</p> <p><b>Enabled:</b> ‘Run Link Test with Multiple LUID’s using Legacy scheduler, ignoring configured CIR’s. Legacy scheduler is used here regardless of which scheduling mode has been configured.</p> <p><b>Disabled:</b> If Legacy scheduler is enabled, test with legacy scheduler, using configured CIR’s. If Proportional scheduler is enabled, test with proportional scheduler.</p> |
| Current Subscriber Module                  | The SM with which the Link Capacity Test is run. This field is only applicable for AP (not SM page).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| LUID List                                  | <p>This field is displayed for PMP 450m Series AP. It is only applicable for “Link Test with Multiple LUIDs” Test mode.</p> <p>Enter <b>LUID List</b> (e.g. 18 or above for low priority LUIDs and 255 or above for high priority LUIDs or 0 for all registered LUIDs) which needs to be used for link test traffic.</p>                                                                                                                                                                                                                                                                                                                                       |
| Duration                                   | This field allows operators to configure a specified time for which the spectrum is scanned. If the entire spectrum is scanned prior to the end of the configured duration, the analyzer will restart at the beginning of the spectrum.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Direction                                  | Configure the direction of the link test. Specify <b>Downlink</b> or <b>Uplink</b> to run the test only in the corresponding direction only. Specific <b>Bi-Directional</b> to run the test in both directions.                                                                                                                                                                                                                                                                                                                                                                                                                                                |

---

|                   |                                                                                                                                                                       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Packets | The total number of packets to be sent during the Link Capacity Test. When Link Test Mode is set to <b>Link Test Without Bridging</b> this field is not configurable. |
| Packet Length     | The size of the packets in Bytes to send during the Link Capacity Test                                                                                                |

---

## Link Capacity Test page of BHM/BHS/SM

The Link Capacity Test page of BHM/BHS is explained in [Table 106](#).

**Table 106 Link Capacity Test page attributes - BHM/BHS**

The screenshot displays two panels for configuring a Link Capacity Test. The top panel, titled 'Link Test Configurations', includes a dropdown for 'Link Test Mode' set to 'Link Test without Bridging', radio buttons for 'Signal to Noise Ratio Calculation during Link Test' (with 'Disabled' selected), and radio buttons for 'Link Test with All Available Data Channels' (with 'All Available Data Channels' selected). A note specifies that the 'All Available Data Channels' option requires at least one additional data channel to be enabled. The bottom panel, titled 'Link Test Settings', contains input fields for 'Duration' (2 seconds), 'Direction' (Bi-directional), 'Number of Packets' (0), and 'Packet Length' (1714 bytes), along with a 'Start Test' button.

| Attribute                                          | Meaning                                     |
|----------------------------------------------------|---------------------------------------------|
| Link Test Mode                                     | See <a href="#">Table 105</a> on page 2-343 |
| Signal to Noise Ratio Calculation during Link Test | See <a href="#">Table 105</a> on page 2-343 |
| Link Test with All Available Data Channels         | See <a href="#">Table 105</a> on page 2-343 |
| Duration                                           | See <a href="#">Table 105</a> on page 2-343 |
| Direction                                          | See <a href="#">Table 105</a> on page 2-343 |
| Number of Packets                                  | See <a href="#">Table 105</a> on page 2-343 |
| Packet Length                                      | See <a href="#">Table 105</a> on page 2-343 |

## Using AP Evaluation tool

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



### Note

The data for this page may be suppressed by the **SM Display of AP Evaluation Data** setting in the **Configuration > Security** tab of the AP.

The AP Eval results can be accessed via SNMP and config file.

## AP Evaluation page

The AP Evaluation page of AP is explained in [Table 107](#).

**Table 107 AP Evaluation tab attributes - AP**

| AP List                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AP Selection Method used: Optimize for Throughput<br>Current entry index: 0 Session Status: REGISTERED (via Primary Color Code 181)<br>*****<br>Index: 0 Frequency: 3657.500 MHz Channel Bandwidth: 20.0 MHz Cyclic Prefix: 1/16<br>ESN: 0a-00-3e-45-11-f2 Region: Other<br>Beacon Receive Power: -52.5 (-55.0 V / -56.0 H) dBm Beacon Count: 9 FECEn: 1<br>Type: Multipoint Avail: 1 Age: 0 Scans Seen: 1 Lockout: 0 RegFail 0 Range: 0 feet MaxRange: 2 miles TxBER:<br>1 EBcast: 0 AES256Rdy: 0<br>Session Count: 1 NoLUIDS: 0 OutOfRange: 0 AuthFail: 0 EncryptFail: 0 Rescan Req: 0 SMLimitReached: 0<br>NoVC's: 0 VCRsv/430smFail: 0 VCActFail: 0 UnsupportedULMap: 0 Air Delay: 0<br>AP Gain: 25 dBm AP RcvT: -55 dBm Color Code: 181 BeaconVersion: 1 SectorUserCount: 0 SyncSrc: 0<br>NumULSlots: 41 NumDLSlots: 40 NumULContSlots: 3<br>WhiteSched: 0 ICC: 0 Authentication: Disabled<br>SM PPPoE: Supported<br>AckBeforeMap: Enabled<br>Frame Period: 2.5 ms<br><div>Rescan APs</div> |
| <b>Last Registered Primary Color Code AP</b><br>MAC Address: 0a-00-3e-45-11-f2<br>Frequency: 3657.500 MHz<br>Channel Bandwidth: 20.0 MHz<br>Color Code: 181<br>Air Delay: 0<br>Receive Power: -33.5 (-37.0 V / -36.0 H) dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Scan Statistics</b><br>Scan Cycle Count : 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Beacon Statistics                     |   |
|---------------------------------------|---|
| Unsupported Feature Beacon Received : | 0 |
| Unknown Feature Beacon Received :     | 0 |
| Old Version Beacon Received :         | 0 |
| Wrong Frequency Beacon Received :     | 0 |
| Non Lite Beacon Received :            | 0 |

| Attribute         | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Index             | This field displays the index value that the system assigns (for only this page) to the AP where this SM is registered.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Frequency         | This field displays the frequency that the AP transmits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Channel Bandwidth | The channel size used by the radio for RF transmission. The setting for the channel bandwidth must match between the AP and the SM.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 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 multi-pathing 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. The Cyclic Prefix 1/16 only can be selected at this time.                                                                                                                                                                             |
| ESN               | This field displays the MAC address (electronic serial number) of the AP. For operator convenience during SM aiming, this tab retains each detected ESN for up to 15 minutes. If the broadcast frequency of a detected AP 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 AP's configured Country Code setting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Power Level       | This field displays the SM's combined received power level from the AP's transmission.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Beacon Count      | A count of the beacons seen in a given time period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| FECEn             | This field contains the SNMP value from the AP that indicates whether the Forward Error Correction feature is enabled.<br><br>0: FEC is disabled<br>1: FEC is enabled                                                                                                                                                                                                                                                                                                                                                                                  |
| Type              | Multipoint indicates that the listing is for an AP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Age               | This is a counter for the number of minutes that the AP has been inactive. At 15 minutes of inactivity for the AP, this field is removed from the AP Evaluation tab in the SM.                                                                                                                                                                                                                                                                                                                                                                         |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lockout        | This field displays how many times the SM has been temporarily locked out of making registration attempts.                                                                                                                                                                                                                                                                                                                                                    |
| RegFail        | This field displays how many registration attempts by this SM 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 AP is sending Radio BER.                                                                                                                                                                                                                                                                                                                                                                                                      |
| Ebcast         | A 1 in this field indicates the AP or BHM is encrypting broadcast packets. A 0 indicates it is not.                                                                                                                                                                                                                                                                                                                                                           |
| 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        | 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.                                                                                                                                              |
| OutOfRange     | 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.                                                                                                                                                                                     |
| AuthFail       | This field displays how many times authentication attempts from this SM have failed in the AP.                                                                                                                                                                                                                                                                                                                                                                |
| EncryptFail    | This field displays how many times an encryption mismatch has occurred between the SM and the AP.                                                                                                                                                                                                                                                                                                                                                             |
| Rescan Req     | 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.                                                                                                                                                                                                                                                                                                                          |
| SMLimitReached | 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.                                                                                                                                                                                                                                                                                                                 |
| NoVC's         | 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 channel (a low priority data channel) or one of the other possible data channel priorities (a Medium priority data channel, or High priority data channel, or Ultra High priority data channel)                                                                                              |

|                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VCRsvFail                                    | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| VCActFail                                    | 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.                                                                                                                                                                                                                                                                                                                                                                                                       |
| AP Gain                                      | This field displays the total external gain (antenna) used by the AP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| RcvT                                         | This field displays the AP's configured receive target for receiving SM transmissions (this field affects automatic SM power adjust).                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Sector ID                                    | This field displays the value of the <b>Sector ID</b> field that is provisioned for the AP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Last Registered Primary Color Code AP</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| MAC Address                                  | This field displays the last registered AP's MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Frequency                                    | This field displays the last registered AP's frequency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Channel Bandwidth                            | This field displays the last registered AP's channel bandwidth.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                     |                                                                                                                                                                                                                                    |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Color Code                          | This field displays the last registered AP's color code.                                                                                                                                                                           |
| Air Delay                           | This field displays the last registered AP's air delay.                                                                                                                                                                            |
| Receive Power                       | This field displays the last registered AP's receive power.                                                                                                                                                                        |
| <b>Scan Statistics</b>              |                                                                                                                                                                                                                                    |
| Scan Cycle Count                    | The file displays the number of scan cycles. This increments after the SM completes scanning every configured frequency and channel bandwidth.                                                                                     |
| <b>Beacon Statistics</b>            |                                                                                                                                                                                                                                    |
| Unsupported Feature Beacon Received | Count of beacons that the SM has received that is from a beacon that it does not support, which will prevent registration. If encounter this, upgrade your SM to the latest supported software version.                            |
| Unknown Feature Beacon Received     | Count of beacons that the SM has received that is from a beacon that is running a feature that is unknown, which will prevent registration. If this stat is encountered, upgrade your SM to the latest supported software version. |
| Old Version Beacon Received         | Count of the beacons where the version in the beacon mismatched and prevented registration.                                                                                                                                        |
| Wrong Frequency Beacon Received     | Count of beacons that was reported on a different frequency than was received.                                                                                                                                                     |

## 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 108](#).

**Table 108 BHM Evaluation tab attributes - BHS**

**BHM List**

Current entry index: 0 Session Status: REGISTERED (via Primary Color Code 254)

\*\*\*\*\*

Index: 0 Frequency: 5490.000 MHz Channel Bandwidth: 10.0 MHz Cyclic Prefix: 1/16  
 ESN: 0a-00-3e-bb-00-fb Region: Other  
 Beacon Receive Power: -44.5 (-47.0 V / -48.0 H) dBm Beacon Count: 13 FECEn: 1  
 Type: Point-to-Point Avail: 1 Age: 0 Lockout: 0 RegFail 0 Range: 0 feet MaxRange: 0 miles TxBER: 1 EBcast: 0  
 Session Count: 1 NoLUIDS: 0 OutOfRange: 0 AuthFail: 0 EncryptFail: 0 Rescan Req: 1 SMLimitReached: 0  
 NoVC's: 0 VCRsv/430smFail: 0 VCActFail: 0  
 AP Gain: -10 dBm Color Code: 254 BeaconVersion: 1 SectorUserCount: N/A  
 NumULSlots: 10 NumDLSlots: 29 NumULContSlots: 0  
 WhiteSched: 0 ICC: 0 Authentication: Disabled  
 PToP VLAN: Supported  
 Frame Period: 2.5 ms

Rescan BHMs  
Update Display

| 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 multi-pathing 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         | This field contains the SNMP value from the BHM that indicates whether the Forward Error Correction feature is enabled.<br>0: FEC is disabled<br>1: FEC is enabled                                                                                                                                                                                                                                                                                                                                                                                        |
| 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 | 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.<br><br>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.                                                                                                                  |

|                |                                                                                                                                                                                                                                                                                                                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 data channel resources are available for allocation. This could be a primary data channel (a low priority data channel) or one of the other possible data channel priorities (a Medium priority data channel, or High priority data channel, or Ultra High priority data channel) |
| 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 <b>Sector ID</b> field that is provisioned for the BHM.                                                                                                                                                                                                                                                                                |
| Color Code     | 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.                                                    |

|                   |                                                                                                                                                                                                                                                                   |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | 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). |
| 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

<https://support.cambiumnetworks.com/files/colocationtool/> 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 109](#).

Table 109 OFDM Frame Calculator page attributes

**OFDM Frame Calculator Parameters**

Link Mode : ☐ Point-To-Point Link  
☒ Multipoint Link

Platform Type AP/BHM : PMP/PTP 450/450i/450m ▼

Platform Type SM/BHS : PMP/PTP 450/450b/450i ▼

Channel Bandwidth : 10.0 MHz ▼

Cyclic Prefix : One Sixteenth ▼

Frame Period : ☐ 5.0 ms  
☒ 2.5 ms

Max Range : 25 km ▼ (Range: 1 — 40 miles / 64 km)

Downlink Data : 50 %

Contention Slots : 4 (Range: 0 — 15)

SM/BHS One Way Air Delay : 0 ns

Calculate

**Calculated Frame Results**

CANOPY 15.2 AP

**Modulation:OFDM**  
Total Frame Bits : 25000  
Frame Period : 2.5 ms  
**AP Details :**  
Data Slots (Down/Up) : 15 /16  
Contention Slots: 4  
Air Delay for Max Range: 86400 ns, 864 bits  
Approximate distance for Max Range: 25885 meters  
AP Antenna Transmit End : **9904, 990.404 µs**  
AP Antenna Receive Start : **13027, 1.302747 ms**  
AP Antenna Receive End : 23761  
**SM Details :**  
SM Receive End : 10468  
SM Transmit Start : 12270  
SM One Way Air Delay : 0 ns  
SM Approximate distance : 0 meters

| Attribute            | Meaning                                                                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Link Mode            | For AP to SM frame calculations, select <b>Multipoint Link</b><br>For BHM to BHS frame calculations, select <b>Point-To-Point Link</b> |
| 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 <b>Max Range</b> parameter is set in the AP(s) or BHM(s).                                                 |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame Period             | Set to the same value as the <b>Frame Period</b> 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 <b>Downlink Data</b> parameter (percentage). Then, use the Frame Calculator tool procedure as described in <a href="#">Using the Frame Calculator</a> on page 2-359, you will vary the value in this parameter to find the proper value to write into the <b>Downlink Data</b> 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 <b>Max Range</b> parameter (above):</p> <p>The default <b>Max Range</b> value is 5 miles and, at that distance, the maximum <b>Downlink Data</b> 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 <b>Contention Slot</b> 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 110 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 <b>Downlink Data</b> setting. For example, a result within the typical range for a <b>Downlink Data</b> 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 <b>Max Range</b> 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 26 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 79 SM Configuration page of AP**

**Select Subscriber**

Current Subscriber Module : No Site Name [0a003ebb0104] Luid: 2 ▼

---

**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 111 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 for each SM or BHS in Session is now available on AP or BHM Link Status Page. From system release 15.2, a single Rate is used and shown for all data channels of an SM.

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

**Table 112 Link Status page attributes – AP/BHM**

| Link Status                                                                                                                                                                                                                                                                                                     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------|------------------------|-------------------------|--------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------|------------------------|-------------------------|--------------|--------------|
| Due to current system load, Downlink Statistics will only be updated at most every 5 seconds.<br>Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.<br>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                                                                                                                                                                                                                                                                                                      | LUID | Downlink Statistics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                               |                                  |                        |                         |              | Uplink Statistics                                             |                                                                                                        |                                  |                        |                         |              | BER Results  |
|                                                                                                                                                                                                                                                                                                                 |      | Beacon % Received<br>Curr/Min/Avg/Max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Power Level<br>dBm: Signal<br>Strength<br>Ratio (dB V -<br>H) | Signal to<br>Noise<br>Ratio (dB) | Average<br>EVM<br>(dB) | Link Test<br>Efficiency | Rate         | Power Level<br>dBm: Signal<br>Strength<br>Ratio (dB V -<br>H) | Fragments Modulation                                                                                   | Signal to<br>Noise<br>Ratio (dB) | Average<br>EVM<br>(dB) | Link Test<br>Efficiency | Rate         |              |
| ySM-[0a-00-3e-45-11-ed]                                                                                                                                                                                                                                                                                         | 002  | 100/100/100/100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -52.0 (-55.0 V / -55.0 H) 0.0                                 | 35 V / 36 H                      | -30 V / -26 H          | NA                      | 8X/8X MIMO-B | -54.5 (-56.0 V / -60.0 H) 4.0                                 | Path V:QPSK 31% 16-QAM 25% 64-QAM 25% 256-QAM 18%<br>Path H:QPSK 25% 16-QAM 25% 64-QAM 25% 256-QAM 25% | 35 V / 37 H                      | -27 V / -25 H          | NA                      | 8X/8X MIMO-B | 0.000000e+00 |
| Path Info: Path A = -45° Path B = +45°                                                                                                                                                                                                                                                                          |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
| Attribute                                                                                                                                                                                                                                                                                                       |      | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
| Subscriber                                                                                                                                                                                                                                                                                                      |      | This field displays the MAC address and Site Name of the SM.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
|                                                                                                                                                                                                                                                                                                                 |      |  <b>Note</b><br>The MAC is hot link 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.<br><br>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 sysName SNMP MIB-II object and can be polled by an SNMP management server. |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
| LUID                                                                                                                                                                                                                                                                                                            |      | This field displays the LUID (logical unit ID) 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.                                                                                                                                                                                                                                                                   |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
|                                                                                                                                                                                                                                                                                                                 |      |  <b>Note</b><br>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.                                                                                                                                                                                                                    |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
| Downlink Statistics – Beacon % Received Curr/Min/Max/Avg                                                                                                                                                                                                                                                        |      | This field displays a count of beacons received by the SM in percentage. 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.                                                                                                                                                                                                                                                                                                                                                      |                                                               |                                  |                        |                         |              |                                                               |                                                                                                        |                                  |                        |                         |              |              |
| 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 – Average EVM (dB)                 | This field displays the average EVM statistics that measures RF signal quality.                                                                                                                                                                                                                         |
| Downlink Statistics – Link Test Efficiency             | This field displays the efficiency of the radio link, expressed as a percentage, for the radio downlink.                                                                                                                                                                                                |
| Downlink Statistics – SU-MIMO Rate                     | The SU-MIMO rate applies to all AP platforms.<br>For 450m, this field indicates the rate being used for symbols where this particular VC is not being MU-MIMO grouped with other SMs.<br>For 450 and 450i platforms, there is no grouping and this field indicates the modulation rate for all symbols. |
| Downlink Statistics – MU-MIMO Rate                     | This field indicates the modulation rate used for symbols where the low or medium priority data channels are MU-MIMO scheduled by grouping it in the same slot with other low or Medium priority data channels from other SM's.                                                                         |
| 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.                                                                                                                                                                                                  |
| Uplink Statistics – SU-MIMO Rate                       | The SU-MIMO rate applies to all AP platforms.<br>For 450m, this field indicates the rate being used for symbols where a VC is not being MU-MIMO grouped with other SMs.<br>For 450 and 450i platforms, there is no grouping and this field indicates the modulation rate for all symbols.               |
| Uplink Statistics – MU-MIMO Rate                       | This field indicates the modulation rate used for symbols where the low or medium priority data channels are MU-MIMO scheduled by grouping it in the same slot with other high or ultra high priority data channels from other SM's.                                                                    |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 (<math>1 \times 10^{-4}</math>) 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 113 Link Status page attributes – SM/BHS**

| Downlink Status                                 |                                                                                                        |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Receive Power :                                 | -52.5 dBm ( -56.0 dBm V / -55.0 dBm H )                                                                |
| Path Info :                                     | Path A = -45° Path B = +45°                                                                            |
| Signal Strength Ratio :                         | -1.0dB V - H                                                                                           |
| Signal to Noise Ratio :                         | 35 V / 37 H dB                                                                                         |
| Average EVM :                                   | -30 V / -26 H dB                                                                                       |
| Beacons :                                       | 100 %                                                                                                  |
| Receive Fragments Modulation :                  | Path V:QPSK:29% 16-QAM:29% 64-QAM:22% 256-QAM:20%<br>Path H:QPSK:27% 16-QAM:27% 64-QAM:27% 256-QAM:18% |
| Latest Remote Link Test Efficiency Percentage : | NA %                                                                                                   |
| BER Total Avg Results :                         | 0.000000e+00                                                                                           |
| Beacons Received Last 15 minutes :              | 100/100/100% (min/avg/max)                                                                             |

| Uplink Status                                   |                                                 |
|-------------------------------------------------|-------------------------------------------------|
| Transmit Power :                                | 25 dBm (target power [27 dBm] exceeded maximum) |
| Max Transmit Power :                            | 25 dBm                                          |
| Power Level :                                   | -54.5 (-56.0 V / -60.0 H) dBm                   |
| Signal Strength Ratio :                         | 4.0dB V - H                                     |
| Signal to Noise Ratio :                         | 36 dB V / 37 dB H                               |
| Average EVM :                                   | -27 V / -25 H dB                                |
| Latest Remote Link Test Efficiency Percentage : | NA %                                            |

| Local Status        |                         |
|---------------------|-------------------------|
| Session Status :    | REGISTERED 8X/8X MIMO-B |
| Spatial Frequency : | 2048                    |

| Link Quality Indicator                    |      |
|-------------------------------------------|------|
| LQI :                                     | 100% |
| Downlink LQI :                            | 100% |
| Downlink Actual Average Modulation Rate : | 8.0X |
| Downlink Expected Modulation Rate :       | 8X   |
| Beacon Quality Index :                    | 100% |
| Uplink LQI :                              | 100% |
| Uplink Actual Average Modulation Rate :   | 8.0X |
| Uplink Expected Modulation Rate :         | 8X   |
| Re-Registration Quality Index :           | 100% |
| Re-Registration Count :                   | 0    |

| Reference LQI                      |                   |
|------------------------------------|-------------------|
| Reference Downlink Quality Index : | 100 %             |
| Reference Uplink Quality Index :   | 100 %             |
| Access Point MAC Address :         | 0a-00-3e-45-11-f2 |

| Latest Local Link Test Results               |  |
|----------------------------------------------|--|
| No test results available.                   |  |
| <input type="button" value="Run Link Test"/> |  |

| Attribute                                     | Meaning                                                                                                                                                                                                     |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Downlink Status</b>                        |                                                                                                                                                                                                             |
| Receive Power                                 | This field lists the current combined receive power level, in dBm.                                                                                                                                          |
| Path Info                                     |                                                                                                                                                                                                             |
| 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.                                                               |
| Average EVM                                   | This field displays the average EVM statistics that measures RF signal quality.                                                                                                                             |
| 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.                                   |
| <b>Uplink Status</b>                          |                                                                                                                                                                                                             |
| 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.                                                                                                       |
| Average EVM                                   | This field displays the average EVM statistics that measures RF signal quality.                                                                                                                                                                   |
| Latest Remote Link Test Efficiency Percentage | This field is not applicable.                                                                                                                                                                                                                     |
| <b>Local Stats</b>                            |                                                                                                                                                                                                                                                   |
| Session Status                                | This field displays the current state, Virtual channel, 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                                 | <div>Run Link Test</div> <p>See Exploratory Test section of <a href="#">Performing Extrapolated Link Test</a> on page 2-342</p>                                                                                                                   |
| <b>Link Quality Indicator</b>                 |                                                                                                                                                                                                                                                   |
| LQI                                           | <p>This field displays the quality of the link used for data communication between AP and SM.</p> <p>This value is derived by calculating:</p> $\text{Downlink LQI value} * \text{Uplink LQI value} * \text{Re-Registration Quality Index value}$ |
| Downlink LQI                                  | This field displays the downlink quality of the link. It is the ratio of Actual Average Modulation Rate of the data packets and the expected modulation rate.                                                                                     |
| Downlink Actual Average Modulation Rate       | This field displays the average value of the actual Downlink modulation rate.                                                                                                                                                                     |
| Downlink Expected Modulation Rate             | This field displays the expected Downlink modulation rate.                                                                                                                                                                                        |
| Beacon Quality Index                          | This field displays the Beacon Quality Index. It is calculated based on the receive beacon percentage.                                                                                                                                            |
| Uplink LQI                                    | This field displays the uplink quality of the link. It is the ratio of Actual Average Modulation Rate of the data packets and the expected modulation rate.                                                                                       |
| Uplink Actual Average Modulation Rate         | This field displays the average value of the actual uplink modulation rate.                                                                                                                                                                       |
| Uplink Expected Modulation Rate               | This field displays the expected Uplink modulation rate.                                                                                                                                                                                          |

|                                  |                                                                                                                                    |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Re-Registration Quality Index    | This field displays the number of re-registrations of the SM. When there are no re-registrations, this quality index will be 100%. |
| Re-Registration Count            | This field displays the re-registration count of the SM.                                                                           |
| Reference Downlink Quality Index | Downlink reference EVM used for LQI calculations.                                                                                  |
| Reference Uplink Quality Index   | Uplink reference EVM used for LQI calculations.                                                                                    |
| Access Point MAC Address         | This field displays the MAC address of the AP to which this SM is registered.                                                      |

## 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.

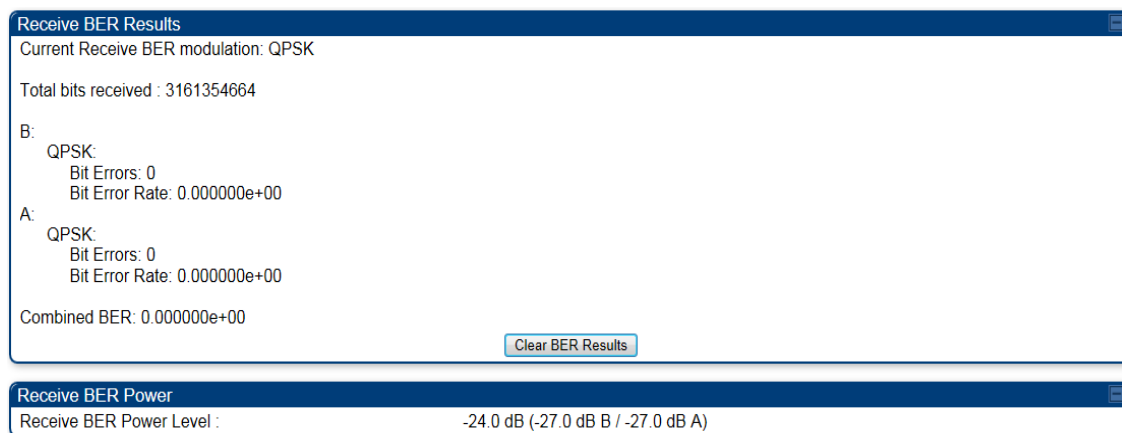
BER is only instrumented on the downlink and is displayed on the BER Results tab of the Tools page in any SM. Each time the tab is clicked, the current results are read and counters are reset to zero.

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.

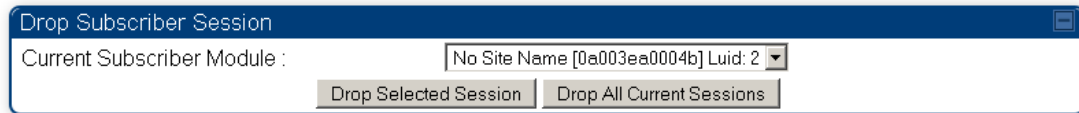
**Figure 80 BER Results tab of the SM**



## 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.

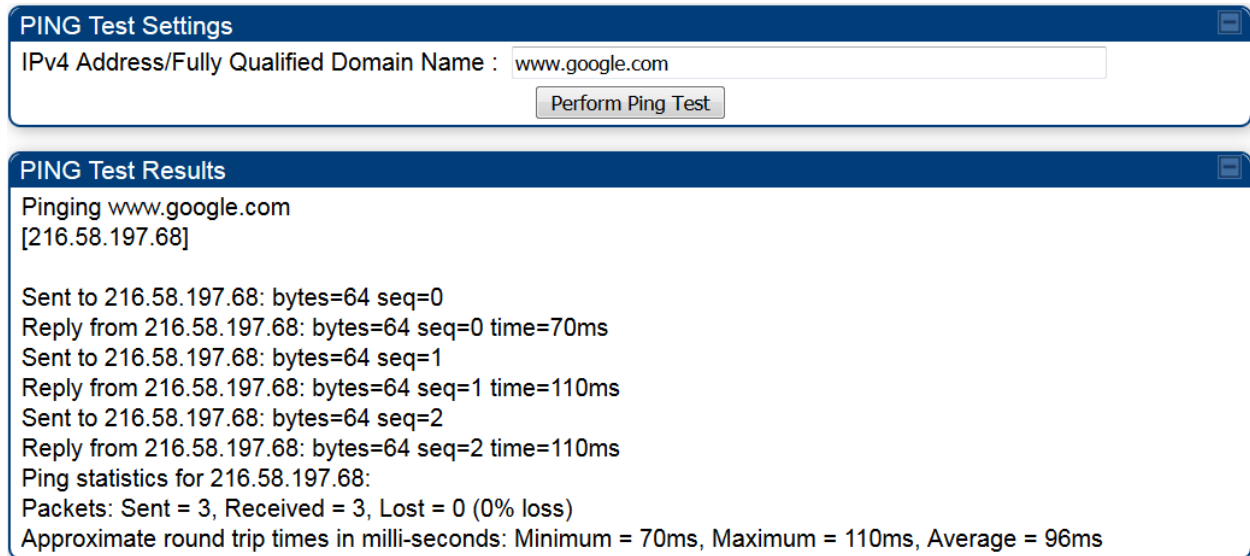
**Figure 81 Sessions tab of the AP**



## Using the Ping Test tool

The PMP 450 Platform Family AP has a tab **Ping Test** under the Tools category which allows users to check the accessibility of the given IP V4 address or a valid domain name

Figure 82 Ping Test tab of the AP



The screenshot displays the 'PING Test Settings' and 'PING Test Results' sections of the tool. The settings section includes a text input field for the 'IPv4 Address/Fully Qualified Domain Name' containing 'www.google.com' and a 'Perform Ping Test' button. The results section shows the target IP as '216.58.197.68' and provides detailed statistics for three sent packets, including byte counts, sequence numbers, and round-trip times.

| PING Test Settings                         |                |
|--------------------------------------------|----------------|
| IPv4 Address/Fully Qualified Domain Name : | www.google.com |
| <button>Perform Ping Test</button>         |                |

| PING Test Results                                                                              |  |
|------------------------------------------------------------------------------------------------|--|
| Pinging www.google.com<br>[216.58.197.68]                                                      |  |
| Sent to 216.58.197.68: bytes=64 seq=0                                                          |  |
| Reply from 216.58.197.68: bytes=64 seq=0 time=70ms                                             |  |
| Sent to 216.58.197.68: bytes=64 seq=1                                                          |  |
| Reply from 216.58.197.68: bytes=64 seq=1 time=110ms                                            |  |
| Sent to 216.58.197.68: bytes=64 seq=2                                                          |  |
| Reply from 216.58.197.68: bytes=64 seq=2 time=110ms                                            |  |
| Ping statistics for 216.58.197.68:                                                             |  |
| Packets: Sent = 3, Received = 3, Lost = 0 (0% loss)                                            |  |
| Approximate round trip times in milli-seconds: Minimum = 70ms, Maximum = 110ms, Average = 96ms |  |



### Note

When a domain name (for example, [www.google.com](http://www.google.com)) is used for ping test, make sure that Preferred DNS Server and Alternate DNS Server parameters are configured in the **Configuration > IP** tab of the AP.

## Chapter 3: Operation

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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 3-2](#)
  - o [Viewing General Status on page 3-2](#)
  - o [Viewing Session Status on page 3-24](#)
  - o [Viewing Remote Subscribers on page 3-35](#)
  - o [Interpreting messages in the Event Log on page 3-35](#)
  - o [Viewing the Network Interface on page 3-38](#)
  - o [Viewing the Layer 2 Neighbors on page 3-38](#)
- [System statistics on page 3-39](#)
  - o [Viewing the Scheduler statistics on page 3-39](#)
  - o [Viewing list of Registration Failures statistics on page 3-41](#)
  - o [Interpreting Bridging Table statistics on page 3-43](#)
  - o [Interpreting Translation Table statistics on page 3-43](#)
  - o [Interpreting Ethernet statistics on page 3-44](#)
  - o [Interpreting RF Control Block statistics](#)
  - o [Interpreting VLAN statistics on page 3-51](#)
  - o [Interpreting Data Channels statistics on page 3-52](#)
  - o [Interpreting Proportional Scheduler on page 3-55](#)
  - o [Interpreting MIR/Burst statistics on page 3-55](#)
  - o [Interpreting Overload statistics on page 3-61](#)
  - o [Interpreting DHCP Relay statistics on page 3-63](#)
  - o [Interpreting Filter statistics on page 3-65](#)
  - o [Viewing ARP statistics on page 3-66](#)
  - o [Viewing NAT statistics on page 3-66](#)
  - o [Viewing NAT DHCP Statistics on page 3-68](#)
  - o [Interpreting Sync Status statistics on page 3-69](#)
  - o [Interpreting PPPoE Statistics for Customer Activities on page 3-70](#)
  - o [Interpreting Bridge Control Block statistics on page 3-72](#)
  - o [Interpreting Pass Through Statistics on page 3-75](#)
  - o [Interpreting SNMPv3 Statistics on page 3-76](#)
  - o [Interpreting syslog statistics on page 3-78](#)
  - o [Interpreting Frame Utilization statistics on page 3-79](#)
- [Radio Recovery on page 3-89](#)

## 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 3-2
- [Viewing Session Status](#) on page 3-24
- [Viewing Remote Subscribers](#) on page 3-35
- [Interpreting messages in the Event Log](#) on page 3-35
- [Viewing the Network Interface](#) on page 3-38
- [Viewing the Layer 2 Neighbors](#) on page 3-38

### 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 114](#)

The **General Status** page of PMP 450 AP is explained in [Table 115](#)

The **General Status** page of PMP 450i AP is explained in [Table 116](#).

