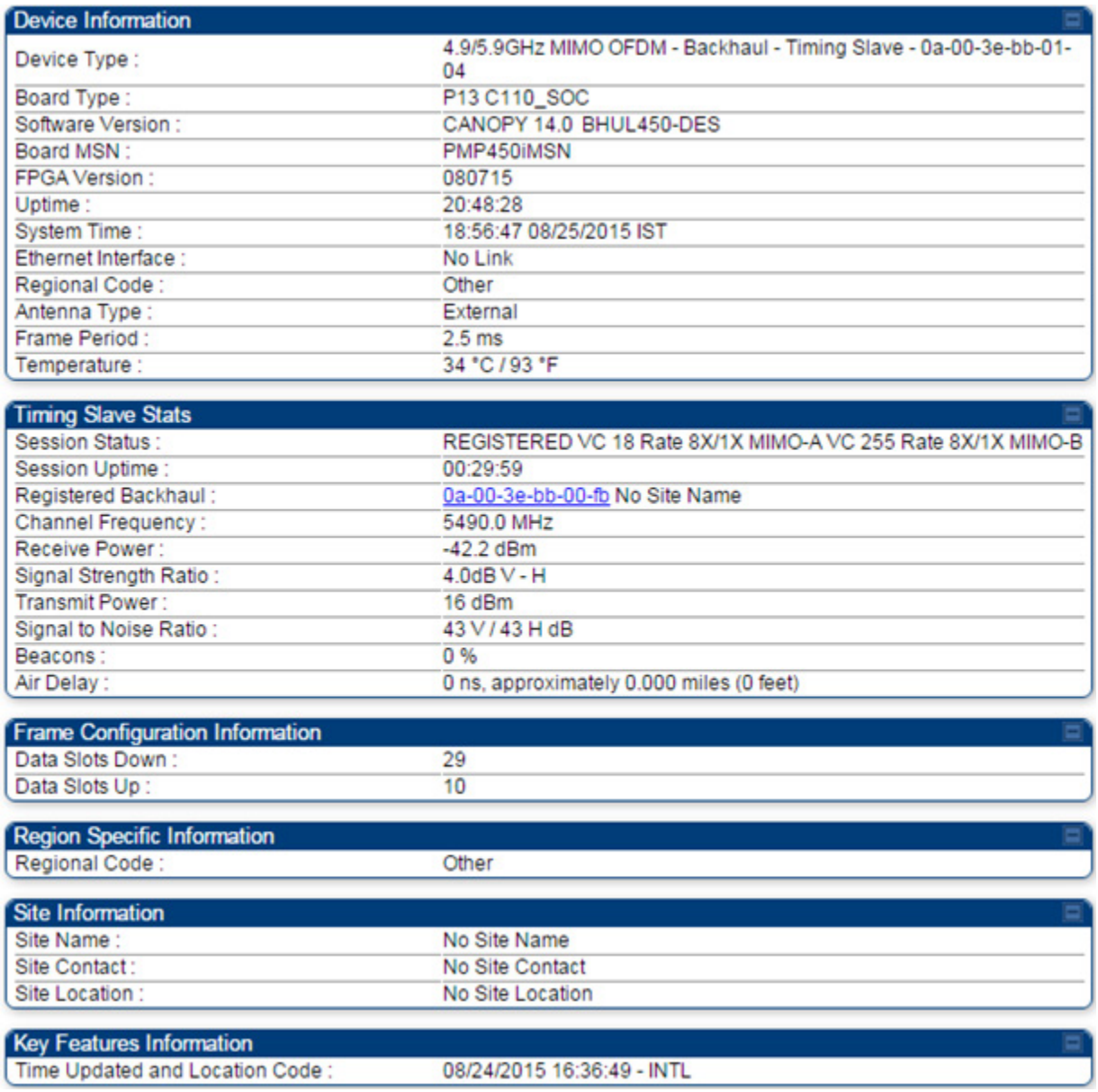
Transmit Power	This field lists the current combined transmit power level, in dBm.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.
Beacons	Displays a count of beacons received by the BHM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Air Delay	This field displays the distance in feet between this BHS and the BHM. To derive the distance in meters, multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.
Data Slots Down	This field lists the number of slots used for downlink data transmission.
Data Slots Up	This field lists the number of slots used for uplink data transmission.
Regional Code	A parameter that offers multiple fixed selections, each of which automatically implements frequency band range restrictions for the selected region. Units shipped to regions other than the United States must be configured with the corresponding Country Code to comply with local regulatory requirements.
Site Name	This field indicates the name of the physical module. Assign or change this name in the **Configuration > SNMP** page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

General Status page of BHS

The BHS's **General Status** page is explained in Table 141.

Table 142 General Status page attributes - BHS



Device Information	
Device Type :	4.9/5.9GHz MIMO OFDM - Backhaul - Timing Slave - 0a-00-3e-bb-01-04
Board Type :	P13 C110_SOC
Software Version :	CANOPY 14.0 BHUL450-DES
Board MSN :	PMP450iMSN
FPGA Version :	080715
Uptime :	20:48:28
System Time :	18:56:47 08/25/2015 IST
Ethernet Interface :	No Link
Regional Code :	Other
Antenna Type :	External
Frame Period :	2.5 ms
Temperature :	34 °C / 93 °F

Timing Slave Stats	
Session Status :	REGISTERED VC 18 Rate 8X/1X MIMO-A VC 255 Rate 8X/1X MIMO-B
Session Uptime :	00:29:59
Registered Backhaul :	0a-00-3e-bb-00-fb No Site Name
Channel Frequency :	5490.0 MHz
Receive Power :	-42.2 dBm
Signal Strength Ratio :	4.0dB V - H
Transmit Power :	16 dBm
Signal to Noise Ratio :	43 V / 43 H dB
Beacons :	0 %
Air Delay :	0 ns, approximately 0.000 miles (0 feet)

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

Region Specific Information	
Regional Code :	Other

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

Key Features Information	
Time Updated and Location Code :	08/24/2015 16:36:49 - INTL

Attribute	Meaning
Device Type	See Table 141 on page 9-13.
Board Type	See Table 141 on page 9-13.
Software Version	See Table 141 on page 9-13.
Board MSN	See Table 141 on page 9-13.
FPGA Version	See Table 141 on page 9-13.

Uptime	See Table 141 on page 9-13.
System Time	See Table 141 on page 9-13.
Ethernet Interface	See Table 141 on page 9-13.
Antenna Type	See Table 141 on page 9-13.
Temperature	See Table 141 on page 9-13.
Session Status	See Table 141 on page 9-13.
Session Uptime	See Table 141 on page 9-13.
Registered Backhaul	See Table 141 on page 9-13.
Channel Frequency	See Table 141 on page 9-13.
Receive Power	See Table 141 on page 9-13.
Signal Strength Ratio	See Table 141 on page 9-13.
Transmit Power	See Table 141 on page 9-13.
Signal to Noise Ratio	See Table 141 on page 9-13.
Beacons	See Table 141 on page 9-13.
Air Delay	See Table 141 on page 9-13.
Data Slots Down	See Table 141 on page 9-13.
Data Slots Up	See Table 141 on page 9-13.
Regional Code	See Table 141 on page 9-13.
Site Name	See Table 141 on page 9-13.
Site Contact	See Table 141 on page 9-13.
Site Location	See Table 141 on page 9-13.
Time Updated and Location Code	See Table 141 on page 9-13.

Viewing Session Status

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

Note

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

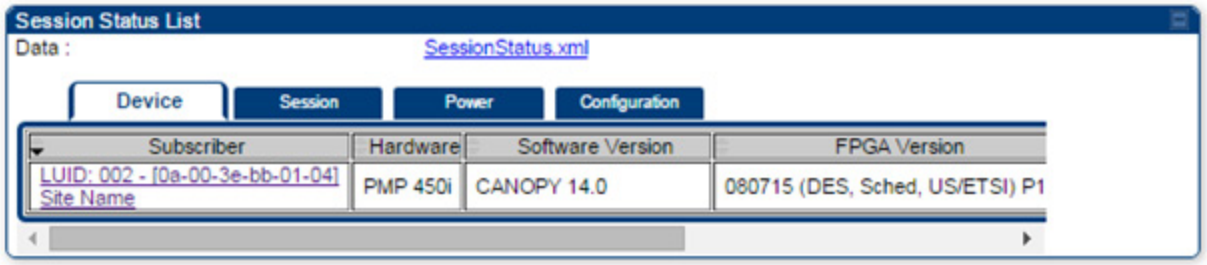
The Session Status List has four tab: Device, Session, Power and Configuration.

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

Device tab

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

Table 143 Device tab attributes



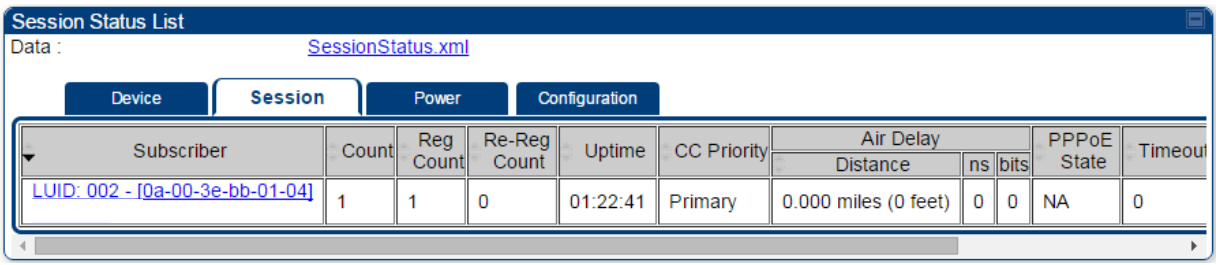
Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM, the system assigns an LUID of 2 or a higher unique number to the SM/BHS. If a SM/BHS loses registration with the AP/BHS and then regains registration, the SM/BHS will retain the same LUID. **Note** The LUID associated is lost when a power cycle of the AP/BHM occurs. Both the LUID and the MAC are hot links to open the interface to the SM/BHS. In some instances, depending on network activity and network design, this route to the interface yields a blank web page. If this occurs, refresh your browser view. Site Name indicates the name of the SM/BHS. Change this name on the Configuration web page of the SM/BHS. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Hardware	This field displays the SMs or BHS hardware type.

Software Version	This field displays the software release that operates on the SM/BHS, the release date and time of the software.
FPGA Version	This field displays the version of FPGA that runs on the SM/BHS
State	This field displays the current status of the SM/BHS as either **IN SESSION** to indicate that the SM/BHS is currently registered to the AP/BHM. **IDLE** to indicate that the SM/BHS was registered to the AP/BHM at one time, but now is not. This field also indicates whether the encryption scheme in the module is enabled.

Session tab

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

Table 144 Session tab attributes

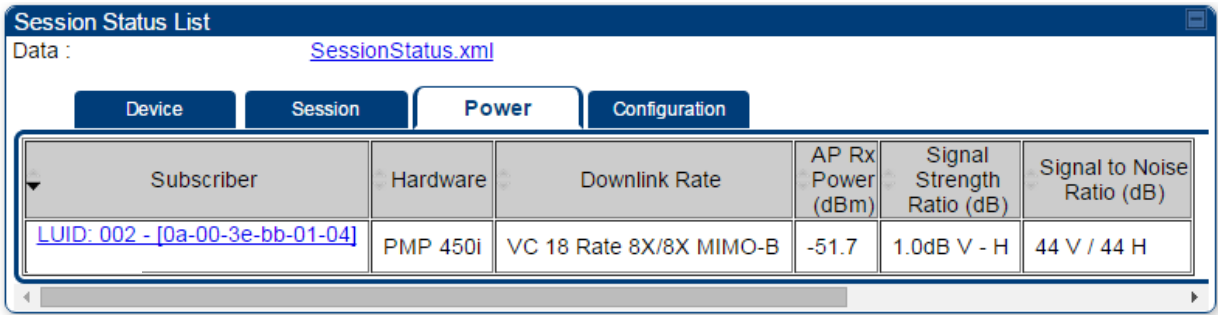


Attribute	Meaning
Subscriber	See Table 142 on page 9-15.
Count	This field displays how many sessions the SM/BHS has had with the AP/BHM. Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum. If the number of sessions is significantly greater than the number for other SMs or BHS, then this may indicate a link problem or an interference problem.
Reg Count	When a SM/BHS makes a registration request, the AP/BHM checks its local data to see whether it considers the SM/BHS to be already registered. If the AP/BHM concludes that the SM/BHS is not, then the request increments the value of this field. If the number of sessions is significantly greater than the number for other SMs or BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem

	(conduct a spectrum scan).
Re-Reg Count	When a SM/BHS makes a registration request, the AP/BHM checks its local data to see whether it considers the SM/BHS to be already registered. If the AP/BHM concludes that the SM/BHS is not, then the request increments the value of this field. Typically, a Re-Reg is the case where both: • SM/BHS attempts to reregister for having lost communication with the AP/BHM. • AP/BHM has not yet observed the link to the SM/BHS as being down. If the number of sessions is significantly greater than the number for other SMs or BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).
Uptime	Once a SM/BHS successfully registers to an AP/BHM, this timer is started. If a session drops or is interrupted, this timer is reactivated once re-registration is complete.
AirDelay	This field displays the distance of the SM/BHS from the AP/BHM in meters, nanoseconds and bits. At close distances, the value in this field is unreliable.
PPPoE state	This field displays the current PPPoE state (whether configured) of the SM/BHS.
Timeout	This field displays the timeout in seconds for management sessions via HTTP, ftp access to the SM/BHS. 0 indicates that no limit is imposed.

Power tab

Table 145 Power tab attributes

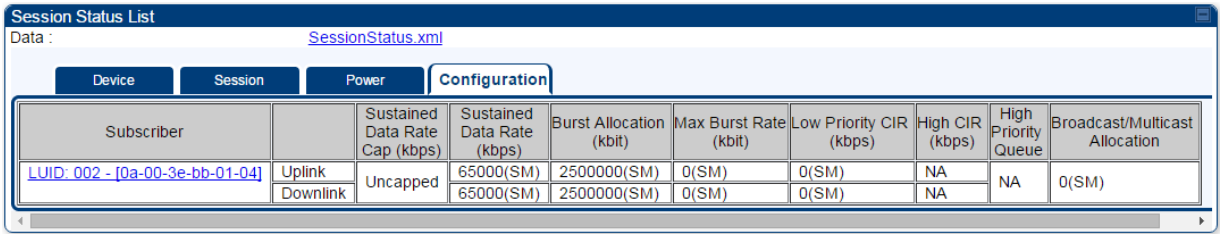


Attribute	Meaning
Subscriber	See Table 142 on page 9-15.
Hardware	This field displays the SMs or BHS hardware type.
Rate	This field displays whether the high-priority channel is enabled in the

	SM/BHS and the status of rate adapt. For example, if “8X/4X” is listed, the radio is capable of operating at 8X but is currently operating at 4X, due to RF conditions. This field also states whether it is MIMO-A or MIMO-B radio e.g. “8X/8X MIMO-B” indicates MIMO-B and “8X/4X MIMO-A” indicates MIMO-A.
AP Receive Power Level	This field indicates the AP’s or BHM’s combined receive power level for the listed SM/BHS.
Signal Strength Ratio	This field displays the ratio of the Vertical path received signal power to the Horizontal path received signal power. This ratio can be useful for determining multipathing conditions (high vertical to horizontal ratio).
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.

