IP4 and IPv6

Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

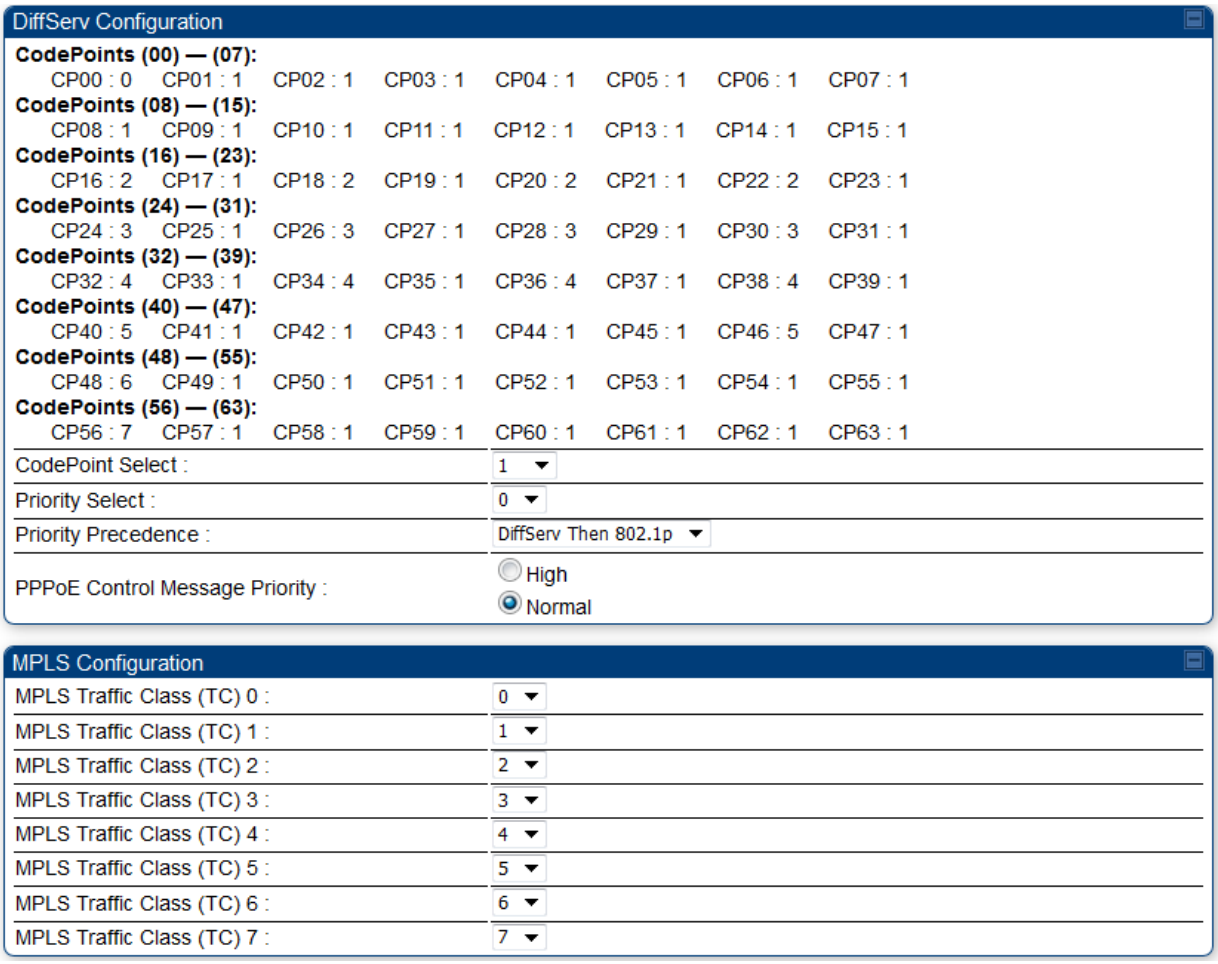
IPv4 and IPv6 Prioritization

450 Platform Family provides operators the ability to prioritize IPv6 traffic in addition to IPv4 traffic. IPv6/IPv4 prioritization can be configured by selecting a CodePoint and the corresponding priority from the GUI of the AP/BHM and the IPv6/IPv4 packet is set up accordingly. There is no GUI option for selecting IPv6 or IPv4 priority. Once the priority is set, it is set for IPv4 and IPv6 packets.

Configuring IPv4 and IPv6 Priority

IPv4 and IPv6 prioritization is set using the DiffServ tab on the AP/BHM and SM/BHS (located at **Configuration > DiffServ**). A priority set to a specific CodePoint will apply to both IPv4 and IPv6 traffic.

Table 132 DiffServ attributes – AP/BHM



<table>
<tr><th>Attribute</th><th>Meaning</th></tr>
<tr><td>Codepoints 1 through 63</td><td>The PMP family of APs support four levels of QoS. The mapping of these eight priority values to data channels is determined by the number of data channels configured per SM as shown in the table below:
<table><tr><th>Number of QoS levels →</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Level 1</td><td>0-7</td><td>0-3</td><td>0-1</td><td>0-1</td></tr><tr><td>Level 2</td><td>-</td><td>4-7</td><td>2-3</td><td>2-3</td></tr><tr><td>Level 3</td><td>-</td><td>-</td><td>4-7</td><td>4-5</td></tr><tr><td>Level 4</td><td>-</td><td>-</td><td>-</td><td>6-7</td></tr></table>
For example, for an AP that uses the default table shown above has configured 3 QoS levels per SM, would see codepoints 0 through 15 mapped to the Low Priority data channels, codepoint 16 would be mapped to the Medium Priority data channels, and so on.
Note that CodePoints 0, 8, 16, 24, 32, 48, and 56 are predefined to the fixed values shown in Table 132 above and are not user configurable. Operator cannot change any of these three fixed priority values. Among the configurable parameters, the priority values (and therefore the handling of packets in the high or low priority channel) are set in the AP/BHM for all downlinks within the sector and in the SM/BHS for each uplink.</td></tr>
<tr><td>CodePoint Select</td><td>This represents the CodePoint Selection to be modified via Priority Select.</td></tr>
<tr><td>Priority Select</td><td>The priority setting input for the CodePoint selected in CodePoint Select.</td></tr>
<tr><td>Priority Precedence</td><td>Allows operator to decide if 802.1p or DiffServ priority bits must be used first when making priority decisions.</td></tr>
<tr><td>PPPoE Control Message Priority</td><td>Operators may configure the AP/BHM to utilize the high priority channel for PPPoE control messages. Configuring the AP/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 AP/BHM.</td></tr>
<tr><td>MPLS Traffic Class (TC) 0 through MPLS Traffic Class (TC) 7</td><td>The Multi-Protocol Label Switching (MPLS) protocol is used to route traffic based on the priority setting configured each MPLS Traffic Class.
MPLS Traffic Class (TC) 0 through MPLS Traffic Class (TC) 7 can be configured with 0 through 7 priority settings.</td></tr>
</table>

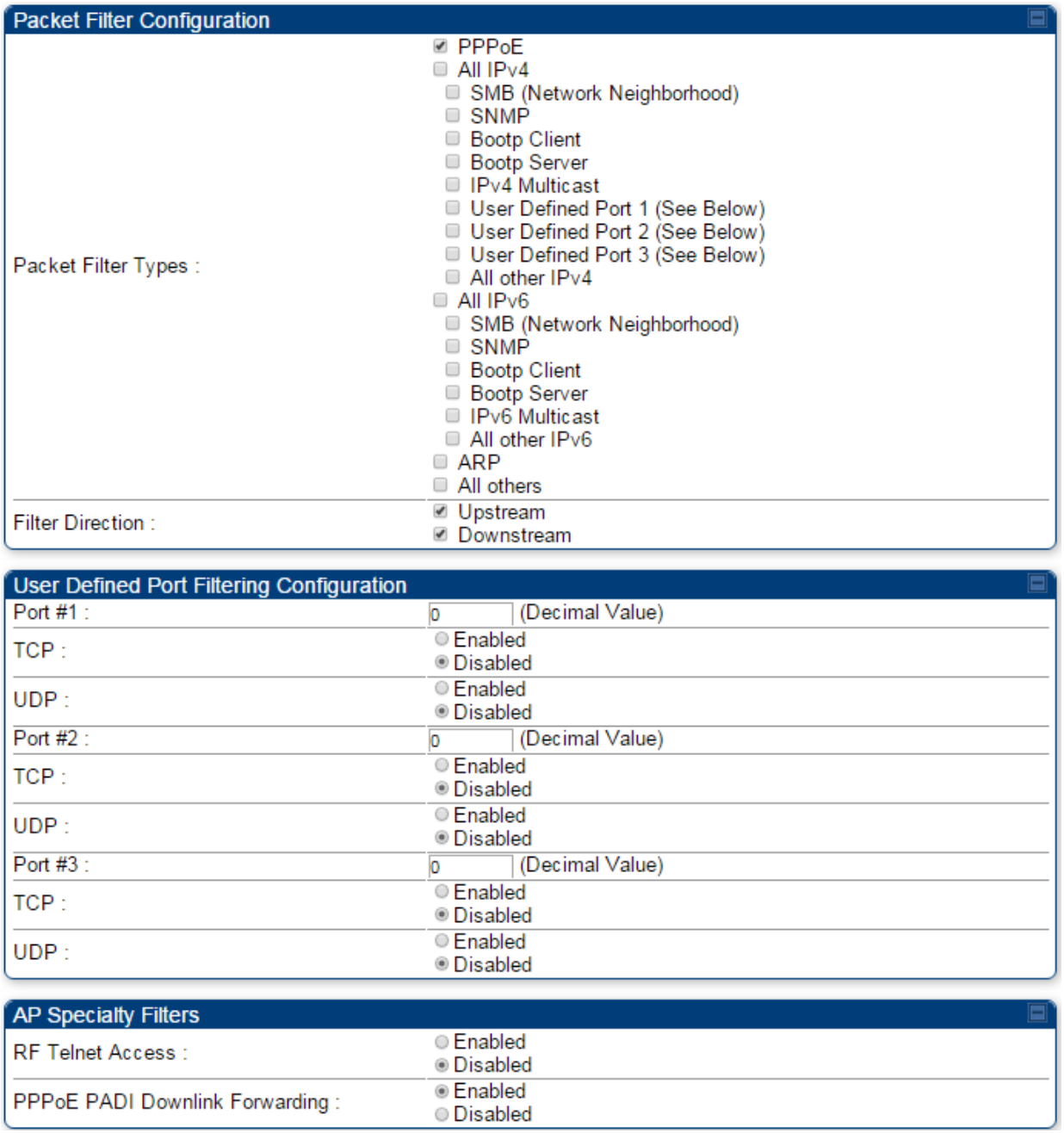
IPv4 and IPv6 Filtering

The operator can filter (block) specified IPv6 protocols including IPv4 and ports from leaving the AP/BHM and SM/BHS and entering the network. This protects the network from both intended and inadvertent packet loading or probing by network users. By keeping the specified protocols or ports off the network, this feature also provides a level of protection to users from each other.

Configuring IPv4 and IPv6 Filtering

IPv6 filters are set using the Protocol Filtering tab on the AP/BHM and SM/BHS (at **Configuration > Protocol Filtering**). Once a filter is set for a packet type, those packets will not be sent over the RF interface depending on “Filter Direction” setting.

Table 133 Packet Filter Configuration attributes



Attribute	Meaning
Packet Filter Types	For any box selected, the Protocol and Port Filtering feature blocks the associated protocol type. To filter packets in any of the user-defined ports, you must do all of the following: • Check the box for **User Defined Port *n* (See Below)** in the **Packet Filter Types** section of this tab. • Provide a port number at **Port #*n*.** in the **User Defined Port Filtering** Configuration section of this tab

	• Enable **TCP** and/or **UDP** by clicking the associated radio button
Filter Direction	Operators may choose to filter upstream (uplink) RF packets or downstream (downlink) RF packets.
User Defined Port Filtering Configuration	You can specify ports for which to block subscriber access, regardless of whether NAT is enabled.

Upgrading the software version and using CNUT

This section consists of the following procedures:

Caution

If the link is operational, ensure that the remote end of the link is upgraded first using the wireless connection, and then the local end can be upgraded. Otherwise, the remote end may not be accessible.

Use CNUT 4.11.2 or later version and always refer to the software release notes before upgrading system software. The release notes are available at:

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

https://support.cambiumnetworks.com/files/ptp450

Checking the installed software version

To check the installed software version, follow these instructions:

Procedure 18 Checking the installed software version

1. Click on **General** tab under **Home** menu.
2. Note the installed Software Version (under Device Information):

   PMP/PTP 450/450i/450m

Software Version :	CANOPY 15.0.1 AP-None

3. Go to the support website (see Contacting Cambium Networks on page 1) and find Point-to-Multipoint software updates. Check that the latest 450 Platform Family software version is the same as the installed Software Version.
4. To upgrade software to the latest version, see Upgrading to a new software version on page 7-67.

Upgrading to a new software version

All 450 platform modules are upgraded using the Canopy Network Updater Tool. The Canopy Network Updater Tool (CNUT) manages and automates the software upgrade process for a Canopy radio, or CMM4 (but not its 14-port switch) across the network. This eliminates the need for an administrator to visit each radio in the network (or each AP/BHM while using the Auto update feature) to upgrade the modules.

Note

Please ensure that you have the most up-to-date version of CNUT by browsing to the Customer Support Web Page located: https://www.cambiumnetworks.com/products/software-tools/cambium-network-updater-tool/

This section includes an example of updating a single unit before deployment. System-wide upgrading procedures may be found in the *CNUT Online Help* manual, which can be found on the Cambium support website (see Contacting Cambium Networks on page 1).

CNUT functions

The Canopy Network Updater tool has the following functions:

- Automatically discovers all network elements
- Executes a UDP command that initiates and terminates the Auto-update mode within APs/BHMs. This command is both secure and convenient:
  - For security, the AP/BHM accepts this command from only the IP address that you specify in the Configuration page of the AP/BHM.
  - For convenience, Network Updater automatically sets this Configuration parameter in the APs/BHMs to the IP address of the Network Updater server when the server performs any of the update commands.
- CNUT supports HTTP and HTTPS
- Allows you to choose the following among updating:
  - Your entire network.
  - Only elements that you select.
  - Only network branches that you select.
- Provides a Script Engine that you can use with any script that:
  - You define.
  - Cambium supplies.
- Configurability of any of the following to be the file server for image files:
  - The AP/BHM, for traditional file serving via UDP commands and monitoring via UDP messaging
  - CNUT HTTP/HTTPS Server, for upgrading via SNMP commands and monitoring via SNMP messaging. This also supports an option to either set the image order specifically for this file server or to allow the AP to determine the order.
  - Local TFTP Server, for traditional file serving via UDP commands and monitoring via UDP messaging. This supports setting the number of simultaneous image transfers per AP/BHM
- The capability to launch a test of connectivity and operational status of the local HTTP, HTTPS and TFTP file servers
- An interface that supports efficient specification of the proper IP address for the local file server(s) where Network Updater resides on a multi-homed computer
- An md5 checksum calculator utility for identifying corruption of downloaded image files before Network Updater is set to apply them.

Network element groups

With the Canopy Network Updater Tool, you can identify element groups composed of network elements that you select. Identifying these element groups does the following:

- Organizes the display of elements (for example, by region or by AP/BHM cluster).
- Allows to:
  - Perform an operation on all elements in the group simultaneously.
  - Set group-level defaults for ftp password access and SNMP Community String (defaults that can be overridden in an individual element when necessary).

Network layers

A typical network contains multiple layers of elements, with each layer farther from the Point of Presence. For example, SMs (or BHS) are behind an AP/BHM and thus, in this context, at a lower layer than the AP/BHM. Correctly portraying these layers in Network Updater is essential so that Network Updater can perform radio and AP/BHM cluster upgrades in an appropriate order.

Script engine

Script Engine is the capability in Network Updater that executes any user-defined script against any network element or element group. This capability is useful for network management, especially for scripts that you repetitively execute across your network.

The Autodiscovery capability in Network Updater finds all of your network elements. This comprehensive discovery:

- Ensures that, when you intend to execute a script against *all* elements, the script is indeed executed against *all* elements.
- Maintains master lists of elements (element groups) against which you selectively execute scripts.

The following scripts are included with CNUT:

- Gather Customer Support Information
- Set Access Point Authentication Mode
- Set Autoupdate Address on APs/BHMs
- Set SNMP Accessibility
- Reset Unit

Software dependencies for CNUT

CNUT functionality requires

- one of the following operating systems
  - Windows® 2000
  - Windows Server 2003
  - Windows 7 and Windows 8
  - Windows XP or XP Professional
  - Red Hat Enterprise Linux (32-bit) Version 4 or 5
- Java™ Runtime Version 2.0 or later (installed by the CNUT installation tool)

CNUT download

CNUT can be downloaded together with each system release that supports CNUT. Software for these system releases is available from https://www.cambiumnetworks.com/products/software-tools/cambium-network-updater-tool/http://www.cambiumnetworks.com/support/management-tools/cnut/, as either:

- A `.zip` file for use without the CNUT application.
- A `.pkg` file that the CNUT application can open.

Upgrading a module prior to deployment

To upgrade to a new software version, follow this:

Procedure 19 Upgrading a module prior to deployment

1. Go to the support website (see Contacting Cambium Networks on page 1) and find Point-to-Multipoint software updates. Download and save the required software image.
2. Start CNUT
3. If you don't start up with a blank new network file in CNUT, then open a new network file with the **New Network Archive** operation (located at **File > New Network**).
4. Enter a new network element to the empty network tree using the **Add Elements to Network Root** operation (located at **Edit > Add Elements to Network Root**).
5. In the **Add Elements** dialogue, select a type of **Access Point** or **Subscriber Module** and enter the IP address of **169.254.1.1**.
6. Make sure that the proper Installation Package is active with the **Package Manager** dialogue (located at **Update > Manage Packages**).
7. To verify connectivity with the radio, perform a **Refresh, Discover Entire Network** operation (located at **View > Refresh/Discover Entire Network**). You must see the details columns for the new element filled in with ESN and software version information.
8. Initiate the upgrade of the radio using **Update Entire Network Root** operation (located at **Update > Update Entire Network Root**). When this operation finishes, the radio is done being upgraded.

General configuration

The **Configuration > General** page of the AP/BMH or BHM/BHS contains many of the configurable parameters that define how the ratios operate in sector or backhaul.

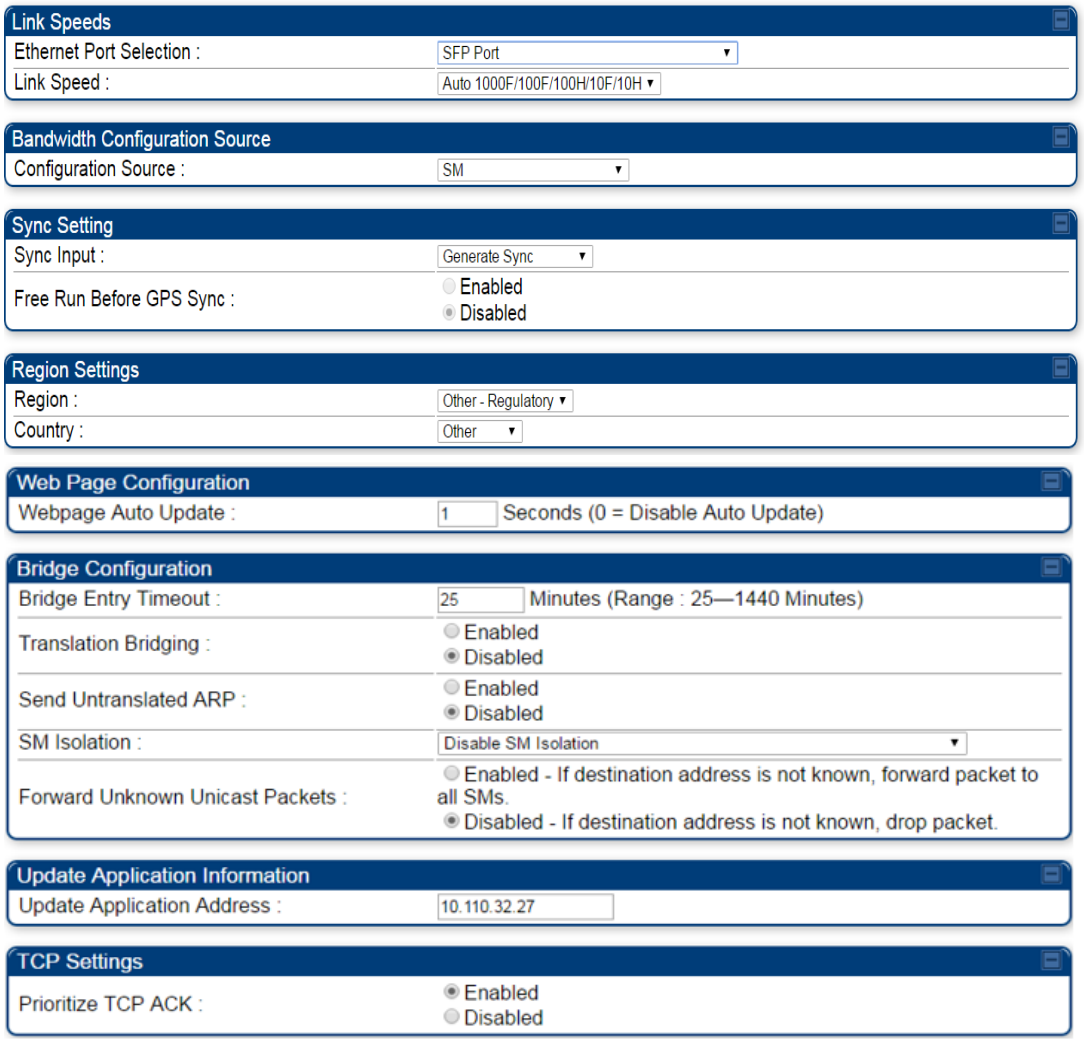
Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

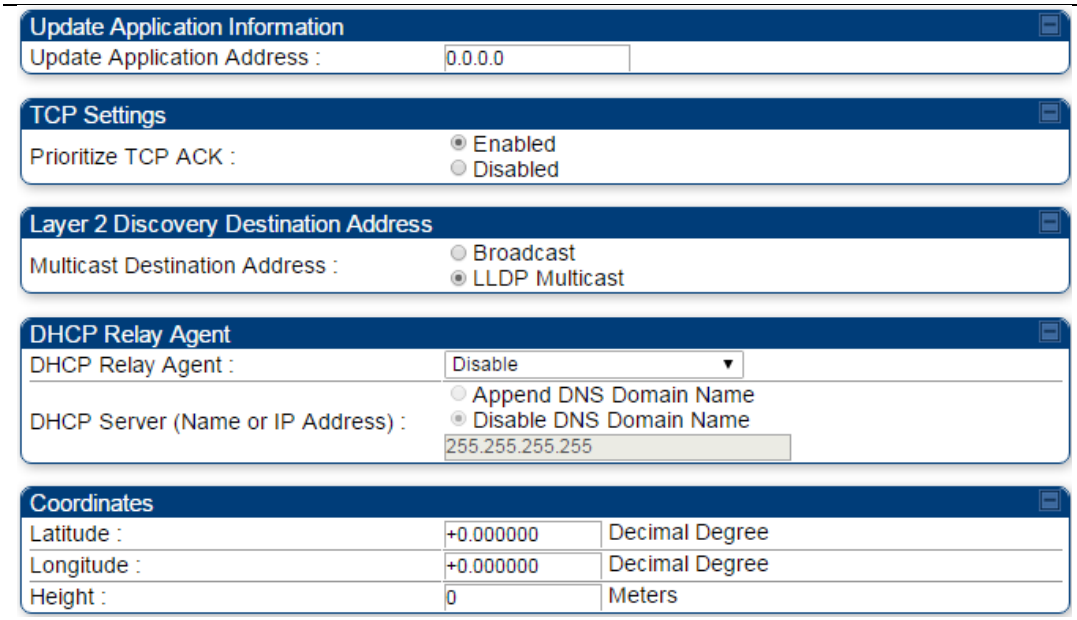
PMP 450m and PMP/PTP 450i Series

General page - PMP 450i AP

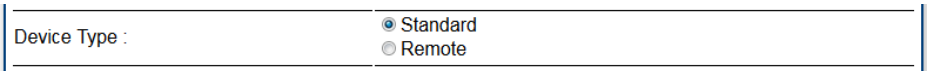
The General page of AP is explained in Table 134.

Table 134 General page attributes – PMP 450i AP





Attribute	Meaning
Ethernet Port Selection	Ethernet Port selection is applicable to the 450m platform only with two choices in the drop-down list: • Main: A selection of main indicates that link connectivity and power to the 450m is provided through the RF45 connection on the Main port of the AP • SFP: A selection of SFP indicates that link connectivity will be provided through the SFP port on the 450m Power continues to be provided via the RJ45 Main port
Link Speeds	From the drop-down list of options, select the type of link speed for the Ethernet connection. The Auto settings allow the two ends of the link to automatically negotiate with each other the best possible speed, and check whether the Ethernet traffic is full duplex or half duplex. However, some Ethernet links work best when either: • both ends are set to the same forced selection • both ends are set to auto-negotiate and both have capability in least one common speed and traffic type combination.
802.3at Type 2 PoE Status and PoE Classification (PMP 450i Series only)	When the PoE Classification functionality is enabled and if Type 2 power is not present, the PAs do not power up and draw too much power. By default, the PoE Classification feature is disabled and the PAs will power up regardless of the classification presented by the power source. This is supported only on 450i series devices. PoE Classification configuration status also can be check under home > General > Device Information tab: 802.3at Type 2 PoE Status : Not Present (Ignored)
Configuration Source	See Setting the Configuration Source on page 7-237.

Sync Input	See Configuring synchronization on page 7-100
Device Type	**Standard**: The Autosync mechanism will source GPS synchronization from the AP's RJ-11 port, the AP's power port, or from the device on-board GPS module. **Remote**: The Autosync mechanism will source GPS synchronization from the AP's RJ-11 port or from the device on-board GPS module. 
Region	From the drop-down list, select the region in which the radio is operating.
Country	From the drop-down list, select the country in which the radio is operating. Unlike selections in other parameters, your **Country** selection requires a **Save Changes** and a **Reboot** cycle before it will force the context-sensitive GUI to display related options (for example, **Alternate Frequency Carrier *1 and 2*** in the **Configuration** > **Radio** tab). PMP 450i Series ODUs shipped to the United States is locked to a Region Code setting of "United States". Units shipped to regions other than the United States must be configured with the corresponding Region Code to comply with local regulatory requirements. Country Code settings affect the radios in the following ways: • Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain) • DFS operation is enabled based on the configured region code, if applicable For more information on how transmit power limiting and DFS is implemented for each country, see the *PMP 450 Planning Guide*.
Webpage Auto Update	Enter the frequency (in seconds) for the web browser to automatically refresh the web-based interface. The default setting is 0. The 0 setting causes the web-based interface to never be automatically refreshed.
Bridge Entry Timeout	Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. The Bridge Entry Timeout must be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network. **Caution** An inappropriately low Bridge Entry Timeout setting may lead to temporary loss of communication with some end users.
Translation Bridging	Optionally, you can configure the AP to change the source MAC address in every packet it receives from its SMs to the MAC address of the SM that bridged the packet, before forwarding the packet toward the public network. If you do, then:

	Not more than 128 IP devices at any time are valid to send data to the AP from behind the SM. SM populates the Translation Table tab of its Statistics web page, displaying the MAC address and IP address of all the valid connected devices. Each entry in the Translation Table is associated with the number of minutes that have elapsed since the last packet transfer between the connected device and the SM. If 128 are connected and another attempts to connect: If no Translation Table entry is older than 255 minutes, the attempt is ignored. If an entry is older than 255 minutes, the oldest entry is removed and the attempt is successful. The Send Untranslated ARP parameter in the General tab of the Configuration page can be: Disabled, so that the AP overwrites the MAC address in Address Resolution Protocol (ARP) packets before forwarding them. Enabled, so that the AP forwards ARP packets regardless of whether it has overwritten the MAC address. When this feature is disabled, the setting of the **Send Untranslated ARP** parameter has no effect, because all packets are forwarded untranslated (with the source MAC address intact).
Send Untranslated ARP	If the **Translation Bridging** parameter is set to **Enabled**, then the **Send Untranslated ARP** parameter can be: **Disabled -** so that the AP will overwrite the MAC address in Address Resolution Protocol (ARP) packets before forwarding them. **Enabled -** so that the AP will forward ARP packets regardless of whether it has overwritten the MAC address. If the **Translation Bridging** parameter is set to **Disabled**, then the **Send Untranslated ARP** parameter has no effect.
SM Isolation	Prevent or allow SM-to-SM communication by selecting from the following drop-down menu items: **Disable SM Isolation** (the default selection). This allows full communication between SMs. **Block SM Packets from being forwarded -** This prevents both multicast/broadcast and unicast SM-to-SM communication. **Block and Forward SM Packets to Backbone -** This not only prevents multicast/broadcast and unicast SM-to-SM communication but also sends the packets, which otherwise are handled SM to SM, through the Ethernet port of the AP.