**Table 114 General Status page attributes – PMP 450m AP**

| Device Information        |                                                        |
|---------------------------|--------------------------------------------------------|
| Device Type :             | 5.7GHz MU-MIMO OFDM - Access Point - 0a-00-3e-60-34-c8 |
| Board Type :              | P14                                                    |
| Product Type :            | PMP 450m                                               |
| Software Version :        | CANOPY 15.2 AP                                         |
| Bootloader Version :      | BOOTLOADER 15.1.1/161 2017-06-21 06:50:26 -0500        |
| CPU Usage :               | 0%                                                     |
| Board MSN :               | M9SM0024C4GC                                           |
| Board Model :             | C050045A101A                                           |
| FPGA Version :            | 031c76                                                 |
| Uptime :                  | 3d, 03:55:00                                           |
| System Time :             | 09:45:10 05/25/2018 UTC                                |
| Main Ethernet Interface : | 100Base-TX Full Duplex                                 |
| Region Code :             | Other                                                  |
| Regulatory :              | Passed                                                 |
| Channel Frequency :       | 5800.0 MHz                                             |
| Channel Bandwidth :       | 10.0 MHz                                               |
| Cyclic Prefix :           | 1/16                                                   |
| Frame Period :            | 2.5 ms                                                 |
| Encryption :              | Capable of AES-256 but configured to None              |
| Color Code :              | 245                                                    |
| Max Range :               | 25 km                                                  |
| EIRP :                    | 33 dBm                                                 |
| Temperature :             | 47 °C / 116 °F                                         |

| Access Point Stats                |                                              |
|-----------------------------------|----------------------------------------------|
| Registered SM Count :             | 1 (1 Data Channels)                          |
| Sync Pulse Status :               | Receiving Sync (100.0% Sync pulses received) |
| Sync Pulse Source :               | Power Port (Canopy Sync)                     |
| Maximum Count of Registered SMs : | 1                                            |

| Frame Configuration Information |    |
|---------------------------------|----|
| Data Slots Down :               | 15 |
| Data Slots Up :                 | 16 |
| Contention Slots :              | 4  |

| cnMaestro Connection Stats |                                                        |
|----------------------------|--------------------------------------------------------|
| Connection Status :        | Device Approval Pending (qa.cloud.cambiumnetworks.com) |
| AccountID :                |                                                        |

| Site Information |                  |
|------------------|------------------|
| Site Name :      | 450m             |
| Site Contact :   | No Site Contact  |
| Site Location :  | No Site Location |

| Feature Key Information          |                           |
|----------------------------------|---------------------------|
| MU-MIMO Mode :                   | MU-MIMO                   |
| AES-256 Encryption Keyed :       | False                     |
| Time Updated and Location Code : | 08/10/2017 09:12:40 - sdf |

| 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.                                                                                                                                                                                                                                                                                                            |
| 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"> <li>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.</li> </ul> <p>MU-MIMO: This model works in MU-MIMO mode.</p> |
| Software Version        | This field indicates the system release, the time and date of the release and whether communications involving the module are secured by AES encryption. If you request technical support, provide the information from this field.                                                                                                                     |
| Bootloader Version      | This field indicates the version of Uboot running on the 450m AP platform.                                                                                                                                                                                                                                                                              |
| CPU Usage               | This field indicates the current CPU utilization of the device.                                                                                                                                                                                                                                                                                         |
| Board MSN               | This field indicates the Manufacturer’s Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control.                                                                                                                                                                                                  |
| Board Model             | This field indicates the Manufacturer’s Model number. A unique serial number assigned to each 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.                                                                                                                                                                   |
| Main Ethernet Interface | This field indicates the speed and duplex state of the Ethernet interface to the 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 <b>Country Code</b> 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.                                                                                                                                                                              |
| DFS (Dynamic Frequency Selection) | This field dynamically selects frequency based on detection of radar pulses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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 multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.                                                                                                                                                                                                                                                                                  |
| Frame Period                      | This field indicates the current Frame Period setting of the radio in ms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Encryption                        | This field indicates the capability and the encryption configuration of the device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 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><b>Generating Sync</b> indicates that the module is set to <i>generate</i> the sync pulse.</p> <p><b>Receiving Sync</b> indicates that the module is set to <i>receive</i> a sync pulse from an outside source and is receiving the pulse.</p> <p><b>No Sync Since Boot up / ERROR: No Sync Pulse</b> indicates that the module is set to <i>receive</i> a sync pulse from an outside source and is not receiving the pulse.</p> <div>  <p><b>Note</b></p> <p>When this message is displayed, the AP transmitter is turned off to avoid self-interference within the system.</p> </div> |
| Sync Pulse Source               | <p>This field indicates the status of the synchronization source:</p> <p><b>Searching</b> indicates that the unit is searching for a GPS fix</p> <p><b>Timing Port/UGPS</b> indicates that the module is receiving sync via the timing AUX/SYNC timing port</p> <p><b>Power Port</b> indicates that the module is receiving sync via the power port (Ethernet port).</p> <p><b>On-board GPS</b> 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 <b>Max Range, Downlink Data</b> and (reserved) <b>Contention Slots</b> 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 <a href="#">Contention slots</a> on page1-208.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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).                                                                                             |
| AES-256 Encryption Keyed       | <p>This displays the status of the entered AES-256 Encryption Key.</p> <div>  <div> <p><b>Note</b></p> <p>To enable AES-256 Encryption, a feature key needs to be purchased.</p> </div> </div>    |
| Time Updated and Location Code | This field displays information about the keying of the radio.                                                                                                                                                                                                                     |

Table 115 General Status page attributes – PMP 450 AP

| Device Information                |                                                     |
|-----------------------------------|-----------------------------------------------------|
| Device Type :                     | 5.7GHz MIMO OFDM - Access Point - 0a-00-3e-b1-2a-78 |
| Board Type :                      | P12                                                 |
| Product Type :                    | PMP 450                                             |
| Software Version :                | CANOPY 15.2 AP                                      |
| CPU Usage :                       | Curr/Max: 9%/95%                                    |
| Board MSN :                       | 6069QU0F0C                                          |
| FPGA Version :                    | 062618                                              |
| PLD Version :                     | 20                                                  |
| Uptime :                          | 03:44:31                                            |
| System Time :                     | 09:11:33 07/12/2018 UTC                             |
| Main Ethernet Interface :         | 100Base-TX Full Duplex                              |
| Region Code :                     | Other                                               |
| Regulatory :                      | Passed                                              |
| Antenna Type :                    | External                                            |
| Channel Frequency :               | 5850.0 MHz                                          |
| Channel Bandwidth :               | 20.0 MHz                                            |
| Cyclic Prefix :                   | 1/16                                                |
| Frame Period :                    | 2.5 ms                                              |
| Encryption :                      | Capable of AES-128 but configured to None           |
| Color Code :                      | 171                                                 |
| Max Range :                       | 3 Miles                                             |
| Transmit Power :                  | 0 dBm                                               |
| Total Antenna Gain :              | 0 dBi                                               |
| Temperature :                     | 29 °C / 85 °F                                       |
| Access Point Stats                |                                                     |
| Registered SM Count :             | 1 (1 Data Channels)                                 |
| Sync Pulse Status :               | Generating Sync                                     |
| Sync Pulse Source :               | Self Generate                                       |
| Maximum Count of Registered SMs : | 1                                                   |
| Frame Configuration Information   |                                                     |
| Data Slots Down :                 | 40                                                  |
| Data Slots Up :                   | 41                                                  |
| Contention Slots :                | 3                                                   |
| cnMaestro Connection Stats        |                                                     |
| Connection Status :               | Connected (cloud.cambiumnetworks.com)               |
| AccountID :                       | GRE001                                              |
| Site Information                  |                                                     |
| Site Name :                       | No Site Name                                        |
| Site Contact :                    | No Site Contact                                     |
| Site Location :                   | No Site Location                                    |
| Feature Key Information           |                                                     |
| AES-256 Encryption Keyed :        | False                                               |
| Time Updated and Location Code :  | 05/09/2017 06:23:21 - INTL                          |

| Attribute                | Meaning                                                                                                                                                |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device Type              | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Board Type               |                                                                                                                                                        |
| Product Type             | This indicates model of the device.                                                                                                                    |
| Software Version         | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| CPU Usage                | This field indicates the current CPU utilization of the device.                                                                                        |
| Board MSN                | This field indicates the Manufacturer's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control. |
| FPGA Version             | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| PLD Version              | This field indicates the firmware version on the Programmable Logic Device.                                                                            |
| Uptime                   | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| System Time              |                                                                                                                                                        |
| Main Ethernet Interface  |                                                                                                                                                        |
| Region Code              | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Regulatory               |                                                                                                                                                        |
| Antenna Type             |                                                                                                                                                        |
| Channel Center Frequency |                                                                                                                                                        |
| Channel Bandwidth        |                                                                                                                                                        |
| Cyclic Prefix            |                                                                                                                                                        |
| Frame Period             |                                                                                                                                                        |
| Color Code               |                                                                                                                                                        |
| Max Range                |                                                                                                                                                        |
| Transmit 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 <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Total Antenna Gain       | This field indicates the total antenna gain.                                                                                                           |
| Sync Pulse Status        |                                                                                                                                                        |
| Sync Pulse Source        |                                                                                                                                                        |

|                                 |                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------|
| Maximum Count of Registered SMs |                                                                                                    |
| Data Slots Down                 |                                                                                                    |
| Data Slots Up                   |                                                                                                    |
| Contention Slots                | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details |
| Connection Status               |                                                                                                    |
| Account ID                      |                                                                                                    |
| Site Name                       |                                                                                                    |
| Site Contact                    |                                                                                                    |
| Site Location                   |                                                                                                    |
| Time Updated and Location Code  |                                                                                                    |

Table 116 General Status page attributes – PMP 450i AP

| Device Information        |                                                     |
|---------------------------|-----------------------------------------------------|
| Device Type :             | 5.4GHz MIMO OFDM - Access Point - 0a-00-3e-bb-01-77 |
| Board Type :              | P13                                                 |
| Product Type :            | PMP 450i                                            |
| Software Version :        | CANOPY 15.1.5 AP-None                               |
| CPU Usage :               | 2%                                                  |
| Board MSN :               | PMP450IMSN                                          |
| Board Model :             | C050045A010A                                        |
| FPGA Version :            | 020118                                              |
| Uptime :                  | 2d, 07:56:57                                        |
| System Time :             | 17:58:46 01/03/2016 UTC                             |
| Main Ethernet Interface : | 100Base-TX Full Duplex                              |
| Aux Ethernet Interface :  | Disabled (PoE Disabled)                             |
| Region Code :             | Other                                               |
| Regulatory :              | Passed                                              |
| DFS :                     | Idle                                                |
| Antenna Type :            | External                                            |
| Channel Frequency :       | 5705.0 MHz                                          |
| Channel Bandwidth :       | 40.0 MHz                                            |
| Cyclic Prefix :           | 1/16                                                |
| Frame Period :            | 2.5 ms                                              |
| Color Code :              | 133                                                 |
| Max Range :               | 2 Miles                                             |
| Transmit Power :          | 27 dBm                                              |
| Total Antenna Gain :      | 40 dBi                                              |
| Temperature :             | 36 °C / 97 °F                                       |

| Access Point Stats                |                                              |
|-----------------------------------|----------------------------------------------|
| Registered SM Count :             | 1 (1 Data Channels)                          |
| Sync Pulse Status :               | Receiving Sync (100.0% Sync pulses received) |
| Sync Pulse Source :               | Power Port (Canopy Sync)                     |
| Maximum Count of Registered SMs : | 1                                            |

| Frame Configuration Information |     |
|---------------------------------|-----|
| Data Slots Down :               | 129 |
| Data Slots Up :                 | 43  |
| Contention Slots :              | 3   |

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

| Site Information |                  |
|------------------|------------------|
| Site Name :      | 450i AP-133      |
| Site Contact :   | No Site Contact  |
| Site Location :  | No Site Location |

| Feature Key Information          |                            |
|----------------------------------|----------------------------|
| Time Updated and Location Code : | 11/01/2017 13:21:54 - INTL |

| Attribute               | Meaning                                                                                                                                                |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device Type             | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Board Type              |                                                                                                                                                        |
| Product Type            | This indicates model of the device.                                                                                                                    |
| Software Version        | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| CPU Usage               | This field indicates the current CPU utilization of the device.                                                                                        |
| Board MSN               | This field indicates the Manufacturer's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control. |
| Board Model             | This field indicates the Manufacturer's Model number.                                                                                                  |
| FPGA Version            | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Uptime                  |                                                                                                                                                        |
| System Time             |                                                                                                                                                        |
| Main Ethernet Interface |                                                                                                                                                        |
| Aux Ethernet Interface  | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Region Code             | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                                     |
| Regulatory              |                                                                                                                                                        |

|                                 |                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Antenna Type                    |                                                                                                                                        |
| Channel Center Frequency        |                                                                                                                                        |
| Channel Bandwidth               |                                                                                                                                        |
| Cyclic Prefix                   |                                                                                                                                        |
| Frame Period                    |                                                                                                                                        |
| Color Code                      |                                                                                                                                        |
| Max Range                       |                                                                                                                                        |
| Transmit 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. |
| Total Antenna Gain              | This field indicates the total antenna gain.                                                                                           |
| Temperature                     | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 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 <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                     |
| Sync Pulse Status               |                                                                                                                                        |
| Sync Pulse Source               |                                                                                                                                        |
| Maximum Count of Registered SMs |                                                                                                                                        |
| Data Slots Down                 |                                                                                                                                        |
| Data Slots Up                   |                                                                                                                                        |
| Contention Slots                | See <a href="#">Table 114 General Status page attributes - PMP 450m AP</a> on page 3-3 for details                                     |
| Connection Status               |                                                                                                                                        |
| Account ID                      |                                                                                                                                        |
| 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 117](#).



### Note

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

**Table 117 General Status page attributes - SM**

| Device Information        |                                                              |
|---------------------------|--------------------------------------------------------------|
| Device Type :             | 4.9/5.9GHz MIMO OFDM - Subscriber Module - 0a-00-3e-78-15-10 |
| Board Type :              | P15                                                          |
| Product Type :            | PMP 450b High Gain                                           |
| Software Version :        | CANOPY 15.2 SM                                               |
| CPU Usage :               | 3%                                                           |
| Board MSN :               | M9SM00Z7P2P2                                                 |
| Board Model :             | C050045C012A                                                 |
| FPGA Version :            | 051918                                                       |
| Uptime :                  | 3d, 03:53:38                                                 |
| System Time :             | 09:49:44 05/25/2018 UTC                                      |
| Main Ethernet Interface : | No Link                                                      |
| Region Code :             | Other                                                        |
| DFS :                     | Idle                                                         |
| Antenna Type :            | Integrated                                                   |
| Frame Period :            | 2.5 ms                                                       |
| Encryption :              | None                                                         |
| Temperature :             | 68 °C / 155 °F                                               |

| Subscriber Module Stats |                                                             |
|-------------------------|-------------------------------------------------------------|
| Session Status :        | REGISTERED VC 18 Rate 8X/6X MIMO-B VC 255 Rate 8X/6X MIMO-B |
| Session Uptime :        | 1 d, 17:17:57                                               |
| Registered AP :         | 0a-00-3e-bb-01-77 450i AP-133                               |
| Color Code :            | 133 ( Primary )                                             |
| Sector ID :             | 0                                                           |
| Channel Frequency :     | 5800.0 MHz                                                  |
| Channel Bandwidth :     | 40.0 MHz                                                    |
| Cyclic Prefix :         | 1/16                                                        |
| Air Delay :             | 0 ns, approximately 0.000 miles (0 feet)                    |
| Receive Power :         | -61.5 dBm                                                   |
| Signal Strength Ratio : | -1.0dB V - H                                                |
| Signal to Noise Ratio : | 30 V / 31 H dB                                              |
| Beacons :               | 99 %                                                        |
| Transmit Power :        | 19 dBm (target power [34 dBm] exceeded maximum)             |
| Total Antenna Gain :    | 16 dBi                                                      |

| Frame Configuration Information |     |
|---------------------------------|-----|
| Data Slots Down :               | 129 |
| Data Slots Up :                 | 43  |
| Contention Slots :              | 3   |

| Region Specific Information |                |
|-----------------------------|----------------|
| Region Code :               | United Kingdom |

| cnMaestro Connection Stats |                                                               |
|----------------------------|---------------------------------------------------------------|
| Connection Status :        | Resolving URL (cloud.cambiumnetworks.com - Default Cloud URL) |
| AccountID :                |                                                               |

| Site Information |                  |
|------------------|------------------|
| Site Name :      | 450b LG          |
| Site Contact :   | No Site Contact  |
| Site Location :  | No Site Location |

| Feature Key Information          |                            |
|----------------------------------|----------------------------|
| Maximum Throughput :             | Unlimited                  |
| Time Updated and Location Code : | 03/02/2018 09:16:11 - INTL |

| 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.                    |
| CPU Usage          | This field indicates the current CPU utilization of the device.                                                                                                          |
| Board MSN          | This field indicates the Manufacturer's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control.                   |
| Board Model        | This field indicates the Manufacturer's Model number.                                                                                                                    |
| 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 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Encryption        | This field indicates the capability and the encryption configuration of the device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Temperature       | The current operating temperature of the board.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Session Status    | <p>This field displays the following information about the current session:</p> <p><b>Scanning</b> indicates that this SM currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page.</p> <p><b>Syncing</b> indicates that this SM currently attempts to receive sync.</p> <p><b>Registering</b> indicates that this SM has sent a registration request message to the AP and has not yet received a response.</p> <p><b>Registered</b> indicates that this SM is both:</p> <ul style="list-style-type: none"> <li>• registered to an AP.</li> <li>• ready to transmit and receive data packets.</li> </ul> |
| Session Uptime    | This field displays the duration of the current link. The syntax of the displayed time is hh:mm:ss.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 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 multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.                                                                                                                                                                                                                                                                                                                                                                  |
| 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        | <p>This field lists the current combined transmit power level, in dBm.</p> <div>  <p><b>Note</b></p> <p>The red SM message “target power exceeded maximum” does not necessarily indicate a problem.</p> <p><u>7 dBm (target power [24 dBm] exceeded maximum)</u></p> <p>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.</p> </div> |
| 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 <a href="#">Contention slots</a> on page1-208.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 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 118](#).

**Table 118 General Status page attributes - BHM**

| Device Information               |                                                                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Device Type :                    | 5.7GHz MIMO OFDM - Backhaul - Timing Master - 0a-00-3e-bb-b0-c1                                                                 |
| Board Type :                     | P13                                                                                                                             |
| Product Type :                   | PTP 450i                                                                                                                        |
| Software Version :               | CANOPY 15.1.5 BHUL450-None                                                                                                      |
| CPU Usage :                      | 2%                                                                                                                              |
| Board MSN :                      | M9TJ1G92GCJH                                                                                                                    |
| Board Model :                    | C050045B001A                                                                                                                    |
| FPGA Version :                   | 020118                                                                                                                          |
| Uptime :                         | 01:01:51                                                                                                                        |
| System Time :                    | 23:19:08 01/02/2016 UTC                                                                                                         |
| Main Ethernet Interface :        | 100Base-TX Full Duplex                                                                                                          |
| Aux Ethernet Interface :         | Disabled (PoE Disabled)                                                                                                         |
| Region Code :                    | Other                                                                                                                           |
| Regulatory :                     | Passed                                                                                                                          |
| Antenna Type :                   | External                                                                                                                        |
| Channel Frequency :              | 5750.0 MHz                                                                                                                      |
| Channel Bandwidth :              | 40.0 MHz                                                                                                                        |
| Cyclic Prefix :                  | 1/16                                                                                                                            |
| Frame Period :                   | 5.0 ms                                                                                                                          |
| Color Code :                     | 38                                                                                                                              |
| Transmit Power :                 | 16 dBm                                                                                                                          |
| Total Antenna Gain :             | 0 dBi                                                                                                                           |
| Temperature :                    | 31 °C / 88 °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 :                | 191                                                                                                                             |
| Data Slots Up :                  | 192                                                                                                                             |
| cnMaestro Connection Stats       |                                                                                                                                 |
| Connection Status :              | Remote management using cnMaestro is disabled                                                                                   |
| AccountID :                      |                                                                                                                                 |
| Site Information                 |                                                                                                                                 |
| Site Name :                      |                                                                                                                                 |
| Site Contact :                   | No Site Contact                                                                                                                 |
| Site Location :                  | No Site Location                                                                                                                |
| Feature Key Information          |                                                                                                                                 |
| Time Updated and Location Code : | 01/03/2018 05:59:03 - FXGD                                                                                                      |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| CPU Usage           | This field indicates the current CPU utilization of the device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Board Model         | This field indicates the Manufacturer's Model number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 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      | <p>This field displays the following information about the current session:</p> <p><b>Scanning</b> indicates that this BHS currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page.</p> <p><b>Syncing</b> indicates that this BHM currently attempts to receive sync.</p> <p><b>Registering</b> indicates that this BHM has sent a registration request message to the BHM and has not yet received a response.</p> <p><b>Registered</b> indicates that this BHM is both:</p> <ul style="list-style-type: none"> <li>Registered to a BHM.</li> <li>Ready to transmit and receive data packets.</li> </ul> |
| 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 <b>Configuration &gt; SNMP</b> page. This information is also set into the <i>sysName</i> SNMP MIB-II object and can be polled by an SNMP management server.                                                            |
| Time Updated and Location Code | This field displays information about the keying of the radio.                                                                                                                                                                                                                                                  |

## General Status page of BHS

The BHS's **General Status** page is explained in [Table 119](#).

**Table 119 General Status page attributes - BHS**

| Device Information              |                                                                    |
|---------------------------------|--------------------------------------------------------------------|
| Device Type :                   | 4.9/5.9GHz MIMO OFDM - Backhaul - Timing Slave - 0a-00-3e-bb-ae-1b |
| Board Type :                    | P13                                                                |
| Product Type :                  | PTP 450i                                                           |
| Software Version :              | CANOPY 15.1.5 BHUL450-DES                                          |
| CPU Usage :                     | 2%                                                                 |
| Board MSN :                     | M9TJ1DRLGM5L                                                       |
| Board Model :                   | C050045B001A                                                       |
| FPGA Version :                  | 020118                                                             |
| Uptime :                        | 01:00:23                                                           |
| System Time :                   | 23:22:08 01/02/2016 UTC                                            |
| Main Ethernet Interface :       | No Link                                                            |
| Aux Ethernet Interface :        | Disabled (PoE Disabled)                                            |
| Region Code :                   | Other                                                              |
| DFS :                           | Idle                                                               |
| Antenna Type :                  | External                                                           |
| Frame Period :                  | 5.0 ms                                                             |
| Temperature :                   | 27 °C / 81 °F                                                      |
| 802.3at Type 2 PoE Status :     | Not Present (Ignored)                                              |
| Timing Slave Stats              |                                                                    |
| Session Status :                | REGISTERED VC 18 Rate 8X/1X MIMO-A VC 255 Rate 8X/8X MIMO-B        |
| Session Uptime :                | 00:59:53                                                           |
| Registered Backhaul :           | 0a-00-3e-bb-b0-c1                                                  |
| Channel Frequency :             | 5750.0 MHz                                                         |
| Channel Bandwidth :             | 40.0 MHz                                                           |
| Cyclic Prefix :                 | 1/16                                                               |
| Air Delay :                     | 100 ns, approximately 0.009 miles (49 feet)                        |
| Receive Power :                 | -42.9 dBm                                                          |
| Signal Strength Ratio :         | 2.0dB V - H                                                        |
| Signal to Noise Ratio :         | 43 V / 43 H dB                                                     |
| Transmit Power :                | 16 dBm                                                             |
| Total Antenna Gain :            | 0 dBi                                                              |
| Beacons :                       | 100 %                                                              |
| Frame Configuration Information |                                                                    |
| Data Slots Down :               | 191                                                                |
| Data Slots Up :                 | 192                                                                |
| Region Specific Information     |                                                                    |
| Region Code :                   | Other                                                              |
| cnMaestro Connection Stats      |                                                                    |
| Connection Status :             | Device Not Claimed (cloud.cambiumnetworks.com - Default Cloud URL) |
| AccountID :                     |                                                                    |

| Site Information |                  |
|------------------|------------------|
| Site Name :      | No Site Name     |
| Site Contact :   | No Site Contact  |
| Site Location :  | No Site Location |

| Feature Key Information          |                            |
|----------------------------------|----------------------------|
| Time Updated and Location Code : | 01/03/2018 06:11:06 - HJDJ |

| Attribute             | Meaning                                    |
|-----------------------|--------------------------------------------|
| Device Type           | See <a href="#">Table 119</a> on page 3-21 |
| Board Type            |                                            |
| Software Version      |                                            |
| CPU Usage             |                                            |
| Board MSN             |                                            |
| Board Model           |                                            |
| FPGA Version          |                                            |
| Uptime                | See <a href="#">Table 119</a> on page 3-21 |
| System Time           |                                            |
| Ethernet Interface    |                                            |
| Antenna Type          |                                            |
| Temperature           |                                            |
| Session Status        |                                            |
| Session Uptime        |                                            |
| Registered Backhaul   |                                            |
| Channel Frequency     |                                            |
| Receive Power         |                                            |
| Signal Strength Ratio |                                            |
| Transmit Power        |                                            |
| 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

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

The Session Status List has four tabs: Device, Session, Power, Configuration, and Link Quality.

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 120 Device tab attributes**

| Subscriber                       | LUID | Hardware | Software Version | FPGA Version | State      |
|----------------------------------|------|----------|------------------|--------------|------------|
| No Site Name [0a-00-3e-42-a9-4d] | 002  | PMP 450  | CANOPY 15.2      | 062618 P11   | IN SESSION |

| Attribute  | Meaning                                                                                  |
|------------|------------------------------------------------------------------------------------------|
| Subscriber | This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. |



**Note**

The MAC is a hot link 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.

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LUID             | <p>This field displays the LUID (logical unit ID) 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.</p> <hr/> <div>  <div> <p><b>Note</b></p> <p>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.</p> </div> </div> |
| 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"> <li>• <b>IN SESSION</b> to indicate that the SM/BHS is currently registered to the AP/BHM.</li> <li>• <b>IDLE</b> to indicate that the SM/BHS was registered to the AP/BHM at one time, but now is not.</li> </ul> <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 121 Session tab attributes**

| Session Status List                              |      |            |                   |               |                                      |                          |             |                      |    |      |             |         |
|--------------------------------------------------|------|------------|-------------------|---------------|--------------------------------------|--------------------------|-------------|----------------------|----|------|-------------|---------|
| Data :                                           |      |            |                   |               | <a href="#">SessionStatus.xml</a>    |                          |             |                      |    |      |             |         |
| Encryption Information :                         |      |            |                   |               | Encryption is disabled on this radio |                          |             |                      |    |      |             |         |
| Device                                           |      | Session    |                   | Power         |                                      | Configuration            |             | Link Quality         |    |      |             |         |
| Subscriber                                       | LUID | State      | Uptime (Downtime) | Session Count | Registration Requests                | Re-Registration Requests | CC Priority | Air Delay            |    |      | PPPoE State | Timeout |
|                                                  |      |            |                   |               |                                      |                          |             | Distance             | ns | bits |             |         |
| <a href="#">No Site Name [0a-00-3e-42-a9-4d]</a> | 002  | IN SESSION | 02:38:38          | 1             | 1                                    | 0                        | Primary     | 0.000 miles (0 feet) | 0  | 0    | NA          | 0       |

| Attribute             | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber            | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                      |
| LUID                  | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                      |
| State                 | This field displays the status of the registered SM.                                                                                                                                                                                                                                                                                                                                                                                             |
| Uptime (Downtime)     | 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.                                                                                                                                                                                                                                                                      |
| Session Count         | <p>This field displays how many sessions the SM/BHS has had with the AP/BHM. Typically, this is the sum of Registration Requests and Re-Registration Requests. 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> |
| Registration Requests | <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 Registration Requests indicates total number of connected SMs to an AP.</p>                         |



### Note

The user can clear Registration Requests by dropping all current sessions of SM (or BHS) from Configuration > Tools > Sessions menu.

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Re- Registration Requests | <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-Registration Requests is the case where both:</p> <ul style="list-style-type: none"> <li>SM/BHS attempts to reregister for having lost communication with the AP/BHM.</li> <li>AP/BHM has not yet observed the link to the SM/BHS as being down.</li> </ul> <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> |
| 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 122 Power tab attributes**

| Session Status List                             |         |                                      |               |              |              |              |                   |                            |                            |
|-------------------------------------------------|---------|--------------------------------------|---------------|--------------|--------------|--------------|-------------------|----------------------------|----------------------------|
| Data :                                          |         | <a href="#">SessionStatus.xml</a>    |               |              |              |              |                   |                            |                            |
| Encryption Information :                        |         | Encryption is disabled on this radio |               |              |              |              |                   |                            |                            |
| Device                                          | Session | Power                                | Configuration | Link Quality |              |              |                   |                            |                            |
| Subscriber                                      | LUID    | Hardware                             | Downlink Rate |              | Uplink Rate  |              | AP Rx Power (dBm) | Signal Strength Ratio (dB) | Signal to Noise Ratio (dB) |
|                                                 |         |                                      | SU-MIMO       | MU-MIMO      | SU-MIMO      | MU-MIMO      |                   |                            |                            |
| <a href="#">LUID: 010 - [0a-00-3e-b0-12-9f]</a> | 010     | NA                                   | NA            | NA           | NA           | NA           | NA                | NA                         | NA                         |
| <a href="#">LUID: 011 - [0a-00-3e-70-3f-b5]</a> | 011     | NA                                   | NA            | NA           | NA           | NA           | NA                | NA                         | NA                         |
| <a href="#">LUID: 013 - [0a-00-3e-b4-d3-03]</a> | 013     | NA                                   | NA            | NA           | NA           | NA           | NA                | NA                         | NA                         |
| <a href="#">SM15 [0a-00-3e-b4-d2-c9]</a>        | 012     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/8X MIMO-B | 8X/8X MIMO-B | -50.0             | 0.0dB V - H                | 35 V / 38 H                |
| <a href="#">SM11 11 [0a-00-3e-b4-24-1a]</a>     | 003     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/8X MIMO-B | 8X/1X MIMO-A | -51.2             | 0.5dB V - H                | 35 V / 38 H                |
| <a href="#">SM2 12 [0a-00-3e-b4-24-08]</a>      | 008     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/8X MIMO-B | 8X/8X MIMO-B | -50.0             | 0.0dB V - H                | 34 V / 38 H                |
| <a href="#">SM3 13 [0a-00-3e-b4-d2-e0]</a>      | 007     | PMP 450                              | 4X/4X MIMO-B  | 4X/4X MIMO-B | 4X/4X MIMO-B | 4X/4X MIMO-B | -50.5             | 1.0dB V - H                | 20 V / 20 H                |
| <a href="#">SM4 21 [0a-00-3e-b4-d3-36]</a>      | 002     | PMP 450                              | 4X/4X MIMO-B  | 4X/2X MIMO-A | 4X/4X MIMO-B | 4X/4X MIMO-B | -50.4             | -0.8dB V - H               | 20 V / 20 H                |
| <a href="#">SM5 24 [0a-00-3e-b4-d2-fe]</a>      | 005     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/6X MIMO-B | 8X/6X MIMO-B | -50.5             | 1.0dB V - H                | 27 V / 32 H                |
| <a href="#">SM6 22 [0a-00-3e-b4-d2-ff]</a>      | 009     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/6X MIMO-B | 8X/6X MIMO-B | -51.0             | 0.0dB V - H                | 26 V / 33 H                |
| <a href="#">SM7 23 [0a-00-3e-b4-c2-5c]</a>      | 004     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/6X MIMO-B | 8X/6X MIMO-B | -51.6             | 0.8dB V - H                | 26 V / 33 H                |
| <a href="#">SM8 26 [0a-00-3e-b4-c2-65]</a>      | 006     | PMP 450                              | 8X/8X MIMO-B  | 8X/8X MIMO-B | 8X/8X MIMO-B | 8X/8X MIMO-B | -51.3             | -0.7dB V - H               | 32 V / 36 H                |

| Attribute             | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber            | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| LUID                  | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Hardware              | This field displays the SMs or BHS hardware type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Downlink Rate SU-MIMO | <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 data channel starts at its lowest modulation and slowly rate adapts up, as traffic is successfully transmitted over the data channel. From system release 15.2, all data channels in a single SM will have the same modulation rates.</p> <p><b>Note:</b> 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 SMs.</p> |
| Downlink Rate MU-MIMO | This field indicates the modulation rate used for symbols where the low or medium priority data channels are MU-MIMO scheduled by grouping it in the same slot with other low or Medium priority data channels from other SM's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Uplink Rate SU-MIMO   | <p>This field 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 data channel starts at its lowest modulation and slowly rate adapts up, as traffic is successfully transmitted over the data channel. From system release 15.2, all data channels in a single SM will have the same modulation rates.</p> <p><b>Note:</b> 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 SMs.</p>                                                                         |
| Uplink Rate MU-MIMO   | This field indicates the modulation rate used for symbols where the MUMIMO groupable data channels are MU-MIMO scheduled by grouping it in the same slot with other MU-MIMO groupable data channels from other SM's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| AP Rx Power (dBm)     | This field indicates the AP's or BHM's combined receive power level for the listed SM/BHS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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|                            |                                                                                                                                                                                                                                         |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                         |

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## 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 Medium Priority CIR, UL/DL High Priority CIR, UL/DL Ultra High Priority CIR, the UL/DL Broadcast or Multicast Allocation, SM Prioritization Group, RADIUS Authentication Reply, and RADIUS Authentication Server. This data is refreshed based on the Web Page Auto Update setting on the AP's or BHS's General Configuration page.

