Configuring syslog

PMP/PTP 450 platform Series includes below sections.

- Syslog event logging
- Configuring system logging

Syslog event logging

Following events are logged in syslog as explained in Table 136.

Table 136 Syslog parameters

Attribute	Meaning
Timestamp	All syslog messages captured from the radio have a timestamp.
Configuration Changes	This includes any device setting that has changed and includes the old or new parameter value, including the device reboots.
User Login and Logout	Syslog records each user login and logout, with username.
Add or Delete of user accounts through GUI and SNMP	Syslog captures any user accounts that are added or deleted.
Spectrum Analysis	Syslog records a message every time Spectrum Analysis runs.  **Note** Since the AP/BHM must be set to a SM/BHS for Spectrum Analysis, syslog messages are not reported from the radio until the scan is done and the radio mode is switched back to AP/BHM.
Link Test	Syslog records a message every time a Link Test is run.
Clear Statistics	Syslog sends a message when Statistics are cleared. This is done individually for each statistics page that is cleared.
SM Register or De-register	Syslog records a message when a SM registers or deregisters.
BHS Connect or Disconnect	Syslog records a message when a BHS connects or disconnects.

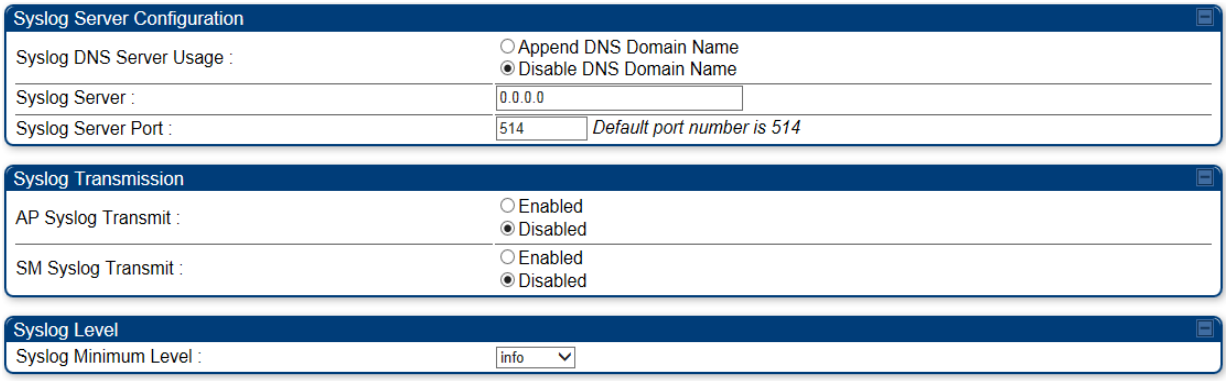
Configuring system logging

To configure system logging, select the menu option **Configuration > Syslog**.

Syslog page of AP/BHM

The Syslog Configuration page for AP/BHM is shown in Table 137.

Table 137 Syslog Configuration attributes - AP

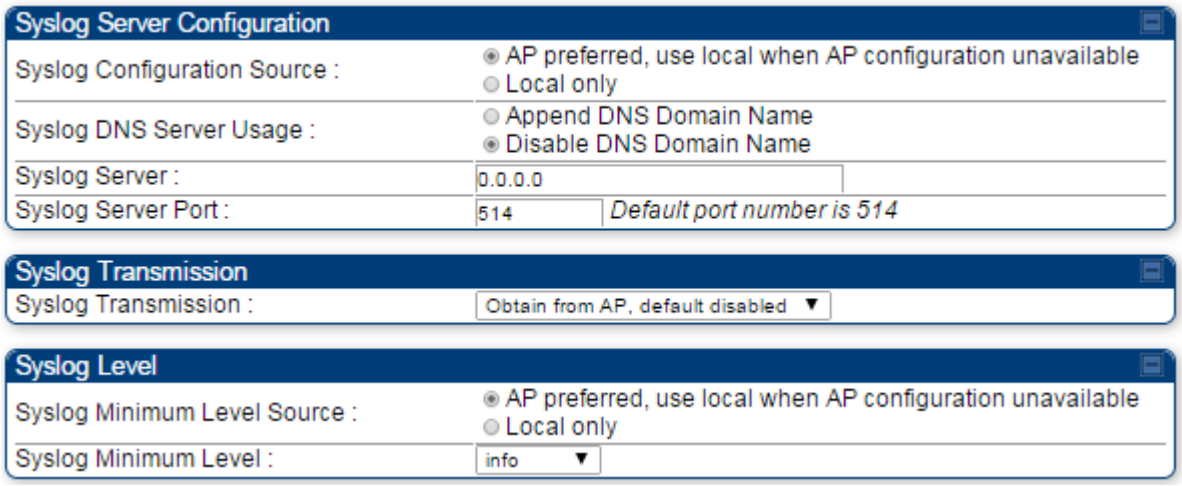


Attribute	Meaning
Syslog DNS Server Usage	To configure the AP/BHM to append or not append the DNS server name to the syslog server name.
Syslog Server	The dotted decimal or DNS name of the syslog server address.
Syslog Server Port	The syslog server port (default 514) to which syslog messaging is sent.
AP Syslog Transmit Or BHM Syslog Transmit	When enabled, syslog messages are sent from the AP/BHM.
SM Syslog Transmit Or BHS Syslog Transmit	When enabled, syslog messages are sent from all the registered SMs/BHS, unless they are individually set to override this.
Syslog Minimum Level	This provides a selection for the minimum syslog message severity that is sent to the syslog server. Values range from fatal (highest severity and least verbose) to info (lowest severity, maximum verbosity). For example: If the Syslog Minimum Level is set to notice, then only messages with severity notice and above are sent.

Syslog page of SM

To configure system logging, select the menu option **Configuration > Syslog**. The Syslog Configuration page is shown in Table 138.

Table 138 Syslog Configuration attributes - SM



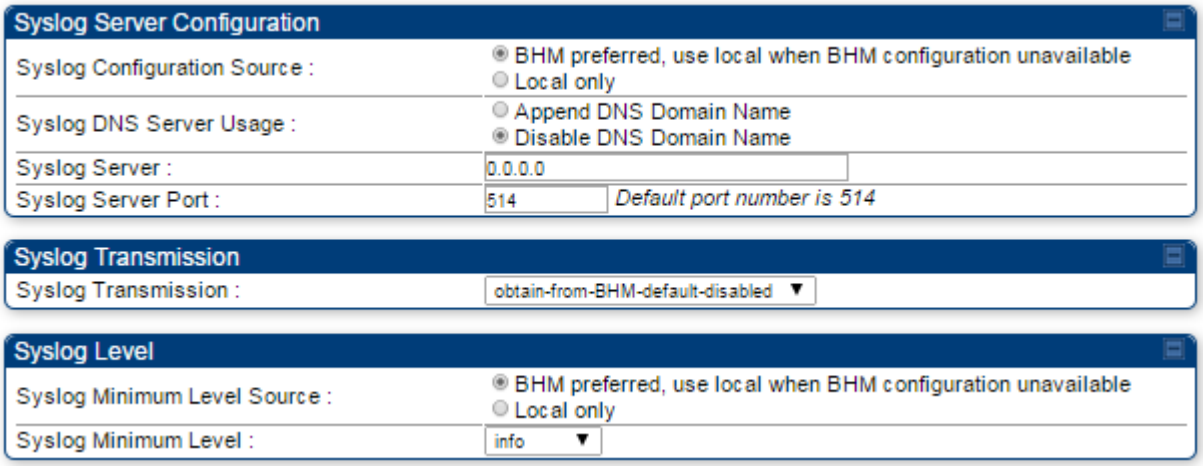
Attribute	Meaning
Syslog Configuration Source	This control determines whether the SM will attempt to use the syslog server definition from the AP, or whether it will use a local server definition. When set to **AP preferred, use local when AP configuration unavailable**, and if the SM can register with an AP, then it uses the syslog server defined on that AP. If the SM cannot register then it will syslog to its locally defined syslog server through its wired connection, if any. When set to **Local only** the SM ignores the AP's definition of the syslog server and allows the syslog server to be configured individually for each SM.
Syslog DNS Server Usage	To configure the SM to append or not the DNS server name to the syslog server name.
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 Transmission	Controls the SMs ability to transmit syslog messages. When set to "Learn from AP" the AP will control whether this SM transmits syslog messages. When set to "enable" or "disable" the SM will control whether it sends syslog messages. This allows an operator to override the AP settings for individual SMs in a sector.
Syslog Minimum Level Source	This control determines whether the SM attempts to use the minimum syslog level defined by the AP, or whether it uses a local defined value using the "Syslog Minimum Level" parameter. When set to "AP preferred, use local when AP configuration unavailable", and if the SM can register with an AP, then it uses the Syslog Minimum Level defined on that AP. If the SM cannot register then it uses its own Syslog Minimum Level setting. When set to "Local only" the SM will always use its own Syslog Minimum Level setting and ignores the AP's setting.

Syslog Minimum Level	This provides a selection for the minimum syslog message severity that is sent to the syslog server. Values range from fatal (highest severity and least verbose) to info (lowest severity, maximum verbosity). For example: If the Syslog Minimum Level is set to notice, then only messages with severity notice and above are sent.

Syslog page of BHS

The Syslog Configuration page is shown in Table 139.

Table 139 Syslog Configuration attributes - BHS



Attribute	Meaning
Syslog Configuration Source	This control determines whether the BHS will attempt to use the syslog server definition from the BHM, or whether it will use a local server definition. • When set to **BHM preferred, use local when BHM configuration unavailable**, and if the BHS can register with a BHM, then it uses the syslog server defined on that BHM. If the BHS cannot register then it will syslog to its locally defined syslog server through its wired connection, if any. • When set to **Local only** the BHS ignores the BHM's definition of the syslog server and allows the syslog server to be configured individually for each BHS.
Syslog DNS Server Usage	To configure the BHS to append or not to append the DNS server name to the syslog server name.
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 Transmission	Controls the BHSs ability to transmit syslog messages. When set to **Learn from BHM** the BHM will control whether this BHS transmits syslog messages. When set to **enable** or **disable** the BHS will control

	whether it sends syslog messages. This allows an operator to override the BHM settings for individual BHSs in a sector.
Syslog Minimum Level Source	This control determines whether the BHS attempts to use the minimum syslog level defined by the BHM, or whether it uses a local defined value using the **Syslog Minimum Level** parameter. • When set to **BHM preferred, use local when BHM configuration unavailable**, and if the BHS can register with a BHM, then it uses the Syslog Minimum Level defined on that BHM. If the BHS cannot register then it uses its own Syslog Minimum Level setting. When set to **Local only** the BHS will always use its own Syslog Minimum Level setting and ignores the BHM's setting.
Syslog Minimum Level	This provides a selection for the minimum syslog message severity that is sent to the syslog server. Values range from fatal (highest severity and least verbose) to info (lowest severity, maximum verbosity). For example: If the Syslog Minimum Level is set to notice, then only messages with severity notice and above are sent.

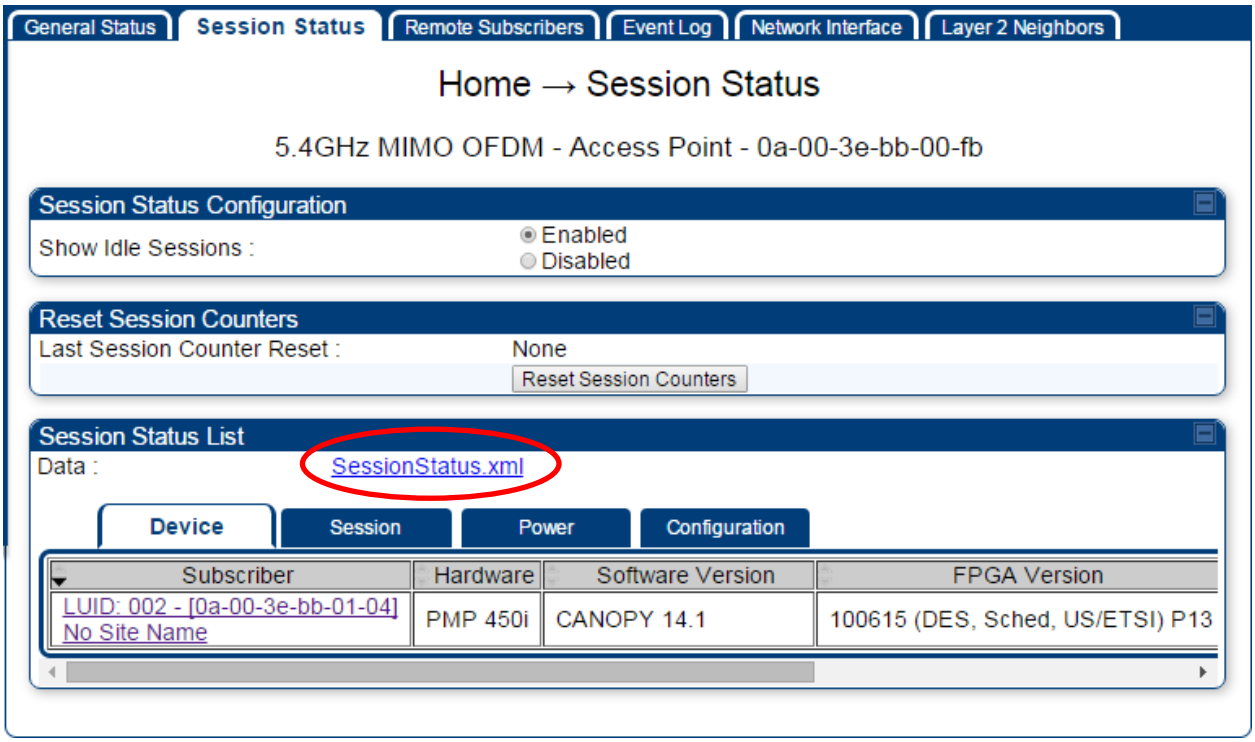
Configuring remote access

Accessing SM/BHS over-the-air by Web Proxy

The SM/BHS may be accessed via the AP/BHM management GUI by navigating to **Home > Session Status** (or **Home** > **Remote Subscribers** for AP only) and clicking on the SM's hyperlink.

For example, to access one of the SMs, click **LUID: 002 – [0a-00-3e-37-b9-fd]**, as shown in Figure 120.

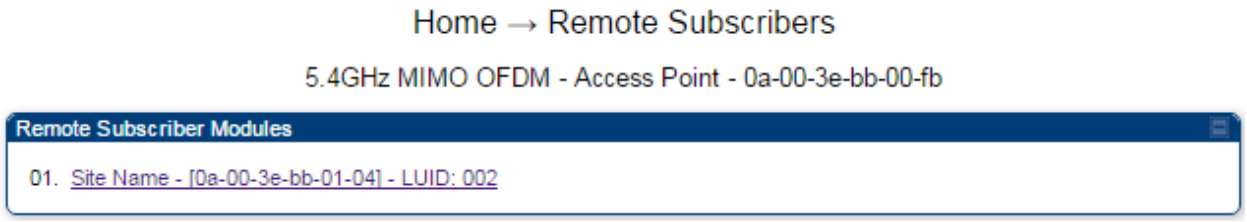
Figure 120 AP Session Status page



The **SessionStatus.xml** hyper link allows user to export all displayed SM data in Session Status table into an xml file.

To access any one of the SMs, click PMP450 platform SM hyperlink, as shown in Figure 121.

Figure 121 AP Remote Subscribers page



Monitoring the Link

Link monitoring procedure

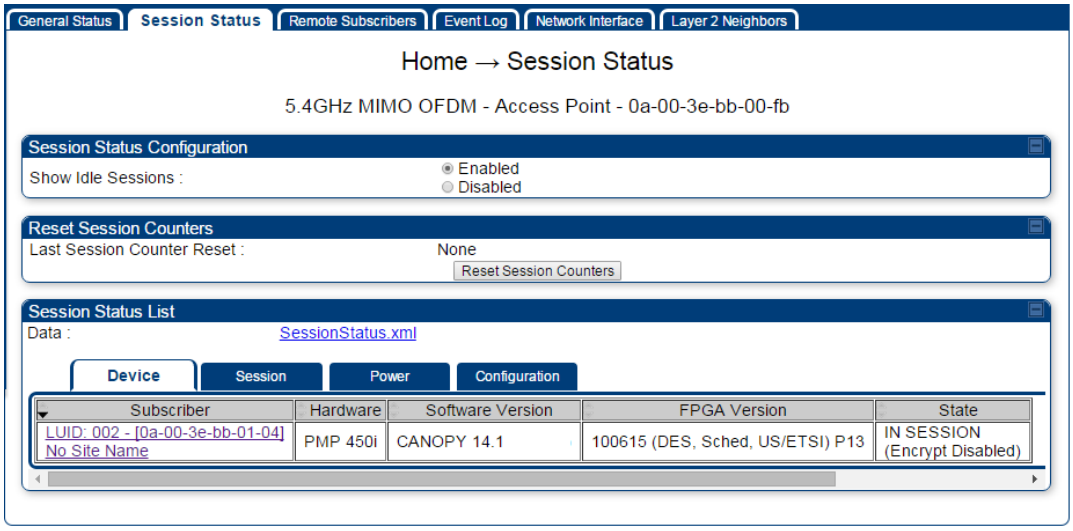
After configuring the link, either an operator in the network office or the SM/BHS INSTALLER user in the field (if read access to the AP/BHM is available to the INSTALLER) must perform the following procedure. Who is authorized and able to do this depends on local operator password policy, management VLAN setup and operational practices.

To monitor the link for performance, follow these instructions:

Procedure 21 Monitoring the AP-SM link

1. Access the web interface of the AP/BHM
2. In the left-side menu of the AP/BHM interface, select **Home**.
3. Click the **Session Status** tab.

   Figure 122 Session Status page



4. The **Device** tab of Session Status List display all displayed SMs – MAC address, PMP/PTP Hardware, Software Version, FPGA Version and State
5. Click **Session Count** tab of Session Status List to display values for **Session Count**, **Reg Count**, and **Re-Reg Count**.

- **Session 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.
- **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.

6 Click **Power** tab of Session Status list to display Downlink Rate, AP Tx Power (dBm), Signal Strength Radio (dB) and Signal to Noise Radio (dB).

7 Click **Configuration** tab of Session Status list to get QoS configuration details:

- Sustained Data Rate (kbps)
- Burst Allocation (kbit)
- Max Burst Rate (kbit)
- Low Priority CIR (kbps)

8 Briefly monitor these values, occasionally refreshing this page by clicking another tab and then the Session Status tab again.

9 If these values are low (for example, 1, 1, and 0, respectively, meaning that the SM/BHS registered and started a stable session once) and are not changing:

- Consider the installation successful.
- Monitor these values from the network office over the next several hours and days.

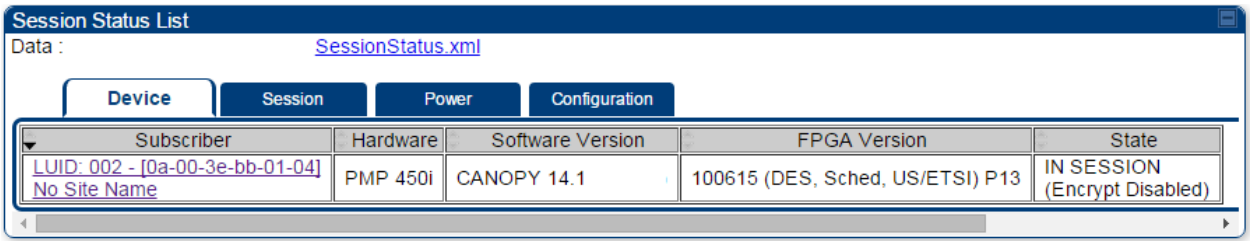
If these values are greater than 1, 1, and 0, or they increase while you are monitoring them, troubleshoot the link. (For example, Use **Receive Power Level** for aiming and then use Link Tests to confirm alignment).

Refer Viewing Session Status on page 9-15 for more details.

Exporting Session Status page of AP/BHM

The SessionStatus.xml hyper link allows user to export all displayed SMs or BHS data in Session Status table into an xml file.

Figure 123 Exporting Session Status page of PMP 450i AP



In case of PMP, if the session status page does not list any SM, the SessionStatus.xml will still be visible but the file would be empty. The file will contain data from all of the 5 different tables.

Export from command line

The scripts users can also get this file from command line, you have to authenticate successfully in order to download the file.

Wget

http://169.254.1.1/SessionStatus.xml?CanopyUsername=test&CanopyPassword=test

Configuring quality of service

Maximum Information Rate (MIR) Parameters

Point-to-multipoint links use the following MIR parameters for bandwidth management:

- Sustained Uplink Data Rate (kbps)
- Uplink Burst Allocation (kb)
- Sustained Downlink Data Rate (kbps)
- Downlink Burst Allocation (kb)
- Max Burst Downlink Data Rate (kbps)
- Max Burst Uplink Data Rate (kbps)

Set each of these parameters per AP or per SM independently.

Token Bucket Algorithm

The software uses a *token bucket* algorithm that has the following features:

- Stores credits (tokens) for the SM to spend on bandwidth for reception or transmission.
- Drains tokens during reception or transmission.
- Refills with tokens at the sustained rate set by the network operator.

For each token, the SM can send toward the network in the uplink (or the AP can send toward the SM in the downlink) an equivalent number of kilobits. Two buckets determine the permitted throughput: one in the SM for uplink and one in the AP for downlink.

The applicable set of **Uplink Burst Allocation** and **Downlink Burst Allocation** parameters determine the *number* of tokens that can fill each bucket. When the SM transmits (or the AP transmits) a packet, the equivalent number of tokens is removed from the uplink (or downlink) bucket.

Except when full, the bucket is continuously being refilled with tokens at *rates* that the applicable set of **Sustained Uplink Data Rate** and **Sustained Downlink Data Rate** parameters specify. The bucket often drains at a rate that is much faster than the sustained data rate but can refill at only the sustained data rate. Thus, the effects of the allocation and rate parameters on packet delay are as follows:

- The burst allocation affects how many kilobits are processed before packet delay is imposed.
- The sustained data rate affects the packet delay that is imposed.

MIR Data Entry Checking

Uplink and downlink MIR is enforced as shown in Figure 124.

Note

In these figures, *entry* refers to the setting in the data rate parameter, not the burst allocation parameter.

Figure 124 Uplink and downlink rate caps adjusted to apply aggregate cap

$$\text{uplink cap enforced} = \frac{\text{uplink entry} \times \text{aggregate cap for the SM}}{\text{uplink entry} + \text{downlink entry}}$$

$$\text{downlink cap enforced} = \frac{\text{downlink entry} \times \text{aggregate cap for the SM}}{\text{uplink entry} + \text{downlink entry}}$$

For example, in the SM, if you set the **Sustained Uplink Data Rate** parameter to 2,000 kbps and the **Sustained Downlink Data Rate** parameter to 10,000 kbps, then the uplink and downlink MIR that is enforced for the SM can be calculated as shown in Figure 125.

Figure 125 Uplink and downlink rate cap adjustment example

$$\text{uplink cap enforced} = \frac{2{,}000 \text{ kbps} \times 7{,}000 \text{ kbps}}{2{,}000 \text{ kbps} + 10{,}000 \text{ kbps}} = 1{,}167 \text{ kbps}$$

$$\text{downlink cap enforced} = \frac{10{,}000 \text{ kbps} \times 7{,}000 \text{ kbps}}{2{,}000 \text{ kbps} + 10{,}000 \text{ kbps}} = 5{,}833 \text{ kbps}$$

In this example case, the derived 1,167-kbps uplink and 5,833-kbps downlink MIR sum to the fixed 7,000-kbps aggregate cap of the SM.

Committed Information Rate (CIR)

The Committed Information Rate (CIR) capability feature enables the service provider to guarantee to any subscriber that bandwidth will never decrease to below a specified minimum unless CIR is oversubscribed or RF conditions are degraded. CIR is oversubscribed when there is not enough available bandwidth to support CIR configuration for all subscribers. In this condition, SMs which are configured with a nonzero CIR will all operate at the maximum data rate supported by the link (subject to Maximum Information Rate and Burst Rate/Allocations). SMs which are configured with a CIR of 0 kbps will not transmit until CIR-configured SMs have completed transmission. CIR may be configured independently for high priority traffic and for low priority traffic.

CIR parameters may be configured in the following ways:

- Web-based management GUI
- SNMP
- Authentication Server (RADIUS) - when a SM successfully registers and authenticates, CIR information is retrieved from the RADIUS server.

Active CIR configuration can be verified via the AP's **Home > Session Status** page.

Bandwidth from the SM Perspective

In the SM, normal web browsing, e-mail, small file transfers and short streaming video are rarely rate limited with practical bandwidth management (QoS) settings. When the SM processes large downloads such as software upgrades and long streaming video or a series of medium-size downloads, the bucket rapidly drains, the burst limit is reached, and some packets are delayed. The subscriber experience is more affected in cases where the traffic is more latency sensitive.

Interaction of Burst Allocation and Sustained Data Rate Settings

If the Burst Allocation is set to 1200 kb and the Sustained Data Rate is set to 128 kbps, a data burst of 1000 kb is transmitted at full speed because the Burst Allocation is set high enough. After the burst, the bucket experiences a significant refill at the Sustained Data Rate. This configuration uses the advantage of the settable Burst Allocation.

If both the Burst Allocation and the Sustained Data Rate are set to 128 kb, a burst is limited to the Burst Allocation value. This configuration does not take advantage of the settable Burst Allocation.

If the Burst Allocation is set to 128 kb and the Sustained Data Rate is set to 256 kbps, the actual rate is the burst allocation (but in kbps). As above, this configuration does not take advantage of the settable Burst Allocation.

High-priority Bandwidth

To support low-latency traffic such as VoIP (Voice over IP) or video, the system implements a high-priority channel. This channel does not affect the inherent latencies in the system but allows high-priority traffic to be immediately served. The high-priority pipe separates low-latency traffic from traffic that is latency tolerant, such as standard web traffic and file downloads.

The number of channels available on the AP is reduced by the number of SMs configured for the high-priority channel (each SM operating with high-priority enabled uses two channels (virtual circuits) instead of one).

A module prioritizes traffic by

- reading the Low Latency bit (Bit 3) in the IPv4 Type of Service (ToS) byte in a received packet. Bit 3 is set by a device outside the system.
- reading the 802.1p field of the 802.1Q header in a received packet, where VLAN is enabled on the module.
- comparing the 6-bit Differentiated Services Code Point (DSCP) field in the ToS byte of a received packet to a corresponding value in the **Diffserv** tab of the Configuration page of the module. A packet contains no flag that indicates whether the encoding is for the Low Latency bit or the DSCP field. For this reason, you must ensure that all elements in your trusted domain, including routers and endpoints, set and read the ToS byte with the same scheme.

Modules monitor ToS bytes with DSCP fields, but with the following differences:

- The 6-bit length of the field allows it to specify one of 64 service differentiations.

- These correlate to 64 individual (**CodePoint**) parameters in the **Diffserv** tab of the Configuration page.
- Per RFC 2474, 3 of these 64 are preset and cannot be changed. (See http://www.faqs.org/rfcs/rfc1902.html.)
- For any or all of the remaining 61 CodePoint parameters, you can specify a value of
  - 0 through 3 for low-priority handling.
  - 4 through 7 for high-priority handling.

Note

Ensure that your Differentiated Services domain boundary nodes mark any entering packet, as needed, so that it specifies the appropriate Code Point for that traffic and domain. This prevents theft of service level.

An example of the **Diffserv** page in the Configuration menu and parameter descriptions are provided under DiffServ attributes – AP/BHM on page 7-63. This tab and its rules are identical from module type to module type. However, any of the 61 configurable Code Points can be set to a different value from module to module, thus defining unique per-hop behavior for some traffic.

This tab in the AP sets the priorities for the various packets in the downstream (sent from the public network). This tab in the SM sets the priorities for the various packets in the upstream (sent to the public network).

Typically, some SMs attach to older devices that use the ToS byte as originally formatted, and others to newer devices that use the DSCP field. The *default* values in the **Diffserv** page allow your modules to prioritize traffic from the older devices roughly the same as they traditionally have. However, these default values may result in more high-priority traffic as DSCP fields from the newer devices are read and handled. So, after making changes in the **Diffserv** page, carefully monitor the high-priority channel for high packet rates

- in SMs that you have identified as those to initially set and watch.
- across your network when you have broadly implemented Code Point values, such as via SNMP.

Traffic Scheduling

The characteristics of traffic scheduling in a sector are summarized in Table 140.

Table 140 Characteristics of traffic scheduling

Category	Factor	Treatment
Throughput	Aggregate throughput, less additional overhead	132 Mbps
Latency	Number of frames required for the scheduling process	1
	Round-trip latency	≈ 6 ms
	AP broadcast the download schedule	No
High-priority Channel	Allocation for *uplink* high-priority traffic on amount of high-priority traffic	Dynamic, based on amount of high-priority traffic
	Allocation for *downlink* high-priority traffic on amount of high-priority traffic	Dynamic, based on amount of high-priority traffic
	Order of transmission	CIR high-priority CIR low-priority Other high-priority Other low-priority

Caution

Power requirements affect the recommended maximums for power cord length feeding the CMM4. See the dedicated user guide that supports the CMM that you are deploying.

Packets that have a priority of 4 to 7 in either the DSCP or a VLAN 802.1p tag are automatically sent on the high-priority channel, but only where the high-priority channel is enabled.

Setting the Configuration Source

The AP includes a **Configuration Source** parameter, which sets where SMs that register to the AP are controlled for MIR, CIR, VLAN, and the high-priority channel as follows. The **Configuration Source** parameter affects the source of:

- all MIR settings:
  - Sustained Uplink Data Rate
  - Uplink Burst Allocation
  - Max Burst Uplink Data Rate
  - Sustained Downlink Data Rate
  - Downlink Burst Allocation
  - Max Burst Downlink Data Rate
- all CIR settings:
  - Low Priority Uplink CIR
  - Low Priority Downlink CIR
  - Hi Priority Uplink CIR
  - Hi Priority Downlink CIR
- all SM VLAN settings
  - Dynamic Learning
  - Allow Only Tagged Frames
  - VLAN Aging Timeout
  - Untagged Ingress VID
  - Management VID
  - VLAN Membership
- the Hi Priority Channel setting

Table 141 Recommended combined settings for typical operations

Most operators who use…	must set this parameter…	in this web page/tab…	in the AP to…
no authentication server	**Authentication Mode**	Configuration/ Security	**Disabled**
	Configuration Source	Configuration/ General	**SM**
Wireless Manager (Authentication Server)	**Authentication Mode**	Configuration/ Security	**Authentication Server**
	Configuration Source	Configuration/ General	**Authentication Server**
RADIUS AAA server	**Authentication Mode**	Configuration/ Security	**RADIUS AAA**
	Configuration Source	Configuration/ General	**Authentication Server**

Table 142 Where feature values are obtained for a SM with authentication required

Configuration Source Setting in the AP	Values are obtained from		
	MIR Values	VLAN Values	High Priority Channel State
Authentication Server	Authentication Server	Authentication Server	Authentication Server
SM	SM	SM	SM
Authentication Server+SM	Authentication Server	Authentication Server, then SM	Authentication Server, then SM

Note

HPC represents the Hi Priority Channel (enable or disable).

Where Authentication Server, then SM is the indication, parameters for which Authentication Server does not send values are obtained from the SM. This is the case where the Authentication Server server is operating on a Authentication Server release that did not support the feature. This is also the case where the feature enable/disable flag in Authentication Server is set to disabled. The values are those previously set or, if none ever were, then the default values.

Where Authentication Server is the indication, values in the SM are disregarded.

Where SM is the indication, values that Authentication Server sends for the SM are disregarded.

For any SM whose **Authentication Mode** parameter *is not* set to 'Authentication Required', the listed settings are derived as shown in Table 143.

Table 143 MIR, VLAN, HPC, and CIR Configuration Sources, Authentication Disabled

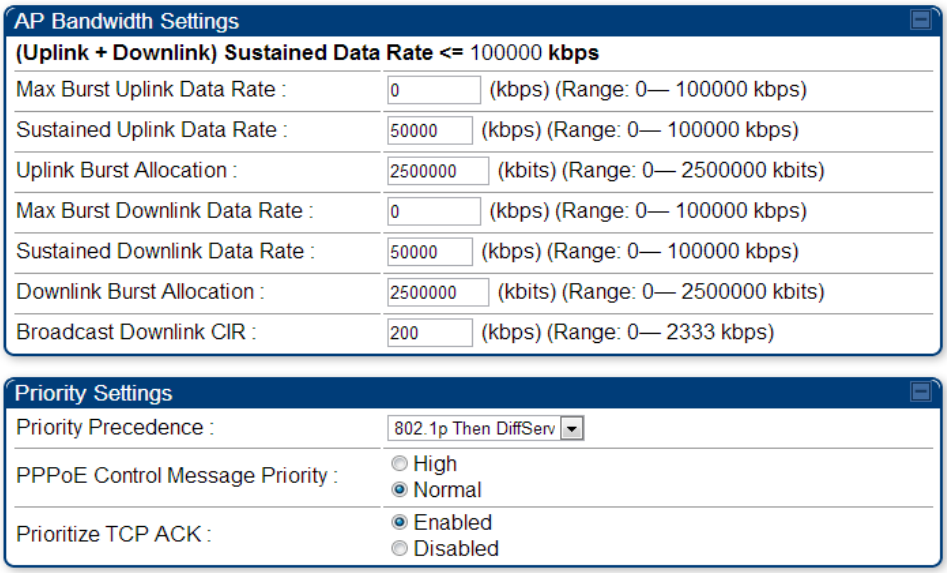
Configuration Source Setting in the AP	Values are obtained from			
	MIR Values	VLAN Values	High Priority Channel State	CIR Values
Authentication Server	AP	AP	AP	AP
SM	SM	SM	SM	SM
Authentication Server+SM	SM	SM	SM	SM

Configuring Quality of Service (QoS)

Quality of Service (QoS) page of AP

The QoS page of AP is explained in Table 144.