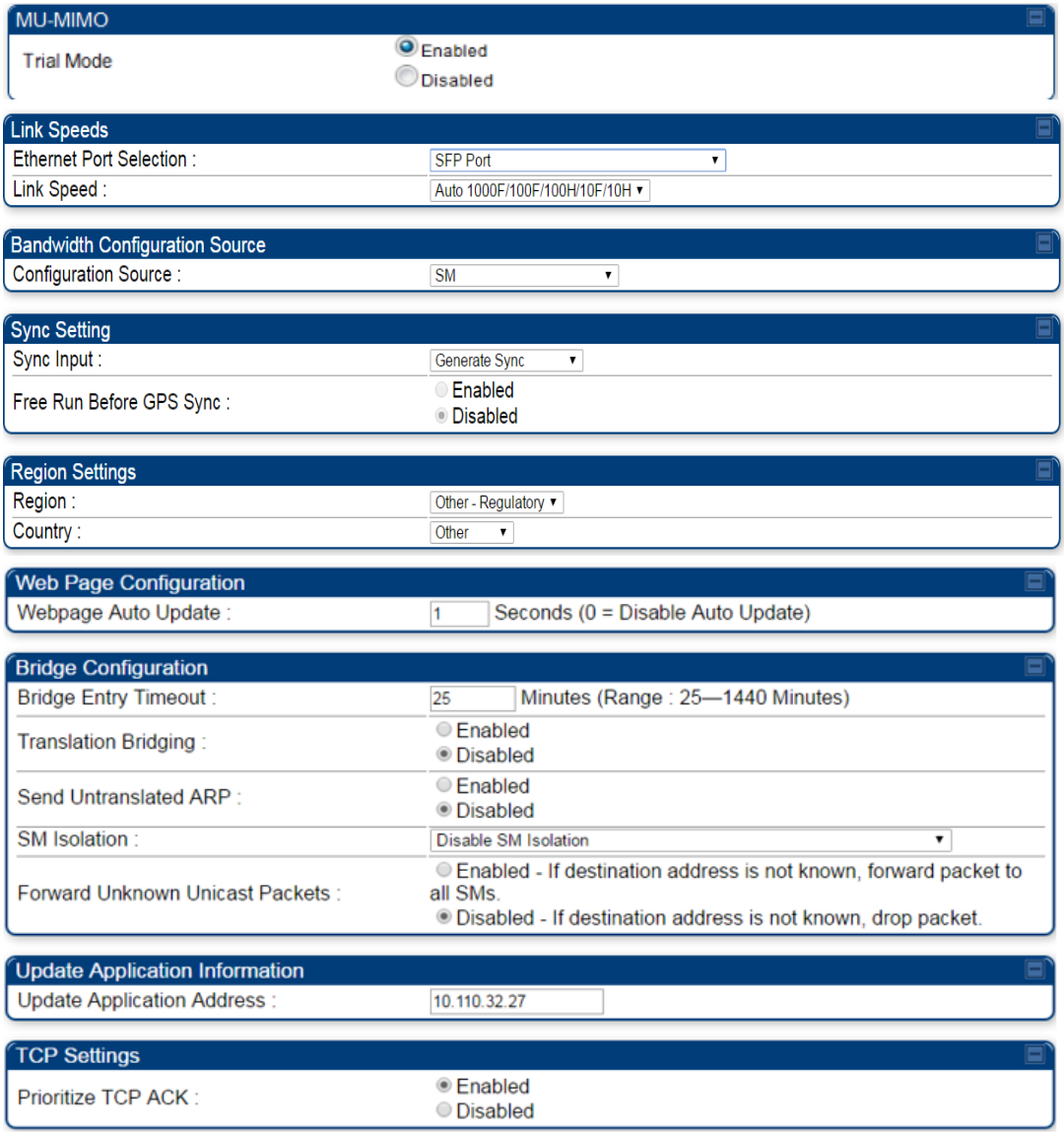
Forward Unknown Unicast Packets	**Enabled**: All unknown Unicast packets (no entry in the AP's bridge table) received via the AP's Ethernet LAN interface are forwarded to registered SMs. If the target device is situated beneath a particular SM, when the device responds the SM and AP will learn and add the device to their bridge tables so that subsequent packets to that device is bridged to the proper SM. **Disabled**: All unknown Unicast packets (no entry in the AP's bridge table) received via the AP's Ethernet LAN interface are discarded at the AP.
Update Application Address	Enter the address of the server to access for software updates on this AP and registered SMs.
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 set this parameter to **Disable**.
Multicast Destination Address	Using Link Layer Discovery Protocol (LLDP), a module exchanges multicast addresses with the device to which it is wired on the Ethernet interface. Although some switches (CMM4, for example) do not pass LLDP addresses upward in the network, a radio can pass it as the value of the **Multicast Destination Address** parameter value in the connected device that has it populated.
DHCP Relay Agent	The AP may act as a DHCP relay for SMs and CPEs underneath it. The AP will make use of the DHCP Option 82 (DHCP Relay Agent Information) from RFC 3046 when performing relay functions. The AP offers two types of DHCP relay functionality: **Full Relay Information -** Configuring the DHCP Full Relay Operation will take broadcast DHCP packets and send them to a Unicast server in unicast mode. This way the DHCP requests and replies can be routed like any other UDP packet. **Only Insert Option 82 -** This option leaves the DHCP request on its broadcast domain as opposed to DHCP Full Relay Operation which will turn it into a unicast packet. In order to accommodate setting up pools or classes for different VLANs, the Option 82 field will include information to tell the server what VLAN the client is on.
DHCP Server (Name or IP Address)	The DHCP relay server may be either a DNS name or a static IP address in dotted decimal notation. Additionally, the management DNS domain name may be toggled such that the name of the DHCP relay server only needs to be specified and the DNS domain name is automatically appended to that name. The default DHCP relay server addresses are 255.255.255.255 with the appending of the DNS domain name disabled.

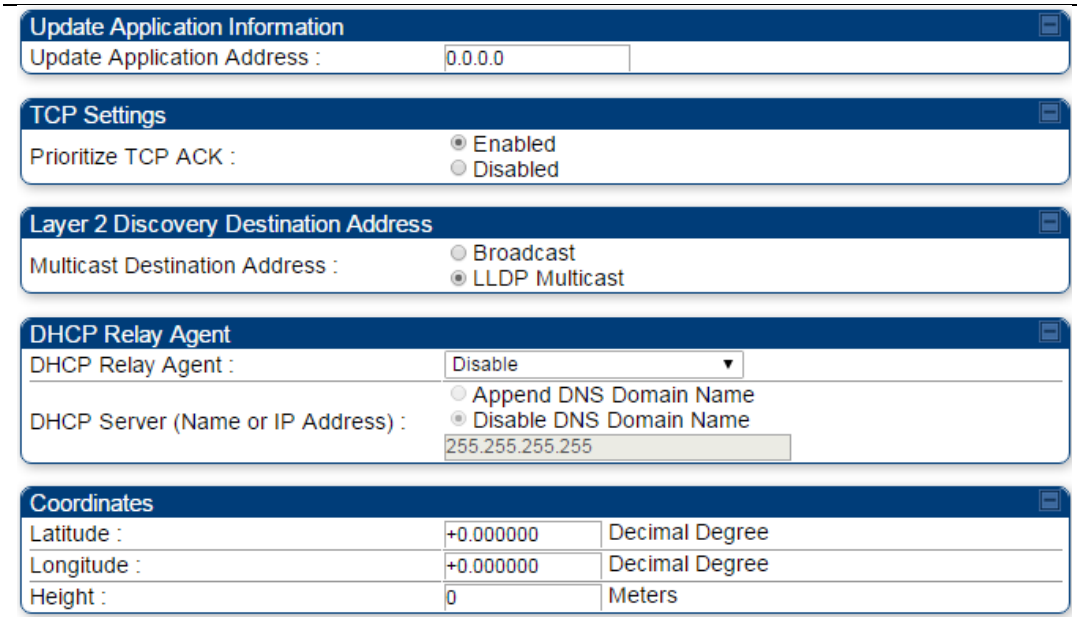
Latitude Longitude Height	Physical radio location data may be configured via the **Latitude**, **Longitude** and **Height** fields. Latitude and Longitude is measured in *Decimal Degree* while the Height is calculated in *Meters.*

General page - PMP 450m AP

The General page of AP is explained in Table 135.

Table 135 General page attributes –PMP 450m AP





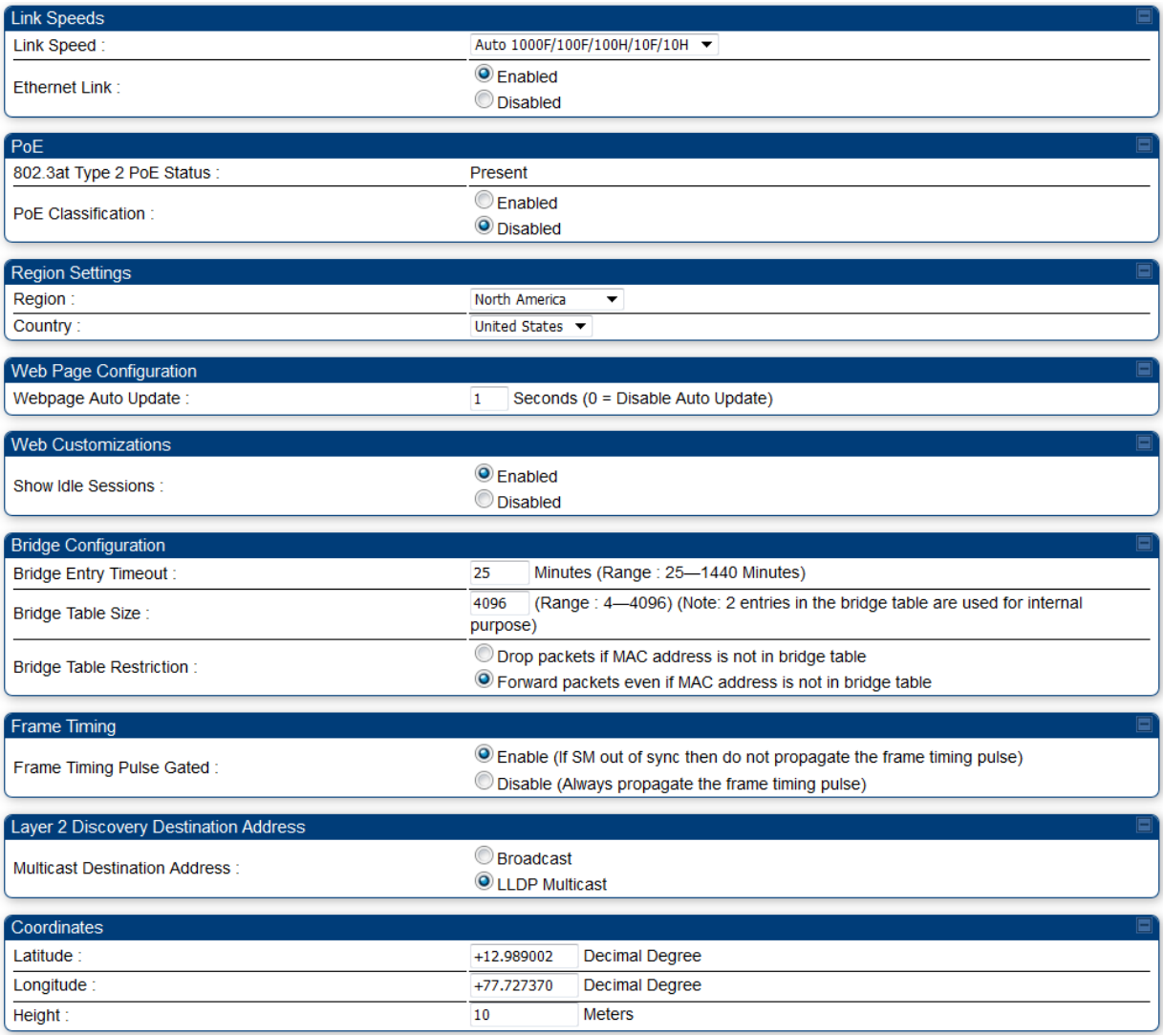
Attribute	Meaning
Trial Mode	This parameter allows to enable or disable Trial mode for radios with a Limited key. Once the trial key is applied, the 30-day trial can be enabled or disabled at any time.

For information about remaining attributes, refer Table 134.

General page - PMP 450i SM

The General page of PMP 450i SM is explained in Table 136. The General page of PMP 450 SM looks the same as PMP 450i SM.

Table 136 General page attributes – PMP 450i SM



Attribute	Meaning
Link Speeds	From the drop-down list of options, select the type of link speed for the Ethernet connection. The default for this parameter is that all speeds are selected. The recommended setting is a single speed selection for all APs and SMs in the operator network.
802.3at Type 2 PoE Status and PoE Classification	When the PoE Classification functionality is enabled and if Type 2 power is not present, the Pas do not power up and draw too much power. By default, the PoE Classification feature is disabled and the Pas will power up regardless of the classification presented by the power source. This is supported only on 450i series ODUs. PoE Classification configuration status also can be check under home > General > Device Information tab:

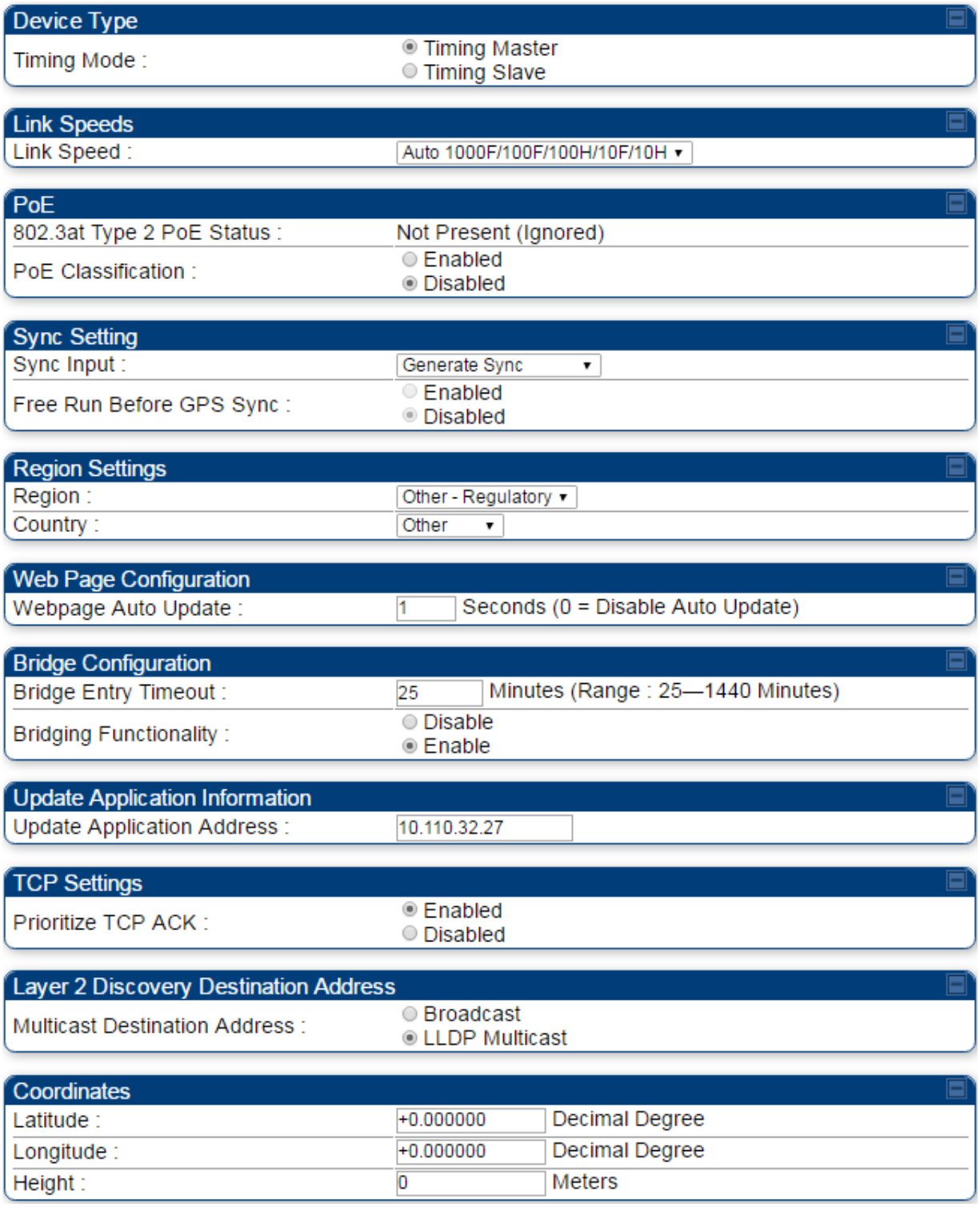
	802.3at Type 2 PoE Status : Not Present (Ignored)
Ethernet Link Enable/Disable	Specify whether to enable or disable Ethernet/802.3 connectivity on the wired port of the SM. This parameter has no effect on the wireless link. When you select **Enable**, this feature allows traffic on the Ethernet/802.3 port. This is the factory default state of the port. When you select **Disable**, this feature prevents traffic on the port. Typical cases of when you may want to select **Disable** include: The subscriber is delinquent with payment(s). You suspect that the subscriber is sending or flooding undesired broadcast packets into the network, such as when • a virus is present in the subscriber's computing device. • the subscriber's home router is improperly configured.
Region	This parameter allows you to set the region in which the radio will operate. The SM radio automatically inherits the Region type of the master. This behavior ignores the value of the **Region** parameter in the SM, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region.
Country	This parameter allows you to set the country in which the radio will operate. The SM radio automatically inherits the Country Code type of the master. This behavior ignores the value of the **Country** parameter in the SM, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region. PMP/PTP 450i Series ODU shipped to the United States is locked to a Region Code setting of "United States". Units shipped to regions other than the United States must be configured with the corresponding Region Code to comply with local regulatory requirements.
Webpage Auto Update	See Table 134 General page attributes – PMP 450i AP on page 7-71
Show Idle Sessions	This parameter allows to enable or disable displaying idle sessions.
Bridge Entry Timeout	Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. Timeout occurs when the AP encounters no activity with the SM (whose MAC address is the bridge entry) within the interval that this parameter specifies. The Bridge Entry Timeout must be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

	Caution This parameter governs the timeout interval, even if a router in the system has a longer timeout interval. The default value of this field is *25* (minutes). An inappropriately low Bridge Entry Timeout setting may lead to temporary loss of communication with some end users.
Bridge Table Size	This parameter allows to restrict devices to connect to the SM. It is configurable from 4 to 4096. **Note** Configure **Bridge Table Restriction parameter** to **Drop packets if MAC address is not in bridge table** option to restrict the number of devices configured from connecting to SM.
Bridge Table Restriction	This parameter allows to either allow or restrict devices to connect to SM using the following options: • Drop packets if MAC address is not in bridge table: Select this option to restrict communication from devices not listed in bridge table. • Forward packets even if MAC address is not in bridge table: Select this option to allow communication from any device.
Frame Timing Pulse Gated	If this SM extends the sync pulse to a BH master or an AP, select either **Enable**—If this SM loses sync from the AP, then *do not* propagate a sync pulse to the BH timing master or another AP. This setting prevents interference in the event that the SM loses sync. **Disable**—If this SM loses sync from the AP, then propagate the sync pulse to the BH timing master or another AP.
Multicast Destination Address	Using Link Layer Discovery Protocol (LLDP), a module exchanges multicast addresses with the device to which it is wired on the Ethernet interface. Although some switches (CMM4, for example) do not pass LLDP addresses upward in the network, a radio can pass it as the value of the **Multicast Destination Address** parameter value in the connected device that has it populated.
Coordinates	Physical radio location data may be configured via the **Latitude**, **Longitude** and **Height** fields.

General page - PTP 450i BHM

The General page of BHM is explained in Table 137. The General page of PTP 450 BHM looks the same as PTP 450i BHM.

Table 137 General page attributes – PTP 450i BHM



Attribute	Meaning
Timing Mode	Allows the user to choose the mode between Timing Master and Timing Slave.
Link Speed	See Table 134 General page attributes – PMP 450i AP on page 7-71
802.3at Type 2 PoE Status and PoE Classification	When the PoE Classification functionality is enabled and if Type 2 power is not present, the PAs do not power up and draw too much power. By default, the PoE Classification feature is disabled and the PAs will power up regardless of the classification presented by the power source. This is supported only on 450i Series ODUs. PoE Classification configuration status also can be check under home > General > Device Information tab: 802.3at Type 2 PoE Status : Not Present (Ignored)
Sync Input	See Configuring synchronization on page 7-100
Region Country Webpage Auto Update Bridge Entry Timeout	See Table 134 General page attributes – PMP 450i AP on page 7-71
Bridging Functionality	Select whether you want bridge table filtering active (**Enable**) or not (**Disable**) on this BH. **Disable:** allows user to use redundant BHs without causing network addressing problems. Through a spanning tree protocol, this reduces the convergence time from 25 minutes to few seconds. However, you must disable bridge table filtering as only a deliberate part of your overall network design since disabling it allows unwanted traffic across the wireless interface. **Enable**: Allows user to enable bridge functionality. **Note** Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. The Bridge Entry Timeout must be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.
Prioritize TCP ACK Multicast Destination Address	See Table 134 General page attributes – PMP 450i AP on page 7-71

Latitude
Longitude
Height

General page - PTP 450i BHS

The General page of PTP 450i BHS is explained in Table 138. The General page of PTP 450 BHS looks the same as PTP 450i BHS.

Table 138 General page attributes – PTP 450i BHS

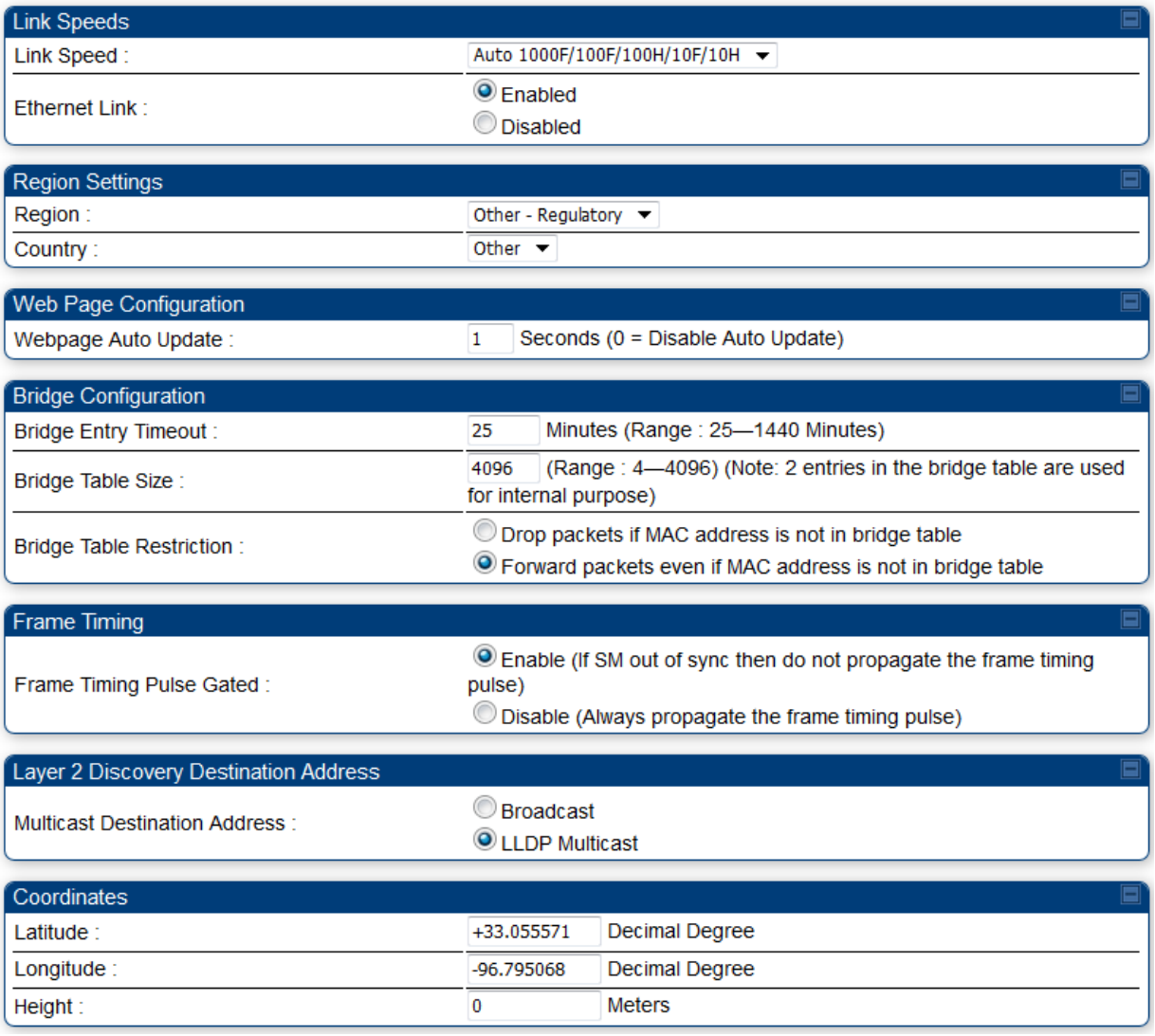
Attribute	Meaning
Timing Mode	Allows the user to choose the mode between Timing Master and Timing Slave.
Link Speed	From the drop-down list of options, select the type of link speed for the Ethernet connection. The default for this parameter is that all speeds are selected. The recommended setting is a single speed selection for all BHMs and BHSs in the operator network.
802.3at Type 2 PoE Status and PoE Classification	When the PoE Classification functionality is enabled and if Type 2 power is not present, the PAs do not power up and draw too much power. By default, the PoE Classification feature is disabled and the PAs will power up regardless of the classification presented by the power source. This is supported only on 450i Series ODUs. PoE Classification configuration status also can be check under home > General > Device Information tab: 802.3at Type 2 PoE Status : Not Present (Ignored)
Region	This parameter allows you to set the region in which the radio will operate. The BHS radio automatically inherits the Region type of the master. This behavior ignores the value of the **Region** parameter in the BHS, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region.
Country	This parameter allows you to set the country in which the radio will operate. The BHS radio automatically inherits the Country Code type of the master. This behavior ignores the value of the **Country** parameter in the BHS, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region. PMP/PTP 450i Series ODU shipped to the United States is locked to a Region Code setting of “United States”. Units shipped to regions other than the United States must be configured with the corresponding Region Code to comply with local regulatory requirements.
Webpage Auto Update	See Table 134 General page attributes – PMP 450i AP on page 7-71
Bridge Entry Timeout	Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. Timeout occurs when the BHM encounters no activity with the BHS (whose MAC address is the bridge entry) within the interval that this parameter specifies. The Bridge Entry Timeout must be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

	Caution This parameter governs the timeout interval, even if a router in the system has a longer timeout interval. The default value of this field is *25* (minutes). An inappropriately low Bridge Entry Timeout setting may lead to temporary loss of communication with some end users.
Bridging Functionality	See Table 134 General page attributes – PMP 450i AP on page 7-71
Frame Timing Pulse Gated	If this BHS extends the sync pulse to a BH master or an BHM, select either **Enable**—If this BHS loses sync from the BHM, then *do not* propagate a sync pulse to the BH timing master or other BHM. This setting prevents interference in the event that the BHS loses sync. **Disable**—If this BHS loses sync from the BHM, then propagate the sync pulse to the BH timing master or other BHM.
Multicast Destination Address	See Table 134 General page attributes – PMP 450i AP on page 7-71
Latitude Longitude Height	See Table 134 General page attributes – PMP 450i AP on page 7-71

General page - PMP 450b SM

The General page of PMP 450b SM is explained in Table 139. The General page of PMP 450b SM looks the same as PMP 450i SM.

Table 139 General page attributes – PMP 450b SM



Attribute	Meaning
Link Speed	From the drop-down list of options, select the type of link speed for the Ethernet connection. The default for this parameter is that all speeds are selected. The recommended setting is a single speed selection for all APs and SMs in the operator network.
Ethernet Link Enabled/Disbaled	Specify whether to enable or disable Ethernet/802.3 connectivity on the wired port of the SM. This parameter has no effect on the wireless link. When you select **Enable**, this feature allows traffic on the Ethernet/802.3 port. This is the factory default state of the port. When you select **Disable**, this feature prevents traffic on the port. Typical cases of when you may want to select **Disable** include: The subscriber is delinquent with payment(s). You suspect that the subscriber is sending or flooding undesired broadcast packets into the network, such as when • a virus is present in the subscriber's computing device. • the subscriber's home router is improperly configured.
Region	This parameter allows you to set the region in which the radio will operate. The SM radio automatically inherits the Region type of the master. This behavior ignores the value of the **Region** parameter in the SM, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region.
Country	This parameter allows you to set the country in which the radio will operate. The SM radio automatically inherits the Country Code type of the master. This behavior ignores the value of the **Country** parameter in the SM, even when the value is **None**. Nevertheless, since future system software releases may read the value in order to configure some other region-sensitive feature(s), this parameter must be always set to the value that corresponds to the local region. PMP/PTP 450i Series ODU shipped to the United States is locked to a Region Code setting of "United States". Units shipped to regions other than the United States must be configured with the corresponding Region Code to comply with local regulatory requirements.
Webpage Auto Update	Enter the frequency (in seconds) for the web browser to automatically refresh the web-based interface. The default setting is 0. The 0 setting causes the web-based interface to never be automatically refreshed.