Configuration tab

The **Configuration** tab provides information on the SMs or BHS Uplink or Downlink (UL/DL) Sustained Data Rate, UL/DL Burst Allocation, UL/DL Burst Rate, UL/DL Low Priority CIR, UL/DL High CIR, UL/DL High Priority Queue Information and the UL/DL Broadcast or Multicast Allocation. This data is refreshed based on the Web Page Auto Update setting on the AP’s or BHS’s General Configuration page. **Table 146** Configuration tab attributes



Attribute	Meaning
Subscriber	See Table 142 on page 9-15.
Sustained Data Rate	This field displays the CIR value in kbps that is currently in effect for the SM/BHS in both the Uplink and Downlink directior. In the Uplink, this is the specified rate at which each SM/BHS registered to this AP/BHM is replenished with credits for transmission. In the Downlink, this is the specified rate at which the AP/BHM must be replenished with credits (tokens) for transmission to each of the SMs or BHS in its sector.
Burst Allocation	This field displays the Burst Allocation value that is currently in effect for the SM/BHS in both the Uplink and Downlink direction. In the Uplink, this is the specified maximum amount of data that each SM/BHS is allowed to transmit before being recharged at the **Sustained Data Rate (Uplink)** with credits to transmit more. In the Downlink, this is the maximum amount of data to allow the AP/BHM to transmit to any registered SM/BHS before the AP/BHM is replenished with transmission credits at

	the **Sustained Data Rate (Downlink)**.
Max Burst Rate	The data rate at which a SM/BHS is allowed to burst (until burst allocation limit is reached) before being recharged at the **Sustained Data Rate (Uplink and Downlink individually)** with credits to transit more. When set to 0 (default), the burst rate is unlimited.
Low Priority CIR	This field indicates the minimum rate at which low priority traffic is sent over the uplink and downlink (unless CIR is oversubscribed or RF link quality is degraded).
High CIR	This field indicates the minimum rate at which high priority traffic is sent over the uplink and downlink (unless CIR is oversubscribed or RF link quality is degraded).
High Priority Queue	Not applicable for PMP/PTP 450i products.
Broadcast/Multicast Allocation	This field displays the data rate at which Broadcast and Multicast traffic is sent via the radio link.

Viewing Remote Subscribers

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

Figure 95 Remote Subscribers page - AP

Interpreting messages in the Event Log

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

Time and Date Stamp

The time and date stamp reflect one of the following:

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

Note

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

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

Event Log Data Collection

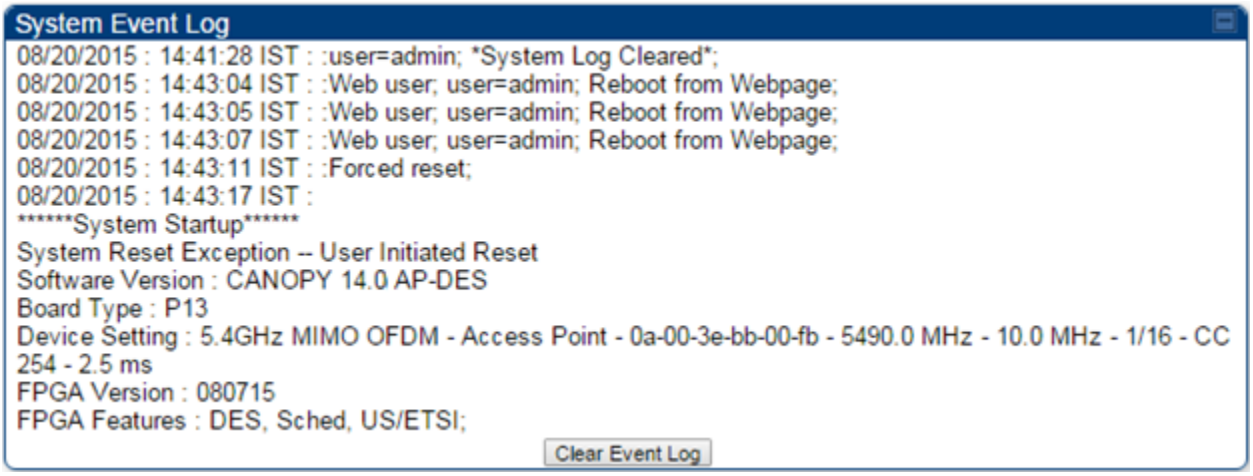
The collection of event data continues through reboots and power cycles. When the buffer allowance for event log data is reached, the system adds new data into the log and discards an identical amount of the oldest data.

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

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

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

Figure 96 Event log data



Messages that Flag Abnormal Events

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

Table 147 Event Log messages for abnormal events

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

Messages that Flag Normal Events

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

Table 148 Event Log messages for normal events

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

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

Viewing the Network Interface

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

Figure 97 Network Interface tab of the AP

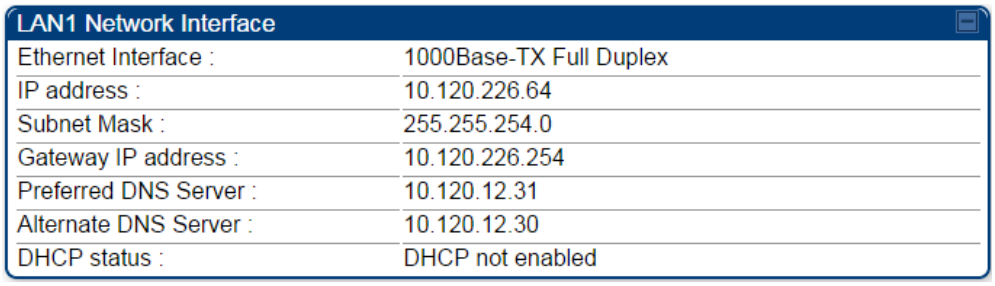
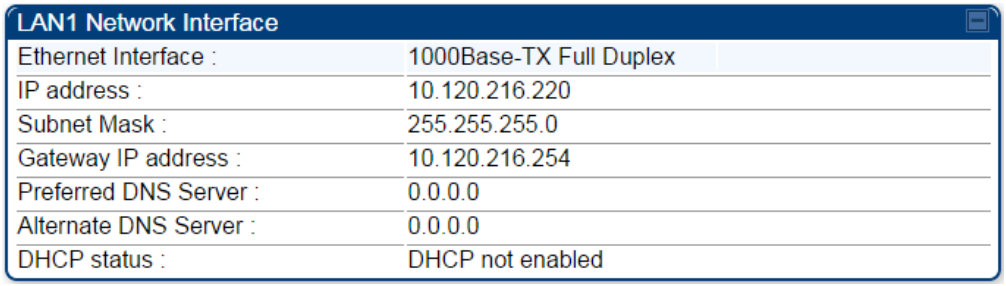


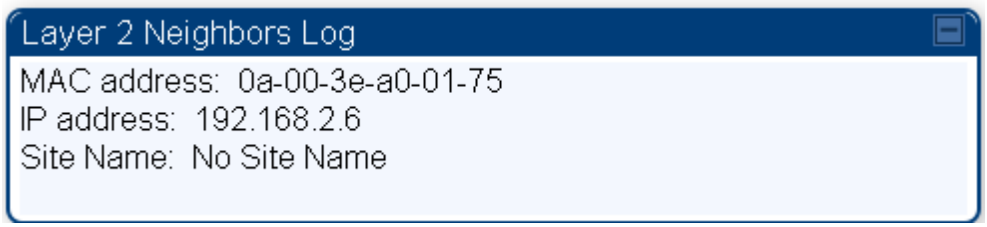
Figure 98 Network Interface tab of the SM



Viewing the Layer 2 Neighbors

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

Figure 99 Layer 2 Neighbors page



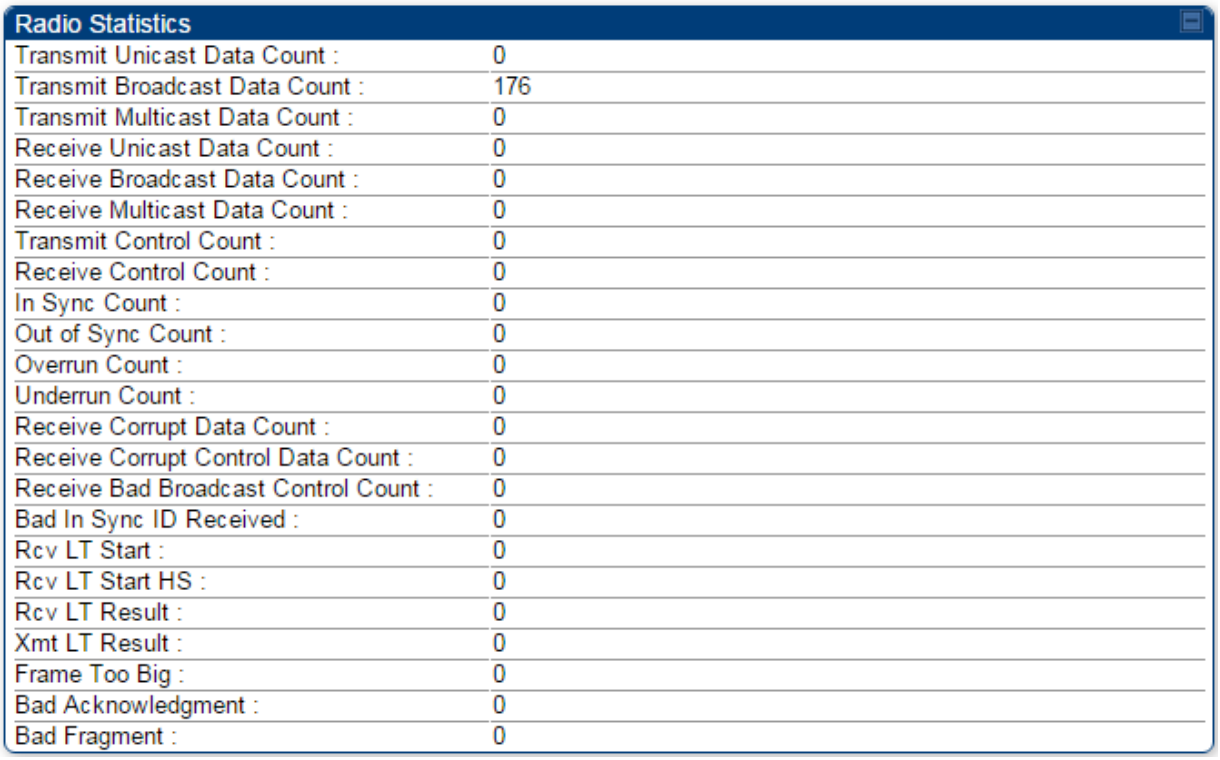
System statistics

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

Viewing the Scheduler statistics

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

Table 149 Scheduler tab attributes



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

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

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

Viewing list of Registration Failures statistics

SM Registration Failures page of AP

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

Table 150 SM Registration Failures page attributes - AP

Attribute	Meaning
Status 17 Flag 0	No response was received from the AAA server and hence SM is trying to send a session request again.

BHS Registration Failures page of BHM

Table 151 BHS Registration Failures page attributes - BHM

Attribute	Meaning
Status 17 Flag 0	No response was received from the AAA server and hence SM is trying to send a session request again.

There is a list of flags from 0 to 20 as shown in Table 151 and the “Flags” can be ignored.

Table 152 Flags status

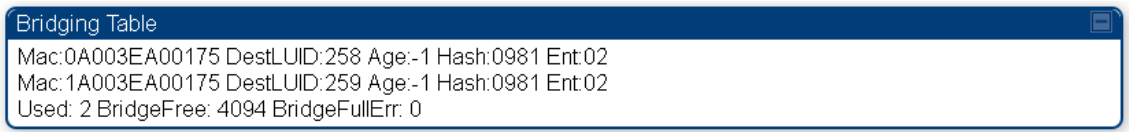
Flag	Meaning	Flag	Meaning
0	Normal	11	AP Lite Limit Reached
1	Out of Range	12	Only Ver 9.5+ Allowed
2	No Luids	13	Temporary Data VC for AAA
3	BH ReRange	14	AAA Authentication Failure
4	Auth Fail	15	Registration Grant Reject
5	Encrypt Fail	16	Blank
6	Power Adjust	17	AAA Session Retry
7	No VCs	18	AAA Reauth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

Interpreting Bridging Table statistics

If NAT (network address translation) is not active on the SM/BHS, then the Bridging Table page provides the MAC address of all devices that are attached to registered SMs/BHS (identified by LUIDs). The bridging table allows data to be sent to the correct module as follows:

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

Figure 100 Bridging Table page



The Bridging Table supports up to 4096 entries.

