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

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

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

| Category | | Specification |
|---|---|---|
| | | (dependent upon Region Code setting) |
| Reflector antenna gain | 2.4 GHz | +12 dBi |
| | 3.5 GHz | +11 dBi |
| | 3.65 GHz | +11 dBi |
| | 5 GHz | +15 dBi |
| Other antenna (5 GHz only) | CLIP Gain | +8 dBi |
| | LENS Gain | +5.5 dBi |
| Physical | | |
| Wind Survival | | 200 mph (322 kph) |
| Antenna Connection | | 50 ohm, N-type (Connectorized version only) |
| Surge Suppression EN61000-4-5 | | EN61000-4-5: 10us/700us, Level 4, 4kV voltage waveform<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<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<br>2.5 kg (5.5 lbs) for 450 ruggedized |
| | 3.6 GHz | 15 kg (33 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna<br>2.5 kg (5.5 lbs) for 450 ruggedized |
| | 5 GHz | 5.9 kg (13 lbs) with antenna<br>2.5 kg (5.5 lbs) without antenna<br>3.5 kg (7.7 lbs) for 450d |
| Dimensions (H x W x D) | | 30 x 9 x 9 cm (11.75” x 3.4” x 3.4”)<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 |

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

## Specifications for PTP 450 Series - BH

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

Table 172: PTP 450 Series - BH specifications

| Category | | Specification |
|---|---|---|
| Model Number | | PTP 450 BH |
| Spectrum | | |
| Channel Spacing | | 5, 7, 10, 15, 20, 30, and 40 MHz Channel Bandwidth<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 |
| **Interface** | | |
| MAC (Media Access Control) Layer | | Cambium Proprietary |
| Physical Layer | | 2x2 MIMO OFDM |
| Ethernet Interface | | 10/100 BaseT, half/full duplex, rate auto negotiated (802.3 compliant) |

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

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

<table>
<tr><th>Category</th><th></th><th colspan="3">Specification</th></tr>
<tr><td rowspan="9">Modulation Levels (Adaptive)</td><td rowspan="9"></td><td>Modulation Levels</td><td></td><td>SNR (in dB)</td></tr>
<tr><td>2x</td><td>QPSK</td><td>10</td></tr>
<tr><td>3x</td><td>8QAM</td><td>14</td></tr>
<tr><td>4x</td><td>16QAM</td><td>17</td></tr>
<tr><td>5x</td><td>32QAM</td><td>21</td></tr>
<tr><td>6x</td><td>64QAM</td><td>24</td></tr>
<tr><td>5x</td><td>128QAM</td><td>28</td></tr>
<tr><td>8x</td><td>256QAM</td><td>32</td></tr>
<tr><td>Latency</td><td></td><td colspan="3">• 3 - 5 ms for 2.5 ms frame period<br>• 6 - 10 ms for 5.0 ms frame period</td></tr>
<tr><td>Packets Per Second</td><td></td><td colspan="3">12,500</td></tr>
<tr><td>Maximum Deployment Range</td><td></td><td colspan="3">Up to 40 miles (64 km)</td></tr>
<tr><td>GPS Synchronization</td><td></td><td colspan="3">Yes, via Autosync (CMM4)</td></tr>
<tr><td>Quality of Service</td><td></td><td colspan="3">Diffserv QoS</td></tr>
<tr><td colspan="5">Link Budget</td></tr>
<tr><td>Combined Transmit Power</td><td>-</td><td colspan="3">• 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)</td></tr>
<tr><td rowspan="6">Antenna Gain (Does not include cable loss, ~1dB)</td><td rowspan="2">3.5 GHz</td><td colspan="3">8 dBi Dual Slant, integrated patch</td></tr>
<tr><td colspan="3">19 dBi Flat Plate, integrated patch</td></tr>
<tr><td rowspan="2">3.65 GHz</td><td colspan="3">8 dBi Dual Slant, integrated patch</td></tr>
<tr><td colspan="3">19 dBi Flat Plate, integrated patch</td></tr>
<tr><td rowspan="2">5 GHz</td><td colspan="3">9 dBi H+V, integrated patch</td></tr>
<tr><td colspan="3">25 dBi H+V, integrated dish</td></tr>
<tr><td>Transmit Power Range</td><td></td><td colspan="3">40 dB dynamic range (to EIRP limit by region) (1 dB step)</td></tr>
<tr><td>Maximum Transmit Power</td><td></td><td colspan="3">• 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)</td></tr>
</table>