Bridge Entry Timeout	Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. Timeout occurs when the AP encounters no activity with the SM (whose MAC address is the bridge entry) within the interval that this parameter specifies. The Bridge Entry Timeout must be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.  **Caution** This parameter governs the timeout interval, even if a router in the system has a longer timeout interval. The default value of this field is *25* (minutes). An inappropriately low Bridge Entry Timeout setting may lead to temporary loss of communication with some end users.
Bridge Table Size	This parameter allows to restrict devices to connect to the SM. It is configurable from 4 to 4096.  **Note** Configure **Bridge Table Restriction parameter** to **Drop packets if MAC address is not in bridge table** option to restrict the number of devices configured from connecting to SM.
Bridge Table Restriction	This parameter allows to either allow or restrict devices to connect to SM using the following options: • Drop packets if MAC address is not in bridge table: Select this option to restrict communication from devices not listed in bridge table. Forward packets even if MAC address is not in bridge table: Select this option to allow communication from any device.
Frame Timing Pulse Gated	If this SM extends the sync pulse to a BH master or an AP, select either **Enable**—If this SM loses sync from the AP, then *do not* propagate a sync pulse to the BH timing master or another AP. This setting prevents interference in the event that the SM loses sync. **Disable**—If this SM loses sync from the AP, then propagate the sync pulse to the BH timing master or another AP.
Multicast Destination Address	Using Link Layer Discovery Protocol (LLDP), a module exchanges multicast addresses with the device to which it is wired on the Ethernet interface. Although some switches (CMM4, for example) do not pass LLDP addresses upward in the network, a radio can pass it as the value of the **Multicast Destination Address** parameter value in the connected device that has it populated.

Latitude Longitude Height	Physical radio location data may be configured via the **Latitude**, **Longitude** and **Height** fields. Latitude and Longitude is measured in *Decimal Degree* while the Height is calculated in *Meters.*

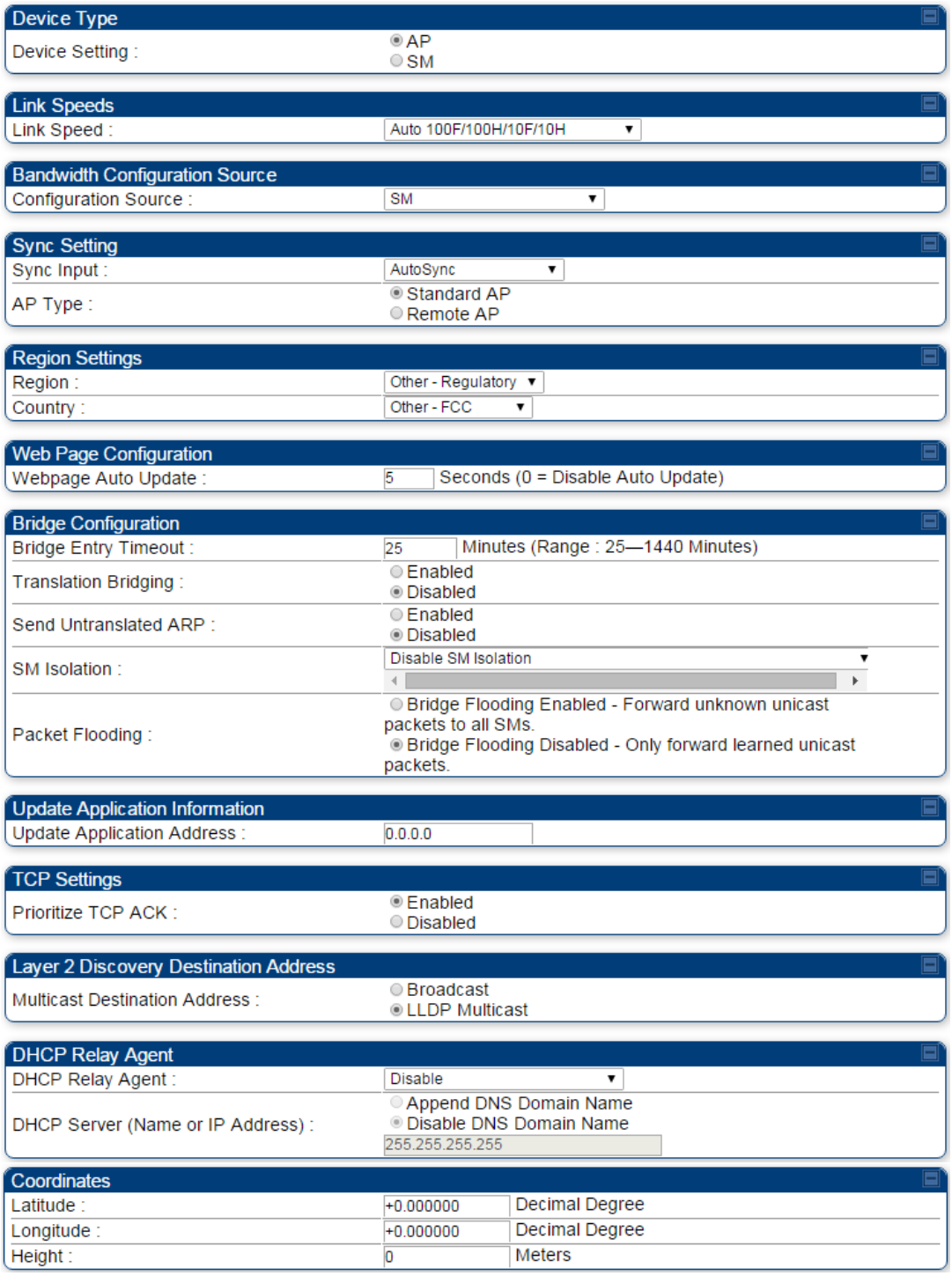
PMP/PTP 450 Series

Note

Refer Table 134 and Table 136 for PMP 450 AP/SM General page parameters details.

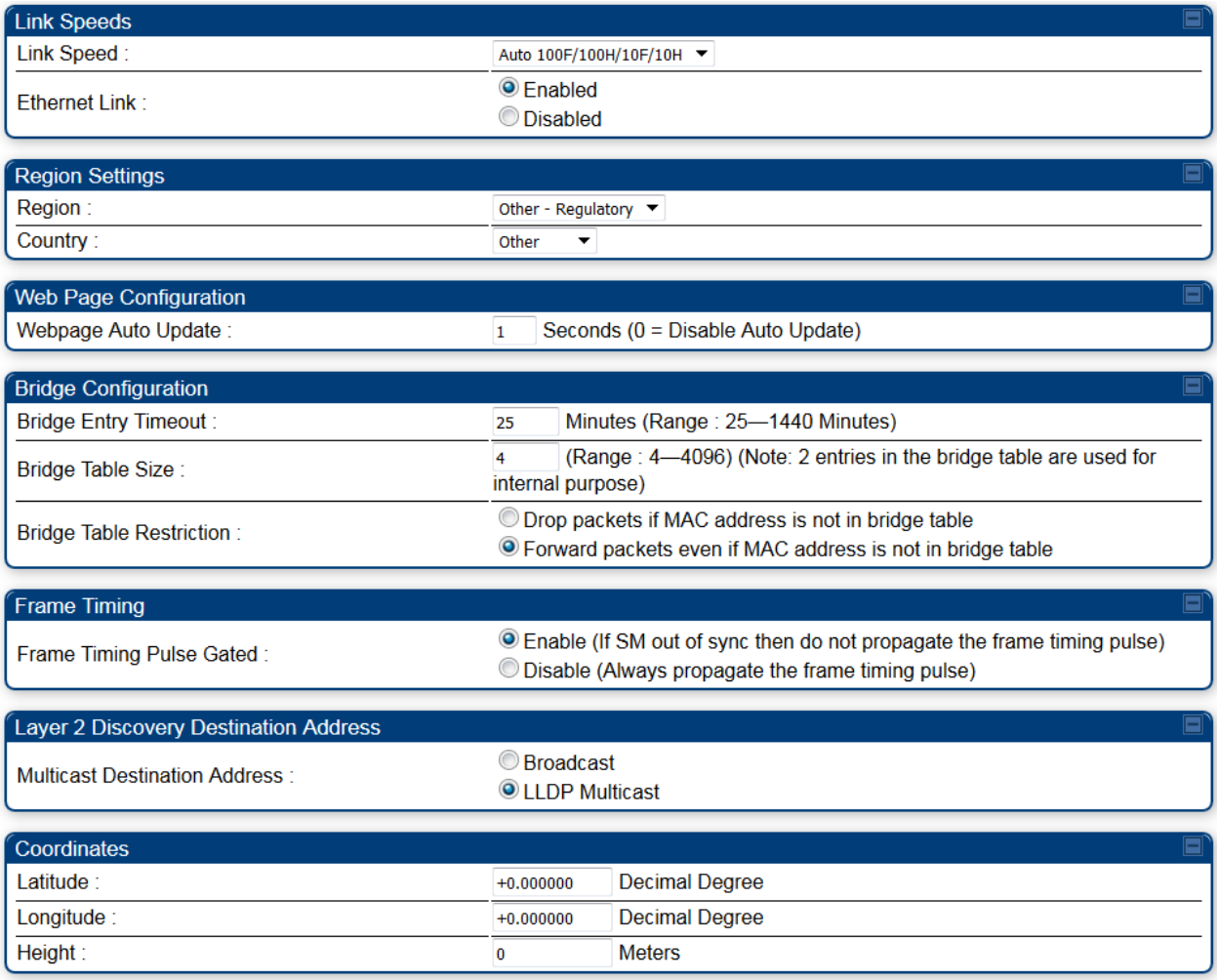
General page - PMP 450 AP

Figure 140 General page attributes - PMP 450 AP



General page - PMP 450 SM

Figure 141 General page attributes - PMP 450 SM

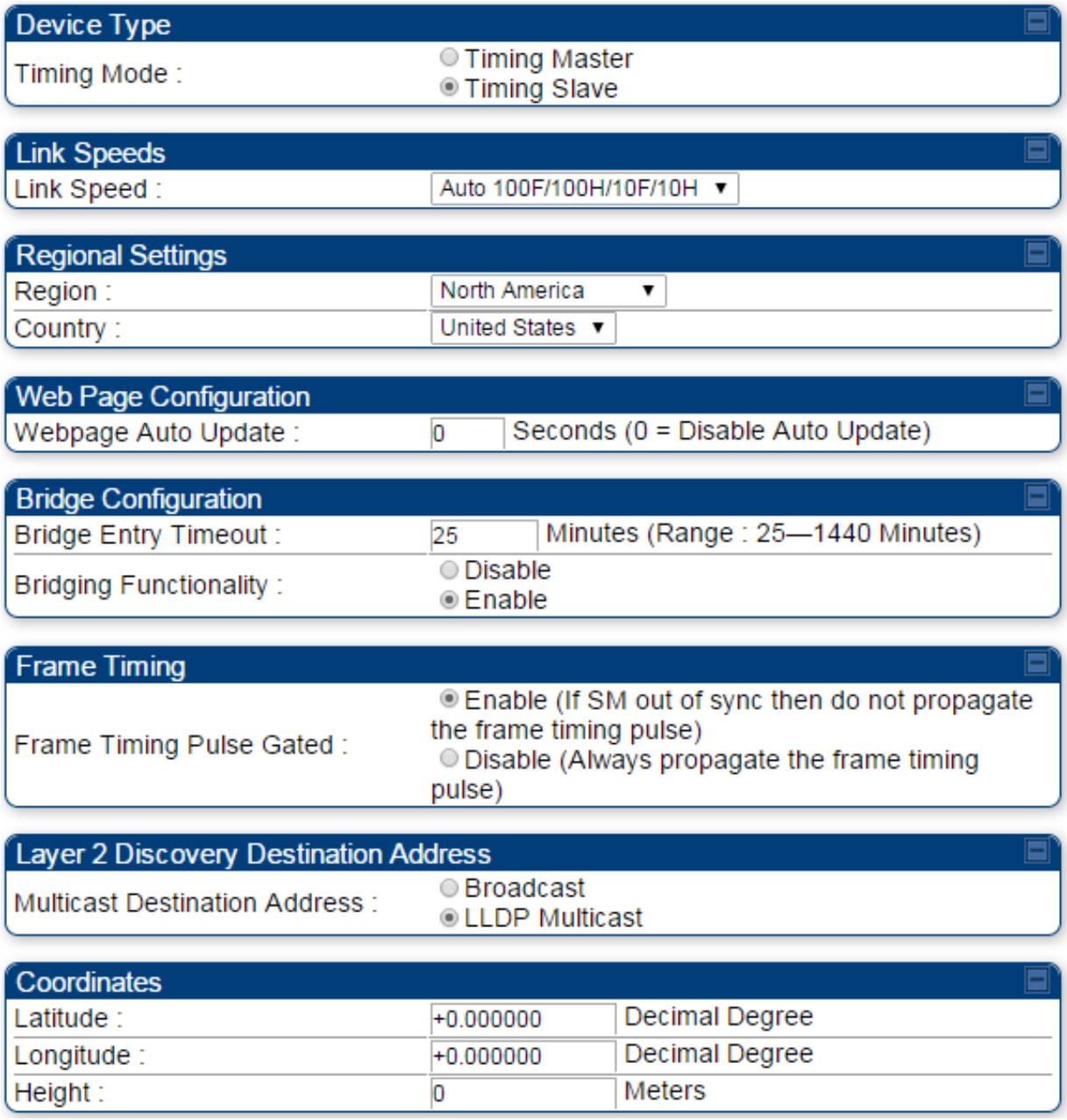


General page – PTP 450 BHM

Figure 142 General page attributes - PTP 450 BHM

General page – PTP 450 BHS

Figure 143 General page attributes - PTP 450 BHS



Configuring Unit Settings page

Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

The **Unit Settings** page of the 450 Platform Family contains following options:

- Unit-Wide Changes
- Download Configuration File
- Upload and Apply Configuration File (for AP and BHM)
- LED Panel Settings (for SM and BHS)

Note

LED Panel setting is applicable for SM and BHS only.

Upload and Apply Configuration File attributes are not supported for SM and BHS.

The 450 Platform Family also supports import and export of configuration from the AP/BHM/SM/BHS as a text file. The configuration file is in JSON format. The logged in user must be an ADMINISTRATOR in order to export or import the configuration file.

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.

The configuration file supports encrypted password. The exported configuration file will contain encrypted password. The import of configuration can have either encrypted or plain text password in Configuration fie. A new tab Encrypt the Password is added under Encrypted Password tab to generate encrypted password for a given password.

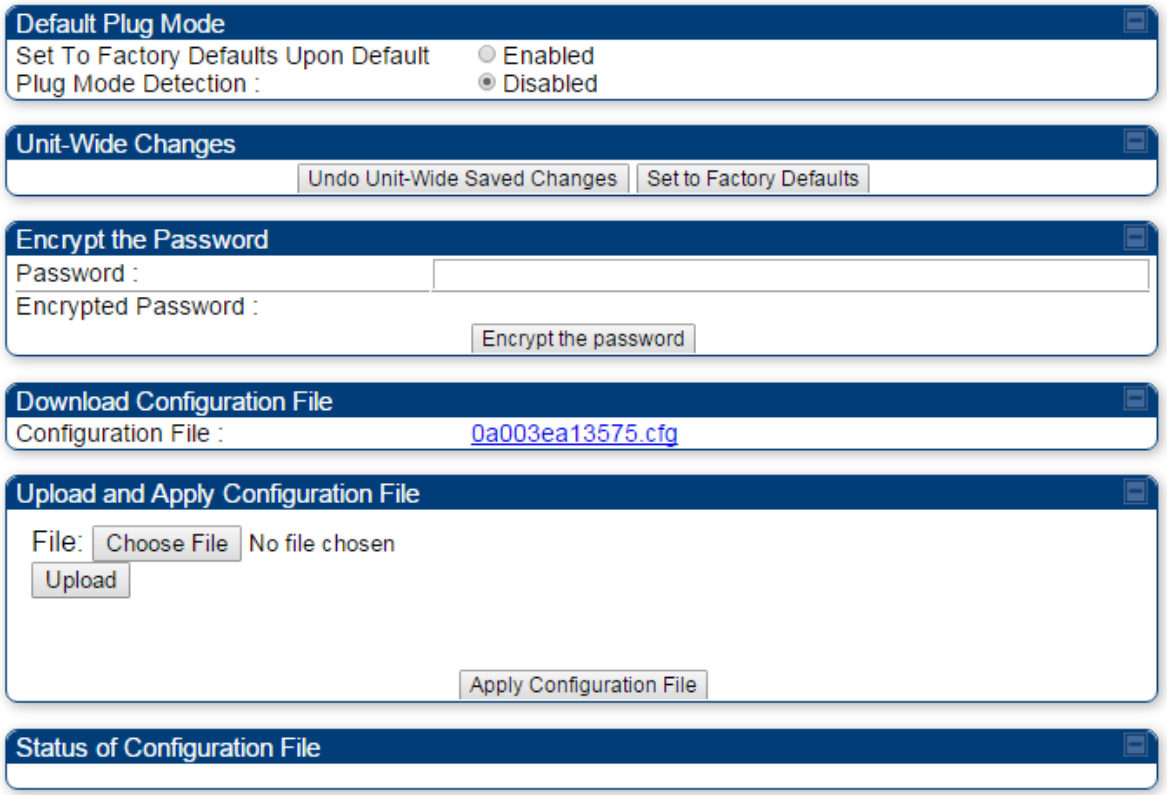
The Import and Export procedure of configuration file is described in Import and Export of config file on page 7-263.

LED Panel Mode has options select Revised mode and Legacy mode. The Legacy mode configures the radio to operate with standard LED behavior.

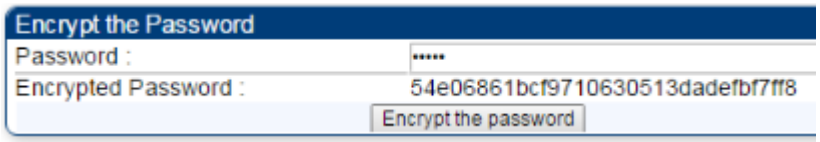
Unit Settings page of 450 Platform Family - AP/BHM

The Unit Setting page of AP/BHM is explained in Table 140.

Table 140 Unit Settings attributes – 450 Platform Family AP/BHM



Attribute	Meaning
Set to Factory Defaults Upon Default Mode Detection	If **Enabled** is checked, then the default mode functions is enabled. When the module is rebooted with Default mode enabled, it can be accessed at the IP address 169.254.1.1 and no password, and all parameter values are reset to defaults. A subscriber, technician, or other person who gains physical access to the module and uses an override *cannot* see or learn the settings that were previously configured in it. If **Disabled** is checked, then the default mode functions are disabled. See Radio recovery mode on page 1-26 **Caution** When **Set to Factory Defaults Upon Default Mode** is set to **Enable**, the radio does not select all of the frequencies for Radio Frequency Scan Selection List. It needs to be selected manually.
Undo Unit-Wide Saved Changes	When you click this button, any changes that you made in any tab but did not commit by a reboot of the module are undone.

Set to Factory Defaults	When you click this button, *all configurable parameters on all tabs* are reset to the factory settings. **Note** This can be reverted by selecting "Undo Unit-Wide Saved Changes", *before* rebooting the radio, though this is not recommended.
Password	This allows to provide encrypted password for a given password. On click of 'Encrypt the password' button, the Encrypted Password field will display encrypted value of entered plain text password in 'Password' field. 
Configuration File	This allows to download the configuration file of the radio. This configuration file contains the complete configuration including all the default values. The configuration file is highlighted as downloadable link and the naming convention is "<mac address of AP>.cfg".
Apply Configuration File	This allows to import and apply configuration to the AP. **Chose File**: Select the file to upload the configuration. The configuration file is named as "<file name>.cfg". **Upload**: Import the configuration to the AP. **Apply Configuration File**: Apply the imported configuration file to the AP. The imported configuration file may either contain a full device configuration or a partial device configuration. If a partial configuration file is imported, only the items contained in the file will be updated, the rest of the device configuration parameters will remain the same. Operators may also include a special flag in the configure file to instruct the device to first revert to factory defaults then to apply the imported configuration.
Status of Configuration file	This section shows the results of the upload.

Unit Settings page of PMP/PTP 450i SM/BHS

The Unit Settings page of PMP/PTP 450i SM/BHS is explained in Table 141.

Table 141 SM Unit Settings attributes

Attribute	Meaning
Set to Factory Defaults Upon Default Plug Detection	See Table 140 Unit Settings attributes – 450 Platform Family AP/BHM on page 7-95
LED Panel Settings	Legacy Mode configures the radio to operate with standard LED behavior.
Undo Unit-Wide Saved Changes	
Password	
Set to Factory Defaults	See Table 140 Unit Settings attributes – 450 Platform Family AP/BHM on page 7-95
Configuration File	
Status of Configuration file	

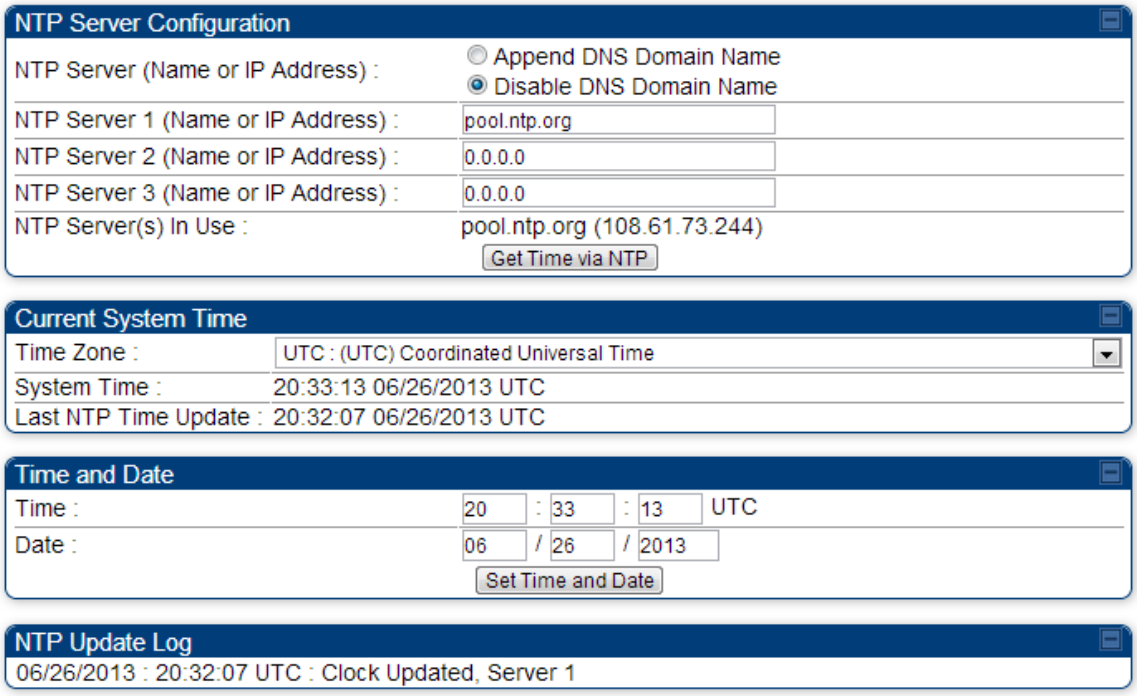
Setting up time and date

Time page of 450 Platform Family - AP/BHM

Applicable products	PMP: ☑ AP	PTP: ☑ BHM

The Time page of 450 Platform Family AP/BHM is explained in Table 142.

Table 142 450 Platform Family - AP/BHM Time attributes



Attribute	Meaning
NTP Server (Name or IP Address)	The management DNS domain name may be toggled such that the name of the NTP server only needs to be specified and the DNS domain name is automatically appended to that name.
NTP Server 1 (Name or IP Address) NTP Server 2 (Name or IP Address) NTP Server 3 (Name or IP Address)	To have each log in the AP/BHM correlated to a meaningful time and date, either a reliable network element must pass time and date to the AP/BHM or must set the time and date whenever a power cycle of the AP/BHM has occurred. A network element passes time and date in any of the following scenarios: • A connected CMM4 passes time and date (GPS time and date, if received). • A connected CMM4 passes the time and date (GPS time and date, if received), but only if both the CMMr is operating on CMMr Release 2.1 or later release. (These releases include NTP server functionality.)

	• A separate NTP server (including APs/BHMs receiving NTP data) is addressable from the AP/BHM. If the AP/BHM needs to obtain time and date from a CMM4, or a separate NTP server, enter the IP address or DNS name of the CMM4 or NTP server on this tab. To force the AP/BHM to obtain time and date before the first (or next) 15-minute interval query of the NTP server, click **Get Time via NTP**. The polling of the NTP servers is done in a sequential fashion, and the polling status of each server is displayed in the NTP Update Log section of the Time Configuration page. An entry of 0.0.0.0 in any of the NTP Server fields indicates an unused server configuration.
NTP Server(s) in Use	Lists the IP addresses of servers used for NTP retrieval.
Time Zone	The Time Zone option may be used to offset the received NTP time to match the operator's local time zone. When set on the AP/BHM, the offset is set for the entire sector SMs (or BHS) are notified of the current Time Zone upon initial registration). If a Time Zone change is applied, the SMs (or BHS) is notified of the change in a best effort fashion, meaning some SMs//BHSs may not pick up the change until the next re-registration. Time Zone changes are noted in the Event Log of the AP/BHM and SM/BHS.
System Time	The current time used by the system.
Last NTP Time Update	The last time that the system time was set via NTP.
Time	This field may be used to manually set the system time of the radio.
Date	This field may be used to manually set the system date of the radio.
NTP Update Log	This field shows NTP clock update log. It includes NTP clock update Date and Time stamp along with server name.

Configuring synchronization

Applicable products	PMP: ☑ AP	PTP: ☑ BHM

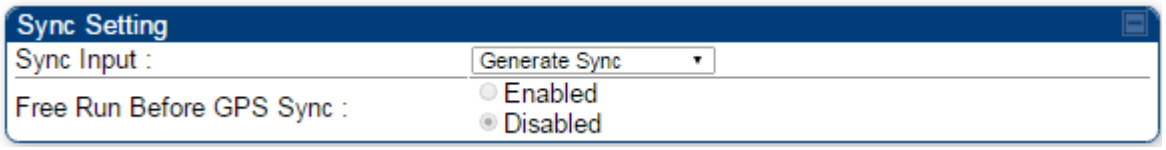
This section describes synchronization options for PMP and PTP configuration.

This **Sync Input** parameter can be configured under Sync Setting tab of **Configure > General** page (see General configuration on page 7-71).

PMP/PTP 450i Series has following synchronization options:

- AutoSync
- AutoSync + Free Run
- Generate Sync
- Free Run Before GPS Sync

Figure 144 Sync Setting configuration



AutoSync

For PTP, the BHM automatically receives sync from one of the following sources:

- GPS Sync over Timing Port (UGPS, co-located AP GPS sync output, or “Remote ” Device feed from a registered SM’s GPS sync output)
- GPS Sync over Power Port (CMM4)

Upon AP/BM power on, the AP/BHM does not transmit until a valid synchronization pulse is received from one of the sources above. If there is a loss of GPS synchronization pulse, within two seconds the AP/BHM automatically attempts to source GPS signaling from another source.

In case of PMP, when there are synchronization sources on both the timing port and the power port, the power port GPS source is chosen first.

If no valid GPS signal is received, the AP/BHM ceases transmission and SM/BHS registration is lost until a valid GPS signal is received again on the AP or BHM.

Note

After an AP reboot, the sync acquisition takes a little longer than it had on 450i (anywhere from 40 seconds to 120 seconds difference).

AutoSync + Free Run

This mode operates similarly to mode “AutoSync”, but if a previously received synchronization signal is lost and no GPS signaling alternative is achieved, the AP/BHM automatically changes to synchronization mode “Generate Sync”. While SM registration ins maintained, in this mode there is no synchronization of APs/BHMs that can “hear” each other; the AP/BHM will only generate a sync signal for the local AP/BHM and its associated SMs/BHS. Once a valid GPS signal is obtained again, the AP/BHM automatically switches to receiving synchronization via the GPS source and SM/BHS registration is maintained.

When the Sync Input field is set to Autosync or Autosync + Free Run, other options become available to be set e.g. UGPS Power and other fields. This is true on APs and BHMs.

Note

In mode AutoSync + Free Run, if a GPS signal is never achieved initially, the system will not switch to “Free Run” mode, and SMs/BHS will not register to the AP/BHM. A valid GPS signal must be present initially for the AP to switch into “Free Run” mode (and to begin self-generating a synchronization pulse).

Also, when an AP/BHM is operating in “Free Run” mode, over a short time it will no longer be synchronized with co-located or nearby APs/BHMs (within radio range). Due to this lack of transmit and receive synchronization across APs/BHMs or across systems, performance while in “Free Run” mode may be degraded until the APs/BHMs operating in “Free Run” mode regain a external GPS synchronization source. Careful attention is required to ensure that all systems are properly receiving an external GPS synchronization pulse, and please consider “Free Run” mode as an emergency option.

Generate Sync (factory default)

This option may be used when the AP/BHM is not receiving GPS synchronization pulses from either a CMM4 or UGPS module, and there are no other APs/BHMs active within the link range. Using this option will not synchronize transmission of APs/BHMs that can “hear” each other; it will only generate a sync signal for the local AP/BHM and its associated SMs/BHS.

Note

When an AP/BHM has its "Regional Code" set to "None", The radio will not provide valid Sync Pulse Information.

There is a RED warning that the radio will not transmit, but the user might expect to see a valid sync if the radio is connected to a working CMM4 or UGPS.

Configuring security

Perform this task to configure the 450 Platform system in accordance with the network operator's security policy. Choose from the following procedures:

- Managing module access by password on page 7-103: to configure the unit access password and access level
- Isolating from the internet on page 7-106: to ensure that APs are properly secured from external networks
- Encrypting radio transmissions on page 7-106: to configure the unit to operate with AES wireless link security
- Requiring SM Authentication on page 7-107: to set up the AP to require SMs to authenticate via the AP, WM, or RADIUS server
- Filtering protocols and ports on page 7-110: to filter (block) specified protocols and ports from leaving the system
- Encrypting downlink broadcasts on page 7-113: to encrypt downlink broadcast transmissions
- Isolating SMs on page 7-113: to prevent SMs in the same sector from directly communicating with each other
- Filtering management through Ethernet on page 7-114: to prevent management access to the SM via the radio's Ethernet port
- Allowing management only from specified IP addresses on page 7-114: to only allow radio management interface access from specified IP addresses
- Restricting radio Telnet access over the RF interface on page 7-114: to restrict Telnet access to the AP
- Configuring SNMP Access on page 7-117
- Configuring Security on page 7-119

Managing module access by password

Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

See Managing module access by passwords on page 3-43.