Interpreting Translation Table statistics

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

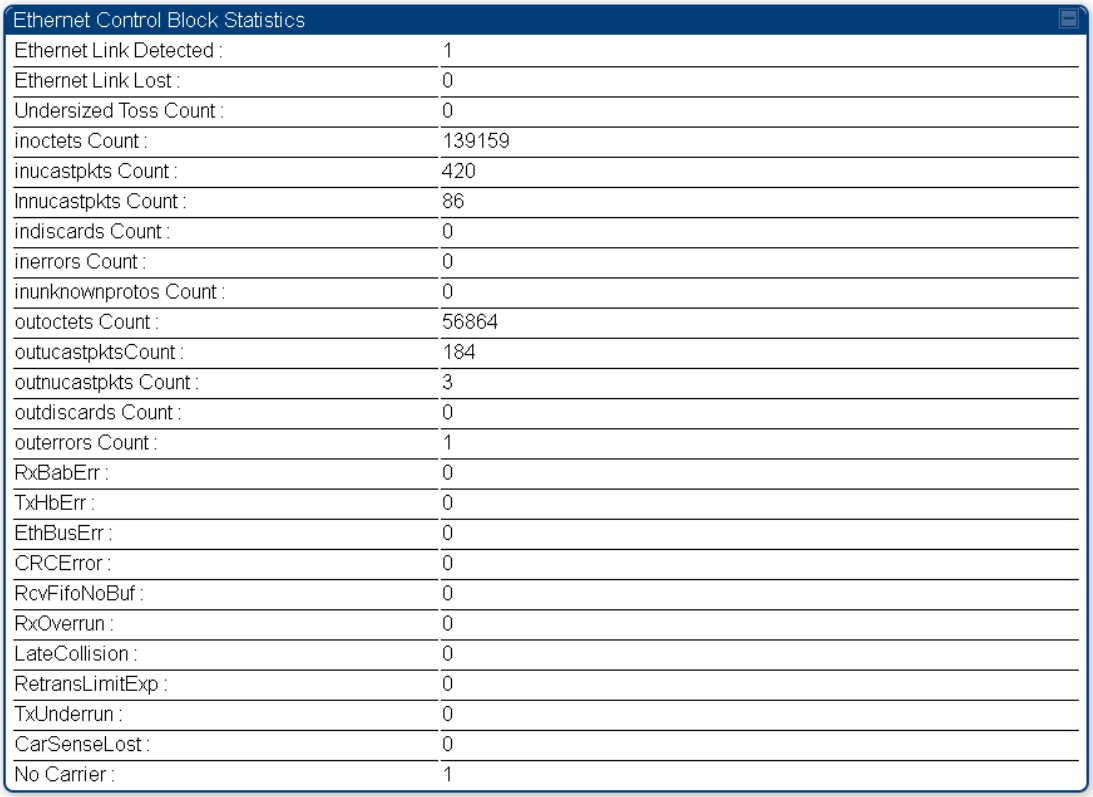
Figure 101 Translation Table page - SM

Interpreting Ethernet statistics

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

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

Table 153 Ethernet tab attributes



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

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

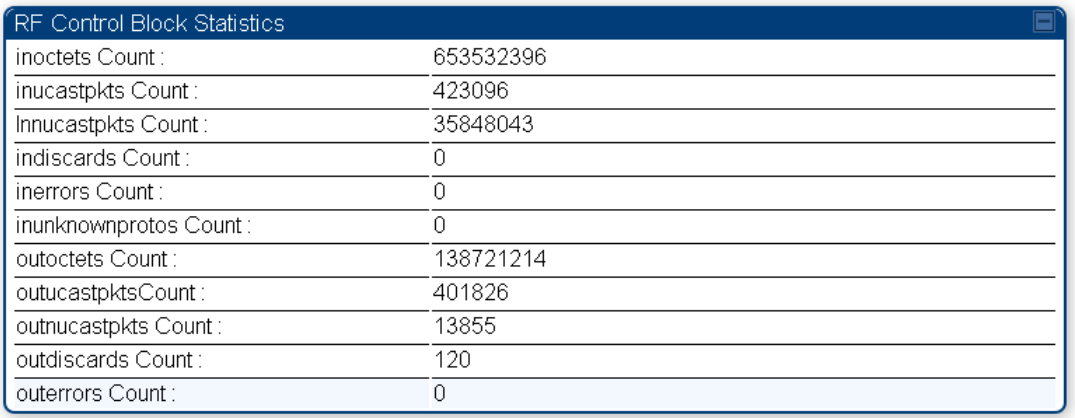
indiscards Count	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)
inerrors Count	This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.
inunknownprotos Count	This field displays how many inbound packets were discarded because of an unknown or unsupported protocol.
outoctets Count	This field displays how many octets were transmitted out of the interface, including those that deliver framing information.
outucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.
outnucastpkts Count	This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.
outdiscards Count	This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)
outerrrors Count	This field displays how many outbound packets contained errors that prevented their transmission.
RxBabErr	This field displays how many receiver babble errors occurred.
TxHbErr	This field displays how many transmit heartbeat errors have occurred.
EthBusErr	This field displays how many Ethernet bus errors occurred on the Ethernet controller.
CRCError	This field displays how many CRC errors occurred on the Ethernet controller.
RcvFifoNoBuf	This field displays the number of times no FIFO buffer space was able to be allocated
RxOverrun	This field displays how many receiver overrun errors occurred on the Ethernet controller.
Late Collision	This field displays how many late collisions occurred on the Ethernet controller. A normal collision occurs during the first 512 bits of the frame transmission. A collision that occurs after the first 512 bits is considered a late collision.  **Caution** A late collision is a serious network problem because the frame

	being transmitted is discarded. A late collision is most commonly caused by a mismatch between duplex configurations at the ends of a link segment.
RetransLimitExp	This field displays how many times the retransmit limit has expired.
TxUnderrun	This field displays how many transmission-underrun errors occurred on the Ethernet controller.
CarSenseLost	This field displays how many carrier sense lost errors occurred on the Ethernet controller.
No Carrier	This field displays how many no carrier errors occurred on the Ethernet controller.

Interpreting RF Control Block statistics

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

Table 154 Radio (Statistics) page attributes



RF Control Block Statistics	
inoctets Count :	653532396
inucastpkts Count :	423096
Innucastpkts Count :	35848043
indiscards Count :	0
inerrors Count :	0
inunknownprotos Count :	0
outoctets Count :	138721214
outucastpktsCount :	401826
outnucastpkts Count :	13855
outdiscards Count :	120
outerrors Count :	0

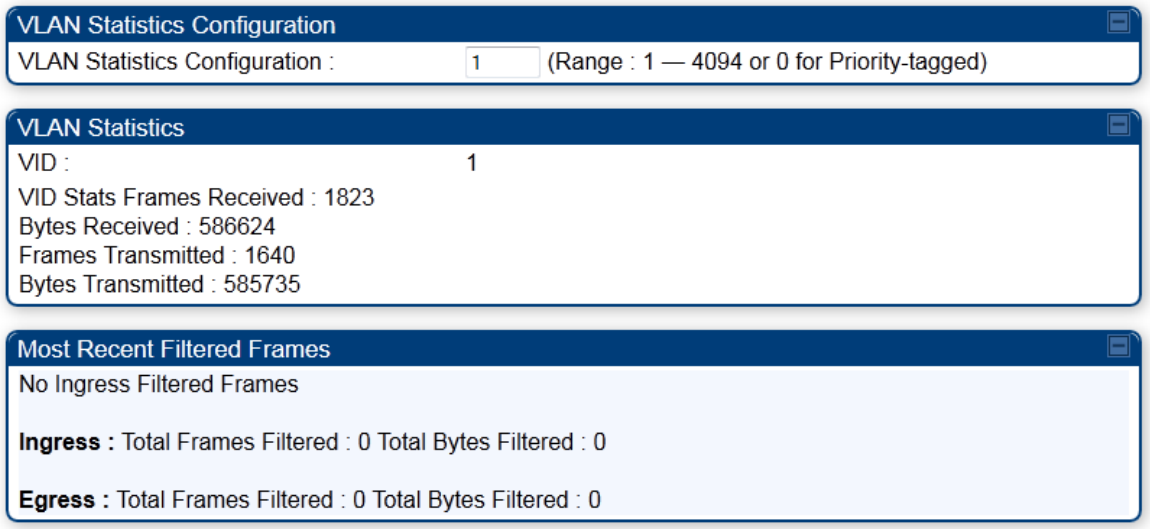
Attribute	Meaning
inoctets Count	This field displays how many octets were received on the interface, including those that deliver framing information.
inucastpkts Count	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
Innucastpkts Count	This field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

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

Interpreting VLAN statistics

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

Table 155 VLAN page attributes



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

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

Interpreting Data VC statistics

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

The **Data VC** tab displays the fields as explained in Table 155.

Table 156 Data VC page attributes

Data VC Statistics (CoS: 00 = Lowest Priority, 07 = Highest Priority)

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

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

Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM, the system assigns an LUID of 2 or a higher unique number to the SM/BHS. If a SM/BHS loses registration with the AP/BHM and then regains registration, the SM/BHS retains the same LUID.
VC	This field displays the virtual channel number. Low priority channels start at VC18 and count up. High priority channels start at VC255 and count down. If one VC is displayed, the high-priority channel is disabled. If two are displayed, the high-priority channel is enabled.
CoS	This field displays the Class of Service for the virtual channel. The low priority channel is a CoS of 00 and the high priority channel is a CoS of 01. CoS of 02 through 07 are not currently used.
Inbound Statistics, octets	This field displays how many octets were received on the interface, including those that deliver framing information.
Inbound Statistics, ucastpkts	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
Inbound Statistics, nucastpkts	This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.
Inbound Statistics, discards	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. Inbound discard statistics are incremented similar to the indiscards stat on the RF control block stats page. The sum of all data VC indiscards must be close to the RF control block in discards. If indiscards are evenly distributed across SMs, then the radio is PPS limited due to either excessive small packet transmissions, or a problem at the Ethernet link. If indiscards are contained to one or a few SMs,

	then there is likely a problem at or underneath the SM which is incrementing the count.
Inbound Statistics, errors	This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.
Inbound Statistics, QPSK frgmts	This field displays how many inbound fragments were received via the QPSK modulation scheme.
Inbound Statistics, 16-QAM frgmts	This field displays how many inbound fragments were received via the 16-QAM modulation scheme.
Inbound Statistics, 64-QAM frgmts	This field displays how many inbound fragments were received via the 64-QAM modulation scheme.
Inbound Statistics, 256-QAM frgmts	This field displays how many inbound fragments were received via the 256-QAM modulation scheme.
Outbound Statistics, octets	This field displays how many octets were transmitted out of the interface, including those that deliver framing information.
Outbound Statistics, ucastpkts	This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.
Outbound Statistics, nucastpkts	This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.
Outbound Statistics, discards	This field displays how many outbound packets were discarded without errors that would have prevented their transmission. Outbound discard statistics are incremented if a VC is not active when a packet is ready to send. This is a rare condition.
Outbound Statistics, errors	This field displays how many outbound packets contained errors that prevented their transmission.
Queue Overflow	This is a count of packets that were discarded because the queue for the VC was already full. If Queue Overflows are being seen across most or all SMs, then there is either an interferer local to the AP or the APs RF link is at capacity. If Queue Overflows are being seen at one or only a few SMs, then it is likely that there is a problem with those specific links whether it is insufficient signal strength, interferer, or a problem with the actual SM hardware.
High Priority Queue	This is a count of packets that were received on high priority queue.

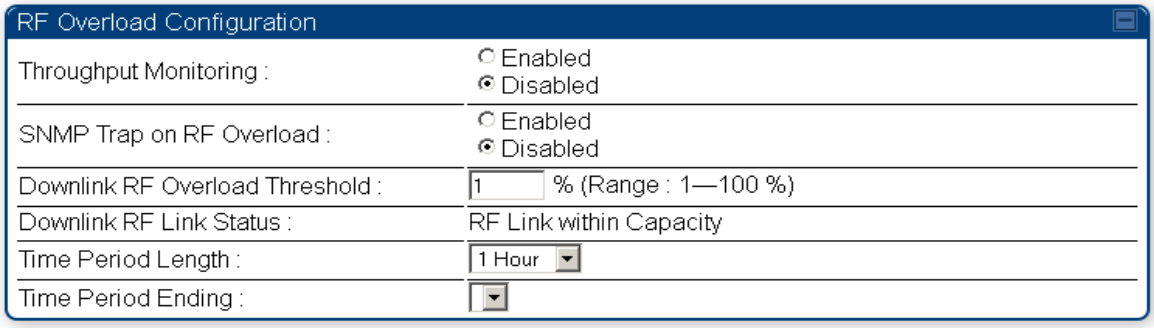
Interpreting Throughput statistics

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

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

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

Table 157 RF overload Configuration attributes – AP/BHM



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

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

Board Performance statistics

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

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

Board Throughput statistics

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

- **Ethernet Statistics** - Statistics collected at the Ethernet port:
  - **inOctets** – Number of octets (bytes) received by the AP/BHM at the Ethernet Interface over the collection interval
  - **outOctets** – Number of octets (bytes) sent by the AP/BHM at the Ethernet Interface over the collection interval
  - **inPkts** – Number of packets received by the AP/BHM at the Ethernet Interface over the collection interval
  - **outPkts** – Number of packets sent by the AP/BHM at the Ethernet Interface over the collection interval

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

LUID RF Throughput statistics

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

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

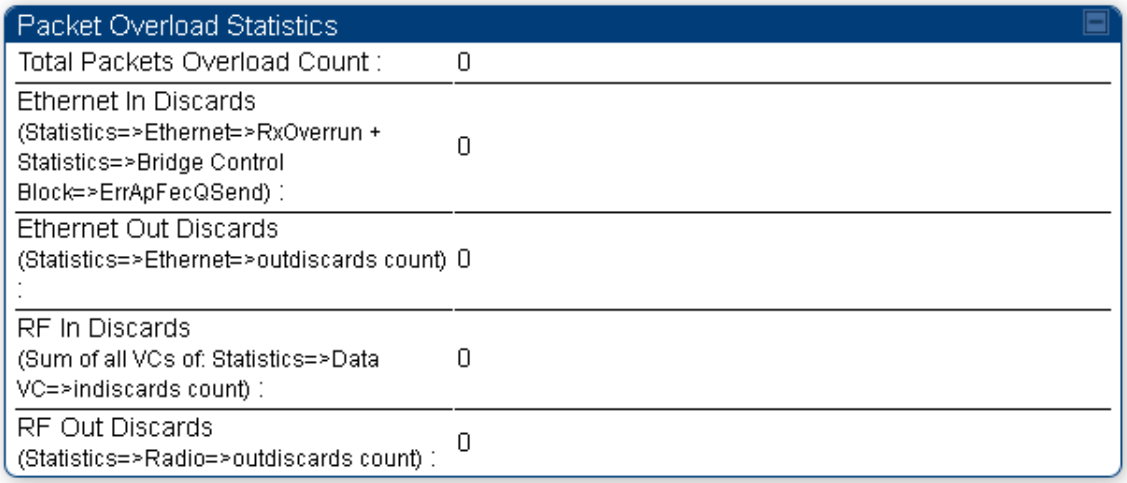
- **discards %** – Percent of the total packets to be transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF Out Queue was full.

Interpreting Overload statistics

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

This statistics page is applicable for all modules (AP/SM/BHM/BHS) and explained in Table 157.