Table 144 QoS page attributes - AP



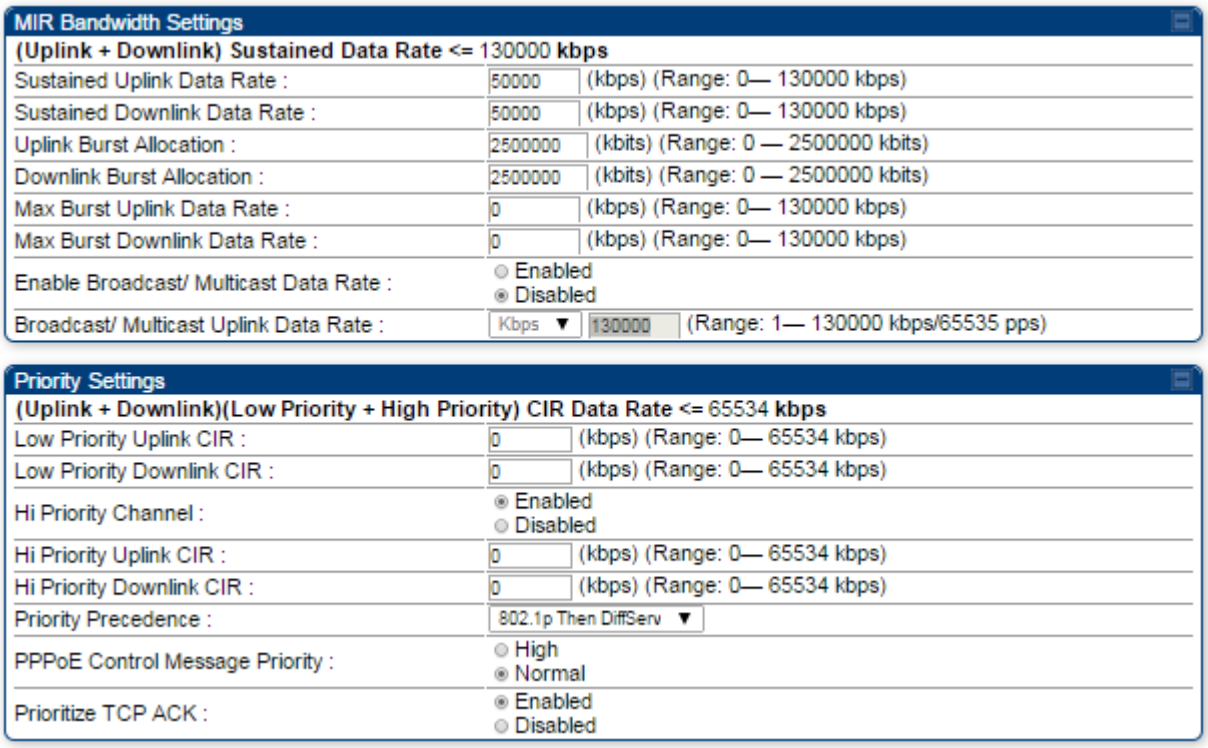
Attribute	Meaning
Max Burst Uplink Data Rate	These parameters allow operators to specify the data rate at which a SM is allowed to transmit (until burst allocation limit is reached) before being recharged at the **Sustained Uplink Data Rate** with credits to transit more. When set to 0 (default), the burst rate is unlimited.
Sustained Uplink Data Rate	Specify the rate that each SM registered to this AP is replenished with credits for transmission. This default imposes no restriction on the uplink. See • Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Uplink Burst Allocation	Specify the maximum amount of data to allow each SM to transmit before being recharged at the **Sustained Uplink Data Rate** with credits to transmit more. See Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Max Burst Downlink Data Rate	These parameters allow operators to specify the data rate at which a SM is allowed to transmit (until burst allocation limit is reached) before

	being recharged at the **Sustained Downlink Data Rate** with credits to transit more. When set to 0 (default), the burst rate is unlimited.
Sustained Downlink Data Rate	Specify the rate at which the AP is replenished with credits (tokens) for transmission to each of the SMs in its sector. This default imposes no restriction on the uplink. See Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Downlink Burst Allocation	Specify the maximum amount of data to allow the AP to transmit to any registered SM before the AP is replenished with transmission credits at the **Sustained Downlink Data Rate**. See • Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Broadcast Downlink CIR	Broadcast Downlink CIR (Committed Information Rate, a minimum) supports system designs where downlink broadcast is desired to have higher priority than other traffic. For many other system designs, especially typical internet access networks, leave the Broadcast Downlink CIR at the default. Broadcast Downlink CIR is closely related to the Broadcast Repeat Count parameter, which is settable in the Radio tab of the Configuration page in the AP: when the Broadcast Repeat Count is changed, the total of available bandwidth is also changed, since packets are being sent one, two, or three times, according to the setting in the Broadcast Repeat Count parameter.
Priority Precedence	Allows operator to decide if 802.1p or DiffServ priority bits must be used first when making priority decisions.
PPPoE Control Message Priority	Operators may configure the SM to utilize the high priority channel for PPPoE control messages. Configuring the SM in this fashion can benefit the continuity of PPPoE connections when there are issues with PPPoE sessions being dropped in the network. This prioritization may be configured in the DiffServ tab in the Configuration menu of the SM.
Prioritize TCP ACK	To reduce the likelihood of TCP acknowledgement packets being dropped, set this parameter to **Enabled**. This can improve throughput that the end user perceives during transient periods of congestion on the link that is carrying acknowledgements.

Quality of Service (QoS) page of SM

The QoS page of SM is explained in Table 145.

Table 145 QoS page attributes - SM



Attribute	Meaning
Sustained Uplink Data Rate	Specify the rate that this SM is replenished with credits for transmission. This default imposes no restriction on the uplink. See Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Sustained Downlink Data Rate	Specify the rate at which the AP is replenished with credits (tokens) for transmission to this SM. This default imposes no restriction on the uplink. See Maximum Information Rate (MIR) Parameters on Page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Uplink Burst Allocation	Specify the maximum amount of data to allow this SM to transmit before being recharged at the **Sustained Uplink Data Rate** with credits to transmit more. See Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Downlink Burst Allocation	Specify the maximum amount of data to allow the AP to transmit to this SM before the AP is replenished at the **Sustained Downlink Data Rate**

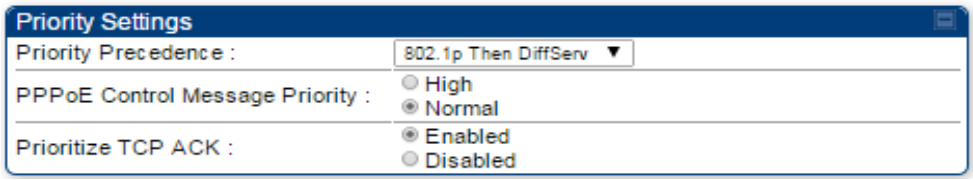
	with transmission credits. See Maximum Information Rate (MIR) Parameters on page 7-185 • Interaction of Burst Allocation and Sustained Data Rate Settings on page 7-187 • Configuration Source on page 7-73
Max Burst Uplink Data Rate	These parameters allow operators to specify the data rate at which a SM is allowed to transmit (until burst allocation limit is reached) before being recharged at the **Sustained Uplink Data Rate** with credits to transit more. When set to 0 (default), the burst rate is unlimited.
Max Burst Downlink Data Rate	These parameters allow operators to specify the data rate at which a SM is allowed to transmit (until burst allocation limit is reached) before being recharged at the **Sustained Downlink Data Rate** with credits to transit more. When set to 0 (default), the burst rate is unlimited.
Enable Broadcast / Multicast Data Rate	This parameter allows the operator to specify if Broadcast and Multicast data is rate-limited. This data rate can be entered in Kbps or PPS (Packets Per Second).
Broadcast / Multicast Data Rate	This parameter allows the operator to specify a data rate at which Broadcast and Multicast traffic is sent via the radio link.
Low Priority Uplink CIR	This field indicates the minimum rate at which low priority traffic is sent over the uplink (unless CIR is oversubscribed or RF link quality is degraded). • Committed Information Rate (CIR) on page 7-186 • Setting the Configuration Source on page 7-190
Low Priority Downlink CIR	This field indicates the minimum rate at which low priority traffic is sent over the downlink (unless CIR is oversubscribed or RF link quality is degraded). • Committed Information Rate (CIR) on page 7-186 • Setting the Configuration Source on page 7-190
Hi Priority Channel	See • High-priority Bandwidth on page 7-187 • Configuration Source on page 7-73
Hi Priority Uplink CIR	This field indicates the minimum rate at which high priority traffic is sent over the uplink (unless CIR is oversubscribed or RF link quality is degraded). • Committed Information Rate (CIR) on page 7-186 • Setting the Configuration Source on page 7-190
Hi Priority Downlink CIR	This field indicates the minimum rate at which high priority traffic is sent over the downlink (unless CIR is oversubscribed or RF link quality is degraded). • Committed Information Rate (CIR) on page 7-186 • Setting the Configuration Source on page 7-190

Priority Precedence	Allows operator to decide if 802.1p or DiffServ priority bits must be used first when making priority decisions.
PPPoE Control Message Priority	Operators may configure the SM to utilize the high priority channel for PPPoE control messages. Configuring the SM in this fashion can benefit the continuity of PPPoE connections when there are issues with PPPoE sessions being dropped in the network. This prioritization may be configured in the DiffServ tab in the Configuration menu of the SM.
Prioritize TCP ACK	To reduce the likelihood of TCP acknowledgement packets being dropped, set this parameter to Enabled. This can improve throughput that the end user perceives during transient periods of congestion on the link that is carrying acknowledgements. This parameter, when enabled, can be particularly useful when running bi-direction FTP sessions over the link. If a link is primarily used for video surveillance, it is recommended to configure this parameter to **Disabled**.

Quality of Service (QoS) page of BHM

The QoS page of BHM is explained in Table 146.

Table 146 QoS page attributes - BHM

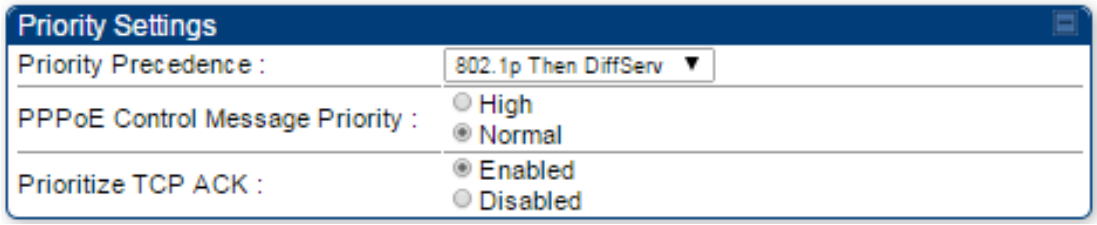


Attribute	Meaning
PPPoE Control Message Priority	Operators may configure the BHM to utilize the high priority channel for PPPoE control messages. Configuring the BHM in this fashion can benefit the continuity of PPPoE connections when there are issues with PPPoE sessions being dropped in the network. This prioritization may be configured in the DiffServ tab in the Configuration menu of the BHS.
Prioritize TCP ACK	To reduce the likelihood of TCP acknowledgement packets being dropped, set this parameter to Enabled. This can improve throughput that the end user perceives during transient periods of congestion on the link that is carrying acknowledgements. This parameter, when enabled, can be particularly useful when running bi-direction FTP sessions over the link. If a link is primarily used for video surveillance, it is recommended to configure this parameter to **Disabled**.

Quality of Service (QoS) page of BHS

The QoS page of BHS is explained in Table 147.

Table 147 QoS page attributes - BHS

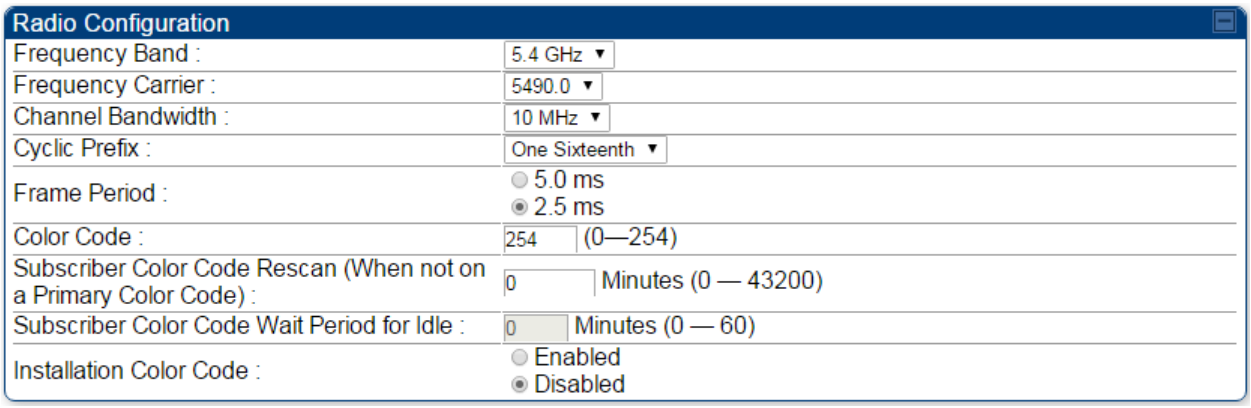


Attribute	Meaning
PPPoE Control Message Priority	Operators may configure the BHS to utilize the high priority channel for PPPoE control messages. Configuring the BHS in this fashion can benefit the continuity of PPPoE connections when there are issues with PPPoE sessions being dropped in the network. This prioritization may be configured in the DiffServ tab in the Configuration menu of the BHS.
Prioritize TCP ACK	To reduce the likelihood of TCP acknowledgement packets being dropped, set this parameter to Enabled. This can improve throughput that the end user perceives during transient periods of congestion on the link that is carrying acknowledgements. This parameter, when enabled, can be particularly useful when running bi-direction FTP sessions over the link. If a link is primarily used for video surveillance, it is recommended to configure this parameter to **Disabled**.

Installation Color Code

With this feature enabled on the AP and SM, operators may install and remotely configure SMs without having to configure matching color codes between the modules. While the SM is accessible for configuration from above the AP (for remote provisioning) and below the SM (for local site provisioning), no user data is passed over the radio link. When using the Installation Color Code feature, ensure that the SM is configured with the factory default Color Code configuration (Color Code 1 is "0", Color Code 2-10 set to "0" and "Disable"). The status of the Installation Color Code can be viewed on the AP Eval web GUI page, and when the SM is registered using the Installation Color Code the message "SM is registered via ICC – Bridging Disabled!" is displayed in red on every SM GUI page. The Installation Color Code parameter is configurable without a radio reboot for both the AP and SM. If an SM is registered via Installation Color Code and the feature is then disabled, operators will need to reboot the SM or force it to reregister (i.e. using the **Rescan APs** functionality on the AP Eval page).

Figure 126 Installation Color Code of AP



Zero Touch Configuration Using DHCP Option 66

This feature allows an SM to get its configuration via DHCP option 66. This can be used for the initial configuration of an SM as well as managing the configuration of SMs on an ongoing basis. Here is how it works in brief:

- When the SM boots up, if it is set to use DHCP client, it will send out a DHCP Discover packet which includes a request for DHCP Option 66.
- In case of a brand new SM out of the box, the DHCP Discover packet is sent out if the SM connects to an AP using Installation Color Code (ICC), even though DHCP client is not enabled in factory default config.
- An appropriately configured DHCP server will respond with a DHCP Offer and include a URL in response to the Option 66 request. The URL should point to the configuration file.
- The device will download the configuration file and apply it. The device will reboot automatically if needed. (Note: this requires "rebootIfRequired" flag to be added to the config file. See Creating a Golden config file on page 7-200.

Configuration Steps

Procedure 22 Zero Touch Configuration steps

1. Create the golden config file(s)
2. Host it on an TFTP/FTP/HTTP/HTTPS server
3. Configure the DHCP server to return the URL of the golden config file in option 66

When the SM boots up, it will get the URL for the golden config from the DHCP server via option 66, download it and apply it.

If all the SMs are configured exactly the same, then you can create just new golden config file that can be used with all SMs.

If the SMs are not configured the same, see if it is possible to group the SMs such that SMs with the same configuration are served by the same DHCP pool. User can then create multiple golden config files and configure the DHCP server to use the appropriate config file for each pool.

User can also create one config file per SM. This provides the most flexibility, but is practical only if you have a software tool/script to generate the config files for each MAC address. The files should be named <mac>.cfg where <mac> is the MAC address of the SM, and stored in the same directory on the file server. The DHCP server should be configured to return the directory name ending with a '/' in option 66. The SM will automatically add "<mac>.cfg" to the path and get its config file.

If some configuration is unique per SM, but rest of the configuration is common, the SMs can be staged with the unique part, and use option 66 to manage the common part. For example, if each SM needs to have its coordinates set, don't include the coordinates in the golden config file. Instead, configure the coordinates for each SM manually. Manage the rest of the configuration using DHCP option 66.

Creating a Golden config file

The easiest way to create the golden config file is to configure an SM, export its configuration and edit it. To export the configuration file from the GUI of the SM, go to "Configuration > Unit Settings" tab, go to the "Download Configuration File" section and click on the "<mac>.cfg" link. This will give you a text file in JSON format. You can edit this file in a text editor but it's easier to use a JSON editor like https://www.jsoneditoronline.org/.

Strip down the config file to remove sections and entries that don't care about, and keep only the items that require changes. If there are many required changes, it can easily get confusing. To identify the exact items changes, first reset the SM to factory default, export the config file, make the necessary changes, export a second config file, then use a tool like WinMerge (http://winmerge.org/) to identify the differences.

The config file contains the following informational entries at the top level.

```
 "cfgUtcTimestamp": "cfgUtcTimestamp",
 "swVersion": "CANOPY 13.3 (Build 15)  SM-AES",
 "cfgFileString": "Canopy configuration file",
 "srcMacAddress": "0a-00-3e-a2-c2-74",
 "deviceType": "5.4/5.7GHz MIMO OFDM - Subscriber Module",
 "cfgFileVersion": "1.0"
```

The "cfgUtcTimestamp", "swVersion", "srcMacAddress" and "deviceType" lines can be deleted. Do not delete the "cfgFileString" and "cfgFileVersion" entries.

Next, create an object named "configFileParameters" at the top level. Under that, add a parameter called "rebootIfRequired" and set it to true. This tells the SM to reboot automatically if a reboot is needed to apply the new configuration.

A sample configuration file that has been edited for use via DHCP option 66 is given below.

```
{
  "userParameters": {
    "smNetworkConfig": {
      "networkAccess": 1
    },
    "location": {
      "siteName": "Test site"
    },
    "smRadioConfig": {
```

```
      "frequencyScanList": [
        5475000,
        5480000
      ],
      "colorCodeList": [
        {
          "colorCode": 42,
          "priority": 1
        }
      ]
    },
    "networkConfig": {
      "lanDhcpState": 1
    }
  },
  "cfgFileVersion": "1.0",
  "cfgFileString": "Canopy configuration file",
  "configFileParameters": {
    "rebootIfRequired": true
  }
}
```

When configuration is imported, only the items that exist in the configuration file are modified. Parameters that are not in the imported file are not changed. If user wish to revert those settings to their factory default values, please add a “setToDefaults” item under “configFileParameters” section with a value of true.

```
  "cfgFileVersion": "1.0",
  "cfgFileString": "Canopy configuration file",
  "configFileParameters": {
    "rebootIfRequired": true,
    "setToDefaults": true
  }
```

In case, the SM needs to fetch the configuration file on each boot up even when not connecting to AP via ICC, set “Network Accessibility” to “Public” and “DHCP State” to “Enabled” in the “Configuration > IP” page before exporting the configuration.

Hosting the config file

Copy the golden configuration file to an FTP, TFTP, HTTP or HTTPS server. This location can be password protected; you just have to include the user name and password in the URL.

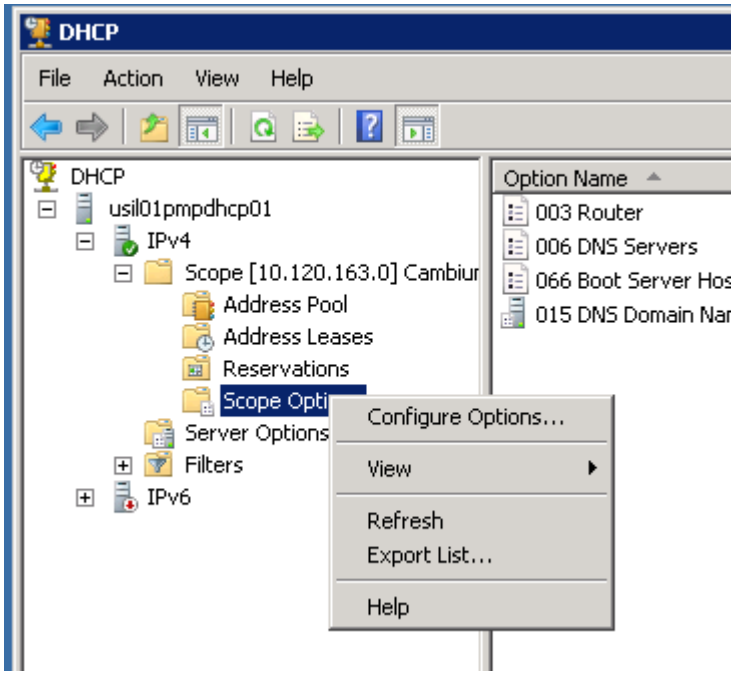
DHCP server configuration

Configure DHCP server to return the full URL to the golden config file as the value of DHCP option 66.

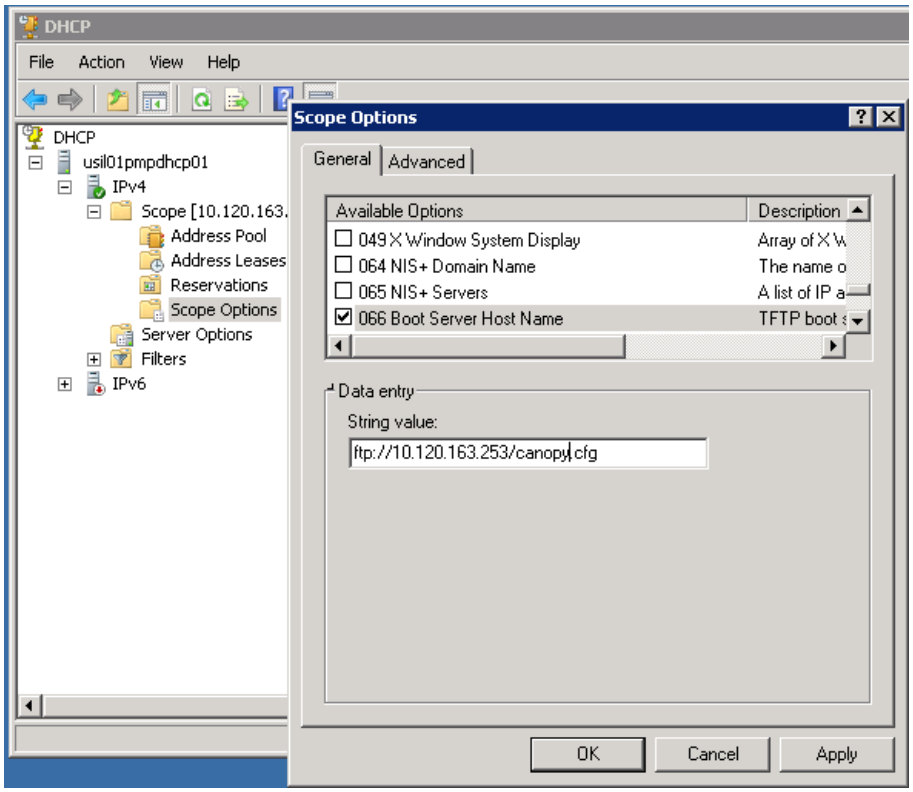
The following example explains how to make the change for Windows Server 2008. Adapt it to your specific DHCP server.

Procedure 23 DHCP server configuration

1. Click “Start > Administrative Tools > DHCP”
2. If you have multiple “Scopes” defined, identify the correct “Scope” that will serve IP addresses for the SMs
3. Right click on “Scope Option” under the correct “Scope” and select “Configure Options”



4 In the “Scope Options” dialog, scroll down to “066 Boot Server Host Name”, select the checkbox and enter the full URL to the golden config file as the “String value”. Then click “OK”.



5 In the DHCP snap-in window, right click and “Refresh” to see the DHCP option 66 in the list of DHCP options

Supported URL Formats

FTP, TFTP, HTTP and HTTPS URLs are supported. Some examples are given below.

- ftp://10.120.163.253/canopy.cfg
- ftp://admin:admin123@10.120.163.253/canopy.cfg (login as admin with password admin123)
- tftp://10.120.163.253/canopy.cfg
- http://10.120.163.253/golden-config.cfg
- https://10.120.163.253/smconfig/golden-config.cfg

User can also specify the URL pointing to a directory and not a specific file. Terminate the URL with a ‘/’ to indicate that it is a directory and not a file. Use this format when each SM has its own individual config file. The directory should contain files named “<mac>.cfg”, one for each SM.

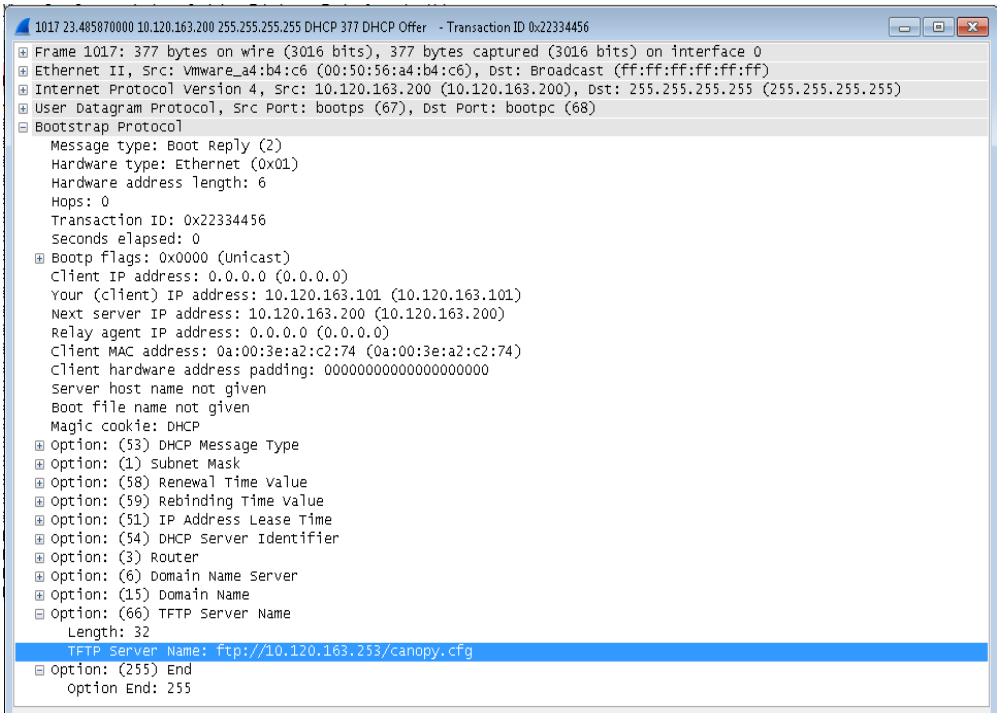
For example:

ftp://10.120.163.253/smconfig/

In this case, the SM will append “<mac>.cfg” to the path and try to get that file. For example, if the SM’s MAC address is 0a-00-3e-a2-c2-74, it will request for ftp://10.120.163.253/smconfig/0a003ea2c274.cfg. This mechanism can be used to serve individual config file for each SM.

Troubleshooting

1. Ensure that te SM is running 13.3 or newer version of software.
2. If the SM has factory default config, confirm ICC is enabled on the AP, so the SM can connect to it.
3. If the SM is connecting to the AP using a color code other than ICC, make sure the SM has “Network Accessibility” set to “Public” and “DHCP State” set to “Enabled” in the “Configuration > IP” page.
4. Make sure the golden config file does not turn off “Network Accessibility” or “DHCP State”. If it does, the SM will no longer request the config file when it is rebooted.
5. Check the event log of the SM to see the status of the configuration file import including any errors that prevented it from importing the file.
6. Capture the DHCP Offer packet from the DHCP server to the SM and verify that Option 66 has the expected URL.



Configuring Radio via config file

The PMP/PTP 450 platform supports export and import of a configuration file from the AP or SM as a text file. The configuration file is in JSON format.

To export or import the configuration file, the logged in user needs to be an ADMINISTRATOR and it must not be a “read-only” account.

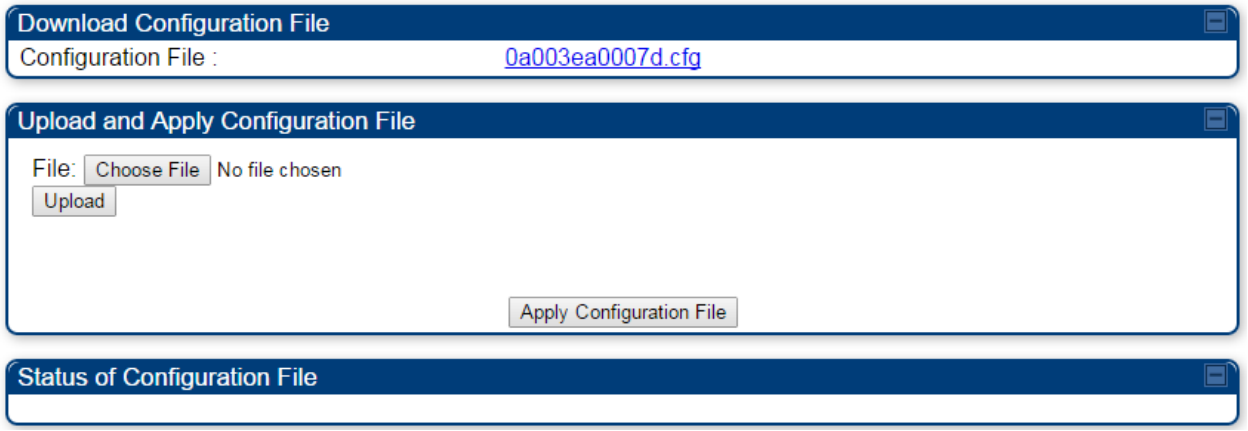
The exported configuration file contains the complete configuration including all the default values. To keep a backup of the current configuration, the file can be saved as-is and imported later.

While importing a configuration file, it can be either imported the full configuration or a sparse configuration containing only the items that need to be changed. If a sparse configuration file is imported, only the items in the file will be imported. Other configuration will remain unchanged. There could also be used a special flag in the configuration file to tell the device to apply the configuration starting from factory default (Refer Special Headers for configuration file on page 7-206).

Import and Export of config file

The config file import and export is supported in **Configuration > Unit Settings** page. The procedure for importing and exporting config file is explained below.

Figure 127 Configuration File upload and download page



The DHCP server configuration procedure is as follows:

Procedure 24 DHCP server configuration

1. Login to the GUI and go to **Configuration** > **Unit Settings.**
2. Under Download Configuration File tab, click on the “<mac>.cfg” link, where <mac> is the MAC address of the device (for example, “01003ea2c274.cfg”).
3. Save the file to the local disk.

The below procedure is to be followed for Importing a config file

Procedure 25 Import the configuration from the GUI

1. Login to the GUI and go to Configuration → Unit Settings.
2. Click on “Browse” button under “Upload and Apply Configuration File” tab and select the configuration file from disk.
3. Click “Upload” followed by “Apply Configuration File” button click.
4. The “Status of Configuration File” section will show the results of the upload.
5. Review it to make sure there are no errors. Then click on “Reboot” to reboot with the imported configuration

The special headers for config file is explained below:

Procedure 26 Special Headers for configuration file

1. A "configFileParameters" section can be added to the header to control the behaviour of the device when importing configuration.
2. The "**setToDefaults**" when set to "true" tell the device to reset to factory default configuration and apply the configuration in the file on top of that. So any attribute not in the configuration file will be set to its factory default value. By default, the configuration in the file is merged with the existing configuration on the device.

   The "**rebootIfRequired**" flag when set to "true" tell the device to reboot automatically if needed to apply the configuration change. By default, the device will not reboot automatically.

```
{
 "cfgFileString": "Canopy configuration file",
 "cfgFileVersion": "1.0",
 "configFileParameters": {
  "setToDefaults":true,
  "rebootIfRequired":true,
 }
}
```

Configuring a RADIUS server

Configuring a RADIUS server in a PMP 450 platform network is optional, but can provide added security, increase ease of network management and provide usage-based billing data.

Understanding RADIUS for PMP 450 platform

PMP 450 platform modules include support for the RADIUS (Remote Authentication Dial In User Service) protocol supporting Authentication and Accounting.

RADIUS Functions

RADIUS protocol support provides the following functions:

- **SM Authentication** allows only known SMs onto the network (blocking "rogue" SMs), and can be configured to ensure SMs are connecting to a known network (preventing SMs from connecting to "rogue" APs). RADIUS authentication is used for SMs, but is not used for APs.
- **SM Configuration:** Configures authenticated SMs with MIR (Maximum Information Rate), CIR (Committed Information Rate), High Priority, and VLAN (Virtual LAN) parameters from the RADIUS server when a SM registers to an AP.
- **SM Accounting provides** support for RADIUS accounting messages for usage-based billing. This accounting includes indications for subscriber session establishment, subscriber session disconnection, and bandwidth usage per session for each SM that connects to the AP.
- **Centralized AP and SM user name and password management** allows AP and SM usernames and access levels (Administrator, Installer, Technician) to be centrally administered in the RADIUS server instead of on each radio and tracks access events (logon/logoff) for each username on the RADIUS server. This accounting does *not* track and report specific configuration actions performed on radios or pull statistics such as bit counts from the radios. Such functions require an Element Management System (EMS) such as Cambium Networks Wireless Manager. This accounting is *not* the ability to perform accounting functions on the subscriber/end user/customer account.
- **Framed IP** allows operators to use a RADIUS server to assign management IP addressing to SM modules (framed IP address).

Tested RADIUS Servers

The Canopy RADIUS implementation has been tested and is supported on

- FreeRADIUS, Version 2.1.8
- Aradial RADIUS, Version 5.1.12

Note

Aradial 5.3 has a bug that prevents "remote device login", so doesn't support the user name and password management feature.