**Table 123 Configuration tab attributes**

The screenshot shows the 'Session Status List' window with the 'Configuration' tab selected. It displays session information for a subscriber with LUID 002. The configuration details are as follows:

| Subscriber                          | LUID | Session  | Sustained Data Rate Cap (kbps) | Sustained Data Rate (kbps) | Burst Allocation (kbit) | Max Burst Rate (kbit) | Low Priority CIR (kbps) | Medium Priority CIR (kbps) | High Priority CIR (kbps) | Ultra High Priority CIR (kbps) | Broadcast/Multicast Allocation | SM Prioritization Group (Disabled) | RADIUS Authentication Reply | RADIUS Authentication Server |
|-------------------------------------|------|----------|--------------------------------|----------------------------|-------------------------|-----------------------|-------------------------|----------------------------|--------------------------|--------------------------------|--------------------------------|------------------------------------|-----------------------------|------------------------------|
| No Site Name<br>[0a-00-3e-42-a9-4d] | 002  | Uplink   | 4000                           | 4000(AAA)                  | 2900(AAA)               | 5000(AAA)             | 0(D)                    | NA                         | 0(D)                     | NA                             | 50000(D)                       | Low(D)                             | SM on 10.110.207.101        | 10.110.207.101               |
|                                     |      | Downlink |                                | 4000(AAA)                  | 2900(AAA)               | 5000(AAA)             | 0(D)                    | NA                         | 0(D)                     | NA                             |                                |                                    |                             |                              |

| Attribute                             | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber                            | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                   |
| LUID                                  | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                                                                                                                                                                                   |
| Sustained Data Rate Cap (kbps)        | This field specifies the maximum sustained data rate between SM/BHS and AP/BHM. If this field displays “Uncapped”, then there is no limit set for data rate. If this field displays 4000, then the maximum sustained data rate between SM/BHS and AP/BHM is limited to 4000 kbps.                                                                                                                                                             |
| Sustained Data Rate (kbps) - Uplink   | <p>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.</p> <p>See <a href="#">Maximum Information Rate (MIR) Parameters</a> on page 1-236.</p>                                 |
| Sustained Data Rate (kbps) - Downlink | <p>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.</p> <p>See <a href="#">Maximum Information Rate (MIR) Parameters</a> on page 1-236.</p> |
| Burst Allocation (kbit) - Uplink      | <p>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 <b>Sustained Uplink Data Rate</b> with credits to transmit more. The configuration source of the value is indicated in parentheses.</p>                                                         |

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       | See <a href="#">Interaction of Burst Allocation and Sustained Data Rate Settings</a> on page <a href="#">1-238</a>                                                                                                                                                                                                                                                                                                                                                                  |
| Burst Allocation (kbit)<br>- Downlink | <p>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.</p> <p>See <a href="#">Interaction of Burst Allocation and Sustained Data Rate Settings</a> on page <a href="#">1-238</a></p> |
| Max Burst Rate (kbit)<br>- Uplink     | <p>The data rate at which an SM/BHS is allowed to burst (until burst allocation limit is reached) before being recharged at the <b>Sustained Uplink Data Rate</b> with credits to transit more. When set to 0 (default), the burst rate is unlimited.</p> <p>See <a href="#">Interaction of Burst Allocation and Sustained Data Rate Settings</a> on page <a href="#">1-238</a></p>                                                                                                 |
| Max Burst Rate (kbit)<br>- Downlink   | <p>The data rate at which an SM/BHS is allowed to burst (until burst allocation limit is reached) before being recharged at the <b>Sustained Downlink Data Rate</b> with credits to transit more. When set to 0 (default), the burst rate is unlimited.</p> <p>See <a href="#">Interaction of Burst Allocation and Sustained Data Rate Settings</a> on page <a href="#">1-238</a></p>                                                                                               |
| 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).                                                                                                                                                                                                                                                                                                             |
| Medium Priority CIR                   | This field indicates the minimum rate at which medium priority traffic is sent over the uplink and downlink (unless CIR is oversubscribed or RF link quality is degraded).                                                                                                                                                                                                                                                                                                          |
| High Priority 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).                                                                                                                                                                                                                                                                                                            |
| Ultra High Priority CIR               | This field indicates the minimum rate at which ultra 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.                                                                                                                                                                                                                                                                                                                                                                              |
| SM Prioritization Group               | This field displays the priority level configured on the SM under SM Prioritization Group.                                                                                                                                                                                                                                                                                                                                                                                          |
| RADIUS Authentication Reply           | This field displays whether RADIUS server is reachable or not.                                                                                                                                                                                                                                                                                                                                                                                                                      |

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|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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. |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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**Table 124 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                                                                                 |

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## Link Quality tab

The **Link Quality** tab provides information on the Subscriber's UID, Link quality, Downlink, Uplink, Beacon, ReReg, and the Uptime.

This data is refreshed based on the **Link Quality Update Interval** parameter configuration under the **Sessions Status** page.

**Link Quality Metric** parameter offers an option to choose either EVM or Rate based LQI calculation.

**Session Status Configuration**

Show Idle Sessions : ☒ Enabled ☐ Disabled

Link Quality Update Interval : 1 minute ▼

Link Quality Metric : EVM ▼  
Rate  
EVM

The **Link Quality** tab displays the calculated Link Quality Indicator (LQI) for the configured interval (**Link Quality Update Interval** parameter).

Table 125 Link Quality tab attributes

### Link Quality Metric: Rate

**Session Status List**

Data : [SessionStatus.xml](#)

Encryption Information : Encryption is disabled on this radio

| Subscriber                 | UID | Link Quality Indicator | Quality Index | Actual Average Rate | Expected Rate | Beacon Quality Index | Beacon % | Quality Index | Actual Average Rate | Expected Rate | Quality Index | Count | Uptime   |
|----------------------------|-----|------------------------|---------------|---------------------|---------------|----------------------|----------|---------------|---------------------|---------------|---------------|-------|----------|
| SM15 [0a-00-3e-b4-d2-c9]   | 012 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 8X                  | 8X            | 100%          | 0     | 02:38:46 |
| SM1 11 [0a-00-3e-b4-24-1a] | 003 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 8X                  | 8X            | 100%          | 0     | 02:38:13 |
| SM2 12 [0a-00-3e-b4-24-08] | 008 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 8X                  | 8X            | 100%          | 0     | 02:38:13 |
| SM3 13 [0a-00-3e-b4-d2-e0] | 007 | 100                    | 100%          | 4X                  | 4X            | 100%                 | 100%     | 100%          | 4X                  | 4X            | 100%          | 0     | 02:38:17 |
| SM4 21 [0a-00-3e-b4-d3-36] | 002 | 100                    | 100%          | 4X                  | 4X            | 100%                 | 100%     | 100%          | 4X                  | 4X            | 100%          | 0     | 02:38:17 |
| SM5 24 [0a-00-3e-b4-d2-fe] | 005 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 6X                  | 6X            | 100%          | 0     | 02:38:15 |
| SM6 22 [0a-00-3e-b4-d2-f]  | 009 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 6X                  | 6X            | 100%          | 0     | 02:38:15 |
| SM7 23 [0a-00-3e-b4-c2-5c] | 004 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 6X                  | 6X            | 100%          | 0     | 02:38:17 |
| SM8 26 [0a-00-3e-b4-c2-65] | 006 | 100                    | 100%          | 8X                  | 8X            | 100%                 | 100%     | 100%          | 8X                  | 8X            | 100%          | 0     | 02:38:15 |

### Link Quality Metric: EVM

**Session Status List**

Data : [SessionStatus.xml](#)

Encryption Information : Encryption is disabled on this radio

| Subscriber              | UID | Link Quality Indicator | Quality Index | Actual Average EVM | Expected EVM | Beacon Quality Index | Beacon % | Quality Index | Actual Average EVM | Expected EVM | Quality Index | Count | Uptime           |
|-------------------------|-----|------------------------|---------------|--------------------|--------------|----------------------|----------|---------------|--------------------|--------------|---------------|-------|------------------|
| vSM [0a-00-3e-45-11-ed] | 002 | 99                     | 99%           | -28.1              | -29.0        | 100%                 | 100%     | 100%          | -27.1              | -25.0        | 100%          | 0     | 3 days, 18:16:17 |

#### Attribute

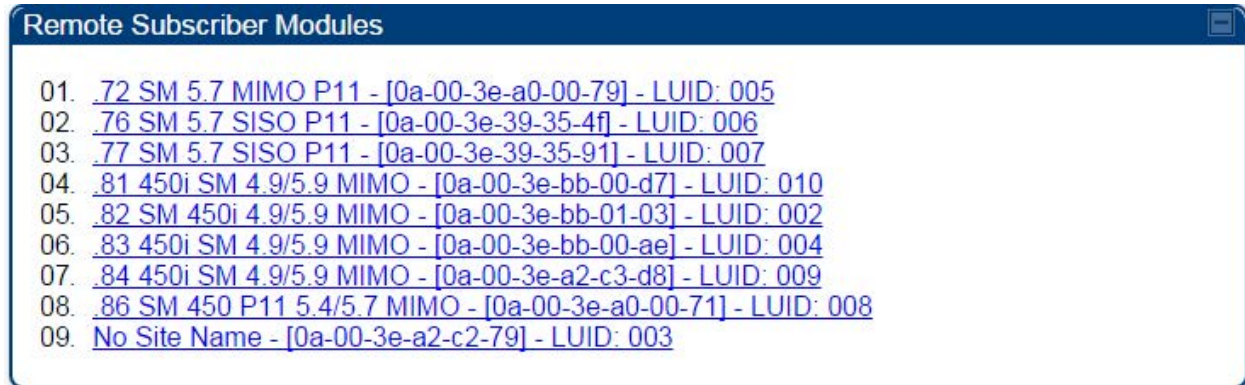
#### Meaning

|                                 |                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber                      | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                  |
| LUID                            | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                  |
| Link Quality Indicator          | This field displays quality of the link. It is calculated based on receive power, modulation rate, re-registrations and beacon percentage.                                                                   |
| Downlink - Quality Index        | This field displays the downlink quality in percentage. It is calculated based on Downlink receiver power, modulation rate, and beacon percentage.                                                           |
| Downlink -Actual Average Rate   | This field displays the average Downlink modulation rate. For 450m, this field specifies the SU-MIMO Modulation Rate. When Rate based LQI is selected, only actual rate and expected rate will be displayed. |
| Downlink -Actual Average EVM    | This field displays the average Downlink EVM rate.                                                                                                                                                           |
| Downlink - Expected Rate        | This field displays the expected modulation rate based on receive power in Downlink. When EVM based LQI is selected, only actual EVM and expected EVM will be displayed.                                     |
| Downlink - Beacon Quality Index | This field displays the beacon quality index. It is calculated based on beacon percentage.                                                                                                                   |
| Downlink - Beacon %             | This field displays the received beacon percentage.                                                                                                                                                          |
| Uplink - Quality Index          | This field displays the uplink quality in percentage. It is calculated based on Uplink receiver power and modulation rate.                                                                                   |
| Uplink -Actual Average Rate     | This field displays the average Uplink modulation rate.                                                                                                                                                      |
| Uplink -Actual Average EVM      | This field displays the average Uplink EVM rate.                                                                                                                                                             |
| Uplink - Expected Rate          | This field displays the expected modulation rate based on receive power in Uplink.                                                                                                                           |
| Re-Reg - Quality Index          | This field displays the re-registration quality. It is calculated based on the re-registration count.                                                                                                        |
| Re-Reg Count                    | This field displays the number of re-registrations.                                                                                                                                                          |
| Uptime                          | This field displays the uptime of the device.                                                                                                                                                                |

## 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 83 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 UT: 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 UT: 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

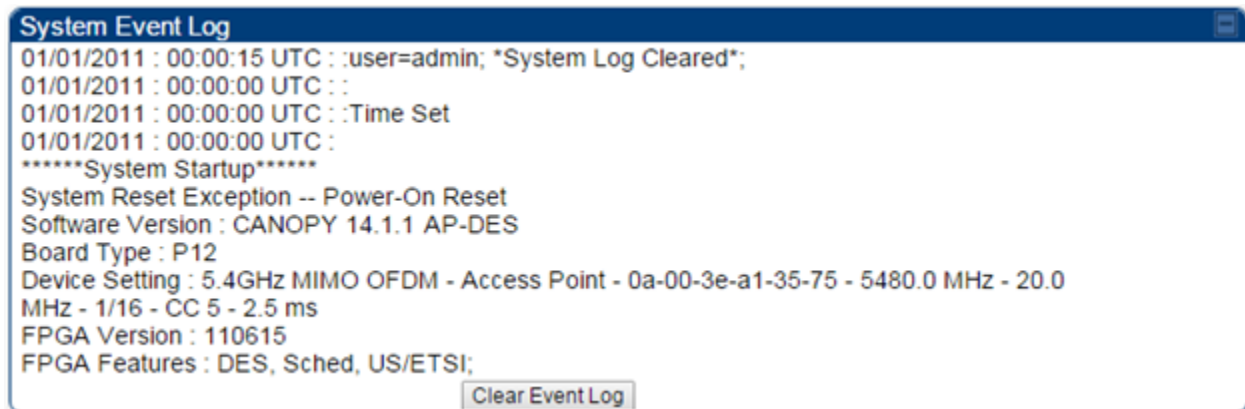
The collection of event data continues through reboots and power cycles. When the buffer allowance for event log data is reached, the system adds new data into the log and discards an identical amount of the oldest data.

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 84 Event log data**



## 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 126 Event Log messages for abnormal events**

| Event Message                                          | Meaning                                                                                                                                                                                                                      |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Expected LUID = 6<br>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<br>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 127 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 85 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 86 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 87 Layer 2 Neighbors page**

| Layer 2 Neighbors Log |                   |
|-----------------------|-------------------|
| MAC address:          | 0a-00-3e-a0-01-75 |
| IP address:           | 192.168.2.6       |
| Site Name:            | No Site Name      |

## 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 128 Scheduler tab attributes**

| Radio Statistics                      |         |
|---------------------------------------|---------|
| Transmit Unicast Data Count :         | 6715    |
| Transmit Broadcast Data Count :       | 904747  |
| Transmit Multicast Data Count :       | 0       |
| Receive Unicast Data Count :          | 1328470 |
| Receive Broadcast Data Count :        | 57683   |
| Receive Multicast Data Count :        | 0       |
| Transmit Control Count :              | 98      |
| Receive Control Count :               | 177     |
| In Sync Count :                       | 0       |
| Out of Sync Count :                   | 0       |
| Overflow Count :                      | 0       |
| Underrun Count :                      | 0       |
| Receive Corrupt Data Count :          | 0       |
| Receive Corrupt Control Data Count :  | 0       |
| Receive Bad Broadcast Control Count : | 0       |
| Rcv LT Start :                        | 3       |
| Rcv LT Start HS :                     | 5       |
| Rcv LT Result :                       | 5       |
| Xmt LT Result :                       | 0       |
| Frame Too Big :                       | 0       |
| Bad RCV Fragment :                    | 0       |
| Bad RCV Fragment Length :             | 0       |
| VC Clear Error Count :                | 0       |
| Rx No Buffer Count :                  | 0       |
| Scheduler Error :                     | 90      |
| Transmit Ring Error :                 | 0       |
| TDD Slips :                           | 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, etc.)                                                                                                                 |
| Receive Control Count               | Amount of radio control type messages received (registration requests and grants, 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 packet has been received at the FPGA.                                                                                                                                            |
| Receive Corrupt Control Data Count  | Number of times a corrupt control data packet 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).                                                                                                                 |
| 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 statistic indicates the number of packets received and processed by the radios which were greater than max packet size 1700 bytes.                                                                                                                |
| Bad Acknowledgment   | This statistic 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.                                                                                                                                                 |
| VC Clear Error Count | This statistic indicates number of times VC clear failed.                                                                                                                                                                                              |
| 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 called as “VC Error”.                                                                                                                           |
| Transmit Ring Error  | This is a state that records when Canopy’s MAC Transmit Ring Error. One or more of these will cause the session to drop and be re-established. That static should be zero. If you are seeing this statistic increment, please contact Cambium support. |
| TDD Slips            | TDD Slips indicate that the 450m AP processor is heavily loaded and could lead to buffer discards.                                                                                                                                                     |

## 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 129 SM Registration Failures page attributes - AP**

| <div> <div>Registration Failures Statistics</div> <div>Number of Registration Grant Failures : 1</div> </div> <div> <div>Most Recent Registration Failure List</div> <div>MAC : 0a-00-3e-04-a7-26 AAA Session Retry 12/31/2010 : 19:23:30 CST : Status : 17 Flag : 0</div> </div> |                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 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 130 BHS Registration Failures page attributes - BHM**

| Registration Failures Statistics                                                           |                                                                                                       |
|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Number of Registration Grant Failures :                                                    | 1                                                                                                     |
| Most Recent Registration Failure List                                                      |                                                                                                       |
| MAC : 0a-00-3e-04-a7-26 AAA Session Retry 12/31/2010 : 19:23:30 CST : Status : 17 Flag : 0 |                                                                                                       |
| Attribute                                                                                  | Meaning                                                                                               |
| Status 17 Flag 0                                                                           | No response was received from the AAA server and hence BHS is trying to send a session request again. |

There is a list of flags from 0 to 20 as shown in [Table 131](#) and the “Flags” can be ignored.

**Table 131 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 de-registered. This alleviates the arp cache > bridge cache timeout problems.

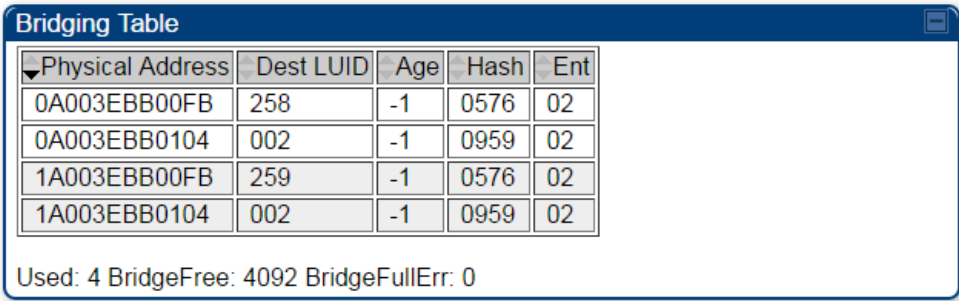
The bridging table allows data to be sent to the correct module as follows:

- 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 88 Bridging Table page

Statistics → Bridging Table

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



| 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 89 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 132 Ethernet tab attributes**

| Ethernet Control Block Statistics |        |
|-----------------------------------|--------|
| Ethernet Link Detected :          | 1      |
| Ethernet Link Lost :              | 0      |
| Undersized Toss Count :           | 0      |
| inoctets Count :                  | 139159 |
| inucastpkts Count :               | 420    |
| Innucastpkts Count :              | 86     |
| indiscards Count :                | 0      |
| inerrors Count :                  | 0      |
| inunknownprotos Count :           | 0      |
| outoctets Count :                 | 56864  |
| outucastpktsCount :               | 184    |
| outnucastpkts 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      |

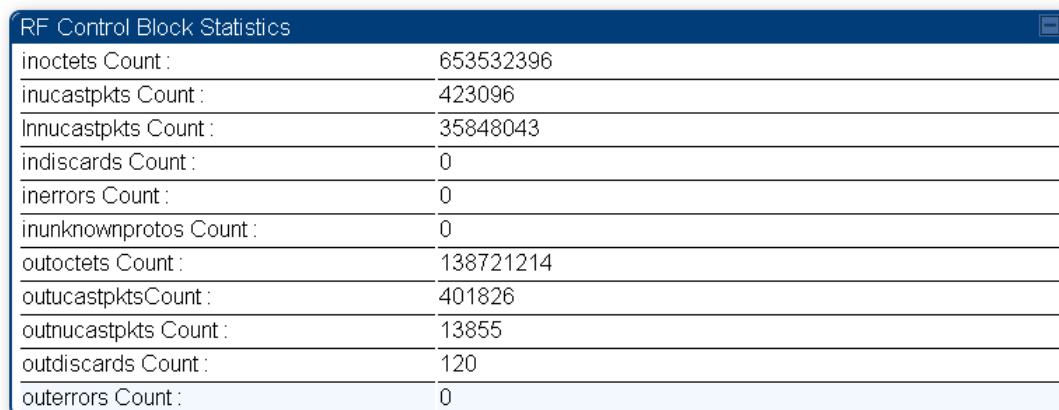
| Attribute              | Meaning                                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------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

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CRCErrors       | This field displays how many CRC errors occurred on the Ethernet controller.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| RcvFifoNoBuf    | <p>This field displays the number of times no FIFO buffer space was able to be allocated.</p> <div>  <p><b>Note:</b></p> <p>PMP 450 AP running in Gigabit Ethernet Mode displays error “RcfFifoNoBuf” which indicates packet loss.</p> <p>For 450 AP platforms, if ethernet auto-negotiation is set to Gigabit, then it is a known limitation that “RcfFifoNoBuf” error will be seen. This issue is not seen if autonegotiation is set to 100Mbps or lower, and the issue is not seen on 450i or 450m AP's.</p> </div>   |
| RxOverrun       | This field displays how many receiver overrun errors occurred on the Ethernet controller.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Late Collision  | <p>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.</p> <div>  <p><b>Caution</b></p> <p>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.</p> </div> |
| 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 133 Radio (Statistics) page attributes – RF Control Block**



| RF Control Block Statistics |           |
|-----------------------------|-----------|
| inoctets Count :            | 653532396 |
| inucastpkts Count :         | 423096    |
| Innucastpkts Count :        | 35848043  |
| indiscards Count :          | 0         |
| inerrors Count :            | 0         |
| inunknownprotos Count :     | 0         |
| outoctets Count :           | 138721214 |
| outucastpktsCount :         | 401826    |
| outnucastpkts 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| inucastpkts 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      | <p>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.</p> <p>Corrupt data is a very unusual event because all packets are CRC checked by hardware before being passed into software.</p> <p>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.</p> |
| 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 for AP

In the 450m AP GUI, sounding statistics can be found under **Statistics > Sounding Statistics**.

**Table 134 Sounding Statistics - 450m AP page attributes**

| Sounding Statistics        |      |                   |                   |                |              |                |              |
|----------------------------|------|-------------------|-------------------|----------------|--------------|----------------|--------------|
| Subscriber                 | LUID | Spatial Frequency | Azimuth (Degrees) | Downlink       |              | Uplink         |              |
|                            |      |                   |                   | Sounding State | MU-MIMO Rate | Sounding State | MU-MIMO Rate |
| SM4 21 [0a-00-3e-b4-d3-36] | 002  | 879               | -59.7, -9.1, 41.6 | TRACKING       | 4X/2X MIMO-A | TRACKING       | 4X/4X MIMO-B |
| SM1 11 [0a-00-3e-b4-24-1a] | 003  | 2                 | -50.6, 0.1, 50.7  | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/1X MIMO-A |
| SM7 23 [0a-00-3e-b4-c2-5c] | 004  | 879               | -59.7, -9.1, 41.6 | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/6X MIMO-B |
| SM5 24 [0a-00-3e-b4-d2-fe] | 005  | 879               | -59.7, -9.1, 41.6 | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/6X MIMO-B |
| SM8 26 [0a-00-3e-b4-c2-65] | 006  | 879               | -59.7, -9.1, 41.6 | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/8X MIMO-B |
| SM3 13 [0a-00-3e-b4-d2-e0] | 007  | 2                 | -50.6, 0.1, 50.7  | TRACKING       | 4X/4X MIMO-B | TRACKING       | 4X/4X MIMO-B |
| SM2 12 [0a-00-3e-b4-24-08] | 008  | 2                 | -50.6, 0.1, 50.7  | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/8X MIMO-B |
| SM6 22 [0a-00-3e-b4-d2-f7] | 009  | 879               | -59.7, -9.1, 41.6 | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/6X MIMO-B |
| SM15 [0a-00-3e-b4-d2-c9]   | 012  | 2                 | -50.6, 0.1, 50.7  | TRACKING       | 8X/8X MIMO-B | TRACKING       | 8X/8X MIMO-B |

| Attribute                 | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber                | This field displays the MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LUID                      | This field displays the LUID (logical unit ID) 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.                                                                                                                                                                                                                                                                             |
| Spatial Frequency         | This field displays the spatial frequency value of the LUID or SM. Values 0 to 1023 are valid and value 2048 is considered as invalid.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Azimuth                   | This field displays the Azimuth range in degrees corresponding to the spatial frequencies of the bin. The zero-degree azimuth is boresight.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                           | <div>  <div> <b>Note</b> <p>Some SF ranges correspond to multiple azimuth ranges. This is because for some spatial frequencies the AP generates beams in multiple azimuth directions. The SM can be physically located in any of the azimuth ranges.</p> </div> </div>                                                                                                                                                                                                                         |
| Downlink - Sounding State | <p>Different types of Sounding states are:</p> <ul style="list-style-type: none"> <li>UNKNOWN: SM has recently registered to the AP but not registered with the channel manager yet.</li> <li>NEW: SM has been registered with the channel manager and will soon transition to ASSESSING.</li> <li>ASSESSING: AP will instruct SM to take the channel measurements. Channel estimates and spatial frequencies will be calculated.</li> <li>TRACKING: Valid measurements resulted in good channel estimates and spatial frequency. This SM can now be used for MU-MIMO.</li> </ul> |

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|                         |                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <ul style="list-style-type: none"> <li>INVALID: Inconsistent measurements resulting in no channel estimate or spatial frequency. This SM cannot be used for MU-MIMO and it will ultimately be re-assessed.</li> <li>NOT ELIGIBLE: Due to poor RF link conditions, the RF link as rate adapted down to SU-MIMO transmissions.</li> </ul> |
| Downlink - MU-MIMO Rate | This field indicates the modulation rate used for symbols where this particular LUID is MU-MIMO scheduled by grouping it in the same slot with other LUIDs.                                                                                                                                                                             |
| Uplink - Sounding State | This field indicates the status of uplink sounding.                                                                                                                                                                                                                                                                                     |
| Uplink - MU-MIMO Rate   | This field indicates the modulation rate used for symbols where the MU-MIMO groupable data channels are MU-MIMO scheduled by grouping it in the same slot with other MU-MIMO groupable data channels from other SM's.                                                                                                                   |

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## 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 135 VLAN page attributes**

| <div> <div>VLAN Statistics Configuration</div> <div> VLAN Statistics Configuration : <input type="text" value="1"/> (Range : 1 — 4094 or 0 for Priority-tagged) </div> </div>                                                                          |                                                                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> <div>VLAN Statistics</div> <div> VID : 1<br/> VID Stats Frames Received : 1823<br/> Bytes Received : 586624<br/> Frames Transmitted : 1640<br/> Bytes Transmitted : 585735 </div> </div>                                                         |                                                                                                                                                                                      |
| <div> <div>Most Recent Filtered Frames</div> <div> No Ingress Filtered Frames<br/><br/> <b>Ingress</b> : Total Frames Filtered : 0 Total Bytes Filtered : 0<br/><br/> <b>Egress</b> : Total Frames Filtered : 0 Total Bytes Filtered : 0 </div> </div> |                                                                                                                                                                                      |
| 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 Channels statistics

The **Statistics > Data Channels** page displays information about data channels 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 136](#).

**Table 136 Data Channel page attributes**

Data Channel Statistics

| Subscriber | LUID | Channel Priority | Inbound Statistics |            |             |          |        | Outbound Statistics |            |             |          |        | Queue Overflow | High Priority Queue |
|------------|------|------------------|--------------------|------------|-------------|----------|--------|---------------------|------------|-------------|----------|--------|----------------|---------------------|
|            |      |                  | octets             | ucast pkts | nucast pkts | discards | errors | octets              | ucast pkts | nucast pkts | discards | errors |                |                     |
| SM4 21     | 002  | Low              | 88471406           | 8          | 51742       | 0        | 0      | 78002604            | 681        | 45566       | 0        | 0      | 0              | 160                 |
| SM4 21     | 002  | Medium           | 107730             | 0          | 63          | 0        | 0      | 107730              | 0          | 63          | 0        | 0      | 0              | 0                   |
| SM4 21     | 002  | High             | 107730             | 0          | 63          | 0        | 0      | 107730              | 0          | 63          | 0        | 0      | 0              | 0                   |
| SM4 21     | 002  | Ultra High       | 1038574            | 6678       | 100         | 0        | 0      | 152829              | 158        | 311         | 0        | 0      | 0              | 406                 |
| SM1 11     | 003  | Low              | 1959               | 4          | 2           | 0        | 0      | 99422               | 777        | 0           | 0        | 0      | 0              | 241                 |
| SM1 11     | 003  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM1 11     | 003  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM1 11     | 003  | Ultra High       | 648533             | 3960       | 36          | 0        | 0      | 41899               | 158        | 198         | 0        | 0      | 0              | 356                 |
| SM7 23     | 004  | Low              | 10898303           | 5          | 6375        | 0        | 0      | 98431               | 811        | 1           | 0        | 0      | 0              | 292                 |
| SM7 23     | 004  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM7 23     | 004  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM7 23     | 004  | Ultra High       | 636897             | 4008       | 37          | 0        | 0      | 45099               | 158        | 248         | 0        | 0      | 0              | 406                 |
| SM5 24     | 005  | Low              | 10893173           | 5          | 6372        | 0        | 0      | 98204               | 764        | 1           | 0        | 0      | 0              | 234                 |
| SM5 24     | 005  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM5 24     | 005  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM5 24     | 005  | Ultra High       | 671486             | 4291       | 37          | 0        | 0      | 45099               | 158        | 248         | 0        | 0      | 0              | 406                 |
| SM8 26     | 006  | Low              | 14487593           | 5          | 8474        | 0        | 0      | 95888               | 742        | 1           | 0        | 0      | 0              | 224                 |
| SM8 26     | 006  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM8 26     | 006  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM8 26     | 006  | Ultra High       | 751670             | 4625       | 36          | 0        | 0      | 45057               | 157        | 248         | 0        | 0      | 0              | 405                 |
| SM3 13     | 007  | Low              | 12993053           | 5          | 7600        | 0        | 0      | 89789               | 670        | 1           | 0        | 0      | 0              | 154                 |
| SM3 13     | 007  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM3 13     | 007  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM3 13     | 007  | Ultra High       | 636026             | 3966       | 36          | 0        | 0      | 45099               | 158        | 248         | 0        | 0      | 0              | 406                 |
| SM2 12     | 008  | Low              | 21802973           | 5          | 12752       | 0        | 0      | 94194               | 739        | 1           | 0        | 0      | 0              | 220                 |
| SM2 12     | 008  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM2 12     | 008  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM2 12     | 008  | Ultra High       | 637607             | 3981       | 36          | 0        | 0      | 45099               | 158        | 248         | 0        | 0      | 0              | 406                 |
| SM6 22     | 009  | Low              | 10908563           | 5          | 6381        | 0        | 0      | 100175              | 801        | 1           | 0        | 0      | 0              | 275                 |
| SM6 22     | 009  | Medium           | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM6 22     | 009  | High             | 0                  | 0          | 0           | 0        | 0      | 0                   | 0          | 0           | 0        | 0      | 0              | 0                   |
| SM6 22     | 009  | Ultra High       | 696681             | 4521       | 36          | 0        | 0      | 45099               | 158        | 248         | 0        | 0      | 0              | 406                 |
| SM15       | 012  | Low              | 22323135           | 3924       | 12741       | 0        | 0      | 142215              | 946        | 250         | 0        | 0      | 0              | 675                 |
| Multicast  | 252  | NA               | NA                 | NA         | NA          | NA       | NA     | 86504               | 0          | 415         | 0        | 0      | NA             | NA                  |
| Broadcast  | 255  | NA               | NA                 | NA         | NA          | NA       | NA     | 1006314             | 18         | 15912       | 0        | 0      | NA             | NA                  |

Fragments Modulation

Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.

| Subscriber   | LUID | Receive Fragments Modulation |              |              |           | Retransmitted Fragments |
|--------------|------|------------------------------|--------------|--------------|-----------|-------------------------|
|              |      | QPSK                         | 16-QAM       | 64-QAM       | 256-QAM   |                         |
| No Site Name | 002  | 44171<br>256                 | 43626<br>221 | 43594<br>173 | 231<br>99 | 0                       |

### Fragments Modulation

Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.

| Subscriber   | LUID | Receive Fragments Modulation |              |              |           | Retransmitted Fragments |
|--------------|------|------------------------------|--------------|--------------|-----------|-------------------------|
|              |      | QPSK                         | 16-QAM       | 64-QAM       | 256-QAM   |                         |
| No Site Name | 002  | 44171<br>256                 | 43626<br>221 | 43594<br>173 | 231<br>99 | 0                       |

| Attribute  | Meaning                                                                                                                                                                                                                                                                                               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber | This field displays the MAC address and Site Name of the SM/BHS.                                                                                                                                                                                                                                      |
| LUID       | This field displays the LUID (logical unit ID) 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**

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.