Table 158 Overload page attributes – AP/SM/BHM/BHS



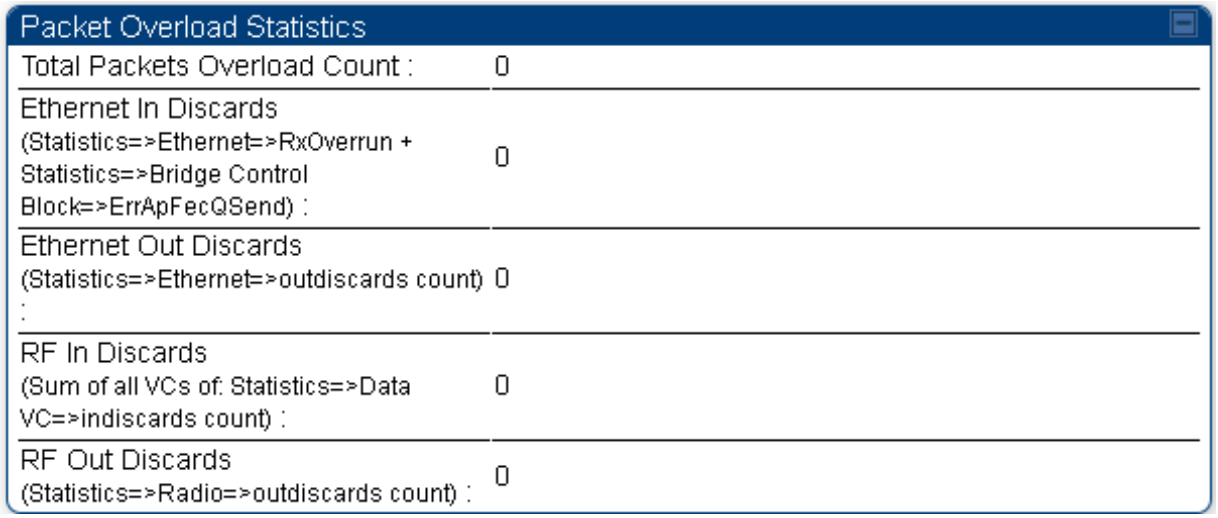
Attribute	Meaning
Total Packets Overload Count	This field represents the sum of all RF and Ethernet in/out discards.
Ethernet In Discards	This field represents the number of packets tossed due to the Ethernet queue being full. If a climb in this stat accompanies a climb in RF Out Discards stat, then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

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

Interpreting DHCP Relay statistics

The **Statistics > DHCP Relay** page displays requests and replies received, relayed and discarded when the AP is configured as a DHCP relay. Typically, in a working DHCP relay configuration a one-to-one ratio is established between requests and replies that are received and relayed. This statistics page is only applicable for PMP (AP and SM modules) and it is explained in Table 158.

Table 159 DHCP Relay page attributes – AP/SM



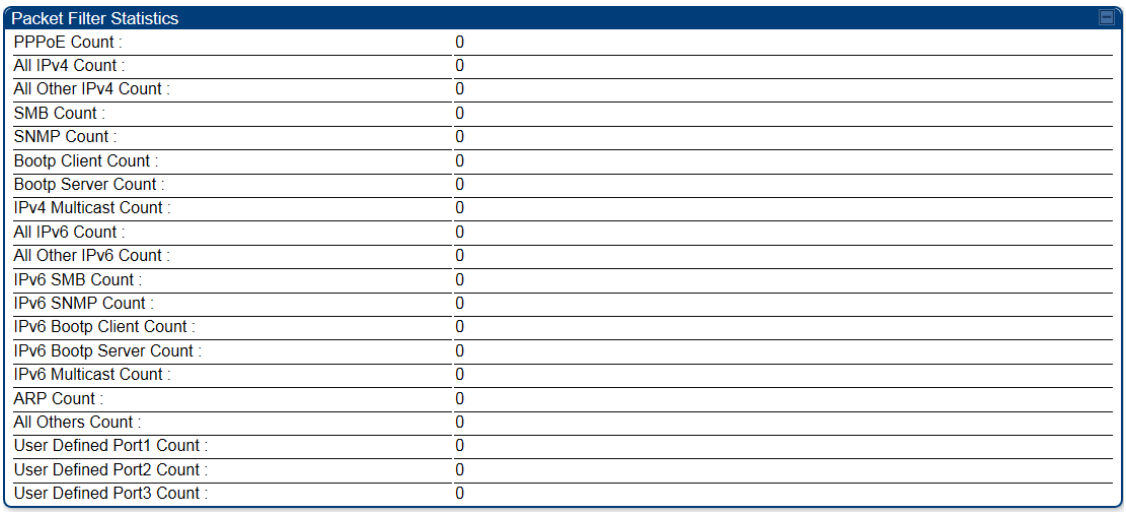
Attribute	Meaning
Requests Received	This field represents the number of DHCP relay requests received by the AP.
Requests Relayed	This field represents the number of DHCP relay requests relayed by the AP.

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

Interpreting Filter statistics

The **Statistics > Filter** page displays statistics on packets that have been filtered (dropped) due to the filters set on the **Protocol Filtering** page. The filter page of SM is explained in Table 159.

Table 160 Filter page attributes - SM

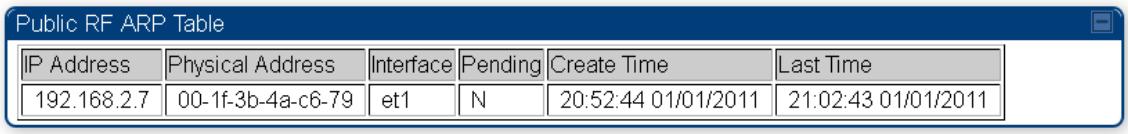


Attribute	Meaning
PPPoE Count	Number of PPoE packets filtered.
All IPv4 Count	Number of IPv4 packets filtered.
All Other IPv4 Count	Any IPv4 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out.
SMB Count	Number of IPv4 Server Message Block (file sharing) packets filtered.
SNMP Count	Number of IPv4 SNMP packets filtered.
Bootp Client Count	Total number of IPv4 DHCP requests filtered.
Bootp Server Count	Total number of IPv4 DHCP replies filtered.
IPv4 Multicast Count	Number of IPv4 Multicast messages filtered.
All IPv6 Count	Number of IPv6 messages filtered.
All Other IPv6 Count	Any IPv6 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out.
IPv6 SMB Count	Number of IPv6 Server Message Block (file sharing) packets filtered
IPv6 SNMP Count	Number of IPv6 SNMP messages filtred
IPv6 Bootp Client Count	Total number of IPv6 DHCP replies filtered
IPv6 Bootp Server Count	Total number of IPv6 DHCP replies filtered
IPv6 Multicast Count	Number of IPv6 Multicast messages filtered
ARP Count	Total number of ARP packets filtered.
All other Count	The count of any messages that did not fit above that were filtered out
User Defined Port1 Count	Number of packets defined by the user port1 that were filtered.
User Defined Port2 Count	Number of packets defined by the user port2 that were filtered.
User Defined Port3 Count	Number of packets defined by the user port3 that were filtered.

Viewing ARP statistics

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

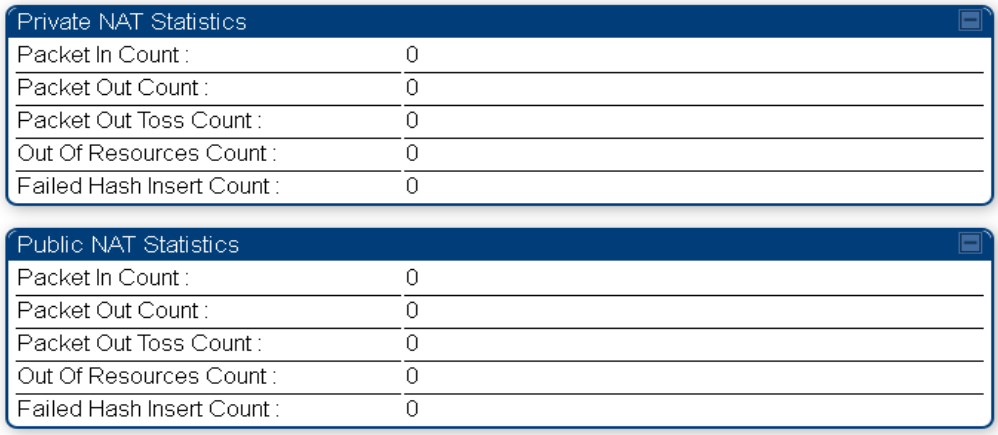
Figure 102 ARP page of the SM



Viewing NAT statistics

When NAT is enabled on a SM, statistics are kept on the Public and Private (WAN and LAN) sides of the NAT and displayed on the **Statistics > NAT Stats** page. The NAT page of SM is explained in Table 160.

Table 161 NAT page attributes - SM



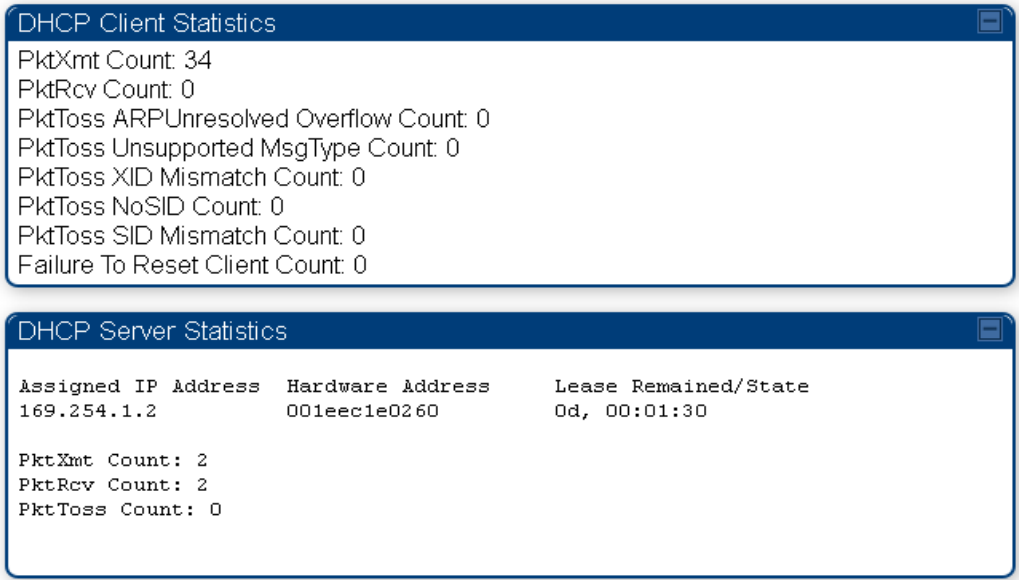
Attribute	Meaning
Private NAT Statistics, Packet In Count	This field represents the number of packets received on the SM's LAN/Ethernet interface
Private NAT Statistics, Packet Out Count	This field represents the number of packets sent from the SM's LAN/Ethernet interface
Private NAT Statistics, Packet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

Viewing NAT DHCP Statistics

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

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

Table 162 NAT DHCP Statistics page attributes - SM



Attribute	Meaning
PktXmt Count	Represents the number of DHCP packets transmitted from the client
PktRcv Count	This field represents the number of DHCP packets received by the client
PktToss ARPUnresolved Overflow Count	This field represents the number of packets tossed due to failed attempts to resolve an IP address into a physical MAC address
PktToss Unsupported MsgType Count	This field represents the number of packets tossed due to the receipt of an unsupported message type (cannot be interpreted by DHCP client)
PktToss XID Mismatch Count	The field represents the number of packets that were tossed due to a transaction ID mismatch
PktToss NoSID Count	This field represents the number of packets that were tossed due to lack of a DHCP session ID
PktToss SID Mismatch Count	Represents the number of packets tossed due to a session ID mismatch

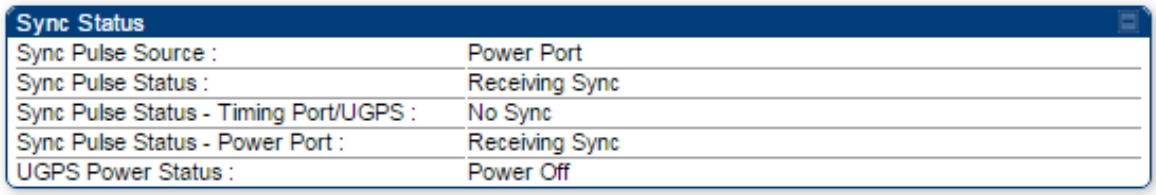
Failure to Reset Client Count	This field represents the number of times the DHCP client was unable to be reset (resulting in no IP address being served).

Interpreting Sync Status statistics

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

The Sync Status page is explained in Table 162.

Table 163 Sync Status page attributes - AP



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

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

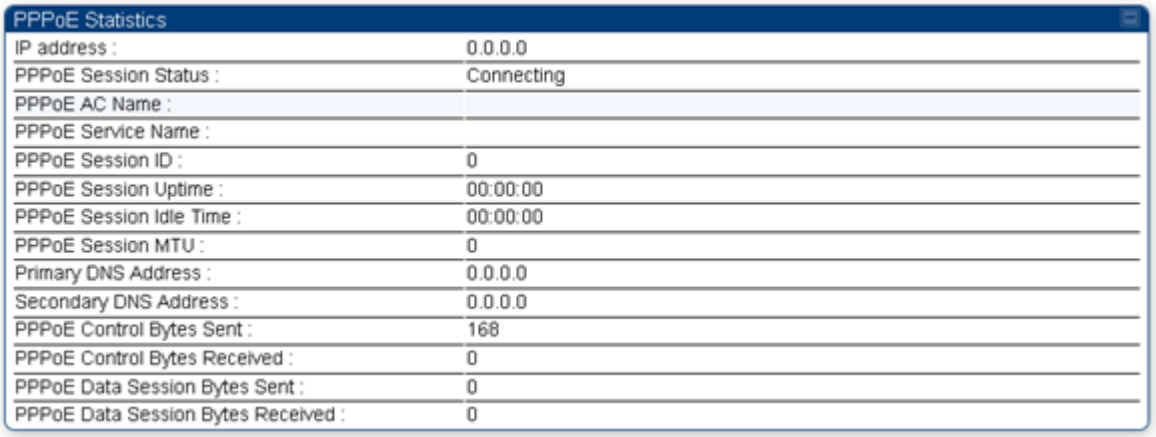
Interpreting PPPoE Statistics for Customer Activities

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

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

The PPPoE Statistics of SM is explained in Table 163.