Choosing Authentication Mode and Configuring for Authentication Servers - AP

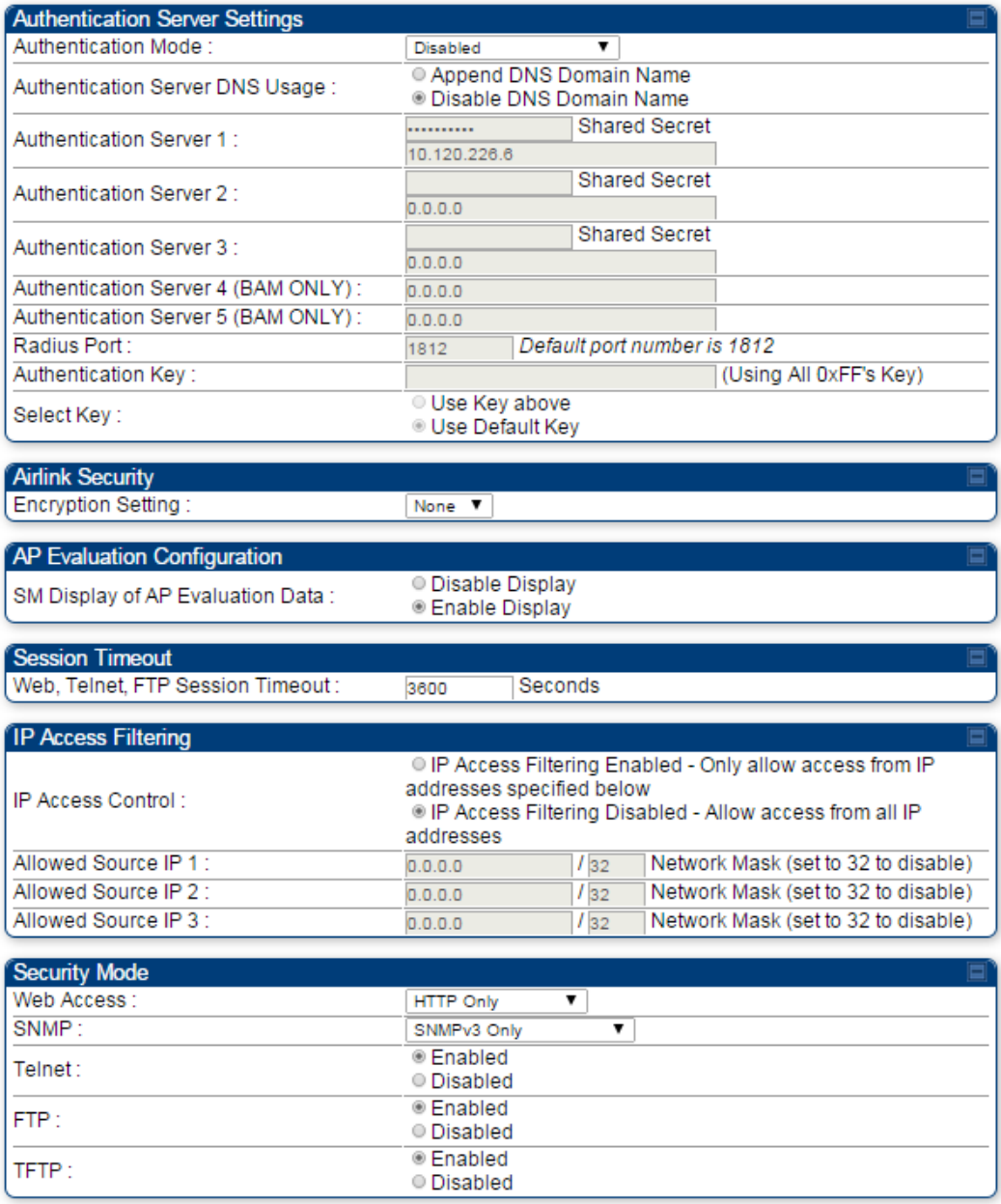
On the AP's **Configuration > Security** tab, select the **RADIUS AAA Authentication Mode**. The following describes the other **Authentication Mode** options for reference, and then the **RADIUS AAA** option.

- **Disabled:** Requires no authentication. Any SM (except a SM that itself has been configured to *require* RADIUS authentication by enabling Enforce Authentication as described below) is allowed to register to the AP.
- **Authentication Server:** Authentication Server in this instance refers to Wireless Manager in BAM-only mode. Authentication is required for a SM to register to the AP. Only SMs listed by MAC address in the Wireless Manager database is allowed to register to the AP.
- **AP Pre-Shared Key:** Canopy offers a pre-shared key authentication option. In this case, an identical key must be entered in the Authentication Key field on the AP's Configuration > Security tab and in the Authentication Key field on each desired SM's Configuration > Security tab.
- **RADIUS AAA:** To support RADIUS authentication of SMs, on the AP's Configuration > Security tab select RADIUS AAA. Only properly configured SMs with a valid certificate is allowed to register to the AP.

When RADIUS AAA is selected, up to 3 Authentication Server (RADIUS Server) IP addresses and Shared Secrets can be configured. The IP address(s) configured here must match the IP address(s) of the RADIUS server(s). The shared secret(s) configured here must match the shared secret(s) configured in the RADIUS server(s). Servers 2 and 3 are meant for backup and reliability, not splitting the database. If Server 1 doesn't respond, Server 2 is tried, and then server 3. If Server 1 rejects authentication, the SM is denied entry to the network, and does not progress trying the other servers.

The default IP address is 0.0.0.0. The default Shared Secret is "CanopySharedSecret". The Shared Secret can be up to 32 ASCII characters (no diacritical marks or ligatures, for example).

Table 148 Security tab attributes



Attribute	Meaning
Authentication Mode	Operators may use this field to select the following authentication modes: **Disabled**—the AP requires no SMs to authenticate. **Authentication Server** —the AP requires any SM that attempts registration to be authenticated in Wireless Manager before registration. **AP PreShared Key** - The AP acts as the authentication server to its SMs and will make use of a user-configurable pre-shared authentication key. The operator enters this key on both the AP and all SMs desired to register to that AP. There is also an option of leaving the AP and SMs at their default setting of using the "Default Key". Due to the nature of the authentication operation, if you want to set a specific authentication key, then you MUST configure the key on all of the SMs and reboot them BEFORE enabling the key and option on the AP. Otherwise, if you configure the AP first, none of the SMs is able to register. **RADIUS AAA** - When RADIUS AAA is selected, up to 3 Authentication Server (RADIUS Server) IP addresses and Shared Secrets can be configured. The IP address(s) configured here must match the IP address(s) of the RADIUS server(s). The shared secret(s) configured here must match the shared secret(s) configured in the RADIUS server(s). Servers 2 and 3 are meant for backup and reliability, not for splitting the database. If Server 1 doesn't respond, Server 2 is tried, and then server 3. If Server 1 rejects authentication, the SM is denied entry to the network and does not progress trying the other servers.
Authentication Server DNS Usage	The management DNS domain name may be toggled such that the name of the authentication server only needs to be specified and the DNS domain name is automatically appended to that name.
Authentication Server 1	Enter the IP address or server name of the authentication server (RADIUS or WM) and the Shared Secret configured in the authentication server. When **Authentication Mode RADIUS AAA** is selected, the default value of **Shared Secret** is "CanopySharedSecret". The **Shared Secret** may consist of up to 32 ASCII characters.
Authentication Server 2	
Authentication Server 3	
Authentication Server 4 (BAM Only)	
Authentication Server 5 (BAM Only)	
Radius Port	This field allows the operator to configure a custom port for RADIUS server communication. The default value is *1812*.
Authentication Key	The authentication key is a 32-character hexadecimal string used when **Authentication Mode** is set to **AP Pre-Shared Key**. By default, this key is set to 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF.

Selection Key	This option allows operators to choose which authentication key is used: **Use Key above** means that the key specified in **Authentication Key** is used for authentication **Use Default Key** means that a default key (based off of the SM's MAC address) is used for authentication
Encryption Key	Specify the type of airlink security to apply to this AP. The encryption setting must match the encryption setting of the SMs. **None** provides no encryption on the air link. **DES** (Data Encryption Standard): An over-the-air link encryption 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. DES encryption does not affect the performance or throughput of the system. **AES** (Advanced Encryption Standard)**:** An over-the-air link encryption option that uses the Rijndael algorithm and 128-bit keys to establish a higher level of security than DES. AES products are certified as compliant with the Federal Information Processing Standards (FIPS 197) in the U.S.A.
SM Display of AP Evaluation Data	You can use this field to suppress the display of data about this AP on the AP Evaluation tab of the Tools page in all SMs that register.
Web, Telnet, FTP Session Timeout	Enter the expiry in seconds for remote management sessions via HTTP, telnet, or ftp access to the AP.
IP Access Control	You can permit access to the AP from any IP address (**IP Access Filtering Disabled**) or limit it to access from only one, two, or three IP addresses that you specify (**IP Access Filtering Enabled**). If you select **IP Access Filtering Enabled**, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted from any IP address
Allowed Source IP 1	If you selected **IP Access Filtering Enabled** for the **IP Access Control** parameter, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted to the AP from any IP address. You may populate as many as all three.
Allowed Source IP 2 Allowed Source IP 3	If you selected **IP Access Filtering Disabled** for the **IP Access Control** parameter, then no entries in this parameter are read, and access from all IP addresses is permitted.
Web Access	The Radio supports secured and non-secured web access protocols. Select suitable web access from drop down list: • **HTTP Only** – provides non-secured web access. The radio to be accessed via http://<IP of Radio>. • **HTTPS Only** – provides a secured web access. The radio to be accessed via https1://<IP of Radio>. • **HTTP and HTTPS** – If enabled, the radio can be accessed via both

	http and https.
SNMP	This option allows to configure SNMP agent communication version. It can be selected from drop down list : • **SNMPv2c Only** – Enables SNMP v2 community protocol. • **SNMPv3 Only** – Enables SNMP v3 protocol. It is secured communication protocol. • **SNMPv2c and SNMPv3** – It enables both the protocols.
Telnet	This option allows to **Enable** and **Disable** Telnet access to the Radio.
FTP	This option allows to **Enable** and **Disable** FTP access to the Radio.
TFTP	This option allows to **Enable** and **Disable** TFTP access to the Radio.

SM Authentication Mode – Require RADIUS or Follow AP

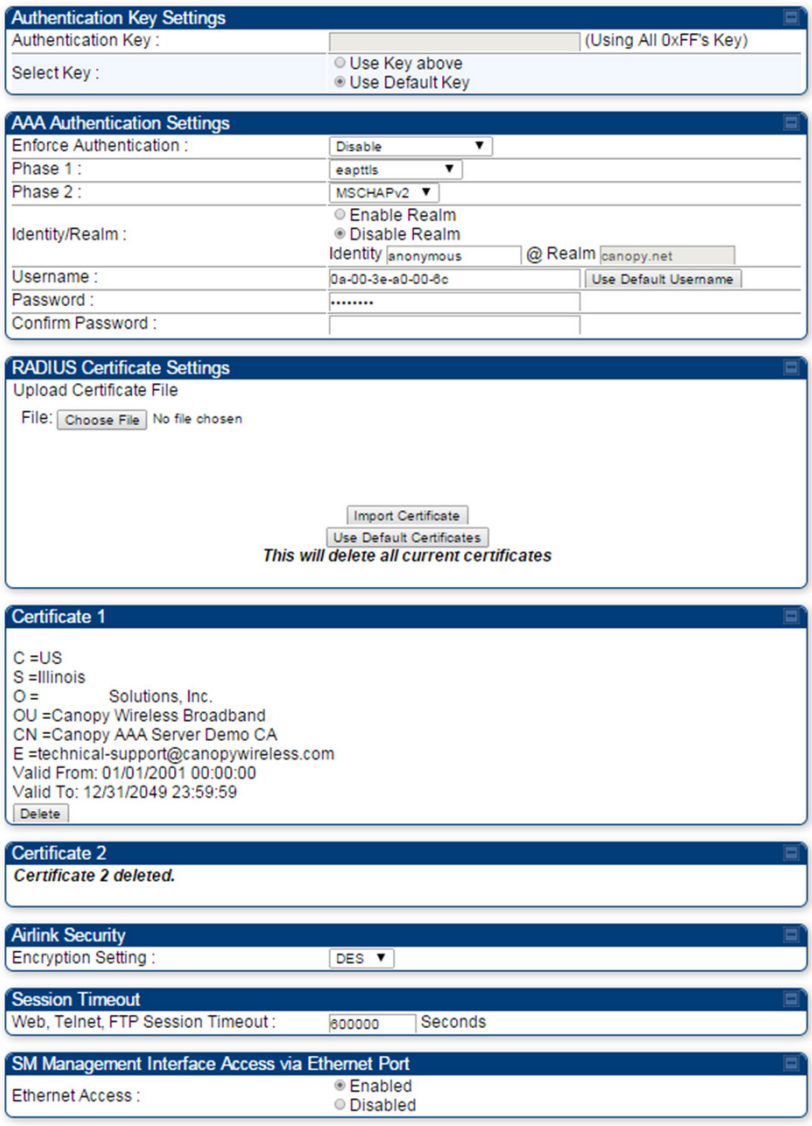
If it is desired that a SM will only authenticate to an AP that is using RADIUS, on the SM's Configuration Security tab set **Enforce Authentication** to **AAA**. With this enabled, SM does not register to an AP that has any **Authentication Mode** other than **RADIUS AAA** selected.

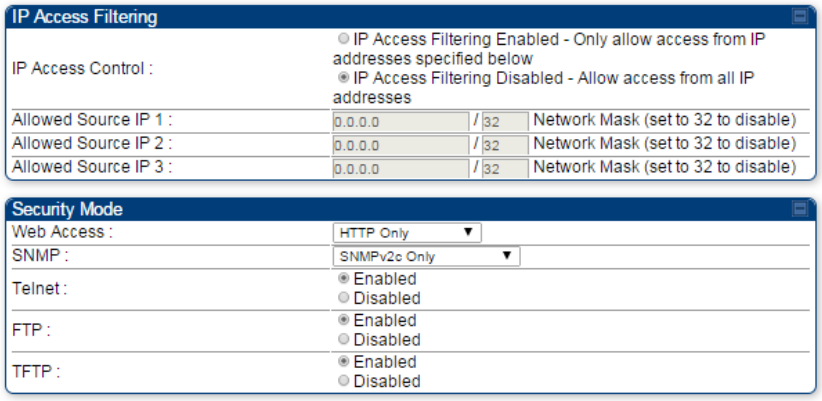
If it is desired that a SM use the authentication method configured on the AP it is registering to, set **Enforce Authentication** to **Disabled.** With **Enforce Authentication** disabled, a SM will attempt to register using whichever **Authentication Mode** is configured on the AP it is attempting to register to.

Note

Having SMs to use RADIUS by enabling **Enforce Authentication** avoids the security issue of SMs possibly registering to "rogue" APs, which have authentication disabled.

Table 149 SM Security tab attributes





Attribute	Meaning
Authentication Key	The authentication key is a 32-character hexadecimal string used when **Authentication Mode** is set to **AP PreShared Key**. By default, this key is set to 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF.
Select Key	This option allows operators to choose which authentication key is used: **Use Key above** means that the key specified in **Authentication Key** is used for authentication **Use Default Key** means that a default key (based off of the SM's MAC address) is used for authentication
Enforce Authentication	The SM may enforce authentication types of **AAA** and **AP Pre-sharedKey**. The SM will not finish the registration process if the AP is not using the configured authentication method (and the SM locks out the AP for 15 minutes). Enforce Authentication default setting is **Disable.**
Phase 1	The protocols supported for the **Phase 1** (Outside Identity) phase of authentication are EAPTTLS (Extensible Authentication Protocol Tunneled Transport Layer Security) or MSCHAPv2 (Microsoft Challenge-Handshake Authentication Protocol version 2).
Phase 2	Select the desired **Phase 2** (Inside Identity) authentication protocol from the **Phase 2** options of **PAP** (Password Authentication Protocol), **CHAP** (Challenge Handshake Authentication Protocol), and **MSCHAP** (Microsoft's version of CHAP, version 2 is used). The protocol must be consistent with the authentication protocol configured on the RADIUS server.

Identity/Realm	If Realms are being used, select **Enable Realm** and configure an outer identity in the **Identity** field and a Realm in the **Realm** field. These must match the Phase 1/Outer Identity and Realm configured in the RADIUS server. The default **Identity** is "anonymous". The **Identity** can be up to 128 non-special (no diacritical markings) alphanumeric characters. The default **Realm** is "canopy.net". The **Realm** can also be up to 128 non-special alphanumeric characters. Configure an outer Identity in the **Username** field. This must match the Phase 1/Outer Identity username configured in the RADIUS server. The default Phase 1/Outer Identity **Username** is "anonymous". The **Username** can be up to 128 non-special (no diacritical markings) alphanumeric characters.
Username	Enter a **Username** for the SM. This must match the username configured for the SM on the RADIUS server. The default **Username** is the SM's MAC address. The **Username** can be up to 128 non-special (no diacritical markings) alphanumeric characters.
Password Confirm Password	Enter the desired password for the SM in the **Password** and **Confirm Password** fields. The **Password** must match the password configured for the SM on the RADIUS server. The default **Password** is "password". The **Password** can be up to 128 non-special (no diacritical markings) alphanumeric characters.
Upload Certificate File	To upload a certificate manually to a SM, first load it in a known place on your PC or network drive, then click on a **Delete** button on one of the Certificate description blocks to delete a certificate to provide space for your certificate. Click on **Choose File,** browse to the location of the certificate, and click the **Import Certificate** button, and then reboot the radio to use the new certificate. When a certificate is in use, after the SM successfully registers to an AP, an indication of **In Use** will appear in the description block of the certificate being used. The public certificates installed on the SMs are used with the private certificate on the RADIUS server to provide a public/private key encryption system. Up to 2 certificates can be resident on a SM. An installed certificate can be deleted by clicking the **Delete** button in the certificate's description block on the Configuration > Security tab. To restore the 2 default certificates, click the **Use Default Certificates** button in the **RADIUS Certificate Settings** parameter block and reboot the radio.
Encryption Setting	Specify the type of airlink security to apply to this AP. The encryption setting must match the encryption setting of the SMs. **None** provides no encryption on the air link. **DES** (Data Encryption Standard): An over-the-air link encryption 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. DES encryption does not affect the performance or throughput of the system. **AES** (Advanced Encryption Standard)**:** An over-the-air link encryption option that uses the Rijndael algorithm and 128-bit keys to establish a higher level of security than DES. AES products are certified as compliant with the Federal Information Processing Standards (FIPS 197) in the U.S.A.
Web, Telnet, FTP Session Timeout	Enter the expiry in seconds for remote management sessions via HTTP, telnet or ftp access to the AP.
Ethernet Access	If you want to prevent any device that is connected to the Ethernet port of the SM from accessing the management interface of the SM, select **Ethernet Access Disabled**. This selection disables access through this port to via HTTP (the GUI), SNMP, telnet, FTP, and TFTP. With this selection, management access is available through only the RF interface via either an IP address (if **Network Accessibility** is set to **Public** on the SM) or the Session Status or Remote Subscribers tab of the AP.. See **IP Access Control** below. If you want to allow management access through the Ethernet port, select **Ethernet Access Enabled**. This is the factory default setting for this parameter.
IP Access Control	You can permit access to the AP from any IP address (**IP Access Filtering Disabled**) or limit it to access from only one, two, or three IP addresses that you specify (**IP Access Filtering Enabled**). If you select **IP Access Filtering Enabled**, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted from any IP address
Allowed Source IP 1 Allowed Source IP 2 Allowed Source IP 3	If you selected **IP Access Filtering Enabled** for the **IP Access Control** parameter, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted to the AP from any IP address. You may populate as many as all three. If you selected **IP Access Filtering Disabled** for the **IP Access Control** parameter, then no entries in this parameter are read, and access from all IP addresses is permitted.
Web Access	The Radio supports secured and non-secured web access protocols. Select suitable web access from drop down list: • **HTTP Only** – provides non-secured web access. The radio to be accessed via http://<IP of Radio>. • **HTTPS Only** – provides a secured web access. The radio to be accessed via https://<IP of Radio>. • **HTTP and HTTPS** – If enabled, the radio can be accessed via both http and https.
SNMP	This option allows to configure SNMP agent communication version. It can be selected from drop down list :

	• **SNMPv2c Only** – Enables SNMP v2 community protocol. • **SNMPv3 Only** – Enables SNMP v3 protocol. It is secured communication protocol. • **SNMPv2c and SNMPv3** – It enables both the protocols.
Telnet	This option allows to **Enable** and **Disable** Telnet access to the Radio.
FTP	This option allows to **Enable** and **Disable** FTP access to the Radio.
TFTP	This option allows to **Enable** and **Disable** TFTP access to the Radio.

SM - Phase 1 (Outside Identity) parameters and settings

The protocols supported for the **Phase 1** (Outside Identity) phase of authentication are **eapttls** (Extensible Authentication Protocol Tunneled Transport Layer Security) and **eapMSChapV2** (Extensible Authentication Protocol – Microsoft Challenge-Handshake Authentication Protocol).

Configure an outer Identity in the **Username** field. This must match the Phase 1/Outer Identity username configured in the RADIUS server. The default Phase 1/Outer Identity **Username** is "anonymous". The **Username** can be up to 128 non-special (no diacritical markings) alphanumeric characters. If Realms are being used in the RADIUS system (**eapttls** only), select **Enable Realm** and configure an outer identity in the **Identity** field and a Realm in the **Realm** field. These must match the Phase 1/Outer Identity and Realm configured in the RADIUS server. The default **Identity** is "anonymous". The **Identity** can be up to 128 non-special (no diacritical markings) alphanumeric characters. The default **Realm** is "canopy.net". The **Realm** can also be up to 128 non-special alphanumeric characters.

SM - Phase 2 (Inside Identity) parameters and settings

If using **eapttls** for Phase 1 authentication, select the desired **Phase 2** (Inside Identity) authentication protocol from the **Phase 2** options of **PAP** (Password Authentication Protocol), **CHAP** (Challenge Handshake Authentication Protocol), and **MSCHAPv2 (**Microsoft's version of CHAP). The protocol must be consistent with the authentication protocol configured on the RADIUS server. Enter a **Username** for the SM. This must match the username configured for the SM on the RADIUS server. The default **Username** is the SM's MAC address. The **Username** can be up to 128 non-special (no diacritical markings) alphanumeric characters.

Enter the desired password for the SM in the **Password** and **Confirm Password** fields**.** The **Password** must match the password configured for the SM on the RADIUS server. The default **Password** is "password". The **Password** can be up to 128 non-special (no diacritical markings) alphanumeric characters.

Handling Certificates

Managing SM Certificates via the SM GUI

The default public Canopy certificates are loaded into SMs upon factory software installation. The default certificates are not secure and are intended for use during lab and field trials as part of gaining experience with the RADIUS functionalities or as an option during debug. For secure operation, an operator will want to create or procure their own certificates. Resetting a SM to its factory defaults will remove the current certificates and restore the default certificates.

Up to two certificates can be resident on a SM. An installed certificate can be deleted by clicking the **Delete** button in the certificate's description block on the Configuration > Security tab. To restore the 2 default certificates, click the **Use Default Certificates** button in the **RADIUS Certificate Settings** parameter block and reboot the radio.

To upload a certificate manually to a SM, first load it in a known place on your PC or network drive, then click on a **Delete** button on one of the Certificate description blocks to delete a certificate to provide space for your certificate. Click on **Choose File,** browse to the location of the certificate, and click the **Import Certificate** button, and then reboot the radio to use the new certificate.

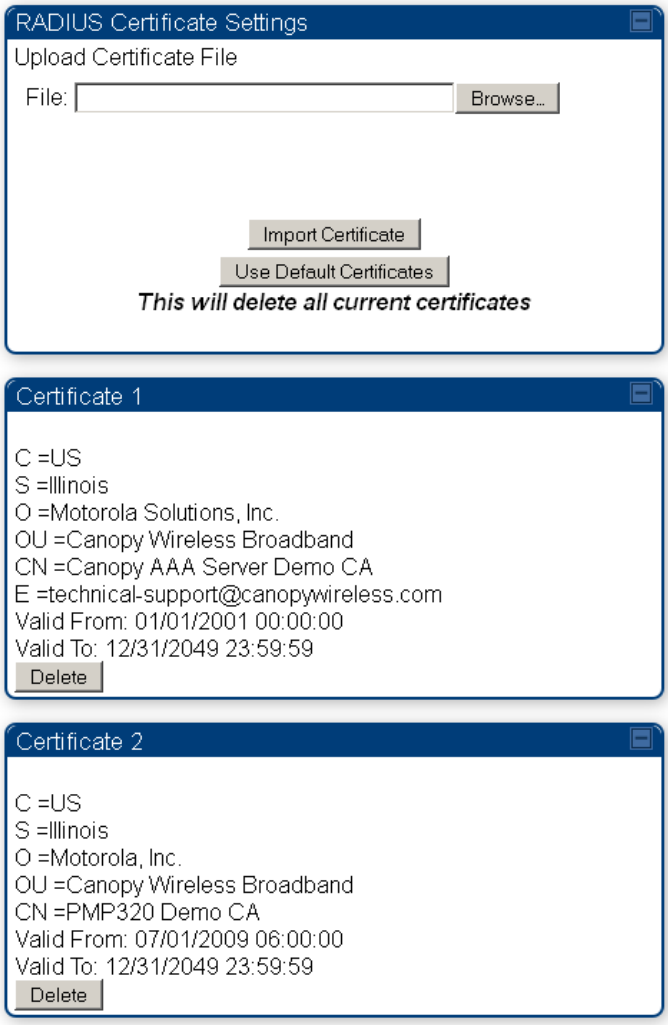
When a certificate is in use, after the SM successfully registers to an AP, an indication of **In Use** will appear in the description block of the certificate being used.

The public certificates installed on the SMs are used with the private certificate on the RADIUS server to provide a public/private key encryption system.

Note

Root certificates of more than one level (Example - a certificate from someone who received their CA from Verisign) fails. Certificates must be either root or self-signed.

Figure 128 SM Certificate Management



Configuring RADIUS servers for SM authentication

Your RADIUS server must be configured to use the following:

- EAPTTLS or MSCHAPv2 as the Phase 1/Outer Identity protocol.
- If **Enable Realm** is selected on the SM's **Configuration** > **Security** tab, then the same Realm appears there (or access to it).
- The same Phase 2 (Inner Identity) protocol as configured on the SM's **Configuration** > **Security** tab under Phase 2 options.
- The username and password for each SM configured on each SM's **Configuration > Security** tab.
- An IP address and NAS shared secret that is the same as the IP address and **Shared Secret** configured on the AP's **Configuration > Security** tab for that RADIUS server.

- A server private certificate, server key, and CA certificate that complement the public certificates distributed to the SMs, as well as the Canopy dictionary file that defines Vendor Specific Attributes (VSAa). Default certificate files and the dictionary file are available from the software site: https://support.cambiumnetworks.com/files/pmp450 after entering your name, email address, and either Customer Contract Number or the MAC address of a module covered under the 12 month warranty.

Optionally, operators may configure the RADIUS server response messages (Accept or Reject) so that the user has information as to why they have been rejected. The AP displays the RADIUS Authentication Reply message strings in the Session Status list as part of each SM's information. The SM will show this string (listed as Authentication Response on the SM GUI) on the main Status page in the Subscriber Module Stats section.

Note

Aradial AAA servers only support operator-configurable Authentication Accept responses, not Authentication Reject responses.

Assigning SM management IP addressing via RADIUS

Operators may use a RADIUS AAA server to assign management IP addressing to SM modules (framed IP address). SMs now interpret attributes Framed-IP-Address, Framed-IP-Netmask, and Cambium-Canopy-Gateway from RADIUS. The RADIUS dictionary file has been updated to include the Cambium-Canopy-Gateway attribute and is available on the Cambium Software Support website.

In order for these attributes to be assigned and used by the SM, the following must be true:

- The system is configured for AAA authentication
- The SM is *not* configured for DHCP on its management interface. If DHCP is enabled and these attributes are configured in the RADIUS server, the attributes is ignored by the SM.
- The SM management interface must be configured to be publically accessible. If the SM is configured to have local accessibility, the management interface will still be assigned the framed addressing, and the SM iscome publicly accessible via the assigned framed IP addressing.
- When using these attributes, for the addressing to be implemented by the SM operators must configure Framed-IP-Address in RADIUS. If Framed-IP-Address is not configured but Framed-IP-Netmask and/or Cambium-Canopy-Gateway is configured, the attributes is ignored. In the case where only the Framed-IP-Address is configured, Framed-IP-Netmask defaults to 255.255.0.0 (NAT disabled) / 255.255.255.0 (NAT enabled) and Cambium-Canopy-Gateway defaults to 0.0.0.0.

Configuring RADIUS server for SM configuration

Canopy Vendor Specific Attributes (VSAs) along with VSA numbers and other details are listed in Table 150. The associated SM GUI page, tab and parameter are listed to aid cross-referencing and understanding of the VSAs.

A RADIUS dictionary file is available from the software site:

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

The RADIUS dictionary file defines the VSAs and their values and is usually imported into the RADIUS server as part of server and database setup.

Note

Beginning with System Release 12.0.2, two RADIUS dictionary files are available on the Cambium website – "RADIUS Dictionary file – Cambium" and "RADIUS Dictionary file – Motorola".

In addition to a renaming of attributes, the Cambium-branded dictionary file contains two new VSAs for controlling uplink and downlink Maximum Burst Data Rate (these VSAs are listed below in Table 150).

If you are transitioning from the Motorola-branded dictionary file to the Cambium-branded dictionary file, ensure that all RADIUS profiles containing Motorola-Canopy attribute references are updated to include Cambium-Canopy attribute references (for all applicable VSAs listed in Table 150). Also, ensure that all RADIUS configuration files reference the new dictionary file (as an alternative, operators may rename the Cambium-branded dictionary file to the filename currently in use by the RADIUS server). Once the profiles are updated and the new Cambium-branded dictionary file is installed on the RADIUS server, restart the RADIUS server to ensure that the new VSAs and attribute names are enabled.

Table 150 RADIUS Vendor Specific Attributes (VSAs)

Name	Number	Type	Required	Value	
MS-MPPE-Send-Key[2]	26.311.16	-	Y	-	
-				-	-
MS-MPPE-Recv-Key[3]	26.311.17	-	Y	-	
-				-	-
Cambium-Canopy-LPULCIR	26.161.1	integer	N	0-65535 kbps	
Configuration > Quality of Service > Low Priority Uplink CIR				0 kbps	32 bits
Cambium-Canopy-LPDLCIR	26.161.2	integer	N	0-65535 kbps	
Configuration > Quality of Service > Low Priority Downlink CIR				0 kbps	32 bits
Cambium-Canopy-HPULCIR	26.161.3	integer	N	0-65535 kbps	
Configuration > Quality of Service > Hi Priority Uplink CIR				0 kbps	32 bits
Cambium-Canopy-HPDLCIR	26.161.4	integer	N	0-65535 kbps	
Configuration > Quality of Service > Hi Priority Uplink CIR				0 kbps	32 bits
Cambium-Canopy-HPENABLE	26.161.5	integer	N	0-disable, 1-enable	

[2] Contains key for encrypting packets sent by the NAS to the remote host (for Microsoft Point-to-Point Encryption Protocol)

[3] Contains key for encrypting packets received by the NAS from the remote host (for Microsoft Point-to-Point Encryption Protocol)

Configuration > Quality of Service > Hi Priority Channel Enable/Disable				0	32 bits
26.161.6		integer	N	0-100000 kbps	
Configuration > Quality of Service > Sustained Uplink Data Rate				dependent on radio feature set	32 bits
Cambium-Canopy-ULBL	26.161.7	integer	N	0-2500000 kbps	
Configuration > Quality of Service > Uplink Burst Allocation				dependent on radio feature set	32 bits
Cambium-Canopy-DLBR	26.161.8	integer	N	0-100000 kbps	
Configuration > Quality of Service > Sustained Downlink Data Rate				dependent on radio feature set	32 bits
Cambium-Canopy-DLBL	26.161.9	integer	N	0-2500000 kbps	
Configuration > Quality of Service > Downlink Burst Allocation				dependent on radio feature set	32 bits
Cambium-Canopy-VLLEARNEN	26.161.14	integer	N	0-disable, 1-enable	
Configuration > VLAN > Dynamic Learning				1	32 bits
Cambium-Canopy-VLFRAMES	26.161.15	integer	N	0-all, 1-tagged, 2-untagged	
Configuration > VLAN > Allow Frame Types				0	32 bits
Cambium-Canopy-VLIDSET	26.161.16	integer	N	VLAN Membership (1-4094)	
Configuration > VLAN Membership				0	32 bits
Cambium-Canopy-VLAGETO	26.161.20	integer	N	5 - 1440 minutes	
Configuration > VLAN > VLAN Aging Timeout				25 mins	32 bits
Cambium-Canopy-VLIGVID	26.161.21	integer	N	1 – 4094	
Configuration > VLAN > Default Port VID				1	32 bits
Cambium-Canopy-VLMGVID	26.161.22	integer	N	1 – 4094	
Configuration > VLAN > Management VID				1	32 bits
Cambium-Canopy-VLSMMGPASS	26.161.23	integer	N	0-disable, 1-enable	
Configuration > VLAN > SM Management VID Pass-through				1	32 bits
Cambium-Canopy-BCASTMIR	26.161.24	integer	N	0-100000 kbps, 0=disabled	
Configuration > Quality of Service > Broadcast/Multicast Uplink Data Rate				dependent on radio feature set	32 bits

Cambium-Canopy-Gateway	26.161.25	ipaddr	N	-	
Configuration > IP > Gateway IP Address				0.0.0.0	-
Cambium-Canopy-ULMB	26.161.26	integer	N	0-100000 kbps	
Configuration > Quality of Service > Max Burst Uplink Data Rate				0	32 bits
Cambium-Canopy-DLMB	26.161.27	integer	N	0-100000 kbps	
Configuration > Quality of Service > Max Burst Downlink Data Rate				0	32 bits
Cambium-Canopy-UserLevel	26.161.50	integer	N	1-Technician, 2-Installer, 3-Administrator	
Account > Add User > Level				0	32 bits

Note

VSA numbering:

26 connotes Vendor Specific Attribute, per RFC 2865

26.311 is Microsoft Vendor Code, per IANA

Using RADIUS for centralized AP and SM user name and password management

AP – Technician/Installer/Administrator Authentication

To control technician, installer, and administrator access to the AP from a centralized RADIUS server:

Procedure 27 Centralized user name and password management for AP

1. Set **Authentication Mode** on the AP's Configuration > Security tab to **RADIUS AAA**
2. Set **User Authentication Mode** on the AP's Account > User Authentication tab (the tab only appears after the AP is set to RADIUS authentication) to **Remote** or **Remote then Local**.
   - **Local**: The local SM is checked for accounts. No centralized RADIUS accounting (access control) is performed.
   - **Remote**: Authentication by the centralized RADIUS server is required to gain access to the SM if the SM is registered to an AP that has **RADIUS AAA Authentication Mode** selected. For up to 2 minutes a test pattern is displayed until the server responds or times out.
   - **Remote then Local**: Authentication using the centralized RADIUS server is attempted. If the server sends a reject message, then the setting of **Allow Local Login after Reject from AAA** determines if the local user database is checked or not. If the configured servers do not respond within 2 minutes, then the local user database is used. The successful login method is displayed in the navigation column of the SM.