Adding a User for Access to a module

The **Account > Add User** page allows to create a new user for accessing 450 Platform Family - AP/SM/BHM/BHS. The Add User page is explained in Table 143.

Table 143 Add User page of account page - AP/ SM/BH

Attribute	Meaning
User Name	User Account name.
Level	Select appropriate level for new account. It can be INSTALLER, ADMINISTRATOR or TECHNICIAN. See Managing module access by passwords on page 3-43.
New Password	Assign the password for new user account
Confirm Password	This new password must be confirmed in the "**Confirm Password**" field.
User Mode	User Mode is used to create an account which are mainly used for viewing the configurations. The local and remote Read-Only user account can be created by "Admin", "Installer" or "Tech" logins. To create a Read-Only user, the "read-only" check box needs to be checked.

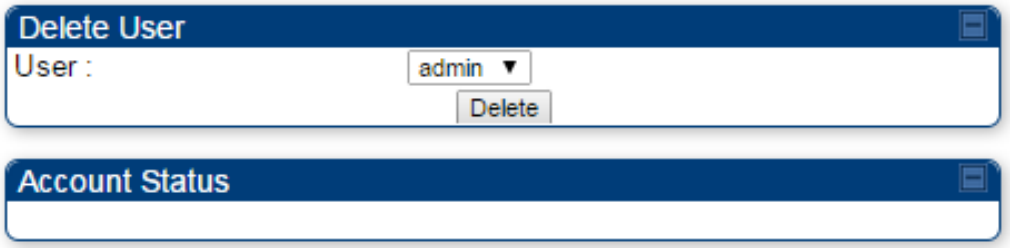
Note

The Read-Only user cannot perform any service impacting operations like creating read-only accounts, editing and viewing read-only user accounts, changes in login page, read-only user login, Telnet access, SNMP, RADIUS and upgrade/downgrade.

Deleting a User from Access to a module

The **Account > Delete User** page provides a drop-down list of configured users from which to select the user you want to delete. The Delete User page is explained in Table 144.

Table 144 Delete User page - 450 Platform Family - AP/ SM/BH



Attribute	Meaning
User	Select a user from drop-down list which has to be deleted and click **Delete** button. Accounts that cannot be deleted are • the current user's own account. • the last remaining account of ADMINISTRATOR level.

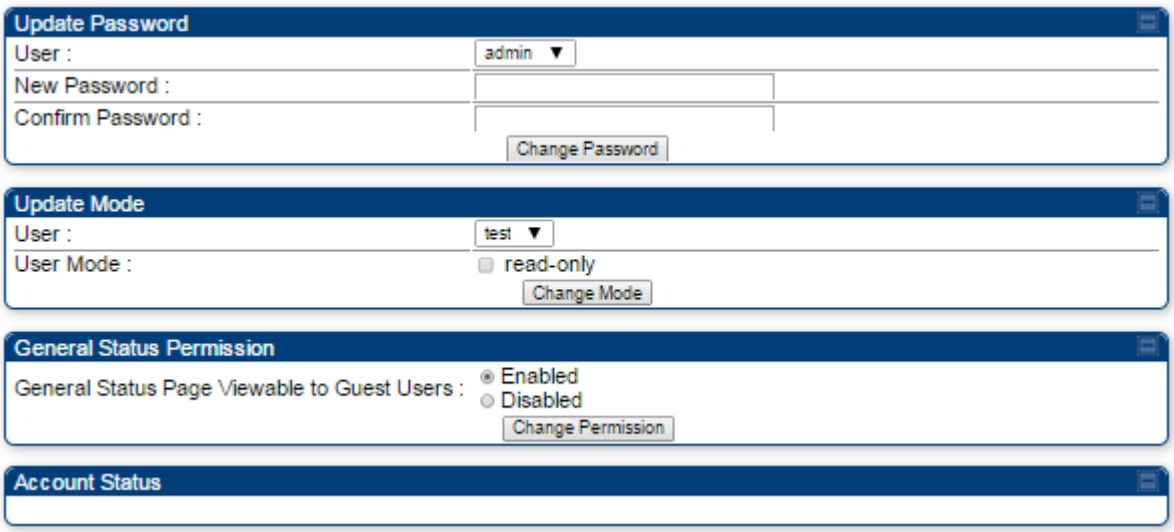
Changing a User Setting

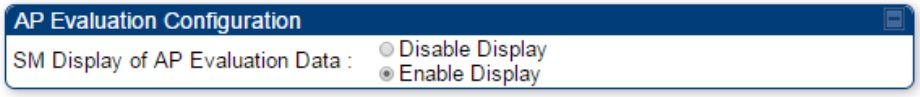
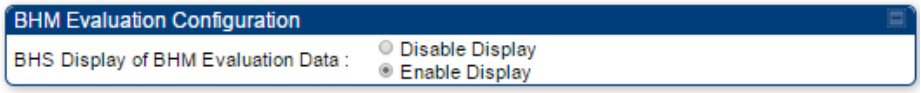
The **Account > Change User Setting** page allows to update password, mode update and general status permission for a user.

From the factory default state, configure passwords for both the root and admin account at the ADMINISTRATOR permission level, using **Update Password** tab of Change Users Setting page.

The Change User Setting page is explained in Table 145.

Table 145 Change User Setting page - 450 Platform Family AP/ SM/BH



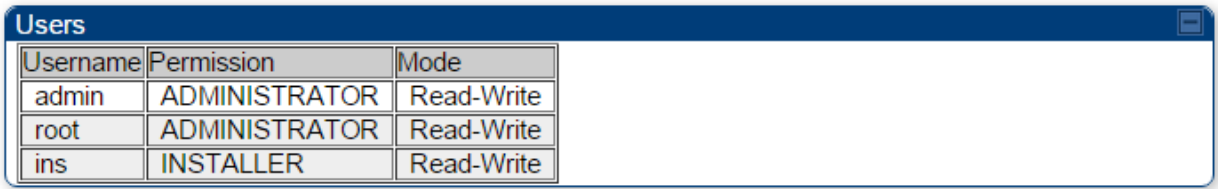
Attribute	Meaning
Update Password tab	This tab provides a drop-down list of configured users from which a user is selected to change password.
Update Mode tab	This tab facilitates to convert a configured user to a Read-Only user.
General Status Permission tab	This tab enables and disables visibility of **General Status Page** for all Guest users. To display of Radio data on SMs/BHS main Login page for Guest login, it can be enabled or disabled in Security tab of Configuration page. **Figure 145** AP Evaluation Configuration parameter of Security tab for PMP  **Figure 146** BHM Evaluation Configuration parameter of Security tab for PTP 

Users account

The **Account > Users** page allows to view all configured users account for accessing the module.

The Users page is explained in Table 146.

Table 146 User page –450 Platform Family AP/SM/BH



Attribute	Meaning
Username	User access account name
Permission	Permission of configured user – INSTALLER, ADMINISTRATOR or TECHNICIAN
Mode	This field indicate access mode of user – Read-Write or Read-Only.

Overriding Forgotten IP Addresses or Passwords on AP and SM

See Radio recovery mode on page 1-26

Isolating from the internet – APs/BHMs

Applicable products	PMP: ☑ AP	PTP: ☑ BHM

See Isolating AP/BHM from the Internet on page 3-41.

Encrypting radio transmissions

Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

See Encrypting radio transmissions on page 3-41.

Requiring SM Authentication

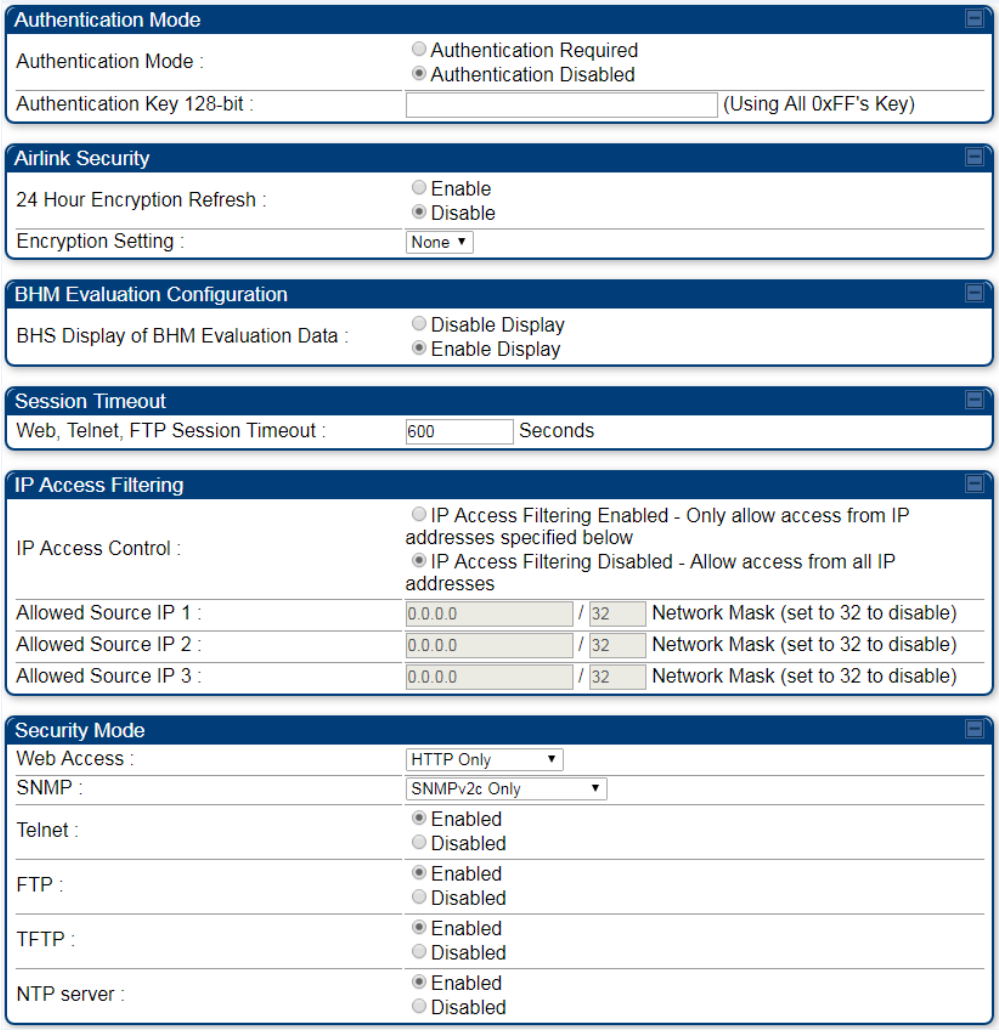
Applicable products	PMP: ☑ AP ☑ SM

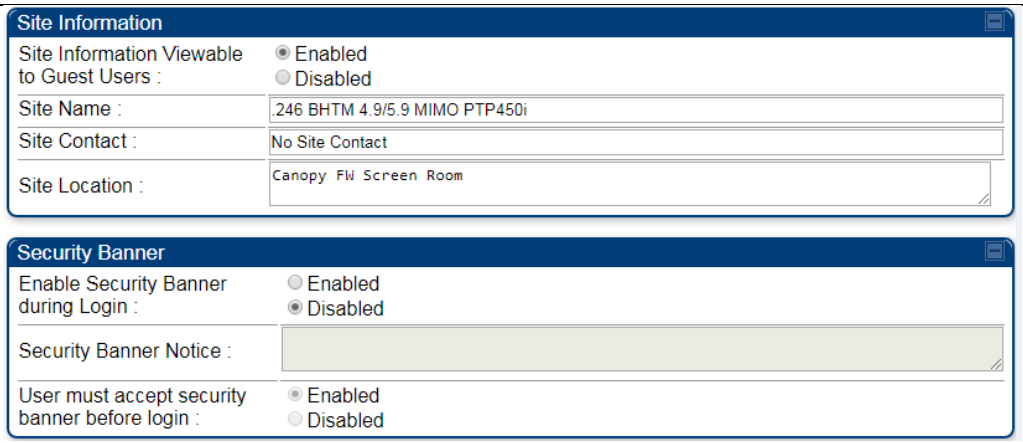
Through the use of a shared AP key, or an external RADIUS (Remote Authentication Dial In User Service) server, it enhances network security by requiring SMs to authenticate when they register.

For descriptions of each of the configurable security parameters on the AP, see Configuring Security on page 7-119. For descriptions of each of the configurable security parameters on the SM, see Security page – 450 Platform Family BHM

The security page of AP/BHM is explained in Table 151.

Table 151 Security attributes –450 Platform Family BHM

- 



Attribute	Meaning
Authentication Mode	Operators may use this field to select from among the following authentication modes: Authentication Required: the BHS requires to be authenticated. Authentication Disabled: the BHM requires no BHS to authenticate. (Factory default).
Authentication Key 128-bit	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
24 Hour Encryption Refresh	Operators may use this field to select from among the following options: Enabled: Allows BHS re-registration every 24 hours. Disabled: Disables 24-hour encryption refresh. This parameter is disabled by default.
Encryption Setting	
BHS Display of BHM Evaluation Data	
Web, Telnet, FTP Session Timeout	
IP Access Control	
Allowed Source IP *1 to 3*	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
Web Access	
SNMP	
Telnet	
FTP	
TFTP	
NTP Server	

Site Information viewable to Guest Users	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
Site Name	
Site Contact	
Site Location	
Enable Security Banner during Login	
Security Banner Notice	
User must accept security banner before login	

Security on page 7-124.

Operators may use the AP's **Authentication Mode** field to select from among the following authentication modes:

- **Disabled**—the AP requires no SMs to authenticate (factory default setting).
- **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.

  For more information on configuring the PMP 450 Platform network to utilize a RADIUS server, see Configuring a RADIUS server on page 7-271.

Filtering protocols and ports

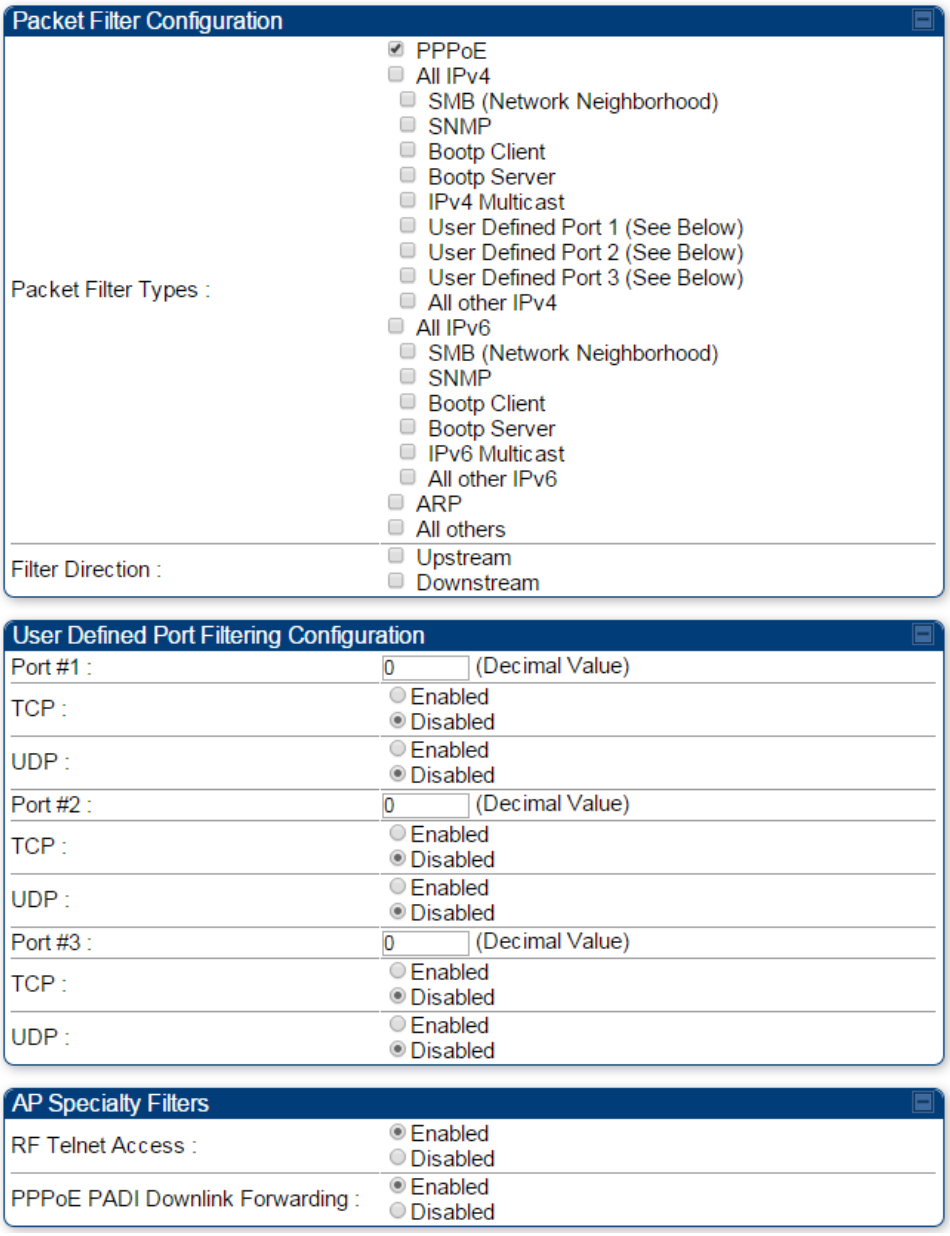
Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

The filtering protocols and ports allows to configure filters for specified protocols and ports from leaving the AP/SM/BHM/BHS and entering the network. See Filtering protocols and ports on page 3-44.

Protocol filtering page of 450 Platform Family AP/BHM

The Protocol Filtering page of 450 Platform Family - AP/BHM is explained in Table 147.

Table 147 AP/BHM Protocol Filtering attributes

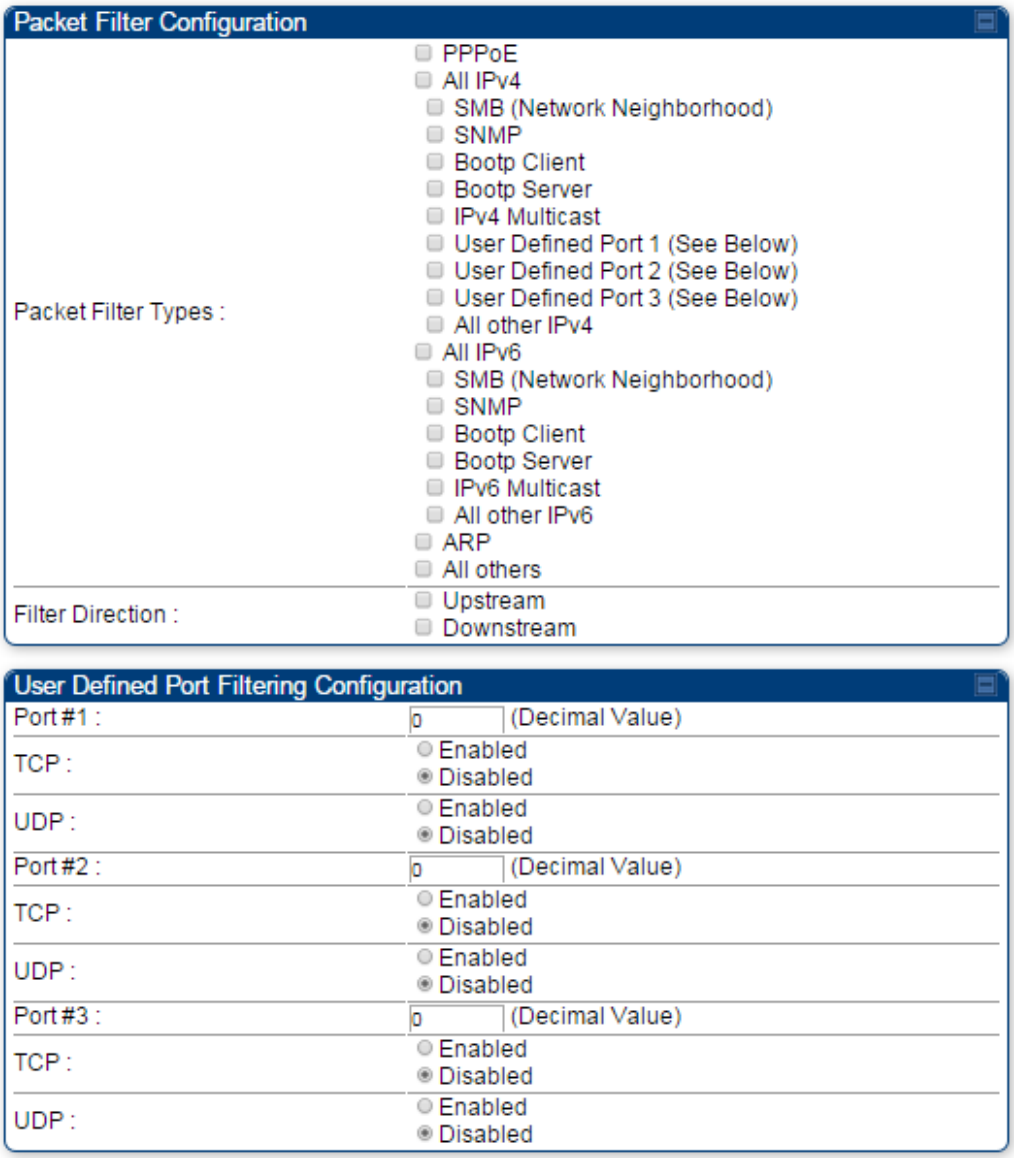


Attribute	Meaning
Packet Filter Types	For any box selected, the Protocol and Port Filtering feature blocks the associated protocol type. To filter packets in any of the user-defined ports, must do all of the following: Check the box for **User Defined Port *n* (See Below)** in the **Packet Filter Types** section of this tab. In the **User Defined Port Filtering Configuration** section of this tab: • provide a port number at **Port #*n***. • enable **TCP** and/or **UDP** by clicking the associated radio button
Filter Direction	Operators may choose to filter upstream (uplink) RF packets or downstream (downlink) RF packets.
User Defined Port Filtering Configuration	You can specify ports for which to block subscriber access, regardless of whether NAT is enabled.
RF Telnet Access	RF Telnet Access restricts Telnet access to the AP/BHM from a device situated below a network SM/BHS (downstream from the AP/BHM). This is a security enhancement to restrict RF-interface sourced AP access specifically to the LAN1 IP address and LAN2 IP address (Radio Private Address, typically 192.168.101.[LUID]). This restriction disallows unauthorized users from running Telnet commands on the AP/BHM that can change AP/BHM configuration or modifying network-critical components such as routing and ARP tables.
PPPoE PADI Downlink Forwarding	**Enabled**: the AP/BHM allows downstream and upstream transmission of PPPoE PADI packets. By default, PPPoE PADI Downlink Forwarding is set to "Enabled". **Disabled**: the AP/BHM disallows PPPoE PADI packets from entering the Ethernet interface and exiting the RF interface (downstream to the SM/BHS). PPPoE PADI packets are still allowed to enter the AP's RF interface and exit the AP's /BHM's Ethernet interface (upstream).

Protocol filtering page of SM/BHS

The Protocol Filtering page of SM/BHS is explained in Table 148.

Table 148 SM/BHS Protocol Filtering attributes



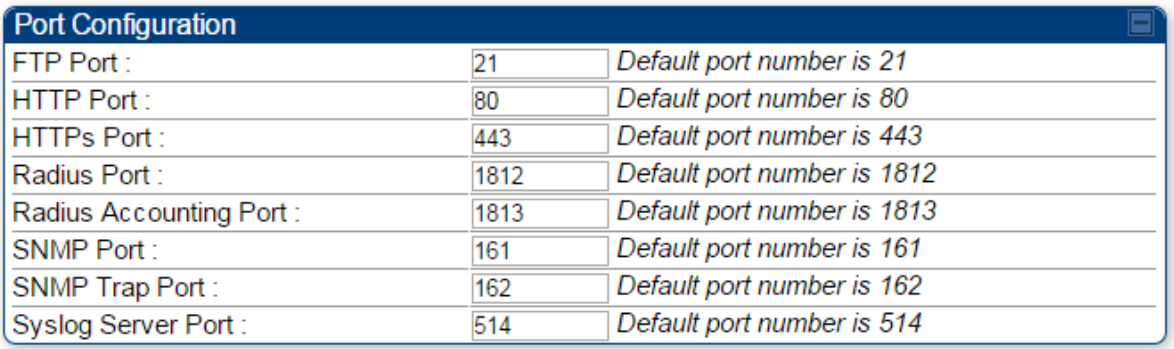
Attribute	Meaning
Packet Filter Configuration tab	See Table 147 AP/BHM Protocol Filtering attributes on page 7-110
User Defined Port Filtering Configuration tab	See Table 147 AP/BHM Protocol Filtering attributes on page 7-110

Port configuration

450 Platform Family ODUs support access to various communication protocols and only the ports required for these protocols are available for access by external entities. Operators may change the port numbers for these protocols via the radio GUI or SNMP.

The **Port Configuration** page of the AP/SM/BHM/BHS is explained in Table 149.

Table 149 Port Configuration attributes – AP/SM/BHM/BMS



Attribute	Meaning
FTP Port	The listen port on the device used for FTP communication.
HTTP Port	The listen port on the device used for HTTP communication.
HTTPS Port	The listen port on the device used for HTTPS communication
Radius Port	The destination port used by the device for RADIUS communication.
Radius Accounting Port	The destination port used by the device for RADIUS accounting communication.
SNMP Port	The listen port on the device used for SNMP communication.
SNMP Trap Port	The destination port used by the device to which SNMP traps are sent.
Syslog Server Port	The destination port used by the device to which Syslog messaging is sent.

Encrypting downlink broadcasts

See Encrypting downlink broadcasts on page 3-48.

Isolating SMs

See Isolating SMs in PMP on page 3-48.

Filtering management through Ethernet

See Filtering management through Ethernet on page 3-48.

Allowing management only from specified IP addresses

See Allowing management from only specified IP addresses on page 3-49.

Restricting radio Telnet access over the RF interface

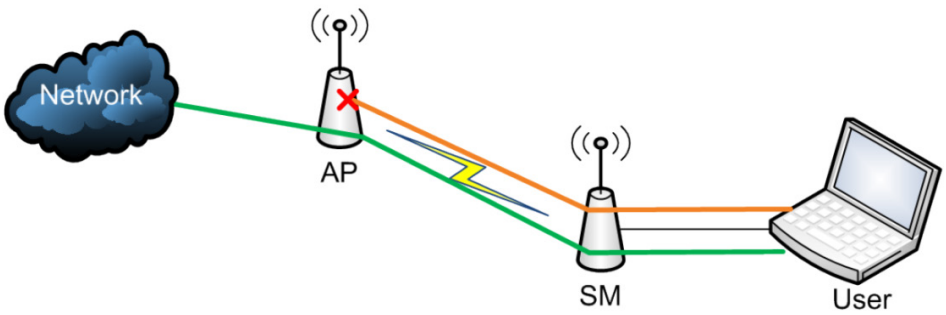
RF Telnet Access restricts Telnet access to the AP from a device situated below a network SM (downstream from the AP). This is a security enhancement to restrict RF-interface sourced AP access specifically to the LAN1 IP address and LAN2 IP address (Radio Private Address, typically 192.168.101. [LUID]). This restriction disallows unauthorized users from running Telnet commands on the AP that can change AP configuration or modifying network-critical components such as routing and ARP tables.

The RF Telnet Access may be configured via the AP GUI or via SNMP commands, and RF Telnet Access is set to “Enabled” by default. Once RF Telnet Access is set to “Disabled”, if there is a Telnet session attempt to the AP originating from a device situated below the SM (or any downstream device), the attempt is dropped. This also includes Telnet session attempts originated from the SM’s management interface (if a user has initiated a Telnet session to a SM and attempts to Telnet from the SM to the AP). In addition, if there are any active Telnet connections to the AP originating from a device situated below the SM (or any downstream device), the connection is dropped. This behavior must be considered if system administrators use Telnet downstream from an AP (from a registered SM) to modify system parameters.

Setting RF Telnet Access to “Disabled” does not affect devices situated above the AP from accessing the AP via Telnet, including servers running the CNUT (Canopy Network Updater tool) application. Also, setting RF Telnet Access to “Disabled” does not affect any Telnet access into upstream devices (situated above or adjacent to the AP) through the AP (see Figure 147).

The figure below depicts a user attempting two telnet sessions. One is targeted for the AP (orange) and one is targeted for the network upstream from the AP (green). If RF Telnet Access is set to “Disabled” (factory default setting), the Telnet attempt from the user to the AP is blocked, but the attempt from the user to Network is allowed to pass through the Cambium network.