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Channel Priority                | This field displays the channel priority for the virtual channel. The values supported are Low, Medium, High, and Ultra High.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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. |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                           |
| Fragments Modulation - Receive Fragments Modulation |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| QPSK                                                | This field displays how many inbound fragments were received via the QPSK modulation scheme.                                                                                                                                                                                                                                                                                                                                                                                    |
| 16-QAM                                              | This field displays how many inbound fragments were received via the 16-QAM modulation scheme.                                                                                                                                                                                                                                                                                                                                                                                  |
| 64-QAM                                              | This field displays how many inbound fragments were received via the 64-QAM modulation scheme.                                                                                                                                                                                                                                                                                                                                                                                  |
| 256-QAM                                             | This field displays how many inbound fragments were received via the 256-QAM modulation scheme.                                                                                                                                                                                                                                                                                                                                                                                 |
| Retransmitted Fragments                             | This field displays how many outbound fragments were retransmitted.                                                                                                                                                                                                                                                                                                                                                                                                             |

## Interpreting Proportional Scheduler

The **Statistics > Proportional Scheduler** page displays information:

**Table 137** MIR/Burst page attributes for AP

| Proportional Scheduler Stats |      |                        |            |        |                     |                    |                  |                                     |                            |                   |                    |                  |                                     |                            |  |
|------------------------------|------|------------------------|------------|--------|---------------------|--------------------|------------------|-------------------------------------|----------------------------|-------------------|--------------------|------------------|-------------------------------------|----------------------------|--|
| Subscriber                   | LUID | Configuration          |            |        | Downlink Statistics |                    |                  |                                     |                            | Uplink Statistics |                    |                  |                                     |                            |  |
|                              |      | Lock Modulation        | Modulation | Weight | Rate Plan (Kbps)    | Current Modulation | Slots Percentage | Guaranteed Minimum Throughput(Kbps) | Sustained Data Rate (Kbps) | Rate Plan (Kbps)  | Current Modulation | Slots Percentage | Guaranteed Minimum Throughput(Kbps) | Sustained Data Rate (Kbps) |  |
| Broadcast                    | 255  | Disable                |            | 1.0    | 1000                | 1X                 | 11.9%            | 998                                 | NA                         | NA                | NA                 | NA               | NA                                  | NA                         |  |
| SM11 - SF4                   | 002  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM3 - SF1                    | 003  | Enable Below Threshold | 4X         | 1.0    | 10000               | 2X                 | 8.8%             | 1475                                | 155000                     | 10000             | 2X                 | 10.0%            | 1720                                | 155000                     |  |
| SM10 - SF4                   | 004  | Disable                |            | 1.0    | 20000               | 8X                 | 8.8%             | 5898                                | 155000                     | 20000             | 8X                 | 10.0%            | 6881                                | 155000                     |  |
| SM8 - SF3                    | 005  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM9 - SF3                    | 006  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM7 - SF3                    | 007  | Disable                |            | 1.0    | 20000               | 8X                 | 8.8%             | 5898                                | 155000                     | 20000             | 8X                 | 10.0%            | 6881                                | 155000                     |  |
| SM12 - SF4                   | 008  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM5 - SF2                    | 009  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM2 SF1                      | 010  | Disable                |            | 1.0    | 10000               | 4X                 | 8.8%             | 2949                                | 155000                     | 10000             | 4X                 | 10.0%            | 3441                                | 155000                     |  |
| SM4 SF2                      | 011  | Disable                |            | 1.0    | 20000               | 8X                 | 8.8%             | 5898                                | 155000                     | 20000             | 8X                 | 10.0%            | 6881                                | 155000                     |  |
| SM6 - SF2                    | 012  | Disable                |            | 1.0    | 10000               | 8X                 | 4.4%             | 2949                                | 155000                     | 10000             | 8X                 | 5.0%             | 3441                                | 155000                     |  |
| SM1 SF1                      | 013  | Disable                |            | 1.0    | 20000               | 4X                 | 17.6%            | 5919                                | 155000                     | 20000             | 4X                 | 20.0%            | 6881                                | 155000                     |  |
| Total                        |      |                        |            |        | 161000              |                    | 99.9%            | 46729                               | 1860000                    | 160000            |                    | 100.0%           | 53331                               | 1860000                    |  |

| Attribute                     | Meaning                                                                                                                                                                                                                                                                               |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subscriber                    | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                           |
| LUID                          | See <a href="#">Table 120</a> on page 3-24.                                                                                                                                                                                                                                           |
| Lock Modulation               | This field displays the Lock Modulation mode of all registered SMs.                                                                                                                                                                                                                   |
| Modulation                    | The database configured Lock Modulation value if lock modulation is set to <b>Enable below threshold</b> or <b>Enabled</b> .                                                                                                                                                          |
| Weight                        | This field displays the weight of each registered SM. For more information about Weight, See <a href="#">Table 84</a> on page 1-250.                                                                                                                                                  |
| Downlink Statistics           | This field displays the Dowlink statistics of every registered SM.                                                                                                                                                                                                                    |
| Uplink Statistics             | This field displays the Uplink statistics of every registered SM.                                                                                                                                                                                                                     |
| Rate Plan                     | This field displays the rate plan associated with each SM.                                                                                                                                                                                                                            |
| Current Modulation            | The currently operating modulation of this SM.                                                                                                                                                                                                                                        |
| Slots Percentage              | This field displays the percentage of slot used by each SM.                                                                                                                                                                                                                           |
| Guaranteed minimum throughput | Guaranteed minimum throughput based on the SM's Rate Plan configuration, it's current modulation rate, and any Lock Modulation settings.<br><br>For 450m AP's the maximum possible Throughput shown here assumes all SUMIMO scheduling. MUMIMO scheduling will result in higher TPUT. |
| Sustained Data Rate           | This field displays the preset rate limit of data transfer for every SM.                                                                                                                                                                                                              |

## Interpreting MIR/Burst statistics

The **Statistics > MIR/Burst** page displays information about MIR/Burst. This page is applicable for all modules (AP/SM).

The **MIR/Burst** tab displays the fields as explained in [Table 138](#) and [Table 139](#).

**Table 138 MIR/Burst page attributes for AP**

| MIR / Burst Statistics                                                                         |                              |              |                                 |                          |                               |                        |                                           |            |                        |                      |
|------------------------------------------------------------------------------------------------|------------------------------|--------------|---------------------------------|--------------------------|-------------------------------|------------------------|-------------------------------------------|------------|------------------------|----------------------|
| Note: Uplink values are configuration values only. Live uplink values will be shown on the SM. |                              |              |                                 |                          |                               |                        |                                           |            |                        |                      |
| Subscriber                                                                                     | Current Downlink Bucket Size | Downlink MIR | Downlink MIR Per 500ms Interval | Downlink Max Bucket Size | Current Max Burst Bucket Size | Downlink Max Burst MIR | Downlink Max Burst MIR Per 500ms Interval | Uplink MIR | Uplink Max Bucket Size | Uplink Max Burst MIR |
| No Site Name - LUID: 002                                                                       | 2500000000                   | 30000000     | 15000000                        | 2500000000               | 0                             | 0 (Not Limited)        | 0 (Not Limited)                           | 30000000   | 2500000000             | 0 (Not Limited)      |

| 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. As of release 15.2, if an SM/BHS loses registration with the AP/BHM and then regains registration, the SM/BHS retains the same LUID. |
| Current Downlink Bucket Size              | This field displays the number of bits in the bucket to be potentially consumed at above-MIR rates, up to Max Burst MIR rate.                                                                                                                                                                                                                     |
| Downlink MIR                              | This field displays the active configured MIR rate per second. This is the rate that the bucket is filled with bits.                                                                                                                                                                                                                              |
| Downlink MIR Per 500ms Interval           | This field displays the rate that the bucket is filled with bits at every 500 ms interval.                                                                                                                                                                                                                                                        |
| Downlink Max Bucket Size                  | This field displays the configured maximum bucket size, which is the maximum number of bits that can be in the bucket. The bucket fills at MIR rate and can hold this number of bits, which is a configuration value.                                                                                                                             |
| Current Max Burst Bucket Size             | If Max Burst is enabled, there is a secondary “bucket” that controls the maximum rate of bit consumption. If Max Burst is not enabled (which means not limited), this will be 0 as the bucket is not used.                                                                                                                                        |
| Downlink Max Burst MIR                    | This field displays the configured value of the Max Burst rate. This is the maximum rate at which bits can be consumed above MIR. Once excess (> MIR) bits have been consumed, the link will be throttled to MIR.                                                                                                                                 |
| Downlink Max Burst MIR Per 500ms Interval | This field displays the configured value of the Max Burst rate at every 500 ms interval.                                                                                                                                                                                                                                                          |
| Uplink MIR                                | This field displays the active configured MIR rate per second in the SM.                                                                                                                                                                                                                                                                          |
| Uplink Max Bucket Size                    | This field displays the configured maximum bucket size of the SM, which is the maximum number of bits that can be in the bucket. The bucket fills at MIR rate and can hold this number of bits, which is a configuration value.                                                                                                                   |
| Uplink Max Burst MIR                      | This field displays the configured value of the MaxBurst rate of the SM. This is the maximum rate at which bits can be consumed above MIR. Once excess (> MIR) bits have been consumed, the link will be throttled to MIR.                                                                                                                        |

**Table 139 MIR/Burst page attributes for SM**

| MIR / Burst Statistics                                                                             |            |                               |                        |                               |                      |                                         |                         |                      |                           |              |                          |                        |
|----------------------------------------------------------------------------------------------------|------------|-------------------------------|------------------------|-------------------------------|----------------------|-----------------------------------------|-------------------------|----------------------|---------------------------|--------------|--------------------------|------------------------|
| Note: Downlink values are configuration values only. Live downlink values will be shown on the AP. |            |                               |                        |                               |                      |                                         |                         |                      |                           |              |                          |                        |
| Current Uplink Bucket Size                                                                         | Uplink MIR | Uplink MIR Per 100ms Interval | Uplink Max Bucket Size | Current Max Burst Bucket Size | Uplink Max Burst MIR | Uplink Max Burst MIR Per 100ms Interval | Uplink Broadcast Credit | Uplink Broadcast MIR | Uplink Broadcast MIR Type | Downlink MIR | Downlink Max Bucket Size | Downlink Max Burst MIR |
| 2500000000                                                                                         | 155000000  | 15500000                      | 2500000000             | 0                             | 0 (Not Limited)      | 0 (Not Limited)                         | 0                       | 0                    | kbps                      | 155000000    | 2500000000               | 0 (Not Limited)        |

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

## Interpreting Throughput statistics

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

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

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

**Table 140 RF overload Configuration attributes – AP/BHM**

| RF Overload Configuration        |                                                                            |
|----------------------------------|----------------------------------------------------------------------------|
| Throughput Monitoring :          | <input type="radio"/> Enabled<br><input checked="" type="radio"/> Disabled |
| SNMP Trap on RF Overload :       | <input type="radio"/> Enabled<br><input checked="" type="radio"/> Disabled |
| Downlink RF Overload Threshold : | 1 % (Range : 1—100 %)                                                      |
| Downlink RF Link Status :        | RF Link within Capacity                                                    |
| Time Period Length :             | 1 Hour                                                                     |
| Time Period Ending :             |                                                                            |

| 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<br>Time Period Ending | These two configuration parameters determine what set of collection samples to show on the GUI display. The Time Period Length can be set from one to three hours. Time Period Ending allows the operator to set the end time for the set of collection samples to display. |

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

## Board Performance statistics

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

- **Ethernet Throughput** - Statistics collected at the Ethernet port:
  - o **kbps in** - average throughput over the collection interval in Kbps into the AP/BHM on the Ethernet Interface
  - o **kbps out** - average throughput over the collection interval in Kbps out of the AP/BHM on the Ethernet Interface
  - o **PPS in** - average packets per second over the collection interval into the AP/BHM on the Ethernet Interface
  - o **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:
  - o **kbps in** - average throughput over the collection interval in Kbps into the AP/BHM on the RF Interface
  - o **kbps out** - average throughput over the collection interval in Kbps out of the AP/BHM on the RF Interface
  - o **PPS in** - average packets per second over the collection interval into the AP/BHM on the RF Interface
  - o **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:
  - o **kbps** - average bidirectional throughput over the collection interval in Kbps
  - o **PPS** - average bidirectional packets per second over the collection interval
  - o **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:
  - o **inOctets** - Number of octets (bytes) received by the AP/BHM at the Ethernet Interface over the collection interval
  - o **outOctets** - Number of octets (bytes) sent by the AP/BHM at the Ethernet Interface over the collection interval
  - o **inPkts** - Number of packets received by the AP/BHM at the Ethernet Interface over the collection interval

- o **outPkts** – Number of packets sent by the AP/BHM at the Ethernet Interface over the collection interval
- o **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:
  - o **inOctets** – Number of octets (bytes) received by the AP/BHM at the RF Interface over the collection interval
  - o **outOctets** – Number of octets (bytes) sent by the AP/BHM at the RF Interface over the collection interval
  - o **inPkts** – Number of packets received by the AP/BHM at the RF Interface over the collection interval
  - o **outPkts** – Number of packets sent by the AP/BHM at the RF Interface over the collection interval
  - o **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
  - o **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:
  - o **octets** – Number of octets (bytes) received by the AP/BHM at the RF Interface for this LUID over the collection interval
  - o **pkts** – Number of packets received by the AP/BHM at the RF Interface for this LUID over the collection interval
  - o **Ave Pkt Size** – Average size of the packets received by the AP/BHM at the RF Interface for this LUID over the collection interval
  - o **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
  - o **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:
  - o **octets** – Number of octets (bytes) transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval
  - o **pkts** – Number of packets transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval

- o **Ave Pkt Size** – Average size of the packets transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval
- o **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
- o **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 141](#).

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

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

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**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 142](#).

**Table 142 DHCP Relay page attributes – AP/SM**

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

| DHCP Relay Option 82 Data    |      |        |                           |                          |                                   |
|------------------------------|------|--------|---------------------------|--------------------------|-----------------------------------|
| Subscriber                   | LUID |        | Circuit ID<br>\$apmacbi\$ | Remote ID<br>\$smmacbi\$ | Vendor Specific ID<br>\$smvidbi\$ |
| <a href="#">No Site Name</a> | 002  |        | Binary Option 82 Data     |                          |                                   |
|                              |      | Binary | 0a003ea0005b              | 0a003ebb016a             | 000000a106130401025858            |
|                              |      | ASCII  |                           |                          | XX                                |

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

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| Subscriber         | See <a href="#">Table 120</a> on page 3-24.                                   |
| LUID               | See <a href="#">Table 120</a> on page 3-24.                                   |
| Circuit ID         | This field displays the option 82 data of the SM in binary and ASCII formats. |
| Remote ID          |                                                                               |
| Vendor Specific ID |                                                                               |

## Interpreting Filter statistics

The **Statistics > Filter** page displays statistics on packets that have been filtered (dropped) due to the filters set on the **Protocol Filtering** page. The filter page of SM is explained in [Table 143](#).

**Table 143 Filter page attributes - SM**

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

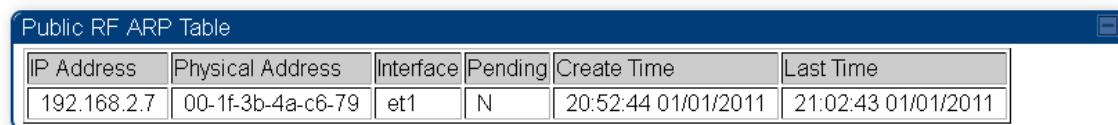
| Attribute            | Meaning                                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| PPPoE Count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

|                          |                                                                                                                      |
|--------------------------|----------------------------------------------------------------------------------------------------------------------|
| All Other IPv6 Count     | Any IPv6 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out. |
| IPv6 SMB Count           | Number of IPv6 Server Message Block (file sharing) packets filtered                                                  |
| IPv6 SNMP Count          | Number of IPv6 SNMP messages filtered                                                                                |
| IPv6 Bootp Client Count  | Total number of IPv6 DHCP replies filtered                                                                           |
| IPv6 Bootp Server Count  | Total number of IPv6 DHCP replies filtered                                                                           |
| 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 90 ARP page of the SM**



| 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 144](#).

**Table 144 NAT page attributes - SM**

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

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

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

## Viewing NAT DHCP Statistics

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

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

**Table 145 NAT DHCP Statistics page attributes - SM**

The screenshot displays two windows from the NAT DHCP Statistics page. The top window, titled 'DHCP Client Statistics', lists the following counts: PktXmt Count: 34, PktRcv Count: 0, PktToss ARPUnresolved Overflow Count: 0, PktToss Unsupported MsgType Count: 0, PktToss XID Mismatch Count: 0, PktToss NoSID Count: 0, PktToss SID Mismatch Count: 0, and Failure To Reset Client Count: 0. The bottom window, titled 'DHCP Server Statistics', shows a table with three columns: Assigned IP Address, Hardware Address, and Lease Remained/State. The first row contains the values 169.254.1.2, 001eec1e0260, and 0d, 00:01:30. Below this table, it lists PktXmt Count: 2, PktRcv Count: 2, and PktToss Count: 0.

| DHCP Client Statistics                |    |  |
|---------------------------------------|----|--|
| PktXmt Count:                         | 34 |  |
| PktRcv Count:                         | 0  |  |
| PktToss ARPUnresolved Overflow Count: | 0  |  |
| PktToss Unsupported MsgType Count:    | 0  |  |
| PktToss XID Mismatch Count:           | 0  |  |
| PktToss NoSID Count:                  | 0  |  |
| PktToss SID Mismatch Count:           | 0  |  |
| Failure To Reset Client Count:        | 0  |  |

| DHCP Server Statistics |                  |                      |
|------------------------|------------------|----------------------|
| Assigned IP Address    | Hardware Address | Lease Remained/State |
| 169.254.1.2            | 001eec1e0260     | 0d, 00:01:30         |

PktXmt Count: 2  
PktRcv Count: 2  
PktToss Count: 0

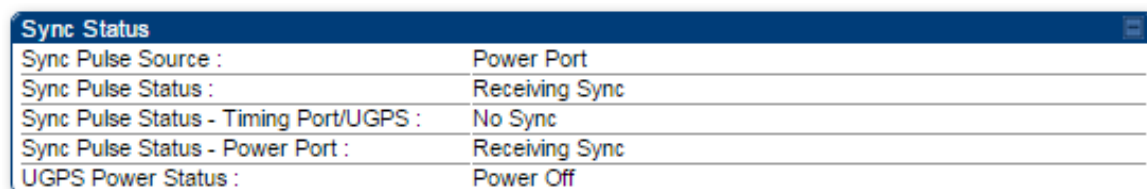
| Attribute                            | Meaning                                                                                                                                     |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------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

## Interpreting Sync Status statistics

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

The Sync Status page is explained in [Table 146](#).

**Table 146 Sync Status page attributes - AP**



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

| Attribute                            | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sync Pulse Source                    | This field indicates the status of the synchronization source: <ul style="list-style-type: none"> <li>• <b>Searching</b> indicates that the unit is searching for a GPS fix</li> <li>• <b>Timing Port/UGPS</b> indicates that the module is receiving sync via the timing AUX/SYNC timing port</li> <li>• <b>Power Port</b> indicates that the module is receiving sync via the power port (Ethernet port).</li> </ul> |
| 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.

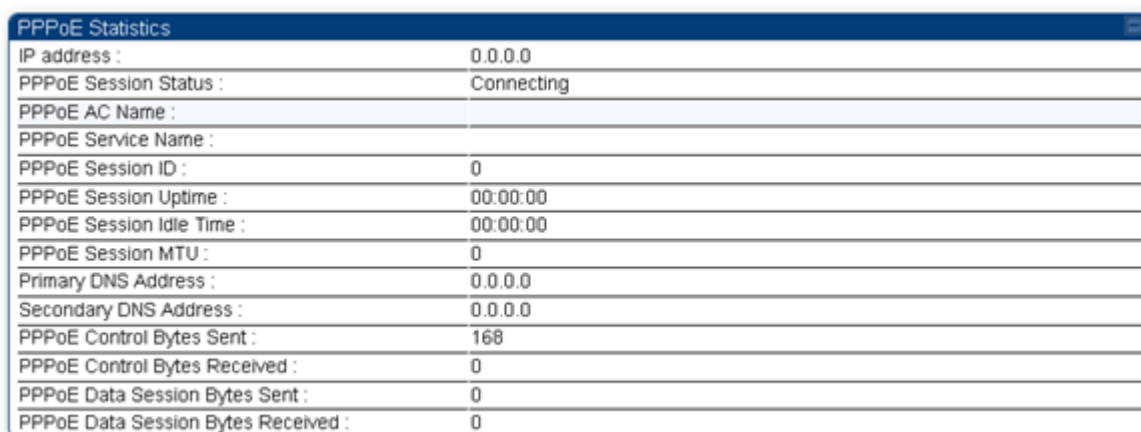
## Interpreting PPPoE Statistics for Customer Activities

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 147](#).

**Table 147 PPPoE Statistics page attributes - SM**



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

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

---

|                                   |                                                                                                                          |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| PPPoE Control Bytes Received      | This field displays the total number of PPPoE session control bytes received by the SM                                   |
| PPPoE Data Session Bytes Sent     | This field displays the total number of PPPoE data session (non-control/non-session management user data) sent by the SM |
| PPPoE Data Session Bytes Received | This field displays the total number of PPPoE data session (non-control/non-session management user data)                |

---

## Interpreting Bridge Control Block statistics

The **Statistics > Bridge Control Block** page displays statistics of Bridge FEC, Bridge ratio and Bridge error. The page is applicable for all modules (AP/SM/BHM/BHS). The Bridge Control Block Statistics page is explained in [Table 148](#).

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

| Bridge FEC Stats |      |
|------------------|------|
| FEC bin :        | 437  |
| FEC bout :       | 24   |
| FEC btoss :      | 0    |
| FEC btosschap :  | 0    |
| FEC uin :        | 3915 |
| FEC uout :       | 5745 |
| FEC utoss :      | 0    |
| FEC utosschap :  | 0    |

| Bridge Eth Aux Stats |   |
|----------------------|---|
| Eth Aux bin :        | 0 |
| Eth Aux bout :       | 0 |
| Eth Aux btoss :      | 0 |
| Eth Aux btosschap :  | 0 |
| Eth Aux uin :        | 0 |
| Eth Aux uout :       | 0 |
| Eth Aux utoss :      | 0 |
| Eth Aux utosschap :  | 0 |

| Bridge Radio Stats        |     |
|---------------------------|-----|
| RF bin :                  | 3   |
| RF bout :                 | 441 |
| RF unknown ucast floods : | 0   |
| RF btoss :                | 0   |
| RF btosschap :            | 0   |
| RF uin :                  | 331 |
| RF uout :                 | 9   |
| RF utoss :                | 0   |
| RF utosschap :            | 0   |

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

| Attribute                   | Meaning                                                                                                                       |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>Bridge FEC Stats</b>     |                                                                                                                               |
| 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 btossap                 | 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 utossap                 | This field indicates the number of unicast packets tossed out at the Main Ethernet interface due to MIR cap being exceeded.   |
| <b>Bridge Eth Aux Stats</b> |                                                                                                                               |
| 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 btossap                 | 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 utossap                 | This field indicates the number of unicast packets tossed out at the Aux Ethernet interface due to MIR cap being exceeded.    |
| <b>Bridge Radio Stats</b>   |                                                                                                                               |

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

## Interpreting Pass Through Statistics

The **Statistics > Pass Through Statistics** page displays radius related statistics. The page is applicable for PMP 450 Platform Family - AP only. The Pass Through Statistics page is explained in [Table 149](#).

**Table 149 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 150](#).

**Table 150 SNMPv3 Statistics page attributes – AP**

| SNMPv3 Statistics                             |  |
|-----------------------------------------------|--|
| <b>Statistics for snmpMPDStats group</b>      |  |
| snmpUnknownSecurityModels = 0                 |  |
| snmpInvalidMsgs = 0                           |  |
| snmpUnknownPDUHandlers = 0                    |  |
| <b>Statistics for usmStats group</b>          |  |
| usmStatsUnsupportedSecLevels = 0              |  |
| usmStatsNotInTimeWindows = 0                  |  |
| usmStatsUnknownUserNames = 0                  |  |
| usmStatsUnknownEngineIDs = 0                  |  |
| usmStatsWrongDigests = 0                      |  |
| usmStatsDecryptionErrors = 0                  |  |
| <b>Statistics for snmpTargetObjects group</b> |  |
| snmpTargetSpinLock = 0                        |  |
| snmpUnavailableContexts = 0                   |  |
| snmpUnknownContexts = 0                       |  |
| <b>Statistics for usmUser group</b>           |  |
| usmUserSpinLock = 0                           |  |
| <b>Statistics for vacmMIBViews group</b>      |  |
| vacmViewSpinLock = 0                          |  |
| <b>Value of Globals</b>                       |  |
| 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                           |  |
| <b>Misc. statistics</b>                       |  |
| assertsfailed = 0                             |  |
| lenassertsfailed = 0                          |  |
| oidlenassertsfailed = 0                       |  |
| delfailed = 0                                 |  |
| <b>Compile time options</b>                   |  |
| 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 re-booted/re-initialized since snmpEngineID was last configured                                    |
| snmpEngineTime<br>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 151](#).

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

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

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

## Interpreting Frame Utilization statistics

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

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



### Note

The backhauls (BHM and BHS) will have only the downlink scheduler-based statistics

Table 152 Frame utilization statistics for 450m

MU-MIMO Utilization

Slot Grouping

| Group Size    | % Downlink Distribution | % Uplink Distribution |
|---------------|-------------------------|-----------------------|
| 1 (ungrouped) | 34.9                    | 11.5                  |
| 2             | 0.3                     | 0.0                   |
| 3             | 0.3                     | 88.5                  |
| 4             | 0.5                     | 0.0                   |
| 5             | 3.2                     | 0.0                   |
| 6             | 32.3                    | 0.0                   |
| 7             | 28.7                    | 0.0                   |

Additional Statistics

|                                   | Downlink | Uplink |
|-----------------------------------|----------|--------|
| Average MU-MIMO Group Size - Data | 4.5      | 2.8    |
| Multiplexing Gain                 | 2.9      | 2.2    |

Sector Utilization

|                       | Downlink | Uplink |
|-----------------------|----------|--------|
| SU-MIMO               | 31%      | 8%     |
| MU-MIMO               | 57%      | 58%    |
| ACK                   | 3%       | 29%    |
| MU-MIMO ACK           |          | 5%     |
| Broadcast & Multicast | 0%       |        |
| Total Utilization     | 91%      | 100%   |

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

| Frame Utilization           |      |
|-----------------------------|------|
| Downlink :                  | 19 % |
| Uplink :                    | 17 % |
| Bandwidth Request Success : | 52 % |

| Maximum Possible Counts |         |
|-------------------------|---------|
| Downlink :              | 960000  |
| Uplink :                | 984000  |
| Contention :            | 1056000 |

| Packet Discard Counts  |   |
|------------------------|---|
| Ethernet indiscards :  | 0 |
| Ethernet outdiscards : | 0 |
| Radio indiscards :     | 0 |
| Radio outdiscards :    | 0 |

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

| Frame Utilization Interval  |                                                                                                                                                                                                                                    |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Statistics Display interval | This allows to configure timer interval to monitor and display the frame utilization statistics. It can be configured for 1 minute (low interval), 5 minutes (medium interval) or 15 minutes (high interval) based on requirement. |
| Next Update                 | This field displays when the next update will occur.                                                                                                                                                                               |

| MU-MIMO Utilization        |                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Slot Grouping - Group Size | <p>This specifies the distribution of group size for the past 1/5/15 minutes. For each group size, from 1 to 7, the table shows the percentage of slots using that group size.</p> <ul style="list-style-type: none"> <li>A group size of 1 corresponds to beamformed transmissions.</li> <li>A group size of 2 to 7 corresponds to MU-MIMO transmissions.</li> </ul> |

| Additional Statistics             |                                                                                                                           |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Average MU-MIMO Group Size - Data | This specifies the average number of users in the MU-MIMO groups formed in the last 1/5/15 minutes for data traffic only. |
| Total Utilization                 | This is a percentage of available timeslots used in the past 1/5/15 minutes.                                              |

|                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Multiplexing Gain                                     | <p>This specifies the ratio between the number of logical slots and the number of physical slots used.</p> <p>A physical slot is an OFDM symbol. In non MU-MIMO mode, each logical slot is sent during one physical slot. In MU-MIMO mode a number of logical slots are sent during a physical slot, equal to the number of VCs in the group. A logical slot carries new information; if data is repeated in a group, because some VCs have more data to send than others, then the repeated transmissions are not counted as a logical slots.</p> <p>Without MU-MIMO operation, the multiplexing gain would always be equal to 1.</p> <p>With MU-MIMO operation, this number accounts for parallel transmissions to multiple users in the MU-MIMO group.</p> <p>The difference between the Average MU-MIMO Group Size and the Multiplexing Gain is that the Average MU-MIMO Group Size only considers the MU-MIMO groups, and it averages the number of VCs in the Group. The Multiplexing Gain also considers non MU-MIMO transmissions, which are counted as groups of size 1.</p> |
| <b>Sector Utilization</b>                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| SU-MIMO                                               | This specifies the portion of the Total Utilization used for SU-MIMO transmissions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| MU-MIMO                                               | This specifies the portion of the Total Utilization used for MU-MIMO transmissions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ACK                                                   | This specifies the portion of the Total Utilization used for acknowledgments transmission.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| MU-MIMO ACK                                           | <p>This specifies the portion of the Total Utilization used for acknowledgments transmissions that are MU-MIMO scheduled. Currently only the UL direction supports MU-MIMO scheduling of ACK's.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Broadcast & Multicast                                 | This specifies the portion of the Total Utilization used for broadcast and multicast transmissions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Slots Counts - Uplink and Downlink Slot Counts</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Per Frame Average                                     | This indicates the average data per frame in the downlink traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Low Priority                                          | The number of downlink data slots used for low priority downlink traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Medium Priority                                       | The number of downlink data slots used for medium priority downlink traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| High Priority                                         | The number of downlink data slots used for high priority downlink traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Ultra High Priority                                                                                                                                                                                                                                                                                                                                       | The number of downlink data slots used for ultra high priority downlink traffic.                                                        |
| <p>Note: The above Low, Medium, High, and Ultra High Priority Counts are physical slot transmissions. For MU-MIMO scheduling, some transmissions can contain data from more than 1 data channel priority. In those cases, the highest data channel used is "counted" in these statistics, and the other data channels are not, to avoid overcounting.</p> |                                                                                                                                         |
| Broadcast & Multicast                                                                                                                                                                                                                                                                                                                                     | The number of downlink data slots used for broadcast and multicast traffic.                                                             |
| Authentication and Configuration                                                                                                                                                                                                                                                                                                                          | The number of slots used for registration and control message transmissions                                                             |
| Registration and control                                                                                                                                                                                                                                                                                                                                  | The number of slots used for Authentication and Configuration transmissions.                                                            |
| MAC Acknowledgements                                                                                                                                                                                                                                                                                                                                      | The number of downlink data slots used as ACKs.                                                                                         |
| Contention Slots Average Per Frame                                                                                                                                                                                                                                                                                                                        | It is the average number of contention slots in a frame for the last duration. Duration is 1/5/15 mins.                                 |
| Bandwidth Requests Received                                                                                                                                                                                                                                                                                                                               | This indicates the number of Bandwidth Requests received from SMs.                                                                      |
| Bandwidth Requests Missed                                                                                                                                                                                                                                                                                                                                 | This indicates how many of Bandwidth Requests are colliding.                                                                            |
| Total                                                                                                                                                                                                                                                                                                                                                     | This indicates the sum of all downlink data slots used in the configured interval.                                                      |
| <b>Frame Utilization</b>                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                         |
| 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 Request Success      | <p>The "Bandwidth Request Success" is a message sent from the SM to the AP asking to be scheduled for bandwidth to send in the uplink. This gets transmitted in the unscheduled portion of the uplink. Unscheduled uplink is defined as Contention Slots + unscheduled uplink slots. Since this is sent in the unscheduled portion of the uplink, it will result in collisions when SMs randomly pick the same slot.</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> |
| <b>Maximum possible counts</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Packet Discard counts</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Ethernet indiscards            | This indicates the number of Ethernet packets discarded in the IN queue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ethernet outdiscards           | This indicates the number of Ethernet packets discarded in the OUT queue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Radio indiscards               | This indicates the number of packets discarded over radio in the IN queue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Radio outdiscards              | This indicates the number of packets discarded over radio in the OUT queue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 153 Frame utilization statistics for 450, 450i**

| Frame Utilization Interval    |            |
|-------------------------------|------------|
| Statistics Display Interval : | 1 minute ▼ |
| Next Update :                 | 43 seconds |

| Frame Utilization           |     |
|-----------------------------|-----|
| Downlink :                  | 0 % |
| Uplink :                    | 0 % |
| Bandwidth Request Success : | 0 % |

| Downlink Counts                             |     |
|---------------------------------------------|-----|
| Total :                                     | 223 |
| Per Frame Average :                         | 0   |
| Low Priority :                              | 1   |
| Medium Priority :                           | 0   |
| High Priority :                             | 0   |
| Ultra High Priority :                       | 0   |
| Broadcast/Multicast :                       | 120 |
| Canopy MAC Acknowledgments :                | 102 |
| Authentication and Configuration Messages : | 0   |
| Registration and Control Messages :         | 0   |

| Uplink Counts                               |         |
|---------------------------------------------|---------|
| Total :                                     | 60      |
| Per Frame Average :                         | 0       |
| Low Priority :                              | 0       |
| Medium Priority :                           | 0       |
| High Priority :                             | 0       |
| Ultra High Priority :                       | 0       |
| Authentication and Configuration Messages : | 0       |
| Canopy MAC Acknowledgments :                | 60      |
| Contention Slots :                          | 1055940 |
| Contention Slots Average Per Frame :        | 44      |
| Bandwidth Requests Received :               | 0       |
| Bandwidth Requests Missed :                 | 0       |

| Maximum Possible Counts |         |
|-------------------------|---------|
| Downlink :              | 960000  |
| Uplink :                | 984000  |
| Contention :            | 1056000 |

| Packet Discard Counts  |   |
|------------------------|---|
| Ethernet indiscards :  | 0 |
| Ethernet outdiscards : | 0 |
| Radio indiscards :     | 0 |
| Radio outdiscards :    | 0 |

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

See Table 152 Frame utilization statistics for 450m.