Figure 129 User Authentication and Access Tracking tab of the AP

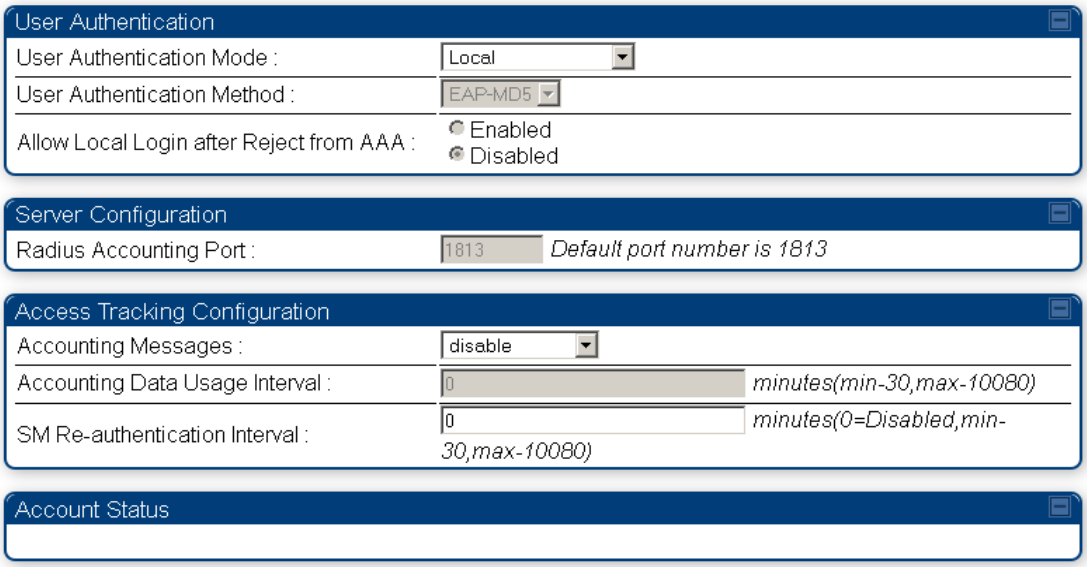
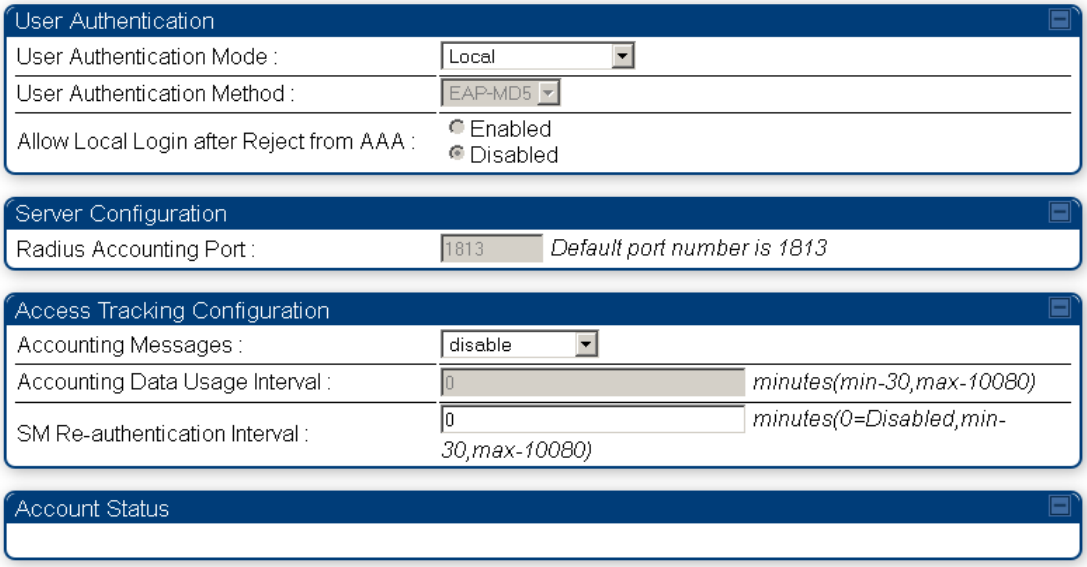


Table 151 AP User Authentication and Access Tracking attributes



Attribute	Meaning
User Authentication Mode	• **Local**: The local SM is checked for accounts. No centralized RADIUS accounting (access control) is performed. • **Remote**: Authentication by the centralized RADIUS server is required to gain access to the AP. For up to 2 minutes a test pattern is displayed until the server responds or times out. • **Remote then Local**: Authentication using the centralized RADIUS server is attempted. If the server sends a reject message, then the setting of **Allow Local Login after Reject from AAA** determines if the local user database is checked or not. If the configured servers do not respond within 2 minutes, then the local user database is used. The successful login method is displayed in the navigation column of the AP.
User Authentication Method	The user authentication method employed by the radios is EAP-MD5.
Allow Local Login after Reject from AAA	If a user authentication is rejected from the AAA server, the user is allowed to login locally to the radio's management interface.
Radius Accounting Port	The destination port on the AAA server used for Radius accounting communication.
Accounting Messages	disable – no accounting messages are sent to the RADIUS server deviceAccess – accounting messages are sent to the RADIUS server regarding device access (see Table 153). dataUsage – accounting messages are sent to the RADIUS server regarding data usage (see Table 153).
Accounting Data Usage Interval	The interval for which accounting data messages are sent from the radio to the RADIUS server. If 0 is configured for this parameter, no data

	usage messages are sent.
SM Re-authentication Interval	The interval for which the SM will re-authenticate to the RADIUS server.

SM – Technician/Installer/Administrator Authentication

The centralized user name and password management for SM is same as AP. Follow AP – Technician/Installer/Administrator Authentication on page 7-225 procedure.

Note

Remote access control is enabled only after the SM registers to an AP that has **Authentication Mode** set to **RADIUS AAA**. Local access control will always be used before registration and is used after registration if the AP is not configured for RADIUS.

Figure 130 User Authentication and Access Tracking tab of the SM

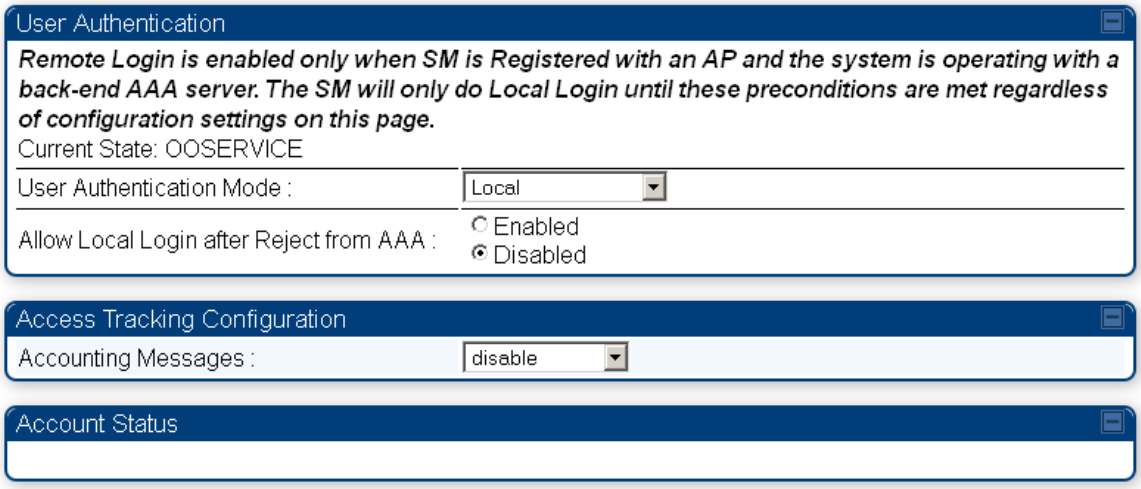
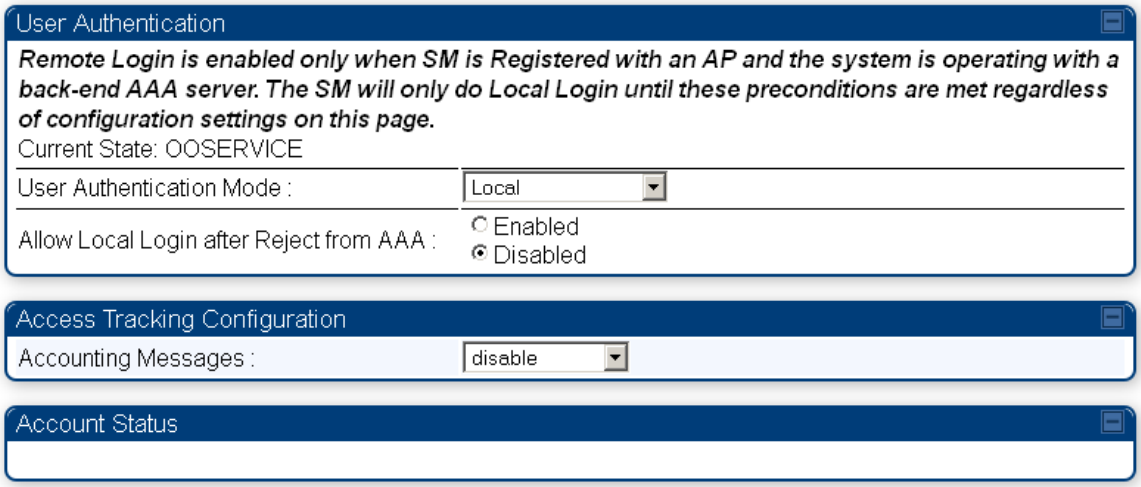


Table 152 SM User Authentication and Access Tracking attributes



Attribute	Meaning
User Authentication Mode	• **Local**: The local SM is checked for accounts. No centralized RADIUS accounting (access control) is performed. • **Remote**: Authentication by the centralized RADIUS server is required to gain access to the SM if the SM is registered to an AP that has **RADIUS AAA Authentication Mode** selected. For up to 2 minutes a test pattern is displayed until the server responds or times out. • **Remote then Local**: Authentication using the centralized RADIUS server is attempted. If the server sends a reject message, then the setting of **Allow Local Login after Reject from AAA** determines if the local user database is checked or not. If the configured servers do not respond within 2 minutes, then the local user database is used. The successful login method is displayed in the navigation column of the SM.
Allow Local Login after Reject from AAA	If a user authentication is rejected from the AAA server, the user is allowed to login locally to the radio's management interface. It is applicable ONLY when the **User Authentication Mode** is set to "**Remote then Local**". **Note** When the radio User Authentication Mode is set to "Local" or "Remote", the Allow Local Login after Reject from AAA does not any effect.
Accounting Messages	• disable – no accounting messages are sent to the RADIUS server • deviceAccess – accounting messages are sent to the RADIUS server regarding device access (see Table 153).

Access Tracking

To track logon and logoff times on individual radios by technicians, installers, and administrators, on the AP or SM's **Account** > **User Authentication and Access Tracking** tab under **Accounting** (Access Tracking) set **Accounting Messages** to "deviceAccess".

Device Access Tracking is enabled separately from **User Authentication Mode**. A given AP or SM can be configured for both, either, or neither.

RADIUS Device Data Accounting

PMP 450 systems include support for RADIUS accounting messages for usage-based billing. This accounting includes indications for subscriber session establishment, subscriber session disconnection, and bandwidth usage per session for each SM that connects to the AP. The attributes included in the RADIUS accounting messages are shown in the table below.

Table 153 Device data accounting RADIUS attributes

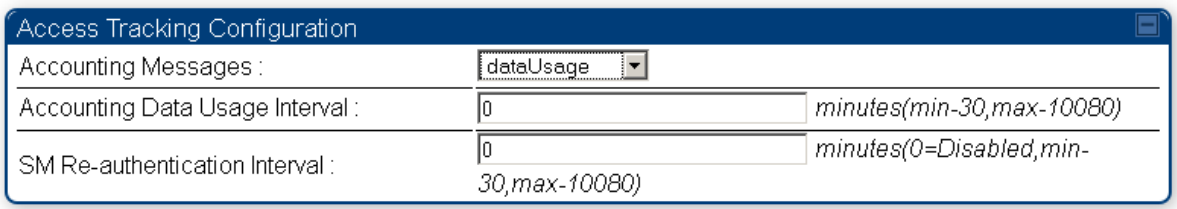
Sender	Message	Attribute	Value	Description
AP	Accounting-Request	Acct-Status-Type	1 - Start	This message is sent every time a SM registers with an AP, and after the SM stats are cleared.
		Acct-Session-Id	Unique per AP session. Initial value is SM MAC, and increments after every start message sent of an in session SM.	
		Event-Timestamp	UTC time the event occurred on the AP	
AP	Accounting-Request	Acct-Status-Type	2 - Stop	This message is sent every time a SM becomes unregistered with an AP, and when the SM stats are cleared.
		Acct-Session-Id	Unique per AP session. Initial value is SM MAC, and increments after every start message sent of an in session SM.	
		Acct-Input-Octets	Sum of the input octets received at the SM over regular data VC and the high priority data VC (if enabled). Will not include broadcast.	
		Acct-Output-Octets	Sum of the output octets sent from the SM over regular data VC and the high priority data VC (if enabled).	

Sender	Message	Attribute	Value	Description
		Acct-Input-Gigawords	Number of times the Acct-Input-Octets counter has wrapped around 2^32 over the course of the session	
		Acct-Output-Gigawords	Number of times the Acct-Output-Octets counter has wrapped around 2^32 over the course of the session	
		Acct-Input-Packets	Sum of unicast and multicast packets that are sent to a particular SM over the regular data VC and the high priority data VC (if enabled). It will not include broadcast.	
		Acct-Output-Packets	Sum of unicast and multicast packets that are sent from a particular SM over the regular data VC and the high priority data VC (if enabled).	
		Acct-Session-Time	Uptime of the SM session.	
		Acct-Terminate-Cause	Reason code for session termination	
AP	Accounting-Request	Acct-Status-Type	3 - Interim-Update	This message is sent periodically per the operator configuration on the AP in seconds. Interim update counts are cumulative over the course of the session
		Acct-Session-Id	Unique per AP session. Initial value is SM MAC, and increments after every start message sent of an in session SM.	
		Acct-Input-Octets	Sum of the input octets sent to the SM over regular data VC and the high priority data VC (if enabled). Will not include broadcast.	
		Acct-Output-Octets	Sum of the output octets set from the SM over regular data VC and the high priority data VC (if enabled).	

Sender	Message	Attribute	Value	Description
		Acct-Input-Gigawords	Number of times the Acct-Input-Octets counter has wrapped around 2^32 over the course of the session	
		Acct-Output-Gigawords	Number of times the Acct-Output-Octets counter has wrapped around 2^32 over the course of the session	
		Acct-Session-Time	Uptime of the SM session.	
		Acct-Input-Packets	Sum of unicast and multicast packets that are sent to a particular SM over the regular data VC and the high priority data VC (if enabled). It will not include broadcast.	
		Acct-Output-Packets	Sum of unicast and multicast packets that are sent from a particular SM over the regular data VC and the high priority data VC (if enabled).	

The data accounting configuration is located on the AP's **Accounts** > **User Authentication and Access Tracking** GUI menu, and the AP's **Authentication Mode** must be set to **Radius AAA** for the menu to appear. The accounting may be configured via the AP GUI as shown in the figures below. By default accounting messages are not sent and the operator has the choice of configuring to send only Device Access accounting messages (when a user logs in or out of the radio), only Data Usage messages, or both. When Data Accounting is enabled, the operator must specify the interval of when the data accounting messages are sent (0 – disabled, or in the range of 30-10080 minutes). The default interval is 30 minutes.

Figure 131 RADIUS accounting messages configuration



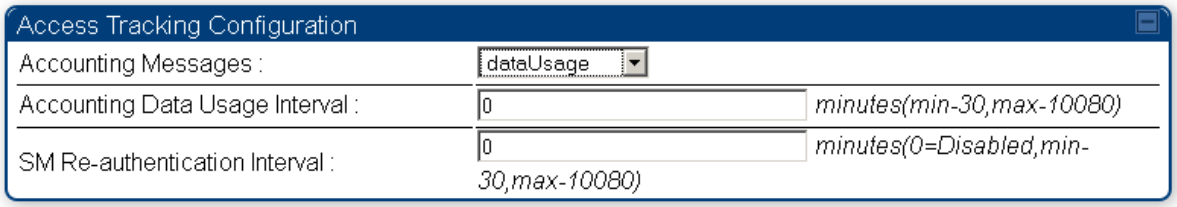
The data accounting message data is based on the SM statistics that the AP maintains, and these statistics may be cleared on the AP by an operator. If an operator clears these messages and data accounting is enabled, an accounting stop message is sent followed by an accounting start message to notify the AAA of the change.

If an operator clears the VC statistics on the device through the management GUI, a RADIUS stop message and data start message is issued for each device affected. The start and stop messages will only be sent once every 5 minutes, so if an operator clears these statistics multiple times within 5 minutes, only one set of data stop/start messages is sent. This may result in inaccurate data accumulation results.

RADIUS Device Re-authentication

PMP 450 platform systems include support for periodic SM re-authentication in a network without requiring the SM to re-register (and drop the session). The re-authentication may be configured to occur in the range of every 30 minutes to weekly.

Figure 132 Device re-authentication configuration



The re-authentication interval is only configurable on the AP. When this feature is enabled, each SM that enters the network will re-authenticate each the interval time has expired without dropping the session. The response that the SM receives from the AAA server upon re-authentication is one of the following:

- **Success**: The SM continues normal operation
- **Reject**: The SM de-registers and will attempt network entry again after 1 minute and then if rejected will attempt re-entry every 15 minutes
- **Timeout or other error**: The SM remains in session and attempt 5 times to re-authenticate with the RADIUS-REQUEST message. If these attempts fail, then the SM will go out of session and proceed to re-authenticate after 5 minutes, then every 15 minutes.

Although re-authentication is an independent feature, it was designed to work alongside with the RADIUS data usage accounting messages. If a user is over their data usage limit the network operator can reject the user from staying in the network. Operators may configure the RADIUS 'Reply-Message' attribute with an applicable message (i.e. "Data Usage Limit Reached") that is sent to the subscriber module and displayed on the general page.

Chapter 8: Tools

The AP and SM GUIs provide several tools to analyze the operating environment, system performance and networking, including:

Using Spectrum Analyzer tool

The integrated spectrum analyzer can be very useful as a tool for troubleshooting and RF planning, but is not intended to replicate the accuracy and programmability of a high-end spectrum analyzer, which sometime can be used for other purposes.

The AP/BHM and SM/BHS perform spectrum analysis together in the Sector Spectrum Analyzer tool.

Caution

On start of the Spectrum Analyzer on a module, it enters a scan mode and drops any RF connection it may have had. When choosing **Start Timed Spectrum Analysis**, the scan is run for the amount of time specified in the **Duration** configuration parameter. When choosing **Start Continuous Spectrum Analysis**, the scan is run continuously for 24 hours, or until stopped manually (using the **Stop Spectrum Analysis** button).

Any module can be used to see the frequency and power level of any detectable signal that is within, just above, or just below the frequency band range of the module.

Note

Vary the days and times when you analyze the spectrum in an area. The RF environment can change throughout the day or throughout the week.

Mapping RF Neighbor Frequencies

The neighbor frequencies can be analyzed using Spectrum Analyzer tool. Following modules allow user to:

- Use a BHS or BHM for PTP and SM or AP for PMP as a Spectrum Analyzer.
- View a graphical display that shows power level in RSSI and dBm at 5 MHz increments throughout the frequency band range, regardless of limited selections in the **Custom Radio Frequency Scan Selection List** parameter of the SM/BHS.
- Select an AP/BHM channel that minimizes interference from other RF equipment.

Caution

The following procedure causes the SM/BHS to drop any active RF link. If a link is dropped when the spectrum analysis begins, the link can be re-established when either a 15 minute interval has elapsed or the spectrum analyzer feature is disabled.

Temporarily deploy a SM/BHS for *each* frequency band range that need to monitor and access the Spectrum Analyzer tab in the Tools web page of the module.

- Using Spectrum Analyzer tool
- Using the Remote Spectrum Analyzer tool

Spectrum Analyzer tool

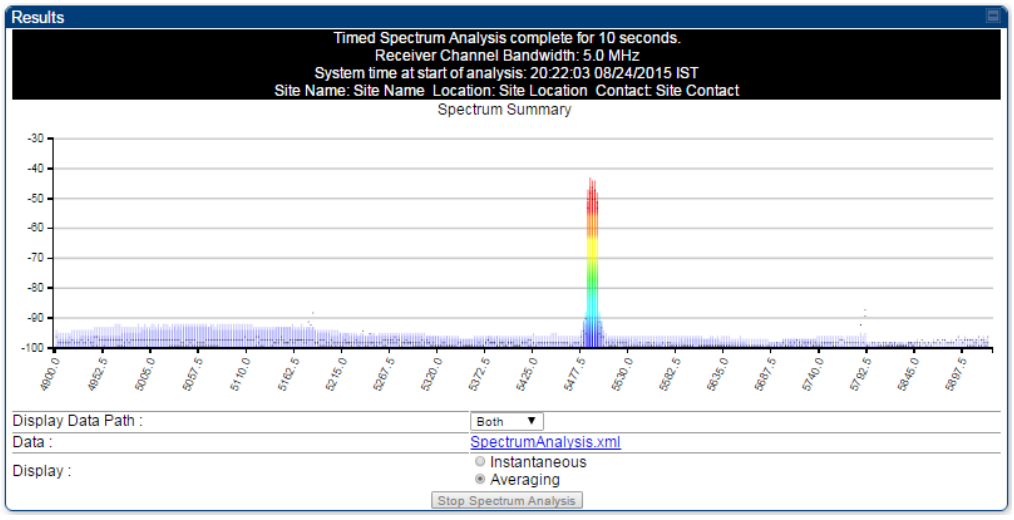
Analyzing the spectrum

To use the built-in spectrum analyzer functionality of the AP/SM/BH, proceed as follows:

Procedure 28 Analyzing the spectrum

1. Predetermine a power source and interface that works for the AP/SM/BH in the area to be analyzed.
2. Take the AP/SM/BH, power source and interface device to the area.
3. Access the **Tools** web page of the AP/SM/BH.
4. Enter **Duration** in Timed Spectrum Analyzer Tab. Default value is 10 Seconds
5. Click **Start Timed Sector Spectrum Analysis**
6. The results are displayed:

Figure 133 Spectrum analysis - Results



Note

AP/SM/BH scans for extra 40 seconds in addition to configured **Duration**

7. Travel to another location in the area to BHS.
8. Click **Start Timed Spectrum Analysis**

9 Repeat Steps 4 and 6 until the area has been adequately scanned and logged.

As with any other data that pertains to your business, a decision today to put the data into a retrievable database may grow in value to you over time.

Note

Wherever the operator find the measured noise level is greater than the sensitivity of the radio that is plan to deploy, use the noise level (rather than the link budget) for your link feasibility calculations.

The AP/SM/BH perform spectrum analysis together in the Sector Spectrum Analyzer feature.

Graphical spectrum analyzer display

The AP/SM/BH display the graphical spectrum analyzer. An example of the **Spectrum Analyzer** page is shown in Figure 133.

The navigation feature includes:

- Results may be panned left and right through the scanned spectrum by clicking and dragging the graph left and right
- Results may be zoomed in and out using mouse

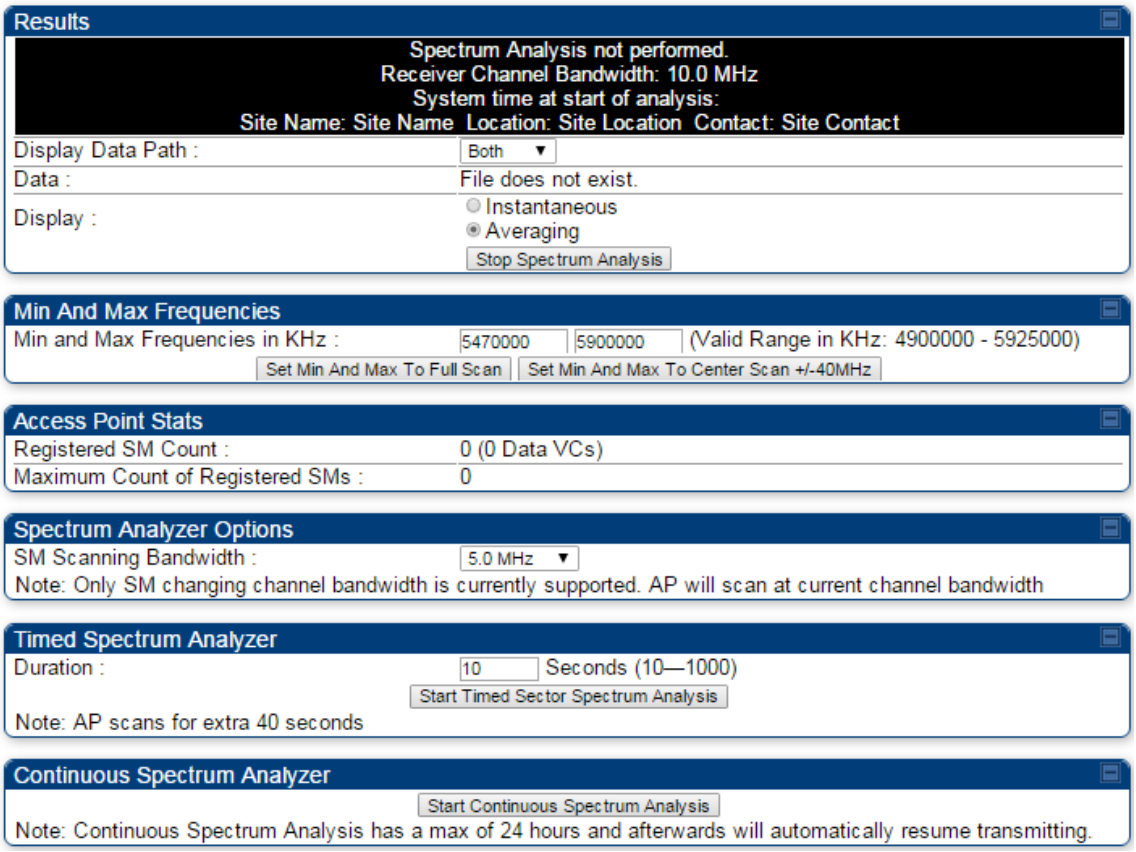
When the mouse is positioned over a bar, the receive power level, frequency, maximum and mean receive power levels are displayed above the graph

To keep the displayed data current, either set “Auto Refresh” on the module’s **Configuration > General.**

Spectrum Analyzer page of AP

The Spectrum Analyzer page of AP is explained in Table 154.

Table 154 Spectrum Analyzer page attributes - AP



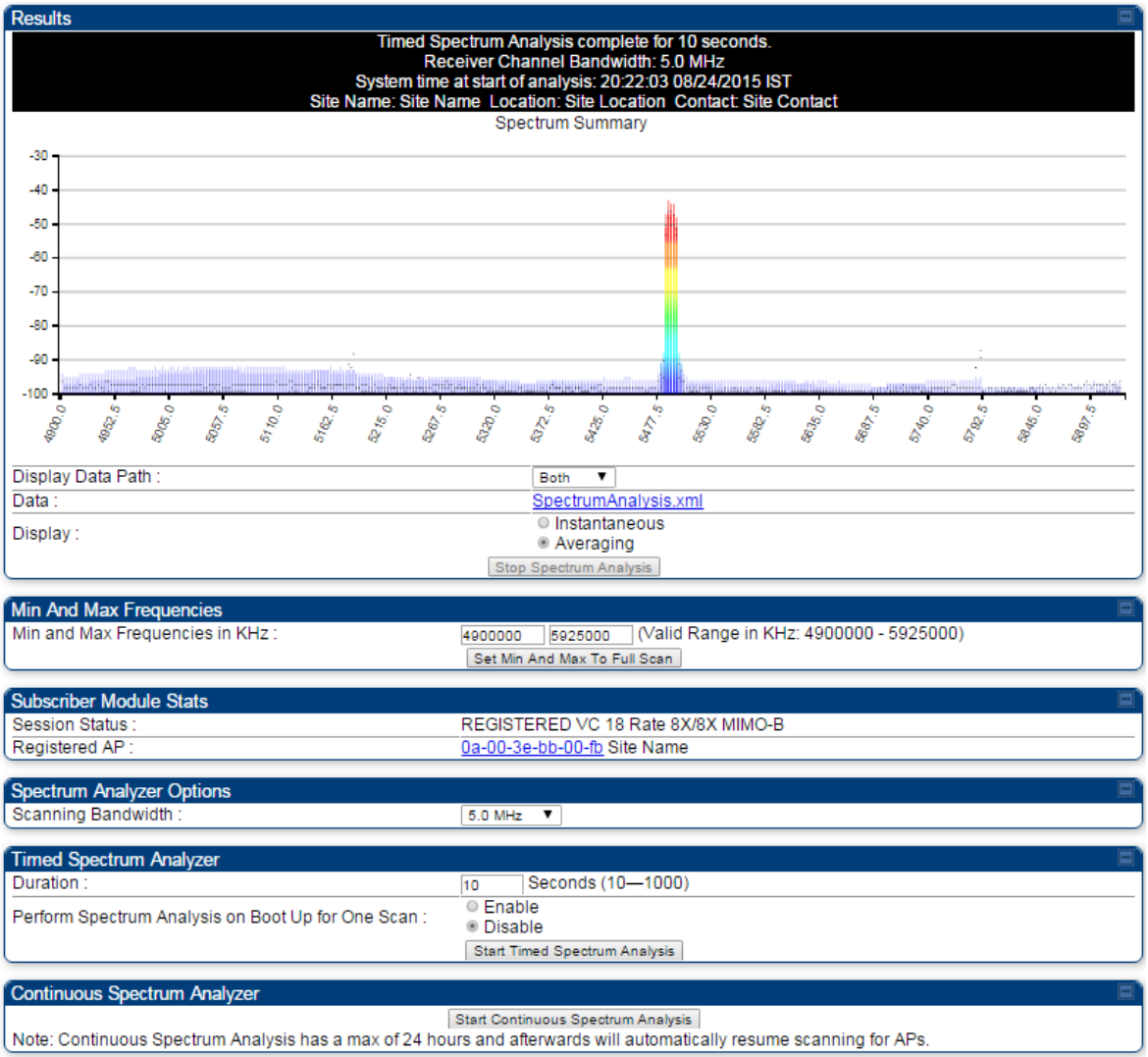
Attribute	Meaning
Display Data Path	**Both** means that the vertical and horizontal paths are displayed or an individual path may be selected to display only a single-path reading.
Data	For ease of parsing data and to facilitate automation, the spectrum analyzer results may be saved as an XML file. To save the results in an XML formatted file, right-click the “SpectrumAnalysis.xml” link and save the file.
Display	**Instantaneous** means that each reading (vertical bar) is displayed with two horizontal lines above it representing the max power level received (top horizontal line) and the average power level received (lower horizontal line) at that frequency. **Averaging** means that each reading (vertical bar) is displayed with an associated horizontal line above it representing the max power level received at that frequency.
Registered SM Count	This field displays the MAC address and Site Name of the registered SM.
Maximum Count of Registered SMs	This field displays the maximum number of registered SMs.
Duration	This field allows operators to configure a specified time for which the

	spectrum is scanned. If the entire spectrum is scanned prior to the end of the configured duration, the analyzer will restart at the beginning of the spectrum.
Continuous Spectrum Analyzer	***Start Continuous Spectrum Analysis*** button ensures that when the SM is powered on, it automatically scans the spectrum for 10 seconds. These results may then be accessed via the **Tools > Spectrum Analyzer** GUI page.

Spectrum Analyzer page of SM

The Spectrum Analyzer page of SM is explained in Table 155.

Table 155 Spectrum Analyzer page attributes - SM



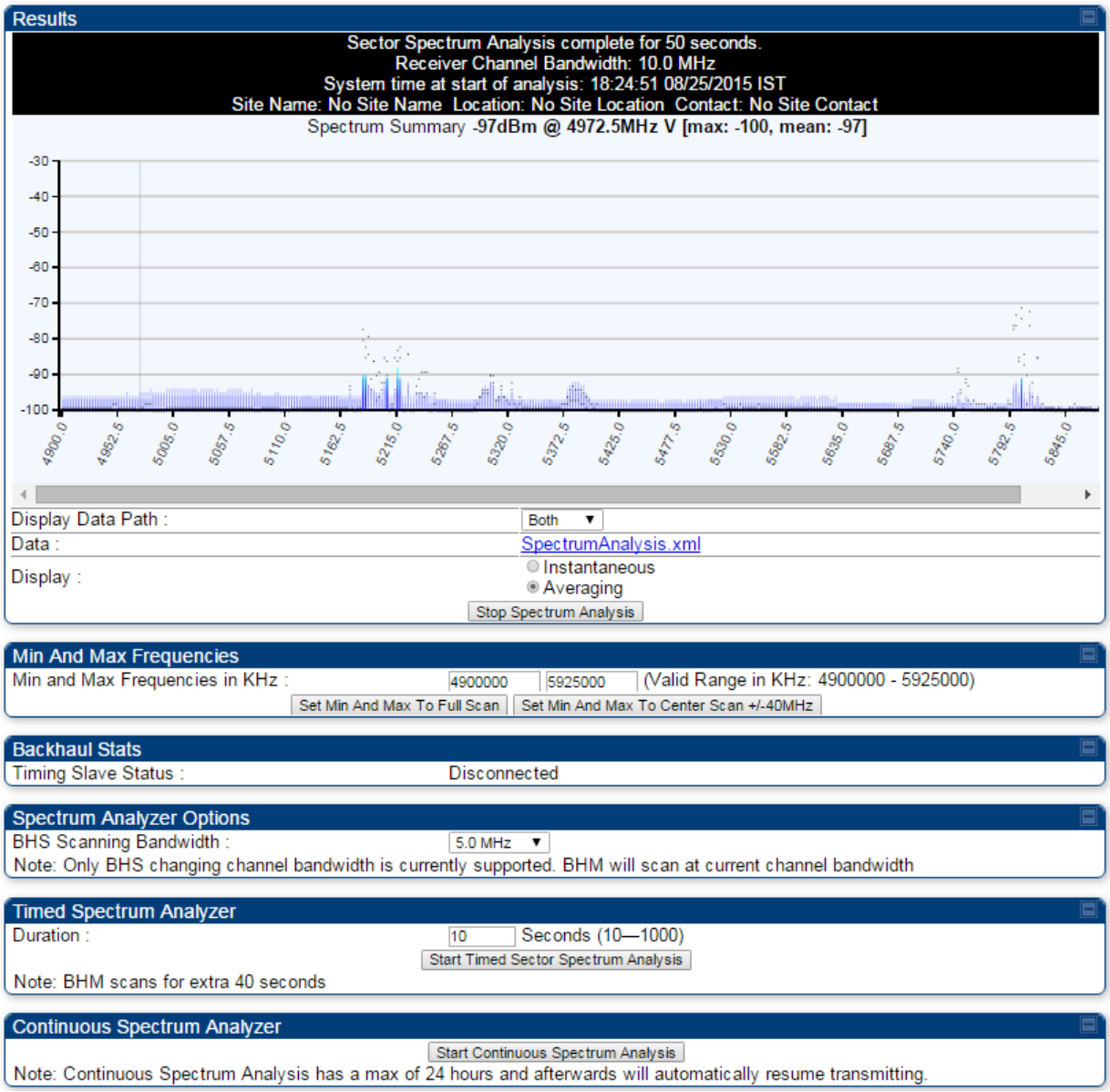
Attribute	Meaning

Display Data Path	Refer Table 154 on page 8-5
Data	Refer Table 154 on page 8-5
Display	Refer Table 154 on page 8-5
Min and Max Frequencies in KHz	To scan min to max range of frequencies, enter min and max frequencies in KHz and press **Set Min and Max to Full Scan** button. To scan +/- 40 MHz from center frequency, enter center frequency in KHz and press **Set Min And Max To Center Scan +/- 40KHz** button.
Registered SM Count	Refer Table 154 on page 8-5
Maximum Count to Registered SMs	Refer Table 154 on page 8-5
Duration	Refer Table 154 on page 8-5

Spectrum Analyzer page of BHM

The Spectrum Analyzer page of BHM is explained in Table 156.