Figure 147 RF Telnet Access Restrictions (orange) and Flow through (green)



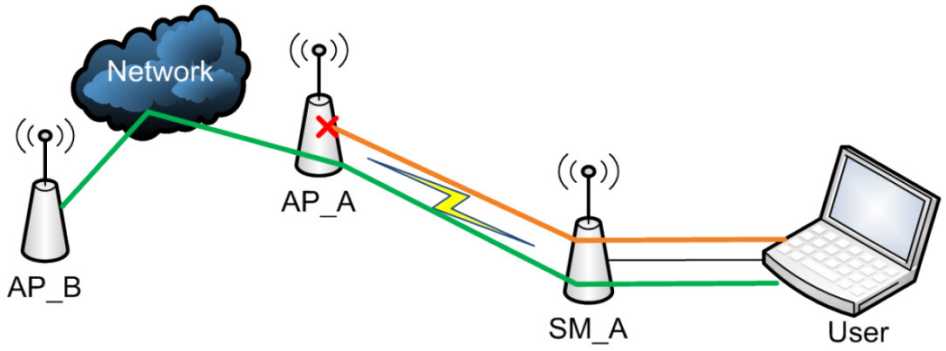
Key Security Considerations when using the RF Telnet Access Feature

To ensure that the network is fully protected from unauthorized AP Telnet sessions, the following topics must be considered:

○ Securing AP Clusters

When working with a cluster of AP units, to eliminate potential security holes allowing Telnet access, ensure that the RF Telnet Access parameter is set to "Disabled" for every AP in the cluster. In addition, since users situated below the AP are able to pass Telnet sessions up through the SM and AP to the upstream network (while AP RF Telnet Access is set to "Disabled"), ensure that all CMM4 or other networking equipment is secured with strong passwords. Otherwise, users may Telnet to the CMM4 or other networking equipment, and subsequently access network APs (see Figure 148) via their Ethernet interfaces (since RF Telnet Access only prevents Telnet sessions originating from the AP's wireless interface).

Figure 148 RF Telnet Access Restriction (orange) and Potential Security Hole (green)



As a common practice, AP administrator usernames and passwords must be secured with strong, non-default passwords.

○ Restricting AP RF Telnet Access

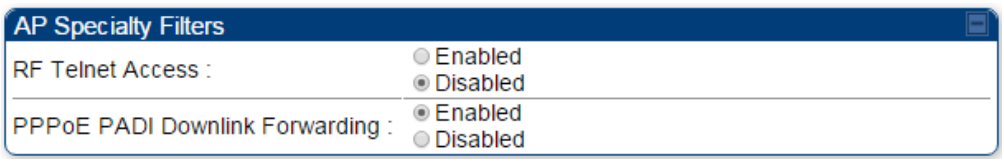
AP Telnet access via the RF interface may be configured in two ways – the AP GUI and SNMP.

○ Controlling RF Telnet Access via the AP GUI

To restrict all Telnet access to the AP via the RF interface from downstream devices, follow these instructions using the AP GUI:

Procedure 20 Restricting RF Telnet access

1. Log into the AP GUI using administrator credentials
2. On the AP GUI, navigate to **Configuration > Protocol Filtering**
3. Under GUI heading "Telnet Access over RF Interface", set **RF Telnet Access** to **Disabled**



4. Click the **Save** button

5 Once the **Save** button is clicked, all RF Telnet Access to the AP from devices situated below the AP is blocked.

Note

The factory default setting for RF Telnet Access is disabled and PPPoE PADI Downlink Forwarding is enabled.

Configuring SNMP Access

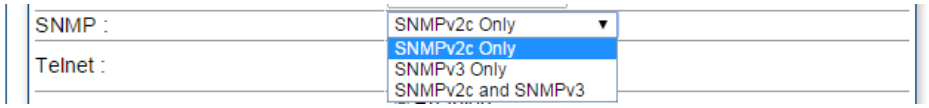
The SNMPv3 interface provides a more secure method to perform SNMP operations. This standard provides services for authentication, data integrity and message encryption over SNMP. Refer to Planning for SNMPv3 operation on page 3-42 for details.

Note

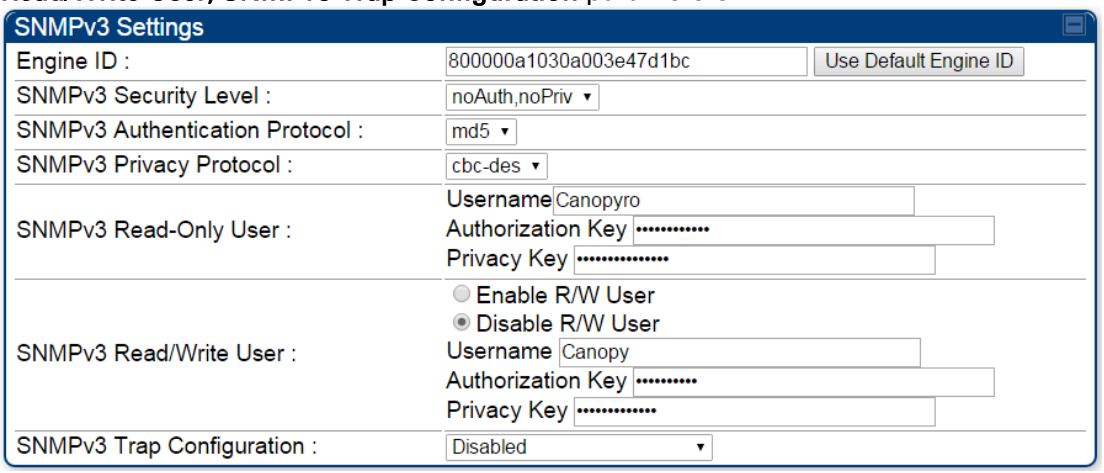
The factory default setting for SNMP is "SNMPv2c Only".

Procedure 21 Configuring SNMPv3

1. Log into the AP GUI using administrator credentials
2. On the AP/SM GUI, navigate to **Configuration > Security Page**
3. Under GUI heading "Security Mode", set **SNMP** to **SNMPv3 Only**



4. Click the **Save Changes** button
5. Go to **Configuration > SNMP Page**
6. Under GUI heading "SNMPv3 setting", set **Engine ID, SNMPv3 Security Level, SNMPv3 Authentication Protocol, SNMPv3 Privacy Protocol, SNMPv3 Read-Only User, SNMPv3 Read/Write User, SNMPv3 Trap Configuration** parameters:



Engine ID:

Each radio (AP/SM/BHM/BHS) has a distinct SNMP authoritative engine identified by a unique Engine ID. While the Engine ID is configurable to the operator it is expected that the operator follows the guidelines of the SNMPEngineID defined in the SNMP-FRAMEWORK-MIB (RFC 3411). The default Engine ID is the MAC address of the device.

SNMPv3 security level, Authentication and Privacy Protocol

The authentication allows authentication of SNMPv3 user and privacy allows for encryption of SNMPv3 message. 450 Platform Family supports MD5 authentication and CBC-DES privacy protocols.

SNMPv3 Read-Only and Read/Write User

The user can be defined by configurable attributes. The attributes and default values are:

- Read-only user
    - Username = Canopyro
    - Authentication Password = authCanopyro
    - Privacy Password = privacyCanopyro
- Read-write user (by default read-write user is disabled)
    - Username = Canopy
    - Authentication Password = authCanopy
    - Privacy Password = privacyCanopy

SNMPv3 Trap Configuration

The traps may be sent from radios in SNMPv3 format based on parameter settings. It can be configured for Disabled, Enabled for Read-Only User, Enable for Read/Write User.

Configuring Security

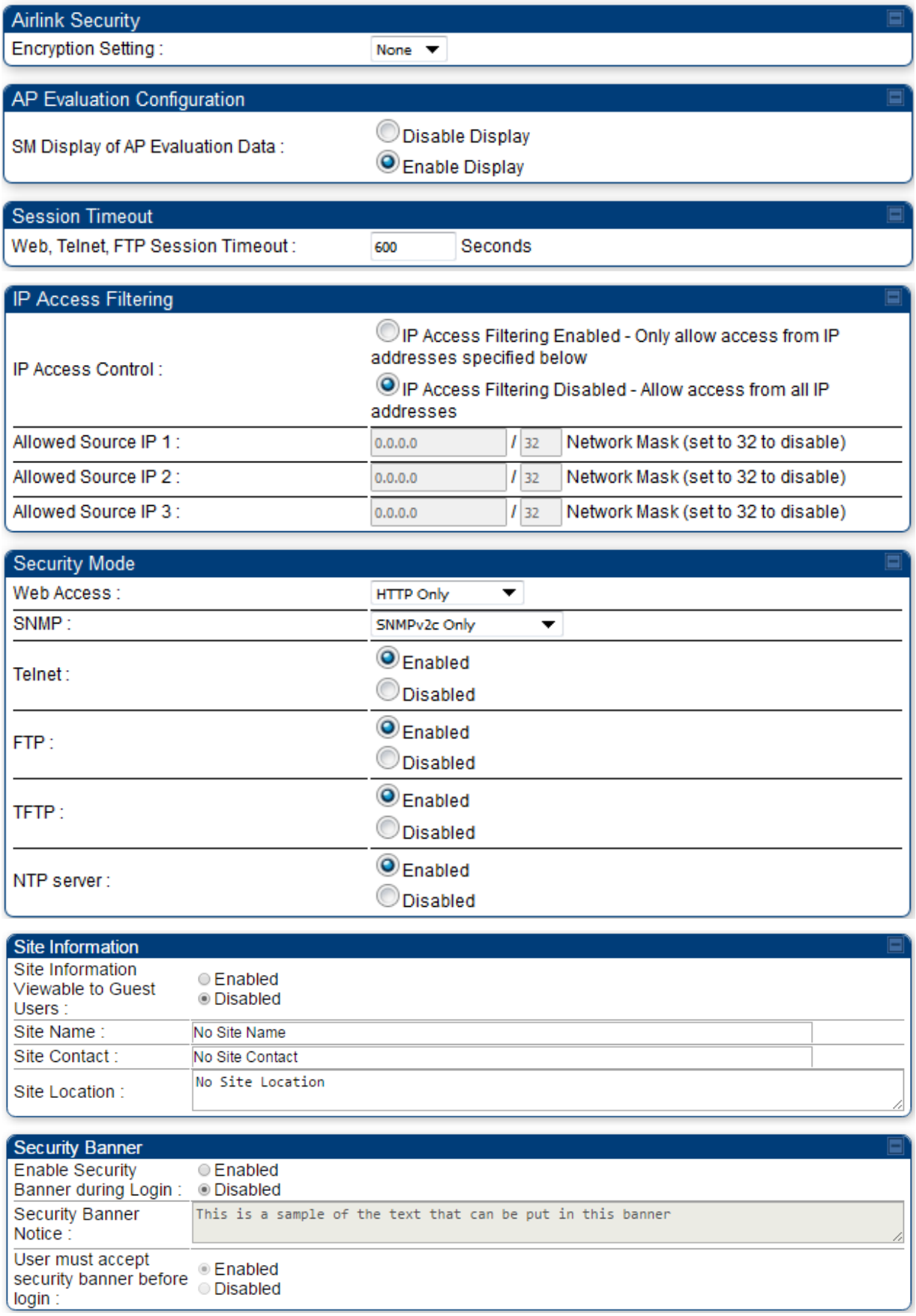
Applicable products	PMP: ☑ AP ☑ SM	PTP: ☑ BHM ☑ BMS

Security page – 450 Platform Family AP

The security page of AP is explained in Table 150.

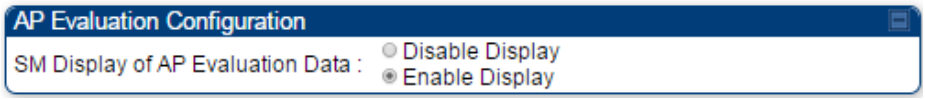
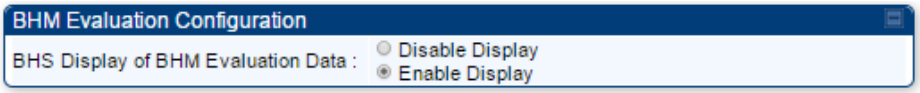
Table 150 Security attributes –450 Platform Family AP

Authentication Server Settings	
Authentication Mode :	Disabled
Authentication Server DNS Usage :	Append DNS Domain Name Disable DNS Domain Name
Authentication Server 1 :	Shared Secret 0.0.0.0
Authentication Server 2 :	Shared Secret 0.0.0.0
Authentication Server 3 :	Shared Secret 0.0.0.0
Authentication Server 4 (BAM ONLY) :	0.0.0.0
Authentication Server 5 (BAM ONLY) :	0.0.0.0
Radius Port :	1812 *Default port number is 1812*
Authentication Key 128-bit :	(Using All 0xFF's Key)
Select Key 128-bit :	Use Key above Use Default Key
Disable AES-128 :	AES-128 Encryption Disabled AES-128 Encryption Available
Authentication Key 256-bit :	(Using All 0xFF's Key)
Select Key 256-bit :	Use Key above Use Default Key
Dynamic Authorization Extensions for RADIUS :	Enable CoA and Disconnect Message Disable CoA and Disconnect Message
Bypass Authentication for ICC SMs :	Enabled Disabled


Airlink Security
Encryption Setting : None
AP Evaluation Configuration
SM Display of AP Evaluation Data : Disable Display Enable Display
Session Timeout
Web, Telnet, FTP Session Timeout : 600 Seconds
IP Access Filtering
IP Access Control : IP Access Filtering Enabled - Only allow access from IP addresses specified below IP Access Filtering Disabled - Allow access from all IP addresses
Allowed Source IP 1 : 0.0.0.0 / 32 Network Mask (set to 32 to disable)
Allowed Source IP 2 : 0.0.0.0 / 32 Network Mask (set to 32 to disable)
Allowed Source IP 3 : 0.0.0.0 / 32 Network Mask (set to 32 to disable)
Security Mode
Web Access : HTTP Only
SNMP : SNMPv2c Only
Telnet : Enabled Disabled
FTP : Enabled Disabled
TFTP : Enabled Disabled
NTP server : Enabled Disabled
Site Information
Site Information Viewable to Guest Users : Enabled Disabled
Site Name : No Site Name
Site Contact : No Site Contact
Site Location : No Site Location
Security Banner
Enable Security Banner during Login : Enabled Disabled
Security Banner Notice : This is a sample of the text that can be put in this banner
User must accept security banner before login : Enabled Disabled

Attribute	Meaning
Authentication Mode	Operators may use this field to select from among the following authentication modes: **Disabled**—the AP requires no SMs to authenticate. (Factory default). **Authentication Server** —the AP/BHM requires any SM/BHS that attempts registration to be authenticated in Wireless Manager before registration. **AP PreShared Key** - The AP/BHM acts as the authentication server to its SMs/BHS and will make use of a user-configurable pre-shared authentication key. The operator enters this key on both the AP/BHM and all SMs/BHS desired to register to that AP/BHM. There is also an option of leaving the AP/BHM and SMs/BHS 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/BHS and reboot them BEFORE enabling the key and option on the AP/BHM. Otherwise, if you configure the AP/BHM first, none of the SMs/BHS 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 to 5*	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.
Radius Port	This field allows the operator to configure a custom port for RADIUS server communication. The default value is *1812*.
Authentication Key 128-bit	This 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 128-bit	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 the SM's MAC address) is used for authentication

Disable AES 128-bit	This option allows to disable the AES-128 encryption. When AES-128 Encryption is disabled, it prevents the use of AES-128 when encryption is enabled. Since changes to other attributes (e.g. PreSharedKey authentication settings) could cause a need for 128-bit Auth and AES-128 upon next registration, Disable AES 128-bit parameter is prevented from being changed on the "Security" webpage while the "Reboot Required" warning is present at the top of the Web GUI pages. The recommendation is to complete other changes first and to ensure that all links at an AP are running AES-256 before disabling the use of AES-128 on all units (AP and SMs) in the sector. When saving and loading a configuration file, Disable AES 128 is saved and loaded as a normal attribute. It will not take effect until a reboot is triggered. Since enabling this attribute could have the effect of preventing a link coming up, care should be taken on networks that enable this attribute on only some units. Select one of the following options to either disable or use AES-128 encryption. • AES-128 Encryption Disabled: • AES-128 Encryption Available
Authentication Key 256-bit	This authentication key is a 64-character hexadecimal string used when **Authentication Mode** is set to **AP PreShared Key**. By default, this key is set to 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF. **Note** The AES-256 parameters are visible only when the feature key is purchased.
Select Key 256-bit	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 **Note** The AES-256 parameters are visible only when the feature key is purchased.
Dynamic Authorization Extensions for RADIUS	**Enable CoA and Disconnect Message**: Allows to control configuration parameters of SM using RADIUS CoA and Disconnect Message feature. **Disable CoA and Disconnect Message**: Disables RADIUS CoA and Disconnect Message feature. To enable CoA and Disconnect feature, the Authentication Mode should be set to RADIUS AAA.

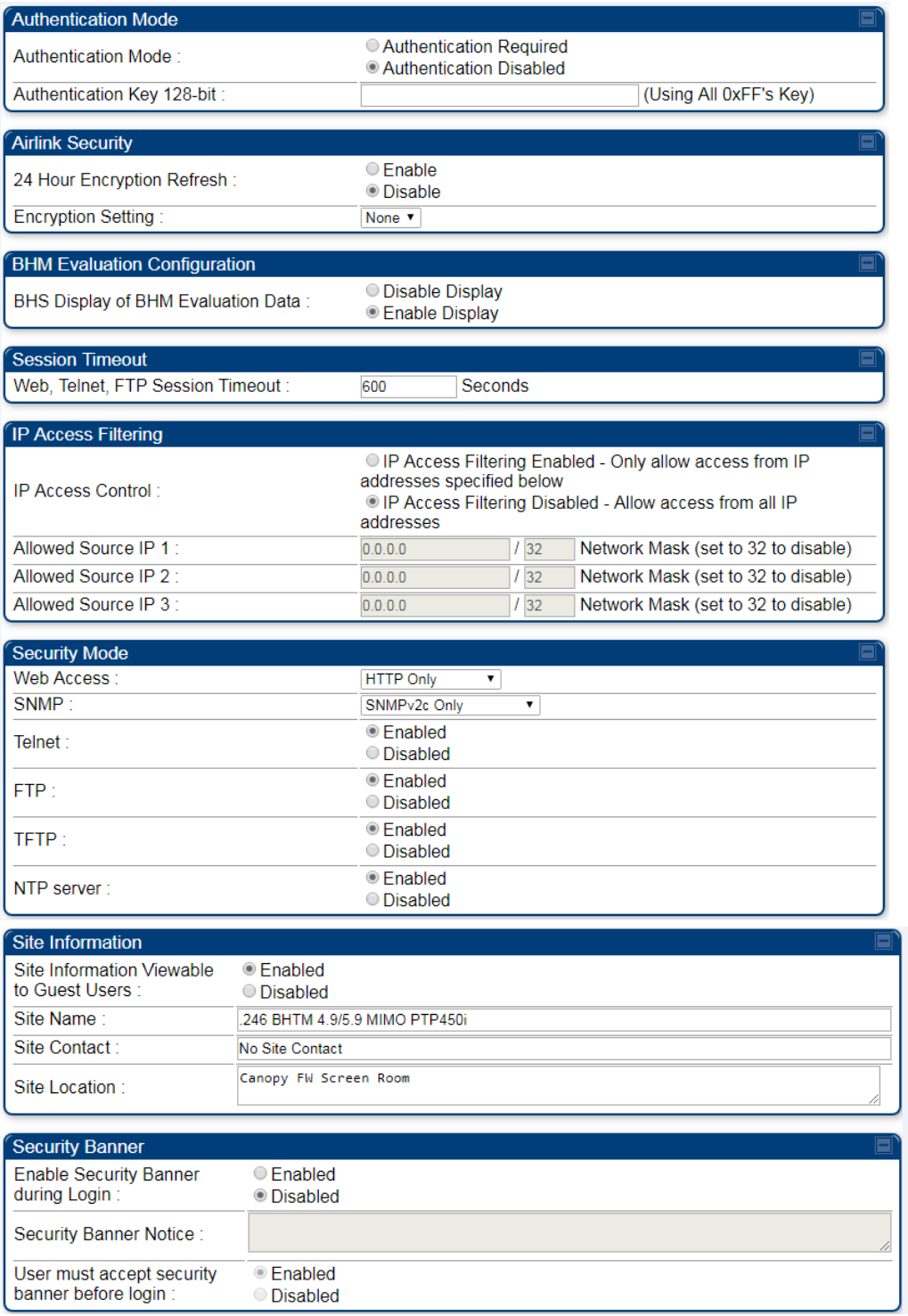
Bypass Authentication for ICC SMs	**Enabled**: SM authentication is disabled when SM connects via ICC (Installation Color Code). **Disabled**: SM authentication is enabled.
Encryption Setting	Specify the type of airlink security to apply to this AP. The encryption setting must match the encryption setting of the SMs. **None** provides no encryption on the air link. **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. AES products are certified as compliant with the Federal Information Processing Standards (FIPS 197) in the U.S.A. **Note** This parameter is applicable to BHM.
SM Display of AP Evaluation Data Or BHS Display of BHM Evaluation Data	Allows operators to suppress the display of data about this AP/BHM on the AP/BHM Evaluation tab of the Tools page in all SMs/BHS that register. The factory default setting for SM Display of AP Evaluation Data or BHS Display of BHM Evaluation Data is enabled display. PMP 450/450i Series – SM display of AP Evaluation Data parameter  PTP 450/450i Series – BHS display of BHM Evaluation Data parameter 
Web, Telnet, FTP Session Timeout	Enter the expiry in seconds for remote management sessions via **HTTP**, **telnet**, or **ftp** access to the AP/BHM.
IP Access Control	You can permit access to the AP/BHM 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 to 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 a 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.
NTP Server	This option allows to **Enable** and **Disable** NTP server access to the Radio.
Site Information viewable to Guest Users	This option allows to Enable or Disable displaying site information with Guest users.
Site Name	Specify a string to associate with the physical module.
Site Contact	Enter contact information for the module administrator.
Site Location	Enter information about the physical location of the module.
Enable Security Banner during Login	**Enable**: The Security Banner Notice will be displayed before login. **Disable**: The Security Banner Notice will not be displayed before login.
Security Banner Notice	User can enter ASCII (0-9a-zA-Z newline, line-feed are allowed) text up-to 1300 characters.
User must accept security banner before login	**Enable**: login area (username and password) will be disabled unless user accepts the security banner. **Disable**: User can't login to radio without accepting security banner.

Security page – 450 Platform Family BHM

The security page of AP/BHM is explained in Table 151.

Table 151 Security attributes –450 Platform Family BHM



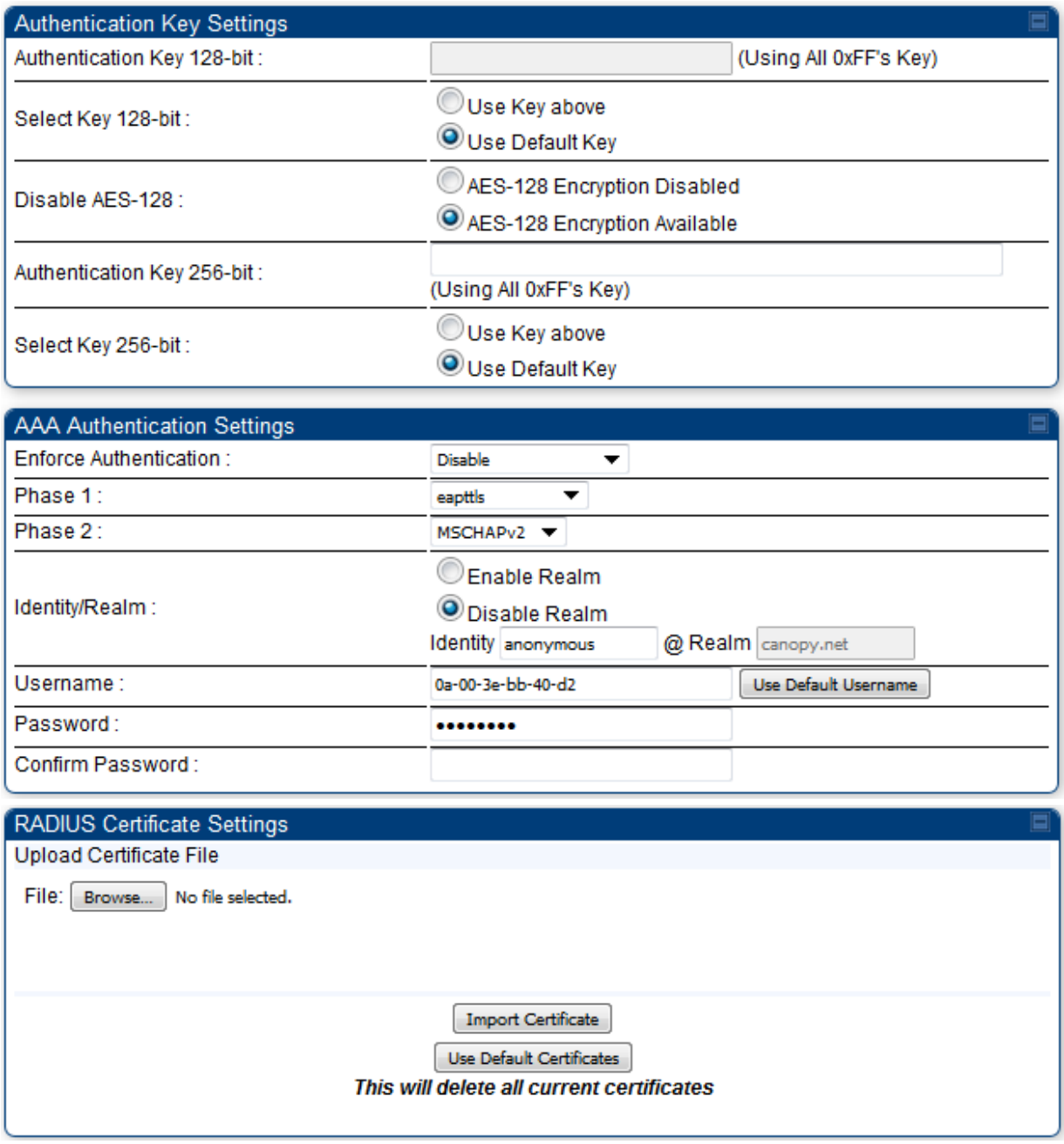
Attribute	Meaning
Authentication Mode	Operators may use this field to select from among the following authentication modes: Authentication Required: the BHS requires to be authenticated. Authentication Disabled: the BHM requires no BHS to authenticate. (Factory default).
Authentication Key 128-bit	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
24 Hour Encryption Refresh	Operators may use this field to select from among the following options: Enabled: Allows BHS re-registration every 24 hours. Disabled: Disables 24-hour encryption refresh. This parameter is disabled by default.
Encryption Setting	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
BHS Display of BHM Evaluation Data	
Web, Telnet, FTP Session Timeout	
IP Access Control	
Allowed Source IP *1 to 3*	
Web Access	
SNMP	
Telnet	
FTP	
TFTP	
NTP Server	
Site Information viewable to Guest Users	Refer Table 150 Security attributes –450 Platform Family AP on page 7-119 for parameter details
Site Name	
Site Contact	
Site Location	
Enable Security Banner during Login	
Security Banner Notice	

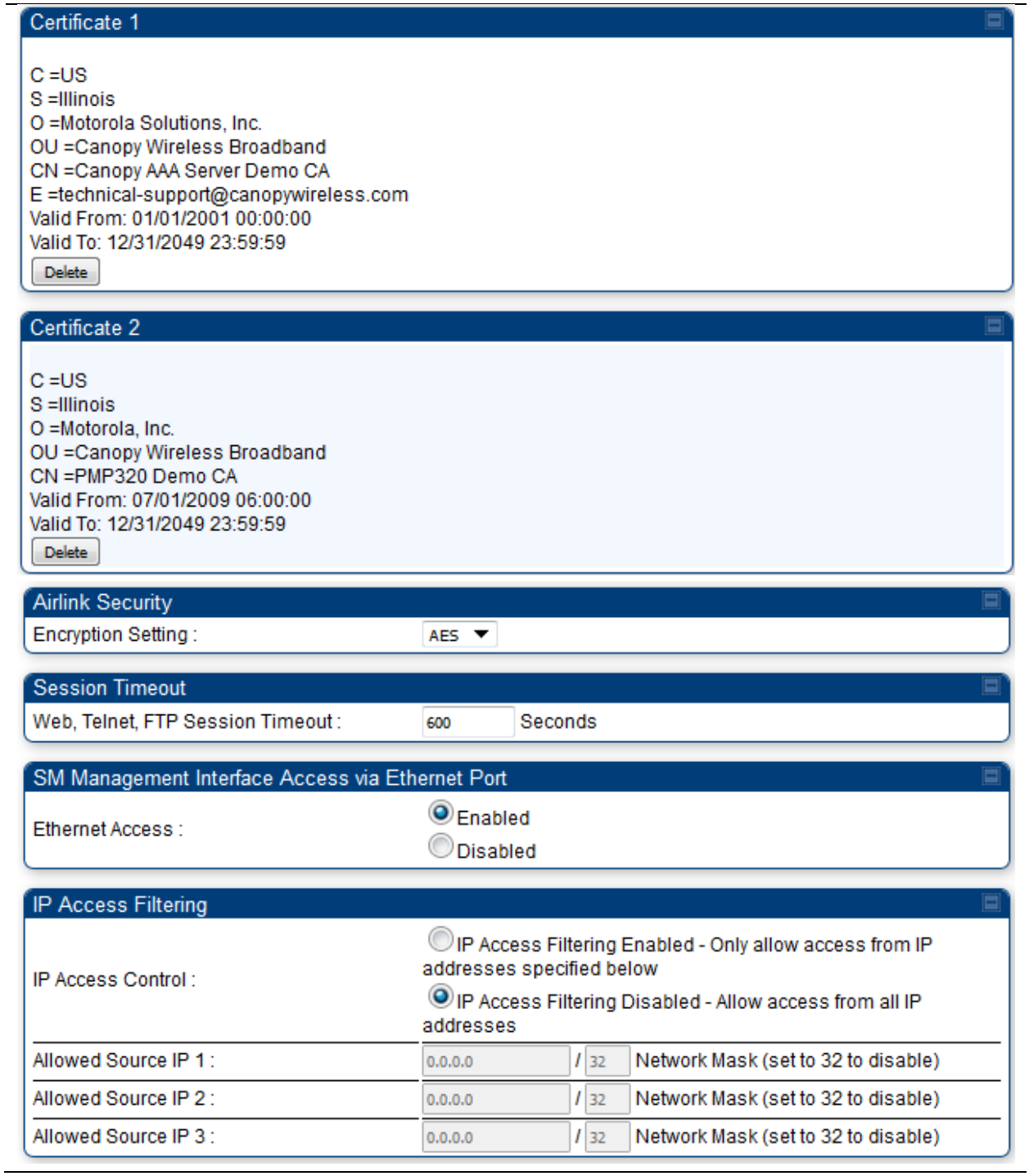
User must accept security banner before login	