Table 164 PPPoE Statistics page attributes - SM



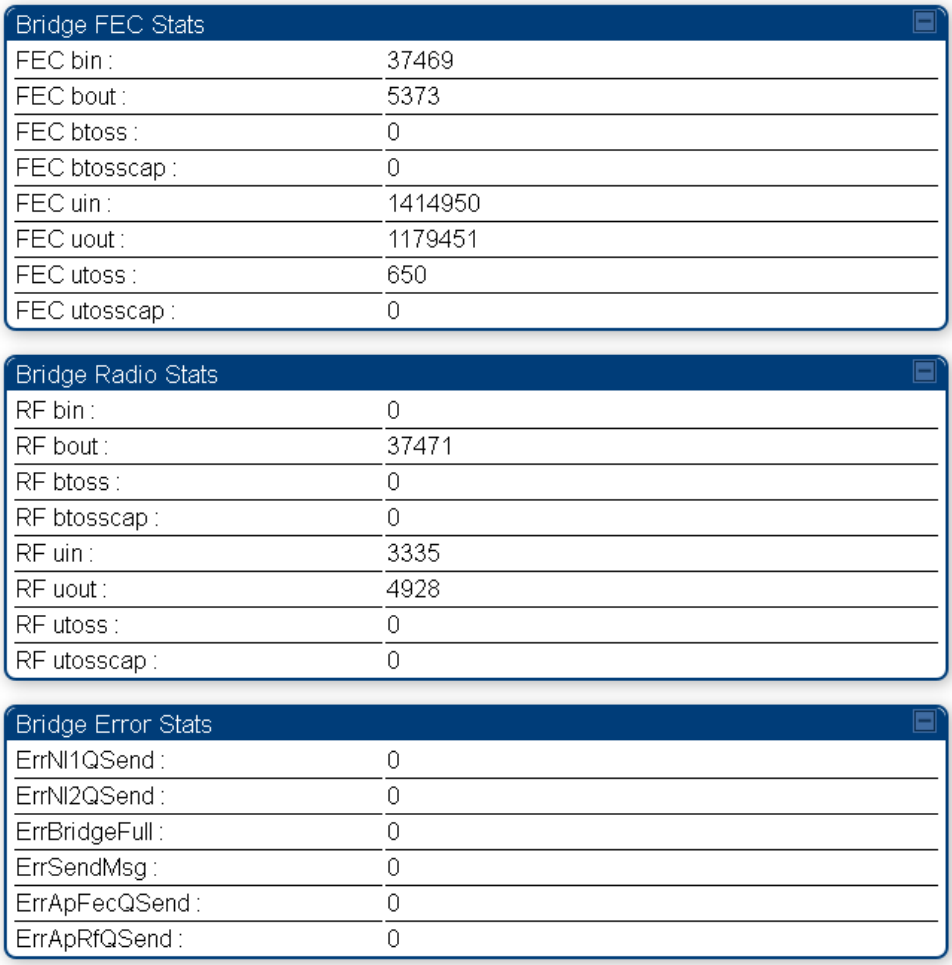
Attribute	Meaning
IP address	This field displays the IP address of the PPPoE session initiator (situated below the SM)
PPPoE Session Status	This field displays the operational status of the PPPoE Session
PPPoE AC Name	This field displays access concentrator name used in the PPPoE session
PPPoE Service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

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

Interpreting Bridge Control Block statistics

The **Statistics > Bridge Control Block** page dipslays statistics of Bridge FEC, Bridge ratio and Bridge error. The page is applicable for all module (AP/SM/BHM/BHS). The Bridge Control Block Statistics page is explained in Table 164.

Table 165 Bridge Control Block page attributes – AP/SM/BHM/BHS



Bridge FEC Stats	
FEC bin :	37469
FEC bout :	5373
FEC btoss :	0
FEC btosscap :	0
FEC uin :	1414950
FEC uout :	1179451
FEC utoss :	650
FEC utosscap :	0

Bridge Radio Stats	
RF bin :	0
RF bout :	37471
RF btoss :	0
RF btosscap :	0
RF uin :	3335
RF uout :	4928
RF utoss :	0
RF utosscap :	0

Bridge Error Stats	
ErrNl1QSend :	0
ErrNl2QSend :	0
ErrBridgeFull :	0
ErrSendMsg :	0
ErrApFecQSend :	0
ErrApRfQSend :	0

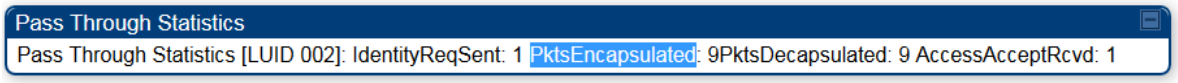
Attribute	Meaning
FEC bin	This field indicates the number of broadcast packets received by the bridge control block on the Ethernet interface
FEC bout	This field indicates the number of broadcast packets sent by the bridge control block on the Ethernet interface
FEC btoss	This field indicates the number of broadcast packets tossed out by the bridge control block on the Ethernet interface
FEC btosscap	This field indicates the number of broadcast packets tossed out at the Ethernet interface due to MIR cap being exceeded.
FEC uin	This field indicates the number of unicast packets received by the bridge control block on the Ethernet interface
FEC uout	This field indicates the number of unicast packets sent by the bridge control block on the Ethernet interface
FEC utoss	This field indicates the number of unicast packets tossed by the bridge control block on the Ethernet interface
FEC utosscap	This field indicates the number of unicast packets tossed out at the Ethernet interface due to MIR cap being exceeded.
RF bin	This field indicates the number of broadcast packets received by the bridge control block on the radio interface
RF bout	This field indicates the number of broadcast packets sent by the bridge control block on the radio interface
RF btoss	This field indicates the number of broadcast packets tossed by the bridge control block on the radio interface
RF btosscap	This field indicates the number of broadcast packets tossed out at the radio interface due to MIR cap being exceeded.
RF uin	This field indicates the number of unicast packets received by the bridge control block on the radio interface
RF uout	This field indicates the number of unicast packets sent by the bridge control block on the radio interface
RF utoss	This field indicates the number of unicast packets tossed by the bridge control block on the radio interface
RF utosscap	This field indicates the number of unicast packets tossed out at the radio interface due to MIR cap being exceeded.
ErrNI1QSend	This field indicates that a packet which was sourced from the radio network stack interface 1 (Ethernet interface) could not be sent because the radio bridge queue was full. The packet was tossed out.
ErrNI2QSend	This field indicates that a packet which was sourced from the radio

	network stack interface 2 (RF interface) could not be sent because the radio bridge queue was full. The packet was tossed out.
ErrBridgeFull	This field indicates the total number of times the bridging table was full and could not accept new entries.
ErrSendMsg	This field displays the error message from bridge core call back routine.
ErrApFecQSend	This field indicates that a packet which was received on the Ethernet interface could not be processed because the radio bridge queue was full and packet was tossed out.
ErrApRfQSend	This field indicates that a packet which was received on the RF interface could not be processed because the radio bridge queue was full. The packet was tossed out.

Interpreting Pass Through Statistics

The **Statistics > Pass Through Statistics** page displays radius related statistics. The page is applicable for PMP 450i AP only. The Pass Through Statistics page is explained in Table 165.

Table 166 Pass Through Statistics page attributes – AP

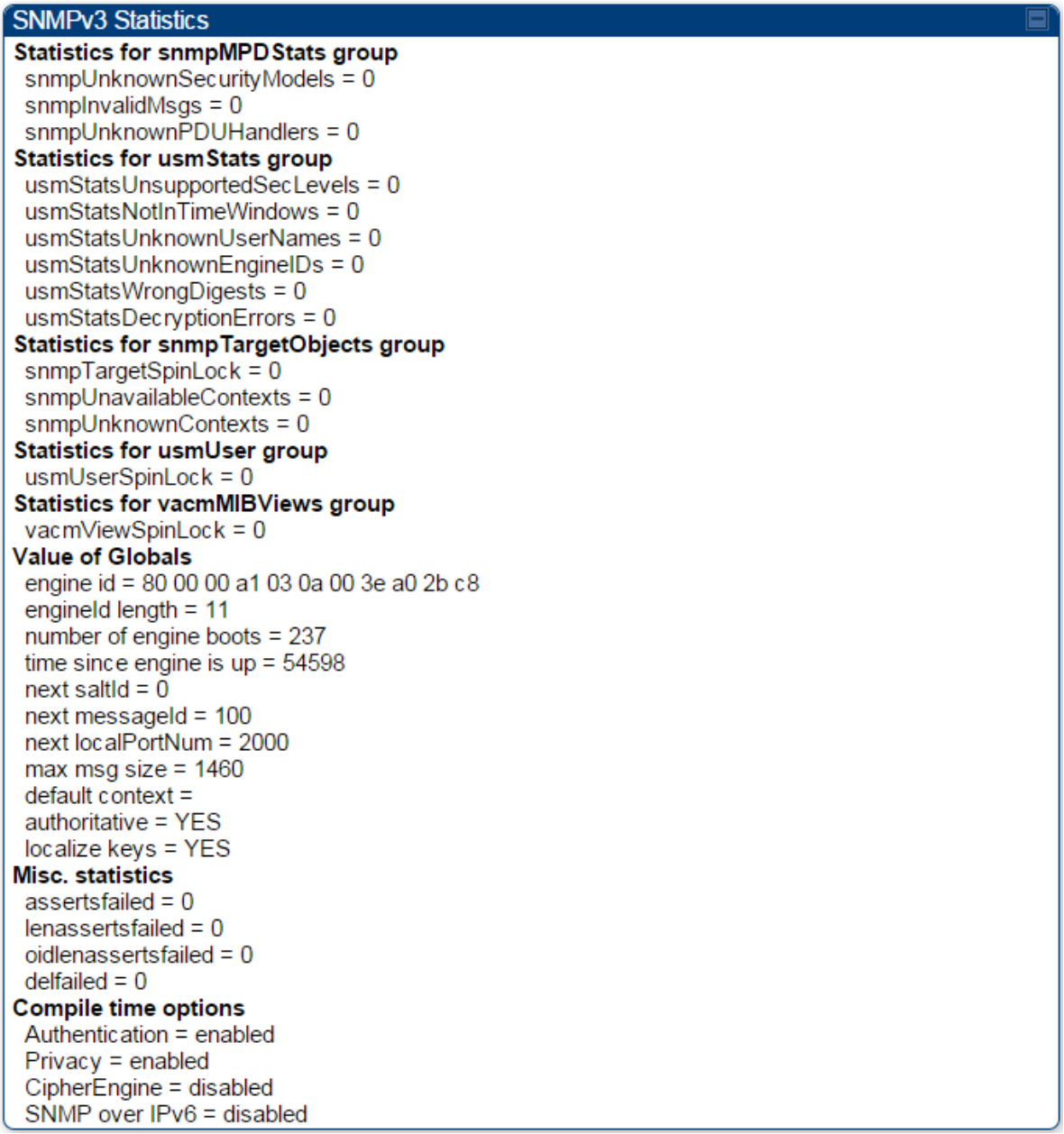


Attribute	Meaning
IdentityReqSent	This field indicates the number of EAP Identity requests sent through the AP with respect to an SM.
PktsEncapsulated	This field indicates no of packets received from the SM which are encapsulated by the AP.
PktsDecasulated	This field indicates no of packets received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

Interpreting SNMPv3 Statistics

The **Statistics > SNMPv3 Statistics** page displays all SNMPv3 related statistics. The page is applicable for all platform of PMP 450i. The SNMPv3 Statistics page is explained in.

Table 167 SNMPv3 Statistics page attributes – AP



Attribute	Meaning
Statistics for snmpMPDStats group	SNMP Message Processing and Dispatching RFC 3412

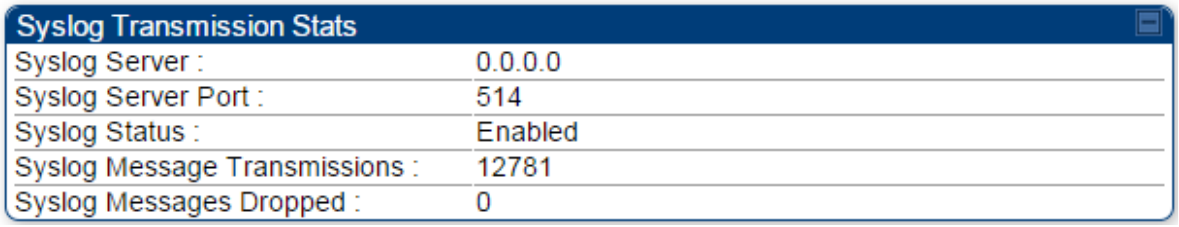
snmpUnknownSecurityModels	The total number of packets received by the SNMP engine which were dropped because they referenced a securityModel that was not known to or supported by the SNMP engine.
snmpInvalidMsgs	The total number of packets received by the SNMP engine which were dropped because there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

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

Interpreting syslog statistics

The **Statistics > Syslog Statistics** page dipslays statistics of syslog messages. The page is applicable for all module (AP/SM/BHM/BHS). The Syslog Statistics page is explained in Table 167.

Table 168 Syslog statistics page attributes – AP/SM/BH



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

Interpreting Frame Utilization statistics

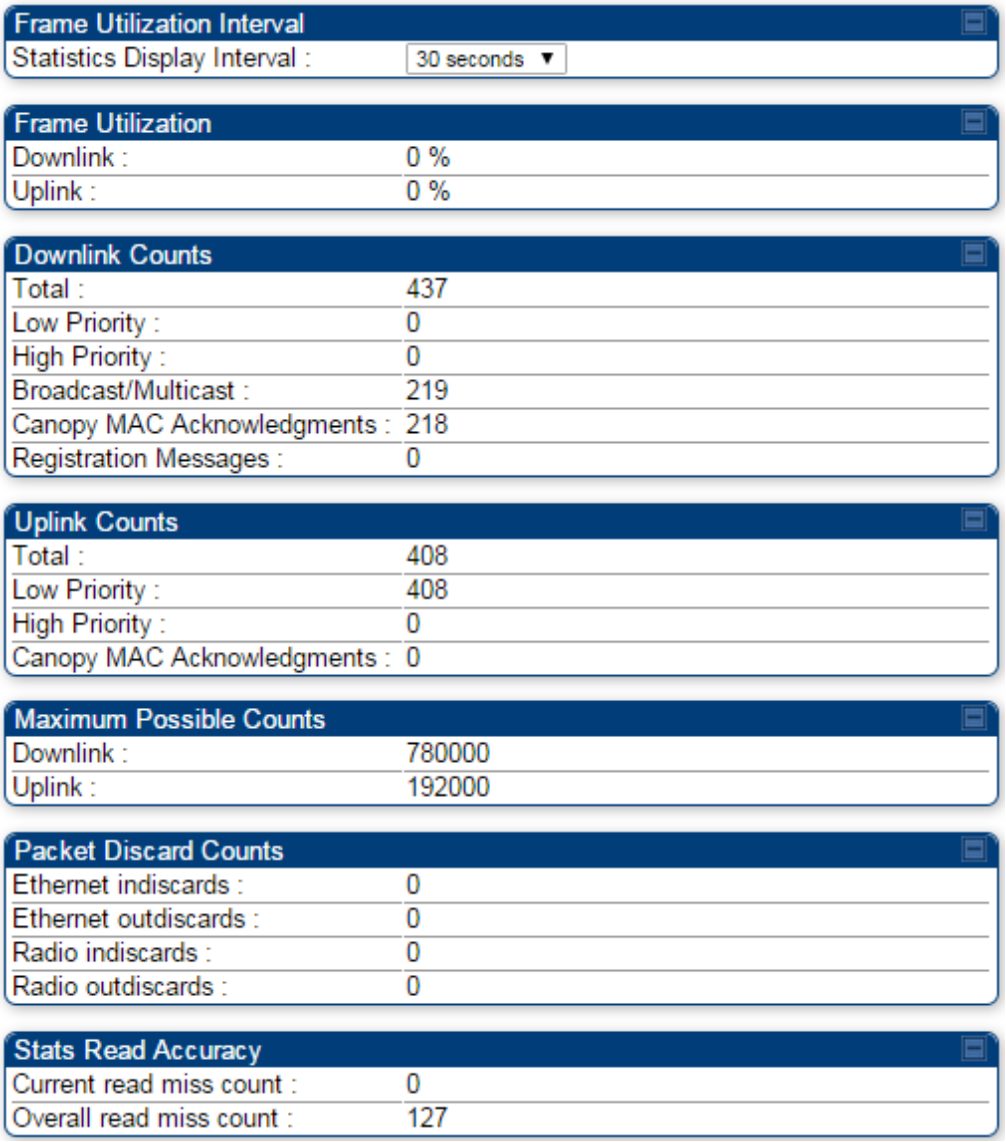
The Frame Utilization Statistics is a feature helps user to understand how effectively the RF channel is being utilized. This feature allows to check Time Division Duplex (TDD) frame utilization pattern and diagnose for any excessive usage in uplink or downlink direction.