Table 156 Spectrum Analyzer page attributes - BHM

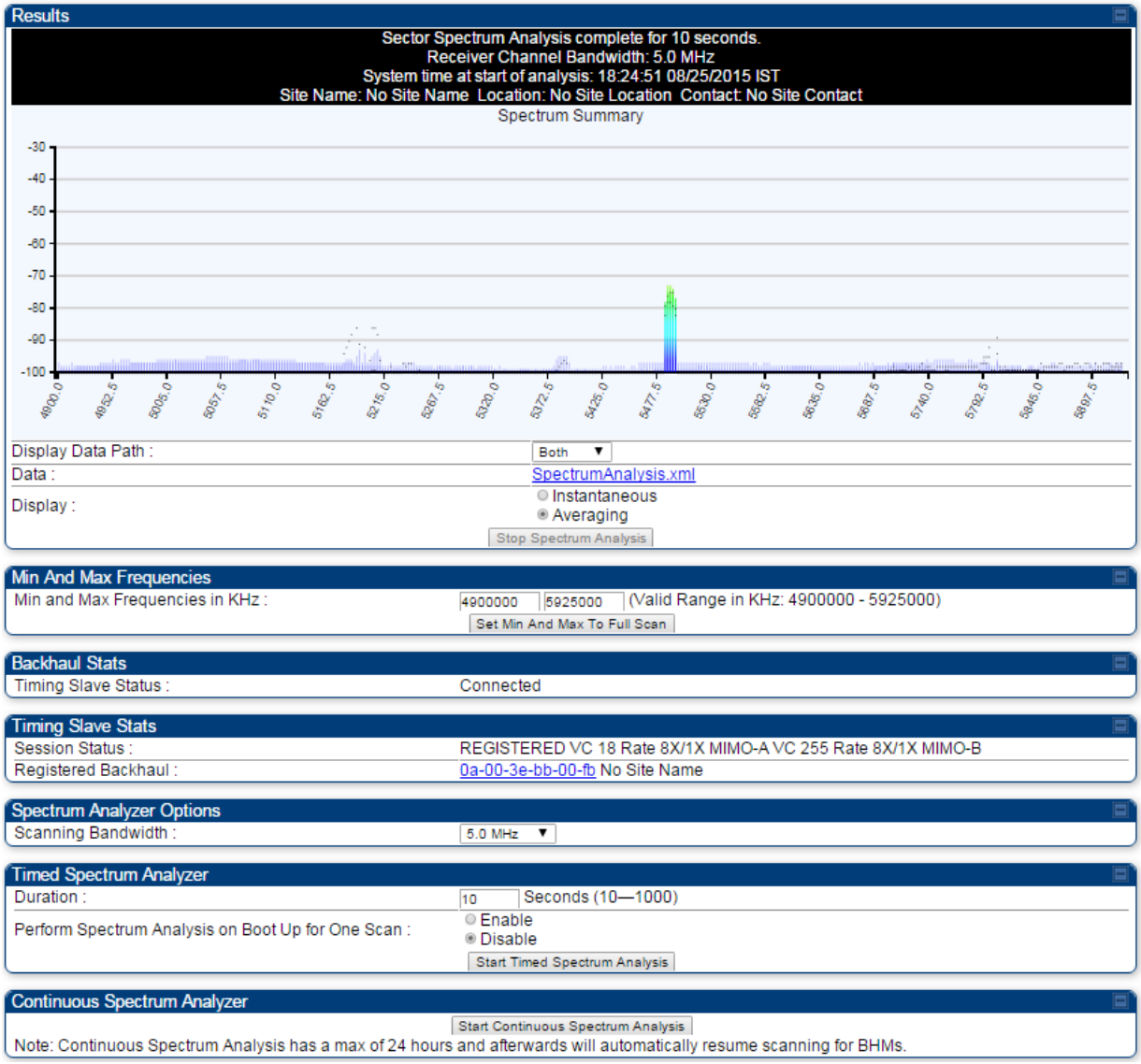


Attribute	Meaning
Data	Refer Table 154 on page 8-5
Display	Refer Table 154 on page 8-5
Duration	Refer Table 154 on page 8-5
Continuous Spectrum Analyzer	Refer Table 154 on page 8-5

Spectrum Analyzer page of BHS

The Spectrum Analyzer page of BHS is explained in Table 157.

Table 157 Spectrum Analyzer page attributes - BHS

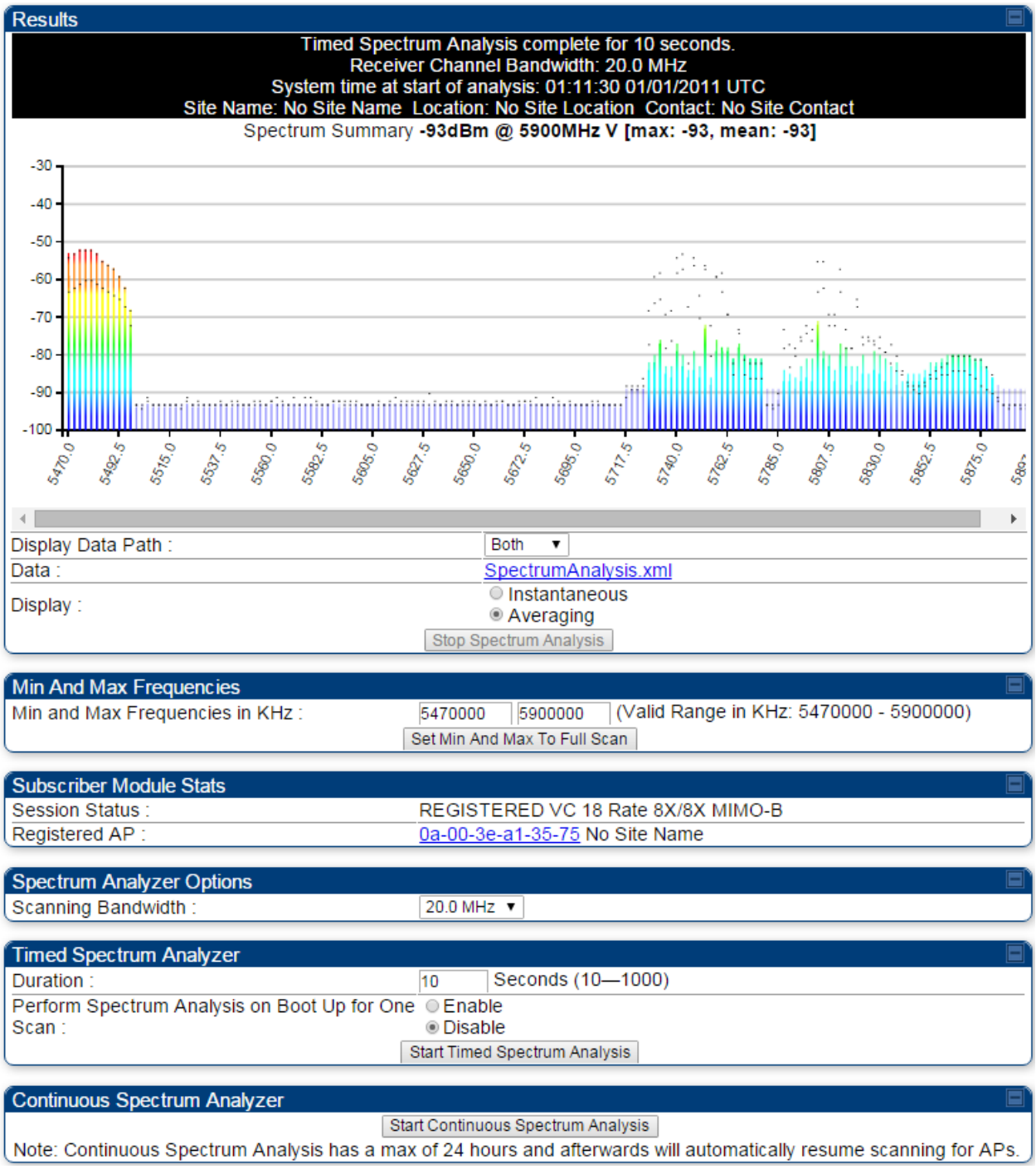


Attribute	Meaning
Data	Refer Table 154 on page 8-5
Display	Refer Table 154 on page 8-5
Session Status	This field displays current session status and rates. The session states can be Scanning, Syncing, Registering or Registered.
Registered Backhaul	This field displays MAC address of BHM and PTP model number
Duration	Refer Table 154 on page 8-5

Perform Spectrum Analysis on Boot Up for one scan	This field allows to Enable or Disable to start Spectrum Analysis on boot up of module for one scan.
Continuous Spectrum Analyzer	Refer Table 154 on page 8-5

Spectrum Analyzer page result of PMP 450 SM

Figure 134 Spectrum Analyzer page result – PMP 450 SM



Remote Spectrum Analyzer tool

The Remote Spectrum Analyzer tool in the AP/BHM provides additional flexibility in the use of the spectrum analyzer in the SM/BHS. Set the duration of 10 to 1000 seconds, then click the **Start Remote Spectrum Analysis** button to launch the analysis from that SM/BHS.

In PMP configuration, a SM has to be selected from the drop-down list before launching **Start Remote Spectrum Analysis**.

Analyzing the spectrum remotely

Procedure 29 Remote Spectrum Analyzer procedure

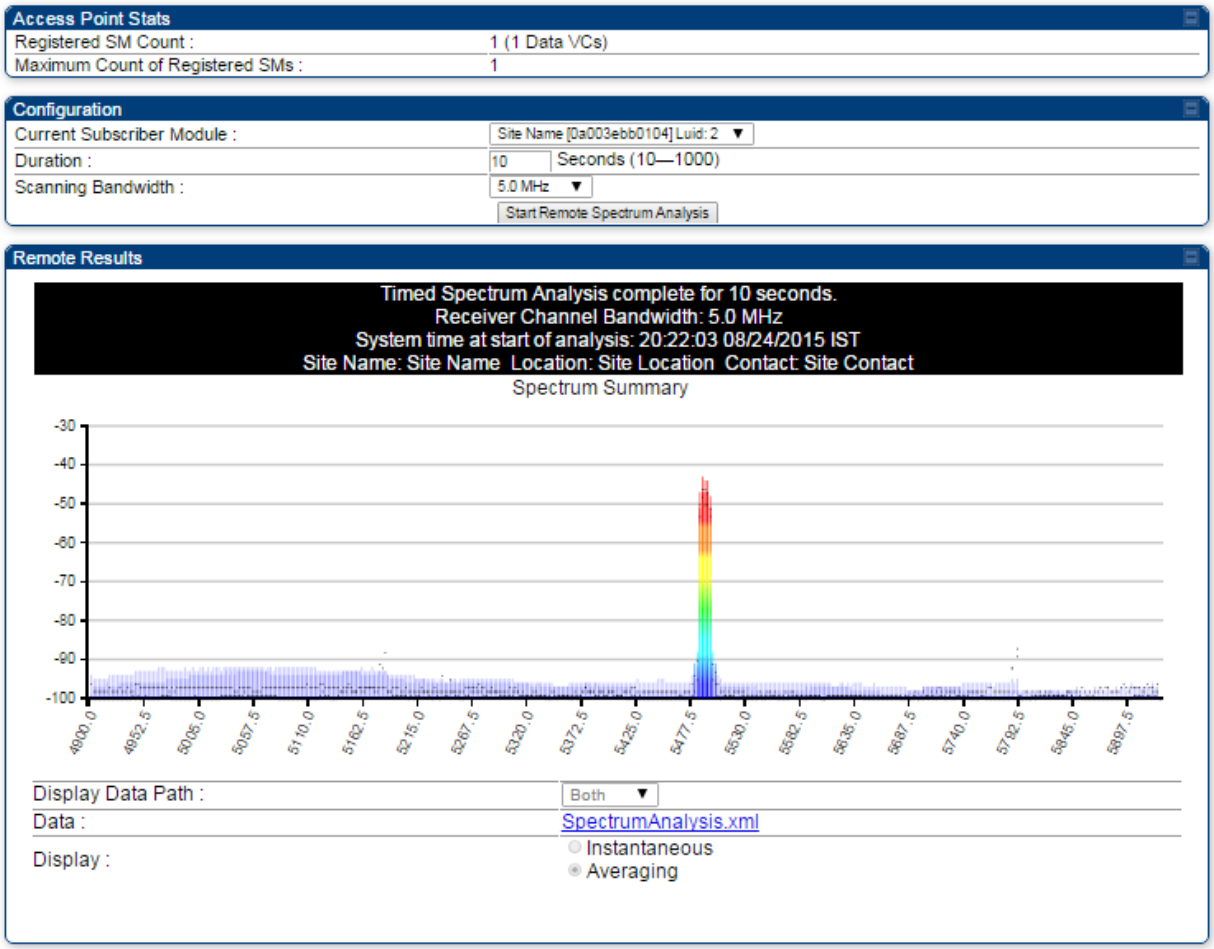
1. The AP/BHM de-registers the target SM/BHS.
2. The SM/BHS scans (for the duration set in the AP/BHM tool) to collect data for the bar graph.
3. The SM/BHS re-registers to the AP/BHM.
4. The AP/BHM displays the bar graph.

The bar graph is an HTML file, but can be changed to an XML file, which is then easy to analyze through the use of scripts that you may write for parsing the data. To transform the file to XML, click the “SpectrumAnalysis.xml” link below the spectrum results. Although the resulting display appears mostly unchanged, the bar graph is now coded in XML. You can now right-click on the bar graph for a **Save Target As** option to save the `Spectrum Analysis.xml` file.

Remote Spectrum Analyzer page of AP

The Remote Spectrum Analyzer page of AP is explained in Table 158.

Table 158 Remote Spectrum Analyzer attributes - AP

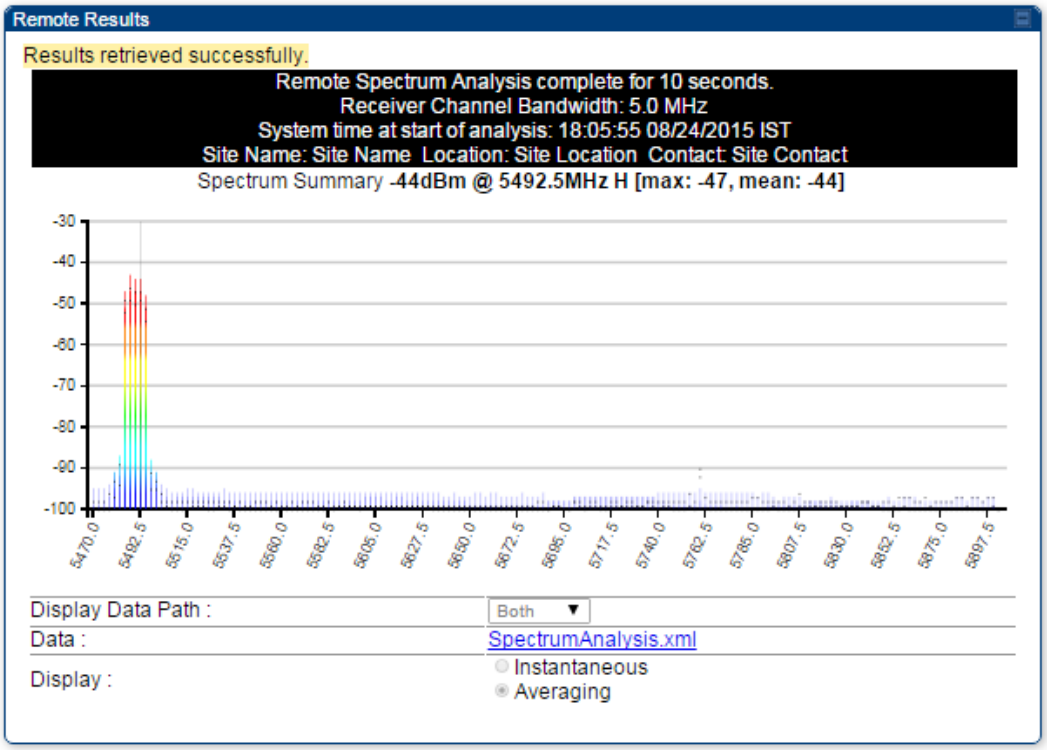


Attribute	Meaning
Registered SM Count	This field displays the number of SMs that were registered to the AP before the SA was started. This helps the user know all the SMs re-registered after performing a SA.
Maximum Count of Registered SMs	This field displays the largest number of SMs that have been simultaneously registered in the AP since it was last rebooted. This count can provide some insight into sector history and provide comparison between current and maximum SM counts at a glance.
Current Subscriber Module	The SM with which the Link Capacity Test is run.
Duration	This field allows operators to configure a specified time for which the spectrum is scanned. If the entire spectrum is scanned prior to the end of the configured duration, the analyzer will restart at the beginning of the spectrum.
Scanning Bandwidth	This parameter defines the size of the channel scanned when running the analyzer.

Remote Spectrum Analyzer page of BHM

The Remote Spectrum Analyzer page of BHM is explained in Table 159.

Table 159 Remote Spectrum Analyzer attributes - BHM



Attribute	Meaning
Duration	Refer Table 154 on page 8-5

Using the Alignment Tool

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

Note

To get best performance of the link, the user has to ensure the maximum Receive Power Level during alignment by pointing correctly. The proper alignment is important to prevent interference in other cells. The achieving Receive Power Level green (>- 70 dBm) is not sufficient for the link.

Figure 135 Alignment Tool tab of SM – Receive Power Level > -70 dBm

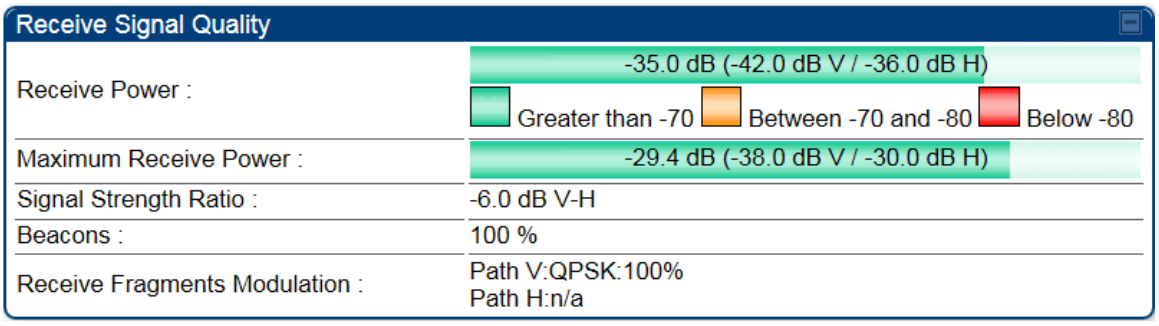


Figure 136 Alignment Tool tab of SM – Receive Power Level between -70 to -80 dBm

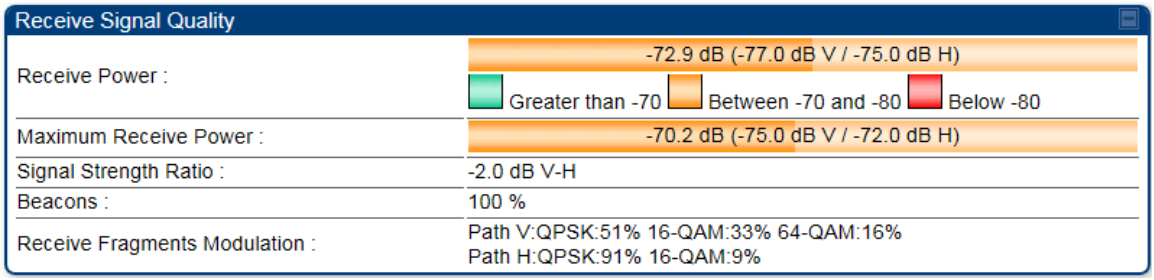
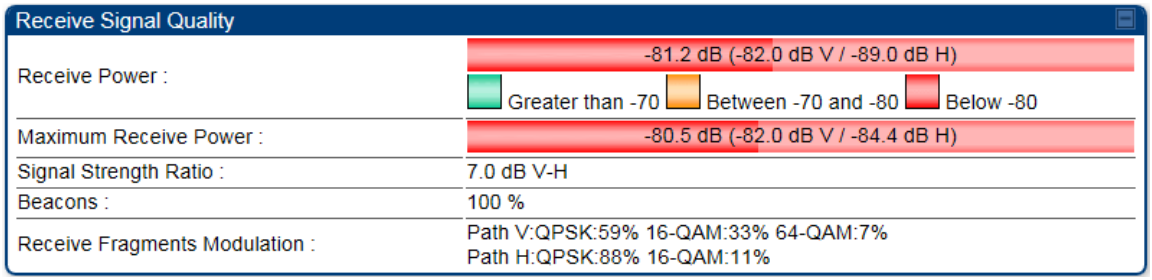


Figure 137 Alignment Tool tab of SM – Receive Power Level < -80 dBm



Alignment Tool and Diagnostic LED – SM/BHS

The SM's/BHS's Alignment Tool (located in GUI **Tools -> Alignment**) may be used to configure the SM's/BHS's LED panel to indicate received signal strength and to display decoded beacon information/power levels. The SM/BHS LEDs provide different status based on the mode of the SM/BHS. A SM/BHS in "operating" mode will register and pass traffic normally. A SM/BHS in "aiming" mode will not register or pass traffic, but will display (via LED panel) the strength of received radio signals (based on radio channel selected via **Tools** -> **Alignment**). To enter "aiming" mode, configure parameter **Scan Radio Frequency Only Mode** to "Enabled". See SM/BHS LEDs on page 2-12.

Note

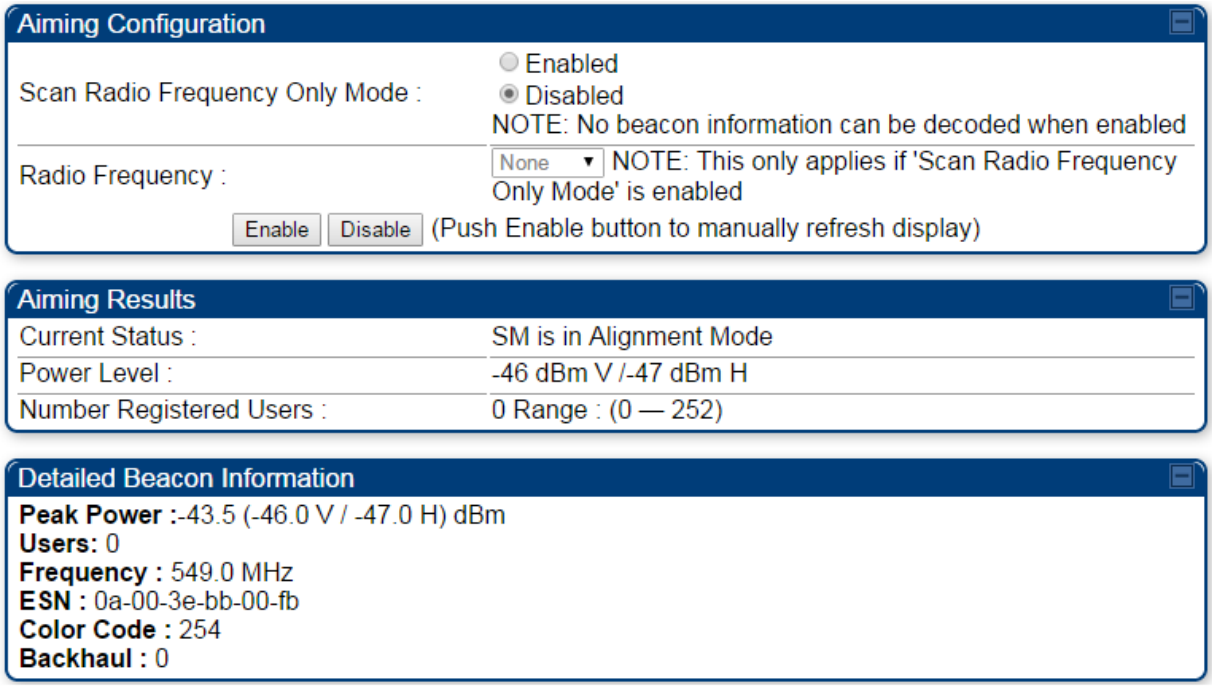
In order for accurate power level readings to be displayed, traffic must be present on the radio link.

Refer Table 15 SM/BHS LED descriptions on page 2-13 for SM/BHS LED details.

Alignment page of SM

The Alignment page of SM is explained in Table 160.

Table 160 Alignment page attributes – SM

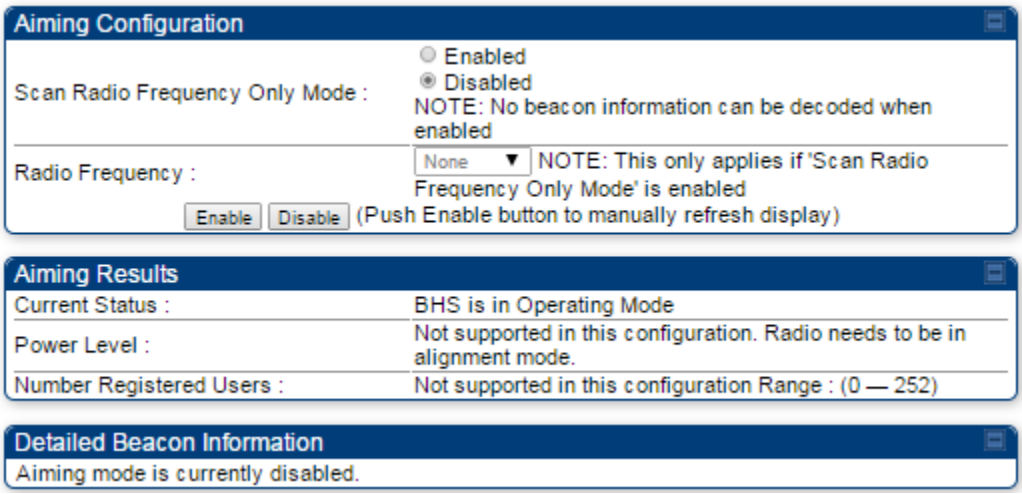


Attribute	Meaning
Scan Radio Frequency Only Mode	**Enabled**: the radio is configured to "aiming" or "alignment" mode, wherein the LED panel displays an indication of receive power level. See Table 15 SM/BHS LED descriptions on page 2-13. **Disabled:** the radio is configured to "operating" mode, wherein the SM registers and passes traffic normally.
Radio Frequency	This field indicates the center frequency for which results are displayed.
Current Status	This field indicates the current mode of the radio, "alignment" or "operating".
Power Level	This field indicates the current receive power level (vertical channel) for the frequency configured in parameter **Radio Frequency**.
Number Registered Users	When the radio is in "operating" mode, this field reports the number of registered SMs for the AP operating at the frequency defined in parameter **Radio Frequency**.
Peak Power	This field indicates the highest power level see by the SMs receiver.
Users	This field indicates the number of SMs currently registered to the AP which is transmitting the beacon information.
Frequency	This field indicates the frequency of the AP which is transmitting the beacon information.
ESN	This field indicates the MAC, or hardware address of the AP which is transmitting the beacon information.
Color Code	This field displays a value from 0 to 254 indicating the AP's configured color code. For registration to occur, the color code of the SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
Backhaul	**0** indicates that the beacon transmitter is an AP.

Alignment page of BHS

The Alignment page of BHS is explained in Table 161.

Table 161 Alignment page attributes - BHS



Attribute	Meaning
Scan Radio Frequency Only Mode	**Enabled**: the radio is configured to “aiming” or “alignment” mode, wherein the SM’s LED panel displays an indication of receive power level. See Table 171 on page 9-7. **Disabled:** the radio is configured to “operating” mode, wherein the SM registers and passes traffic normally.
Radio Frequency	This field indicates the center frequency for which results are displayed.
Current Status	This field indicates the current mode of the radio, “alignment” or “operating”.
Power Level	This field indicates the current receive power level (vertical channel) for the frequency configured in parameter **Radio Frequency**.
Number Registered Users	When the radio is in “operating” mode, this field reports the number of registered BHS for the BHM operating at the frequency defined in parameter **Radio Frequency**.
Peak Power	This field indicates the highest power level see by the SMs receiver.
Users	This field indicates the number of BHS currently registered to the BHM which is transmitting the beacon information.
Frequency	This field indicates the frequency of the AP which is transmitting the beacon information.
ESN	This field indicates the MAC, or hardware address of the BHM which is transmitting the beacon information.
Color Code	This field displays a value from 0 to 254 indicating the BHM’s configured

	color code. For registration to occur, the color code of the BHS and the BHM *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. Color code allows you to force a BHS to register to only a specific BHM, even where the BHS can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
Backhaul	**1** indicates that the beacon transmitter is a BHM.

Alignment Tone

For coarse alignment of the SM/BHS, use the Alignment Tool located at **Tools -> Alignment Tool**. Optionally, connect a headset alignment tone kit to the AUX/SYNC port of the SM/BHS and listen to the alignment tone, which indicates greater SM/BHS receive signal power by pitch. By adjusting the SM's/BHS's position until the highest frequency pitch is obtained operators and installers can be confident that the SM/BHS is properly positioned. For information on device GUI tools available for alignment, see sections Alignment Tool and Diagnostic LED – SM/BHS on page 8-16, Using the Link Capacity Test tool on page 8-21 and Using AP Evaluation tool on page 8-24.

Figure 138 PMP/PTP 450i link alignment tone

Note

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

Using the Link Capacity Test tool

The **Link Capacity Test** tab allows you to measure the throughput and efficiency of the RF link between two modules. Many factors, including packet length, affect throughput. The **Link Capacity Test** tab contains the settable parameter **Packet Length** with a range of 64 to 1714 bytes. This allows you to compare throughput levels that result from various packet sizes.

Performing link capacity test

To run a simple link capacity test that floods the link with 1714 byte packets for 10 seconds, perform the following procedure:

Procedure 30 Performing a simple Link Capacity Test

1. Access the Link Capacity Test tab in the Tools web page of the module.
2. Select Link Test Mode **Link Test with Bridging**
3. Select the subscriber module to test using the Current Subscriber Module parameter.
4. Type into the **Duration** field how long (in seconds) the RF link must be tested.
5. Type into the **Number of Packets** field a value of **0** to flood the link for the duration of the test.
6. Type into the **Packet Length** field a value of **1714** to send 1714-byte packets during the test.
7. Click the **Start Test** button.
8. In the Current Results Status block of this tab, view the results of the test. See Figure 139 on page 8-21.

Figure 139 Link Capacity Test tab with 1714-byte packet length

Current Results Status

Stats for LUID: 2 Test Duration: 10 Pkt Length: 1714 Test Direction Bi-Directional

RF Link Test

VC	Downlink	Uplink	Aggregate	Packet Transmit	Packet Receive
				Actual	Actual
18	40.95 Mbps	13.09 Mbps	54.05 Mbps, 3907 pps	9476 (947 pps)	29605(2960 pps)

Efficiency

Downlink			Uplink		
Efficiency	Fragments count		Efficiency	Fragments count	
	Actual	Expected		Actual	Expected
100%	799840	799840	100%	255856	255856

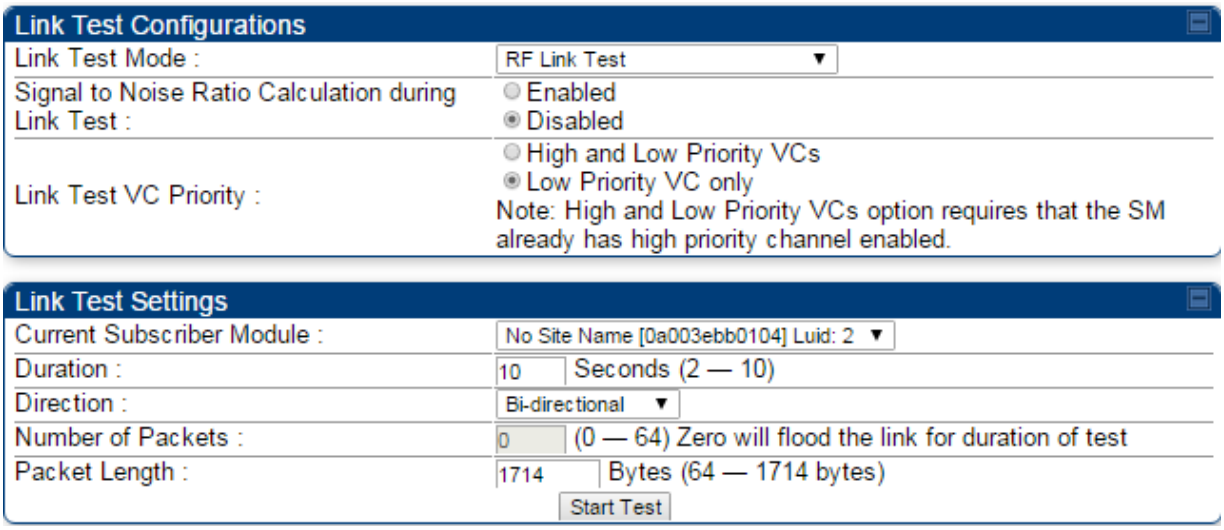
Link Test ran on 21:06:00 08/20/2015 IST

Currently transmitting at:
VC 18 Rate 8X/8X MIMO-B

Link Capacity Test page of AP/SM

The Link Capacity Test page of AP is explained in Table 162.

Table 162 Link Capacity Test page attributes - AP



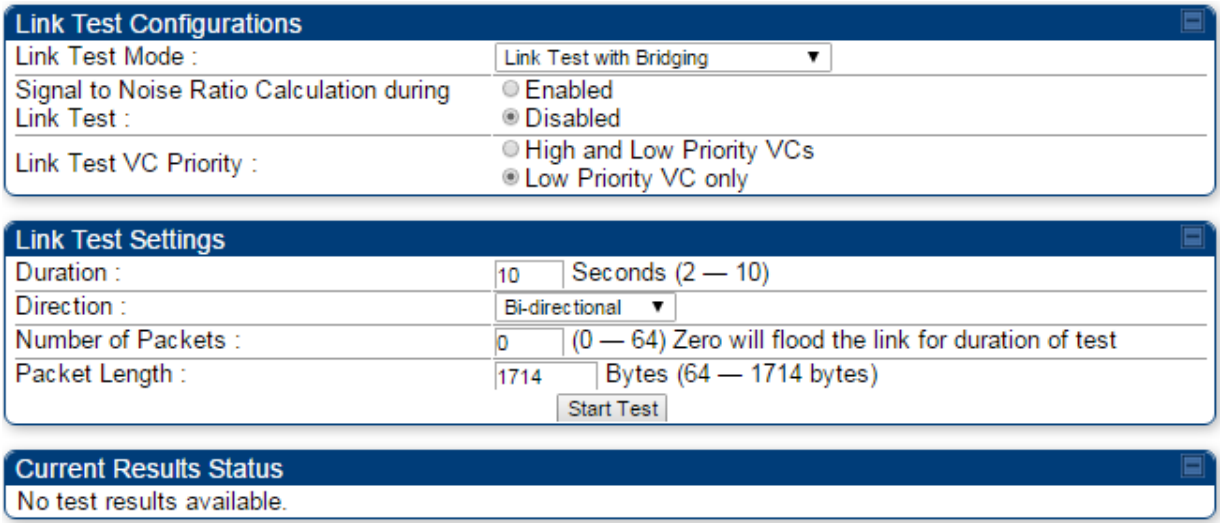
Attribute	Meaning
Link Test Mode	• RF Link Test: Fully tests radio-to-radio communication, but does not bridge traffic. • Link Test with Bridging: Bridges traffic to "simulated" Ethernet ports, providing a status of the bridged link. • Link Test with Bridging and MIR: Bridges the traffic during test and also adheres to any MIR (Maximum Information Rate) settings for the link. **Note** This mode setting must be equal on both the AP and the SM when running the link test for proper bridging and MIR handling.
Signal to Noise Ratio Calculation during Link Test	Enable this attribute to display Signal-to-Noise information for the downlink and uplink when running the link test.
Link Test VC Priority	This attribute may be used to enable/disable usage of the high priority virtual channel during the link test.
Current Subscriber Module	The SM with which the Link Capacity Test is run. This field is only applicable for AP (not SM page).
Duration	This field allows operators to configure a specified time for which the spectrum is scanned. If the entire spectrum is scanned prior to the end of the configured duration, the analyzer will restart at the beginning of the

	spectrum.
Direction	Configure the direction of the link test. Specify **Downlink** or **Uplink** to run the test only in the corresponding direction only. Specific **Bi-Directional** to run the test in both directions.
Number of Packets	The total number of packets to send during the Link Capacity Test. When Link Test Mode is set to **RF Link Test** this field is not configurable.
Packet Length	The size of the packets in Bytes to send during the Link Capacity Test

Link Capacity Test page of BHM/BHS

The Link Capacity Test page of BHM/BHS is explained in Table 163.