## Interpreting Spatial Utilization statistics

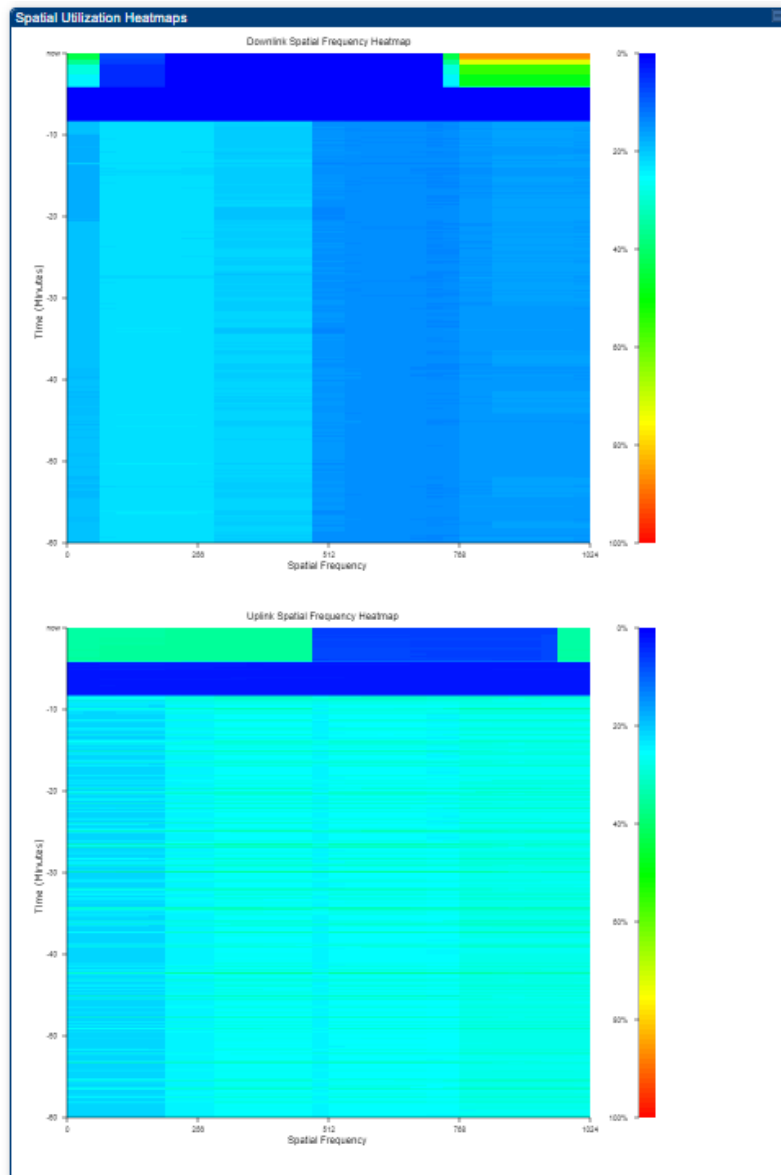
Table 154 Spatial Utilization statistics

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

| Spatial Utilization |                |                   |           |         |                                             |
|---------------------|----------------|-------------------|-----------|---------|---------------------------------------------|
| Spatial Frequency   | LUIDs in Range | Downlink          |           |         |                                             |
|                     |                | Instantaneous (%) | Total (%) | Max (%) | Min (%)                                     |
| Azimuth (degrees)   |                |                   |           |         |                                             |
| 0 - 31              | 2              | 100               | 100       | 99      | (-50.7 - -49.3), (0.0 - 1.4), (50.7 - 52.0) |
| 32 - 63             | 5              | 100               | 100       | 99      | (-49.3 - -47.9), (1.4 - 2.8), (52.0 - 53.4) |
| 64 - 95             | 9              | 100               | 100       | 99      | (-47.9 - -46.5), (2.8 - 4.2), (53.4 - 54.8) |
| 96 - 127            |                | 100               | 100       | 99      | (-46.5 - -45.1), (4.2 - 5.5), (54.8 - 56.2) |
| 128 - 159           | 14             | 100               | 100       | 99      | (-45.1 - -43.7), (5.5 - 6.9), (56.2 - 57.6) |
| 160 - 191           |                | 100               | 100       | 99      | (-43.7 - -42.3), (6.9 - 8.3), (57.6 - 59.0) |
| 192 - 223           | 8              | 100               | 100       | 99      | (-42.3 - -40.9), (8.3 - 9.7), (59.0 - 60.0) |
| 224 - 255           | 19             | 100               | 100       | 99      | (-40.9 - -39.5), (9.7 - 11.1)               |
| 256 - 287           | 11             | 100               | 100       | 99      | (-39.5 - -38.1), (11.1 - 12.6)              |
| 288 - 319           |                | 100               | 100       | 99      | (-38.1 - -36.7), (12.6 - 14.0)              |
| 320 - 351           | 22             | 100               | 100       | 99      | (-36.7 - -35.2), (14.0 - 15.4)              |
| 352 - 383           | 18             | 100               | 100       | 99      | (-35.2 - -33.8), (15.4 - 16.9)              |
| 384 - 415           |                | 100               | 100       | 99      | (-33.8 - -32.3), (16.9 - 18.3)              |
| 416 - 447           | 2              | 100               | 100       | 99      | (-32.3 - -30.9), (18.3 - 19.8)              |
| 448 - 479           | 8              | 100               | 100       | 99      | (-30.9 - -29.4), (19.8 - 21.3)              |
| 480 - 511           |                | 100               | 100       | 99      | (-29.4 - -27.9), (21.3 - 22.7)              |
| 512 - 543           | 4              | 100               | 100       | 99      | (-27.9 - -26.4), (22.7 - 24.3)              |
| 544 - 575           |                | 100               | 100       | 99      | (-26.4 - -24.9), (24.3 - 25.8)              |
| 576 - 607           | 17             | 100               | 100       | 99      | (-24.9 - -23.3), (25.8 - 27.3)              |
| 608 - 639           | 10             | 100               | 100       | 99      | (-23.3 - -21.8), (27.3 - 28.9)              |
| 640 - 671           |                | 100               | 100       | 99      | (-21.8 - -20.2), (28.9 - 30.5)              |
| 672 - 703           | 2              | 100               | 100       | 99      | (-20.2 - -18.5), (30.5 - 32.1)              |
| 704 - 735           | 42             | 100               | 100       | 99      | (-18.5 - -16.9), (32.1 - 33.6)              |
| 736 - 767           |                | 100               | 100       | 99      | (-16.9 - -15.2), (33.6 - 35.5)              |
| 768 - 799           | 12             | 100               | 100       | 99      | (-15.2 - -13.5), (35.5 - 37.2)              |
| 800 - 831           |                | 100               | 100       | 99      | (-13.5 - -11.7), (37.2 - 38.9)              |
| 832 - 863           | 18             | 100               | 100       | 99      | (-11.7 - -9.9), (38.9 - 40.7)               |
| 864 - 895           | 13             | 100               | 100       | 99      | (-9.9 - -8.1), (40.7 - 42.6)                |
| 896 - 927           | 21             | 100               | 100       | 99      | (-8.1 - -6.2), (42.6 - 44.5)                |
| 928 - 959           |                | 100               | 100       | 99      | (-6.2 - -4.2), (44.5 - 46.5)                |
| 960 - 991           | 15             | 100               | 100       | 99      | (-4.2 - -2.1), (46.5 - 48.5)                |
| 992 - 1023          |                | 100               | 100       | 99      | (-2.1 - 0.0), (48.5 - 50.7)                 |

## Spatial Frequency Heatmap



| Attribute                  | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instantaneous Distribution | <p>This table is updated every 500 ms and displays the following:</p> <ul style="list-style-type: none"> <li>• <b>Group:</b> Each row corresponds to the top (most active) 1, 2, 8, 16, 32, 64, 128 and 256 VCs.</li> <li>• <b>Median Slot Count:</b> Median value of the average number of slots scheduled for the VCs in each group in the past 500 ms.</li> <li>• <b>LUIDs in Group:</b> List of LUIDs belonging to each bin.</li> </ul> |
| Spatial Utilization        | <p>This is a table (32 rows) that lists frame utilization for each spatial frequency (SF) range with following information:</p>                                                                                                                                                                                                                                                                                                             |

| Attribute                    | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <ul style="list-style-type: none"> <li>• <b>Spatial Frequency:</b> Range of spatial frequency for each bin. Each bin includes 32 consecutive spatial frequency values.</li> <li>• <b>Azimuth (degrees):</b> Azimuth range in degrees corresponding to the spatial frequencies of the bin. The zero-degree Azimuth is boresight.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                             |
|                              | <div data-bbox="581 562 678 674"></div> <div data-bbox="699 562 1421 751"> <p><b>Note</b></p> <p>Some SF ranges correspond to multiple azimuth ranges. This is because for some spatial frequencies the AP generates beams in multiple azimuth directions. The SM can be physically located in any of the azimuth ranges.</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                   |
| Spatial Utilization (Contd.) | <ol style="list-style-type: none"> <li>7. Instantaneous (%): Frame utilization for the SF bin, updated every 500 ms. The frame utilization percentage accounts for all traffic, sector mode, beamforming mode, and MU-MIMO mode.</li> <li>8. Total (%): Average utilization in the SF bin for the past 1/5/15 minutes, as selected in the Statistics Display interval.</li> <li>9. Max (%): Maximum instantaneous utilization in the 1/5/15 minute interval.</li> <li>10. Min (%): Minimum instantaneous utilization in the 1/5/15 minute interval.</li> <li>11. VCs in Range: List of VCs with spatial frequency falling in the bin.</li> <li>12. LUIDs in Range: List of LUIDs with spatial frequency falling in the bin.</li> </ol> |
|                              | <div data-bbox="581 1283 678 1394"></div> <div data-bbox="699 1283 1421 1633"> <p><b>Note</b></p> <p>The size of each SF bin is smaller than the beam generated by the AP during a MU-MIMO transmission. This means that when a VC in a bin is scheduled for a MU-MIMO transmission, the adjacent bins also receive the signal, and the transmission is counted towards their utilization as well. Bins with consistent low utilization indicate the areas of the sector where more SMs could be installed, or the customers that could be offered higher data plans.</p> </div>                                                                                                                                                       |
| Spatial Frequency Heatmap    | <p>The spatial frequency heatmap allow the operator to see how the 450m spatial frequency have been occupied (utilised) over the previous hour of operation. There are two heatmaps the first displays downlink utilisation and the lower the uplink utilisation. The heatmaps are useful when operators are identifying:</p> <ul style="list-style-type: none"> <li>• congested spatial directions</li> </ul>                                                                                                                                                                                                                                                                                                                         |

| Attribute | Meaning                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <ul style="list-style-type: none"><li>• spare capacity in spatial directions</li></ul> <p>The heatmap uses a graduated colour scale to represent the percentage utilisation. The graphic to the right-hand side of the heatmap should be used as a key to interpret the GUI. Where dark blue represents zero percent utilisation and red represents 100% utilisation.</p> |

## Radio Recovery

This section describes:

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

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

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

**Note**

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

---

Options in recovery mode are:

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

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

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

**Note**

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

---

**Note**

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

---

Use below procedure to enter in recovery console manually.

**Procedure 27 Radio Recovery Console**

- 1 Apply power to PSU for at least 10 seconds.
- 2 Remove power from the PSU, and then re-apply it as soon as the power indicator light goes out (about 1 - 2 seconds).
- 3 When the unit is in recovery mode, access the web interface by entering the default IP address **169.254.1.1**. The Recovery Image Warning page is displayed.
- 4 Review the Boot Selection (Table 155).
- 5 Select a recovery option

**Figure 91 Recovery Options page**

**Cambium Networks™**

Normal boot in 44 seconds

**General**

### Radio Recovery Console

0A:00:3E:BB:00:F6

**Boot Selection**

Boot - Default Mode

Boot - Normal

**Device Information**

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

**Backup Recovery**

Choose File :  CANOPY 14.0

**Table 155 Recovery Options attributes**

| Attribute                    | Meaning                                                                                                                                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Boot Selection               | <p><b>Boot – Default Mode:</b> Use this option to temporarily set the IP and Ethernet attributes to factory defaults until the next reboot.</p> <p><b>Boot – Normal:</b> 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 <https://btpa.com/Cambium-Products/> as Part BT-0583 (RJ-11 Default Plug).

Alternatively, you can fabricate an override plug. See Override plug cable in Planning and Installation Guide for pinout.

---

## Using the Default/Override Plug

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

**Note**

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

---

**Note**

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

---

Use below procedure to enter in default mode manually.

**Procedure 28 Default mode**

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

## Chapter 4: Reference information

---

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

The following topics are described in this chapter:

- [Equipment specifications](#) on page 4-2 contains specifications of the 450 Platform Family, ODU specifications including RF bands, channel width and link loss.
- [Data network specifications](#) on page 4-56 shows the 450 Platform Family Ethernet interface specifications.
- [Wireless specifications](#) on page 4-57 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 4-59 describes how the 450 Platform Family complies with the radio regulations that are enforced in various countries.
- [Equipment Disposal](#) on page 4-63 describes the Equipment Disposal system for Electronic and Electric Equipment.

## Equipment specifications

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

### Specifications for 5 GHz PMP 450m Series - AP

The 5 GHz PMP 450m AP conforms to the specifications listed in [Table 156](#).

**Table 156 5 GHz PMP 450m Series - AP specifications**

| Category                                             |         | Specification                                                           |
|------------------------------------------------------|---------|-------------------------------------------------------------------------|
| Model Number                                         |         | PMP 450m AP                                                             |
| <b>Spectrum</b>                                      |         |                                                                         |
| Channel Spacing                                      |         | Configurable on 2.5 MHz increments                                      |
| Frequency Range                                      |         | 4900 to 5925 MHz                                                        |
| Channel Bandwidth                                    |         | 5, 10, 15, 20, 30, and 40 MHz                                           |
| <b>Interface</b>                                     |         |                                                                         |
| 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   |
| <b>Sensitivity</b>                                   |         |                                                                         |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 4.9 GHz | 1x=-101.6 dBm, 2x=-96.2 dBm, 4x=-90.2 dBm, 6x=-84 dBm, 8x=-76.6 dBm     |
|                                                      | 5.1 GHz | 1x=-101.6 dBm, 2x=-96.2 dBm, 4x=-90.2 dBm, 6x=-84 dBm, 8x=-76.6 dBm     |
|                                                      | 5.2 GHz | 1x=-101.3 dBm, 2x=-96.3 dBm, 4x=-89.7 dBm, 6x=-83.3 dBm, 8x=-75.7 dBm   |

|                                                       |         |                                                                       |
|-------------------------------------------------------|---------|-----------------------------------------------------------------------|
|                                                       | 5.4 GHz | 1x=-101.1 dBm, 2x=-96.8 dBm, 4x=-90 dBm, 6x=-83.9 dBm, 8x=-76.2 dBm   |
|                                                       | 5.8 GHz | 1x=-101.6 dBm, 2x=-96.6 dBm, 4x=-89.9 dBm, 6x=-83.7 dBm, 8x=-76.3 dBm |
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 5.1 GHz | 1x=-99 dBm, 2x=-94.6 dBm, 4x=-87.8 dBm, 6x=-81.6 dBm, 8x=-74.6 dBm    |
|                                                       | 5.2 GHz | 1x=-98.8 dBm, 2x=-93.8 dBm, 4x=-87.6 dBm, 6x=-81.4 dBm, 8x=-73.6 dBm  |
|                                                       | 5.4 GHz | 1x=-98.1 dBm, 2x=-94.1 dBm, 4x=-87.5 dBm, 6x=-81.5 dBm, 8x=-73.8 dBm  |
|                                                       | 5.8 GHz | 1x=-98.5 dBm, 2x=-93.6 dBm, 4x=-87.5 dBm, 6x=-81.2 dBm, 8x=-73.7 dBm  |
| Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel | 4.9 GHz | 1x=-97.3 dBm, 2x=-92.5 dBm, 4x=-86.3 dBm, 6x=-79.9 dBm, 8x=-72.9 dBm  |
|                                                       | 5.1 GHz | 1x=-97.3 dBm, 2x=-92.5 dBm, 4x=-86.3 dBm, 6x=-79.9 dBm, 8x=-72.9 dBm  |
|                                                       | 5.2 GHz | 1x=-96.7 dBm, 2x=-91.9 dBm, 4x=-85.7 dBm, 6x=-79.5 dBm, 8x=-72.5 dBm  |
|                                                       | 5.4 GHz | 1x=-96.2 dBm, 2x=-92.1 dBm, 4x=-85.5 dBm, 6x=-79.4 dBm, 8x=-72.4 dBm  |
|                                                       | 5.8 GHz | 1x=-97.2 dBm, 2x=-92.4 dBm, 4x=-85.5 dBm, 6x=-79.4 dBm, 8x=-72.5 dBm  |
| Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel | 4.9 GHz | 1x=-96.3 dBm, 2x=-91.9 dBm, 4x=-85.3 dBm, 6x=-79.3 dBm, 8x=-71.3 dBm  |
|                                                       | 5.1 GHz | 1x=-96.3 dBm, 2x=-91.9 dBm, 4x=-85.3 dBm, 6x=-79.3 dBm, 8x=-71.3 dBm  |
|                                                       | 5.2 GHz | 1x=-95.8 dBm, 2x=-91.8 dBm, 4x=-84.8 dBm, 6x=-78.8 dBm, 8x=-71.8 dBm  |
|                                                       | 5.4 GHz | 1x=-95.1 dBm, 2x=-91.4 dBm, 4x=-84.8 dBm, 6x=-78.3 dBm, 8x=-71.1 dBm  |
|                                                       | 5.8 GHz | 1x=-95.8 dBm, 2x=-91.3 dBm, 4x=-84.7 dBm, 6x=-78.3 dBm, 8x=-70.8 dBm  |
| Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel | 4.9 GHz | 1x=-93.1 dBm, 2x=-89.0 dBm, 4x=-83.0 dBm, 6x=-76.7 dBm, 8x=-69.8 dBm  |
|                                                       | 5.1 GHz | 1x=-93.1 dBm, 2x=-89.0 dBm, 4x=-83.0 dBm, 6x=-76.7 dBm, 8x=-69.8 dBm  |

|                                                       |         |                                                                                                   |        |             |
|-------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------|--------|-------------|
|                                                       | 5.2 GHz | 1x=-93.1 dBm, 2x=-88.7 dBm, 4x=-82.5 dBm, 6x=-76.2 dBm, 8x=-69.4 dBm                              |        |             |
|                                                       | 5.4 GHz | 1x=-93.6 dBm, 2x=-89.1 dBm, 4x=-82.9 dBm, 6x=-76.5 dBm, 8x=-69.7 dBm                              |        |             |
|                                                       | 5.8 GHz | 1x=-94.1dBm, 2x=-89.4 dBm, 4x=-83.2 dBm, 6x=-76.8 dBm, 8x=-69.9 dBm                               |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 4.9 GHz | 1x=-92.1 dBm, 2x=-88.1 dBm, 4x=-82.0 dBm, 6x=-75.5 dBm, 8x=-68.2 dBm                              |        |             |
|                                                       | 5.1 GHz | 1x=-92.1 dBm, 2x=-88.1 dBm, 4x=-82.0 dBm, 6x=-75.5 dBm, 8x=-68.2 dBm                              |        |             |
|                                                       | 5.2 GHz | 1x=-92.0 dBm, 2x=-87.7 dBm, 4x=-81.7 dBm, 6x=-75.3 dBm, 8x=-67.9 dBm                              |        |             |
|                                                       | 5.4 GHz | 1x=-92.7 dBm, 2x=-87.4 dBm, 4x=-81.8 dBm, 6x=-75.4 dBm, 8x=-68.2 dBm                              |        |             |
|                                                       | 5.8 GHz | 1x=-93.0 dBm, 2x=-87.9 dBm, 4x=-82.1 dBm, 6x=-75.6 dBm, 8x=-68.1 dBm                              |        |             |
| Performance                                           |         |                                                                                                   |        |             |
| Subscriber Per Sector                                 |         | Up to 238                                                                                         |        |             |
| ARQ                                                   |         | Yes                                                                                               |        |             |
| Cyclic Prefix                                         |         | 1/16                                                                                              |        |             |
| Frame Period                                          |         | 2.5 ms, 5 ms                                                                                      |        |             |
| Modulation Levels (Adaptive)                          |         | Modulation Levels                                                                                 | 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 for the traffic that is MU-MIMO scheduled.) |        |             |
| 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 EIRP                 |            | +48 dBm                                                                                                                                                         |       |
| Physical                     |            |                                                                                                                                                                 |       |
| Data, Sync/AUX and SFP port  | RJ45       | <ul style="list-style-type: none"><li>1000BASE-T Ethernet Data</li><li>AUX port for UGPS or PoE out to 802.3at</li></ul>                                        |       |
| Antenna Connection           |            | Integrated Sector Array                                                                                                                                         |       |
| Surge Suppression (with LPU) |            | EN61000-4-5: 1.2 us/50 us, 500 V voltage waveform<br>Recommended external surge suppressor:<br>Cambium Networks Model # C000065L007B                            |       |
| Mean Time Between Failure    |            | > 40 Years                                                                                                                                                      |       |
| Environmental                |            | IP66, IP67                                                                                                                                                      |       |
| Temperature / Humidity       |            | -40°C to +60°C (-40°F to +140°F)<br>0-95% non-condensing                                                                                                        |       |
| Weight                       | Integrated | Approx. 14.2 kg (31 bs)                                                                                                                                         |       |
| Wind Loading - Front Facing  |            | @90 mph / 144 kph                                                                                                                                               | 376 N |
|                              |            | @110 mph /177 kph                                                                                                                                               | 562 N |
| Dimension (HxWxD)            | Integrated | 52 x 65 x 11 cm (20.3" x 25.7" x 4.4")                                                                                                                          |       |
| Power Consumption            |            | 70 W typical, 80 W peak<br>(up to 110 W max with AUX port PoE enabled)                                                                                          |       |
| Input Voltage                |            | 58 V, 1.7 A                                                                                                                                                     |       |
| Mounting                     |            | Pole mount with included brackets                                                                                                                               |       |
| Security                     |            |                                                                                                                                                                 |       |
| Encryption                   |            | 128-bit AES and 256-bit AES                                                                                                                                     |       |
|                              |            | <div><div></div><div><b>Note</b> AES-256 requires a license key.</div></div> |       |

## Specifications for 3 GHz PMP 450m Series - AP

The 3GHz PMP 450m AP conforms to the specifications listed in Table 157.

**Table 157 3GHz PMP 450m Series - AP specifications**

| Category                                              |         | Specification                                                                                           |
|-------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------------|
| Model Number                                          |         | 3GHz PMP 450m AP                                                                                        |
| <b>Spectrum</b>                                       |         |                                                                                                         |
| Channel Spacing                                       |         | Customizable channel selection to 50KHz raster                                                          |
| Frequency Range                                       |         | 3300 – 3900 MHz                                                                                         |
| Channel Bandwidth                                     |         | 5, 7, 10, 15, 20, 30 and 40MHz                                                                          |
| <b>Interface</b>                                      |         |                                                                                                         |
| MAC (Media Access Control) Layer                      |         | Cambium Networks Proprietary                                                                            |
| Physical Layer                                        |         | 8x8 Multi-User MIMO OFDM                                                                                |
| Ethernet Interface                                    |         | 100/1000BaseT, full duplex, rate auto negotiated (802.3 compliant), dual SFP support for 1 Gbps optical |
| Protocols Used                                        |         | IPv4, IPv6, UDP, TCP/IP, ICMP, Telnet, SNMP, HTTP, FTP                                                  |
| Network Management                                    |         | IPv4/IPv6 (dual stack), HTTP, HTTPS, Telnet, FTP, SNMPv2c and v3, Cambium Networks cnMaestro™           |
| VLAN                                                  |         | 802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID                                    |
| <b>Sensitivity</b>                                    |         |                                                                                                         |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel  | 3.5 GHz | 1x=-97.3 dBm, 2x=-95.1 dBm, 4x=-88.7 dBm, 6x=-82.6 dBm, 8x=-74.9 dBm                                    |
|                                                       | 3.6 GHz | 1x=-96.6 dBm, 2x=-94.4 dBm, 4x=-88.0 dBm, 6x=-82.0 dBm, 8x=-74.2 dBm                                    |
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 3.5 GHz | 1x=-94.9 dBm, 2x=-92.9 dBm, 4x=-86.4 dBm, 6x=-80.3 dBm, 8x=-73.2 dBm                                    |
|                                                       | 3.6 GHz | 1x=-94.3 dBm, 2x=-92.2 dBm, 4x=-85.8 dBm, 6x=-79.6 dBm, 8x=-72.3 dBm                                    |
|                                                       | 3.5 GHz | 1x=-93.1 dBm, 2x=-91.1 dBm, 4x=-84.6 dBm, 6x=-78.3 dBm, 8x=-71.9 dBm                                    |

| Category                                              |         | Specification                                                        |        |             |
|-------------------------------------------------------|---------|----------------------------------------------------------------------|--------|-------------|
| Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel | 3.6 GHz | 1x=-92.6 dBm, 2x=-90.3 dBm, 4x=-84.0 dBm, 6x=-77.8 dBm, 8x=-71.2 dBm |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel | 3.5 GHz | 1x=-92.0 dBm, 2x=-89.8 dBm, 4x=-83.3 dBm, 6x=-77.1 dBm, 8x=-68.7 dBm |        |             |
|                                                       | 3.6 GHz | 1x=-91.3 dBm, 2x=-89.2 dBm, 4x=-82.7 dBm, 6x=-76.5 dBm, 8x=-69.9 dBm |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel | 3.5 GHz | 1x=-90.2 dBm, 2x=-88.0 dBm, 4x=-81.5 dBm, 6x=-75.3 dBm, 8x=-68.7 dBm |        |             |
|                                                       | 3.6 GHz | 1x=-89.5 dBm, 2x=-87.4 dBm, 4x=-80.9 dBm, 6x=-74.7 dBm, 8x=-68.1 dBm |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 3.5 GHz | 1x=-89.0 dBm, 2x=-86.8 dBm, 4x=-80.3 dBm, 6x=-74.1 dBm, 8x=-67.5 dBm |        |             |
|                                                       | 3.6 GHz | 1x=-88.3 dBm, 2x=-86.2 dBm, 4x=-79.7 dBm, 6x=-73.5 dBm, 8x=-66.9 dBm |        |             |
| Performance                                           |         |                                                                      |        |             |
| Subscriber Per Sector                                 |         | Up to 238                                                            |        |             |
| ARQ                                                   |         | Yes                                                                  |        |             |
| Cyclic Prefix                                         |         | 1/16                                                                 |        |             |
| Frame Period                                          |         | 2.5 ms, 5 ms                                                         |        |             |
| Modulation Levels (Adaptive)                          |         | Modulation Levels                                                    | MCS    | SNR (in dB) |
|                                                       |         | 2x                                                                   | QPSK   | 10          |
|                                                       |         | 4x                                                                   | 16QAM  | 17          |
|                                                       |         | 6x                                                                   | 64QAM  | 24          |
|                                                       |         | 8x                                                                   | 256QAM | 32          |
| Latency                                               |         | 10 ms, typical                                                       |        |             |
| Maximum Deployment Range                              |         | Up to 40 miles (64 km)                                               |        |             |
| GPS Synchronization                                   |         | Yes, via Autosync (UGPS, CMM5 (GPS only, no power))                  |        |             |
| Quality of Service                                    |         | Diffserv QoS                                                         |        |             |
| Link Budget                                           |         |                                                                      |        |             |

| Category                       |            | Specification                                                                                                                                                                                                                                         |
|--------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Antenna Beam Width (Azimuth)   |            | 90° integrated sector (3dB rolloff), 120° (6dB rolloff), (dual slant polarity, ±45°)                                                                                                                                                                  |
| Antenna Beam Width (Elevation) |            | 2° Electrical Downtilt, 8° Elevation (with Null Fill)                                                                                                                                                                                                 |
| Antenna Gain                   |            | +16 dBi                                                                                                                                                                                                                                               |
| Maximum EIRP                   |            | +52 dBm (or up to maximum allowed by regulation)                                                                                                                                                                                                      |
| <b>Physical</b>                |            |                                                                                                                                                                                                                                                       |
| Data ports                     |            |                                                                                                                                                                                                                                                       |
| Main port                      | RJ45       | 1000BASE-T Ethernet Data                                                                                                                                                                                                                              |
| Aux port                       | RJ45       | 100BASE-T with 802.3at PoE out; UGPS power/sync                                                                                                                                                                                                       |
| SFP port 1                     | SFP        | Single channel SFP, 1 Gbps                                                                                                                                                                                                                            |
| SFP port 2                     | SFP        | Dual channel SFP, 1 Gbps                                                                                                                                                                                                                              |
|                                |            |                                                                                                                                                                                                                                                       |
| Power                          | 4-pin      | DC power input                                                                                                                                                                                                                                        |
| Antenna Connection             |            | Integrated Sector Array                                                                                                                                                                                                                               |
| Surge Suppression (with LPU)   |            | <p>MAIN and AUX ports: EN61000-4-5: 10/700us, 4 kV voltage waveform. Recommended external surge suppressor: Model # C000065L007B</p> <p>DC IN port: EN61000-4-5: 1.2/50us, 2 kV/4 kV. Recommended external surge suppressor: Model # C000000L114A</p> |
| Mean Time Between Failure      |            | > 40 Years                                                                                                                                                                                                                                            |
| Environmental                  |            | IP66, IP67                                                                                                                                                                                                                                            |
| Temperature / Humidity         |            | -40°C to +60°C (-40°F to +140°F) / 100% condensing                                                                                                                                                                                                    |
| Weight                         | Integrated | Without Mounting Brackets: 20.4 kg (45 lbs) With Mounting Brackets: 22.6 kg (49.8 lbs)                                                                                                                                                                |
| Wind Loading - Front Facing    |            | @90 mph / 144 kph      521 N                                                                                                                                                                                                                          |
|                                |            | @110 mph /177 kph      787 N                                                                                                                                                                                                                          |
|                                |            | @124 mph/ 200kph      986 N                                                                                                                                                                                                                           |
| Dimension (HxWxD)              | Integrated | 69 x 61 x 17.5 cm (27.2" x 24" x 7")                                                                                                                                                                                                                  |

| Category                                                                                                                                 | Specification                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Power Consumption                                                                                                                        | 140 W typical, 150 W peak (up to 180 W max with AUX port PoE enabled) |
| Input Voltage                                                                                                                            | 40 - 60 V DC                                                          |
| Mounting                                                                                                                                 | Pole mount with included brackets (1.25" to 4" pole diameter)         |
| <b>Security</b>                                                                                                                          |                                                                       |
| Encryption                                                                                                                               | FIPS-197 128-bit AES, Optional 256-bit AES                            |
| <div> <b>Note</b> AES-256 requires a license key.</div> |                                                                       |

## Specifications for PMP 450i Series - AP

The PMP 450i AP conforms to the specifications listed in [Table 158](#).

**Table 158 PMP 450i Series - AP specifications**

| Category                                             |                 | Specification                                                                            |
|------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------|
| Model Number                                         |                 | PMP 450i AP                                                                              |
| <b>Spectrum</b>                                      |                 |                                                                                          |
| Channel Spacing                                      |                 | 5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth<br>Configurable on 2.5 MHz increments |
| Frequency Range                                      |                 | 902 to 928 MHz                                                                           |
|                                                      |                 | 3300 - 3900 MHz                                                                          |
|                                                      |                 | 4900 - 5925 MHz                                                                          |
| Channel Bandwidth                                    | 902 - 928 MHz   | 5, 7, 10, 15, and 20 MHz                                                                 |
|                                                      | 3300 - 3900 MHz | 5, 7, 10, 15, 20, 30, and 40 MHz                                                         |
|                                                      | 4900 - 5925 MHz | 5, 10, 15, 20, 30, and 40 MHz                                                            |
| <b>Interface</b>                                     |                 |                                                                                          |
| 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                    |
| <b>Sensitivity</b>                                   |                 |                                                                                          |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 900 MHz         | 1x = -91.9 dBm, 2x = -86.7 dBm, 4x = -80.9 dBm, 6x = -75 dBm, 8x = -68.8 dBm             |
|                                                      | 3.5 GHz         | 1x = -92.7 dBm, 2x = -88.7 dBm, 4x = -82.7 dBm, 6x = -75.8 dBm, 8x = -69 dBm             |

| Category                                              | Specification |                                                                                |
|-------------------------------------------------------|---------------|--------------------------------------------------------------------------------|
|                                                       | 3.6 GHz       | 1x=-91 dBm, 2x=-86.1 dBm, 4x=-80.2 dBm, 6x=-73.1 dBm, 8x=-66 dBm               |
|                                                       | 4.9 GHz       | 1x = -91.6 dBm, 2x = -87.6 dBm, 4x = -80.4 dBm, 6x = -73.2 dBm, 8x = -66 dBm   |
|                                                       | 5.1 GHz       | 1x = -91.4 dBm, 2x = -88 dBm, 4x = -80.8 dBm, 6x = -73.7 dBm, 8x = -67 dBm     |
|                                                       | 5.2 GHz       | 1x = -91.8 dBm, 2x = -87.3 dBm, 4x = -80 dBm, 6x = -73.9 dBm, 8x = -66.6 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   |
|                                                       | 3.5 GHz       | 1x=-91.8 dBm, 2x=-87.7 dBm, 4x=-80.8 dBm, 6x=-74.7 dBm, 8x=-67.3 dBm           |
|                                                       | 3.6 GHz       | 1x=-90 dBm, 2x=-87 dBm, 4x=-79.8 dBm, 6x=-73.8 dBm, 8x=-67.2 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 |
|                                                       | 3.5 GHz       | 1x=-90.2 dBm, 2x=-86.2 dBm, 4x=-80 dBm, 6x=-73.1 dBm, 8x=-66.7 dBm             |
|                                                       | 3.6 GHz       | 1x=-89.5 dBm, 2x=-85.7 dBm, 4x=-79.8 dBm, 6x=-72.8 dBm, 8x=-66.3 dBm           |
|                                                       | 4.9 GHz       | 1x = -89.1 dBm, 2x = -85 dBm, 4x = -77.9 dBm, 6x = -71.8 dBm, 8x = -64.6 dBm   |
|                                                       | 5.1 GHz       | 1x = -89.5 dBm, 2x = -85 dBm, 4x = -78.3 dBm, 6x = -72 dBm, 8x = -65 dBm       |
|                                                       | 5.2 GHz       | 1x = -88.6 dBm, 2x = -84.7 dBm, 4x = -78 dBm, 6x = -71.5 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 |

| Category                                              | Specification |                                                                                |
|-------------------------------------------------------|---------------|--------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 15 MHz Channel | 5.8 GHz       | 1x = -89.5 dBm, 2x = -84.7 dBm, 4x = -77.8 dBm, 6x = -71.6 dBm, 8x = -64 dBm   |
|                                                       | 900 MHz       | 1x=-88.2 dBm, 2x=-83.2 dBm, 4x=-76.3 dBm, 6x=-70.2 dBm, 8x=-64.3 dBm           |
|                                                       | 3.5 GHz       | 1x=-89 dBm, 2x=-84 dBm, 4x=-77.9 dBm, 6x=-72 dBm, 8x=-64.8 dBm                 |
|                                                       | 3.6 GHz       | 1x=-87.6 dBm, 2x=-83.7 dBm, 4x=-77.5 dBm, 6x=-71.6 dBm, 8x=-64.5 dBm           |
|                                                       | 4.9 GHz       | 1x = -87.2 dBm, 2x = -83 dBm, 4x = -75.8 dBm, 6x = -69.6 dBm, 8x = -62.6 dBm   |
|                                                       | 5.1 GHz       | 1x = -87.4 dBm, 2x = -83.5 dBm, 4x = -76.2 dBm, 6x = -70.3 dBm, 8x = -63.1 dBm |
|                                                       | 5.2 GHz       | 1x = -87.5 dBm, 2x = -82.9 dBm, 4x = -76.5 dBm, 6x = -69.5 dBm, 8x = -62.8 dBm |
|                                                       | 5.4 GHz       | 1x = -87.2 dBm, 2x = -83.3 dBm, 4x = -76.2 dBm, 6x = -70.1 dBm, 8x = -63 dBm   |
| Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel | 5.8 GHz       | 1x = -87.7 dBm, 2x = -82.7 dBm, 4x = -75.5 dBm, 6x = -69.6 dBm, 8x = -62.4 dBm |
|                                                       | 900 MHz       | 1x = -86.99 dBm, 2x = -82 dBm, 4x = -75.9 dBm, 6x = -69.9 dBm, 8x = -62.9 dBm  |
|                                                       | 3.5 GHz       | 1x=-87.4 dBm, 2x=-83 dBm, 4x=-76.9 dBm, 6x=-69.9 dBm, 8x=-63 dBm               |
|                                                       | 3.6 GHz       | 1x=-86.4 dBm, 2x=-82.5 dBm, 4x=-76.4 dBm, 6x=-69.4 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 |
|                                                       | 5.1 GHz       | 1x = -86.9 dBm, 2x = -82 dBm, 4x = -75.2 dBm, 6x = -69.1 dBm, 8x = -61.8 dBm   |
|                                                       | 5.2 GHz       | 1x = -85.5 dBm, 2x = -81.6 dBm, 4x = -75 dBm, 6x = -68.6 dBm, 8x = -61.6 dBm   |