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

Note:

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

Table 169 Frame utilization statistics



Attribute	Meaning
Frame Utilization Interval	
Statistics Display interval	This allows to configure timer interval to monitor and display the frame utilization statistics. It can be configured for 30 seconds (low interval), 3 minutes (medium interval) or 15 minutes (high interval) based on requirement.
Frame Utilization	

Downlink	This indicates the percentage of downlink data slots used against the maximum number of slots possible in configured interval.
Uplink	This indicates the percentage of uplink data slots used against the maximum number of uplink slots possible in configured interval.
Downlink Counts	
Total	This indicates the sum of all downlink data slots used in the configured interval.
Low Priority	The number of downlink data slots used for low priority downlink traffic.
High Priority	The number of downlink data slots used for high priority downlink traffic.
Broadcast/Multicast	The number of downlink data slots used for broadcast and multicast traffic.
Canopy MAC Acknowledgements	The number of downlink data slots used as ACKs.
Registration and Control message slots	The number of downlink data slots used for registration and other control messages.
Uplink Counts	
Total	This indicates the sum of all uplink data slots used in configured interval.
Low Priority	The number of downlink data slots used for low priority uplink traffic.
High Priority	The number of downlink data slots used for high priority downlink traffic.
Canopy MAC Acknowledgements	The number of downlink data slots used as ACKs.
Maximum possible counts	
Downlink	This indicates the maximum possible downlink data slots. This is based on the configuration of Channel Bandwidth, Frame period, uplink/downlink allocation, contention slots and configured Statistics Display interval.
Uplink	This indicates the maximum possible uplink data slots. This is based on the configuration of Channel Bandwidth, Frame period, uplink/downlink allocation, contention slots and configured Statistics Display interval.
Packet Discard counts	

Ethernet indiscards	This indicates the number of Ethernet packets discarded in the IN queue.
Ethernet outdiscards	This indicates the number of Ethernet packets discarded in the OUT queue.
Radio indiscards	This indicates the number of packets discarded over radio in the IN queue.
Radio outdiscards	This indicates the number of packets discarded over radio in the OUT queue.

Radio Recovery Console

This section describes how to recover a PMP/PTP 450i unit from configuration errors or software image corruption.

Entering in Radio Recovery Console

Use this procedure to enter recovery console manually.

Note

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

Note

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

Procedure 32 Recovery mode

1. Apply power to PSU for at least 10 seconds.
2. Remove power for two seconds.
3. Re-apply power to the PSU.
4. When the unit is in recovery mode, access the web interface by entering the default IP address **169.254.1.1**. The Recovery Image Warning page is displayed.
5. Review the Boot Selection (Table 169).
6. Select a recovery option

Figure 103 Recovery Options page

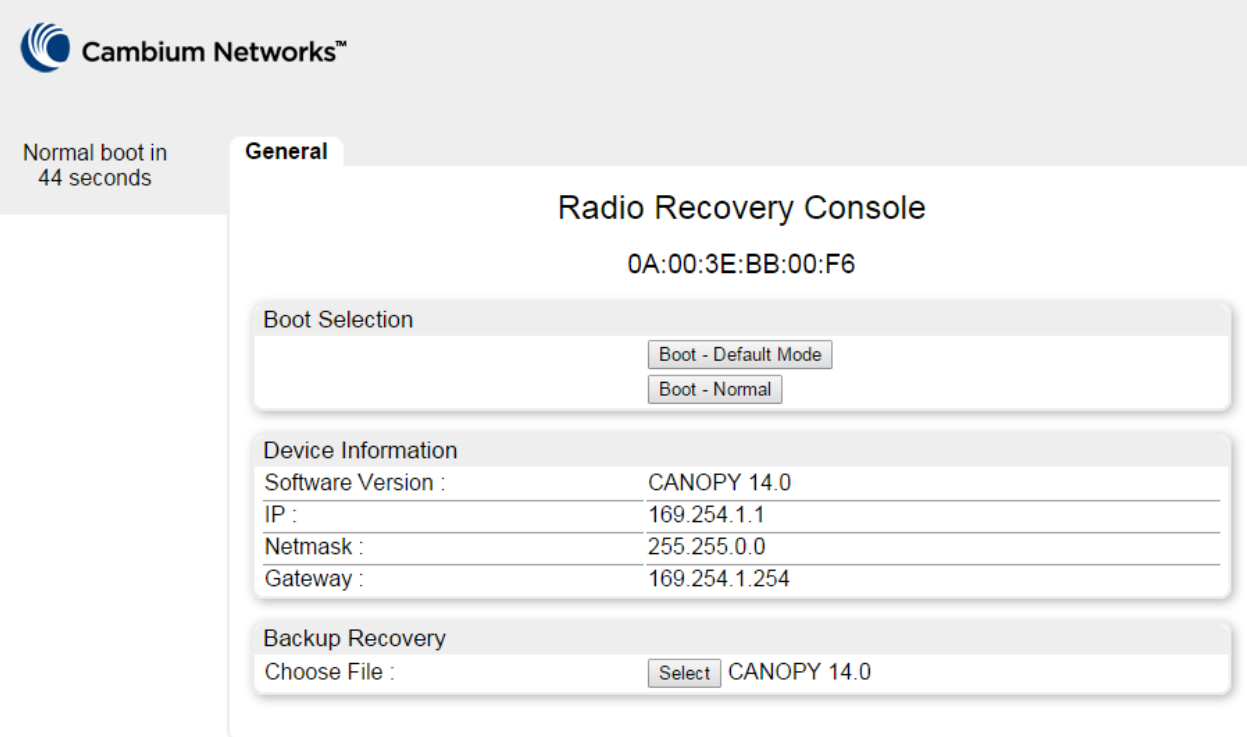


Table 170 Recovery Options attributes

Attribute	Meaning
Boot Selection	**Boot – Default Mode**: Use this option to temporarily set the IP and Ethernet attributes to factory defaults until the next reboot. **Boot – Normal**: Use this option to reboot the unit.
IP address, Netmask, Gateway	These fields display IP address, Netmask and Gateway of the radio while it is in recovery or default mode.
Backup Recovery Choose File	Use this option to restore a working software version when software corruption is suspected, or when an incorrect software image has been loaded.

Chapter 10: Reference Information

This chapter contains reference information and regulatory notices that apply to the PMP/PTP 450i Series products.

The following topics are described in this chapter:

- Equipment specifications on page 10-2 contains specifications of the PMP/PTP 450i, ODU specifications including RF bands, channel width and link loss.
- Data network specifications on page 10-13 shows the PMP/PTP 450i Ethernet interface specifications.
- Compliance with safety standards on page 10-16 lists the safety specifications against which the PMP/PTP 450i has been tested and certified. It also describes how to keep RF exposure within safe limits.
- Compliance with radio regulations on page 10-17 describes how the PMP/PTP 450i complies with the radio regulations that are enforced in various countries.
- Equipment Disposal on page 10-2 shows the notifications made to regulatory bodies for the PMP/PTP 450i.

Equipment specifications

This section contains specifications of the AP, SM, BHM and BHS associated supplies required for PMP/PTP 450i installations.

Specifications for AP

The PMP 450i AP conforms to the specifications listed in Table 170.

Table 171 AP specifications

Category		Specification
Model Number		PMP 450i AP
Spectrum		
Channel Spacing		5, 10 and 20 MHz Channel Bandwidth Configurable on 2.5 MHz increments
Frequency Range		4900 - 5925 MHz
Channel Width		5, 10 and 20 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v3
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = --90 dBm, 2x = -85.7 dBm, 4x = -80 dBm, 6x = -72.4 dBm, 8x = -65.7 dBm
	5.4 GHz	1x = --91 dBm, 2x = -86.3 dBm, 4x = -79.8 dBm, 6x = -73.5 dBm, 8x = -66 dBm
	5.8 GHz	1x = -91 dBm, 2x = -86.3 dBm, 4x = --79.8 dBm, 6x = -

		73.5 dBm, 8x = -66 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = --87.9 dBm, 2x = -84.1 dBm, 4x = -78 dBm, 6x = -71.5 dBm, 8x = -64.8 dBm
	5.4 GHz	1x = --88 dBm, 2x = -84.1 dBm, 4x = -77.1 dBm, 6x = -71.2 dBm, 8x = -64.2 dBm
	5.8 GHz	1x = --88 dBm, 2x = -84.1 dBm, 4x = -77.1 dBm, 6x = -71.2 dBm, 8x = -64.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = --85.6 dBm, 2x = -80.4 dBm, 4x = -74.3 dBm, 6x = -68.2 dBm, 8x = -61 dBm
	5.4 GHz	1x = --86 dBm, 2x = -82 dBm, 4x = -75 dBm, 6x = -68.9 dBm, 8x = -61 dBm
	5.8 GHz	1x = --86 dBm, 2x = -82 dBm, 4x = -75 dBm, 6x = -68.9 dBm, 8x = -61 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms
Modulation Levels (Adaptive)		Modution Levels / MCS / SNR (in dB)
		2x / QPSK / 10
		4x / 16QAM / 17
		6x / 64QAM / 24
		8x / 256QAM / 32
Latency		3 - 5 ms
Maximum Deployment Range		Up to 40 miles (64 km)
GPS Synchronization		Yes, via Autosync (CMM4), via uGPS
Quality of Service		Diffserv QoS
Link Budget		
Antenna Beam Width		90° (3dB rolloff) sector for integrated (Dual polarity, H+V)

Antenna Gain (Does not include cable loss, ~1dB)	5 GHz	16 dBi integrated 90° sector or external
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)
Maximum Transmit Power		+27 dBm combined output
Physical		
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output • Sync input or output (Connection and powering of UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension(HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.3” x 5.3” x 3.3”)
	Integrated	37.0 x 37.0 x 6.3 cm (14.5” x 14.5” x 3.2”)
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		

Encryption	56-bit DES, FIPS-197 128-bit AES

Specifications for SM

The PMP 450i SM conforms to the specifications listed in Table 171.

Table 172 PMP 450i SM specifications

Category		Specification
Model Number		PMP 450i SM
Spectrum		
Channel Spacing		5, 10 and 20 MHz Channel Bandwidth Configurable on 2.5 MHz iments
Frequency Range		4900 - 5925 MHz
Channel Width		5, 10 and 20 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -93 dBm, 2x = -88.5 dBm, 4x = -81.4 dBm, 6x = -75 dBm, 8x = -67.5 dBm
	5.4 GHz	1x = -93 dBm, 2x = -88.7 dBm, 4x = -82.4 dBm, 6x = -76.1 dBm, 8x = -68.5 dBm
	5.8 GHz	1x = -93 dBm, 2x = -89.6 dBm, 4x = -82.6 dBm, 6x = -76.4 dBm, 8x = -67 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -89.7 dBm, 2x = -84.6 dBm, 4x = -78.6 dBm, 6x = -71.7 dBm, 8x = -65.7 dBm
	5.4 GHz	1x = -89.5 dBm, 2x = -86.3 dBm, 4x = -79.3 dBm, 6x = -73.1 dBm, 8x = -65.4 dBm

	5.8 GHz	1x = -90 dBm, 2x = -85.2 dBm, 4x = -78.7 dBm, 6x = -73 dBm, 8x = -65.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -86.8 dBm, 2x = -82 dBm, 4x = -75.7 dBm, 6x = -69.4 dBm, 8x = -62.7 dBm
	5.4 GHz	1x = -86.1 dBm, 2x = -82.3 dBm, 4x = -76 dBm, 6x = -69.3 dBm, 8x = -62.3 dBm
	5.8 GHz	1x = -87.5 dBm, 2x = -83.1 dBm, 4x = -76.3 dBm, 6x = -69.1 dBm, 8x = -61.3 dBm
Performance		
ARQ		Yes
Cyclic Prefix		1/16
Frame Period		2.5 ms or 5.0 ms
Modulation Levels (Adaptive)		Modution Levels / MCS / SNR (in dB)
		2x / QPSK / 10
		4x / 16QAM / 17
		6x / 64QAM / 24
		8x / 256QAM / 32
Latency		3 - 5 ms
Maximum Deployment Range		Up to 40 miles (64 km)
GPS Synchronization		Yes, via Autosync (CMM4)
Quality of Service		Diffserv QoS
Link Budget		
Antenna Beam Width		10° azimuth for 23 dBi integrated antenna
Antenna Gain (Does not include cable loss, ~1dB)	5 GHz	+23 dBi H+V, integrated or external
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)
Maximum Transmit Power		+27 dBm combined output

Physical		
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output • Sync input or output (Connection and powering of UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension(HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.3″ x 5.3″ x 3.3″)
	Integrated	31.0 x 31.0 x 6.4 cm (12″ x 12″ x 2.5″)
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		56-bit DES, FIPS-197 128-bit AES

Specifications for BH

The PTP 450i BH conforms to the specifications listed in Table 172.