Table 163 Link Capacity Test page attributes – BHM/BHS



Attribute	Meaning
Link Test Mode	See Table 162 on page 8-22
Signal to Noise Ratio Calculation during Link Test	See Table 162 on page 8-22
Link Test VC Priority	See Table 162 on page 8-22
Duration	See Table 162 on page 8-22
Direction	See Table 162 on page 8-22
Number of Packets	See Table 162 on page 8-22
Packet Length	See Table 162 on page 8-22

Using AP Evaluation tool

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

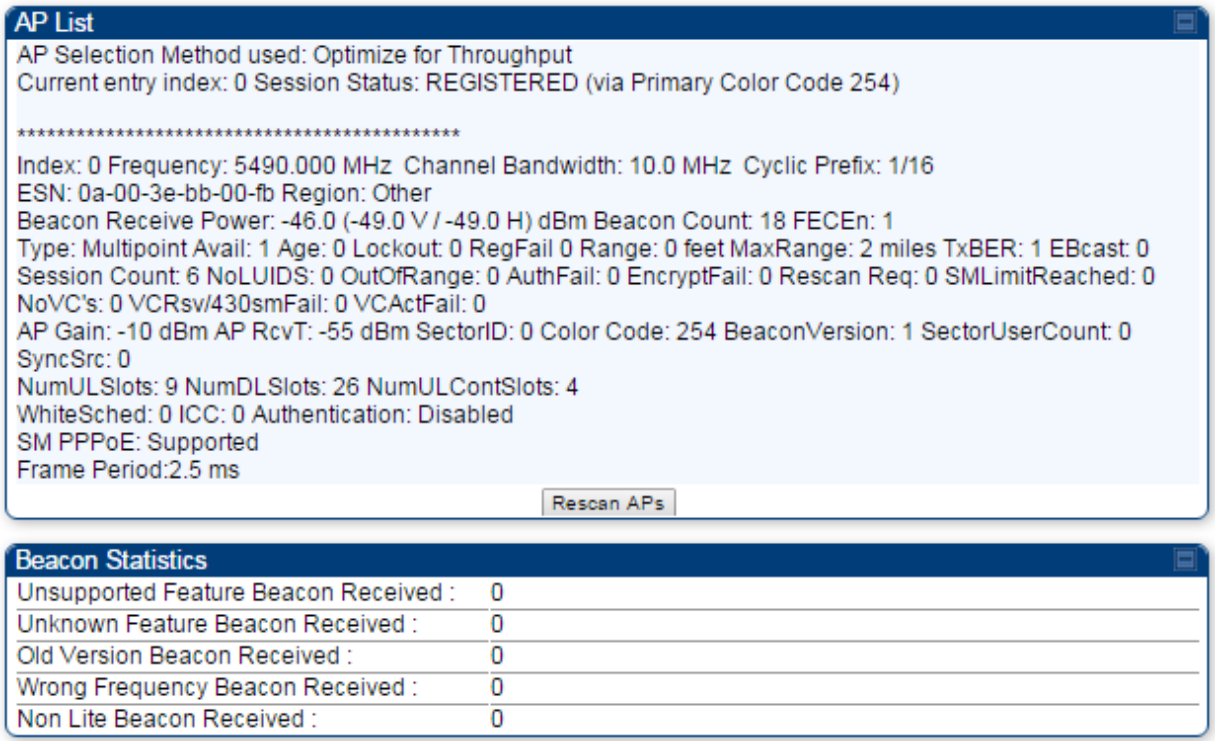
Note

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

AP Evaluation page of AP

The AP Evaluation page of AP is explained in Table 164.

Table 164 AP Evaluation tab attributes - AP



Attribute	Meaning
Index	This field displays the index value that the system assigns (for only this page) to the AP where this SM is registered.
Frequency	This field displays the frequency that the AP transmits.
Channel Bandwidth	The channel size used by the radio for RF transmission. The setting for the channel bandwidth must match between the AP and the SM.

Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefixes mean that for every 16 bits of throughput data transmitted, an additional bit is used. The Cyclic Prefix 1/16 only can be selected at this time.
ESN	This field displays the MAC address (electronic serial number) of the AP. For operator convenience during SM aiming, this tab retains each detected ESN for up to 15 minutes. If the broadcast frequency of a detected AP changes during a 15-minute interval in the aiming operation, then a multiple instance of the same ESN is possible in the list. Eventually, the earlier instance expires and disappears and the later instance remains to the end of its interval, but you can ignore the early instance(s) whenever two or more are present.
Region	This field displays the AP's configured Country Code setting.
Power Level	This field displays the SM's combined received power level from the AP's transmission.
Beacon Count	A count of the beacons seen in a given time period.
FECEn	This field contains the SNMP value from the AP that indicates whether the Forward Error Correction feature is enabled. 0: FEC is disabled 1: FEC is enabled
Type	Multipoint indicates that the listing is for an AP.
Age	This is a counter for the number of minutes that the AP has been inactive. At 15 minutes of inactivity for the AP, this field is removed from the AP Evaluation tab in the SM.
Lockout	This field displays how many times the SM has been temporarily locked out of making registration attempts.
RegFail	This field displays how many registration attempts by this SM failed.
Range	This field displays the distance in feet for this link. To derive the distance in meters, multiply the value of this parameter by 0.3048.
MaxRange	This field indicates the configured value for the AP's Max Range parameter.
TxBER	A 1 in this field indicates the AP is sending Radio BER.
EBcast	A 1 in this field indicates the AP or BHM is encrypting broadcast packets. A 0 indicates it is not.
Session Count	This field displays how many sessions the SM (or BHS) has had with the AP (or BHM). Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value

	that slightly differs from the sum. In the case of a multipoint link, if the number of sessions is significantly greater than the number for other SMs, then this may indicate a link problem or an interference problem.
NoLUIDs	This field indicates how many times the AP has needed to reject a registration request from a SM because its capacity to make LUID assignments is full. This then locks the SM out of making any valid attempt for the next 15 minutes. It is extremely unlikely that a non-zero number would be displayed here.
OutOfRange	This field indicates how many times the AP has rejected a registration request from a SM because the SM is a further distance away than the range that is currently configured in the AP. This then locks the SM out of making any valid attempt for the next 15 minutes.
AuthFail	This field displays how many times authentication attempts from this SM have failed in the AP.
EncryptFail	This field displays how many times an encryption mismatch has occurred between the SM and the AP.
Rescan Req	This field displays how many times a re-range request has occurred for the BHM that is being evaluated in the AP Eval page of a BHS.
SMLimitReached	This field displays 0 if additional SMs may be registered to the AP. If a 1 is displayed, the AP will not accept additional SM registrations.
NoVC's	This counter is incremented when the SM is registering to an AP which determines that no VC resources are available for allocation. This could be a primary data VC or a high priority data VC.
VCRsvFail	This counter is incremented when the SM is registering to an AP which has a VC resource available for allocation but cannot reserve the resource for allocation.
VCActFail	This counter is incremented when the SM is registering to an AP which has a VC resource available for allocation and has reserved the VC, but cannot activate the resource for allocation.
AP Gain	This field displays the total external gain (antenna) used by the AP.
RcvT	This field displays the AP's configured receive target for receiving SM transmissions (this field affects automatic SM power adjust).
Sector ID	This field displays the value of the **Sector ID** field that is provisioned for the AP.
Color Code	This field displays a value from 0 to 254 indicating the AP's configured color code. For registration to occur, the color code of the SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color

	code. Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
BeaconVersion	This field indicates that the beacon is OFDM (value of 1).
Sector User Count	This field displays how many SMs are registered on the AP.
NumULHalfSlots	This is the number of uplink slots in the frame for this AP.
NumDLHalfSlots	This is the number of downlink slots in the frame for this.
NumULContSlots	This field displays how many Contention Slots are being used in the uplink portion of the frame.
WhiteSched	Flag to display if schedule whitening is supported via FPGA
ICC	This field lists the SMs that have registered to the AP with their Installation Color Code (ICC), Primary CC, Secondary CC or Tertiary CC.
SM PPPoE	This filed provides information to the user whether the SM is supporting PPPoE or not.
Frame Period	This field displays the configured Frame Period of the radio.

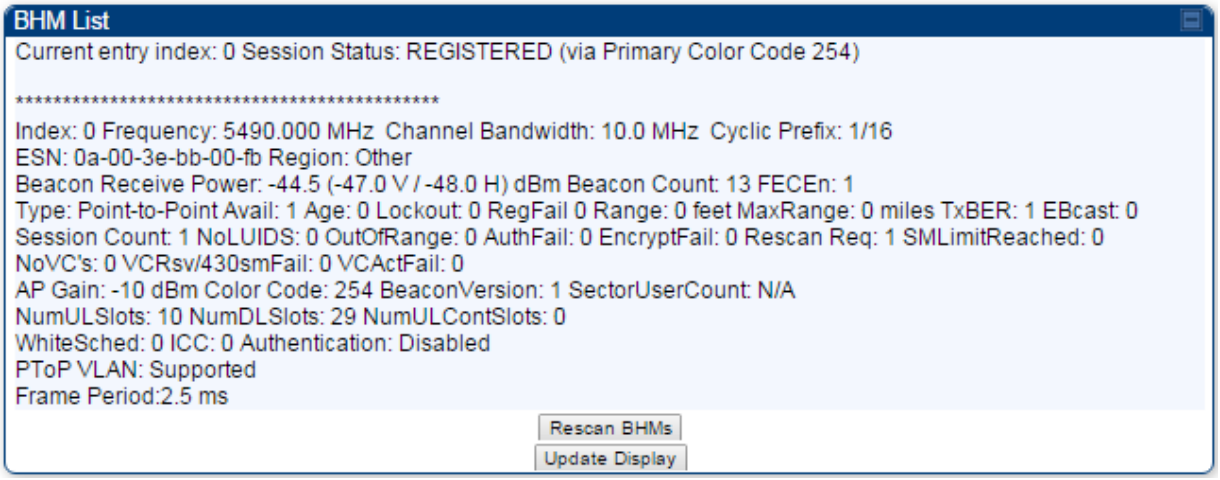
Using BHM Evaluation tool

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

BHM Evaluation page of BHS

The BHM Evaluation page of BHS is explained in Table 165.

Table 165 BHM Evaluation tab attributes - BHS



Attribute	Meaning
Index	This field displays the index value that the system assigns (for only this page) to the BHM where this BHS is registered.
Frequency	This field displays the frequency that the BHM transmits.
Channel Bandwidth	The channel size used by the radio for RF transmission. The setting for the channel bandwidth must match between the BHM and the BHS.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefixes mean that for every 16 bits of throughput data transmitted, an additional bit is used.
ESN	This field displays the MAC address (electronic serial number) of the BHM. For operator convenience during BHS aiming, this tab retains each detected ESN for up to 15 minutes. If the broadcast frequency of a detected BHM changes during a 15-minute interval in the aiming operation, then a multiple instance of the same ESN is possible in the list. Eventually, the earlier instance expires and disappears and the later

	instance remains to the end of its interval, but you can ignore the early instance(s) whenever two or more are present.
Region	This field displays the BHM's configured Country Code setting.
Power Level	This field displays the BHS's combined received power level from the BHM's transmission.
Beacon Count	A count of the beacons seen in a given time period.
FECEn	This field contains the SNMP value from the BHM that indicates whether the Forward Error Correction feature is enabled. 0: FEC is disabled 1: FEC is enabled
Type	Multipoint indicates that the listing is for a BHM.
Age	This is a counter for the number of minutes that the BHM has been inactive. At 15 minutes of inactivity for the BHS, this field is removed from the BHM Evaluation tab in the BHS.
Lockout	This field displays how many times the BHS has been temporarily locked out of making registration attempts.
RegFail	This field displays how many registration attempts by this BHS failed.
Range	This field displays the distance in feet for this link. To derive the distance in meters, multiply the value of this parameter by 0.3048.
MaxRange	This field indicates the configured value for the AP's Max Range parameter.
TxBER	A 1 in this field indicates the BHM is sending Radio BER.
EBcast	A 1 in this field indicates the BHM is encrypting broadcast packets. A 0 indicates it is not.
Session Count	This field displays how many sessions the BHS has had with the BHM. Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum. In the case of a multipoint link, if the number of sessions is significantly greater than the number for other BHS's, then this may indicate a link problem or an interference problem.
NoLUIDs	This field indicates how many times the BHM has needed to reject a registration request from a BHS because its capacity to make LUID assignments is full. This then locks the BHS out of making any valid attempt for the next 15 minutes. It is extremely unlikely that a non-zero number would be displayed here.
OutOfRange	This field indicates how many times the BHM has rejected a registration request from a BHS because the BHS is a further distance away than the

	range that is currently configured in the BHM. This then locks the BHS out of making any valid attempt for the next 15 minutes.
AuthFail	This field displays how many times authentication attempts from this SM have failed in the BHM.
EncryptFail	This field displays how many times an encryption mismatch has occurred between the BHS and the BHM.
Rescan Req	This field displays how many times a re-range request has occurred for the BHM that is being evaluated in the BHM Eval page of a BHM.
SMLimitReached	This field displays 0 if additional BHSs may be registered to the BHM. If a 1 is displayed, the BHM will not accept additional BHS registrations.
NoVC's	This counter is incremented when the BHS is registering to a BHM which determines that no VC resources are available for allocation. This could be a primary data VC or a high priority data VC.
VCRsvFail	This counter is incremented when the BHS is registering to a BHM which has a VC resource available for allocation but cannot reserve the resource for allocation.
VCActFail	This counter is incremented when the BHS is registering to a BHM which has a VC resource available for allocation and has reserved the VC, but cannot activate the resource for allocation.
AP Gain	This field displays the total external gain (antenna) used by the BHM.
RcvT	This field displays the AP's configured receive target for receiving BHS transmissions (this field affects automatic BHS power adjust).
Sector ID	This field displays the value of the **Sector ID** field that is provisioned for the BHM.
Color Code	This field displays a value from 0 to 254 indicating the BHM's configured color code. For registration to occur, the color code of the BHS and the BHM *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. Color code allows you to force a BHS to register to only a specific BHM, even where the BHS can communicate with multiple BHMs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
BeaconVersion	This field indicates that the beacon is OFDM (value of 1).
Sector User Count	This field displays how many BHS's are registered on the BHM.
NumULHalfSlots	This is the number of uplink slots in the frame for this BHM.
NumDLHalfSlots	This is the number of downlink slots in the frame for this.
NumULContSlots	This field displays how many Contention Slots are being used in the

	uplink portion of the frame.
WhiteSched	Flag to display if schedule whitening is supported via FPGA
ICC	This field lists the BHSs that have registered to the BHM with their Installation Color Code (ICC), Primary CC, Secondary CC or Tertiary CC.
SM PPPoE	This filed provides information to the user whether the BHS is supporting PPPoE or not.
Frame Period	This field displays the configured Frame Period of the radio.

Using the OFDM Frame Calculator tool

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

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

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

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

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

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

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

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

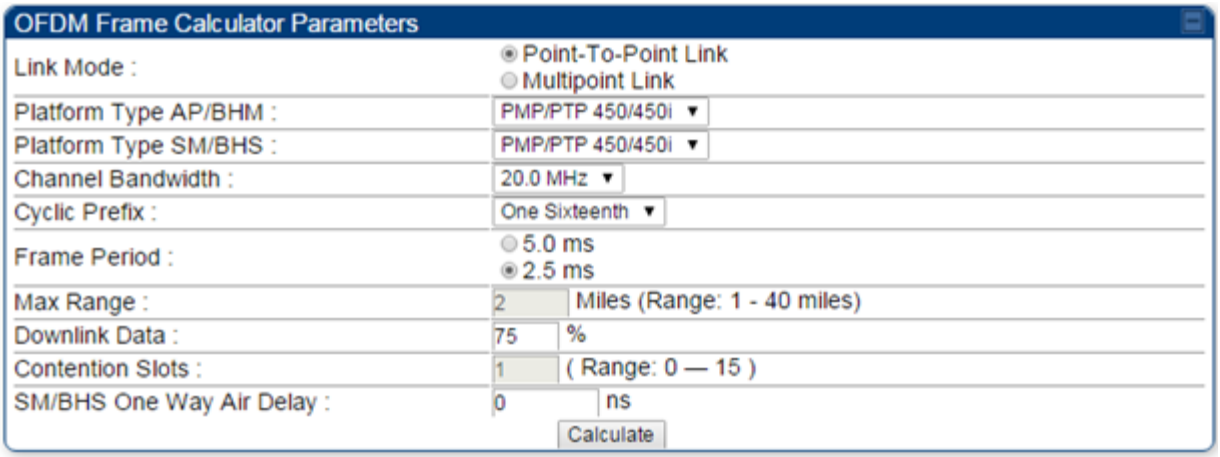
http://www.cambiumnetworks.com/solution-papersThe co-location is also supported for 900 MHz PMP 450i APs (OFDM) and PMP 100 APps (FSK). Please refer *Co-location of PMP 450 and PMP 100 systems in the 900 MHz band and migration recommendations* document for details.

Caution

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

The OFDM Frame Calculator page is explained in Table 166.

Table 166 OFDM Frame Calculator page attributes



Attribute	Meaning
Link Mode	For AP to SM frame calculations, select **Multipoint Link** For BHM to BHS frame calculations, select **Point-To-Point Link**
Platform Type AP/BHM	Use the drop-down list to select the hardware series (board type) of the AP/BHM.
Platform Type SM/BHS	Use the drop-down list to select the hardware series (board type) of the SM/BHS.
Channel Bandwidth	Set this to the channel bandwidth used in the AP/BHM.
Cyclic Prefix	Set this to the cyclic prefix used in the AP/BHM.
Max Range	Set to the same value as the **Max Range** parameter is set in the AP(s) or BHM(s).
Frame Period	Set to the same value as the **Frame Period** parameter is set in the AP(s) or BHM(s).
Downlink Data	Initially set this parameter to the same value that the AP/BHM has for its **Downlink Data** parameter (percentage). Then, use the Frame Calculator tool procedure as described in Using the Frame Calculator on page 8-35,

	you will vary the value in this parameter to find the proper value to write into the **Downlink Data** parameter of all APs or BHMs in the cluster. PMP 450 platform Series APs or BHMs offer a range of 15% to 85% and default to 75%. The value that you set in this parameter has the following interaction with the value of the **Max Range** parameter (above): The default **Max Range** value is 5 miles and, at that distance, the maximum **Downlink Data** value (85% in PMP 450 platform) is functional.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. Set this parameter to the value of the **Contention Slot** parameter is set in the APs or BHMs.
SM/BHS One Way Air Delay	This field displays the time in *ns* (nano seconds), that a SM/BHS is away from the AP/BHM.

The Calculated Frame Results display several items of interest:

Table 167 OFDM Calculated Frame Results attributes

Attribute	Meaning
Modulation	The type of radio modulation used in the calculation (OFDM for PMP/ PTP 450 platform)
Total Frame Bits	The total number of bits used in the calculated frames
Data Slots (Down/Up)	This field is based on the **Downlink Data** setting. For example, a result within the typical range for a **Downlink Data** setting of 75% is 61/21, meaning 61 data slots down and 21 data slots up.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator.
Air Delay for Max Range	This is the roundtrip air delay in bit times for the **Max Range** value set in the calculator
Approximate distance for Max Range	The Max Range value used for frame calculation
AP Transmit End	In bit times, this is the frame position at which the AP/BHM ceases transmission.
AP Receive Start	In bit times, this is the frame position at which the AP/BHM is ready to receive transmission from the SM/BHS.
AP Receive End	In bit times, this is the frame position at which the AP/BHM will cease receiving transmission from the SM/BHS.
SM Receive End	In bit times, this is the frame position at which the SM/BHS will cease receiving transmission from the AP/BHM.

SM Transmit Start	In bit times, this is the frame position at which the SM/BHS starts the transmission.
SM One Way Air Delay	This filed displays the time in *ns,* that SM/BHS is away from the AP/BHM.
SM Approximate distance	This field displays an approximate distance in miles (feet) that the SM/BHS is away from the AP/BHM.

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

Procedure 31 Using the Frame Calculator

1. Populate the OFDM Frame Calculator parameters with appropriate values as described above.
2. Click the **Calculate** button.
3. Scroll down the tab to the Calculated Frame Results section
4. Record the value of the **AP Receive Start** field
5. Enter a parameter set from another AP in the system – for example, an AP in the same cluster that has a higher **Max Range** value configured.
6. Click the **Calculate** button.
7. Scroll down the tab to the Calculated Frame Results section
8. If the recorded values of the **AP Receive Start** fields are within 150 bit times of each other, skip to step 10.

   If the recorded values of the **AP Receive Start** fields are not within 150 bit times of each other, modify the **Downlink Data** parameter until the calculated results for **AP Receive Start** are within 300 bit time of each other, if possible, 150 bit time.
10. Access the Radio tab in the Configuration web page of each AP in the cluster and change its **Downlink Data** parameter (percentage) to the last value that was used in the Frame Calculator.

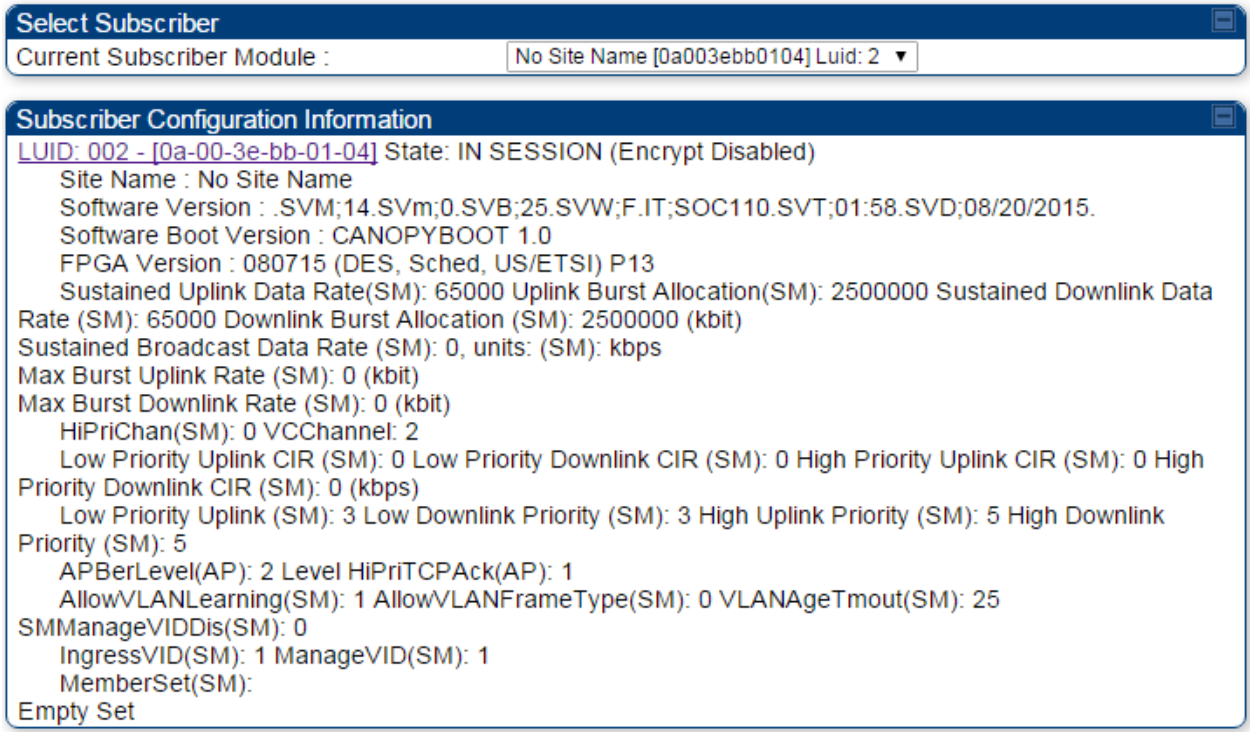
Using the Subscriber Configuration tool

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

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

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

Figure 140 SM Configuration page of AP



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

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

Using the Link Status tool

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

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

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

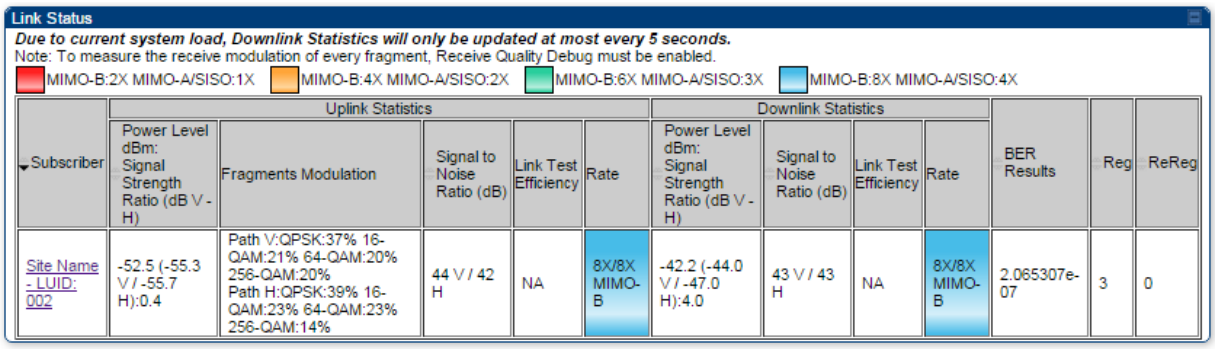
Table 168 Color code vers uplink/downlink rate column

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

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

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

Table 169 Link Status page attributes - AP



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

	Note The LUID associated is lost when a power cycle of the AP occurs. Both the LUID and the MAC are hot links to open the interface to the SM. In some instances, depending on network activity and network design, this route to the interface yields a blank web page. If this occurs, refresh your browser view. Site Name indicates the name of the SM. You can assign or change this name on the Configuration web page of the SM. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Uplink Statistics - Power Level: Signal Strength Ratio	This field represents the combined received power level at the AP/BHM as well as the ratio of horizontal path signal strength to vertical path signal strength.
Uplink Statistics – Fragments Modulation	This field represents the percentage of fragments received at each modulation state, per path (polarization).
Uplink Statistics – Signal to Noise Ratio	This field represents the signal to noise ratio for the uplink (displayed when parameter Signal to Noise Ratio Calculation during Link Test is enabled) expressed for both the horizontal and vertical channels.
Uplink Statistics – Link Test Efficiency	This field displays the efficiency of the radio link, expressed as a percentage, for the radio uplink.
Downlink Statistics – Power Level: Signal Strength Ratio	This field represents the received power level at the SM/BHS as well as the ratio of horizontal path signal strength to vertical path signal strength at the SM/BHS.
Downlink Statistics – Signal to Noise Ratio	This field represents the signal to noise ratio for the downlink (displayed when parameter Signal to Noise Ratio Calculation during Link Test is enabled) expressed for both the horizontal and vertical channels.
Downlink Statistics – Link Test Efficiency	This field displays the efficiency of the radio link, expressed as a percentage, for the radio downlink.
BER Results	This field displays the over-the-air Bit Error Rates for each downlink. (The ARQ [Automatic Resend reQuest] ensures that the transport BER [the BER seen end-to-end through a network] is essentially zero.) The level of acceptable over-the-air BER varies, based on operating requirements, but a reasonable value for a good link is a BER of 1e-4 (1×10^{-4}) or better, approximately a packet resend rate of 5%. BER is generated using unused bits in the downlink. During periods of peak load, BER data is not updated as often, because the system puts priority on transport rather than on BER calculation.

Reg Requests	A Reg Requests count is the number of times the SM/BHS registered after the AP/BHM determined that the link had been down. If the number of sessions is significantly greater than the number for other SMs/BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).
ReReg Requests	A ReReg Requests count is the number of times the AP/BHM received a SM/BHS registration request while the AP/BHM considered the link to be still up (and therefore did not expect registration requests). If the number of sessions is significantly greater than the number for other SMs/BHS, then this may indicate a link problem (check mounting, alignment, receive power levels) or an interference problem (conduct a spectrum scan).

Using BER Results tool

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

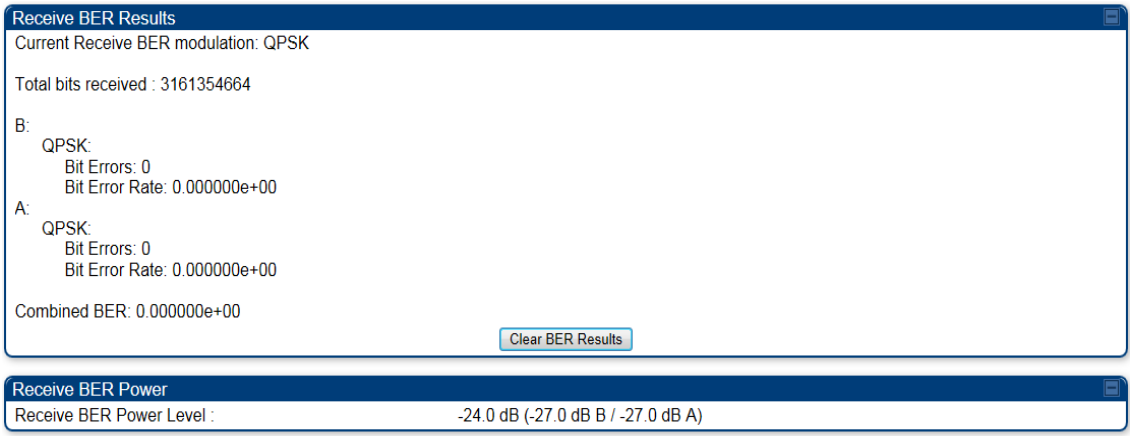
BER is only instrumented on the downlink and is displayed on the BER Results tab of the Tools page in any SM. Each time the tab is clicked, the current results are read and counters are reset to zero.

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

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

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

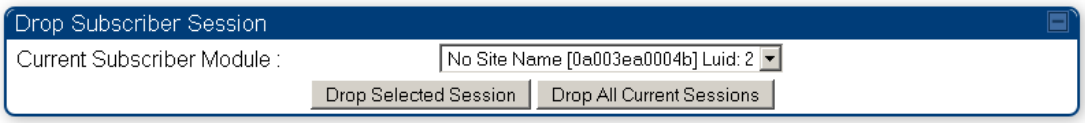
Figure 141 BER Results tab of the SM



Using the Sessions tool

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

Figure 142 Sessions tab of the AP



Chapter 9: Operation

This chapter provides instructions for operators of the PMP/PTP 450 platform wireless Ethernet Bridge. The following topics are described in this chapter:

System information

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

Viewing General Status

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

General Status page of AP

The AP's **General Status** page is explained in Table 170.

Table 170 General Status page attributes - AP

Device Information	
Device Type :	5.4GHz MIMO OFDM - Access Point - 0a-00-3e-bb-00-fb
Board Type :	P13 C110_SOC
Software Version :	CANOPY 14.1 AP-DES
Board MSN :	PMP450iMSN
FPGA Version :	100615
Uptime :	2d, 21:49:56
System Time :	12:45:34 10/12/2015 IST
Ethernet Interface :	100Base-TX Full Duplex
Region Code :	Other
Regulatory :	Passed
Antenna Type :	External
Channel Frequency :	5490.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Frame Period :	2.5 ms
Color Code :	254
Max Range :	2 Miles
Transmit Power :	-10 dBm
Temperature :	34 °C / 93 °F

Access Point Stats	
Registered SM Count :	1 (1 Data VCs)
Sync Pulse Status :	Generating Sync
Sync Pulse Source :	Self Generate
Maximum Count of Registered SMs :	1

Frame Configuration Information	
Data Slots Down :	27
Data Slots Up :	9
Contention Slots :	3

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 :	08/18/2015 06:41:40 - INTL

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the SM, its module type and its MAC address.
Software Version	This field indicates the system release, the time and date of the release and whether communications involving the module are secured by DES

	or AES encryption. If you request technical support, provide the information from this field.
Board Type	This field indicates the series of hardware.
Combo Radio Mode	This field indicates the mode of operation, currently only 'MIMO OFDM Only' is supported.
FPGA Version	This field indicates the version of the field-programmable gate array (FPGA) on the module. If you request technical support, provide the value of this field.
FPGA Type	Where the type of logic as a subset of the logic version in the module as manufactured distinguishes its circuit board, this field is present to indicate that type. If you request technical support, provide the value of this field.
PLD Version	This field indicates the version of the programmable logic device (PLD) on the module. If you request technical support, provide the value of this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. If the AP is connected to a CMM4, then this field provides GMT (Greenwich Mean Time). Any SM that registers to the AP inherits the system time.
Last NTP Time Update	This field displays when the AP last used time sent from an NTP server. If the AP has not been configured in the Time tab of the Configuration page to request time from an NTP server, then this field is populated by 00:00:00 00/00/00.
Ethernet Interface	This field indicates the speed and duplex state of the Ethernet interface to the AP.
Regulatory	This field indicates whether the configured **Country Code** and radio frequency are compliant with respect to their compatibility. PMP 450 equipment shipped to the United States is locked to a Country Code setting of "United States". Units shipped to regions other than the United States must be configured with the corresponding Country Code to comply with local regulatory requirements.
Channel Center Frequency	This field indicates the current operating center frequency, in MHz.
Channel Bandwidth	This field indicates the current size of the channel band used for radio transmission.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an

	additional bit is used.
Frame Period	This field indicates the current Frame Period setting of the radio in ms.
Color Code	This field displays a value from 0 to 254 indicating the AP's configured color code. For registration to occur, the color code of the SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
Max Range	This field indicates the setting of the Max Range parameter, which contributes to the way the radio transmits. Verify that the Max Range parameter is set to a distance slightly greater than the distance between the AP and the furthest SM that must register to this AP.
Transmitter Output Power	This field indicates the combined power level at which the AP is set to transmit, based on the Country Code and Antenna Gain settings.
Temperature	This field indicates the current operating temperature of the device board.
Registered SM Count	This field indicates how many SMs are registered to the AP.
Sync Pulse Status	This field indicates the status of synchronization as follows: **Generating Sync** indicates that the module is set to *generate* the sync pulse. **Receiving Sync** indicates that the module is set to *receive* a sync pulse from an outside source and is receiving the pulse. **No Sync Since Boot up / ERROR: No Sync Pulse** indicates that the module is set to *receive* a sync pulse from an outside source and is not receiving the pulse.  **Note** When this message is displayed, the AP transmitter is turned off to avoid self-interference within the system.
Sync Pulse Source	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). **On-board GPS** indicates that the module is receiving sync via the unit's internal GPS module

Maximum Count of Registered SMs	This field displays the largest number of SMs that have been simultaneously registered in the AP since it was last rebooted. This count can provide some insight into sector history and provide comparison between current and maximum SM counts at a glance.
Data Slots Down	This field indicates the number of frame slots that are designated for use by data traffic in the downlink (sent from the AP to the SM). The AP calculates the number of data slots based on the **Max Range**, **Downlink Data** and (reserved) **Contention Slots** configured by the operator.
Data Slots Up	This field indicates the number of frame slots that are designated for use by data traffic in the uplink (sent from the SM to the AP). The AP calculates the number of data slots based on the Max Range, Downlink Data and (reserved) Contention Slots configured by the operator.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. See Contention slots on page7-165.
Site Name	This field indicates the name of the physical module. You can assign or change this name in the SNMP tab of the AP Configuration page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Site Contact	This field indicates contact information for the physical module. You can provide or change this information in the SNMP tab of the AP Configuration page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Site Location	This field indicates site information for the physical module. You can provide or change this information in the SNMP tab of the AP Configuration page.
Time Updated and Location Code	This field displays information about the keying of the radio.