| Category | | Specification |
|---|---|---|
| Reflector antenna gain | 3.5 GHz | +11 dBi |
| | 3.65 GHz | +11 dBi |
| | 5 GHz | +15 dBi |
| Other antenna (5 GHz only) | CLIP Gain | +8 dBi |
| | LENS Gain | +5.5 dBi |
| Physical | | |
| Sync/AUX port | RJ45 | • 10/100/1000BASE-T Ethernet Data<br>• PoE output<br>• Sync input or output (Connection and powering of UGPS Sync input) |
| Antenna Connection | | 50 ohm, N-type (Connectorized version only) |
| Surge Suppression EN61000-4-5 | | EN61000-4-5: 1.2us/50us, 500 V voltage waveform<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 |
| Security | | |
| Encryption | | 128-bit AES and 256-bit AES<br>  Note<br>AES-256 requires a license key. |

## PSU specifications

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

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

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

**Warning**

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

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

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

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

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

**Note**

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

**Warning**

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

# Data network specifications

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

## Ethernet interface

### 450m/450i Series

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

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

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

### 450/450b Series

Table 176: 450 Series Ethernet bridging specifications

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

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

Note

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

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

# Wireless specifications

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

## General wireless specifications

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

Table 177: 450 Platform Family - wireless specifications

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

| Item | Specification | | |
|---|---|---|---|
| Range | Band | Platform | Range |
| | 900 MHz | PMP 450i Series - AP and<br>PMP 450 Series - SM | 120 mi / 193 km |
| | 2.4 GHz | PMP 450 Series | 40 mi / 64 km |
| | 3.5 GHz | PMP/PTP 450/450b Series | 40 mi / 64 km (PMP)<br>186 mi/ 299 km (PTP) |
| | 3.65 GHz | PMP/PTP 450/450b Series | 40 mi / 64 km (PMP)<br>186 mi/ 299 km (PTP) |
| | 5 GHz | PMP/PTP 450/450i/450b 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 ODUs and installations.

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

Table 178: Radio certifications

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

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

## DFS for 2.4 and 5 GHz Radios

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

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

Table 179: Country & Bands DFS setting

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

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

# Equipment Disposal

## Waste (Disposal) of Electronic and Electric Equipment

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

# Country specific band range maximum transmit power

## Maximum transmit power 900 MHz band

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

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

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

CPL= Conducted Power Limit

## Maximum transmit power 2.4 GHz band

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

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

CPL= Conducted Power Limit

## Maximum transmit power 3 GHz band

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

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

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

(*) = No limit

(X) = Not allowed

CPL= Conducted Power Limit

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

## Maximum transmit power 4.9 GHz band

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

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

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

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

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

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

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

## Maximum transmit power 5.1 GHz band

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

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

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

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

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

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

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

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

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

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

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

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

Note

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

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

## Maximum transmit power 5.2 GHz band

Note

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

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

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

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

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

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

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

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

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

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

Note

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

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

## Maximum transmit power 5.4 GHz band

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

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

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

Note

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

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

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

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

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

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

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

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

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

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

Note

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

## Maximum transmit power 5.8 GHz band

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

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

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

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

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

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

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

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

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

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

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

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

Note

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

## Maximum transmit power 6 GHz band

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

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

**Note**

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

# Country specific frequency range

## Frequency range 900 MHz band

Table 202: Frequency range per country – 900 MHz band

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

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

## Frequency range 2.4 GHz band

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

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

(*) Usable frequency range 2402-2482 MHz

## Frequency range 3.5 GHz band

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

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

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

## Frequency range 3.65 GHz band

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

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

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

Table 206: Power and EIRP Limits to meet EU requirements

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

**Note**

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

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

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

## Frequency range 4.9 GHz band

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

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

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

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

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

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

## Frequency range 5.1 GHz band

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[1] Center frequency 5155 needs a 9 dB backoff

[2] Center frequency 5245 needs a 2 dB backoff

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

[4] The FCC grant allows up to 5250

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

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

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

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

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

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

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

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

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

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

The limits are as follows:

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

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

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

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

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

## Frequency range 5.2 GHz band

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

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

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

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

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

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

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

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

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

[1] The FCC grant allows down to 5250

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

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

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

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

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

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

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

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

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

The limits are as follows:

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

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

## Frequency range 5.4 GHz band

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

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

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

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

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

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

[4] PMP 450 SM supports up to 5722.5

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

[6] PMP 450 SM supports up to 5720

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

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

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

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

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

All other products do not need this notch.