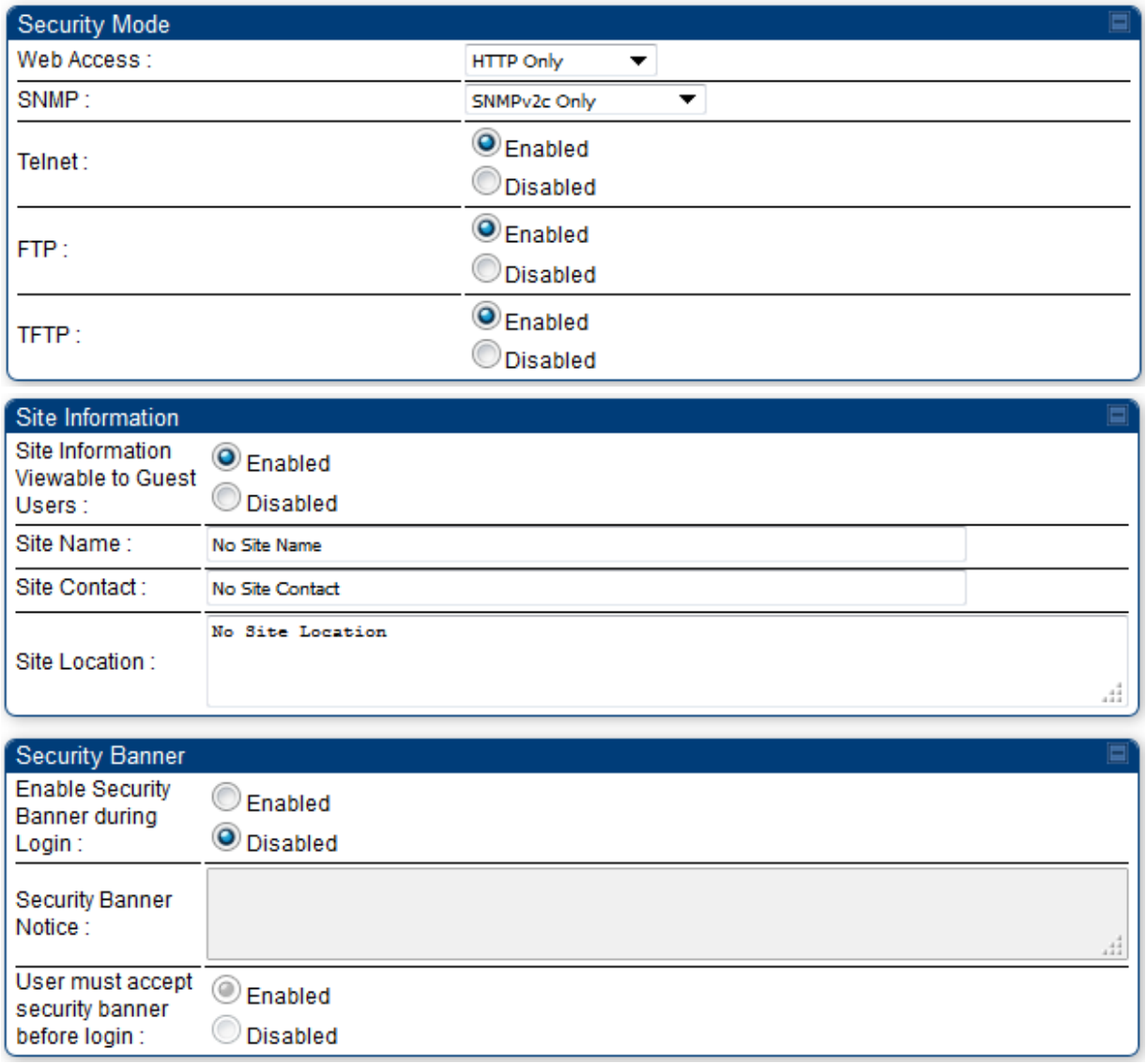
Security page - 450 Platform Family SM

The security page of 450 Platform Family SM is explained in Table 152.

Table 152 Security attributes –450 Platform Family SM




Certificate 1
C =US
S =Illinois
O =Motorola Solutions, Inc.
OU =Canopy Wireless Broadband
CN =Canopy AAA Server Demo CA
E =technical-support@canopywireless.com
Valid From: 01/01/2001 00:00:00
Valid To: 12/31/2049 23:59:59
Delete
Certificate 2
C =US
S =Illinois
O =Motorola, Inc.
OU =Canopy Wireless Broadband
CN =PMP320 Demo CA
Valid From: 07/01/2009 06:00:00
Valid To: 12/31/2049 23:59:59
Delete
Airlink Security
Encryption Setting :
AES
Session Timeout
Web, Telnet, FTP Session Timeout :
600
Seconds
SM Management Interface Access via Ethernet Port
Ethernet Access :
Enabled
Disabled
IP Access Filtering
IP Access Control :
IP Access Filtering Enabled - Only allow access from IP addresses specified below
IP Access Filtering Disabled - Allow access from all IP addresses
Allowed Source IP 1 :
0.0.0.0
/
32
Network Mask (set to 32 to disable)
Allowed Source IP 2 :
0.0.0.0
/
32
Network Mask (set to 32 to disable)
Allowed Source IP 3 :
0.0.0.0
/
32
Network Mask (set to 32 to disable)



Attribute	Meaning
Authentication Key 128-bit	Only if the AP to which this SM will register requires authentication, specify the 128-bit key that the SM will use when authenticating. For alpha characters in this 32-character hex key, use only upper case.
Select Key 128-bit	Refer Table 150 Security attributes –450 Platform Family AP on 7-119 for parameter details.
Disable AES 128-bit	
Authentication Key 256-bit	
Select Key 256-bit	

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).
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	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.

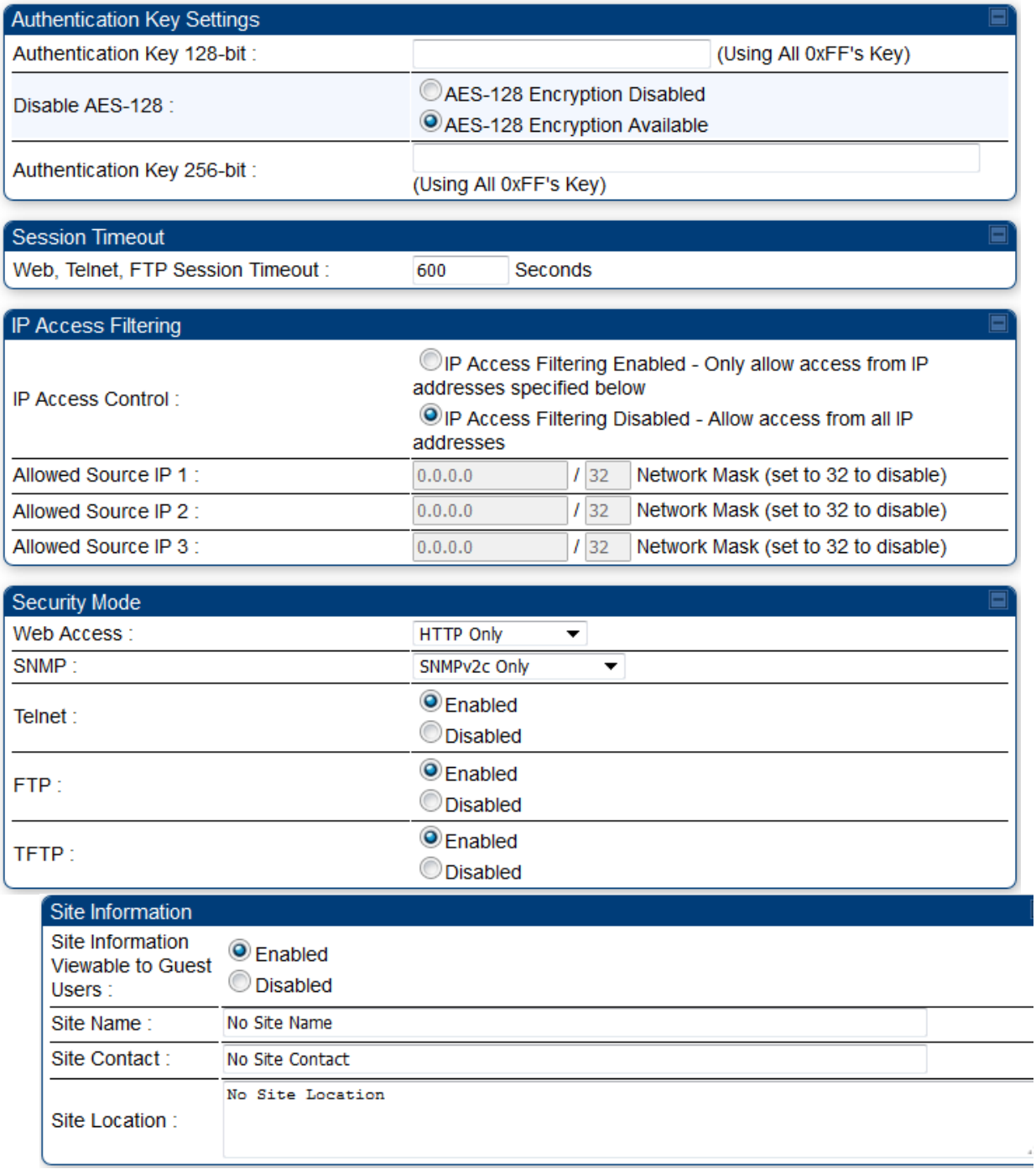
	The public certificates installed on the SMs are used with the private certificate on the RADIUS server to provide a public/private key encryption system. Up to 2 certificates can be resident on a SM. An installed certificate can be deleted by clicking the **Delete** button in the certificate's description 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 SM. The encryption setting must match the encryption setting of the AP. **None** provides no encryption on the air link. **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. 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 SM.
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. **Note** This setting does not prevent a device connected to the Ethernet port from accessing the management interface of other SMs in the network. To prevent this, use the IP Access Filtering Enabled selection in the IP Access Control parameter of the SMs in the network. 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 SM 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

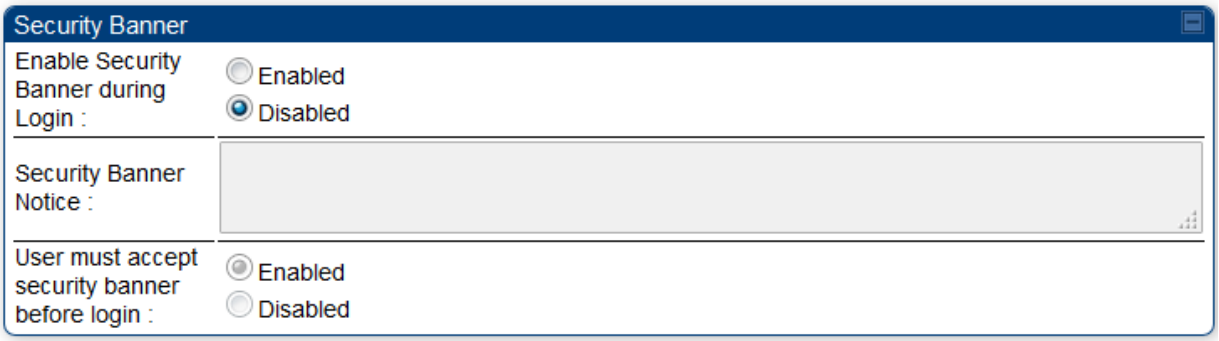
Allowed Source IP *1 to 3*	If you selected **IP Access Filtering Enabled** for the **IP Access Control** parameter, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted to the SM from any IP address. You may populate as many as all three. If you 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. A subnet mask may be defined for each entry to allow for filtering control based on a range of IP addresses.
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.
Site Information viewable to Guest Users	This option allows to Enable or Disable displaying site information with Guest users.
Site Name	Specify a string to associate with the physical module.
Site Contact	Enter contact information for the module administrator.
Site Location	Enter information about the physical location of the module.
Enable Security Banner during Login	**Enable**: The Security Banner Notice will be displayed before login. **Disable**: The Security Banner Notice will not be displayed before login.
Security Banner Notice	User can enter ASCII (0-9a-zA-Z newline, line-feed are allowed) text up-to 1300 characters.
User must accept security banner before login	**Enable**: login area (username and password) will be disabled unless user accepts the security banner. **Disable**: User can't login to radio without accepting security banner.

Security page –450 Platform Family BHS

The Security page of 450 Platform Family BHS is explained in Table 153.

Table 153 Security attributes - 450 Platform Family BHS





Attribute	Meaning
Authentication Key	Only if the BHM to which this BHS registers requires an authentication, specify the key that the BHS will use when authenticating. For alpha characters in this hex key, use only upper case.
Disable AES 128-bit Authentication Key 256-bit	Refer Table 150 Security attributes –450 Platform Family AP on 7-119 for parameter details.
Web, Telnet, FTP Session Timeout	Enter the expiry in seconds for remote management sessions via HTTP, telnet, or FTP access to the BHS.
IP Access Control	You can permit access to the BHS 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 to 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 BHS 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. A subnet mask may be defined for each entry to allow for filtering control based on a range of IP addresses.
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.
Site Information viewable to Guest Users	Refer Table 150 Security attributes –450 Platform Family AP on 7-119 for parameter details.
Site Name	
Site Contact	
Site Location	
Enable Security Banner during Login	
Security Banner Notice	
User must accept security banner before login	

Configuring radio parameters

PMP 450m Series – configuring radio

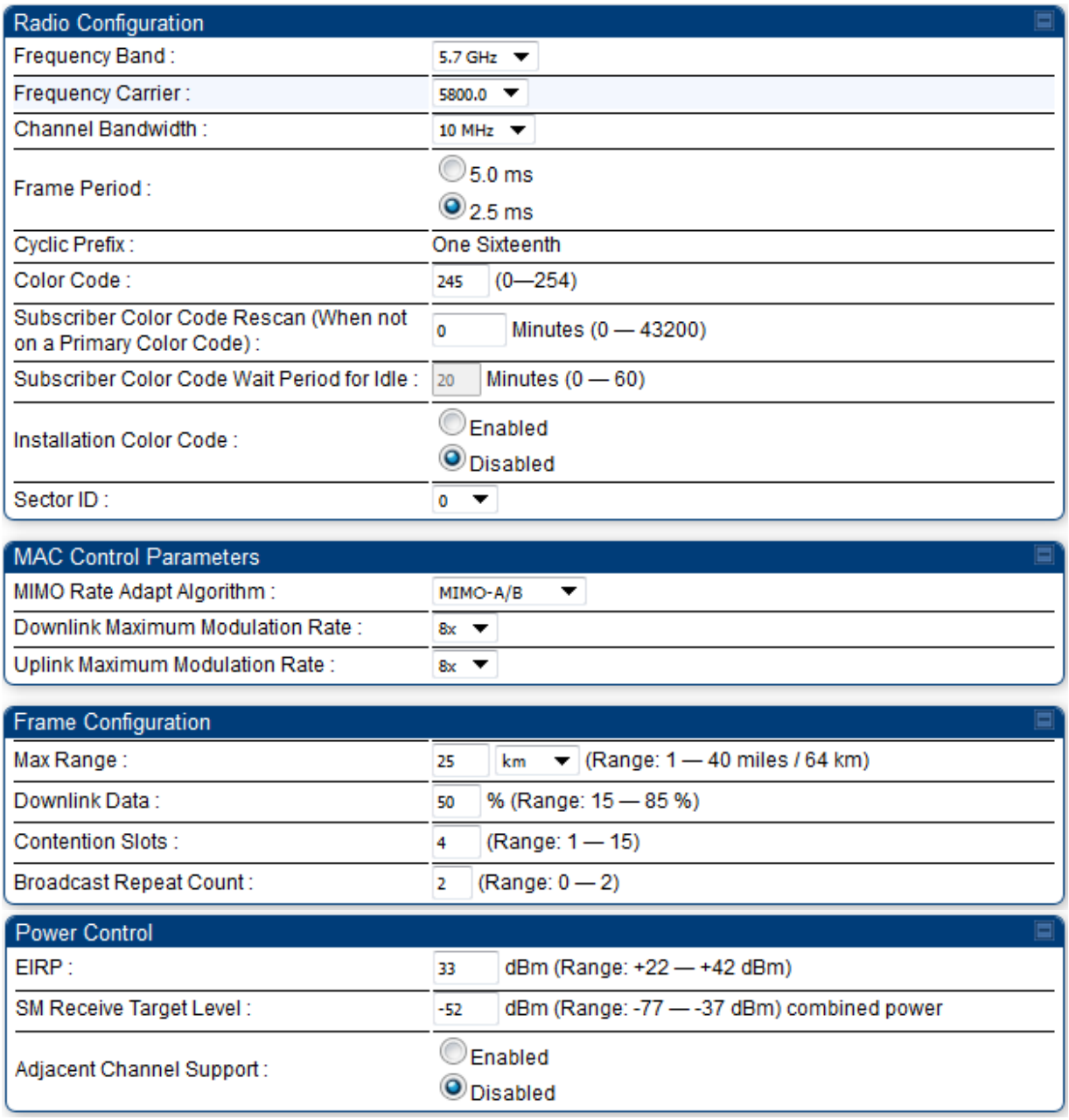
Radio page - PMP 450m AP 5 GHz

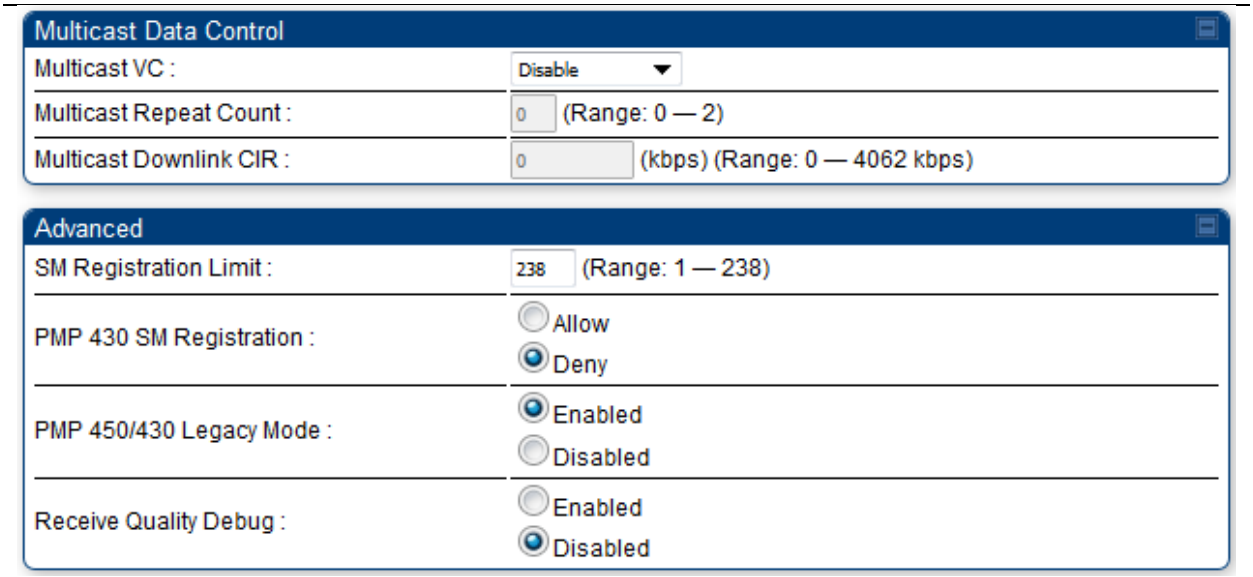
The **Radio** tab of the PMP 450m AP contains some of the configurable parameters that define how an AP operates.

Note

Only the frequencies available for your region and the selected Channel bandwidth are displayed.

Table 154 PMP 450m AP Radio attributes - 5 GHz





Attribute	Meaning
Frequency Band	Select the desired operating frequency band.
Frequency Carrier	Specify the frequency for the module to transmit. The default for this parameter is **None**. For a list of channels in the band, see the drop-down list on the radio GUI.
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. The supported Channel Bandwidths are 5 MHz, 10 MHz, 15 MHz, 20 MHz, 30 MHz, and 40 MHz. **Note for PMP 450m:** 5 ms frame size is not available in 30 MHz and 40 MHz channel bandwidths. **Note:** 40 MHz is not supported on PMP 450 AP, but is supported on PMP 450 SMs.
Frame Period	Select the Frame Period of the radio. The supported Frame Periods are: 5 ms and 2.5 ms.
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.
Color Code	Specify a value from 0 to 254. 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).
Subscriber Color Code Rescan (When not on a Primary Color Code)	This timer may be utilized to initiate SM rescans in order to register to an AP configured with the SM's primary color code. The time (in minutes) for a subscriber to rescan (if this AP is not configured with the SM's primary color code). This timer will only fire once – if the **Subscriber Color Code Wait Period for Idle** timer is configured with a nonzero value and the **Subscriber Color Code Rescan** expires, the **Subscriber Color Code Wait Period for Idle** is started. If the **Subscriber Color Code Wait Period for Idle** timer is configured with a zero value and the **Subscriber Color Code Rescan** timer expires, the SM will immediately go into rescan mode
Subscriber Color Code Wait Period for Idle	The time (in minutes) for a subscriber to rescan while idle (if this AP is not configured with the SM's primary color code). This timer will fire periodic events. The fired event determines if any RF unicast traffic (either inbound or outbound) has occurred since the last event. If the results of the event determine that no RF unicast traffic has occurred (SM is idle), then the subscriber will rescan.
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 a 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 Rescan APs functionality on the AP Eval page).
Sector ID	This pull-down menu helps in configuring the Sector ID at a configurable value from 0 to 15.
MIMO Rate Adapt Algorithm	This pull-down menu helps in configuring the Rate Adapt Algorithm to MIMO-A/B, MIMO-B only, or MIMO-A only.
Downlink Maximum Modulation Rate	This pull-down menu helps in configuring the Downlink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is "8X". The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.

Uplink Maximum Modulation Rate	This pull-down menu helps in configuring the Uplink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “8X”. The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.
Max Range	Enter the number of miles or kilometers for the furthest distance from which a SM is allowed to register to this AP. Do not set the distance to any greater number of miles. A greater distance • does not increase the power of transmission from the AP. • can reduce aggregate throughput. For example, with a 20 MHz channel and 2.5 ms frame, every additional 2.24 miles reduces the data air time by one symbol (around 1% of the frame). Regardless of this distance, the SM must meet the minimum requirements for an acceptable link. The parameters have to be selected so that there is no overlap between one AP transmitting and another AP receiving. A co-location tool is provided to help with selecting sets of parameters that allow co-location. The default value of this parameter is 2 miles (3.2 km).
Downlink Data	Specify the percentage of the aggregate throughput for the downlink (frames transmitted from the AP to the subscriber). For example, if the aggregate (uplink and downlink total) throughput on the AP is 90 Mb, then 75% specified for this parameter allocates 67.5 Mb for the downlink and 22.5 Mb for the uplink. The default for this parameter is 75%. This parameter must be set in the range of 15% - 85%, otherwise the invalid input will not be accepted and the previously-entered valid setting is used. **Note** In order to prevent self-interference, the frame configuration needs to align which includes Downlink Data, Max Range and Contention slots. For DFS regions, the maximum Downlink % for a 5.4 GHz radio is 75% only.
Contention Slots (a.k.a. Control Slots)	This field indicates the number of (reserved) Contention slots configured by the operator. The SM uses reserved Contention slots and unused data slots for bandwidth requests. See Contention slots on page 7-196.
Broadcast Repeat Count	For PMP systems broadcast packets are not acknowledged. So they are sent at the lowest modulation rate 1X. This setting adds an automatic retransmission to broadcast packets to give SMs that have poor signal a higher chance to get the packet.
EIRP	This field indicates the combined power level at which the AP will transmit, based on the Country Code. It also includes the antenna gain and array gain.

SM Receive Target Level	Each SM's Transmitter Output Power is automatically set by the AP. The AP monitors the received power from each SM, and adjusts each SM's Transmitter Output Power so that the received power at the AP from that SM is not greater what is set in this field. This value represents the transmitted and received power (combined power) perceived on the SM.
Adjacent Channel Support	For some frequency bands and products, this setting is needed if AP is operating on adjacent channels with zero guard band.
Multicast VC	This pull-down menu of the Multicast VC screen helps in configuring multicast packets to be transmitted over a dedicated channel at a configurable rate of 2X, 4X or 6X. The default value is "Disable". If set to the default value, all multicast packets are transmitted over the Broadcast VC data path. This feature is available only for the PMP 450 Series and is not backward compatible with PMP 430 series of radios.
Multicast Repeat Count	This value is the number of packets that are repeated for every multicast VC packet received on the AP (located under **Radio** tab of **Configuration**). Multicast (like Broadcast) packets go over a VC that is shared by all SMs, so there is no guaranteed delivery. The repeat count is an attempt to improve the odds of the packets getting over the link. If the user has issues with packets getting dropped, they can use this parameter to improve the performance at the cost of the overall throughput possible on that channel. The default value is *0*.
Multicast Downlink CIR	This value is the committed information rate for the multicast downlink VC (located under the **Radio** tab of **Configuration**). The default value is *0* kbps. The range of this parameter is based on the number of repeat counts. The higher the repeat count, the lower the range for the multicast downlink CIR.
Near Field Operation	This parameter is enabled by the Near Field Operation control. This is only available when the EIRP is set to 22 dBm or below. When Near Field Operation is enabled, the Near Field Range is used to apply compensation to the unit's calibration to support operation in the near field.
SM Registration Limit	This parameter allows to configure the limit for maximum number of SMs that can register to a PMP AP. The configurable range is from 1 to 238. **Note** SM trying to register after the maximum configured limit has been reached is locked out for 15 minutes and a message is displayed at the SM.
PMP 430 SM Registration	This field allows to control PMP 430 SMs. It allows to configure whether PMP 430 SMs are registered to AP or not. By default, it is enabled and PMP 430 SM registrations are accepted. When this field is set to disabled, PMP 430 SM's registrations fail with reject reason 8. This will cause SMs to lock out the AP for 15 minutes.

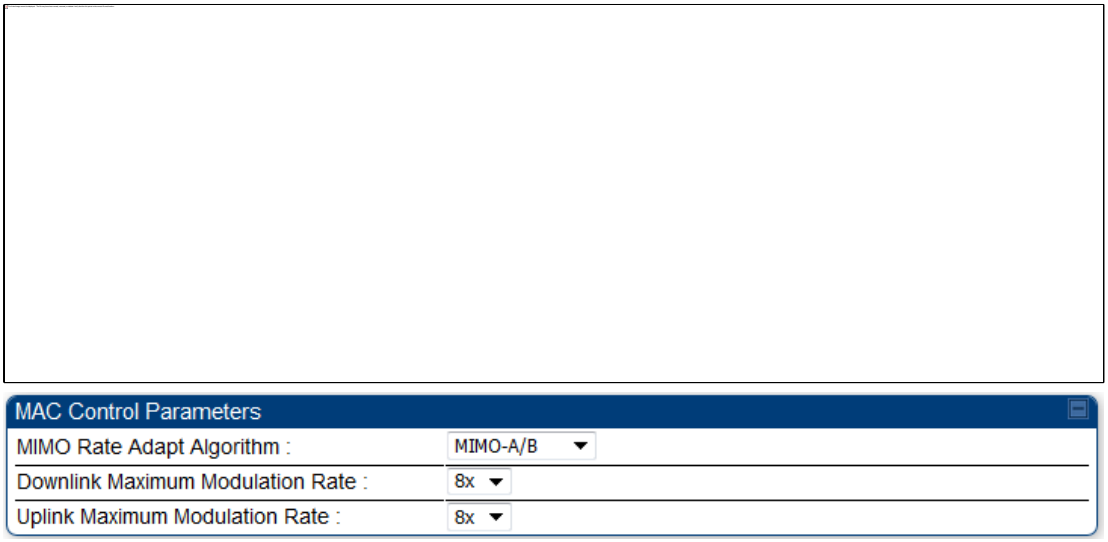
	Note This option is not displayed if the Frame Period is set to 5 ms.
PMP 450/430 Legacy Mode	This setting allows the AP to communicate with SMs on Legacy versions of software (450 SM earlier than 13.2, 430 SM earlier than 13.4.1). This is not recommended to be left enabled as it degrades performance. SMs should then be upgraded to the same version as the AP.
Receive Quality Debug	To aid in link performance monitoring, the AP and SM now report the number of fragments received per modulation (i.e. QPSK, 16-QAM, 64-QAM) and per channel (polarization). **Note** Due to CPU load, this will slightly degrade packet per second processing.