General Status page - SM

The SM's **General Status** page is explained in Table 171.

Note

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

Table 171 General Status page attributes - SM

Device Information	
Device Type :	4.9/5.9GHz MIMO OFDM - Subscriber Module - 0a-00-3e-bb-01-04
Board Type :	P13 C110_SOC
Software Version :	CANOPY 14.1 SM-DES
Board MSN :	PMP450iMSN
FPGA Version :	100615
Uptime :	2d, 19:49:28
System Time :	12:51:51 10/12/2015 IST
Ethernet Interface :	No Link
Region Code :	Other
DFS :	Idle
Antenna Type :	External
Frame Period :	2.5 ms
Temperature :	36 °C / 97 °F

Subscriber Module Stats	
Session Status :	REGISTERED VC 18 Rate 8X/8X MIMO-B
Session Uptime :	2 d, 19:48:29
Registered AP :	0a-00-3e-bb-00-fb No Site Name
Color Code :	254 (Primary)
Channel Frequency :	5490.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Air Delay :	0 ns, approximately 0.000 miles (0 feet)
Receive Power :	-42.5 dBm
Signal Strength Ratio :	3.0dB V - H
Signal to Noise Ratio :	43 V / 43 H dB
Beacons :	100 %
Transmit Power :	-20 dBm

Frame Configuration Information	
Data Slots Down :	27
Data Slots Up :	9
Contention Slots :	3

Region Specific Information	
Region Code :	Other

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

Key Features Information	
Maximum Throughput :	Unlimited
Time Updated and Location Code :	08/18/2015 06:44:37 - INTL

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the SM, its module type and its MAC address.
Board Type	This field indicates the series of hardware.
Software Version	This field indicates the system release, the time and date of the release.

	If you request technical support, provide the information from this field.
FPGA Version	This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.
PLD Version	This field indicates the version of the programmable logic device (PLD) on the module. If you request technical support, provide the value of this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. Any SM that registers to an AP inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).
Ethernet Interface	This field indicates the speed and duplex state of Ethernet interface to the SM.
Regional Code	A parameter that offers multiple fixed selections, each of which automatically implements frequency band range restrictions for the selected region. Units shipped to regions other than the United States must be configured with the corresponding Country Code to comply with local regulatory requirements.
DFS	This field indicates that DFS operation is enabled based on the configured region code, if applicable.
Antenna Type	The current antenna type that has been selected.
Frame Period	This field indicates the current Frame Period setting of the radio in ms.
Temperature	The current operating temperature of the board.
Session Status	This field displays the following information about the current session: **Scanning** indicates that this SM currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page. **Syncing** indicates that this SM currently attempts to receive sync. **Registering** indicates that this SM has sent a registration request message to the AP and has not yet received a response. **Registered** indicates that this SM is both: • registered to an AP. • ready to transmit and receive data packets.
Session Uptime	This field displays the duration of the current link. The syntax of the displayed time is *hh:mm:ss*.
Registered AP	Displays the MAC address and site name of the AP to which the SM is registered to. This parameter provides click-through proxy access to the AP's management interface.

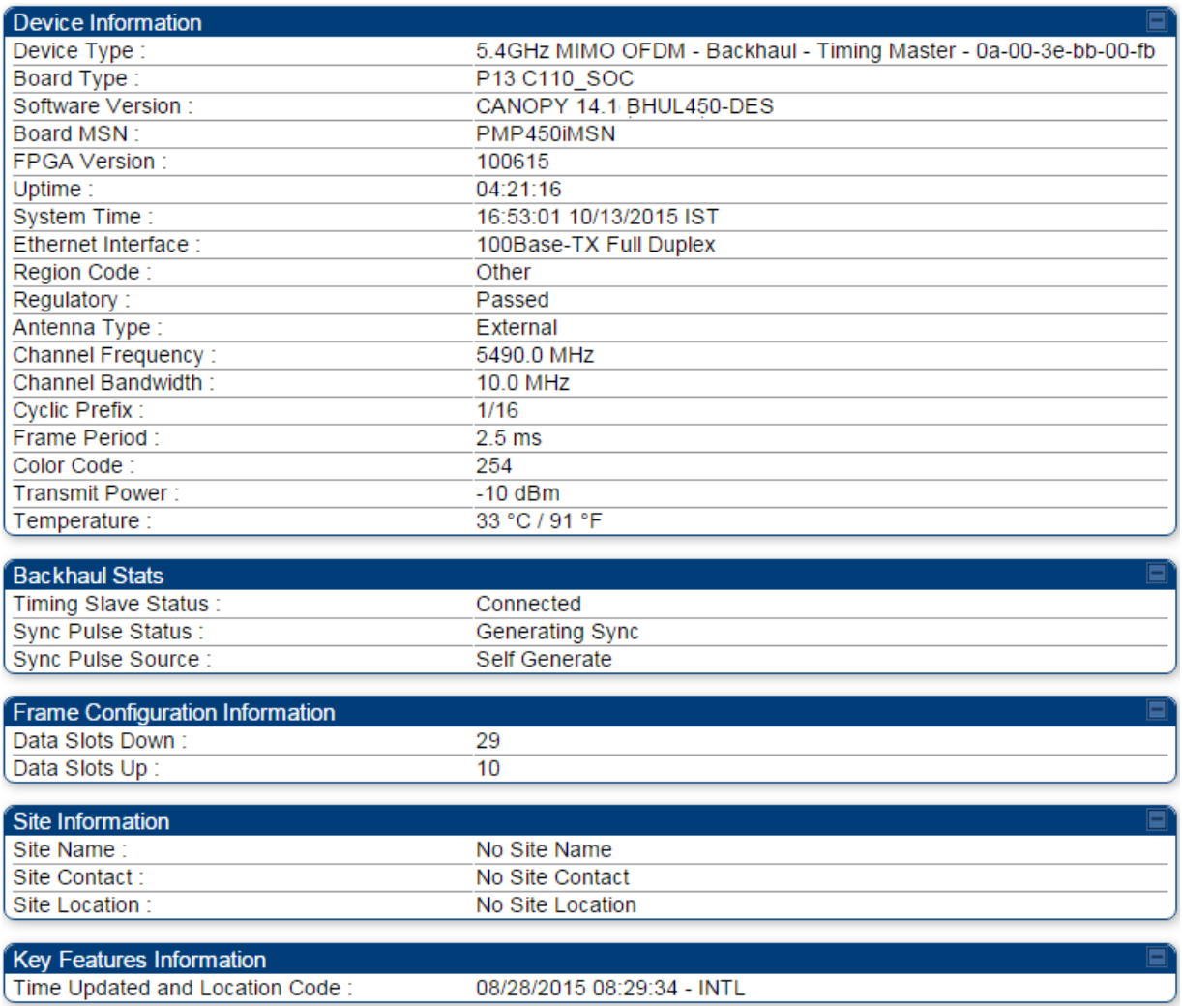
Color Code	This field displays a value from 0 to 254 indicating the SM's configured color code. For registration to occur, the color code of the SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. Color code allows you to force a SM to register to only a specific AP, even where the SM can communicate with multiple APs. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).
Channel Frequency	This field lists the current operating frequency of the radio.
Channel Bandwidth	The size in MHz of the operating channel.
Cyclic Prefix	OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol to allow multi-pathing to settle before receiving the desired data. A 1/16 cyclic prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.
Air Delay	This field displays the distance in feet between this SM and the AP. To derive the distance in meters, multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.
Receive Power	This field lists the current combined receive power level, in dBm.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.
Beacons	Displays a count of beacons received by the SM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Transmit Power	This field lists the current combined transmit power level, in dBm.
Data Slots Down	This field lists the number of slots used for downlink data transmission.
Data Slots Up	This field lists the number of slots used for uplink data transmission.
Contention Slots	This field indicates the number of (reserved) Contention Slots configured by the operator. See Contention slots on page7-165.
Site Name	This field indicates the name of the physical module. You can assign or change this name in the SNMP tab of the SM Configuration page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Site Contact	This field indicates contact information for the physical module. You can provide or change this information in the SNMP tab of the SM

	Configuration page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.
Site Location	This field indicates site information for the physical module. You can provide or change this information in the SNMP tab of the SM Configuration page.
Maximum Throughput	This field indicates the limit of aggregate throughput for the SM and is based on the default (factory) limit of the SM and any floating license that is currently assigned to it.
Time Updated and Location Code	This field displays information about the keying of the radio.

General Status page of BHM

The BHM's **General Status** page is explained in Table 172.

Table 172 General Status page attributes - BHM



Device Information	
Device Type :	5.4GHz MIMO OFDM - Backhaul - Timing Master - 0a-00-3e-bb-00-fb
Board Type :	P13 C110_SOC
Software Version :	CANOPY 14.1 BHUL450-DES
Board MSN :	PMP450iMSN
FPGA Version :	100615
Uptime :	04:21:16
System Time :	16:53:01 10/13/2015 IST
Ethernet Interface :	100Base-TX Full Duplex
Region Code :	Other
Regulatory :	Passed
Antenna Type :	External
Channel Frequency :	5490.0 MHz
Channel Bandwidth :	10.0 MHz
Cyclic Prefix :	1/16
Frame Period :	2.5 ms
Color Code :	254
Transmit Power :	-10 dBm
Temperature :	33 °C / 91 °F

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

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

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 :	08/28/2015 08:29:34 - INTL

Attribute	Meaning
Device Type	This field indicates the type of the module. Values include the frequency band of the BHM, its module type and its MAC address.
Board Type	This field indicates the series of hardware.
Software Version	This field indicates the system release, the time and date of the release. If you request technical support, provide the information from this field.
Board MSN	This field indicates the Manufacture's Serial number. A unique serial number assigned to each radio at the factory for inventory and quality control.
FPGA Version	This field indicates the version of the field-programmable gate array

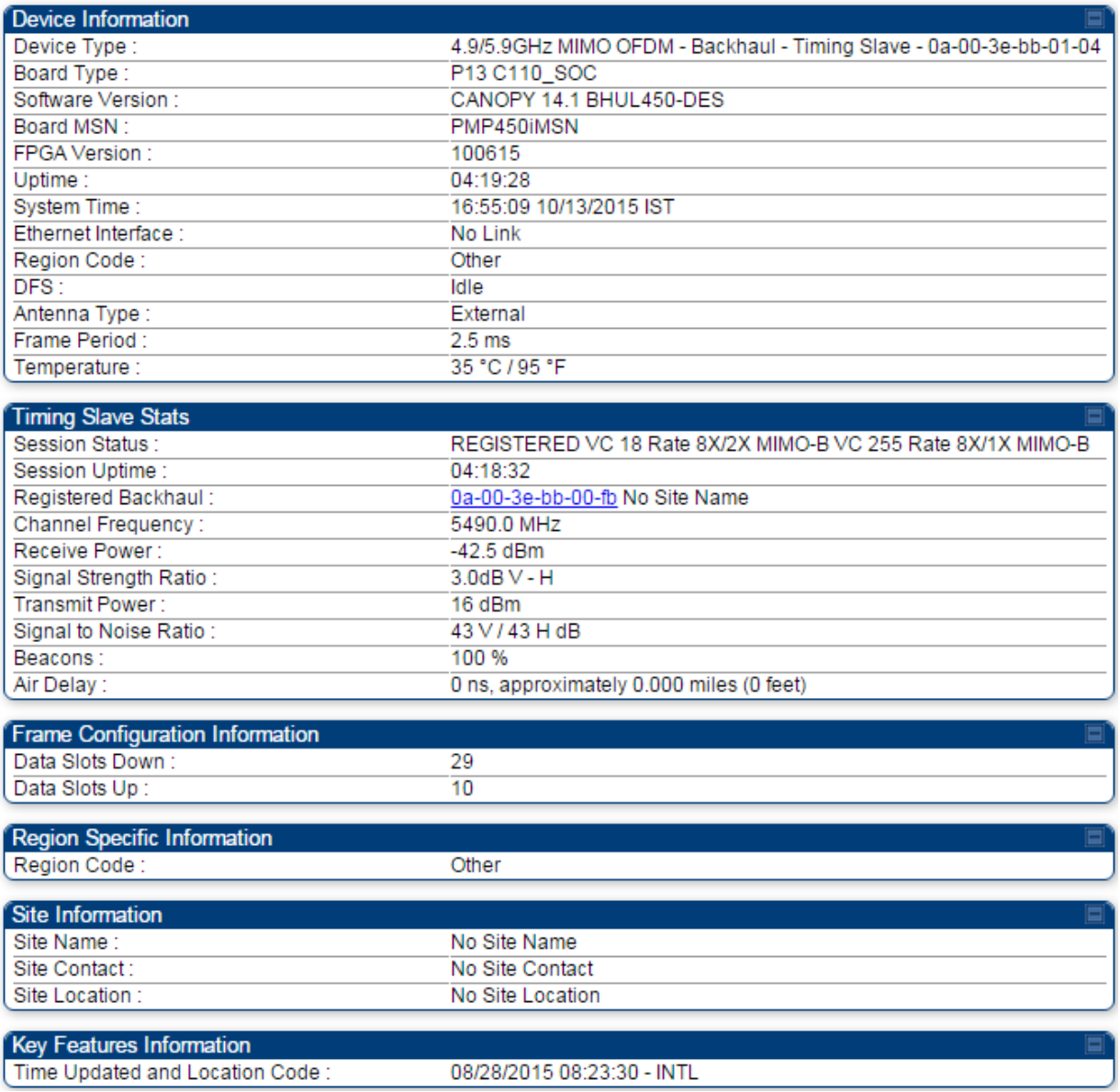
	(FPGA) on the module. When you request technical support, provide the information from this field.
Uptime	This field indicates how long the module has operated since power was applied.
System Time	This field provides the current time. Any BHS that registers to a BHM inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).
Ethernet Interface	This field indicates the speed and duplex state of Ethernet interface to the BHM.
Antenna Type	The current antenna type that has been selected.
Temperature	The current operating temperature of the board.
Session Status	This field displays the following information about the current session: **Scanning** indicates that this BHS currently cycles through the radio frequencies that are selected in the Radio tab of the Configuration page. **Syncing** indicates that this BHM currently attempts to receive sync. **Registering** indicates that this BHM has sent a registration request message to the BHM and has not yet received a response. **Registered** indicates that this BHM is both: • Registered to a BHM. • Ready to transmit and receive data packets.
Session Uptime	This field displays the duration of the current link. The syntax of the displayed time is *hh:mm:ss*.
Registered Backhaul	Displays the MAC address and site name of the BHM to which the BHS is registered to. This parameter provides click-through proxy access to the BHM's management interface.
Channel Frequency	This field lists the current operating frequency of the radio.
Receive Power	This field lists the current combined receive power level, in dBm.
Signal Strength Ratio	This field displays the difference of the Vertical path received signal power to the Horizontal path received signal power.
Transmit Power	This field lists the current combined transmit power level, in dBm.
Signal to Noise Ratio	This field lists the current signal-to-noise level, an indication of the separation of the received power level vs. noise floor.
Beacons	Displays a count of beacons received by the BHM in percentage. This value must be typically between 99-100%. If lower than 99%, it indicates a problematic link. This statistic is updated every 16 seconds.
Air Delay	This field displays the distance in feet between this BHS and the BHM. To derive the distance in meters, multiply the value of this parameter by

	0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.
Data Slots Down	This field lists the number of slots used for downlink data transmission.
Data Slots Up	This field lists the number of slots used for uplink data transmission.
Regional Code	A parameter that offers multiple fixed selections, each of which automatically implements frequency band range restrictions for the selected region. Units shipped to regions other than the United States must be configured with the corresponding Country Code to comply with local regulatory requirements.
Site Name	This field indicates the name of the physical module. Assign or change this name in the **Configuration > SNMP** page. This information is also set into the *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 173.

Table 173 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 14.1 BHUL450-DES
Board MSN :	PMP450iMSN
FPGA Version :	100615
Uptime :	04:19:28
System Time :	16:55:09 10/13/2015 IST
Ethernet Interface :	No Link
Region Code :	Other
DFS :	Idle
Antenna Type :	External
Frame Period :	2.5 ms
Temperature :	35 °C / 95 °F

Timing Slave Stats	
Session Status :	REGISTERED VC 18 Rate 8X/2X MIMO-B VC 255 Rate 8X/1X MIMO-B
Session Uptime :	04:18:32
Registered Backhaul :	0a-00-3e-bb-00-fb No Site Name
Channel Frequency :	5490.0 MHz
Receive Power :	-42.5 dBm
Signal Strength Ratio :	3.0dB V - H
Transmit Power :	16 dBm
Signal to Noise Ratio :	43 V / 43 H dB
Beacons :	100 %
Air Delay :	0 ns, approximately 0.000 miles (0 feet)

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

Region Specific Information	
Region 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 :	08/28/2015 08:23:30 - INTL

Attribute	Meaning
Device Type	See Table 173 on page 9-14
Board Type	
Software Version	
Board MSN	
FPGA Version	

Uptime	
System Time	
Ethernet Interface	
Antenna Type	
Temperature	
Session Status	
Session Uptime	
Registered Backhaul	
Channel Frequency	
Receive Power	
Signal Strength Ratio	
Transmit Power	See Table 173 on page 9-14
Signal to Noise Ratio	
Beacons	
Air Delay	
Data Slots Down	
Data Slots Up	
Regional Code	
Site Name	
Site Contact	
Site Location	
Time Updated and Location Code	

Viewing Session Status

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

Note

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

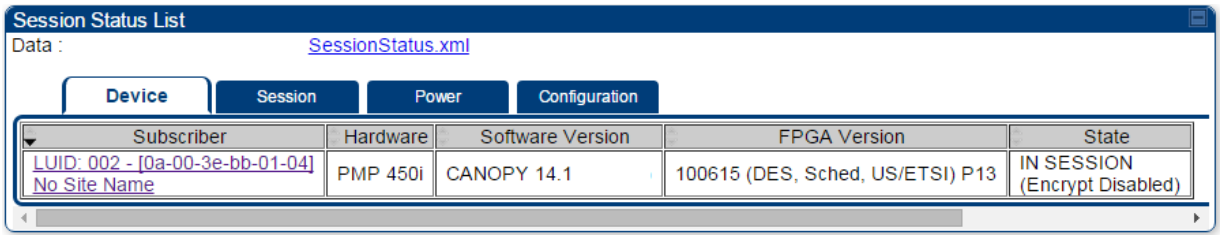
The Session Status List has four tab: Device, Session, Power and Configuration.

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

Device tab

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

Table 174 Device tab attributes



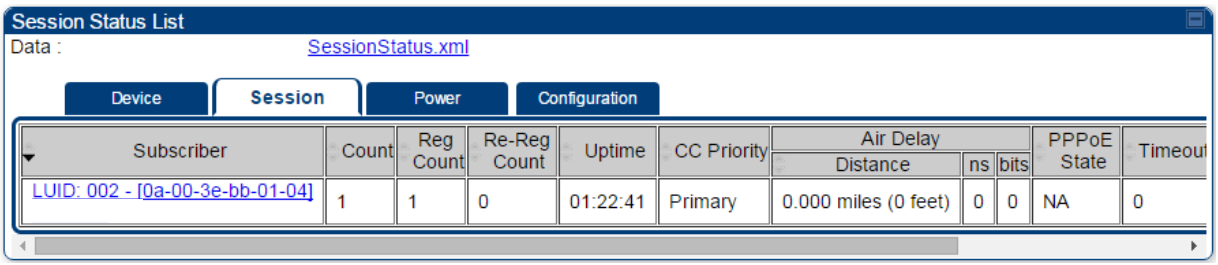
Attribute	Meaning
Subscriber	This field displays the LUID (logical unit ID), MAC address and Site Name of the SM/BHS. As each SM or BHS registers to the AP/BHM, the system assigns an LUID of 2 or a higher unique number to the SM/BHS. If a SM/BHS loses registration with the AP/BHS and then regains registration, 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 175 Session tab attributes

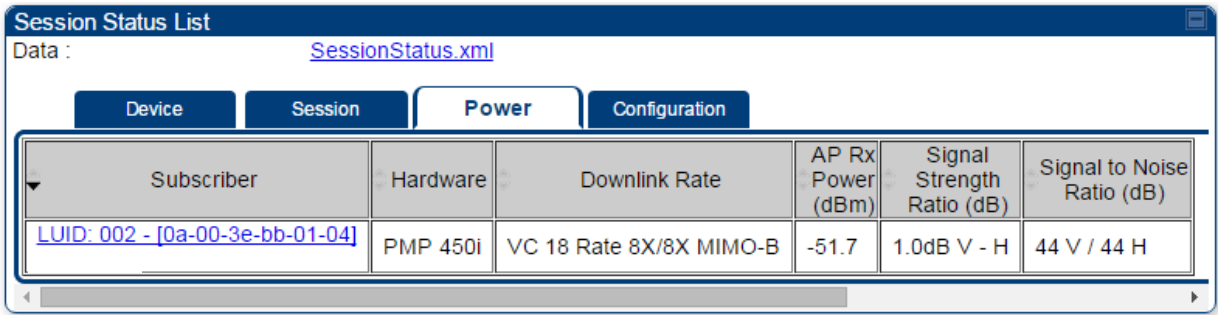


Attribute	Meaning
Subscriber	See Table 174 on page 9-16.
Count	This field displays how many sessions the SM/BHS has had with the AP/BHM. Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum. 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 176 Power tab attributes

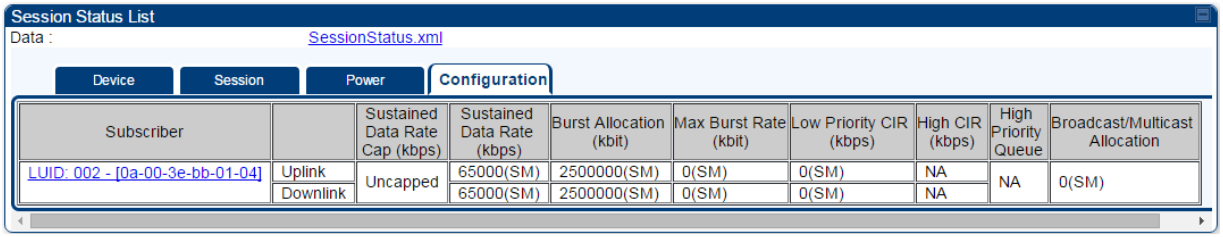


Attribute	Meaning
Subscriber	See Table 174 on page 9-16.
Hardware	This field displays the SMs or BHS hardware type.
Rate	This field displays whether the high-priority channel is enabled in the

	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 177** Configuration tab attributes



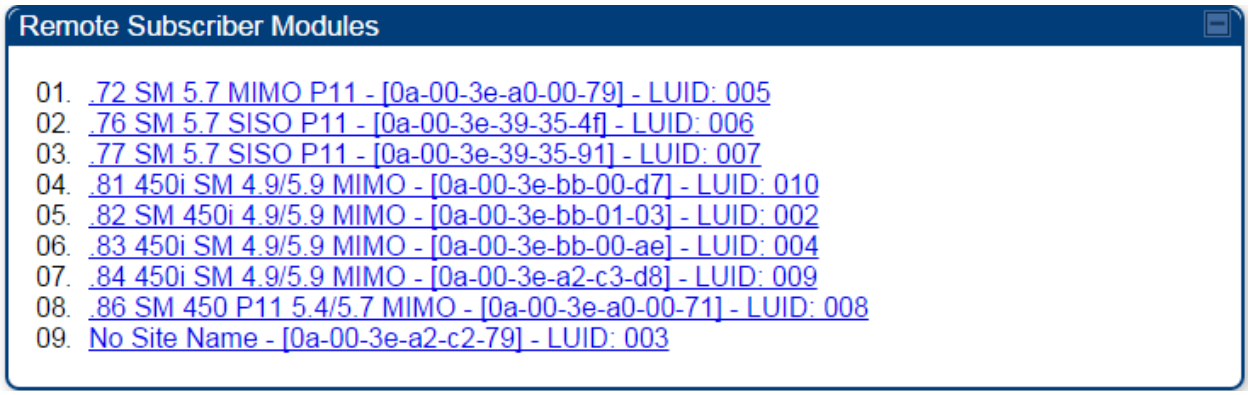
Attribute	Meaning
Subscriber	See Table 174 on page 9-16.
Sustained Data Rate	This field displays the CIR value in kbps that is currently in effect for the SM/BHS in both the Uplink and Downlink direction. In the Uplink, this is the specified rate at which each SM/BHS registered to this AP/BHM is replenished 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 450 platform 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 or BHS over the RF link. To view the pages for a selected SM/BHS, click its link. The **General Status** page of the SM opens.

Figure 143 Remote Subscribers page of AP



Interpreting messages in the Event Log

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

Time and Date Stamp

The time and date stamp reflect one of the following:

- GPS time and date directly or indirectly received from the CMM4.

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

Note

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

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

Event Log Data Collection

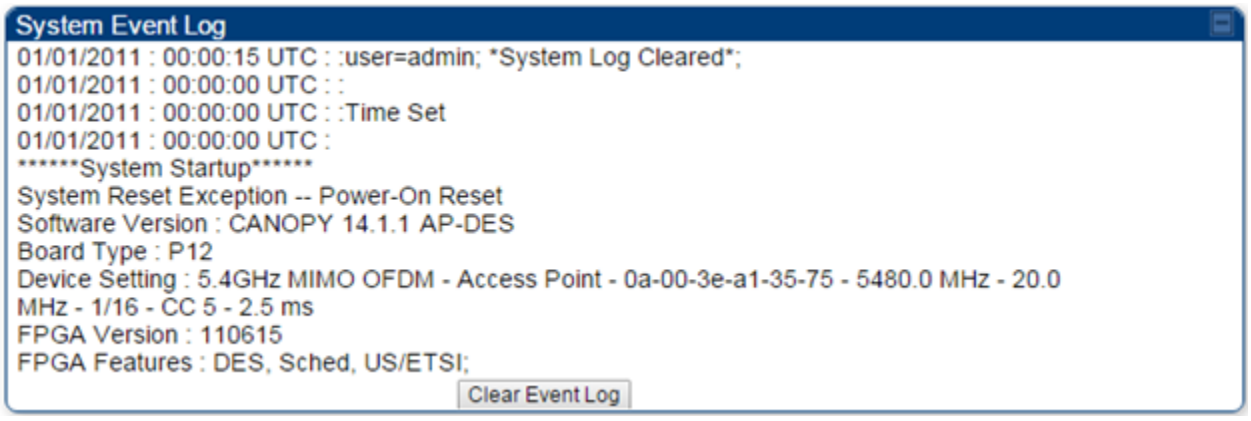
The collection of event data continues through reboots and power cycles. When the buffer allowance for event log data is reached, the system adds new data into the log and discards an identical amount of the oldest data.

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

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

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

Figure 144 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 178 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 179 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 145 Network Interface tab of the AP

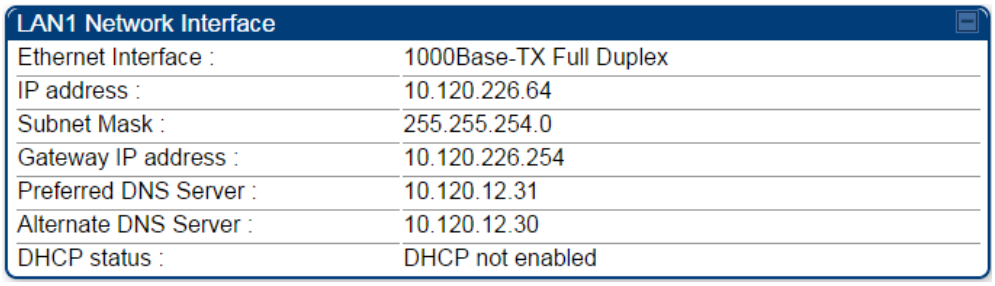
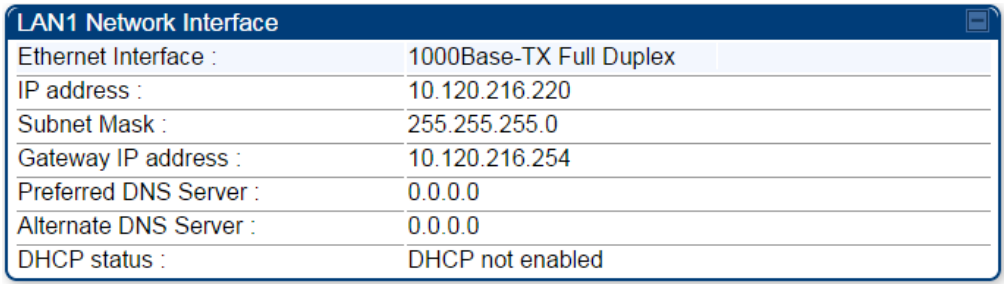


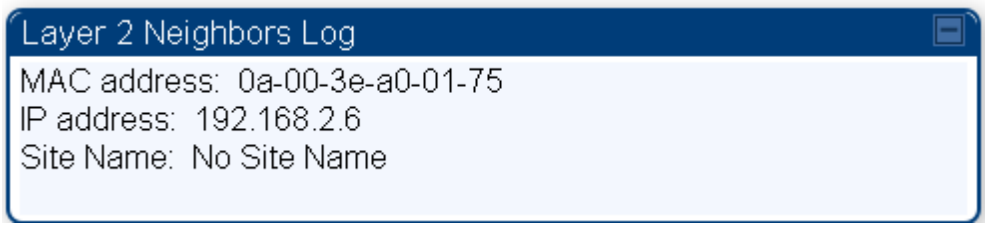
Figure 146 Network Interface tab of the SM



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 147 Layer 2 Neighbors page



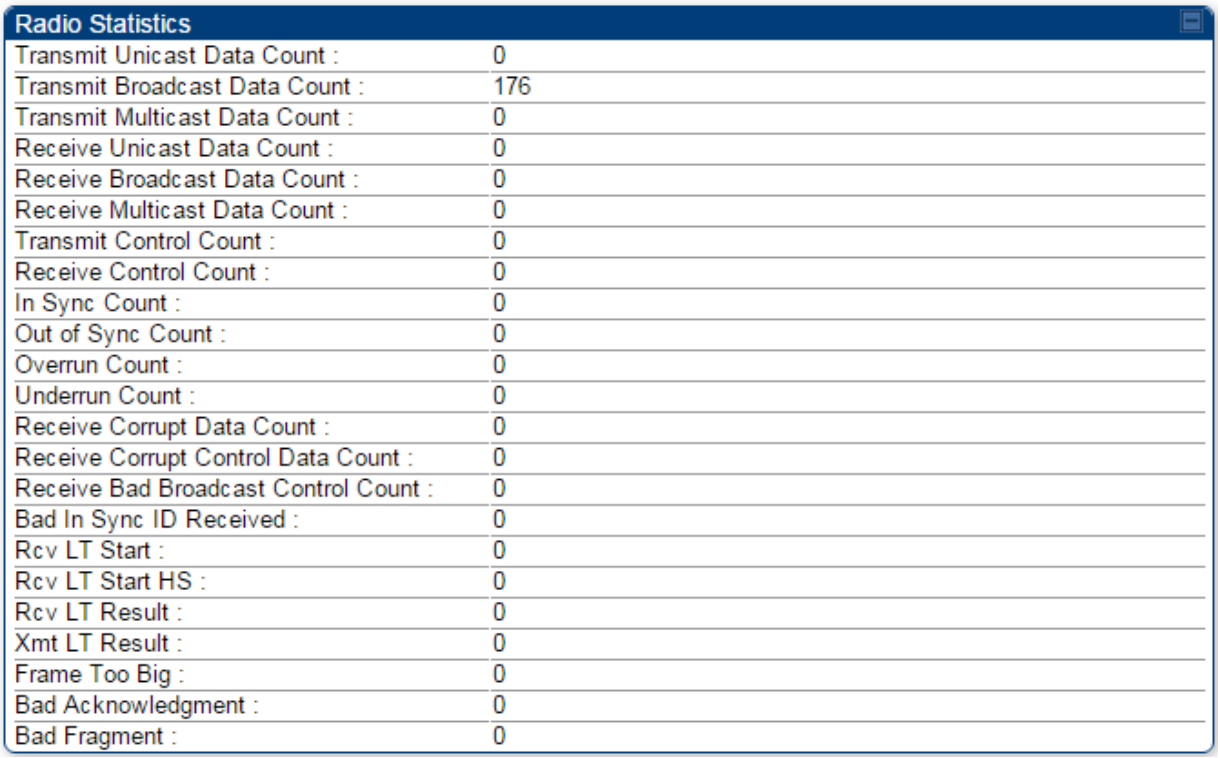
System statistics

This section describes how to use the system statistics pages to manage the performance of the PMP/PTP 450 platform 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 180 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 181 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 182 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 183 and the “Flags” can be ignored.

Table 183 Flags status

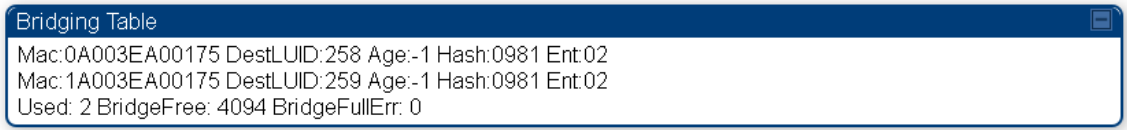
Flag	Meaning	Flag	Meaning
0	Normal	11	AP Lite Limit Reached
1	Out of Range	12	Only Ver 9.5+ Allowed
2	No Luids	13	Temporary Data VC for AAA
3	BH ReRange	14	AAA Authentication Failure
4	Auth Fail	15	Registration Grant Reject
5	Encrypt Fail	16	Blank
6	Power Adjust	17	AAA Session Retry
7	No VCs	18	AAA Reauth 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 148 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.)