Table 173 PMP 450i BH specifications

Category		Specification
Model Number		PMP 450i BH
Spectrum		
Channel Spacing		5, 10 and 20 MHz Channel Bandwidth Configurable on 2.5 MHz increataements
Frequency Range		4900 - 5925 MHz
Channel Width		5, 10 and 20 MHz
Interface		
MAC (Media Access Control) Layer		Cambium Proprietary
Physical Layer		2x2 MIMO OFDM
Ethernet Interface		10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)
Protocols Used		IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management		HTTP, HTTPS, Telnet, FTP, SNMP v2c and v3
VLAN		802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID
Sensitivity		
Nominal Receive Sensitivity (w/ FEC) @ 5 MHz Channel	4.9 GHz	1x = -92.7 dBm, 2x = -88.1 dBm, 4x = -81 dBm, 6x = -75 dBm, 8x = -67.8 dBm
	5.4 GHz	1x = -92.4 dBm, 2x = -88.4 dBm, 4x = -81.3 dBm, 6x = -75.5 dBm, 8x = -67.8 dBm
	5.8 GHz	1x = -92.3 dBm, 2x = -87.5 dBm, 4x = -80.4 dBm, 6x = -74 dBm, 8x = -67.2 dBm
Nominal Receive Sensitivity (w/ FEC) @ 10 MHz Channel	4.9 GHz	1x = -89.2 dBm, 2x = -85.1 dBm, 4x = -77.8 dBm, 6x = -72 dBm, 8x = -64.9 dBm
	5.4 GHz	1x = -90 dBm, 2x = -85 dBm, 4x = -78.7 dBm, 6x = -71.6 dBm, 8x = -64.4 dBm
	5.8 GHz	1x = -89.9 dBm, 2x = -84.3 dBm, 4x = -78 dBm, 6x = -71.5 dBm, 8x = -64 dBm

Nominal Receive Sensitivity (w/ FEC) @ 20 MHz Channel	4.9 GHz	1x = -87.1 dBm, 2x = -82.1 dBm, 4x = -74.7 dBm, 6x = -69.2 dBm, 8x = -61.2 dBm		
	5.4 GHz	1x = -86 dBm, 2x = -81.6 dBm, 4x = -74.9 dBm, 6x = -68.4 dBm, 8x = -61 dBm		
	5.8 GHz	1x = -86.6 dBm, 2x = -80.4 dBm, 4x = -74.7 dBm, 6x = -68.5 dBm, 8x = -61 dBm		
Performance				
ARQ		Yes		
Cyclic Prefix		1/16		
Frame Period		2.5 ms or 5.0 ms		
Modulation Levels (Adaptive)		Modution Levels	MCS	SNR (in dB)
		2x	QPSK	10
		4x	16QAM	17
		6x	64QAM	24
		8x	256QAM	32
Latency		3 - 5 ms		
Maximum Deployment Range		Up to 40 miles (64 km)		
GPS Synchronization		Yes, via Autosync (CMM4)		
Quality of Service		Diffserv QoS		
Link Budget				
Antenna Beam Width		10° azimuth for 23 dBi integrated antenna		
Antenna Gain (Does not include cable loss, ~1dB)	5 GHz	+23 dBi H+V, integrated or external		
Transmit Power Range		40 dB dynamic range (to EIRP limit by region) (1 dB step)		
Maximum Transmit Power		+27 dBm combined output		
Physical				
Sync/AUX port	RJ45	• 10/100/100BASE-T Ethernet Data • PoE output • Sync input or output (Connection and powering of		

		UGPS Sync input)
Antenna Connection		50 ohm, N-type (Connectorized version only)
Surge Suppression EN61000-4-5		EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000000L033A
Mean Time Between Failure		> 40 Years
Environmental		IP66, IP67
Temperature / Humidity		-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing
Weight	Connectorized	Approx. 2.0 kg (4.5 lbs)
	Integrated	Approx. 2.5 kg (5.5 lbs)
Wind Survival	Connectorized	322 km/h (200 mi/h)
	Integrated	200 km/h (124 mi/h)
Dimension(HxWxD)	Connectorized	26.0 x 13.4 x 6.4 cm (10.25″ x 5.25″ x 3.25″)
	Integrated	31.0 x 31.0 x 6.4 cm (12″ x 12″ x 2.5″)
Power Consumption		15 W typical, 25 W max, 55 W max with Aux port PoE out enabled
Input Voltage		48-59 V DC, 802.3at compliant
Mounting		Wall or Pole mount with Cambium Networks Model # N000045L002A
Security		
Encryption		56-bit DES, FIPS-197 128-bit AES

PSU specifications

The PTP 450i AC+DC Enhanced Power Injector conforms to the specifications listed in Table 173.

Table 174 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	0°C to +40°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	55V +/- 5%
AC connector	IEC-320-C8
Efficiency	Better than 85%, efficiency level 'V'
Over Current Protection	Hiccup current limiting, trip point set between 120% to 150% of full load current
Hold up time	At least 10 milliseconds

Data network specifications

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

Ethernet interface

The PMP/PTP 450i Main Ethernet port conforms to the specifications listed in Table 174.

Table 175 PMP/PTP 450i Main Ethernet bridging specifications

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

Note

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

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

Wireless specifications

This section contains specifications of the PMP/PTP 450i 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 PMP/PTP 450i variants are listed under Table 175.

Table 176 PMP/PTP 450i wireless specifications

Item	Specification
Channel selection	Manual selection (fixed frequency).
Manual power control	To avoid interference to other users of the band, maximum power can be set lower than the default power limit.
Duplex scheme	Adaptive TDD
Range	5 GHz – 40 mi / 64 km
Over-the-air encryption	DES, AES
Error Correction	Rate 3/4 RS coder

Link range

Example of the link ranges for PMP and PTP modes are provided in Table 176 and Table 177. These assumes the transmit power is not limited by the country of operation for the selected band.

PMP 450i

Table 177 Link range – PMP 5.8 GHz link, 20 MHz Channel Bandwidth, 2.5ms frame duration, antenna gain of 17 dBi at AP and 23 dBi at the SM

Parameter	Range Details (km)				
	1x	2x	4x	6x	8x
Modulation	QPSK-MIMO-A	QPSK-MIMO-B	16QAM-MIMO-B	64QAM-MIMO-B	256QAM-MIMO-B
Max. LOS (no fade margin)	239.6	68.3	35.4	16.8	6.7
Max. nLOS (additional 5 dB link loss)	134.8	38.4	19.9	9.4	3.8
Max. NLOS1 (additional 15 dB link loss)	42.6	12.1	6.3	3.0	1.2
Max. NLOS2 (additional 25 dB link loss)	13.5	3.8	2.0	0.9	0.4

PTP 450i

Table 178 Link range – PTP 5.8 GHz link, 20 MHz Channel Bandwidth, 2.5ms frame duration, antenna gain of 23 dBi at each end

Parameter	Range Details (km)				
	1x	2x	4x	6x	8x
Modulation	QPSK-MIMO-A	QPSK-MIMO-B	16QAM-MIMO-B	64QAM-MIMO-B	256QAM-MIMO-B
Max. LOS (no fade margin)	239.6	136.3	70.7	33.5	13.3
Max. nLOS (additional 5 dB link loss)	134.8	76.7	39.8	18.8	7.5
Max. NLOS1 (additional 15 dB link loss)	42.6	24.2	12.6	6.0	2.4
Max. NLOS2 (additional 25 dB link loss)	13.5	7.7	4.0	1.9	0.7

Compliance with safety standards

This section lists the safety specifications against which the PMP/PTP 450i has been tested and certified. It also describes how to keep RF exposure within safe limits.

Electrical safety compliance

The PMP/PTP 450i hardware has been tested for compliance to the electrical safety specifications listed in Table 178.

Table 179 PMP 450 safety compliance specifications

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

Electromagnetic compatibility (EMC) compliance

The EMC specification type approvals that have been granted for PMP/PTP 450i are listed under Table 179.

Table 180 EMC emissions compliance

Region	Specification
USA	FCC Part 15 Class B
Canada	RSS Gen
EU	EN 301 489-1 V1.9.2 EN 301 489-17 V2.1.1

Compliance with radio regulations

This section describes how the PMP/PTP 450i 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 products and installations.

The radio specification type approvals that have been granted for PMP 450 frequency variants are listed under Table 180.

Table 181 Radio certifications

Region/Country	Band	Specification
Brazil	4.9 GHz	ANATEL, RESOLUÇÃO N° 633, DE 14 DE MARÇO DE 2014
	5.4 GHz	ANATEL, RESOLUTION No. 506, FROM JULY 1, 2008
	5.8 GHz	ANATEL, RESOLUTION No. 506, FROM JULY 1, 2008
Mexico	4.9 GHz	Protocol Between the UNITED STATES OF AMERICA and MEXICO – Use of 4940 to 4990 MHz band.
	5.4 GHz	Acuerdo del 27 de noviembre de 2012
	5.8 GHz	NOM-121-SCT1-2009
USA	4.9 GHz	FCC 47 CFR Part 90
	5.1 GHz	FCC 47 CFR Part 15 E
	5.8 GHz	FCC 47 CFR Part 15 C
Canada (Pending)	4.9 GHz	IC RSS-111 Issue 5
	5.8 GHz	IC RSS-247 Issue 1
Europe	4.9 GHz	ETSI EN302 625; V1.1.1 Broadband Disaster Relief

DFS for 5 GHz Radios

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

The details of DFS operation and channels available for each Country Code, including whether DFS is active on the AP, SM, which DFS regulation apply, and any channel restrictions are shown in Table 181 on page 10-18.

Table 182 Country & Bands DFS setting

Region Code	Country Code	Band	AP	SM	Weather Radar Notch-Out
North America	Mexico	5.4 GHz	ETSI EN 301 893 v1.8.1 DFS	No effect	No
South America	Brazil	5.4 GHz	ETSI EN 301 893 v1.8.1 DFS	No effect	No
Europe	ETSI	5.4 GHz	ETSI EN 301 893 v1.8.1 DFS	ETSI EN 301 893 v1.8.1 DFS	Yes
		5.8 GHz	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS	Yes
Other-Regulatory	Other-FCC	5.4 GHz	FCC DFS	FCC DFS	No
	Other-ETSI	5.4 GHz	ETSI EN 301 893 v1.8.1 DFS	ETSI EN 301 893 v1.8.1 DFS	No
		5.8 GHz	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS	No

Maximum transmit power per Country Code

Table 183 Default combined transmit power per Country Code – 4.9 GHz band

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Mexico, Canada, Other FCC	AP	Sector	5 MHz	24	40
			10 MHz	24	40
			20 MHz	23	39
		Omni	5 MHz	24	35
			10 MHz	24	36
			20 MHz	23	35
	SM, BH	Flate plate	5 MHz	24	51
			10 MHz	24	51
			20 MHz	23	50
		4ft parabolic	5 MHz	24	52
			10 MHz	24	55
			20 MHz	23	56
		6ft parabolic	5 MHz	24	52
			10 MHz	24	55
			20 MHz	23	58
Brazil	Any	Any	5 MHz	23	54
			10 MHz	27	57
			20 MHz	27	60
Other	Any	Any	Any	27	-

Table 184 Default combined transmit power per Country Code – 5.1 GHz band

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
USA, Other FCC	AP	Sector	5 MHz	12	30
			10 MHz	15	30
			20 MHz	16	30
		Omni	5 MHz	16	30
			10 MHz	17	30
			20 MHz	17	30
	SM, BH	Flate plate	5 MHz	-2	30
			10 MHz	1	30
			20 MHz	3	30
		4ft parabolic	5 MHz	6	30
			10 MHz	9	30
			20 MHz	9	30

Table 185 Default combined transmit power per Country Code – 5.4 GHz band

Countries	Device Type	Antenna Type	Channel BW	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Brazil	Any	Any	10 MHz	19	30
			20 MHz	23	30
Mexico	Any	Any	10 MHz	-	30
			20 MHz	-	30
Other	Any	Any	Any	27	-

Table 186 Default combined transmit power per Country Code – 5.8 GHz band

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

FCC compliance

4.9 GHz FCC notification

The system has been approved under FCC Part 90 for Public Safety Agency usage. The installer or operator is responsible for obtaining the appropriate site licenses before installing or using the system.

5 GHz FCC notification

This device complies with part 15C of the US 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US 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 these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from which the receiver is connected to.
- Consult the dealer and/or experienced radio/TV technician for help.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

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 PMP/PTP 450i products to generally meet the Class B requirement to minimize the potential for interference, the PMP/PTP 450i product range is not marketed for use in a residential environment.

FCC IDs

Table 187 US FCC IDs

FCC ID	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum Combined Tx Output Power
QWP-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
			20 MHz	4950.0 – 4980.0 MHz	23.5 dBm
		5.1 GHz	5 MHz	5156.0 – 5247.5 MHz	16 dBm
			10 MHz	5160.0 – 5164.75 MHz	17 dBm
				5165.0 – 5245.0 MHz	19 dBm
			20 MHz	5169.0 – 5175.75 MHz	17 dBm
				5176.0 – 5240.0 MHz	23 dBm
		5.8 GHz	5 MHz	5730.0 – 5845.0 MHz	28 dBm
			10 MHz	5730.0 – 5845.0 MHz	28 dBm
			20 MHz	5735.0 – 5840.0 MHz	28 dBm

FCC approved antenna list

Table 188 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	N/A	16.0
	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 189 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
	2 ft dual polarised flat plate	Mars Antennas	MA-WA56-DP-28N	28.5
	4 ft parabolic dual polarised	Gabriel Antennas	PX4F-52-N7A/A	34.5
Sector	Integrated 90° sector flat plate	Cambium Networks	N/A	16.0
	90° sectorised	Cambium Networks	#85009324001	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 190 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	N/A	16.0
	90° sectorised	Cambium Networks	#85009324001	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 191 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	N/A	16.0
	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

Industry Canada certification

4.9 GHz IC notification

The system has been approved under Industry Canada 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 IC

Le système a été approuvé en vertu de Industrie Canada 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 IC notification

This device complies with Industry Canada 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 IC

Cet appareil est conforme à Industrie Canada 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.

IC notification 5.8 GHz

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

> This device complies with Industry Canada 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 5650 – 5850 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 IC

RSS-GEN issue 3 (7.1.3) appariel utilisant la bande sans license:

> *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) de la 5650 - spectre 5850 MHz. Ces radars peuvent causer des interférences et / ou interférer avec un réseau local ne nécessitant pas de licence.

IC certification numbers

Table 192 Industry Canada Certification Numbers

IC Cert. #	Product	Frequency Band	Channel Bandwidth	Frequencies	Maximum Combined Tx Output Power
109AO-50450I (Pending)	5 GHz AP, SM & BHM	4.9 GHz	5 MHz	4942.5 – 4987.5 MHz	24 dBm
			10 MHz	4945.0 – 4985.0 MHz	24 dBm
			20 MHz	4950.0 – 4980.0 MHz	23.5 dBm
		5.8 GHz	5 MHz	5730.0 – 5845.0 MHz	28 dBm
			10 MHz	5730.0 – 5845.0 MHz	28 dBm
			20 MHz	5735.0 – 5840.0 MHz	28 dBm

Canada approved antenna list

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. 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, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (PIRE) 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 Industry Canada to operate with the antenna types listed in Compliance with radio regulations, Industry Canada certification, Table 192 and Table 193 with the maximum permissible gain and required antenna impedance for each 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.

Le présent émetteur radio (identifier le dispositif par son numéro de certification) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans la section Compliance with radio regulations, Industry Canada certification, Table 192 and Table 193 et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Table 193 Canada approved 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	N/A	16	16
	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 194 Canada approved 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
	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	N/A	16.0
	90° sectorised	Cambium Networks	#85009324001	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

Brazil notification

For compliant operation in the 5.4 GHz band, the Equivalent Isotropic Radiated Power from the integrated antenna or connectorized antenna shall not exceed 27 dBm (0.5 W).

The operator is responsible for enabling the DFS feature on any Canopy 5.4 GHz radio by setting the Country Code to “Brazil”, including after the module is reset to factory defaults.

Important Note: This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and cannot cause harmful interference on systems operating as primary applications.