| Category                                              | Specification |                                                                              |
|-------------------------------------------------------|---------------|------------------------------------------------------------------------------|
|                                                       | 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 |
| Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel | 3.5 GHz       | 1x=-85.6 dBm, 2x=-81.7 dBm, 4x=-74.5 dBm, 6x=-68 dBm, 8x=-61.5 dBm           |
|                                                       | 3.6 GHz       | 1x=-85.5 dBm, 2x=-80.5 dBm, 4x=-74.4 dBm, 6x=-68.4 dBm, 8x=-61.5 dBm         |
|                                                       | 4.9 GHz       | 1x = -84.1 dBm, 2x = -80 dBm, 4x = -73 dBm, 6x = -66.4 dBm, 8x = -59.6 dBm   |
|                                                       | 5.1 GHz       | 1x = -84.5 dBm, 2x = -80 dBm, 4x = -73.2 dBm, 6x = -67.1 dBm, 8x = -60 dBm   |
|                                                       | 5.2 GHz       | 1x = -84.5 dBm, 2x = -80 dBm, 4x = -73.4 dBm, 6x = -67.3 dBm, 8x = -58.3 dBm |
|                                                       | 5.4 GHz       | 1x = -84.5 dBm, 2x = -82 dBm, 4x = -73.5 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   |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 3.5 GHz       | 1x=-83.9 dBm, 2x=-79.5 dBm, 4x=-73 dBm, 6x=-66 dBm, 8x=-58.5 dBm             |
|                                                       | 3.6 GHz       | 1x=-82.8 dBm, 2x=-79 dBm, 4x=-73 dBm, 6x=-66 dBm, 8x=-59 dBm                 |
|                                                       | 4.9 GHz       | 1x=-83.9 dBm, 2x=-78.9 dBm, 4x=-72 dBm, 6x=-66 dBm, 8x=-56.6 dBm             |
|                                                       | 5.1 GHz       | 1x=-84.2 dBm, 2x=-79 dBm, 4x=-72.2 dBm, 6x=-66.3 dBm, 8x=-57.2 dBm           |
|                                                       | 5.2 GHz       | 1x=-84 dBm, 2x=-79.8 dBm, 4x=-72.6 dBm, 6x=-66.4 dBm, 8x=-57 dBm             |
|                                                       | 5.4 GHz       | 1x=-83.7 dBm, 2x=-78.5 dBm, 4x=-72.4 dBm, 6x=-66 dBm, 8x=-58 dBm             |

| Category                                         |                   | Specification                                                  |
|--------------------------------------------------|-------------------|----------------------------------------------------------------|
|                                                  | 5.8 GHz           | 1x=-83.8 dBm, 2x=-78.4 dBm, 4x=-72 dBm, 6x=-66 dBm, 8x=-57 dBm |
| <b>Performance</b>                               |                   |                                                                |
| ARQ                                              |                   | Yes                                                            |
| Cyclic Prefix                                    |                   | 1/16                                                           |
| Frame Period                                     |                   | 2.5 ms or 5.0 ms                                               |
| Modulation Levels<br>(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)<br>Up to 120 miles (190 km) for 900 MHz |
| GPS Synchronization                              |                   | Yes, via Autosync (CMM4), via UGPS                             |
| Quality of Service                               |                   | Diffserv QoS                                                   |
| <b>Link Budget</b>                               |                   |                                                                |
| Antenna Beam Width                               | 900 MHz           | 65° sector antenna (Dual Slant)                                |
|                                                  | 3 GHz             | 90° sector for integrated (Dual polarity, slant +45° and -45°) |
|                                                  | 5 GHz             | 90° (3 dB roll off) sector for integrated (Dual polarity, H+V) |
| Antenna Gain (Does not include cable loss, -1dB) | 900 MHz           | 13 dBi                                                         |
|                                                  | 3 GHz             | 17 dBi integrated 90° sector or external                       |
|                                                  | 5 GHz             | 17 dBi integrated 90° sector or external                       |
| Transmit Power Range                             |                   | 40 dB dynamic range (to EIRP limit by region) (1 dB step)      |

| Category                         |               | Specification                                                                                                                                                                                                |
|----------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maximum Transmit Power           |               | +27 dBm combined output (for 5 GHz)<br>+25 dBm combined output (for 3 GHz)<br>+25 dBm combined output (for 900MHz)                                                                                           |
| <b>Physical</b>                  |               |                                                                                                                                                                                                              |
| Sync/AUX port                    | RJ45          | <ul style="list-style-type: none"> <li>10/100/100BASE-T Ethernet Data</li> <li>PoE output (planned for future release)</li> <li>Sync input or output (Connection and powering of UGPS Sync input)</li> </ul> |
| Antenna Connection               |               | 50 ohm, N-type (Connectorized version only)                                                                                                                                                                  |
| Surge Suppression<br>EN61000-4-5 |               | EN61000-4-5: 1.2 us/50 us, 500 V voltage waveform<br>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                                                                                                                                                |
| <b>Security</b>                  |               |                                                                                                                                                                                                              |
| Encryption                       |               | 128-bit AES and 256-bit AES                                                                                                                                                                                  |

| Category | Specification                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------|
|          | <div> <b>Note</b> AES-256 requires a license key.</div> |

## Specifications for PMP 450i Series - SM

The PMP 450i SM conforms to the specifications listed in [Table 159](#).

**Table 159 PMP 450i Series - SM specifications**

| Category                                             |                 | Specification                                                                        |
|------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------|
| Model Number                                         |                 | PMP 450i SM                                                                          |
| <b>Spectrum</b>                                      |                 |                                                                                      |
| Channel Spacing                                      |                 | 5, 7, 10, 15, 20, 30, and 40 Channel Bandwidth<br>Configurable on 2.5 MHz increments |
| Frequency Range                                      |                 | 3300 – 3900 MHz<br>4900 – 5925 MHz                                                   |
| Channel Bandwidth                                    | 3300 – 3900 MHz | 5, 7, 10, 15, 20, 30, and 40 MHz                                                     |
|                                                      | 4900 – 5925 MHz | 5, 10, 15, 20, 30, and 40 MHz                                                        |
| <b>Interface</b>                                     |                 |                                                                                      |
| 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                |
| <b>Sensitivity</b>                                   |                 |                                                                                      |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 3.5 GHz         | 1x = -92.6 dBm, 2x = -89.22 dBm, 4x = -83.19 dBm, 6x = -76.5 dBm, 8x = -69.1 dBm     |
|                                                      | 3.6 GHz         | 1x = -92 dBm, 2x = -88.08 dBm, 4x = -82.3 dBm, 6x = -75.9 dBm, 8x = -68.6 dBm        |
|                                                      | 4.9 GHz         | 1x = -92.5 dBm, 2x = -88.5 dBm, 4x = -81 dBm, 6x = -74.2 dBm, 8x = -66 dBm           |

| Category                                              | Specification |                                                                                    |
|-------------------------------------------------------|---------------|------------------------------------------------------------------------------------|
|                                                       | 5.1 GHz       | 1x = -92 dBm, 2x = -88.7 dBm, 4x = -81.2 dBm, 6x = -74.4 dBm, 8x = -67 dBm         |
|                                                       | 5.2 GHz       | 1x = -92 dBm, 2x = -88.8 dBm, 4x = -81.3 dBm, 6x = -74.7 dBm, 8x = -67 dBm         |
|                                                       | 5.4 GHz       | 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm       |
|                                                       | 5.8 GHz       | 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm         |
| Nominal Receive Sensitivity (w/ FEC) @ 7 MHz Channel  | 3.5 GHz       | 1x = -92 dBm, 2x = -88.4 dBm, 4x = -81.4 dBm, 6x = -75.37 dBm, 8x = -68.1 dBm      |
|                                                       | 3.6 GHz       | 1x = -91.02 dBm, 2x = -87.87 dBm, 4x = -80.82 dBm, 6x = -73.6 dBm, 8x = -67.32 dBm |
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 3.5 GHz       | 1x = -90.787 dBm, 2x = -86.6 dBm, 4x = -80.2 dBm, 6x = -73.52 dBm, 8x = -66.34 dBm |
|                                                       | 3.6 GHz       | 1x = -89.8 dBm, 2x = -86 dBm, 4x = -79.84 dBm, 6x = -72.92 dBm, 8x = -66 dBm       |
|                                                       | 4.9 GHz       | 1x = -90.2 dBm, 2x = -85.2 dBm, 4x = -78.8 dBm, 6x = -71.4 dBm, 8x = -64.5 dBm     |
|                                                       | 5.1 GHz       | 1x = -90.4 dBm, 2x = -85.6 dBm, 4x = -79.2 dBm, 6x = -71.7 dBm, 8x = -64.2 dBm     |
|                                                       | 5.2 GHz       | 1x = -90.6 dBm, 2x = -85.5 dBm, 4x = -79 dBm, 6x = -71.8 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 | 3.5 GHz       | 1x = -88.57 dBm, 2x = -84.5 dBm, 4x = -78.4 dBm, 6x = -71.47 dBm, 8x = -65.22 dBm  |
|                                                       | 3.6 GHz       | 1x = -87.6 dBm, 2x = -84.1 dBm, 4x = -77.1 dBm, 6x = -71.03 dBm, 8x = -64.8 dBm    |
|                                                       | 4.9 GHz       | 1x = -88.2 dBm, 2x = -83.1 dBm, 4x = -76.9 dBm, 6x = -70.5 dBm, 8x = -62.3 dBm     |

| Category                                              | Specification |                                                                                  |
|-------------------------------------------------------|---------------|----------------------------------------------------------------------------------|
|                                                       | 5.1 GHz       | 1x = -88.4 dBm, 2x = -83.6 dBm, 4x = -77.3 dBm, 6x = -71 dBm, 8x = -62.9 dBm     |
|                                                       | 5.2 GHz       | 1x = -88.6 dBm, 2x = -83.6 dBm, 4x = -77.5 dBm, 6x = -70.2 dBm, 8x = -62.9 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 | 3.5 GHz       | 1x = -87 dBm, 2x = -83.45 dBm, 4x = -76.25 dBm, 6x = -70.33 dBm, 8x = -63.23 dBm |
|                                                       | 3.6 GHz       | 1x = -86.9 dBm, 2x = -82.9 dBm, 4x = -76.9 dBm, 6x = -69.8 dBm, 8x = -62.8 dBm   |
|                                                       | 4.9 GHz       | 1x = -87 dBm, 2x = -81.8 dBm, 4x = -75.8 dBm, 6x = -68.5 dBm, 8x = -61.4 dBm     |
|                                                       | 5.1 GHz       | 1x = -87.4 dBm, 2x = -82.5 dBm, 4x = -76 dBm, 6x = -69 dBm, 8x = -61.5 dBm       |
|                                                       | 5.2 GHz       | 1x = -87 dBm, 2x = -82.6 dBm, 4x = -75.4 dBm, 6x = -69.1 dBm, 8x = -61.8 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 | 3.5 GHz       | 1x = -86 dBm, 2x = -80.9 dBm, 4x = -75 dBm, 6x = -67.9 dBm, 8x = -61.1 dBm       |
|                                                       | 3.6 GHz       | 1x = -85.5 dBm, 2x = -80.6 dBm, 4x = -74.5 dBm, 6x = -67.5 dBm, 8x = -61 dBm     |
|                                                       | 4.9 GHz       | 1x = -84.9 dBm, 2x = -80.9 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.3 dBm   |
|                                                       | 5.1 GHz       | 1x = -85.1 dBm, 2x = -81 dBm, 4x = -74 dBm, 6x = -67.9 dBm, 8x = -59.8 dBm       |

| Category                                              |         | Specification                                                                  |        |             |
|-------------------------------------------------------|---------|--------------------------------------------------------------------------------|--------|-------------|
|                                                       | 5.2 GHz | 1x = -85.4 dBm, 2x = -80.4 dBm, 4x = -73.3 dBm, 6x = -68 dBm, 8x = -59.9 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   |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 3.5 GHz | 1x = -83.2 dBm, 2x = -79 dBm, 4x = -72.4 dBm, 6x = -66 dBm, 8x = -58.4 dBm     |        |             |
|                                                       | 3.6 GHz | 1x = -82.5 dBm, 2x = -79 dBm, 4x = -71.3 dBm, 6x = -65.4 dBm, 8x = -58.3 dBm   |        |             |
|                                                       | 4.9 GHz | 1x=-84.2 dBm, 2x=-79.3 dBm, 4x=-72.3 dBm, 6x=-66 dBm, 8x=-56.8 dBm             |        |             |
|                                                       | 5.1 GHz | 1x=-84 dBm, 2x=-79.1 dBm, 4x=-73 dBm, 6x=-66 dBm, 8x=-57.8 dBm                 |        |             |
|                                                       | 5.2 GHz | 1x=-84.2 dBm, 2x=-79.3 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |        |             |
|                                                       | 5.4 GHz | 1x=-84.2 dBm, 2x=-79.1 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |        |             |
|                                                       | 5.8 GHz | 1x=-83.6 dBm, 2x=-78.7 dBm, 4x=-72.5 dBm, 6x=-66.4 dBm, 8x=-56.3 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          |

| Category                                         |                                     | Specification                                                                                                                                                                                             |
|--------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Latency                                          |                                     | 3 - 5 ms                                                                                                                                                                                                  |
| Maximum Deployment Range                         |                                     | Up to 40 miles (64 km)                                                                                                                                                                                    |
| GPS Synchronization                              |                                     | Yes, via Autosync (CMM4)                                                                                                                                                                                  |
| Quality of Service                               |                                     | Diffserv QoS                                                                                                                                                                                              |
| Link Budget                                      |                                     |                                                                                                                                                                                                           |
| Antenna Beam Width                               |                                     | 10° azimuth for 23 dBi integrated antenna                                                                                                                                                                 |
| Antenna Gain (Does not include cable loss, ~1dB) | 5 GHz                               | +23 dBi H+V, integrated or external                                                                                                                                                                       |
|                                                  | 3 GHz                               | +19 dBi dual slant, integrated or external                                                                                                                                                                |
| Transmit Power Range                             |                                     | 40 dB dynamic range (to EIRP limit by region) (1 dB step)                                                                                                                                                 |
| Maximum Transmit Power                           | +27 dBm combined output (for 5 GHz) |                                                                                                                                                                                                           |
|                                                  | +25 dBm combined output (for 3 GHz) |                                                                                                                                                                                                           |
| Physical                                         |                                     |                                                                                                                                                                                                           |
| Sync/AUX port                                    | RJ45                                | <ul style="list-style-type: none"><li>10/100/1000BASE-T Ethernet Data</li><li>PoE output (planned for future release)</li><li>Sync input or output (Connection and powering of UGPS Sync input)</li></ul> |
| Antenna Connection                               |                                     | 50 ohm, N-type (Connectorized version only)                                                                                                                                                               |
| Surge Suppression<br>EN61000-4-5                 |                                     | EN61000-4-5: 1.2us/50us, 500 V voltage waveform<br>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)                                                                                                                                                                                       |

| Category          |               | Specification                                                                                                                 |
|-------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------|
| Dimension (HxWxD) | Integrated    | 200 km/h (124 mi/h)                                                                                                           |
|                   | 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                                                                 |
| <b>Security</b>   |               |                                                                                                                               |
| Encryption        |               | 128-bit AES and 256-bit AES                                                                                                   |
|                   |               |  <b>Note</b> AES-256 requires a license key. |

## Specifications for PTP 450i Series - BH

The PTP 450i BH conforms to the specifications listed in [Table 160](#).

**Table 160 PTP 450i Series - BH specifications**

| Category                                             |                 | Specification                                                                            |
|------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------|
| Model Number                                         |                 | PTP 450i BH                                                                              |
| <b>Spectrum</b>                                      |                 |                                                                                          |
| Channel Spacing                                      |                 | 5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth<br>Configurable on 2.5 MHz increments |
| Frequency Range                                      |                 | 4900 - 5925 MHz                                                                          |
| Channel Bandwidth                                    | 4900 - 5925 MHz | 5, 10, 15, 20, 30, and 40 MHz                                                            |
| <b>Interface</b>                                     |                 |                                                                                          |
| 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                    |
| <b>Sensitivity</b>                                   |                 |                                                                                          |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 3.5 GHz         | 1x = -92.7 dBm, 2x = -88.7 dBm, 4x = -82.7 dBm, 6x = -75.8 dBm, 8x = -69 dBm             |
|                                                      | 3.6 GHz         | 1x = -92.7 dBm, 2x = -87.3 dBm, 4x = -81 dBm, 6x = -74.9 dBm, 8x = -68.3 dBm             |
|                                                      | 4.9 GHz         | 1x = -93 dBm, 2x = -88.3 dBm, 4x = -82 dBm, 6x = -74.4 dBm, 8x = -67.9 dBm               |
|                                                      | 5.1 GHz         | 1x = -93 dBm, 2x = -88.7 dBm, 4x = -81.2 dBm, 6x = -74.7 dBm, 8x = -67.6 dBm             |
|                                                      | 5.2 GHz         | 1x = -93 dBm, 2x = -89 dBm, 4x = -81.5 dBm, 6x = -75 dBm, 8x = -67.5 dBm                 |

| Category                                              | Specification |                                                                                |
|-------------------------------------------------------|---------------|--------------------------------------------------------------------------------|
|                                                       | 5.4 GHz       | 1x = -93 dBm, 2x = -88.4 dBm, 4x = -81.3 dBm, 6x = -75.5 dBm, 8x = -67.8 dBm   |
|                                                       | 5.8 GHz       | 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  | 3.5 GHz       | 1x = -91.8 dBm, 2x = -87.7 dBm, 4x = -80.8 dBm, 6x = -74.7 dBm, 8x = -67.3 dBm |
|                                                       | 3.6 GHz       | 1x = -90.0 dBm, 2x = -87.0 dBm, 4x = -79.8 dBm, 6x = -73.8 dBm, 8x = -67.2 dBm |
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 3.5 GHz       | 1x = -90.2 dBm, 2x = -86.2 dBm, 4x = -80.0 dBm, 6x = -73.1 dBm, 8x = -66.7 dBm |
|                                                       | 3.6 GHz       | 1x = -89.5 dBm, 2x = -85.7 dBm, 4x = -79.8 dBm, 6x = -72.8 dBm, 8x = -66.3 dBm |
|                                                       | 4.9 GHz       | 1x = -90 dBm, 2x = -85 dBm, 4x = -78.6 dBm, 6x = -72.5 dBm, 8x = -65 dBm       |
|                                                       | 5.1 GHz       | 1x = -90.4 dBm, 2x = -85.4 dBm, 4x = -79 dBm, 6x = -73 dBm, 8x = -65.5 dBm     |
|                                                       | 5.2 GHz       | 1x = -90.4 dBm, 2x = -85.5 dBm, 4x = -79.2 dBm, 6x = -72 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 | 3.5 GHz       | 1x = -89.0 dBm, 2x = -84.0 dBm, 4x = -77.9 dBm, 6x = -72.0 dBm, 8x = -64.8 dBm |
|                                                       | 3.6 GHz       | 1x = -87.6 dBm, 2x = -83.7 dBm, 4x = -77.5 dBm, 6x = -71.6 dBm, 8x = -64.5 dBm |
|                                                       | 4.9 GHz       | 1x = -88 dBm, 2x = -83.9 dBm, 4x = -76.9 dBm, 6x = -70.7 dBm, 8x = -63.6 dBm   |
|                                                       | 5.1 GHz       | 1x = -89.3 dBm, 2x = -83.3 dBm, 4x = -76.9 dBm, 6x = -70.7 dBm, 8x = -63.6 dBm |
|                                                       | 5.2 GHz       | 1x = -88.5 dBm, 2x = -83.3 dBm, 4x = -76.9 dBm, 6x = -70.7 dBm, 8x = -63 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 = -76.6 dBm, 6x = -69.3 dBm, 8x = -62.1 dBm |

| Category                                               |         | Specification                                                                  |
|--------------------------------------------------------|---------|--------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel' | 3.5 GHz | 1x = -87.4 dBm, 2x = -83.0 dBm, 4x = -76.9 dBm, 6x = -69.9 dBm, 8x = -63.0 dBm |
|                                                        | 3.6 GHz | 1x = -86.4 dBm, 2x = -82.5 dBm, 4x = -76.4 dBm, 6x = -69.4 dBm, 8x = -62.9 dBm |
|                                                        | 4.9 GHz | 1x = -86.9 dBm, 2x = -82.5 dBm, 4x = -75.7 dBm, 6x = -69.4 dBm, 8x = -62.3 dBm |
|                                                        | 5.1 GHz | 1x = -87.3 dBm, 2x = -83.3 dBm, 4x = -76 dBm, 6x = -69.9 dBm, 8x = -62.6 dBm   |
|                                                        | 5.2 GHz | 1x = -87.4 dBm, 2x = -82.6 dBm, 4x = -75.4 dBm, 6x = -69.2 dBm, 8x = -62 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  | 3.5 GHz | 1x = -86.4 dBm, 2x = -81.7 dBm, 4x = -75.1 dBm, 6x = -68 dBm, 8x = -62 dBm     |
|                                                        | 3.6 GHz | 1x = -85.5 dBm, 2x = -80.6 dBm, 4x = -74.4 dBm, 6x = -68.4 dBm, 8x = -61.5 dBm |
|                                                        | 4.9 GHz | 1x = -85 dBm, 2x = -80.7 dBm, 4x = -73.7 dBm, 6x = -66.5 dBm, 8x = -60 dBm     |
|                                                        | 5.1 GHz | 1x = -85 dBm, 2x = -81 dBm, 4x = -74 dBm, 6x = -68 dBm, 8x = -60.7 dBm         |
|                                                        | 5.2 GHz | 1x = -85.2 dBm, 2x = -80.4 dBm, 4x = -74.2 dBm, 6x = -67.1 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   |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel  | 3.5 GHz | 1x=-83.7 dBm, 2x=-79.6 dBm, 4x=-73.5 dBm, 6x=-66.7 dBm, 8x=-58.6 dBm           |
|                                                        | 3.6 GHz | 1x=-83.4 dBm, 2x=-79.3 dBm, 4x=-72.3 dBm, 6x=-66 dBm, 8x=-58.0 dBm             |
|                                                        | 4.9 GHz | 1x=-84.1 dBm, 2x=-79.3 dBm, 4x=-73 dBm, 6x=-66 dBm, 8x=-58.8 dBm               |
|                                                        | 5.1 GHz | 1x=-84.4 dBm, 2x=-79.7 dBm, 4x=-73.5 dBm, 6x=-67.2 dBm, 8x=-59.2 dBm           |

| Category                                         |         | Specification                                                      |        |             |
|--------------------------------------------------|---------|--------------------------------------------------------------------|--------|-------------|
|                                                  | 5.2 GHz | 1x=-84.7 dBm, 2x=-79.4 dBm, 4x=-73.2 dBm, 6x=-66.8 dBm, 8x=-59 dBm |        |             |
|                                                  | 5.4 GHz | 1x=-84.5 dBm, 2x=-79.4 dBm, 4x=-73.3 dBm, 6x=-66.5 dBm, 8x=-58 dBm |        |             |
|                                                  | 5.8 GHz | 1x=-84 dBm, 2x=-79 dBm, 4x=-72 dBm, 6x=-66 dBm, 8x=-58 dBm         |        |             |
| Performance                                      |         |                                                                    |        |             |
| ARQ                                              |         | Yes                                                                |        |             |
| Cyclic Prefix                                    |         | 1/16                                                               |        |             |
| Frame Period                                     |         | 2.5 ms or 5.0 ms                                                   |        |             |
| Modulation Levels<br>(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)                                           |        |             |
| 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                                            |        |             |

| Category                         |               | Specification                                                                                                                                                                    |
|----------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Physical</b>                  |               |                                                                                                                                                                                  |
| Sync/AUX port                    | RJ45          | <ul style="list-style-type: none"> <li>10/100/1000BASE-T Ethernet Data</li> <li>PoE output</li> <li>Sync input or output (Connection and powering of UGPS Sync input)</li> </ul> |
| Antenna Connection               |               | 50 ohm, N-type (Connectorized version only)                                                                                                                                      |
| Surge Suppression<br>EN61000-4-5 |               | EN61000-4-5: 1.2 us/50us, 500 V voltage waveform<br>Recommended external surge suppressor: Cambium Networks Model # C000000L033A                                                 |
| Mean Time Between<br>Failure     |               | > 40 Years                                                                                                                                                                       |
| Environmental                    |               | IP66, IP67                                                                                                                                                                       |
| Temperature / Humidity           |               | -40°C to +60°C (-40°F to +140°F),<br>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                                                                                                                     |
| <b>Security</b>                  |               |                                                                                                                                                                                  |
| Encryption                       |               | 128-bit AES and 256-bit AES                                                                                                                                                      |
|                                  |               |  <b>Note</b> AES-256 requires a license key.                                                  |

## Specifications for PMP/PTP 450b Mid-Gain Series - SM

The PMP/PTP 450b Mid-Gain SM conforms to the specifications listed in [Table 161](#).

**Table 161 PMP/PTP 450b Mid-Gain Series - SM specifications**

| Category                                             |         | Specification                                                                  |
|------------------------------------------------------|---------|--------------------------------------------------------------------------------|
| Model Number                                         |         | PMP 450b Mid-Gain SM                                                           |
| <b>Spectrum</b>                                      |         |                                                                                |
| Channel Spacing                                      |         | Configurable in 2.5 MHz increments                                             |
| Frequency Range                                      |         | 4900 - 5925 MHz                                                                |
| Channel Bandwidth                                    |         | 5, 10, 15, 20, 30, and 40 MHz                                                  |
| <b>Interface</b>                                     |         |                                                                                |
| MAC (Media Access Control) Layer                     |         | Cambium Proprietary                                                            |
| Physical Layer                                       |         | 2x2 MIMO OFDM                                                                  |
| Ethernet Interface                                   |         | 100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)        |
| Protocols Used                                       |         | IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP                              |
| Network Management                                   |         | HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3                                      |
| VLAN                                                 |         | 802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID          |
| <b>Sensitivity</b>                                   |         |                                                                                |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 4.9 GHz | 1x = -92.5 dBm, 2x = -88.5 dBm, 4x = -81 dBm, 6x = -74.2 dBm, 8x = -66 dBm     |
|                                                      | 5.1 GHz | 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm   |
|                                                      | 5.2 GHz | 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm     |
|                                                      | 5.4 GHz | 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm   |
|                                                      | 5.8 GHz | 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm     |
|                                                      | 4.9 GHz | 1x = -90.2 dBm, 2x = -85.2 dBm, 4x = -78.8 dBm, 6x = -71.4 dBm, 8x = -64.5 dBm |

| Category                                              |         | Specification                                                                  |
|-------------------------------------------------------|---------|--------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 5.1 GHz | 1x = -90 dBm, 2x = -85.8 dBm, 4x = -78.5 dBm, 6x = -72.2 dBm, 8x = -65.8 dBm   |
|                                                       | 5.2 GHz | 1x = -89.9 dBm, 2x = -84.9 dBm, 4x = -78.5 dBm, 6x = -71.2 dBm, 8x = -63.8 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 |
|                                                       | 5.1 GHz | 1x = -87.7 dBm, 2x = -83.9 dBm, 4x = -76.6 dBm, 6x = -70.4 dBm, 8x = -63 dBm   |
|                                                       | 5.2 GHz | 1x = -88 dBm, 2x = -82.9 dBm, 4x = -76.7 dBm, 6x = -69.4 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   |
|                                                       | 5.1 GHz | 1x = -87 dBm, 2x = -82.8 dBm, 4x = -75.6 dBm, 6x = -69.3 dBm, 8x = -61.6 dBm   |
|                                                       | 5.2 GHz | 1x = -85.9 dBm, 2x = -81.5 dBm, 4x = -74.8 dBm, 6x = -68.7 dBm, 8x = -61.2 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 |
|                                                       | 4.9 GHz | 1x = -84.9 dBm, 2x = -80.9 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.3 dBm |

| Category                                              |                   | Specification                                                                  |             |
|-------------------------------------------------------|-------------------|--------------------------------------------------------------------------------|-------------|
| Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel | 5.1 GHz           | 1x = -85.2 dBm, 2x = -80.2 dBm, 4x = -74.1 dBm, 6x = -67.9 dBm, 8x = -59.8 dBm |             |
|                                                       | 5.2 GHz           | 1x = -84.9 dBm, 2x = -80 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.4 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   |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 4.9 GHz           | 1x=-84.2 dBm, 2x=-79.3 dBm, 4x=-72.3 dBm, 6x=-66 dBm, 8x=-56.8 dBm             |             |
|                                                       | 5.1 GHz           | 1x=-84.2 dBm, 2x=-79.1 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |             |
|                                                       | 5.2 GHz           | 1x=-83.6 dBm, 2x=-78.7 dBm, 4x=-72.5 dBm, 6x=-66.4 dBm, 8x=-56.3 dBm           |             |
|                                                       | 5.4 GHz           | 1x=-84.2 dBm, 2x=-79.1 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |             |
|                                                       | 5.8 GHz           | 1x=-83.6 dBm, 2x=-78.7 dBm, 4x=-72.5 dBm, 6x=-66.4 dBm, 8x=-56.3 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          |                                                                                |             |

| Category                         |            | Specification                                                                                                                                                                                              |
|----------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maximum Deployment Range         |            | Up to 40 miles (64 km)                                                                                                                                                                                     |
| GPS Synchronization              |            | Yes, via Autosync (CMM4)                                                                                                                                                                                   |
| Quality of Service               |            | Diffserv QoS                                                                                                                                                                                               |
| <b>Link Budget</b>               |            |                                                                                                                                                                                                            |
| Antenna Beam Width               |            | 15° azimuth for 16 dBi integrated antenna<br>30° elevation for 16 dBi integrated antenna                                                                                                                   |
| Antenna Gain                     | 5 GHz      | +16 dBi H+V, integrated                                                                                                                                                                                    |
| Transmit Power Range             |            | 40 dB dynamic range (to EIRP limit by region) (1 dB step)                                                                                                                                                  |
| Maximum Transmit Power           |            | +27 dBm combined output                                                                                                                                                                                    |
| <b>Physical</b>                  |            |                                                                                                                                                                                                            |
| Sync/AUX port                    | RJ45       | <ul style="list-style-type: none"> <li>100/1000BASE-T Ethernet Data</li> <li>PoE output (planned for future release)</li> <li>Sync input or output (Connection and powering of UGPS Sync input)</li> </ul> |
| Antenna Connection               |            | 50 ohm, N-type (Connectorized version only)                                                                                                                                                                |
| Surge Suppression<br>EN61000-4-5 |            | EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform<br>Recommended surge suppressor: Cambium Networks<br>Model # C000000L065A                                                                           |
| Mean Time Between Failure        |            | > 40 Years                                                                                                                                                                                                 |
| Environmental                    |            | IP55                                                                                                                                                                                                       |
| Temperature / Humidity           |            | -40°C to +60°C (-40°F to +140°F), 0-95% non-condensing                                                                                                                                                     |
| Weight                           | Integrated | Approx. 0.5 kg (1.1 lb. including mounting bracket)                                                                                                                                                        |
| Wind Survival                    | Integrated | 190 km/h (118 mi/h)                                                                                                                                                                                        |
| Dimension (HxWxD)                | Integrated | 12.4 x 25.1 x 11.9 cm (4.9" x 9.9" x 4.7")                                                                                                                                                                 |
| Power Consumption                |            | 9 W nominal, 12 W peak                                                                                                                                                                                     |
| Input Voltage                    |            | 20 - 32 V DC,                                                                                                                                                                                              |

| Category   | Specification                                                                                                                                                 |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mounting   | Wall or Pole mount                                                                                                                                            |
| Security   |                                                                                                                                                               |
| Encryption | 128-bit AES and 256-bit AES                                                                                                                                   |
|            | <div><div></div><div><b>Note</b> AES-256 requires a license key.</div></div> |

## Specifications for PMP/PTP 450b High Gain Series - SM

The PMP/PTP 450b High Gain SM conforms to the specifications listed in [Table 162](#).