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

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

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

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

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

[2] The FCC grant allows up to 5725

Center frequencies from 5715 and above need a 1 dB backoff

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

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

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

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

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

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

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

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

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

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

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

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

The limits are as follows:

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

## Frequency range 5.8 GHz band

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

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

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

[1] PMP 450 SM supports down to 5727.5

[2] PMP 450 SM supports up to 5847.5

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The limits are as follows:

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

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

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

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

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

# Federal Communication Commission (FCC) specific information

## FCC compliance testing

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

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

Note

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

Note

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

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

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

## FCC Interference Statement

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

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

**Caution**

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

**Note**

**FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 281 cm between the radiator and your body.

## Industry Canada (IC)

**Note**

**IC Radiation Exposure Statement:**

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 135 cm between the radiator and your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 135 cm de distance entre la source de rayonnement et votre corps.

## FCC IDs

Table 233: US FCC IDs

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

## FCC approved antenna list for 450i

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

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

Note

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

Table 234: USA approved antenna list 4.9 GHz

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

Table 235: USA approved antenna list 5.1 and 5.2 GHz

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

Table 236: USA approved antenna list 5.4 GHz

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

Table 237: USA approved antenna list 5.8 GHz

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

## FCC approved antenna list for 450b Connectorized and 450 MicroPoP

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

# Innovation Science and Economic Development Canada (ISEDC) specific information

## 900 MHz ISEDC notification

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

## 4.9 GHz ISEDC notification

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

## Utilisation de la bande 4.9 GHz FCC et ISEDC

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

d'installer ou d'utiliser le système.

## 5.2 GHz and 5.4 GHz ISEDC notification

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

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

## Utilisation de la bande 5.2 and 5.4 GHz ISEDC

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

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

## ISEDC notification 5.8 GHz

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

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

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

## Utilisation de la bande 5.8 GHz ISEDC

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

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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

## ISEDC certification numbers

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

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

Table 239: ISEDC Certification Numbers – PMP 450i

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

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

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

Table 240: ISEDC Certification Numbers – PMP 450m

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

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

Table 241: ISEDC Certification Numbers – PMP 450b 6

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

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

## Canada approved antenna list

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

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

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

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

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

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

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

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

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

# Chapter 5: Troubleshooting

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

The following topics are described in this chapter:

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

## General troubleshooting procedure

### General planning for troubleshooting

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

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

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

## General fault isolation process

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

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

### Questions to help isolate the problem

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

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

        - is the problem on one AP in the cluster? (If so, focus on that AP)
        - is the problem on multiple, but not all, APs in the cluster? (If so, focus on those APs)
        - is the problem on all APs in the cluster? (If so, focus on the CMM4 and the GPS signal.)

- Based on data in the Event Log
    - does the problem correlate to External Hard Resets with no WatchDog timers? (If so, this indicates a loss of power. Correct your power problem.)
    - is intermittent connectivity indicated? (If so, verify your configuration, power level, cables and connections and the speed duplex of both ends of the link).
    - does the problem correlate to loss-of-sync events?
- Are connections made via shielded cables?
- Does the GPS antenna have an unobstructed view of the entire horizon?
- Has the site grounding been verified?

## Secondary Steps

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

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

# Troubleshooting procedures

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

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

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

## Module has lost or does not establish connectivity

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

Procedure 29 Troubleshooting loss of connectivity

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

| | |
|---|---|
| | • Verify that the Radio Frequency Carrier setting is checked in the Custom Radio Frequency Scan Selection List.<br>• Verify that the Color Code setting matches that of the other module.<br>• Access the browser LAN settings (for example, at Tools > Internet Options > Connections > LAN Settings in Internet Explorer).<br>• Verify that none of the settings are selected.<br>• Access the Link Capacity Test tab in the Tools page of the module.<br>• Perform a link test<br>• Verify that the link test results show efficiency greater than 90% in both the uplink and downlink<br>• Execute ping.<br>◦ Verify that no packet loss was experienced.<br>◦ Verify that response times are not significantly greater than<br>▪ 15 ms from SM to AP<br>▪ 4 ms from AP to SM<br>▪ Replace any cables that you suspect may be causing the problem.<br>  **Note**<br>A ping size larger than 1494 Bytes to a module times out and fails. However, a ping of this size or larger to a system that is behind a Canopy module typically succeeds. It is generally advisable to ping such a system, since Canopy handles that ping with the same priority as is given all other transport traffic. The results are unaffected by ping size and by the load on the Canopy module that brokers this traffic. |
| 6 | After connectivity has been re-established, reinstall network elements and variables that you removed in Step 1. |