Brazil certification numbers

The Anatel certification number for Brazil for the PMP/PTP 450i is 2426-15-7745.

Regulatory Requirements for CEPT Member States (www.cept.org)

When operated in accordance with the instructions for use, Cambium Wireless equipment operating in the 5.1 GHz and 5.4 GHz bands is compliant with CEPT Resolution 229 (REV. WRC-12).

Operating the PMP/PTP 450i in the bands 5150 to 5350 MHz and 5470 to 5725 MHz is granted providing it is not causing interference to the existing primary services allocated to those bands.

For compliant operation in the 5250 to 5350 MHz band, the transmit power from the integrated antenna or a connectorized antenna shall be limited to a maximum mean EIRP of 200 mW and a maximum mean EIRP density of 10 mW/MHz in any 1 MHz band.

For compliant operation in the 5470 to 5725 MHz band, the transmit power shall be restricted to a maximum of 250 mW with a maximum mean EIRP of 1 W and a maximum mean EIRP density of 50 mW/MHz in any 1 MHz band.

For compliant operation in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the PMP/PTP 450i employs transmitter power control.

For EU member states, RLAN equipment in the 5.4GHz bands is exempt from individual licensing under Commission Recommendation 2003/203/EC. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see www.ero.dk for further information.

Cambium Radio equipment operating in the 5470 to 5725 MHz band are categorized as "Class 1" devices within the EU in accordance with ECC DEC(04)08 and are "CE" marked CE 0977 ① to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://www.cambiumnetworks.com/support/ec_doc/.

A European Commission decision, implemented by Member States on 31 October 2005, makes the frequency band 5470-5725 MHz available in all EU Member States for wireless access systems. Under this decision, the designation of Canopy 5.4GHz products become "Class 1 devices" and these do not require notification under article 6, section 4 of the R&TTE Directive. Consequently, these 5.4GHz products are only marked with the CE 0977 ① symbol and may be used in any member state.

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.

Chapter 11: Troubleshooting

This chapter contains procedures for identifying and correcting faults in a PMP/PTP 450 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

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:
  - Operating procedures
  - Site-specific configuration records
  - Network topology
  - Software releases, boot versions and FPGA firmware versions
  - Types of hardware deployed
  - Site-specific troubleshooting processes
  - Escalation procedures
- Capture baseline data into the log from the sources listed above

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 (https://support.cambiumnetworks.com/forum) 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 on page 11-5
  - NAT/DHCP-configured SM has lost or does not establish connectivity on page 11-7
  - SM Does Not Register to an AP on page 11-9
  - Module has lost or does not gain sync on page 11-10
  - Module does not establish Ethernet connectivity on page 11-11
  - CMM4 does not pass proper GPS sync to connected modules on page 11-12
  - Module Software Cannot be Upgraded on page 11-13
  - Module Functions Properly, Except Web Interface Became Inaccessible on page 11-13

Troubleshooting procedures

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

Module has lost or does not establish connectivity

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

Procedure 33 Troubleshooting loss of connectivity

1. Isolate the end user/SM from peripheral equipment and variables such as routers, switches and firewalls.
2. Set up the minimal amount of equipment.
3. On each end of the link:
   - Check the cables and connections.
   - Verify that the cable/connection scheme—straight-through or crossover—is correct.
   - Verify that the LED labeled LNK is green.
   - Access the General Status tab in the Home page of the module.
   - Verify that the SM is registered.
   - Verify that Received Power Level is -87 dBm or higher.
   - Access the IP tab in the Configuration page of the module.
   - Verify that IP addresses match and are in the same subnet.
   - If RADIUS authentication is configured, ensure that the RADIUS server is operational

4 On the SM end of the link:

- Verify that the PC that is connected to the SM is correctly configured to obtain an IP address through DHCP.
- Execute **ipconfig** (Windows) or **ifconfig** (linux)
- Verify that the PC has an assigned IP address.

5 On each end of the link:

- Access the **General** tab in the Configuration page of each module.
- Verify that the setting for **Link Speeds** (or negotiation) matches that of the other module.
- Access the **Radio** tab in the Configuration page of each module.
- Verify that the **Radio Frequency Carrier** setting is checked in the Custom Radio Frequency Scan Selection List.
- Verify that the **Color Code** setting matches that of the other module.
- Access the browser LAN settings (for example, at **Tools > Internet Options > Connections > LAN Settings** in Internet Explorer).
- Verify that none of the settings are selected.
- Access the **Link Capacity Test** tab in the Tools page of the module.
- Perform a link test
- Verify that the link test results show efficiency greater than 90% in both the uplink and downlink
- Execute **ping**.
  - Verify that no packet loss was experienced.
  - Verify that response times are not significantly greater than
    - 4 ms from AP to SM
    - 15 ms from SM to AP
  - Replace any cables that you suspect may be causing the problem.

Note

A ping size larger than 1494 Bytes to a module times out and fails. However, a ping of this size or larger to a system that is behind a Canopy module typically succeeds. It is generally advisable to ping such a system, since Canopy handles that ping with the same priority as is given all other transport traffic. The results are unaffected by ping size and by the load on the Canopy module that brokers this traffic.

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

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

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

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

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

Procedure 34 Troubleshooting loss of connectivity for NAT/DHCP-configured SM

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

SM Does Not Register to an AP

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

Procedure 35 Troubleshooting SM failing to register to an AP

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

Module has lost or does not gain sync

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

Procedure 36 Troubleshooting loss of sync

1. Access the Event Log tab in the Home page of the SM
2. Check for messages with the following format:
   RcvFrmNum =
   ExpFrmNum =
3. If these messages are present, check the Event Log tab of another SM that is registered to the same AP for messages of the same type.
4. If the Event Log of this second SM *does not* contain these messages, then the fault is isolated to the first SM.

   If the Event Log page of this second SM contains these messages, access the GPS Status page of the AP.
5. If the **Satellites Tracked** field in the GPS Status page of the AP indicates fewer than 4 or the **Pulse Status** field does not indicate Generating Sync, check the GPS Status page of another AP in the same AP cluster for these indicators. GPS signal acquisition must not take longer than 5 minutes from unit startup.
6. If these indicators are present in the second AP, then:
   - Verify that the GPS antenna still has an unobstructed view of the entire horizon.
   - Visually inspect the cable and connections between the GPS antenna and the CMM4. If this cable is not shielded, replace the cable with shielded cable
7. If these indicators *are not* present in the second AP, visually inspect the cable and connections between the CMM4 and the AP antenna. If this cable is not shielded, replace the cable with shielded cable.

Module does not establish Ethernet connectivity

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

Procedure 37 Troubleshooting loss of Ethernet connectivity

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

CMM4 does not pass proper GPS sync to connected modules

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

Procedure 38 Troubleshooting CMM4 not passing sync

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

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

Module Software Cannot be Upgraded

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

Procedure 39 Troubleshooting an unsuccessful software upgrade

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

   ```
   Error code 6, unrecognized device
   ```

Module Functions Properly, Except Web Interface Became Inaccessible

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

Procedure 40 Restoring web management GUI access

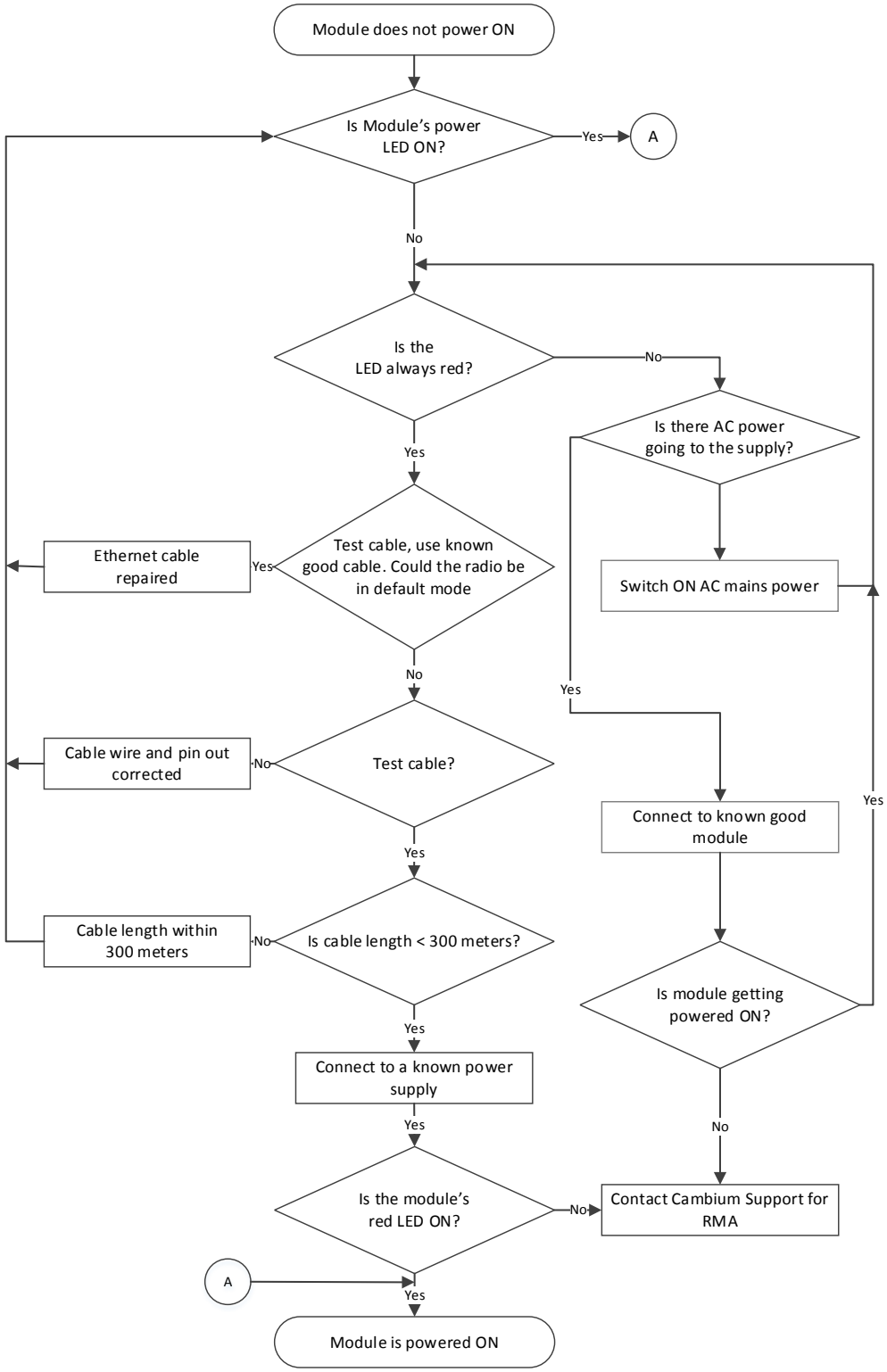
1. Enter **telnet** ***DottedIPAddress***.
   RESULT: A telnet session to the module is invoked.
2. At the Login prompt, enter **root**.
3. At the Password prompt, enter ***PasswordIfConfigured***.
4. At the Telnet +> prompt, enter **reset**.
   RESULT: The web interface is accessible again and this telnet connection is closed.

   Note

   The module may also be rebooted via an SNMP-based NMS (Wireless Manager, for example)
5. If the issue persists, turn off any SNMP-based network/radio monitoring software and repeat steps 1-4.

Power-up troubleshooting



Registration and connectivity troubleshooting

SM/BMS Registration

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

1. More finely aim the SM or SMs toward the AP.
2. Recheck the Session Status tab of the AP for the presence of LUIDs.
3. If still no LUIDs are reported on the Session Status tab, click the **Configuration** button on the left side of the **Home** page.
   RESULT: The AP responds by opening the AP Configuration page.
4. Click the Radio tab.
5. Find the **Color Code** parameter and note the setting.
6. In the same sequence as you did for the AP directly under **Configuring Link for Test** on Page 5-15, connect the SM to a computing device and to power.
7. On the left side of the SM Home page, click the **Configuration** button.
   RESULT: The Configuration page of the SM opens.
8. Click the Radio tab.
9. If the transmit frequency of the AP is not selected in the **Custom Radio Frequency Scan Selection List** parameter, select the frequency that matches.
10. If the **Color Code** parameter on this page is not identical to the **Color Code** parameter you noted from the AP, change one of them so that they match.
11. At the bottom of the Radio tab for the SM, click the **Save Changes** button.
12. Click the **Reboot** button.
13. Allow several minutes for the SM to reboot and register to the AP.
14. Return to the computing device that is connected to the AP.
15. Recheck the Session Status tab of the AP for the presence of LUIDs.

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

Term	Definition
	Information Base.
ASN.1	Abstract Syntax Notation One language. The format of the text files that compose the Management Information Base.
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.
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, High Priority Uplink CIR, and 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

Term	Definition
	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.
Country Code	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.
CRCError Field	This field displays how many CRC errors occurred on the Ethernet controller.
Data Encryption Standard	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.
Demilitarized Zone	Internet Protocol area outside of a firewall. Defined in RFC 2647. See http://www.faqs.org/rfcs/rfc2647.html.
DES	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.
DFS	See Dynamic Frequency Selection
DHCP	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.
DiffServ	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. Cambium modules map each of 64 code points to values of 0 through 7. Three of these code points have fixed values, and the remaining 61 are settable. Values of 0 through 3 map to the low-priority channel; 4 through 7 to the high-priority channel. The mappings are the same as 802.1p VLAN priorities. (However, configuring DiffServ does not automatically enable the VLAN feature.) Among the settable parameters, the values are set in the AP for all downlinks within the sector and in the SM for each uplink.

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

Term	Definition
	receiver.
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.
High-priority Channel	Channel that supports low-latency traffic (such as Voice over IP) over low-latency traffic (such as standard web traffic and file downloads). To recognize the latency tolerance of traffic, this channel reads the IPv4 Type of Service DiffServ Control Point (DSCP) bits. Enabling the high-priority channel reduces the maximum number of SMs that can be served in the sector.
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.
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.

Term	Definition
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.
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

Term	Definition
	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.
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.
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.
PMP	See Point-to-Multipoint Protocol.
Point-to-Multipoint Protocol	Defined in RFC 2178, which specifies that data that originates from a central network element can be received by all other network elements, but data that originates from a non-central network element can be received by only the central network element. See http://www.faqs.org/rfcs/rfc2178.html. Also referenced as PMP.
PPPoE	Point to Point Protocol over Ethernet. Supported on SMs for operators who use PPPoE in other parts of their network operators who want to deploy PPPoE to realize per-subscriber authentication, metrics, and usage control.
PPS	Packet Per Second
PPTP	Point to Point Tunneling Protocol. One of several virtual private

Term	Definition
	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.
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.
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

Term	Definition
	greater than 700.
Self-interference	Interference with a module from another module in the same network.
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.
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.
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.

Term	Definition
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.
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.