**Table 162 PMP/PTP 450b High Gain Series - SM specifications**

| Category                                             |         | Specification                                                                  |
|------------------------------------------------------|---------|--------------------------------------------------------------------------------|
| Model Number                                         |         | PMP 450b High Gain SM                                                          |
| <b>Spectrum</b>                                      |         |                                                                                |
| Channel Spacing                                      |         | Configurable in 2.5 MHz increments                                             |
| Frequency Range                                      |         | 4900 - 5925 MHz                                                                |
| Channel Bandwidth                                    |         | 5, 10, 15, 20, 30, and 40 MHz                                                  |
| <b>Interface</b>                                     |         |                                                                                |
| MAC (Media Access Control) Layer                     |         | Cambium Proprietary                                                            |
| Physical Layer                                       |         | 2x2 MIMO OFDM                                                                  |
| Ethernet Interface                                   |         | 100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)        |
| Protocols Used                                       |         | IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP                              |
| Network Management                                   |         | HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3                                      |
| VLAN                                                 |         | 802.1ad (DVLAN Q-in-Q), 802.1Q with 802.1p priority, dynamic port VID          |
| <b>Sensitivity</b>                                   |         |                                                                                |
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel | 4.9 GHz | 1x = -92.5 dBm, 2x = -88.5 dBm, 4x = -81 dBm, 6x = -74.2 dBm, 8x = -66 dBm     |
|                                                      | 5.1 GHz | 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm   |
|                                                      | 5.2 GHz | 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm     |
|                                                      | 5.4 GHz | 1x = -93 dBm, 2x = -89.1 dBm, 4x = -81.5 dBm, 6x = -74.8 dBm, 8x = -67.4 dBm   |
|                                                      | 5.8 GHz | 1x = -92 dBm, 2x = -88.3 dBm, 4x = -80.8 dBm, 6x = -74 dBm, 8x = -66.2 dBm     |
|                                                      | 4.9 GHz | 1x = -90.2 dBm, 2x = -85.2 dBm, 4x = -78.8 dBm, 6x = -71.4 dBm, 8x = -64.5 dBm |

| Category                                              |         | Specification                                                                  |
|-------------------------------------------------------|---------|--------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel | 5.1 GHz | 1x = -90 dBm, 2x = -85.8 dBm, 4x = -78.5 dBm, 6x = -72.2 dBm, 8x = -65.8 dBm   |
|                                                       | 5.2 GHz | 1x = -89.9 dBm, 2x = -84.9 dBm, 4x = -78.5 dBm, 6x = -71.2 dBm, 8x = -63.8 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 |
|                                                       | 5.1 GHz | 1x = -87.7 dBm, 2x = -83.9 dBm, 4x = -76.6 dBm, 6x = -70.4 dBm, 8x = -63 dBm   |
|                                                       | 5.2 GHz | 1x = -88 dBm, 2x = -82.9 dBm, 4x = -76.7 dBm, 6x = -69.4 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   |
|                                                       | 5.1 GHz | 1x = -87 dBm, 2x = -82.8 dBm, 4x = -75.6 dBm, 6x = -69.3 dBm, 8x = -61.6 dBm   |
|                                                       | 5.2 GHz | 1x = -85.9 dBm, 2x = -81.5 dBm, 4x = -74.8 dBm, 6x = -68.7 dBm, 8x = -61.2 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 |
|                                                       | 4.9 GHz | 1x = -84.9 dBm, 2x = -80.9 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.3 dBm |

| Category                                              |                   | Specification                                                                  |             |
|-------------------------------------------------------|-------------------|--------------------------------------------------------------------------------|-------------|
| Nominal Receive Sensitivity (w/ FEC) @ 30 MHz Channel | 5.1 GHz           | 1x = -85.2 dBm, 2x = -80.2 dBm, 4x = -74.1 dBm, 6x = -67.9 dBm, 8x = -59.8 dBm |             |
|                                                       | 5.2 GHz           | 1x = -84.9 dBm, 2x = -80 dBm, 4x = -73.2 dBm, 6x = -67.4 dBm, 8x = -59.4 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   |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 4.9 GHz           | 1x=-84.2 dBm, 2x=-79.3 dBm, 4x=-72.3 dBm, 6x=-66 dBm, 8x=-56.8 dBm             |             |
|                                                       | 5.1 GHz           | 1x=-84.2 dBm, 2x=-79.1 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |             |
|                                                       | 5.2 GHz           | 1x=-83.6 dBm, 2x=-78.7 dBm, 4x=-72.5 dBm, 6x=-66.4 dBm, 8x=-56.3 dBm           |             |
|                                                       | 5.4 GHz           | 1x=-84.2 dBm, 2x=-79.1 dBm, 4x=-73.1 dBm, 6x=-66 dBm, 8x=-56.9 dBm             |             |
|                                                       | 5.8 GHz           | 1x=-83.6 dBm, 2x=-78.7 dBm, 4x=-72.5 dBm, 6x=-66.4 dBm, 8x=-56.3 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          |                                                                                |             |

| Category                         |            | Specification                                                                                                                                                                                              |
|----------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maximum Deployment Range         |            | Up to 40 miles (64 km)                                                                                                                                                                                     |
| GPS Synchronization              |            | Yes, via Autosync (CMM4)                                                                                                                                                                                   |
| Quality of Service               |            | Diffserv QoS                                                                                                                                                                                               |
| <b>Link Budget</b>               |            |                                                                                                                                                                                                            |
| Antenna Beam Width               |            | 7° azimuth for 23 dBi integrated antenna<br>7° elevation for 23 dBi integrated antenna                                                                                                                     |
| Antenna Gain                     | 5 GHz      | +23 dBi H+V, integrated                                                                                                                                                                                    |
| Transmit Power Range             |            | 22 dB dynamic range (to EIRP limit by region) (1 dB step)                                                                                                                                                  |
| Maximum Transmit Power           |            | +27 dBm combined output (+22 dBm @ 256QAM)                                                                                                                                                                 |
| <b>Physical</b>                  |            |                                                                                                                                                                                                            |
| Sync/AUX port                    | RJ45       | <ul style="list-style-type: none"> <li>100/1000BASE-T Ethernet Data</li> <li>PoE output (planned for future release)</li> <li>Sync input or output (Connection and powering of UGPS Sync input)</li> </ul> |
| Antenna Connection               |            | 50 ohm, N-type (Connectorized version only)                                                                                                                                                                |
| Surge Suppression<br>EN61000-4-5 |            | EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform<br>Recommended surge suppressor: Cambium Networks Model # C000000L065A                                                                              |
| Mean Time Between Failure        |            | > 40 Years                                                                                                                                                                                                 |
| Environmental                    |            | IP67                                                                                                                                                                                                       |
| Temperature / Humidity           |            | -40°C to +60°C (-40°F to +140°F), 0-95% non-condensing                                                                                                                                                     |
| Weight                           | Integrated | Approx. 3.1 kg (7 lb. including mounting bracket)                                                                                                                                                          |
| Wind Survival                    | Integrated | 145 km/h (90 mi/h)                                                                                                                                                                                         |
| Dimension (HxWxD)                | Integrated | 47 cm diameter x 28 cm (18.5" diameter x 11.2")                                                                                                                                                            |
| Power Consumption                |            | 9 W nominal, 12 W peak                                                                                                                                                                                     |
| Input Voltage                    |            | 20 - 32 V DC,                                                                                                                                                                                              |

| Category   | Specification                                                                                                                           |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Mounting   | Wall or Pole mount                                                                                                                      |
| Security   |                                                                                                                                         |
| Encryption | 128-bit AES and 256-bit AES                                                                                                             |
|            | <div><b>Note</b> AES-256 requires a license key.</div> |

## Specifications for PMP 450 Series - AP

The PMP 450 AP conforms to the specifications listed in [Table 163](#).

**Table 163 PMP 450 Series - AP specifications**

| Category                                             |                  | Specification                                                                       |
|------------------------------------------------------|------------------|-------------------------------------------------------------------------------------|
| Model Number                                         |                  | PMP 450 AP                                                                          |
| <b>Spectrum</b>                                      |                  |                                                                                     |
| Channel Spacing                                      |                  | 5, 7, 10, 15, 20 and 30 MHz Channel Bandwidth<br>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                                                                             |
| <b>Interface</b>                                     |                  |                                                                                     |
| 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               |
| <b>Sensitivity</b>                                   |                  |                                                                                     |
| 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      |

| Category                                              | Specification |                                                                                |
|-------------------------------------------------------|---------------|--------------------------------------------------------------------------------|
|                                                       | 3.65 GHz      | 1x = -91 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           |

| Category                                              | Specification     |                                                                                |             |
|-------------------------------------------------------|-------------------|--------------------------------------------------------------------------------|-------------|
|                                                       | 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<br>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                                                    |             |

| Category                                         |          | Specification                                                                                                                                                                                                                                                                            |
|--------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quality of Service                               |          | Diffserv QoS                                                                                                                                                                                                                                                                             |
| <b>Link Budget</b>                               |          |                                                                                                                                                                                                                                                                                          |
| 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)<br>-30 to +25 dBm (to EIRP limit by region) in 1 dB-configurable intervals (3.5 GHz)<br>-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)<br>25 dBm combined OFDM (3.5 GHz, 3.6 GHz), (dependent upon Region Code setting)                                                                                                                              |
| <b>Physical</b>                                  |          |                                                                                                                                                                                                                                                                                          |
| Wind Survival                                    |          | 200 mph (322 kph)                                                                                                                                                                                                                                                                        |
| Antenna Connection                               |          | 50 ohm, N-type (Connectorized version only)                                                                                                                                                                                                                                              |
| Surge Suppression<br>EN61000-4-5                 |          | EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform<br>Recommended surge suppressor: Cambium Networks Model # C000000LO65A                                                                                                                                                            |
| Environmental                                    |          | IP66, IP67                                                                                                                                                                                                                                                                               |
| Temperature / Humidity                           |          | -40°C to +60°C (-40°F to +140°F) /<br>0-95% non-condensing                                                                                                                                                                                                                               |
| Weight                                           | 2.4 GHz  | 15 kg (33 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna                                                                                                                                                                                                                          |
|                                                  | 3.5 GHz  | 15 kg (33 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna                                                                                                                                                                                                                          |
|                                                  | 3.6 GHz  | 15 kg (33 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna                                                                                                                                                                                                                          |

| Category          |         | Specification                                                                                                                  |
|-------------------|---------|--------------------------------------------------------------------------------------------------------------------------------|
| Dimension (HxWxD) | 5 GHz   | 5.9 kg (13 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna                                                               |
|                   | 2.4 GHz | Radio: 27 x 21 x 7 cm (10.6" x 8.3" x 2.8")<br>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")<br>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                                                                                                                   |
| <b>Security</b>   |         |                                                                                                                                |
| Encryption        |         | 128-bit AES and 256-bit AES                                                                                                    |
|                   |         |  <b>Note</b> AES-256 requires a license key. |

## Specifications for PMP 450 Series - SM

The PMP 450 SM conforms to the specifications listed in [Table 164](#).

**Table 164 PMP 450 Series - SM specifications**

| Category                         |                                            | Specification                                                                                                                            |
|----------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Model Number                     |                                            | PMP 450 SM                                                                                                                               |
| <b>Spectrum</b>                  |                                            |                                                                                                                                          |
| Channel Spacing                  |                                            | 5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth<br>Configurable on 2.5 MHz increments                                                 |
| Frequency Range                  | 900 MHz                                    | 902 – 928 MHz                                                                                                                            |
|                                  | 2.4 GHz                                    | 2400 – 2483.5 MHz                                                                                                                        |
|                                  | 3.5 GHz                                    | 3300 – 3600 MHz                                                                                                                          |
|                                  | 3.65 GHz                                   | 3500 – 3850 MHz                                                                                                                          |
|                                  | 5 GHz                                      | 5470 – 5875 MHz                                                                                                                          |
| Channel Bandwidth                | 900 MHz,                                   | 5, 7, 10, 15, and 20 MHz                                                                                                                 |
|                                  | 2.4 GHz, 3.5 GHz,<br>3.65 GHz and 5<br>GHz | 5, 10, 15, 20, 30, and 40 MHz                                                                                                            |
|                                  |                                            |  <b>Note</b><br>2.4 GHz band does not support 40 MHz. |
| OFDM Subcarriers                 |                                            | 512 FFT                                                                                                                                  |
| <b>Interface</b>                 |                                            |                                                                                                                                          |
| MAC (Media Access Control) Layer |                                            | Cambium Proprietary                                                                                                                      |
| Physical Layer                   |                                            | 2x2 MIMO OFDM                                                                                                                            |
| Ethernet Interface               |                                            | 10/100 BaseT, half/full duplex, rate auto negotiated<br>(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,<br>dynamic port VID                                                                 |
| <b>Sensitivity</b>               |                                            |                                                                                                                                          |

| Category                                              |          | Specification                                                                  |
|-------------------------------------------------------|----------|--------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel  | 900 MHz  | 1x = -91 dBm, 2x = -91 dBm, 4x = -85 dBm, 6x = -78 dBm, 8x = -70 dBm           |
|                                                       | 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 | 900 MHz  | 1x = -88.6 dBm, 2x = -85.4 dBm, 4x = -78.1 dBm, 6x = -72.2 dBm, 8x = -65.2 dBm |
|                                                       | 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 |

| Category                                              | Specification |                                                                                |
|-------------------------------------------------------|---------------|--------------------------------------------------------------------------------|
|                                                       | 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 = -84.5dBm, 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   |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 3.5 GHz       | 1x=-83.1 dBm, 2x=-79.3 dBm, 4x=-72.9 dBm, 6x=-66 dBm, 8x=-56.3 dBm             |
|                                                       | 3.65 GHz      | 1x=-83.6 dBm, 2x=-79.6 dBm, 4x=-72.3 dBm, 6x=-65.3 dBm, 8x=-54.4 dBm           |
|                                                       | 5.4 GHz       | 1x=-82.4 dBm, 2x=-78 dBm, 4x=-71.2 dBm, 6x=-64.3 dBm, 8x=-51 dBm               |
|                                                       | 5.8 GHz       | 1x=-82.5 dBm, 2x=-78.8 dBm, 4x=-70.7 dBm, 6x=-64.8 dBm, 8x=-51 dBm             |

| Category                                         |                         | Specification                                                       |                                                                                                                                    |             |  |
|--------------------------------------------------|-------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------|--|
| Performance                                      |                         |                                                                     |                                                                                                                                    |             |  |
| Subscribers Per Sector                           |                         | Up to 238                                                           |                                                                                                                                    |             |  |
| ARQ                                              |                         | Yes                                                                 |                                                                                                                                    |             |  |
| Cyclic Prefix                                    |                         | 1/16                                                                |                                                                                                                                    |             |  |
| Frame Period                                     |                         | 2.5 ms or 5.0 ms                                                    |                                                                                                                                    |             |  |
| Modulation Levels<br>(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<br>6-10 ms for 5.0 ms Frame Period |                                                                                                                                    |             |  |
| Maximum Deployment Range                         |                         | Up to 40 miles (64 km)                                              |                                                                                                                                    |             |  |
| GPS Synchronization                              |                         | Yes                                                                 |                                                                                                                                    |             |  |
| Quality of Service                               |                         | Diffserv QoS                                                        |                                                                                                                                    |             |  |
| Link Budget                                      |                         |                                                                     |                                                                                                                                    |             |  |
| Antenna Gain (Does not include cable loss, ~1dB) | 900 MHz                 | 12 dBi Yagi antenna                                                 |                                                                                                                                    |             |  |
|                                                  | 2.4 GHz                 | 7 dBi Dual Slant, integrated patch                                  |                                                                                                                                    |             |  |
|                                                  | 3.5 GHz                 | 8 dBi Dual Slant, integrated patch                                  |                                                                                                                                    |             |  |
|                                                  |                         | 19 dBi Flat Plate, integrated patch                                 |                                                                                                                                    |             |  |
|                                                  | 3.65 GHz                | 8 dBi Dual Slant, integrated patch                                  |                                                                                                                                    |             |  |
|                                                  |                         | 19 dBi Flat Plate, integrated patch                                 |                                                                                                                                    |             |  |
|                                                  | 5 GHz                   | 9 dBi H+V, integrate d patch                                        |                                                                                                                                    |             |  |
|                                                  |                         | 25 dBi H+V, integrated dish                                         |                                                                                                                                    |             |  |
|                                                  | Combined Transmit Power |                                                                     | -30 to +22 dBm (to EIRP limit by region) - 2.4, 5 GHz<br>-30 to +25 dBm (to EIRP limit by region) - 3.5, 3.6 GHz<br>25 dBm - 3 GHz |             |  |

| Category                         |           | Specification                                                                                                                                                           |
|----------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maximum Transmit Power           |           | 22 dBm combined OFDM (2.4 GHz, 5 GHz)<br>(dependent upon Region Code setting)<br>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                                                                                                                                                                |
| <b>Physical</b>                  |           |                                                                                                                                                                         |
| Wind Survival                    |           | 200 mph (322 kph)                                                                                                                                                       |
| Antenna Connection               |           | 50 ohm, N-type (Connectorized version only)                                                                                                                             |
| Surge Suppression<br>EN61000-4-5 |           | EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform<br>Recommended surge suppressor: Cambium Networks Model # 600SSH                                                 |
| Environmental                    |           | IP55                                                                                                                                                                    |
| Temperature / Humidity           |           | -40°C to +60°C (-40°F to +140°F) /<br>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 GHz     | 5.9 kg (13 lbs) with antenna                                                                                                                                            |
|                                  |           | 2.5 kg (5.5 lbs) without antenna                                                                                                                                        |
|                                  |           | 3.5 kg (7.7 lbs) for 450d                                                                                                                                               |

| Category               | Specification                                                                                                                                             |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dimensions (H x W x D) | 30 x 9 x 9 cm (11.75" x 3.4" x 3.4")<br>50 x 50 x 38 cm (19.69" x 19.69" x 14.96") for 450d<br>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                                                                                                                                              |
| <b>Security</b>        |                                                                                                                                                           |
| Encryption             | 128-bit AES and 256-bit AES                                                                                                                               |
|                        | <div></div> <div><b>Note</b> AES-256 requires a license key.</div>       |

## Specifications for PTP 450 Series - BH

The PTP 450 BH conforms to the specifications listed in [Table 165](#).

**Table 165 PTP 450 Series - BH specifications**

| Category                         |                             | Specification                                                                                                 |
|----------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------|
| Model Number                     |                             | PTP 450 BH                                                                                                    |
| <b>Spectrum</b>                  |                             |                                                                                                               |
| Channel Spacing                  |                             | 5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth<br>Configurable on 2.5 MHz increments                      |
| Frequency Range                  |                             | 902 to 928 MHz                                                                                                |
|                                  |                             | 3300 - 3600 MHz                                                                                               |
|                                  |                             | 3500 - 3850 MHz                                                                                               |
|                                  |                             | 5470 - 5875 MHz                                                                                               |
| Channel Bandwidth                | 900 MHz                     | 5, 7, 10, 15, and 20 MHz                                                                                      |
|                                  | 3.5 GHz, 3.6 GHz, and 5 GHz | 5, 7, 10, 15, 20, 30 , and 40 MHz<br>7 MHz Channel bandwidth configurable for 3.5 GHz and 3.65 GHz band only. |
| OFDM Subcarriers                 |                             | 512 FFT                                                                                                       |
| <b>Interface</b>                 |                             |                                                                                                               |
| 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                                         |
| <b>Sensitivity</b>               |                             |                                                                                                               |

| Category                                              |         | Specification                                                                        |
|-------------------------------------------------------|---------|--------------------------------------------------------------------------------------|
| Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel  | 900 MHz | 1x = -92.2 dBm, 2x = -90.2 dBm, 4x = -83.2 dBm, 6x = -77.2 dBm, 8x = -71.2 dBm       |
|                                                       | 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  | 900 MHz | 1x = -91 dBm, 2x = -86 dBm, 4x = -80 dBm, 6x = -74 dBm, 8x = -67 dBm                 |
|                                                       | 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 | 900 MHz | 1x = -90 dBm, 2x = -84 dBm, 4x = -79 dBm, 6x = -73 dBm, 8x = -66 dBm                 |
|                                                       | 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       |

| Category                                              |         | Specification                                                                       |        |             |
|-------------------------------------------------------|---------|-------------------------------------------------------------------------------------|--------|-------------|
| 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                |        |             |
|                                                       | 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   |        |             |
| Nominal Receive Sensitivity (w/ FEC) @ 40 MHz Channel | 5.4 GHz | OFDM: 1x =-81.8 dBm, 2x = -77.5 dBm, 4x = -71.5 dBm, 6x = -63.5 dBm, 8x = -52.6 dBm |        |             |
|                                                       | 5.8 GHz | OFDM: 1x =-83.0 dBm, 2x = -78.0 dBm, 4x = -71.0 dBm, 6x = -63.3 dBm, 8x = -50 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 for 2.5 ms frame period                                                    |        |             |

| Category                                         |           | Specification                                                                                                                                                                                                                                                                  |
|--------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                  |           | 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                                                                                                                                                                                                                                                                   |
| <b>Link Budget</b>                               |           |                                                                                                                                                                                                                                                                                |
| Combined Transmit Power                          | -         | 30 to +22 dBm (to EIRP limit by region) in 1 dB-configurable intervals (5 GHz)<br>-30 to +25 dBm (to EIRP limit by region) in 1 dB-configurable intervals (3.5 GHz)<br>-30 to +25 dBm (to EIRP limit by region and channel bandwidth) in 1 dB-configurable intervals (3.6 GHz) |
| Antenna Gain (Does not include cable loss, -1dB) | 3.5 GHz   | 8 dBi Dual Slant, integrated patch                                                                                                                                                                                                                                             |
|                                                  |           | 19 dBi Flat Plate, integrated patch                                                                                                                                                                                                                                            |
|                                                  | 3.65 GHz  | 8 dBi Dual Slant, integrated patch                                                                                                                                                                                                                                             |
|                                                  |           | 19 dBi Flat Plate, integrated patch                                                                                                                                                                                                                                            |
|                                                  | 5 GHz     | 9 dBi H+V, integrated patch                                                                                                                                                                                                                                                    |
|                                                  |           | 25 dBi H+V, integrated dish                                                                                                                                                                                                                                                    |
| Transmit Power Range                             |           | 40 dB dynamic range (to EIRP limit by region) (1 dB step)                                                                                                                                                                                                                      |
| Maximum Transmit Power                           |           | 22 dBm combined OFDM (5 GHz) (dependent upon Region Code setting)<br>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                                                                                                                                                                                                                                                                       |
| <b>Physical</b>                                  |           |                                                                                                                                                                                                                                                                                |

| Category                         |      | Specification                                                                                                                                                                    |
|----------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sync/AUX port                    | RJ45 | <ul style="list-style-type: none"> <li>10/100/1000BASE-T Ethernet Data</li> <li>PoE output</li> <li>Sync input or output (Connection and powering of UGPS Sync input)</li> </ul> |
| Antenna Connection               |      | 50 ohm, N-type (Connectorized version only)                                                                                                                                      |
| Surge Suppression<br>EN61000-4-5 |      | EN61000-4-5: 1.2us/50us, 500 V voltage waveform<br>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<br>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                                                                                                                                                                     |
| <b>Security</b>                  |      |                                                                                                                                                                                  |
| Encryption                       |      | 128-bit AES and 256-bit AES                                                                                                                                                      |
|                                  |      |  <b>Note</b> AES-256 requires a license key.                                                  |

## PSU specifications

The PMP/PTP 450i AC+DC Enhanced Power Injector conforms to the specifications listed in [Table 166](#).

**Table 166 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 167](#).

**Table 167 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 168](#).

**Table 168 450m/450i Series Main and Aux Ethernet bridging specifications**

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

#### 450/450b Series

**Table 169 450 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                                                 |

\* 450 SM does not support 1000 BaseT.

\* 450 AP supports 1000 BaseT, but with known CRC errors and it is not recommended to use.



#### Note

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

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

## Wireless specifications

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

### General wireless specifications

The wireless specifications that apply to all 450 Platform variants are listed under [Table 170](#).

**Table 170 450 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                   | <b>Band</b>                                                                                                    | <b>Platform</b>                                           | <b>Range</b>                                |
|                         | 900 MHz                                                                                                        | PMP 450i Series - AP and<br>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)<br>186 mi/ 299 km (PTP) |
|                         | 3.65 GHz                                                                                                       | PMP/PTP 450 Series                                        | 40 mi / 64 km (PMP)<br>186 mi/ 299 km (PTP) |
|                         | 5 GHz                                                                                                          | PMP/PTP 450/450i/450b<br>Series and<br>PMP 450m Series AP | 40 mi / 64 km (PMP)<br>186 mi/ 299 km (PTP) |
| Over-the-air encryption | 128-bit AES and 256-bit AES                                                                                    |                                                           |                                             |
| Error Correction        | Rate 3/4 RS coder                                                                                              |                                                           |                                             |

## Link Range and Throughput

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

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

## Country specific radio regulations

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



### Caution

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

## Type approvals

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

The radio specification type approvals that have been granted for 450 Platform frequency variants are listed in [Table 171](#).

**Table 171 Radio certifications**

| Variant                        | Region | Specification (Type Approvals)   |
|--------------------------------|--------|----------------------------------|
| 900 MHz PMP 450i               | Canada | RSS Gen and RSS 210              |
|                                | USA    | FCC Part 15.247                  |
|                                | Mexico | NOM-121-SCT1-2009                |
| 2.4 GHz PMP 450                | Canada | RSS Gen and RSS 210              |
|                                | USA    | FCC Part 15 Class B              |
| 3.5 GHz PMP/PTP 450            | Canada | RSS Gen and RSS 192              |
|                                | Europe | ETSI EN 302 326-2 V1.2.2         |
| 3.6 GHz PMP/PTP 450            | Canada | RSS Gen and RSS 197              |
|                                | USA    | FCC Part 15 Class B              |
| 3.5 GHz PMP 450m               | Canada | RSS Gen and RSS 192              |
|                                | Europe | ETSI EN 302 326-2 V1.2.2         |
| 3.6 GHz PMP 450m               | Canada | RSS Gen and RSS 197              |
|                                | USA    | FCC Part 90Z and Part 15 Class B |
|                                | Europe | ETSI EN 302 326-2 V1.2.2         |
| 4.9 GHz PMP/PTP 450i/450b/450m | USA    | FCC Part 90 Subpart Y            |
|                                | Canada | RSS Gen and RSS 111              |

| Variant                      | Region | Specification (Type Approvals)                              |
|------------------------------|--------|-------------------------------------------------------------|
| 5.1 GHz PMP/PTP 450i/450b    | USA    | FCC Part 15 Class B                                         |
| 5.1 GHz PMP/PTP 450m         | USA    | FCC Part 15E and Part 15B                                   |
|                              | Europe | ETSI EN 302 625 V1.1.1                                      |
| 5.2 GHz PMP/PTP 450m         | USA    | FCC Part 15E and Part 15B                                   |
| 5.2 GHz PMP/PTP 450i/450b    | USA    | FCC Part 15 Class B                                         |
|                              | Canada | RSS Gen and RSS 247                                         |
| 5.4 GHz PMP/PTP 450 and 450i | Europe | ETSI EN 301 893 v1.6.1                                      |
|                              | USA    | FCC Part 15 Class B                                         |
| 5.4 GHz PMP/PTP 450m         | USA    | FCC Part 15E and Part 15B                                   |
|                              | Canada | RSS Gen and RSS 247                                         |
|                              | Europe | ETSI EN 301 893 v1.8.1<br>ETSI EN 301 893 v2.1.1 Clause 4.8 |
| 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                                      |
| 5.8 GHz PMP/PTP 450m         | USA    | FCC Part 15E and Part 15B                                   |
|                              | Canada | RSS Gen and RSS 247                                         |
|                              | Europe | ETSI EN 302 502 v2.1.1                                      |

## DFS for 2.4 and 5 GHz Radios

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

The details of DFS operation and channels available for each Country Code, including whether DFS is active on the AP, SM, which DFS regulation apply, and any channel restrictions are shown in [Table 172](#) on page [4-61](#).

**Table 172 Country & Bands DFS setting**

| Region Code   | Country Code | Band                                                                                       | AP                         | SM                         | Weather Radar Notch-Out |
|---------------|--------------|--------------------------------------------------------------------------------------------|----------------------------|----------------------------|-------------------------|
| North America | USA          | 2.4 GHz                                                                                    | No effect                  | No effect                  | No                      |
|               |              | 5.2 GHz                                                                                    | FCC DFS                    | No effect                  | No                      |
|               |              | 5.4 GHz                                                                                    | FCC DFS                    | No effect                  | No                      |
|               |              | 5.8 GHz                                                                                    | No effect                  | No effect                  | No                      |
|               | Canada       | 2.4 GHz                                                                                    | No effect                  | No effect                  | No                      |
|               |              | 5.2 GHz                                                                                    | FCC DFS                    | No effect                  | No                      |
|               |              | 5.4 GHz                                                                                    | FCC DFS                    | No effect                  | No*                     |
|               |              | * Weather radar notch-out is required in Canada when the band range is between 5600 - 5650 |                            |                            |                         |
|               |              | 5.8 GHz                                                                                    | No effect                  | No effect                  | No                      |
|               | Mexico       | 2.4 GHz                                                                                    | No effect                  | No effect                  | No                      |
|               |              | 5.2 GHz                                                                                    | ANATEL Res506-2008         | No effect                  | No                      |
|               |              | 5.4 GHz                                                                                    | ANATEL Res506-2008         | No effect                  | No                      |
|               |              | 5.8 GHz                                                                                    | No effect                  | No effect                  | No                      |
| South America | Brazil       | 5.4 GHz                                                                                    | ETSI EN 301 893 v2.1.1DFS  | No effect                  | No                      |
|               |              | 5.8 GHz                                                                                    | No effect                  | No effect                  | No                      |
| Europe        | ETSI         | 5.4 GHz                                                                                    | ETSI EN 301 893 v2.1.1 DFS | ETSI EN 301 893 v1.7.1 DFS | Yes                     |
|               |              | 5.8 GHz                                                                                    | ETSI EN 302 502 v2.1.1 DFS | ETSI EN 302 502 v1.2.1 DFS | Yes                     |
|               | Other-FCC    | 2.4 GHz                                                                                    | No effect                  | No effect                  | No                      |

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

## Equipment Disposal

### Waste (Disposal) of Electronic and Electric Equipment



Waste  
(Disposal)  
of Electronic  
and Electric  
Equipment

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

## Country specific band range maximum transmit power

### Maximum transmit power 900 MHz band

Table 173 Frequency range and Maximum transmit power – 900 MHz band PMP 450i Series

| Region                      | Country                                      | Bang range    |               | Device Type | Antenna Type | EIRP Limit /Conducted Power Limit (dBm) |      |     |     |     |     |     |   |   |
|-----------------------------|----------------------------------------------|---------------|---------------|-------------|--------------|-----------------------------------------|------|-----|-----|-----|-----|-----|---|---|
|                             |                                              | Lower         | Upper         |             |              | 5                                       | 7    | 10  | 15  | 20  | 30  | 40  |   |   |
|                             |                                              |               |               |             |              | MHz                                     | MHz  | MHz | MHz | MHz | MHz | MHz |   |   |
| North America               | Other FCC, USA, Canada, Mexico, Puerto, Rico | 902           | 928           | Any         | Any          | EIRP                                    | 36   | 36  | 36  | 36  | 36  | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     |      |     |     |     |     |     |   |   |
| Oceania                     | Australia                                    | 915           | 928           | Any         | Any          | EIRP                                    | 30   | 30  | 30  | 30  | -   | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     | 19   | 19  | 19  | 19  | -   | -   | - |   |
|                             | New Zealand                                  | 915           | 928           | Any         | Any          | EIRP                                    | 30   | 30  | 30  | 36  | -   | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     | 19   | 19  | 19  | 19  | -   | -   | - |   |
|                             |                                              | 920.5 (7 MHz) | 924.5 (7 MHz) | Any         | Any          | EIRP                                    | 30   | 30  | 30  | 36  | -   | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     | 19   | 19  | 19  | 19  | -   | -   | - |   |
|                             |                                              | 919.5 (5 MHz) | 925.5 (5 MHz) | Any         | Any          | EIRP                                    | 30   | 30  | 30  | 36  | -   | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     | 19   | 19  | 19  | 19  | -   | -   | - |   |
|                             | South America                                | Brazil        | 902           | 907.5       | Any          | Any                                     | EIRP | 36  | 36  | 36  | 36  | -   | - | - |
|                             |                                              |               |               |             |              |                                         | CPL  |     |     |     |     |     |   |   |
| 915                         |                                              |               | 928           | Any         | Any          | EIRP                                    | 36   | 36  | 36  | 36  | -   | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     |      |     |     |     | -   | -   | - |   |
| Ecuador                     |                                              | 902           | 928           | Any         | Any          | EIRP                                    |      |     |     |     |     | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     | 27   | 27  | 27  | 27  | 27  | -   | - |   |
| Colombia, Panama, Venezuela |                                              | 902           | 928           | Any         | Any          | EIRP                                    | 36   | 36  | 36  | 36  | 36  | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     |      |     |     |     |     | -   | - |   |
| Others                      | Others                                       | 902           | 928           | Any         | Any          | EIRP                                    |      |     |     |     |     | -   | - |   |
|                             |                                              |               |               |             |              | CPL                                     |      |     |     |     |     | -   | - |   |

CPL= Conducted Power Limit

## Maximum transmit power 2.4 GHz band

Table 174 Frequency range and Maximum transmit power - 2.4GHz band PMP/PTP 450 Series

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

CPL= Conducted Power Limit

## Maximum transmit power 3 GHz band

Table 175 Frequency range and Maximum transmit power - 3 GHz band PMP/PTP 450 Series

| Country   | Bang range |          | Device Type | Antenna Type | EIRP Limit /Conducted Power Limit (dBm) |       |        |        |        |        |        |    |
|-----------|------------|----------|-------------|--------------|-----------------------------------------|-------|--------|--------|--------|--------|--------|----|
|           | Lower      | Upper    |             |              | 5 MHz                                   | 7 MHz | 10 MHz | 15 MHz | 20 MHz | 30 MHz | 40 MHz |    |
| Other     | 3300 (1)   | 3850 (1) | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| FCC       | 3650       | 3700     | Any         | Any          | EIRP                                    | 37    | 38.5   | 40     | 41.7   | 43     | 44.7   | 46 |
|           |            |          |             |              | CPL                                     | 19    | 20.5   | 22     | 23.7   | 25     | 26.7   | 28 |
| ETSI      | 3410 (2)   | 3800 (2) | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| India     | 3300 (3)   | 3800 (3) | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| Indonesia | 3600       | 3800     | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| China     | 3300       | 3400     | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| Malaysia  |            |          |             |              | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| Pakistan  |            |          |             |              | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| Canada    | 3450       | 3650     | Any         | Any          | EIRP                                    | 62    | 62     | 62     | 62     | 62     | 62     | 62 |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
|           | 3650       | 3700     | Any         | Any          | EIRP                                    | 37    | 38.5   | 40     | 41.7   | 43     | 44.7   | 46 |
|           |            |          |             |              | CPL                                     | 19    | 20.5   | 22     | 23.7   | 25     | 26.7   | 28 |
| USA       | 3550 (4)   | 3700 (4) | Any         | Any          | EIRP                                    | 44    | 45.5   | 47     | 48.7   | 50     | 51.7   | 53 |
|           |            |          |             |              | CPL                                     | 24    | 25.5   | 27     | 28.1   | 30     | 30     | 30 |
|           | 3650       | 3700     | Any         | Any          | EIRP                                    | 37    | 38.5   | 40     | 41.7   | 43     | 44.7   | 46 |
|           |            |          |             |              | CPL                                     | 19    | 20.5   | 22     | 23.7   | 25     | 26.7   | 28 |
| Mexico    | 3300       | 3750     | Any         | Any          | EIRP                                    |       |        |        |        |        |        |    |
|           |            |          |             |              | CPL                                     |       |        |        |        |        |        |    |
| Australia | 3300       | 3800     | Any         | Any          | EIRP                                    | 57    | 58.9   | 60     | 61.7   | 63     | 63     | -  |
|           |            |          |             |              | CPL                                     |       |        |        |        |        | -      | -  |
| Brazil    | 3400       | 3600     | Any         | Any          | EIRP                                    |       |        |        |        |        | -      | -  |
|           |            |          |             |              | CPL                                     |       |        |        |        |        | -      | -  |