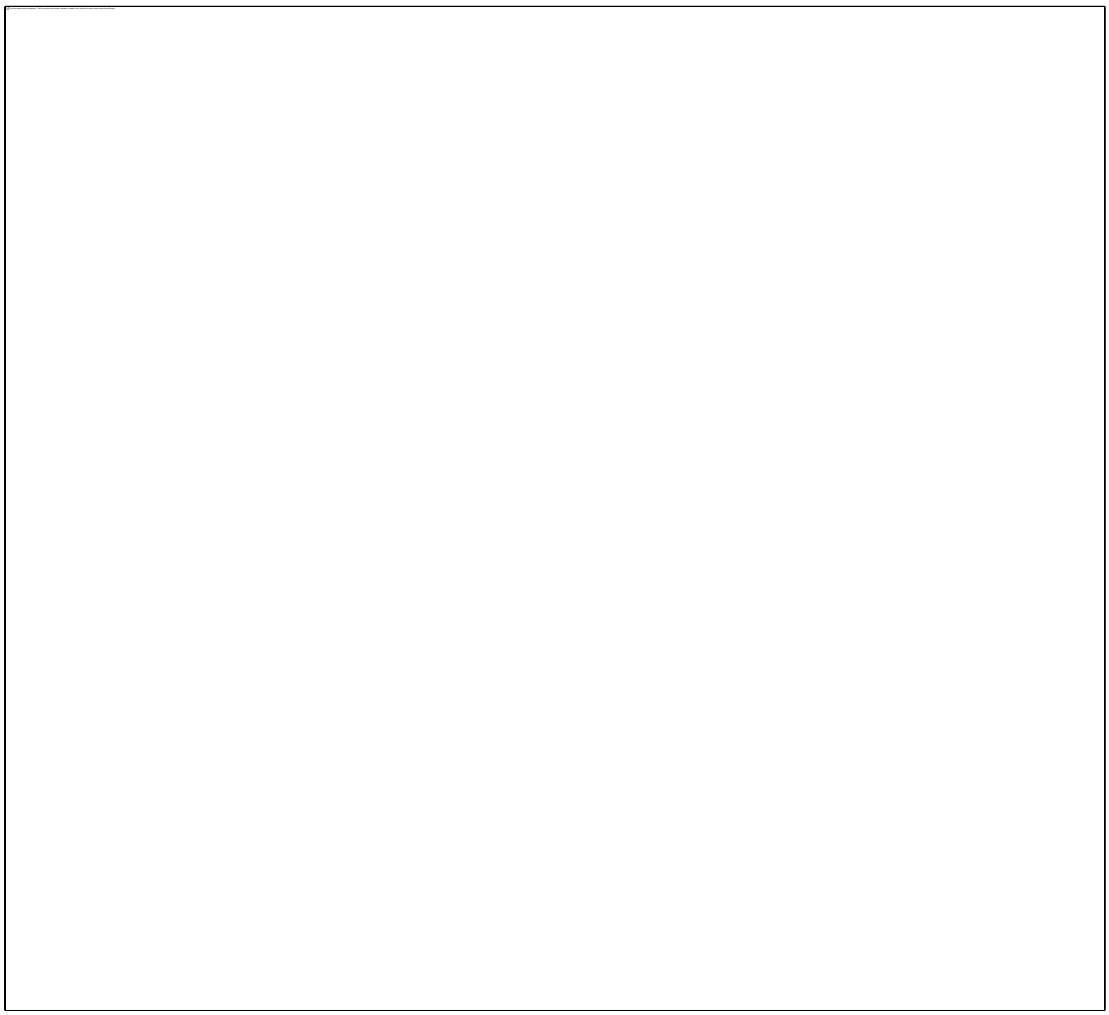
PMP/PTP 450i Series – configuring radio

Radio page - PMP 450i AP 3 GHz

The **Radio** tab of the PMP 450i AP 3 GHz is shown in Figure 149.

Figure 149 PMP 450i AP Radio attributes - 3 GHz





Note

Refer Table 156 PMP 450i SM Radio attributes – 5 GHz on page 7-153 for parameter details

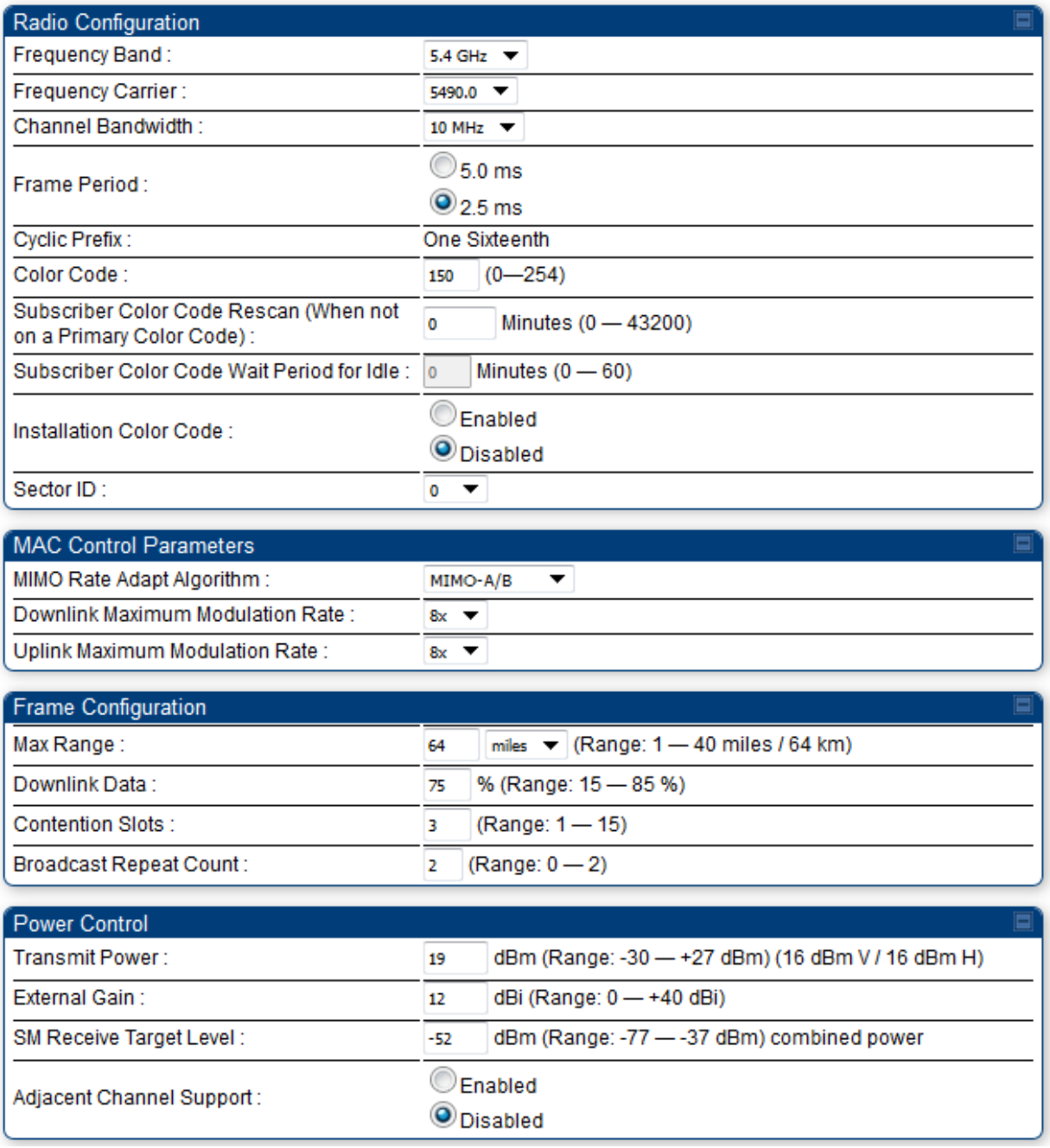
Radio page - PMP 450i AP 5 GHz

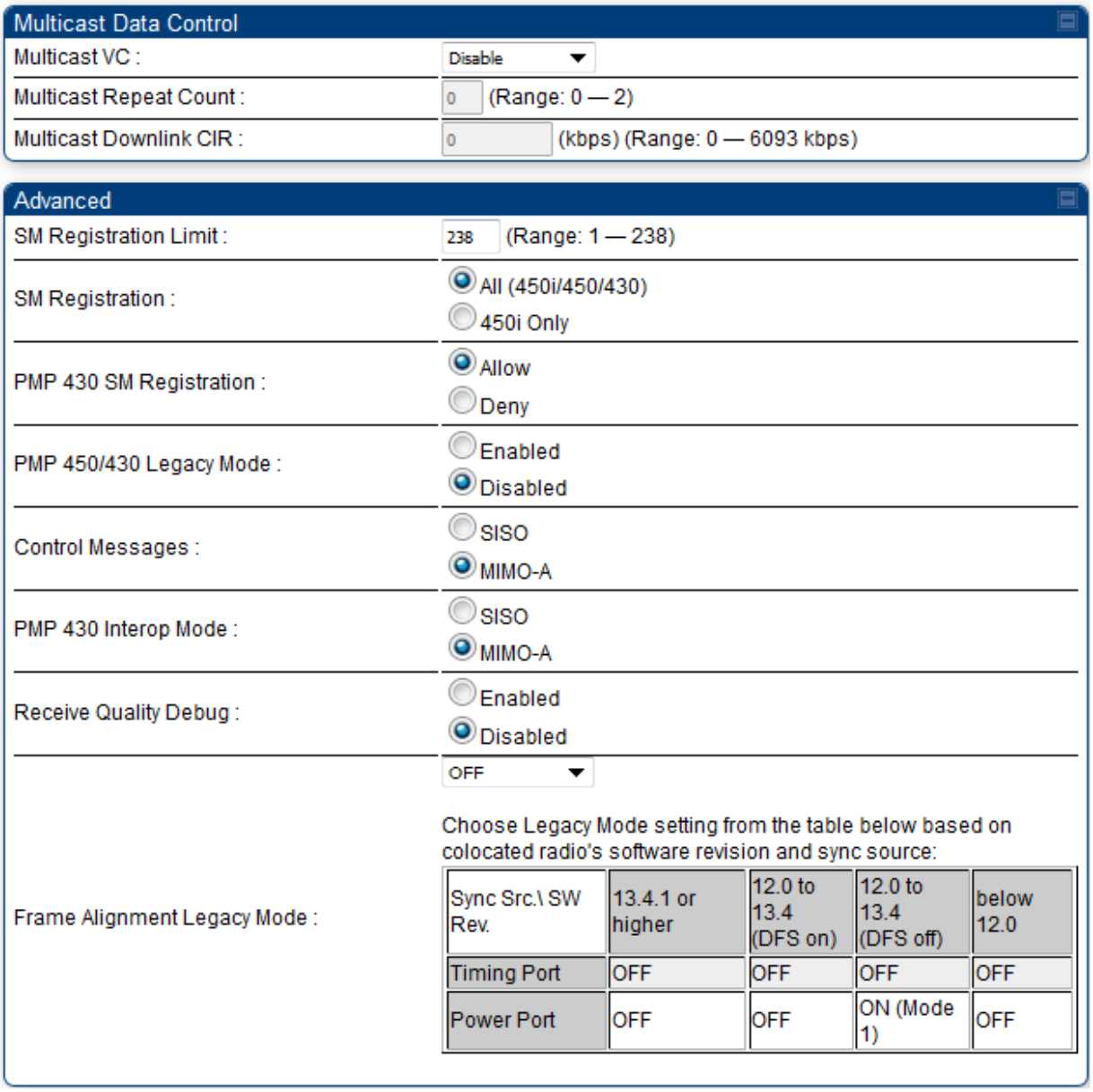
The **Radio** tab of the PMP 450i AP contains some of the configurable parameters that define how an AP operates.

Note

Only the frequencies available for your region and the selected Channel bandwidth are displayed.

Table 155 PMP 450i AP Radio attributes - 5 GHz





Attribute	Meaning
Frequency Band	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Frequency Carrier	
Alternate Frequency Carrier 1 and 2	These parameters are displayed based on Regional Settings. Refer Country on page 7-73
Channel Bandwidth	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Cyclic Prefix	
Frame Period	
Color Code	

Subscriber Color Code Rescan (When not on a Primary Color Code)	
Subscriber Color Code Wait Period for Idle	
Installation Color Code	
Sector ID	
MMO Rate Adapt Algorithm	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Downlink Maximum Modulation Rate	
Uplink Maximum Modulation Rate	
Max Range	
Downlink Data	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Contention Slots (a.k.a. Control Slots)	This field indicates the number of (reserved) Contention slots configured by the operator. The SM uses reserved Contention slots and unused data slots for bandwidth requests. See Contention slots on page7-196.
Broadcast Repeat Count	The default is 2 repeats (in addition to the original broadcast packet, for a total of 3 packets sent for everyone needed), and is settable to 1 or 0 repeats (2 or 1 packets for every broadcast). ARQ (Automatic Repeat reQuest) is not present in downlink broadcast packets, since it can cause unnecessary uplink traffic from every SM for each broadcast packet. For successful transport without ARQ, the AP repeats downlink broadcast packets. The SMs filter out all repeated broadcast packets and, thus, do not transport further. The default of 2 repeats is optimum for typical uses of the network as an internet access system. In applications with heavy download broadcast such as video distribution, overall throughput is significantly improved by setting the repeat count to 1 or 0. This avoids flooding the downlink with repeat broadcast packets.
Transmitter Power	This value represents the combined power of the AP's two transmitters. Nations and regions may regulate transmitter output power. For example • 900 MHz, 5.4 GHz and 5.8 GHz modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance.

	The professional installer of the equipment has the responsibility to • maintain awareness of applicable regulations. • calculate the permissible transmitter output power for the module. • confirm that the initial power setting is compliant with national or regional regulations. • confirm that the power setting is compliant following any reset of the module to factory defaults.
External Gain	This value needs to correspond to the published gain of the antenna used to ensure the radio will meet regulatory requirements.
SM Receive Target Level	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Adjacent Channel Support	For some frequency bands and products, this setting is needed if AP is operating on adjacent channels with zero guard band.
Multicast VC Data Rate	This pull-down menu of the Multicast Data Control screen helps in configuring multicast packets to be transmitted over a dedicated channel at a configurable rate of 2X, 4X or 6X. The default value is "Disable". If set to the default value, all multicast packets are transmitted over the Broadcast VC data path. This feature is available only for the PMP 450 Series and is not backward compatible with PMP 430 series of radios.
Multicast Repeat Count	This value is the number of packets that are repeated for every multicast VC packet received on the AP (located under **Radio** tab of **Configuration**). Multicast (like Broadcast) packets go over a VC that is shared by all SMs, so there is no guaranteed delivery. The repeat count is an attempt to improve the odds of the packets getting over the link. If the user has issues with packets getting dropped, they can use this parameter to improve the performance at the cost of the overall throughput possible on that channel. The default value is *0*.
Multicast Downlink CIR	This value is the committed information rate for the multicast downlink VC (located under the **Radio** tab of **Configuration**). The default value is *0* kbps. The range of this parameter is based on the number of repeat counts. The higher the repeat count, the lower the range for the multicast downlink CIR.
SM Registration Limit	This parameter allows to configure the limit for maximum number of SMs that can register to a PMP AP. The configurable range is from 1 to 238.  **Note** SM trying to register after the maximum configured limit has been reached is locked out for 15 minutes and a message is displayed at the SM..

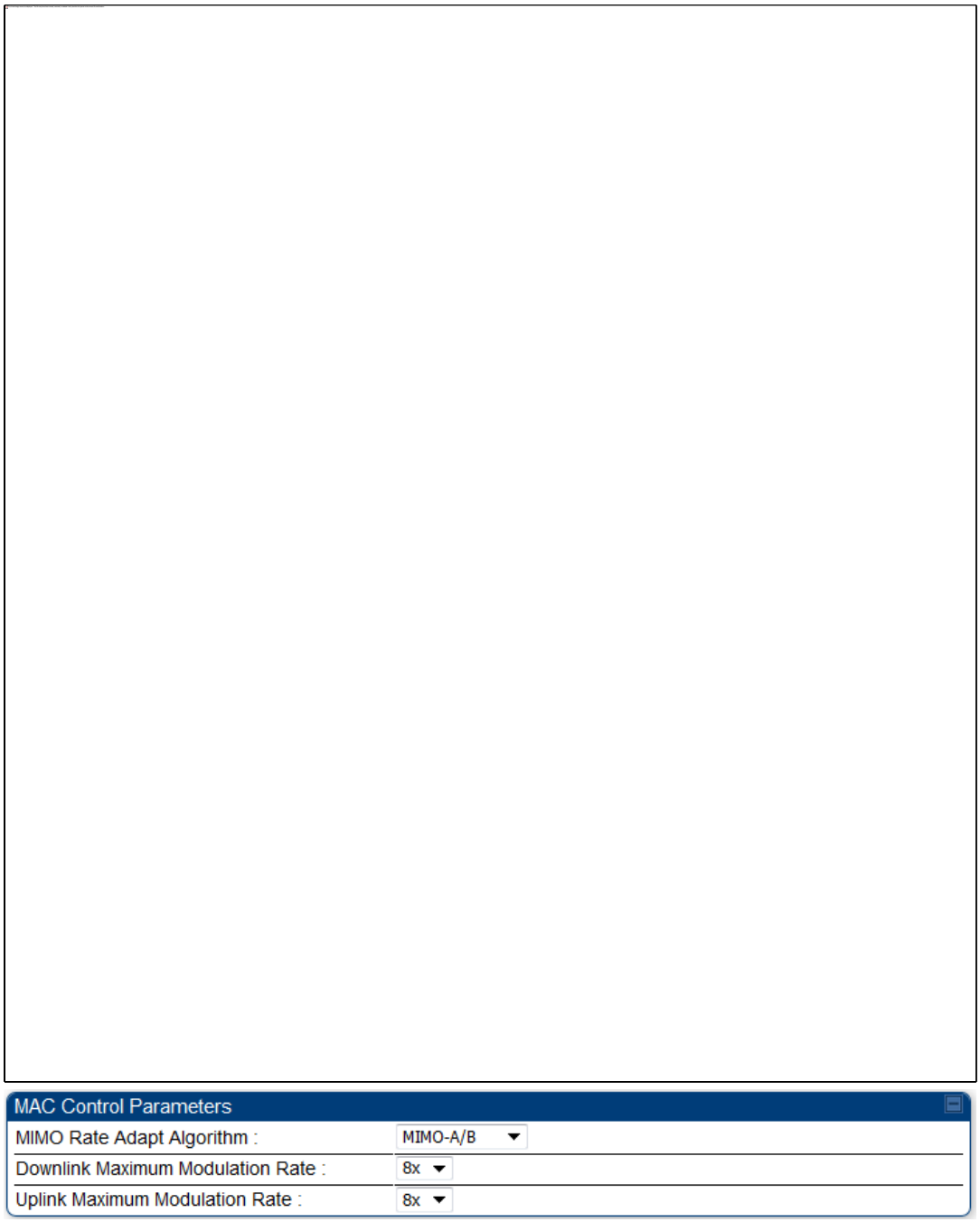
<table>
<tr><td>SM Registration</td><td>All: This field allows to control registration of all type 450 Platform Family SM including 450 Series SM (450i/450b/450/430) or 450i Series SM..
450i Only: This field allows to control registration of 450i Series SM only</td></tr>
<tr><td>PMP 430 SM Registration</td><td>This field allows to control PMP 430 SMs. It allows to configure whether PMP 430 SMs are registered to AP or not. By default, it is enabled and PMP 430 SM registrations are accepted.
When this field is set to disabled, PMP 430 SM’s registrations fail with reject reason 8. This will cause SMs to lock out the AP for 15 minutes.
  Note
This option is not displayed if the Frame Period is set to 5 ms. This option applies only to PMP 450/450i/450m Series APs - 5 GHz.</td></tr>
<tr><td>Control Message</td><td>Controls whether the control messages are sent in MIMO-B or MIMO-A mode. MIMO-A is recommended. However, if an AP on 13.2 is attempting to connect to an SM on 13.1.3 or before, changing to MIMO-B may aid in getting the SM registered.</td></tr>
<tr><td>PMP 450/430 Legacy mode</td><td>See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138</td></tr>
<tr><td>PMP 430 Interop Mode</td><td>For n-1 compatibility, In SISO mode this forces the AP to only send Control and Beacons over one of the RF paths.</td></tr>
<tr><td>Receive Quality Debug</td><td>To aid in link performance monitoring, the AP and SM now report the number of fragments received per modulation (i.e. QPSK, 16-QAM, 64-QAM) and per channel (polarization).
  Note
Due to CPU load, this will slightly degrade packet per second processing.</td></tr>
<tr><td>Frame Alignment Legacy Mode</td><td>
<table>
<tr><th>Mode</th><th>Behavior (non-900 MHz radios)</th><th>Behavior (FSK 900 MHz radios)</th></tr>
<tr><td>OFF</td><td>By default, frame start is aligned with devices with Timing Port synchronization
If the synchronization source changes (due to Autosync or otherwise) the radio will dynamically adjust its frame start to maintain alignment with the</td><td>By default, frame start is aligned with FSK 900 MHz devices with Timing Port synchronization
If the synchronization source changes (due to Autosync or otherwise) the radio will dynamically adjust its frame start to maintain</td></tr>
</table>
</td></tr>
</table>

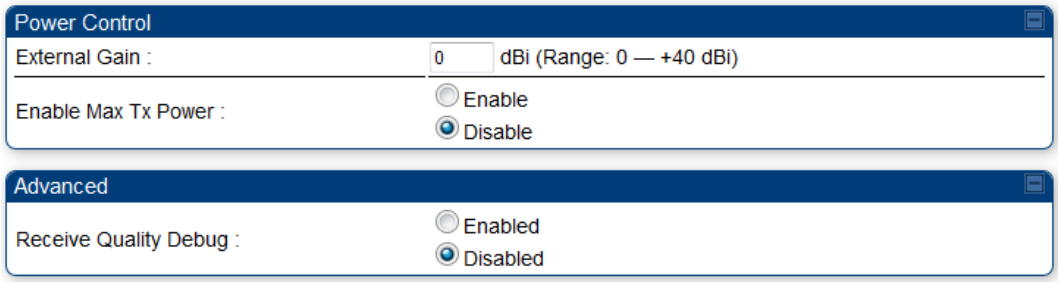
		default frame start timing	alignment with the default frame start timing
	ON (Mode 1)	The radio will align with devices running software versions from 12.0 to 13.4.	The radio will align with FSK 900 MHz devices running software versions from 12.0 to 13.4.
	ON (Mode 2)	N/A	The radio will align with FSK 900 MHz devices with software versions 11.2 or older.

Radio page - PMP 450i SM 3 GHz

The **Radio** tab of the PMP 450i SM 3 GHz is shown in Figure 150.

Figure 150 PMP 450i SM Radio attributes - 3 GHz





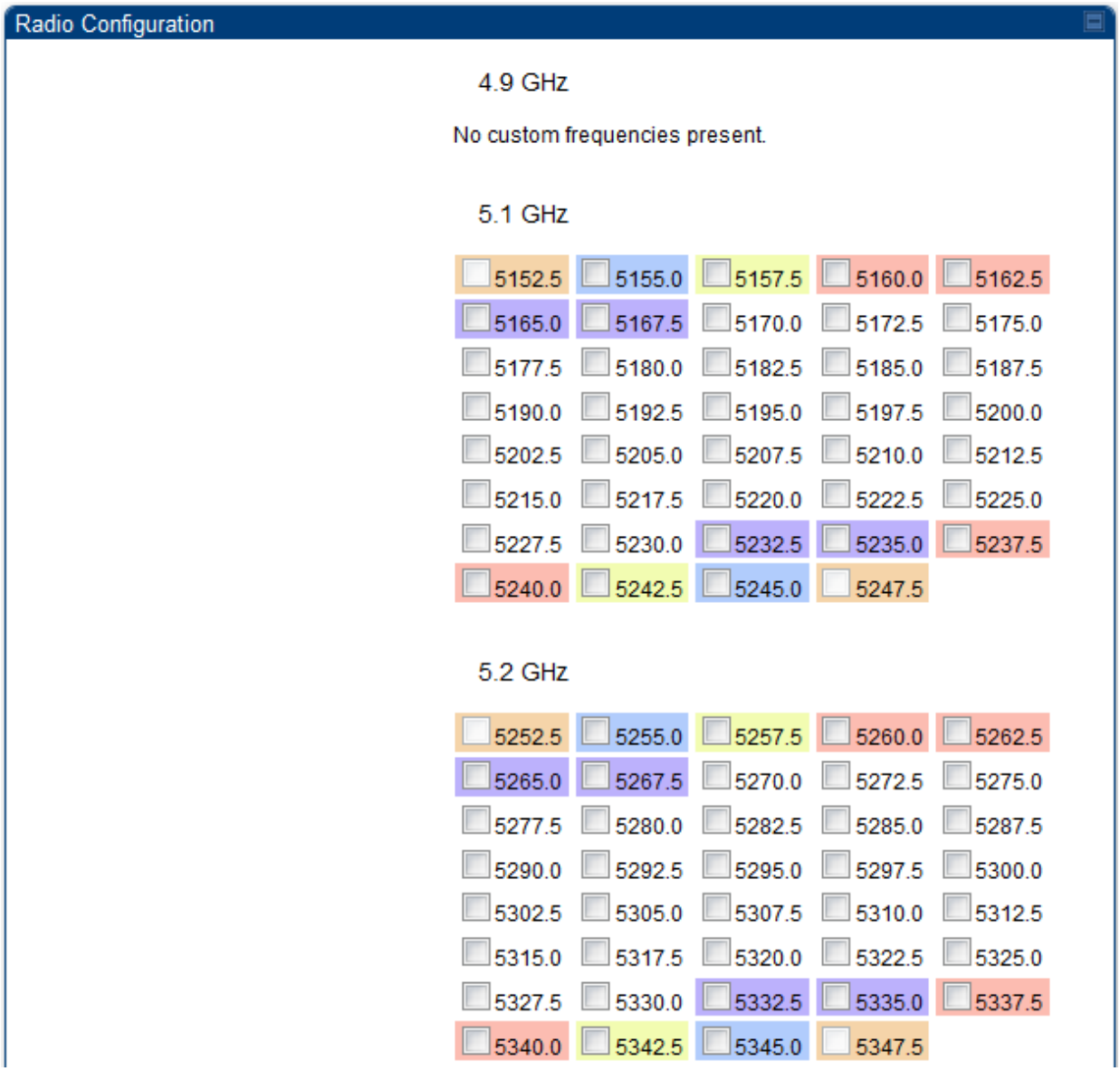
Note

Refer Table 156 PMP 450i SM Radio attributes – 5 GHz on page 7-153 for parameter details

Radio page – PMP 450i SM 5 GHz

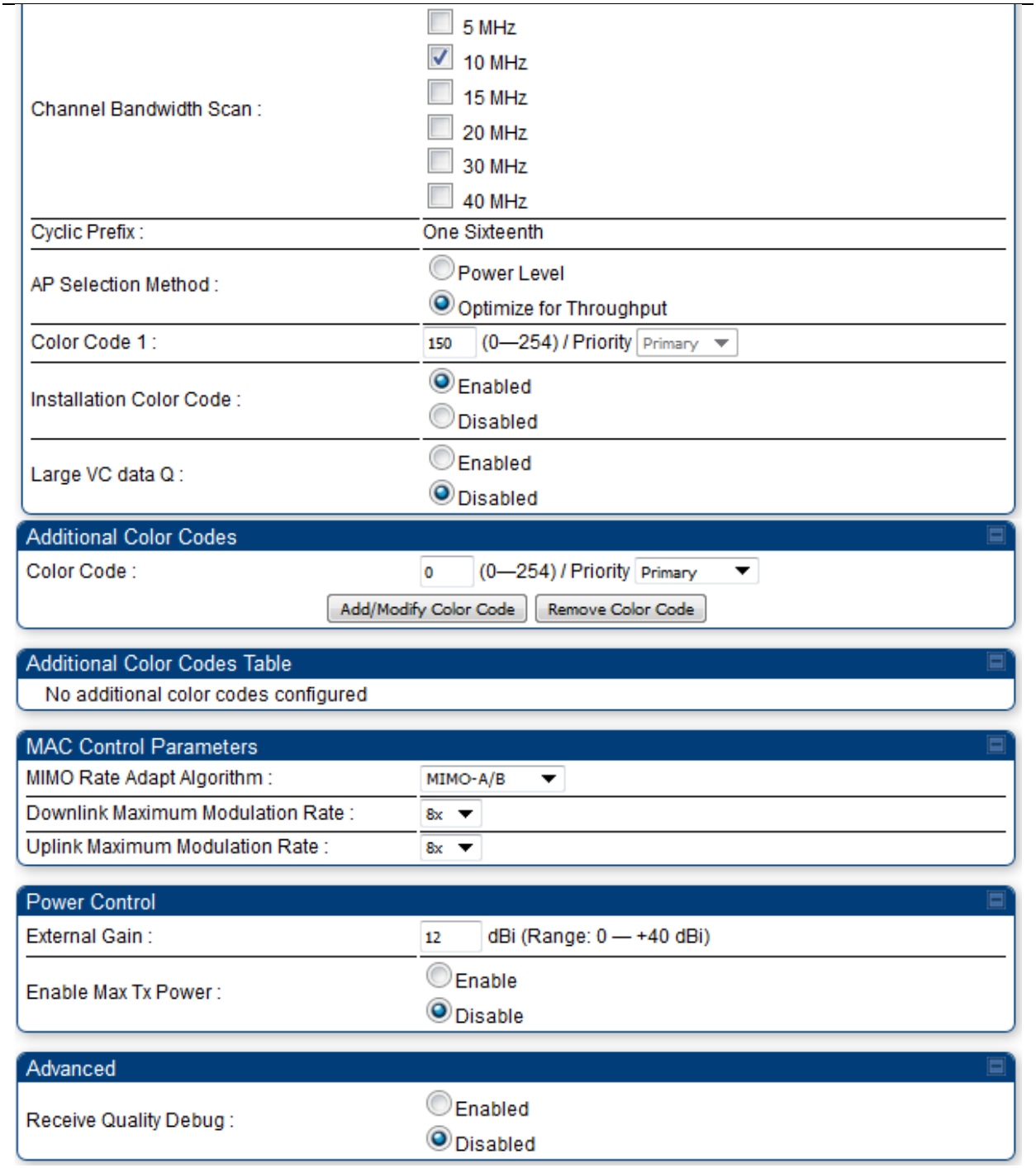
The **Radio** page of PMP 450i SM is explained in Table 156.