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

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

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

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

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

| | |
|---|---|
| 1 | Isolate the end user/SM from peripheral equipment and variables such as routers, switches and firewalls. |
| 2 | Set up the minimal amount of equipment. |
| 3 | On each end of the link:<br>• Check the cables and connections.<br>• Verify that the cable/connection scheme—straight-through or crossover—is correct.<br>• Verify that the LED labeled LNK is green. |
| 4 | At the SM:<br>• Access the NAT Table tab in the Logs web page.<br>• Verify that the correct NAT translations are listed.<br>RESULT: NAT is eliminated as a possible cause if these translations are correct. |
| 5 | If this SM is configured for NAT with DHCP, then at the SM:<br>• Execute ipconfig (Windows) or ifconfig (Linux)<br>• Verify that the PC has an assigned IP address.<br>• If the PC does not have an assigned IP address, then<br>• enter ipconfig /release “Adapter Name”.<br>• enter ipconfig /renew “Adapter Name”.<br>• reboot the PC.<br>• after the PC has completed rebooting, execute ipconfig<br>• if the PC has an assigned IP address, then<br>• access the NAT DHCP Statistics tab in the Statistics web page of the SM.<br>• verify that DHCP is operating as configured. |
| 6 | After connectivity has been re-established, reinstall network elements and variables that you removed in Step 1. |

## SM Does Not Register to an AP

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

Procedure 31 Troubleshooting SM failing to register to an AP

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

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

## Module has lost or does not gain sync

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

Procedure 32 Troubleshooting loss of sync

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

## Module does not establish Ethernet connectivity

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

Procedure 33 Troubleshooting loss of Ethernet connectivity

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

## CMM4 does not pass proper GPS sync to connected modules

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

Procedure 34 Troubleshooting CMM4 not passing sync

| | |
|---|---|
| 1 | Verify that the GPS antenna has an unobstructed view of the entire horizon. |
| 2 | Verify that the GPS coaxial cable meets specifications. |
| 3 | Verify that the GPS sync cable meets specifications for wiring and length. |
| 4 | If the web pages of connected modules indicate any of the following, then find and eliminate the source of noise that is being coupled into the GPS sync cable:<br>• In the GPS Status page:<br>◦ anomalous number of Satellites Tracked (greater than 12, for example)<br>◦ incorrect reported Latitude and/or Longitude of the antenna<br>◦ In the Event Log page:<br>◦ garbled GPS messages<br>◦ large number of Acquired GPS Sync Pulse messages |

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

## Module Software Cannot be Upgraded

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

Procedure 35 Troubleshooting an unsuccessful software upgrade

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

## Module Functions Properly, Except Web Interface Became Inaccessible

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

Procedure 36 Restoring web management GUI access

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

# Power-up troubleshooting

# Registration and connectivity troubleshooting

## SM/BMS Registration

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

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

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

# Logs

## Persistent Logging

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

Navigate to Logs to view:

- SM Session
- SM Authentication
- SM Authorization

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

Figure 125: *SM Logs*

Figure 126: *SM Session log*

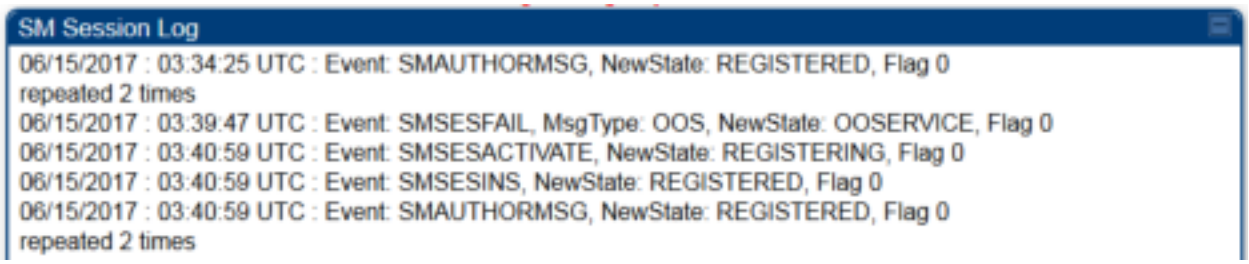
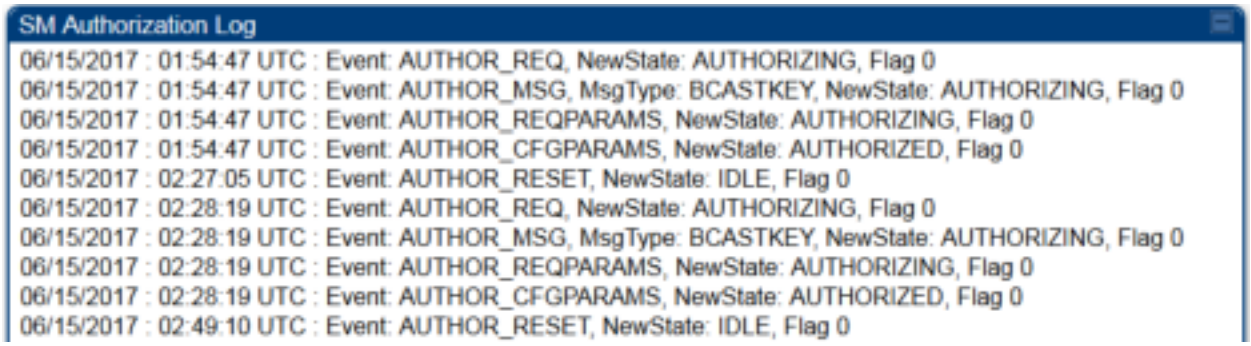



Figure 127: *SM Authentication log*


Figure 128: *SM Authorization log*




## Automated Frequency Coordination Logging

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

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

## PMP 450m Reference information

A.1 Specifications

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

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

A.2 PMP 450m overload

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

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

Figure 129: *Overload tab*


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

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

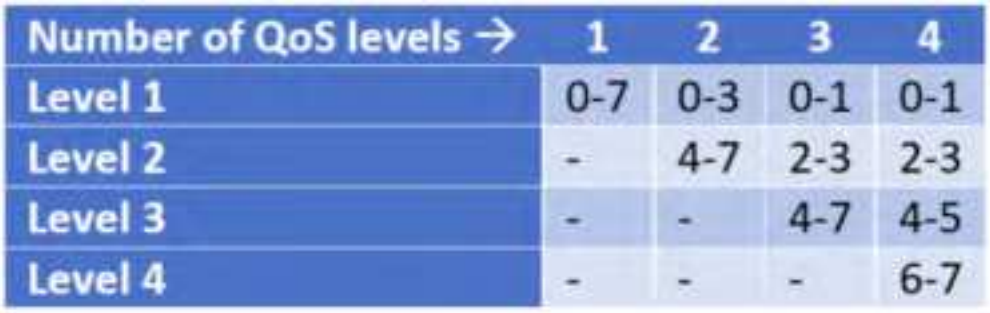
1. High traffic during busy periods: those statistics will be close to 100% and almost all slots will be utilized. In this case if the Overload statistics show that packets are discarded then this is an indication of overload condition.
2. High percentage of VCs with low modulation with moderate traffic.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

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

## Quality of Service (QoS) Glossary

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

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

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

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

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

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

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

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

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

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

# Cambium Networks

Cambium Networks delivers wireless communications that work for businesses, communities, and cities worldwide. Millions of our radios are deployed to connect people, places and things with a unified wireless fabric that spans multiple standards and frequencies of fixed wireless and Wi-Fi, all managed centrally via the cloud. Our multi-gigabit wireless fabric offers a compelling value proposition over traditional fiber and alternative wireless solutions. We work with our Cambium certified ConnectedPartners to deliver purpose built networks for service provider, enterprise, industrial, and government connectivity solutions in urban, suburban, and rural environments, with wireless that just works.

| | |
|---|---|
| User Guides | http://www.cambiumnetworks.com/guides |
| Technical training | https://learning.cambiumnetworks.com/learn |
| Support website (enquiries) | https://support.cambiumnetworks.com |
| Main website | http://www.cambiumnetworks.com |
| Sales enquiries | solutions@cambiumnetworks.com |
| Warranty | https://www.cambiumnetworks.com/support/standard-warranty/ |
| Telephone number list | http://www.cambiumnetworks.com/contact-us/ |
| Address | Cambium Networks Limited,<br>Unit B2, Linhay Business Park,<br>Eastern Road, Ashburton,<br>Devon, TQ13 7UP<br>United Kingdom |

www.cambiumnetworks.com