CPL= Conducted Power Limit

(1) = Frequencies between 3850 and 3900 can also be selected, but performance is not guaranteed in this portion of the band. For example, sensitivity is degraded

(2) = No PTP support in ETSi region

(3) = Either ETSI or FCCC

(4) = This band follows the CBRS rules (devices need to connect to a SAS to be granted a channel)

## Maximum transmit power 4.9 GHz band

Table 176 Default combined transmit power per country - 4.9 GHz band PMP/PTP 450i Series

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

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

Table 177 Default combined transmit power per country - 4.9 GHz band PMP 450b Series

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

Table 178 Default combined transmit power per country - 4.9 GHz band PMP 450m Series

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

## Maximum transmit power 5.1 GHz band

Table 179 Default combined transmit power per Country - 5.1 GHz band PMP/PTP 450i Series

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

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

Table 180 Default combined transmit power per country – 5.1 GHz band PMP 450b Mid Gain and High Gain

| Countries | Device Type | Antenna Type     | Channel BW | Antenna Gain (dBi) | Conducted Power Limit (dBm) | EIRP Limit (dBm) |
|-----------|-------------|------------------|------------|--------------------|-----------------------------|------------------|
| FCC       | SM          | 16 dBi Mid-Gain  | 5 MHz      | 16                 | 31                          | 47               |
|           |             |                  | 10 MHz     | 16                 | 34                          | 50               |
|           |             |                  | 15 MHz     | 16                 | 35                          | 51               |
|           |             |                  | 20 MHz     | 16                 | 37                          | 53               |
|           |             |                  | 30 MHz     | 16                 | 37                          | 53               |
|           |             |                  | 40 MHz     | 16                 | 37                          | 53               |
|           |             | 23 dBi High Gain | 5 MHz      | 23                 | 24                          | 47               |
|           |             |                  | 10 MHz     | 23                 | 27                          | 50               |
|           |             |                  | 15 MHz     | 23                 | 28                          | 51               |
|           |             |                  | 20 MHz     | 23                 | 30                          | 53               |
|           |             |                  | 30 MHz     | 23                 | 30                          | 53               |
|           |             |                  | 40 MHz     | 23                 | 30                          | 53               |

**Table 181 Default combined transmit power per Country - 5.1 GHz band PMP 450m Series**

| Countries | Device Type | Antenna Type | Channel BW | EIRP Limit (dBm) |
|-----------|-------------|--------------|------------|------------------|
| USA       | AP          | Sector       | 5 MHz      | 30               |
|           |             |              | 10 MHz     | 33               |
|           |             |              | 15 MHz     | 34               |
|           |             |              | 20 MHz     | 36               |
|           |             |              | 30 MHz     | 36               |
|           |             |              | 40 MHz     | 36               |
| ETSI      | AP          | Sector       | 5 MHz      | 33               |
|           |             |              | 10 MHz     | 36               |
|           |             |              | 15 MHz     | 37               |
|           |             |              | 20 MHz     | 39               |
| Mexico    | AP          | Sector       | 20 MHz     | 23               |
|           |             |              | 30 MHz     | 23               |
|           |             |              | 40 MHz     | 23               |
| Other     | Any         | Any          | 5 MHz      | 42               |
|           |             |              | 10 MHz     | 42               |
|           |             |              | 15 MHz     | 42               |
|           |             |              | 20 MHz     | 42               |
|           |             |              | 30 MHz     | 42               |
|           |             |              | 40 MHz     | 42               |

**Note**

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

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

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## Maximum transmit power 5.2 GHz band

**Note**

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

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Table 182 Default combined transmit power per country - 5.2 GHz band PMP/PTP 450i Series

| Countries         | Device Type | Antenna Type  | Channel BW | Antenna Gain (dBi) | Conducted Power Limit (dBm) | EIRP Limit (dBm) |
|-------------------|-------------|---------------|------------|--------------------|-----------------------------|------------------|
| USA,<br>Other FCC | AP          | Sector        | 5 MHz      | 16                 | 8                           | 24               |
|                   |             |               | 10 MHz     | 16                 | 11                          | 27               |
|                   |             |               | 15 MHz     | 16                 | 12                          | 28               |
|                   |             |               | 20 MHz     | 16                 | 14                          | 30               |
|                   |             |               | 30 MHz     | 16                 | 14                          | 30               |
|                   |             |               | 40 MHz     | 16                 | 14                          | 30               |
|                   |             | Omni          | 5 MHz      | 12                 | 12                          | 24               |
|                   |             |               | 10 MHz     | 12                 | 15                          | 27               |
|                   |             |               | 15 MHz     | 12                 | 16                          | 28               |
|                   |             |               | 20 MHz     | 12                 | 18                          | 30               |
|                   |             |               | 30 MHz     | 12                 | 18                          | 30               |
|                   |             |               | 40 MHz     | 12                 | 18                          | 30               |
|                   | SM, BH      | Flat plate    | 5 MHz      | 23                 | 27                          | 50               |
|                   |             |               | 10 MHz     | 23                 | 27                          | 50               |
|                   |             |               | 15 MHz     | 23                 | 27                          | 50               |
|                   |             |               | 20 MHz     | 23                 | 27                          | 50               |
|                   |             |               | 30 MHz     | 23                 | 27                          | 50               |
|                   |             |               | 40 MHz     | 23                 | 27                          | 50               |
|                   |             | 4ft parabolic | 5 MHz      | 32                 | 27                          | 59               |
|                   |             |               | 10 MHz     | 32                 | 27                          | 59               |
|                   |             |               | 15 MHz     | 32                 | 27                          | 59               |
|                   |             |               | 20 MHz     | 32                 | 27                          | 59               |
|                   |             |               | 30 MHz     | 32                 | 27                          | 59               |
|                   |             |               | 40 MHz     | 32                 | 27                          | 59               |
|                   |             | 6ft parabolic | 5 MHz      | 36                 | 27                          | 63               |
|                   |             |               | 10 MHz     | 36                 | 27                          | 63               |
|                   |             |               | 15 MHz     | 36                 | 27                          | 63               |

| Countries | Device Type | Antenna Type | Channel BW | Antenna Gain (dBi) | Conducted Power Limit (dBm) | EIRP Limit (dBm) |
|-----------|-------------|--------------|------------|--------------------|-----------------------------|------------------|
| Mexico    | Any         | Any          | 20 MHz     | 36                 | 27                          | 63               |
|           |             |              | 30 MHz     | 36                 | 27                          | 63               |
|           |             |              | 40 MHz     | 36                 | 27                          | 63               |
|           |             |              | 5 MHz      | -                  | -                           | 24               |
|           |             |              | 10 MHz     | -                  | -                           | 27               |
|           |             |              | 15 MHz     | -                  | -                           | 28               |
|           |             |              | 20 MHz     | -                  | -                           | 30               |
| Other     | Any         | Any          | 30 MHz     | -                  | -                           | 30               |
|           |             |              | 40 MHz     | -                  | -                           | 30               |
|           |             |              | Any        | -                  | 27                          | -                |

**Table 183 Default combined transmit power per country - 5.2 GHz band PMP 450b Mid-Gain and High Gain**

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

|       |    |                  |        |    |    |    |
|-------|----|------------------|--------|----|----|----|
|       |    | 40 MHz           | 23     | 7  | 30 |    |
| Other | SM | 16 dBi Mid-Gain  | 5 MHz  | 16 | 27 | 43 |
|       |    |                  | 10 MHz | 16 | 27 | 43 |
|       |    |                  | 15 MHz | 16 | 27 | 43 |
|       |    |                  | 20 MHz | 16 | 27 | 43 |
|       |    |                  | 30 MHz | 16 | 27 | 43 |
|       |    |                  | 40 MHz | 16 | 27 | 43 |
|       |    | 23 dBi High Gain | 5 MHz  | 16 | 27 | 43 |
|       |    |                  | 10 MHz | 16 | 27 | 43 |
|       |    |                  | 15 MHz | 16 | 27 | 43 |
|       |    |                  | 20 MHz | 16 | 27 | 43 |
|       |    |                  | 30 MHz | 16 | 27 | 43 |
|       |    |                  | 40 MHz | 16 | 27 | 43 |

**Table 184 Default combined transmit power per Country – 5.2 GHz band PMP 450m Series**

| Countries         | Device Type | Antenna Type | Channel BW | EIRP Limit (dBm) |
|-------------------|-------------|--------------|------------|------------------|
| USA,<br>Other FCC | AP          | Sector       | 5 MHz      | 24               |
|                   |             |              | 10 MHz     | 27               |
|                   |             |              | 15 MHz     | 28               |
|                   |             |              | 20 MHz     | 30               |
|                   |             |              | 30 MHz     | 30               |
|                   |             |              | 40 MHz     | 30               |
| Mexico            | AP          | Sector       | 5 MHz      | 24               |
|                   |             |              | 10 MHz     | 27               |
|                   |             |              | 15 MHz     | 28               |
|                   |             |              | 20 MHz     | 30               |
|                   |             |              | 30 MHz     | 30               |
|                   |             |              | 40 MHz     | 30               |
| Other             | Any         | Any          | 5 MHz      | 42               |
|                   |             |              | 10 MHz     | 42               |
|                   |             |              | 15 MHz     | 42               |
|                   |             |              | 20 MHz     | 42               |
|                   |             |              | 30 MHz     | 42               |
|                   |             |              | 40 MHz     | 42               |

**Note**

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

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

## Maximum transmit power 5.4 GHz band

Table 185 Default combined transmit power per country - 5.4 GHz band PMP 450m Series

| Countries | Device Type | Antenna Type | Channel BW | EIRP Limit (dBm) |
|-----------|-------------|--------------|------------|------------------|
| FCC       | AP          | Sector       | 5 MHz      | 24               |
|           |             |              | 10 MHz     | 27               |
|           |             |              | 15 MHz     | 28               |
|           |             |              | 20 MHz     | 29               |
|           |             |              | 30 MHz     | 30               |
|           |             |              | 40 MHz     | 30               |
| ETSI      | AP          | Sector       | 5 MHz      | 24               |
|           |             |              | 10 MHz     | 27               |
|           |             |              | 15 MHz     | 28               |
|           |             |              | 20 MHz     | 30               |
|           |             |              | 30 MHz     | 30               |
|           |             |              | 40 MHz     | 30               |
| RoW       | AP          | Sector       | 5 MHz      | 42               |
|           |             |              | 10 MHz     | 42               |
|           |             |              | 15 MHz     | 42               |
|           |             |              | 20 MHz     | 42               |
|           |             |              | 30 MHz     | 42               |
|           |             |              | 40 MHz     | 42               |
| RoW Other | AP          | Sector       | -          | 42               |



### Note

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

Table 186 Default combined transmit power per country - 5.4 GHz band PMP/PTP 450i Series

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

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

**Table 187 Default combined transmit power per country - 5.4 GHz band PMP 450b Mid-Gain and High Gain**

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

Table 188 Default combined transmit power per country - 5.4 GHz band PMP 450 Series

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

| Countries | Device Type | Antenna Type | Channel BW | Antenna Gain (dBi) | Conducted Power Limit (dBm) | EIRP Limit (dBm) |
|-----------|-------------|--------------|------------|--------------------|-----------------------------|------------------|
| Algeria   | AP          | Sector       | 5 MHz      | 16                 | 14                          | 30               |
|           |             |              | 10 MHz     | 16                 | 14                          | 30               |
|           |             |              | 15 MHz     | 16                 | 14                          | 30               |
|           |             |              | 20 MHz     | 16                 | 14                          | 30               |
|           |             |              | 30 MHz     | 16                 | 14                          | 30               |
|           |             |              | 40 MHz     | 16                 | 14                          | 30               |
| Other     | AP          | Sector       | 5 MHz      | 16                 | -                           | No EIRP limit    |
|           |             |              | 10 MHz     | 16                 | 19                          |                  |
|           |             |              | 15 MHz     | 16                 | -                           |                  |
|           |             |              | 20 MHz     | 16                 | 19                          |                  |
|           |             |              | 30 MHz     | 16                 | -                           |                  |
|           |             |              | 40 MHz     | 16                 | -                           |                  |

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



#### Note

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

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

## Maximum transmit power 5.8 GHz band

Table 189 Default combined transmit power per Country - 5.8 GHz band PMP 450m Series

| Countries         | Device Type | Antenna Type | Channel BW | EIRP Limit (dBm) |
|-------------------|-------------|--------------|------------|------------------|
| USA,<br>Other FCC | AP          | Sector       | 5 MHz      | 36               |
|                   |             |              | 10 MHz     | 36               |
|                   |             |              | 15 MHz     | 36               |
|                   |             |              | 20 MHz     | 36               |
|                   |             |              | 30 MHz     | 36               |
|                   |             |              | 40 MHz     | 36               |
| Mexico            | AP          | Sector       | 5 MHz      | 30               |
|                   |             |              | 10 MHz     | 33               |
|                   |             |              | 15 MHz     | 34               |
|                   |             |              | 20 MHz     | 36               |
|                   |             |              | 30 MHz     | 36               |
|                   |             |              | 40 MHz     | 36               |
| ETSI              | AP          | Sector       | 5 MHz      | 30               |
|                   |             |              | 10 MHz     | 33               |
|                   |             |              | 15 MHz     | 34               |
|                   |             |              | 20 MHz     | 36               |
|                   |             |              | 30 MHz     | 36               |
|                   |             |              | 40 MHz     | 36               |
| Other             | AP          | Sector       | 5 MHz      | 42               |
|                   |             |              | 10 MHz     | 42               |
|                   |             |              | 15 MHz     | 42               |
|                   |             |              | 20 MHz     | 42               |
|                   |             |              | 30 MHz     | 42               |
|                   |             |              | 40 MHz     | 42               |

Table 190 Default combined transmit power per country – 5.8 GHz band PMP/PTP 450i Series

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

**Table 191 Default combined transmit power per country – 5.8 GHz band PMP 450b Mid-Gain and High Gain**

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

**Table 192 Default combined transmit power per country - 5.8 GHz band PMP 450 Series**

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

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

**Note**

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

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

## Country specific frequency range

### Frequency range 900 MHz band

Table 193 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     | 915                                   | 928           |
|               |               | 915                                   | 928           |
|               | New Zealand   | 920.5 (7 MHz)                         | 924.5 (7 MHz) |
|               |               | 919.5 (5 MHz)                         | 925.5 (5 MHz) |
| South America | Brazil        | 902                                   | 907.5         |
|               |               | 915                                   | 928           |
|               | Ecuador       | 902                                   | 928           |
|               | Colombia      | 902                                   | 928           |
|               | Panama        | 902                                   | 928           |
|               | Venezuela     | 902                                   | 928           |

## Frequency range 2.4 GHz band

Table 194 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,<br>United States,<br>Other, Other-<br>FCC | Any          | 5 MHz      | 2402.5                                | 2481   |
|                                                   |              | 10 MHz     | 2405                                  | 2478.5 |
|                                                   |              | 15 MHz     | 2407.5                                | 2476   |
|                                                   |              | 20 MHz     | 2410                                  | 2473.5 |
|                                                   |              | 30 MHz     | 2415                                  | 2468.5 |

## Frequency range 3.5 GHz band

Table 195 Frequency range per country – 3.5 GHz band PMP/PTP 450/450i Series

| Countries              | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|------------------------|--------------|------------|---------------------------------------|--------|
|                        |              |            | Lower                                 | Upper  |
| Brazil, Other-<br>ETSI | Any          | 5 MHz      | 3402.5                                | 3597.5 |
|                        |              | 7 MHz      | 3403.5                                | 3596.5 |
|                        |              | 10 MHz     | 3405                                  | 3595   |
|                        |              | 20 MHz     | 3410                                  | 3590   |
| China,<br>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 196 Frequency range per country – 3.65 GHz band PMP/PTP 450/450i Series

| Countries                  | Antenna Type | Channel BW                                                                                                                                     | Channel center Frequency limits (MHz) |        |
|----------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------|
|                            |              |                                                                                                                                                | Lower                                 | Upper  |
| Australia,<br>India, Other | Any          | 5 MHz                                                                                                                                          | 3302.5                                | 3797.5 |
|                            |              | 7 MHz                                                                                                                                          | 3303.5                                | 3796.5 |
|                            |              | 10 MHz                                                                                                                                         | 3305                                  | 3795   |
|                            |              | 15 MHz                                                                                                                                         | 3307.5                                | 3792.5 |
|                            |              | 20 MHz                                                                                                                                         | 3310                                  | 3790   |
|                            |              | 30 MHz                                                                                                                                         | 3315                                  | 3785   |
|                            |              | 40 MHz*                                                                                                                                        | 3320                                  | 3780   |
|                            |              |  Note<br>Australia does not support 40 MHz channel bandwidth. |                                       |        |
| Other – ETSI               | Any          | 5 MHz                                                                                                                                          | 3402.5                                | 3847.5 |
|                            |              | 10 MHz                                                                                                                                         | 3405                                  | 3845   |
|                            |              | 15 MHz                                                                                                                                         | 3407.5                                | 3842.5 |
|                            |              | 20 MHz                                                                                                                                         | 3410                                  | 3840   |
|                            |              | 30 MHz                                                                                                                                         | 3415                                  | 3835   |
|                            |              | 40 MHz                                                                                                                                         | 3420                                  | 3830   |
| Indonesia                  | Any          | 5 MHz                                                                                                                                          | 3602.5                                | 3797.5 |
|                            |              | 7 MHz                                                                                                                                          | 3603.5                                | 3796.5 |
|                            |              | 10 MHz                                                                                                                                         | 3605                                  | 3795   |
|                            |              | 20 MHz                                                                                                                                         | 3610                                  | 3790   |
|                            |              | 40 MHz                                                                                                                                         | 3620                                  | 3780   |
| Mexico                     | Any          | 5 MHz                                                                                                                                          | 3302.5                                | 3747.5 |
|                            |              | 10 MHz                                                                                                                                         | 3305                                  | 3745   |
|                            |              | 20 MHz                                                                                                                                         | 3310                                  | 3740   |
|                            |              | 40 MHz                                                                                                                                         | 3320                                  | 3730   |

## Frequency range 4.9 GHz band

Table 197 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,<br>Mexico,<br>Canada,<br>Other FCC | Any          | 5 MHz      | 4942.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4945                                  | 4985   |
|                                         |              | 15 MHz     | 4947.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4950                                  | 4980   |
| Brazil                                  | Any          | 5 MHz      | 4912.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4915                                  | 4985   |
|                                         |              | 15 MHz     | 4917.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4920                                  | 4980   |
| Other                                   | Any          | 5 MHz      | 4942.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4945                                  | 4985   |
|                                         |              | 15 MHz     | 4947.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4950                                  | 4980   |
|                                         |              | 30 MHz     | 4955                                  | 4975   |
|                                         |              | 40 MHz     | 4960                                  | 4970   |

Table 198 Frequency range per country – 4.9 GHz band PMP 450b Series

| Countries | Antenna Type        | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|---------------------|------------|---------------------------------------|--------|
|           |                     |            | Lower                                 | Upper  |
| FCC       | 16 dBi Mid-Gain     | 5 MHz      | 4942.5                                | 4987.5 |
|           | 23 dBi High<br>Gain | 10 MHz     | 4945                                  | 4985   |
|           |                     | 15 MHz     | 4947.5                                | 4982.5 |
|           |                     | 20 MHz     | 4950                                  | 4980   |
|           |                     | 30 MHz     | 4955                                  | 4975   |
|           |                     | 40 MHz     | 4960                                  | 4970   |

**Table 199 Frequency range per country – 4.9 GHz band PMP 450m Series**

| Countries                               | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------------------------------------|--------------|------------|---------------------------------------|--------|
|                                         |              |            | Lower                                 | Upper  |
| USA,<br>Mexico,<br>Canada,<br>Other FCC | Any          | 5 MHz      | 4942.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4945                                  | 4985   |
|                                         |              | 15 MHz     | 4947.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4950                                  | 4980   |
| Brazil                                  | Any          | 5 MHz      | 4912.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4915                                  | 4985   |
|                                         |              | 15 MHz     | 4917.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4920                                  | 4980   |
| Other                                   | Any          | 5 MHz      | 4942.5                                | 4987.5 |
|                                         |              | 10 MHz     | 4945                                  | 4985   |
|                                         |              | 15 MHz     | 4947.5                                | 4982.5 |
|                                         |              | 20 MHz     | 4950                                  | 4980   |
|                                         |              | 30 MHz     | 4955                                  | 4975   |
|                                         |              | 40 MHz     | 4960                                  | 4970   |

## Frequency range 5.1 GHz band

Table 200 Frequency range per country – 5.1 GHz band PMP/PTP 450i Series

| Countries             | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------------------|--------------|------------|---------------------------------------|--------|
|                       |              |            | Lower                                 | Upper  |
| United States,<br>FCC | Any          | 5 MHz      | 5157.5 <sup>1</sup>                   | 5247.5 |
|                       |              | 10 MHz     | 5160 <sup>2</sup>                     | 5245   |
|                       |              | 15 MHz     | 5165 <sup>3</sup>                     | 5242.5 |
|                       |              | 20 MHz     | 5170 <sup>4</sup>                     | 5240   |
|                       |              | 30 MHz     | 5180 <sup>5</sup>                     | 5235   |
|                       |              | 40 MHz     | 5180 <sup>6</sup>                     | 5230   |
| ETSI                  | Any          | 5 MHz      | 5155                                  | 5245   |
|                       |              | 10 MHz     | 5155                                  | 5245   |
|                       |              | 15 MHz     | 5157.5                                | 5242.5 |
|                       |              | 20 MHz     | 5160                                  | 5240   |
| Other                 | Any          | 5 MHz      | 5152.5                                | 5247.5 |
|                       |              | 10 MHz     | 5155                                  | 5245   |
|                       |              | 15 MHz     | 5157.5                                | 5242.5 |
|                       |              | 20 MHz     | 5160                                  | 5240   |
|                       |              | 30 MHz     | 5165                                  | 5235   |
|                       |              | 40 MHz     | 5170                                  | 5230   |

<sup>1</sup> Center frequency 5160 is the lowest allowed at full power. Max power for edge frequency is 20 dBm.

<sup>2</sup> Center frequency 5165 is the lowest allowed at full power. Max power for edge frequencies is 22 dBm.

<sup>3</sup> Center frequency 5170 is the lowest allowed at full power. Max power for edge frequencies is 23 dBm.

<sup>4</sup> Center frequency 5177.5 is the lowest allowed at full power. Max power for edge frequency is 23 dBm.

<sup>5</sup> Center frequency 5190 is the lowest allowed at full power. Max power for edge frequency is 22 dBm.

<sup>6</sup> Center frequency 5205 is the lowest allowed at full power. Max power for edge frequency is 22 dBm.

**Table 201 Frequency range per country - 5.1 GHz band PMP 450b Mid-Gain Series**

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| FCC       | 16 dBi       | 5 MHz      | 5155                                  | 5247.5 |
|           |              | 10 MHz     | 5155                                  | 5245   |
|           |              | 15 MHz     | 5157.5                                | 5242.5 |
|           |              | 20 MHz     | 5160                                  | 5240   |
|           |              | 30 MHz     | 5165                                  | 5235   |
|           |              | 40 MHz     | 5170                                  | 5230   |

**Table 202 Frequency range per country - 5.1 GHz band PMP 450b High Gain Series**

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| FCC       | 23 dBi       | 5 MHz      | 5155                                  | 5245   |
|           |              | 10 MHz     | 5155                                  | 5245   |
|           |              | 15 MHz     | 5157.5                                | 5242.5 |
|           |              | 20 MHz     | 5160                                  | 5235   |
|           |              | 30 MHz     | 5165                                  | 5235   |
|           |              | 40 MHz     | 5170                                  | 5230   |

**Table 203 Frequency range per country – 5.1 GHz band PMP 450m Series**

| Countries             | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |                 |
|-----------------------|--------------|------------|---------------------------------------|-----------------|
|                       |              |            | Lower                                 | Upper           |
| United States,<br>FCC | Any          | 5 MHz      | 5162.5                                | 5247.5          |
|                       |              | 10 MHz     | 5160 (26 dBm)                         | 5197.5 (26 dBm) |
|                       |              |            | 5200 (33 dBm)                         | 5245 (33 dBm)   |
|                       |              | 15 MHz     | 5165 (26 dBm)                         | 5197.5 (26 dBm) |
|                       |              |            | 5200 (34 dBm)                         | 5242.5 (34 dBm) |
|                       |              | 20 MHz     | 5170 (26 dBm)                         | 5197.5 (26 dBm) |
|                       |              |            | 5200 (36 dBm)                         | 5240 (36 dBm)   |
|                       |              | 30 MHz     | 5165 (30 dBm)                         | 5180 (30 dBm)   |
|                       |              |            | 5182.5 (33 dBm)                       | 5192.5 (33 dBm) |
|                       |              |            | 5195 (36 dBm)                         | 5235 (36 dBm)   |
|                       |              | 40 MHz     | 5170 (30 dBm)                         | 5185 (30 dBm)   |
|                       |              |            | 5187.5 (33 dBm)                       | 5197.5 (33 dBm) |
| ETSI                  | Any          | 5 MHz      | 5152.5                                | 5247.5          |
|                       |              | 10 MHz     | 5155                                  | 5245            |
|                       |              | 15 MHz     | 5157.5                                | 5242.5          |
|                       |              | 20 MHz     | 5160                                  | 5240            |
| Other                 | Any          | 5 MHz      | 5152.5                                | 5247.5          |
|                       |              | 10 MHz     | 5155                                  | 5245            |
|                       |              | 15 MHz     | 5157.5                                | 5242.5          |
|                       |              | 20 MHz     | 5160                                  | 5240            |

## Frequency range 5.2 GHz band

Table 204 Frequency range per country – 5.2 GHz band PMP/PTP 450i Series

| Countries             | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |                     |
|-----------------------|--------------|------------|---------------------------------------|---------------------|
|                       |              |            | Lower                                 | Upper               |
| United States,<br>FCC | Any          | 5 MHz      | 5252.5                                | 5342.5              |
|                       |              | 10 MHz     | 5255                                  | 5340                |
|                       |              | 15 MHz     | 5257.5                                | 5337.5              |
|                       |              | 20 MHz     | 5260                                  | 5332.5 <sup>7</sup> |
|                       |              | 30 MHz     | 5265                                  | 5332.5 <sup>8</sup> |
|                       |              | 40 MHz     | 5270                                  | 5325 <sup>9</sup>   |
| Other                 | Any          | 5 MHz      | 5252.5                                | 5347.5              |
|                       |              | 10 MHz     | 5255                                  | 5345                |
|                       |              | 15 MHz     | 5257.5                                | 5342.5              |
|                       |              | 20 MHz     | 5260                                  | 5340                |
|                       |              | 30 MHz     | 5265                                  | 5335                |
|                       |              | 40 MHz     | 5270                                  | 5330                |

<sup>7</sup> Center frequency 5330 is the highest allowed at full power. Max power for edge frequency is 20 dBm.

<sup>8</sup> Center frequency 5317.5 is the lowest allowed at full power. Max power for edge frequency is 20 dBm.

<sup>9</sup> Center frequency 5310 is the lowest allowed at full power. Max power for edge frequencies is 20 dBm.

**Table 205 Frequency range per country – 5.2 GHz band PMP 450b Mid-Gain Series**

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |          |
|-----------|--------------|------------|---------------------------------------|----------|
|           |              |            | Lower                                 | Upper    |
| FCC       | 16 dBi       | 5 MHz      | -                                     | -        |
|           |              | 10 MHz     | 5255                                  | 5340     |
|           |              | 15 MHz     | 5257.5                                | 5337.5   |
|           |              | 20 MHz     | 5260                                  | 5337.5   |
|           |              | 30 MHz     | 5265                                  | 5330     |
|           |              | 40 MHz     | 5270                                  | 5330 (*) |

(\*) Last channel at full power is 5325. Channel centers 5327.5 and 5330 need a power back off of 5 dB.

**Table 206 Frequency range per country – 5.2 GHz band PMP 450b High Gain Series**

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| FCC       | 23 dBi       | 5 MHz      | -                                     | -      |
|           |              | 10 MHz     | 5255                                  | 5340   |
|           |              | 15 MHz     | 5257.5                                | 5337.5 |
|           |              | 20 MHz     | 5260                                  | 5335   |
|           |              | 30 MHz     | 5265                                  | 5332.5 |
|           |              | 40 MHz     | 5270                                  | 5330   |

**Table 207 Frequency range per country – 5.2 GHz band PMP 450m Series**

| Countries             | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------------------|--------------|------------|---------------------------------------|--------|
|                       |              |            | Lower                                 | Upper  |
| United States,<br>FCC | Any          | 5 MHz      | 5252.5                                | 5347.5 |
|                       |              | 10 MHz     | 5255                                  | 5300   |
|                       |              |            | 5302.5                                | 5340   |
|                       |              | 15 MHz     | 5257.5                                | 5300   |
|                       |              |            | 5302.5                                | 5335   |
|                       |              | 20 MHz     | 5260                                  | 5300   |
|                       |              |            | 5302.5                                | 5340   |
|                       |              | 30 MHz     | 5265                                  | 5335   |
| Other                 | Any          | 40 MHz     | 5270                                  | 5330   |
|                       |              | 5 MHz      | 5252.5                                | 5347.5 |
|                       |              | 10 MHz     | 5255                                  | 5345   |
|                       |              | 15 MHz     | 5257.5                                | 5342.5 |
|                       |              | 20 MHz     | 5260                                  | 5340   |
|                       |              | 30 MHz     | 5265                                  | 5335   |
|                       |              | 40 MHz     | 5270                                  | 5330   |

## Frequency range 5.4 GHz band

Table 208 Frequency range per country - 5.4 GHz band PMP/PTP 450i Series

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| Mexico    | Any          | 5 MHz      | 5472.5                                | 5722.5 |
|           |              | 10 MHz     | 5475                                  | 5720   |
|           |              | 15 MHz     | 5477.5                                | 5717.5 |
|           |              | 20 MHz     | 5480                                  | 5715   |
|           |              | 30 MHz     | 5485                                  | 5710   |
|           |              | 40 MHz     | 5490                                  | 5685   |
| Other     | Any          | 5 MHz      | 5472.5                                | 5722.5 |
|           |              | 10 MHz     | 5475                                  | 5720   |
|           |              | 15 MHz     | 5477.5                                | 5717.5 |
|           |              | 20 MHz     | 5480                                  | 5715   |
|           |              | 30 MHz     | 5485                                  | 5710   |
|           |              | 40 MHz     | 5490                                  | 5705   |
| Other     | FCC          | 5 MHz      | 5475                                  | 5720   |
|           |              | 10 MHz     | 5475                                  | 5717.5 |
|           |              | 15 MHz     | 5480                                  | 5717.5 |
|           |              | 20 MHz     | 5482.5                                | 5715   |
|           |              | 30 MHz     | 5487.5                                | 5710   |
|           |              | 40 MHz     | 5497.5                                | 5705   |
| Other     | ETSI         | 5 MHz      | 5472.5                                | 5597.5 |
|           |              |            | 5652.5                                | 5720   |
|           |              | 10 MHz     | 5475                                  | 5595   |
|           |              |            | 5655                                  | 5720   |
|           |              | 15 MHz     | 5477.5                                | 5592.5 |
|           |              |            | 5657.5                                | 5717.5 |
|           |              | 20 MHz     | 5480                                  | 5590   |
|           |              |            | 5660                                  | 5715   |

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |       |
|-----------|--------------|------------|---------------------------------------|-------|
|           |              |            | Lower                                 | Upper |
| Other     | ETSI         | 30 MHz     | 5485                                  | 5585  |
|           |              |            | 5665                                  | 5710  |
|           |              | 40 MHz     | 5490                                  | 5580  |
|           |              |            | 5670                                  | 5705  |

Table 209 Frequency range per country - 5.4 GHz band PMP 450b Mid-Gain Series

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| FCC       | 16 dBi       | 5 MHz      | -                                     | -      |
|           |              | 10 MHz     | 5477.5                                | 5720   |
|           |              | 15 MHz     | 5480                                  | 5717.5 |
|           |              | 20 MHz     | 5482.5                                | 5715   |
|           |              | 30 MHz     | 5487.5                                | 5710   |
|           |              | 40 MHz     | 5490 (*)                              | 5705   |

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

Table 210 Frequency range per country - 5.4 GHz band PMP 450b High Gain Series

| Countries | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------|--------------|------------|---------------------------------------|--------|
|           |              |            | Lower                                 | Upper  |
| FCC       | 23 dBi       | 5 MHz      | -                                     | -      |
|           |              | 10 MHz     | 5480                                  | 5720   |
|           |              | 15 MHz     | 5487.5                                | 5717.5 |
|           |              | 20 MHz     | 5490                                  | 5715   |
|           |              | 30 MHz     | 5495                                  | 5710   |
|           |              | 40 MHz     | 5490                                  | 5705   |

Table 211 Frequency range per country - 5.4 GHz band PMP/PTP 450 Series

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

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

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

**Table 212 Frequency range per country – 5.4 GHz band PMP 450m Series**

| Countries             | Antenna Type | Channel BW | Channel center Frequency limits (MHz) |        |
|-----------------------|--------------|------------|---------------------------------------|--------|
|                       |              |            | Lower                                 | Upper  |
| United States,<br>FCC | Any          | 5 MHz      | 5475                                  | 5720   |
|                       |              | 10 MHz     | 5475                                  | 5477.5 |
|                       |              |            | 5480                                  | 5720   |
|                       |              | 15 MHz     | 5477.5                                | 5482.5 |
|                       |              |            | 5485                                  | 5717.5 |
|                       |              | 20 MHz     | 5480                                  | 5487.5 |
|                       |              |            | 5490                                  | 5715   |
|                       |              | 30 MHz     | 5485                                  | 5710   |
| ETSI                  | Any          | 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                                  | 5585   |
|                       |              |            | 5670                                  | 5705   |
| Other                 | Any          | 5 MHz      | 5472.5                                | 5722.5 |
|                       |              | 10 MHz     | 5475                                  | 5720   |
|                       |              | 15 MHz     | 5477.5                                | 5717.5 |
|                       |              | 20 MHz     | 5480                                  | 5715   |
|                       |              | 30 MHz     | 5485                                  | 5710   |
|                       |              | 40 MHz     | 5490                                  | 5705   |