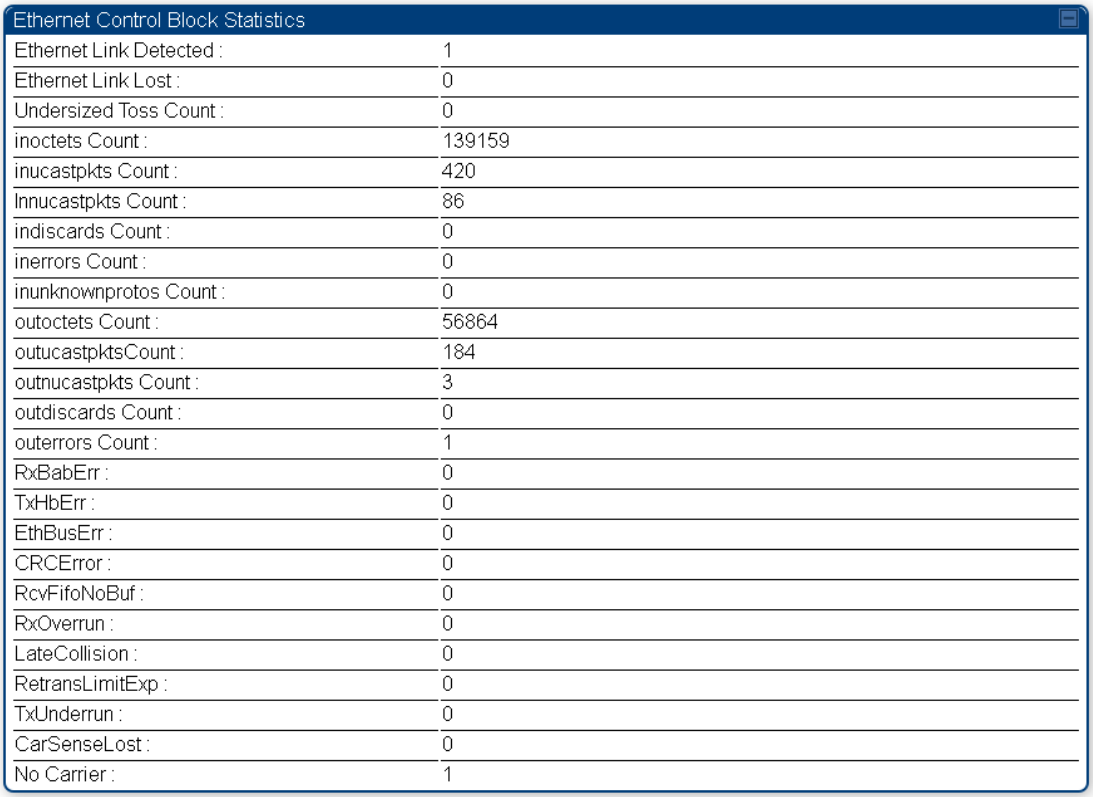
Figure 149 Translation Table page of SM

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 184 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.

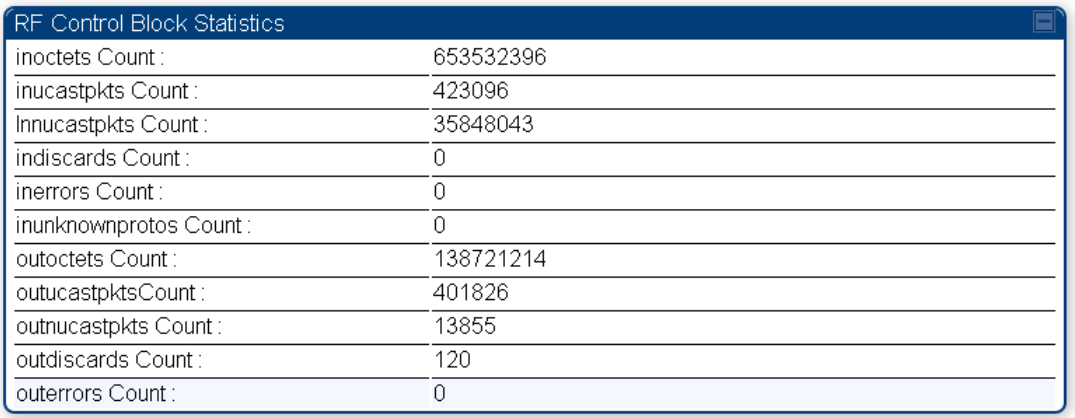
indiscards Count	This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)
inerrors Count	This field displays how many inbound packets contained 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 185 Radio (Statistics) page attributes



RF Control Block Statistics	
inoctets Count :	653532396
inucastpkts Count :	423096
lnnucastpkts 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

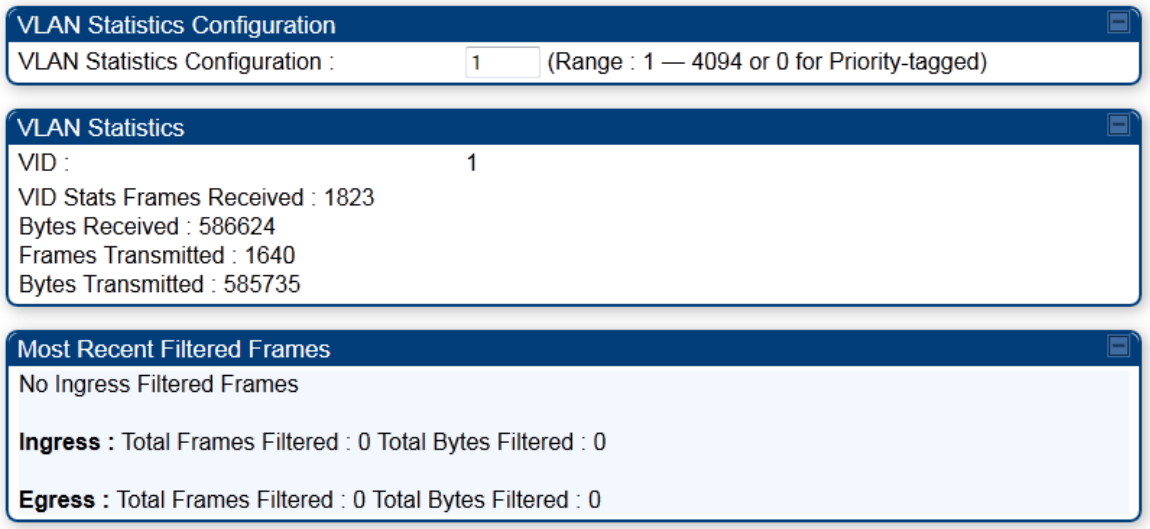
Attribute	Meaning
inoctets Count	This field displays how many octets were received on the interface, including those that deliver framing information.
inucastpkts Count	This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.
lnnucastpkts Count	This field 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 186 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 187.

Table 187 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.

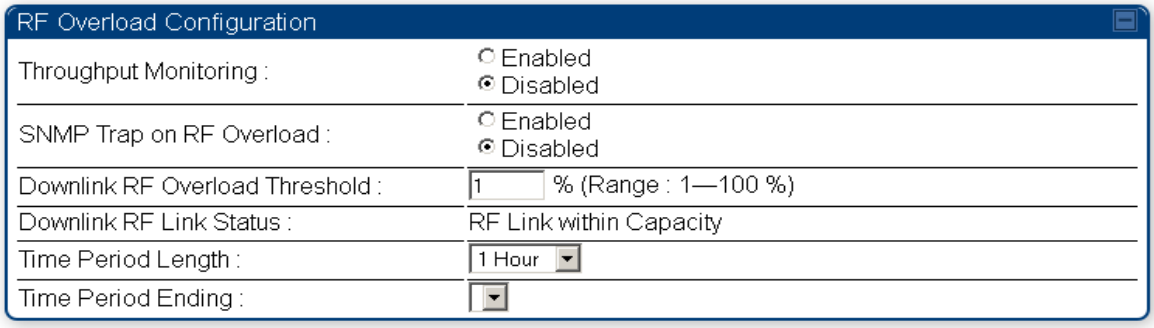
Interpreting Throughput statistics

The PMP/PTP 450 platform 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 188 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

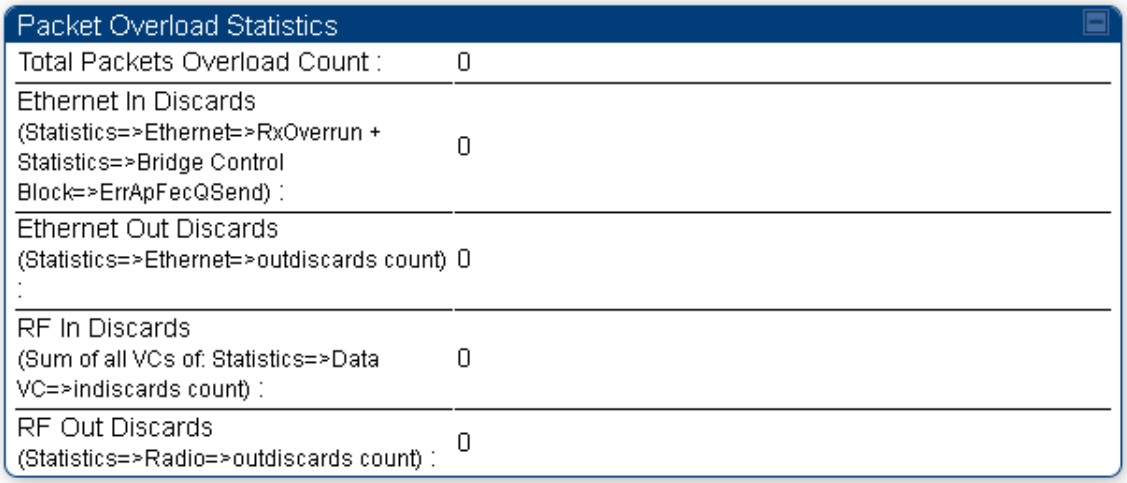
- **discards %** – Percent of the total packets to be transmitted by the AP/BHM at the RF Interface for this LUID over the collection interval that had to be discarded because the RF Out Queue was full.

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 189.

Table 189 Overload page attributes – AP/SM/BHM/BHS



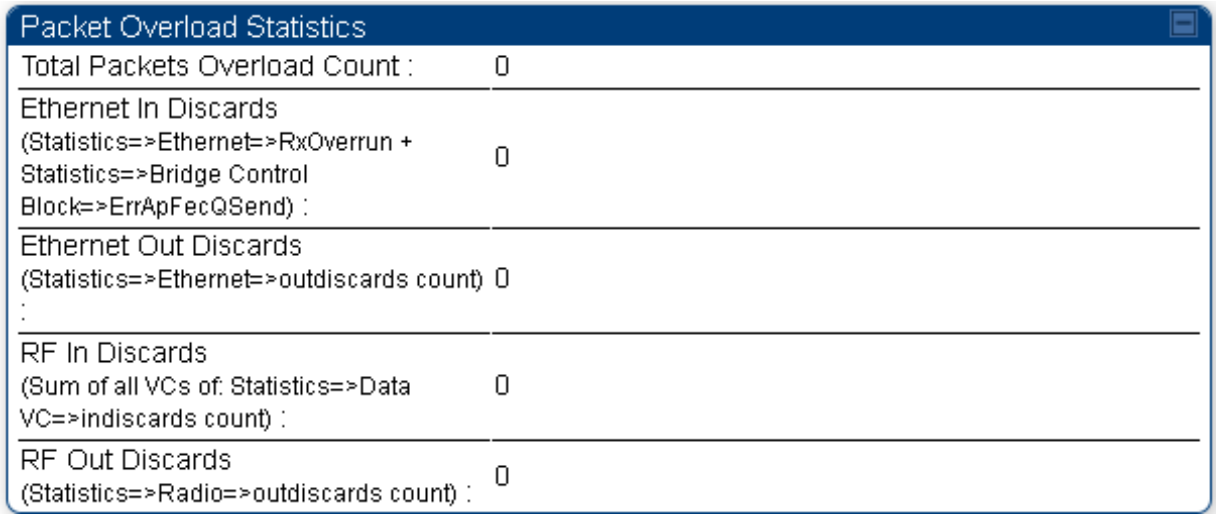
Attribute	Meaning
Total Packets Overload Count	This field represents the sum of all RF and Ethernet in/out discards.
Ethernet In Discards	This field represents the number of packets tossed due to the Ethernet queue being full. If a climb in this stat accompanies a climb in RF Out Discards stat, then 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 190.

Table 190 DHCP Relay page attributes – AP/SM



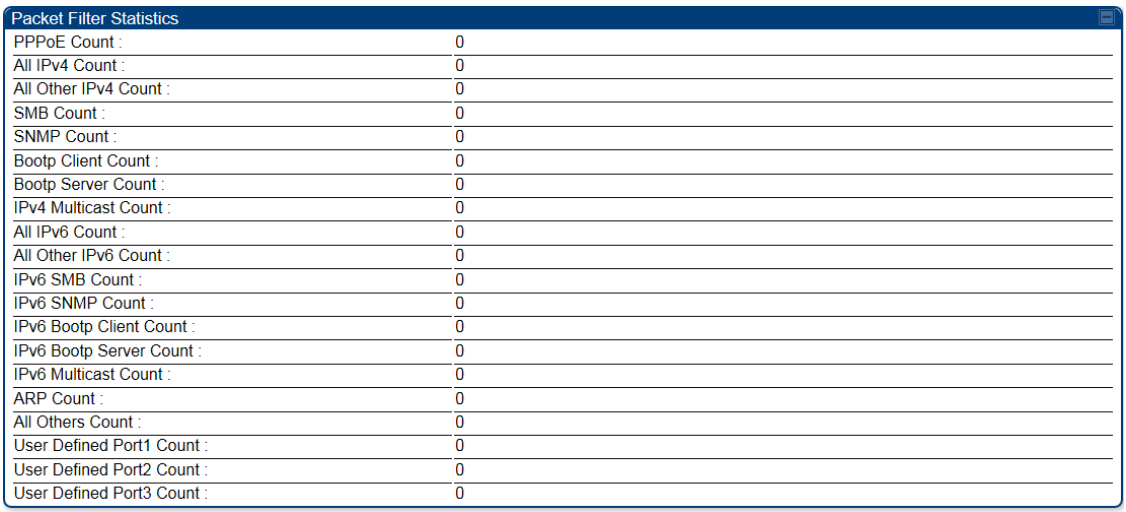
Attribute	Meaning
Requests Received	This field represents the number of DHCP relay requests received by the AP.
Requests Relayed	This field represents the number of DHCP relay requests relayed by the AP.

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 191.

Table 191 Filter page attributes - SM

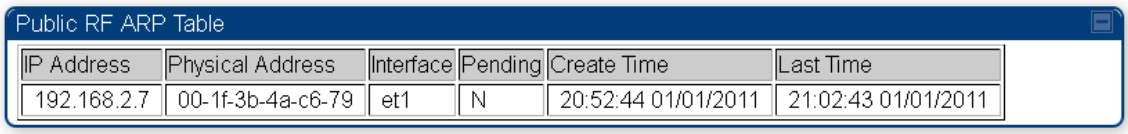


Attribute	Meaning
PPPoE Count	Number of PPoE packets filtered.
All IPv4 Count	Number of IPv4 packets filtered.
All Other IPv4 Count	Any IPv4 message that was not SMB, SNMP, Bootp, Multicast or one of the user defined filters, that was filtered out.
SMB Count	Number of IPv4 Server Message Block (file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

Viewing ARP statistics

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

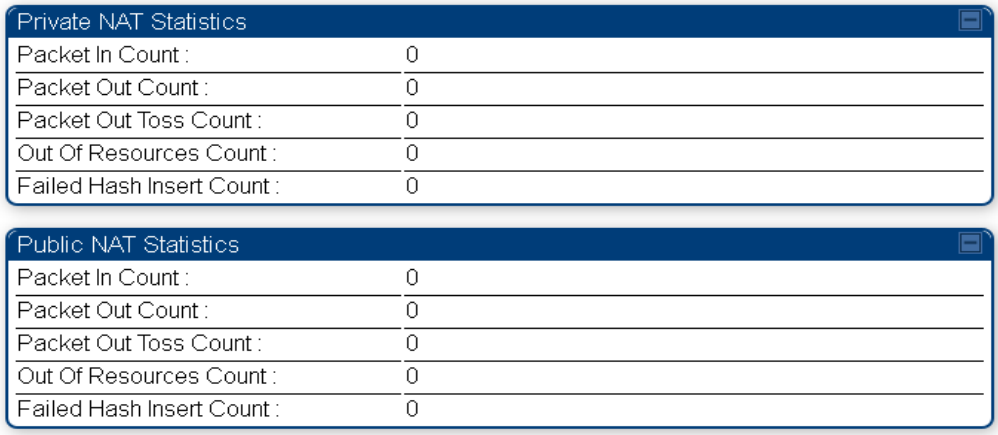
Figure 150 ARP page of the SM



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 192.

Table 192 NAT page attributes - SM



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

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

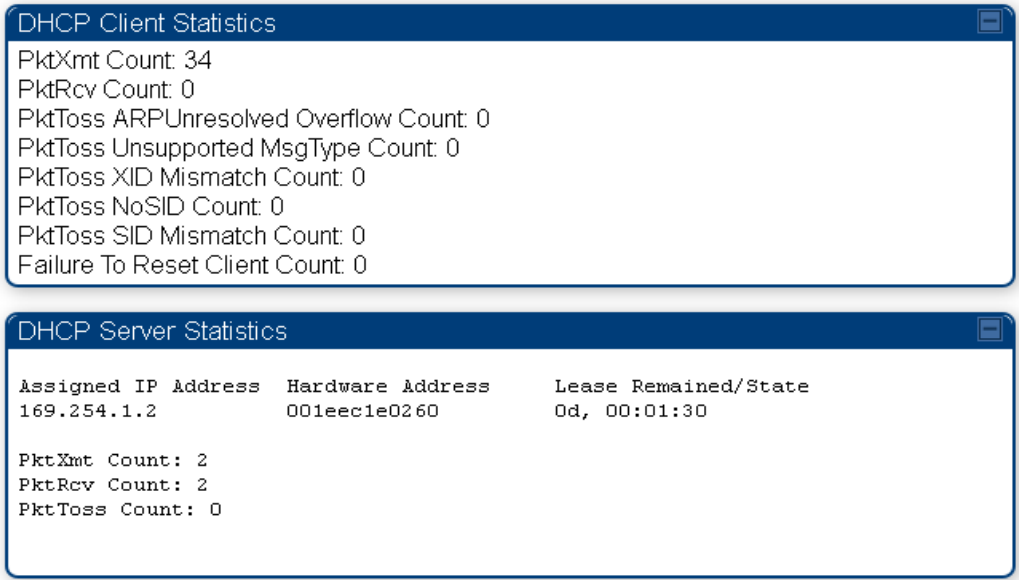
Attribute	Meaning
Private NAT Statistics, Packet In Count	This field represents the number of packets received on the SM's LAN/Ethernet interface
Private NAT Statistics, Packet Out Count	This field represents the number of packets sent from the SM's LAN/Ethernet interface
Private NAT Statistics, Packet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

Viewing NAT DHCP Statistics

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

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

Table 193 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

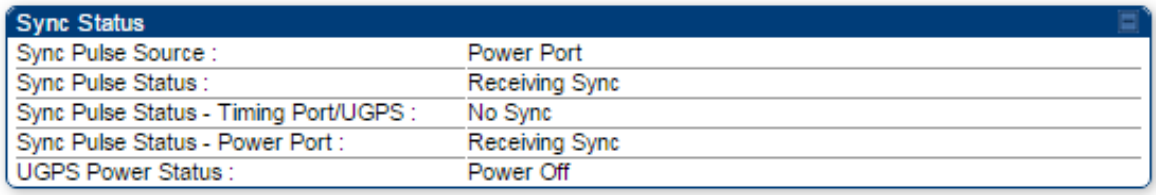
Failure to Reset Client Count	This field represents the number of times the DHCP client was unable to be reset (resulting in no IP address being served).

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 194.

Table 194 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.

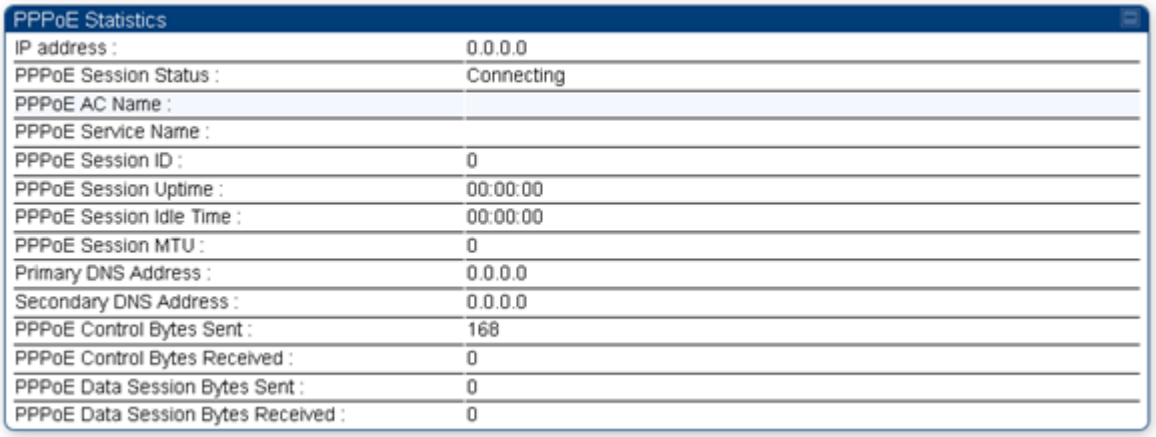
Interpreting PPPoE Statistics for Customer Activities

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 195.

Table 195 PPPoE Statistics page attributes - SM



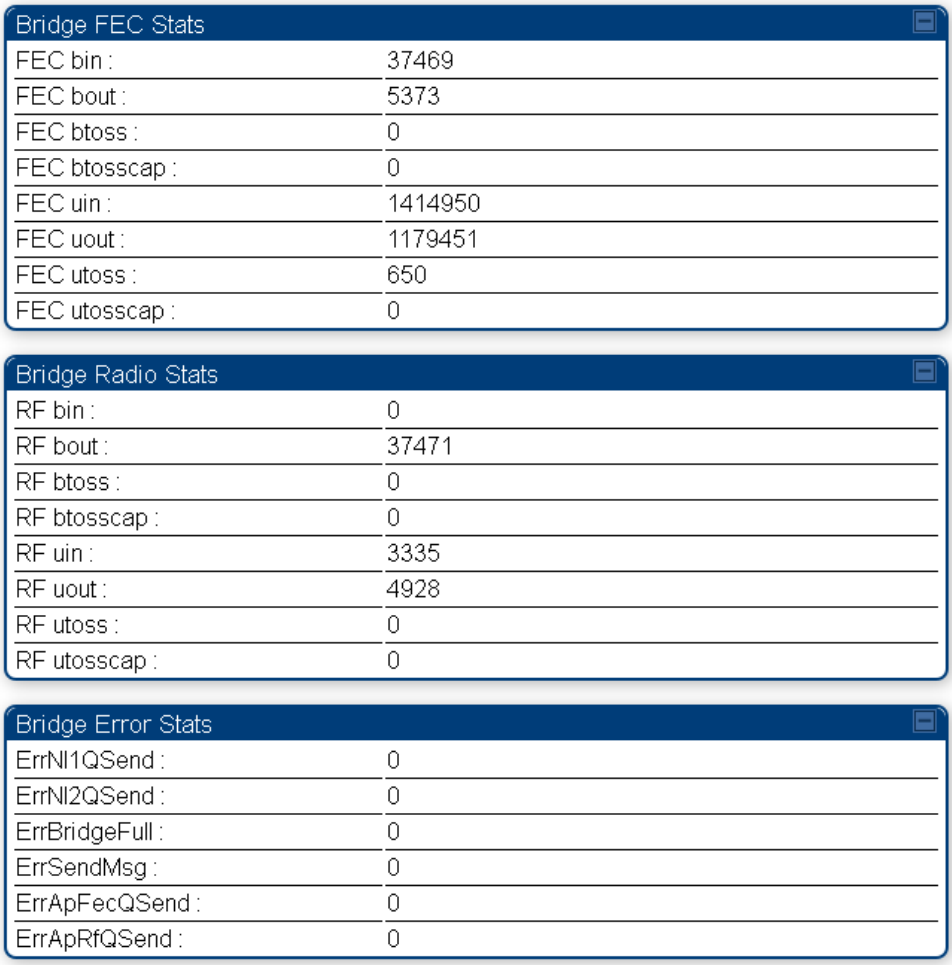
Attribute	Meaning
IP address	This field displays the IP address of the PPPoE session initiator (situated below the SM)
PPPoE Session Status	This field displays the operational status of the PPPoE Session
PPPoE AC Name	This field displays access concentrator name used in the PPPoE session
PPPoE Service 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 displays statistics of Bridge FEC, Bridge ratio and Bridge error. The page is applicable for all modules (AP/SM/BHM/BHS). The Bridge Control Block Statistics page is explained in Table 196.

Table 196 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

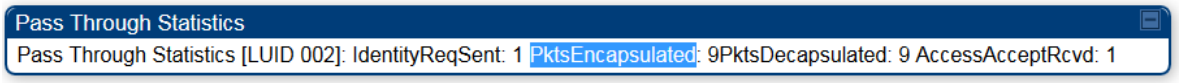
Attribute	Meaning
FEC bin	This field indicates the number of broadcast packets received by the bridge control block on the Ethernet interface
FEC bout	This field indicates the number of broadcast packets sent by the bridge control block on the Ethernet interface
FEC btoss	This field indicates the number 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 450 platform AP only. The Pass Through Statistics page is explained in Table 197.

Table 197 Pass Through Statistics page attributes – AP

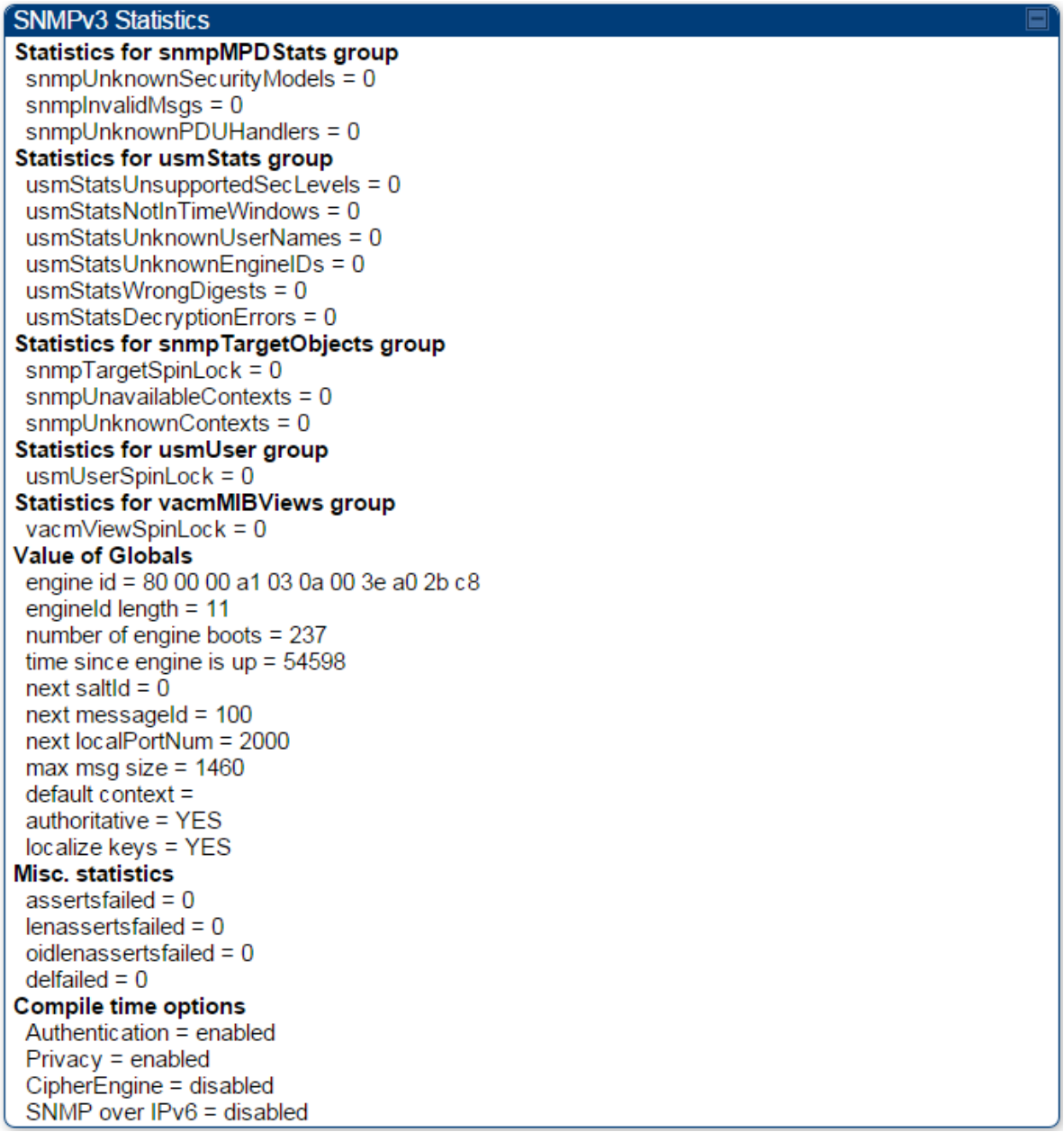


Attribute	Meaning
IdentityReqSent	This field indicates the number of EAP Identity requests sent through the AP with respect to an SM.
PktsEncapsulated	This field indicates no of packets received from the SM which are encapsulated by the AP.
PktsDecasulated	This field indicates no of packets received 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 450 platform. The SNMPv3 Statistics page is explained in Table 198.

Table 198 SNMPv3 Statistics page attributes – AP



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

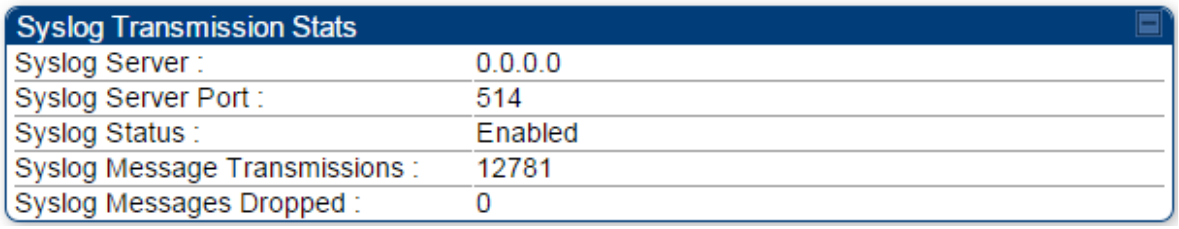
snmpUnknownSecurityModels	The total number of packets received by the SNMP engine which were dropped because they referenced a securityModel that was not known to or supported by the SNMP engine.
snmpInvalidMsgs	The total number of packets received by the SNMP engine which were dropped because there 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 displays statistics of syslog messages. The page is applicable for all modules (AP/SM/BHM/BHS). The Syslog Statistics page is explained in Table 199.

Table 199 Syslog statistics page attributes – AP/SM/BH



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

Interpreting Frame Utilization statistics

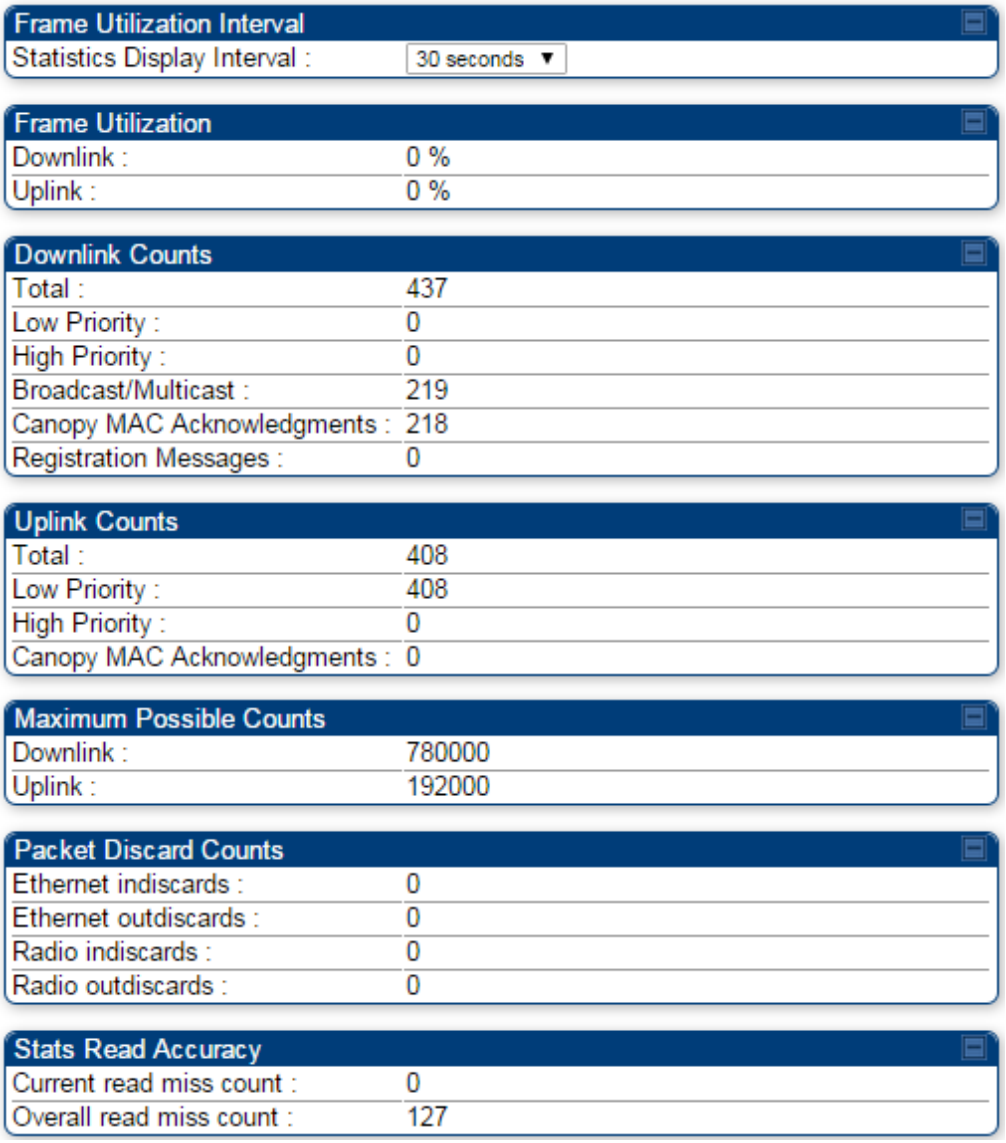
The Frame Utilization Statistics is a feature helps user to understand how effectively the RF channel is being utilized. This feature allows to check Time Division Duplex (TDD) frame utilization pattern and diagnose for any excessive usage in uplink or downlink direction.

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

Note:

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

Table 200 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	