Table 156 PMP 450i SM Radio attributes – 5 GHz



Custom Radio Frequency Scan Selection List :	5.4 GHz ☐ 5472.5 ☐ 5475.0 ☐ 5477.5 ☐ 5480.0 ☐ 5482.5 ☐ 5485.0 ☐ 5487.5 ☑ 5490.0 ☐ 5492.5 ☐ 5495.0 ☐ 5497.5 ☐ 5500.0 ☐ 5502.5 ☐ 5505.0 ☐ 5507.5 ☐ 5510.0 ☐ 5512.5 ☐ 5515.0 ☐ 5517.5 ☐ 5520.0 ☐ 5522.5 ☐ 5525.0 ☐ 5527.5 ☐ 5530.0 ☐ 5532.5 ☐ 5535.0 ☐ 5537.5 ☐ 5540.0 ☐ 5542.5 ☐ 5545.0 ☐ 5547.5 ☐ 5550.0 ☐ 5552.5 ☐ 5555.0 ☐ 5557.5 ☐ 5560.0 ☐ 5562.5 ☐ 5565.0 ☐ 5567.5 ☐ 5570.0 ☐ 5572.5 ☐ 5575.0 ☐ 5577.5 ☐ 5580.0 ☐ 5582.5 ☐ 5585.0 ☐ 5587.5 ☐ 5590.0 ☐ 5592.5 ☐ 5595.0 ☐ 5597.5 ☐ 5600.0 ☐ 5602.5 ☐ 5605.0 ☐ 5607.5 ☐ 5610.0 ☐ 5612.5 ☐ 5615.0 ☐ 5617.5 ☐ 5620.0 ☐ 5622.5 ☐ 5625.0 ☐ 5627.5 ☐ 5630.0 ☐ 5632.5 ☐ 5635.0 ☐ 5637.5 ☐ 5640.0 ☐ 5642.5 ☐ 5645.0 ☐ 5647.5 ☐ 5650.0 ☐ 5652.5 ☐ 5655.0 ☐ 5657.5 ☐ 5660.0 ☐ 5662.5 ☐ 5665.0 ☐ 5667.5 ☐ 5670.0 ☐ 5672.5 ☐ 5675.0 ☐ 5677.5 ☐ 5680.0 ☐ 5682.5 ☐ 5685.0 ☐ 5687.5 ☐ 5690.0 ☐ 5692.5 ☐ 5695.0 ☐ 5697.5 ☐ 5700.0 ☐ 5702.5 ☐ 5705.0 ☐ 5707.5 ☐ 5710.0 ☐ 5712.5 ☐ 5715.0 ☐ 5717.5 ☐ 5720.0 ☐ 5722.5


5.7 GHz
5727.5 5730.0 5732.5 5735.0 5737.5
5740.0 5742.5 5745.0 5747.5 5750.0
5752.5 5755.0 5757.5 5760.0 5762.5
5765.0 5767.5 5770.0 5772.5 5775.0
5777.5 5780.0 5782.5 5785.0 5787.5
5790.0 5792.5 5795.0 5797.5 5800.0
5802.5 5805.0 5807.5 5810.0 5812.5
5815.0 5817.5 5820.0 5822.5 5825.0
5827.5 5830.0 5832.5 5835.0 5837.5
5840.0 5842.5 5845.0 5847.5 5850.0
5852.5 5855.0 5857.5 5860.0 5862.5
5865.0 5867.5 5870.0 5872.5 5875.0
5877.5 5880.0 5882.5 5885.0 5887.5
5890.0 5892.5 5895.0 5897.5 5900.0
5902.5 5905.0 5907.5 5910.0 5912.5
5915.0 5917.5 5920.0 5922.5
5 MHz only
<= 10 MHz
<=15 MHz
<=20 MHz
<=30 MHz
Not available in this region
Select All
Select All 4.9
Select All 5.1
Select All 5.2
Select All 5.4
Select All 5.7
Clear All
Restore



Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.
Channel Bandwidth Scan	The channel size used by the radio for RF transmission. **Note** Selecting multiple channel bandwidths will increase registration and re-registration times.

Cyclic Prefix	The cyclic prefix for which AP scanning is executed.
AP Selection Method	Operators may configure the method by which a scanning SM selects an AP. By default, AP Selection Method is set to "Optimize for Throughput", which has been the mode of operation in releases prior to 12.0.3.1. **Power Level**: AP selection based solely on power level **Note** For operation with a PMP 450m AP, select the Power Level option *or* **Optimize for Throughput**: AP selection based on throughput optimization – the selection decision is based on power level (which affects the modulation state), channel bandwidth (which affects throughput) and number of SM registrations to the AP (which affects system contention performance).
Color Code 1	Color code allows you to force the SM to register to only a specific AP, even where the SM can communicate with multiple APs. For registration to occur, the color code of the SM and the AP *must* match. Specify a value from 0 to 254. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes). SMs may be configured with up to 20 color codes. These color codes can be tagged as **Primary**, **Secondary**, or **Tertiary**, or **Disable**. When the SM is scanning for APs, it will first attempt to register to an AP that matches one of the SM's primary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM's secondary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM's tertiary color codes. This is all done in the scanning mode of the SM and will repeat until a registration has occurred. Color codes in the same priority group are treated equally. For example, all APs matching one of the SM's primary color codes are analyzed equally. Likewise, this evaluation is done for the secondary and tertiary groups in order. The analysis for selecting an AP within a priority group is based on various inputs, including signal strength and number of SMs already registered to each AP. The first color code in the configuration is the pre-Release 9.5 color code. Thus, it is always a primary color code for legacy reasons. The color codes can be disabled, with the exception of the first color code.

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. 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.
Large VC data Queue	SM and BH have a configurable option used to prevent packet loss in the uplink due to bursting IP traffic. This is designed for IP burst traffic particular to video surveillance applications.
Color Code	Color code allows to force the BHS to register to only a specific BHM, even where the BHS can communicate with multiple BHMs. For registration to occur, the color code of the BHS and the BHM *must* match. Specify a value from 0 to 254. The color codes can be disabled, with the exception of the first color code.
MIMO Rate Adapt Algorithm	This pull-down menu helps in configuring the Rate Adapt Algorithm to MIMO-A/B, MIMO-B only, or MIMO-A only.
Downlink Maximum Modulation Rate	This pull-down menu helps in configuring the Downlink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is "8X".
Uplink Maximum Modulation Rate	This pull-down menu helps in configuring the Uplink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is "8X".
External Gain	This value represents the antenna gain. For ODUs with integrated antenna, this is set at the correct value in the factory. For Connectorized ODUs with external antenna, the user must set this value to the overall antenna gain, including any RF cable loss between the ODU and the antenna.
Enable Max Tx Power	This field allows to enable or disable maximum transmission power.
Receive Quality Debug	To aid in link performance monitoring, the AP and SM now report the number of fragments received per modulation (i.e. QPSK, 16-QAM, 64-QAM) and per channel (polarization).  **Note** Due to CPU load, this will slightly degrade packet per second processing.

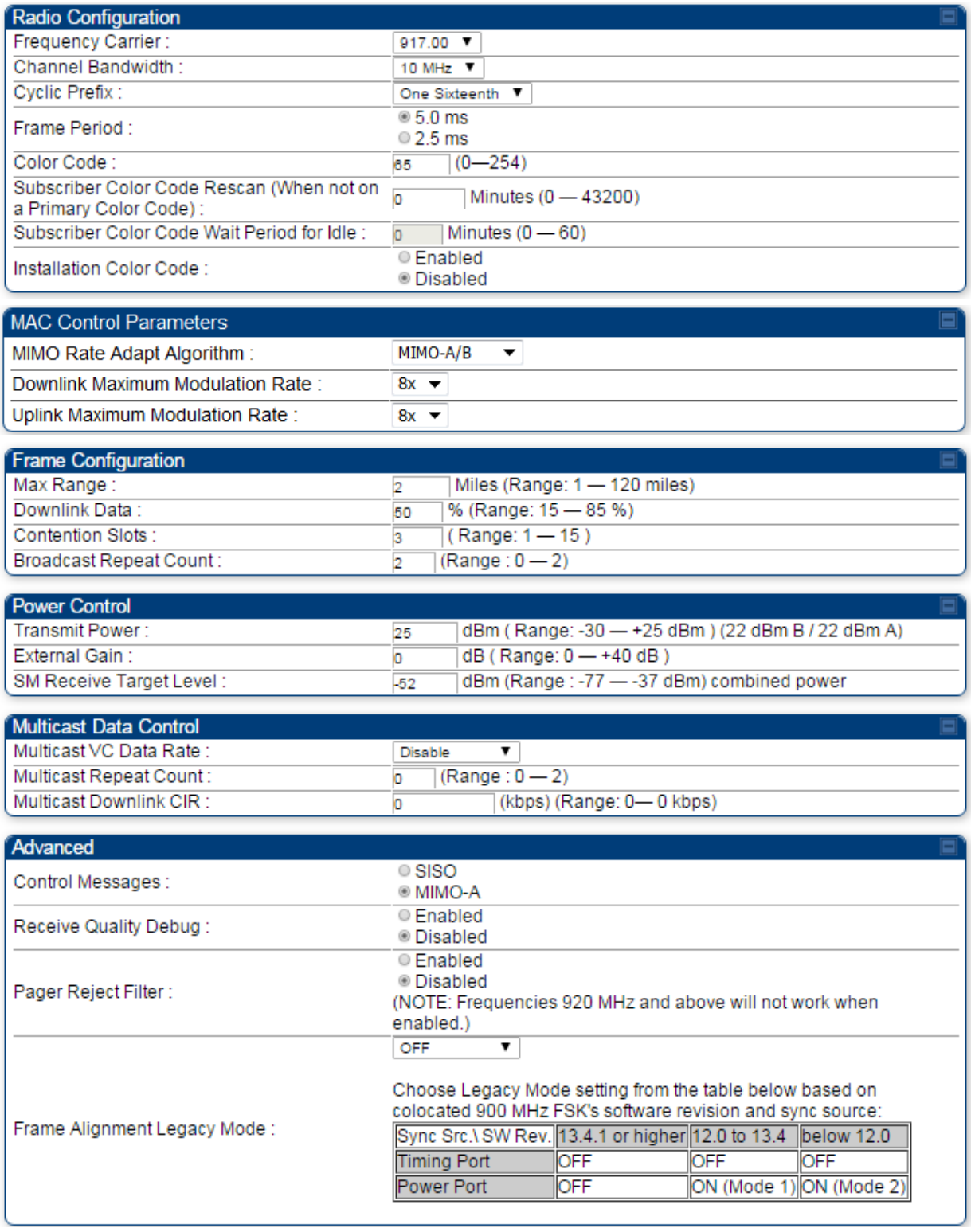
Note

The frequencies that a user can select are controlled by the country or a region and the Channel Bandwidth selected. There can be a case where a user adds a custom frequency (from the Custom Frequencies page on page 7-192) and cannot see it in the pull down menu.

Radio page - PMP 450i AP 900 MHz

The Radio tab of the PMP 450i AP 900 MHz is described in below Table 157.

Table 157 PMP 450i AP Radio attributes - 900 MHz



Radio Configuration

Frequency Carrier :	917.00
Channel Bandwidth :	10 MHz
Cyclic Prefix :	One Sixteenth
Frame Period :	5.0 ms / 2.5 ms
Color Code :	85 (0—254)
Subscriber Color Code Rescan (When not on a Primary Color Code) :	0 Minutes (0 — 43200)
Subscriber Color Code Wait Period for Idle :	0 Minutes (0 — 60)
Installation Color Code :	Enabled / Disabled

MAC Control Parameters

MIMO Rate Adapt Algorithm :	MIMO-A/B
Downlink Maximum Modulation Rate :	8x
Uplink Maximum Modulation Rate :	8x

Frame Configuration

Max Range :	2 Miles (Range: 1 — 120 miles)
Downlink Data :	50 % (Range: 15 — 85 %)
Contention Slots :	3 (Range: 1 — 15)
Broadcast Repeat Count :	2 (Range : 0 — 2)

Power Control

Transmit Power :	25 dBm (Range: -30 — +25 dBm) (22 dBm B / 22 dBm A)
External Gain :	0 dB (Range: 0 — +40 dB)
SM Receive Target Level :	-52 dBm (Range : -77 — -37 dBm) combined power

Multicast Data Control

Multicast VC Data Rate :	Disable
Multicast Repeat Count :	0 (Range : 0 — 2)
Multicast Downlink CIR :	0 (kbps) (Range: 0— 0 kbps)

Advanced

Control Messages :	SISO / MIMO-A
Receive Quality Debug :	Enabled / Disabled
Pager Reject Filter :	Enabled / Disabled (NOTE: Frequencies 920 MHz and above will not work when enabled.)
Frame Alignment Legacy Mode :	OFF Choose Legacy Mode setting from the table below based on colocated 900 MHz FSK's software revision and sync source:

Sync Src.\ SW Rev.	13.4.1 or higher	12.0 to 13.4	below 12.0
Timing Port	OFF	OFF	OFF
Power Port	OFF	ON (Mode 1)	ON (Mode 2)

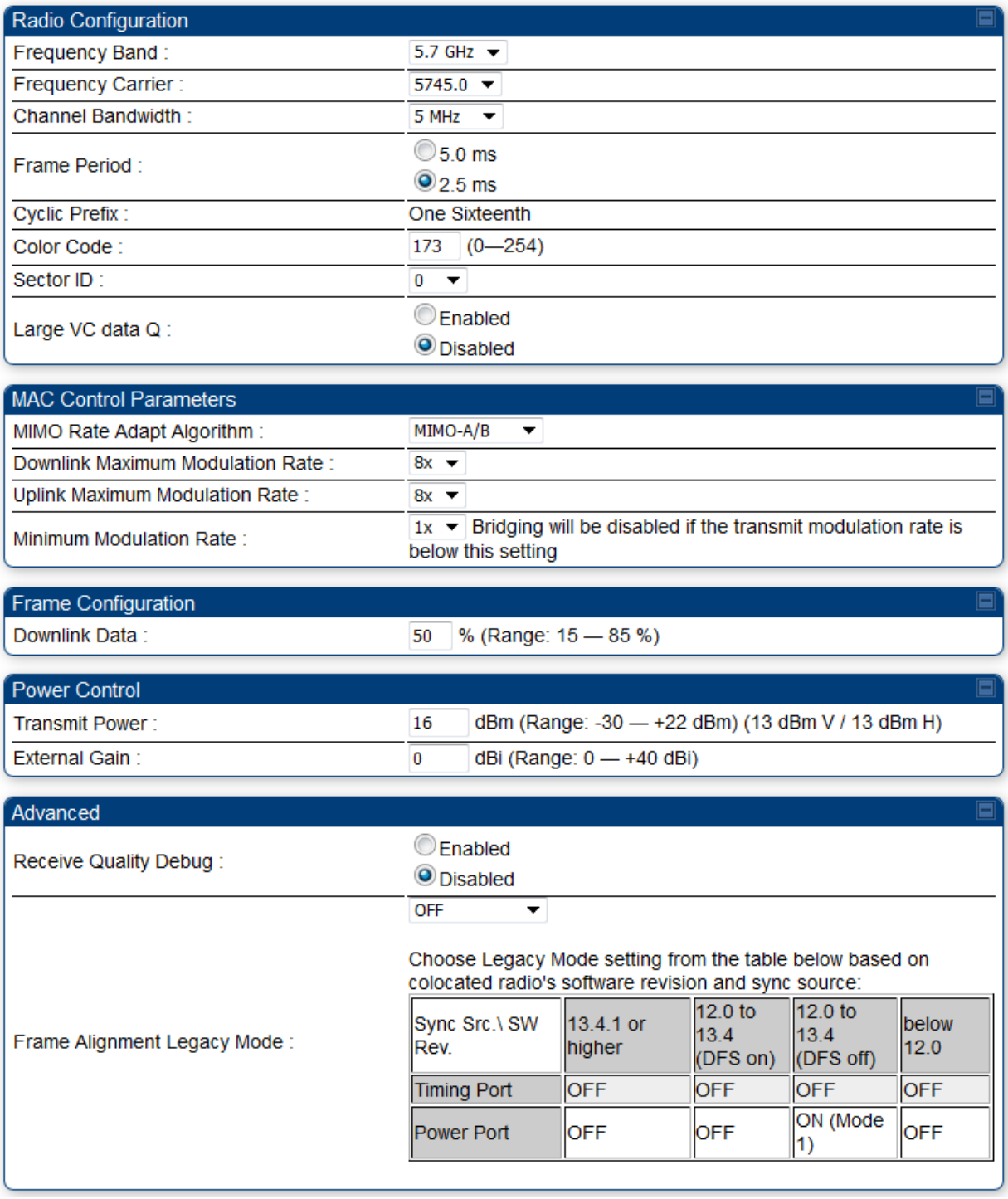
Attribute	Meaning
Frequency Carrier	Specify the frequency for the module to transmit. The default for this parameter is **None**. For a list of channels in the band, see the drop-down list on the radio GUI.
Channel Bandwidth	The channel size used by the radio for RF transmission. The setting for the channel bandwidth must match between the AP and the SM. The supported Channel Bandwidths are 5, 7, 10 and 20 MHz.
Cyclic Prefix	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138.
Frame Period	
Color Code	
Subscriber Color Code Rescan (When not on a Primary Color Code)	
Subscriber Color Code Wait Period for Idle	
Installation Color Code	
MIMO Rate Adapt Algorithm	
Downlink Maximum Modulation Rate	
Uplink Maximum Modulation Rate	
Max Range	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138.
Downlink Data	
Contention Slots (a.k.a. Control Slots)	
Broadcast Repeat Count	
Transmitter Output Power	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.
External Gain	
SM Receive Target Level	See Table 154 PMP 450m AP Radio attributes - 5 GHz on page 7-138
Multicast VC Data Rate	
Multicast Repeat Count	
Multicast Downlink CIR	
Control Message	
Receive Quality Debug	

Pager Reject Filter	In 900 MHz, Pager Reject filter is placed on the AP to block Pager signals which could cause interference to the whole band. The Pager signals typically operate in the 928-930 frequency range. When the filter is enabled, the signals of 920 MHz and above are attenuated which enables better reception of signals in the rest of the band. Note that the AP/SM should not be configured on the frequencies of 920 MHz and above when this filter is enabled.
Frame Alignment Legacy Mode	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PTP 450i BHM 5 GHz

The **Radio** page of PTP 450i BHM is explained in Table 158.

Table 158 PTP 450i BHM Radio page attributes – 5 GHz



Attribute	Meaning
Frequency Band	Select the operating frequency band of the radio. The supported bands are 4.9 GHz, 5.4 GHz and 5.7 GHz.
Frequency Carrier	Specify the frequency for the module to transmit. The default for this parameter is **None**. For a list of channels in the band, see the drop-down list on the radio GUI.
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 prefix means that for every 16 bits of throughput data transmitted, an additional bit is used.
Frame Period	Select the Frame Period of the radio. The supported Frame Periods are: 5 ms and 2.5 ms.
Color Code	Specify a value from 0 to 254. For registration to occur, the color code of the BHM and the BHS must match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each link a different color code. Color code allows you to force a BHS to register to only a specific BHM. The default setting for the color code value is 0. This value matches only the color code of 0 (not all 255 color codes).
Sector ID	This pull-down menu helps in configuring the Sector ID at a configurable value from 0 to 15.
Large VC data Q	**Enable** Large VC Q for applications that burst data high rates. Large Qs may decrease effective throughput for TCP application. **Disable** Large VC Q if application need not handle bursts of data. Large Qs may decrease effective throughput for TCP application.
MIMO Rate Adapt Algorithm	This pull-down menu helps in configuring the Rate Adapt Algorithm to MIMO-A/B, MIMO-B only, or MIMO-A only.

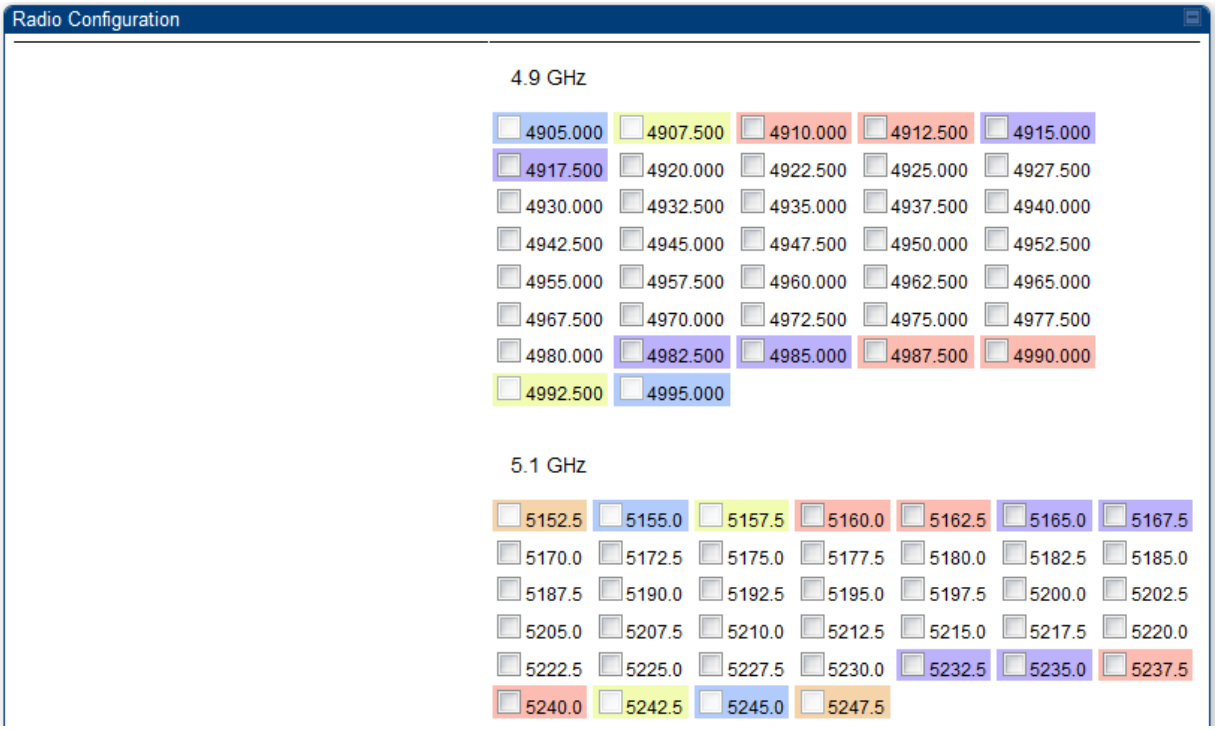
Downlink Maximum Modulation Rate	This pull-down menu helps in configuring the Downlink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “8X”. The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.
Uplink Maximum Modulation Rate	This pull-down menu helps in configuring the Uplink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “8X”. The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.
Minimum Modulation Rate	This pull-down menu helps in configuring the Minimum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “1X”. If the Rate Adapt Algorithm is below this limit, then bridging is disabled. This is used if PTP network can route the traffic through another path.
Downlink Data	Specify the percentage of the aggregate throughput for the downlink (frames transmitted from the BHM to the subscriber). For example, if the aggregate (uplink and downlink total) throughput on the BHM is 132 Mbps, then 75% specified for this parameter allocates 99 Mbps for the downlink and 33 Mbps for the uplink. The default for this parameter is 50%. This parameter must be set in the range of 15% - 85%, otherwise the invalid input will not be accepted and the previously-entered valid setting is used. **Note** In order to prevent self-interference, the frame configuration needs to align. This includes Downlink Data, Max Range and Contention slots.
Transmit Power	This value represents the combined power of the BHM’s two transmitters. Nations and regions may regulate transmit power. For example • PTP 450i Series modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance. The professional installer of the equipment has the responsibility to: • Maintain awareness of applicable regulations. • Calculate the permissible transmitter output power for the module. • Confirm that the initial power setting is compliant with national or regional regulations. Confirm that the power setting is compliant following any reset of the module to factory defaults.
External Gain	This value needs to correspond to the published gain of the antenna used to ensure the radio will meet regulatory requirements.

Receive Quality Debug	To aid in link performance monitoring, the BHM and BHS now report the number of fragments received per modulation (i.e. QPSK, 16-QAM, 64-QAM and 256-QAM) and per channel (polarization). **Note** Due to CPU load, this slightly degrades the packet during per second processing.
Frame Alignment Legacy Mode	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

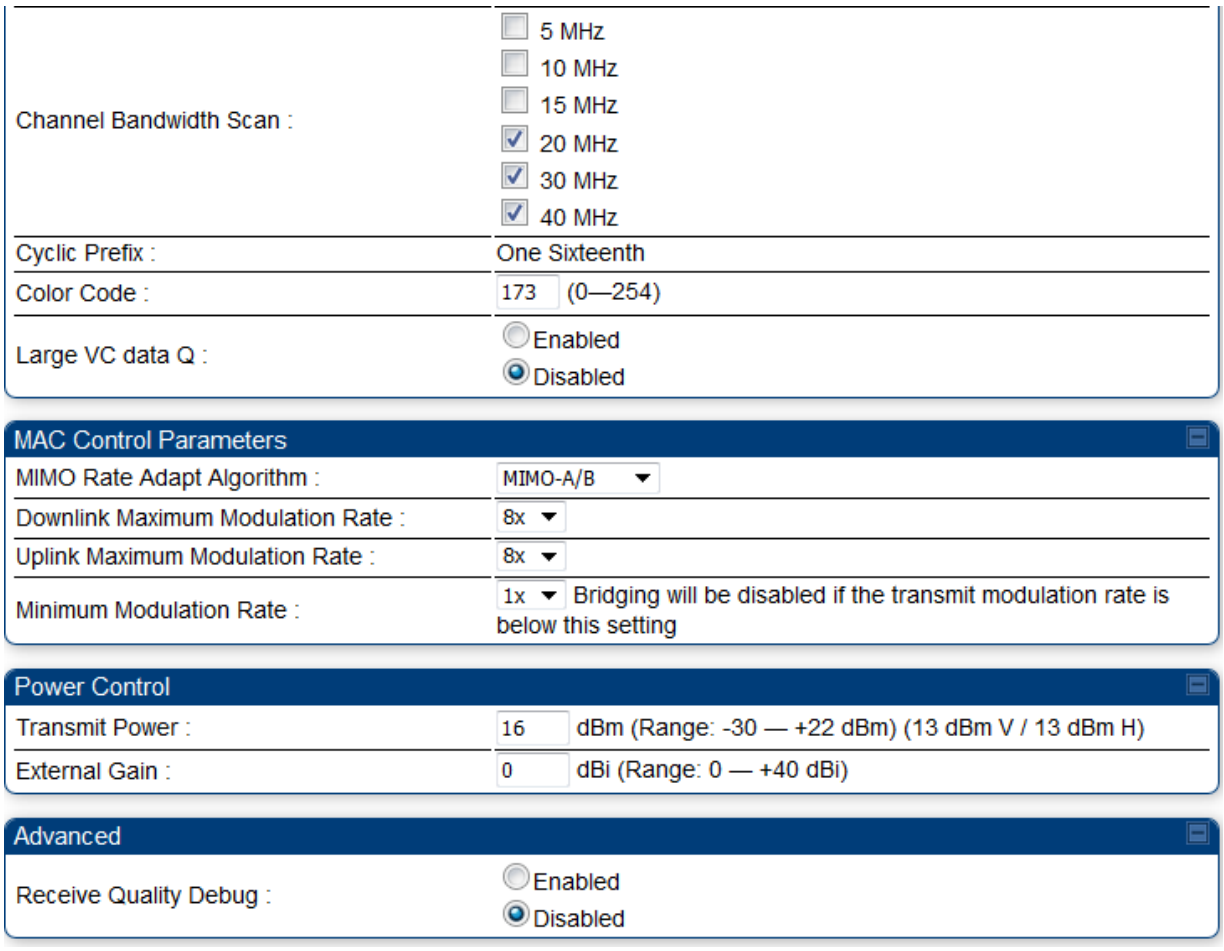
Radio page – PTP 450i BHS 5 GHz

The **Radio** page of PTP 450i BHS is explained in Table 159.

Table 159 PTP 450i BHS Radio attributes – 5 GHz



Custom Radio Frequency Scan Selection List :



Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check any frequency that you want the BHS to scan for BHM transmissions. See Radio Frequency Scan Selection List on page 7-189.
Channel Bandwidth Scan	The channel size used by the radio for RF transmission. **Note** Selecting multiple channel bandwidths will increase registration and re-registration times.
Cyclic Prefix Scan	The cyclic prefix for which BHM scanning is executed.
Color Code	Color code allows to force the BHS to register to only a specific BHM, even where the BHS can communicate with multiple BHMs. For registration to occur, the color code of the BHS and the BHM *must* match. Specify a value from 0 to 254. The color codes can be disabled, with the exception of the first color code.

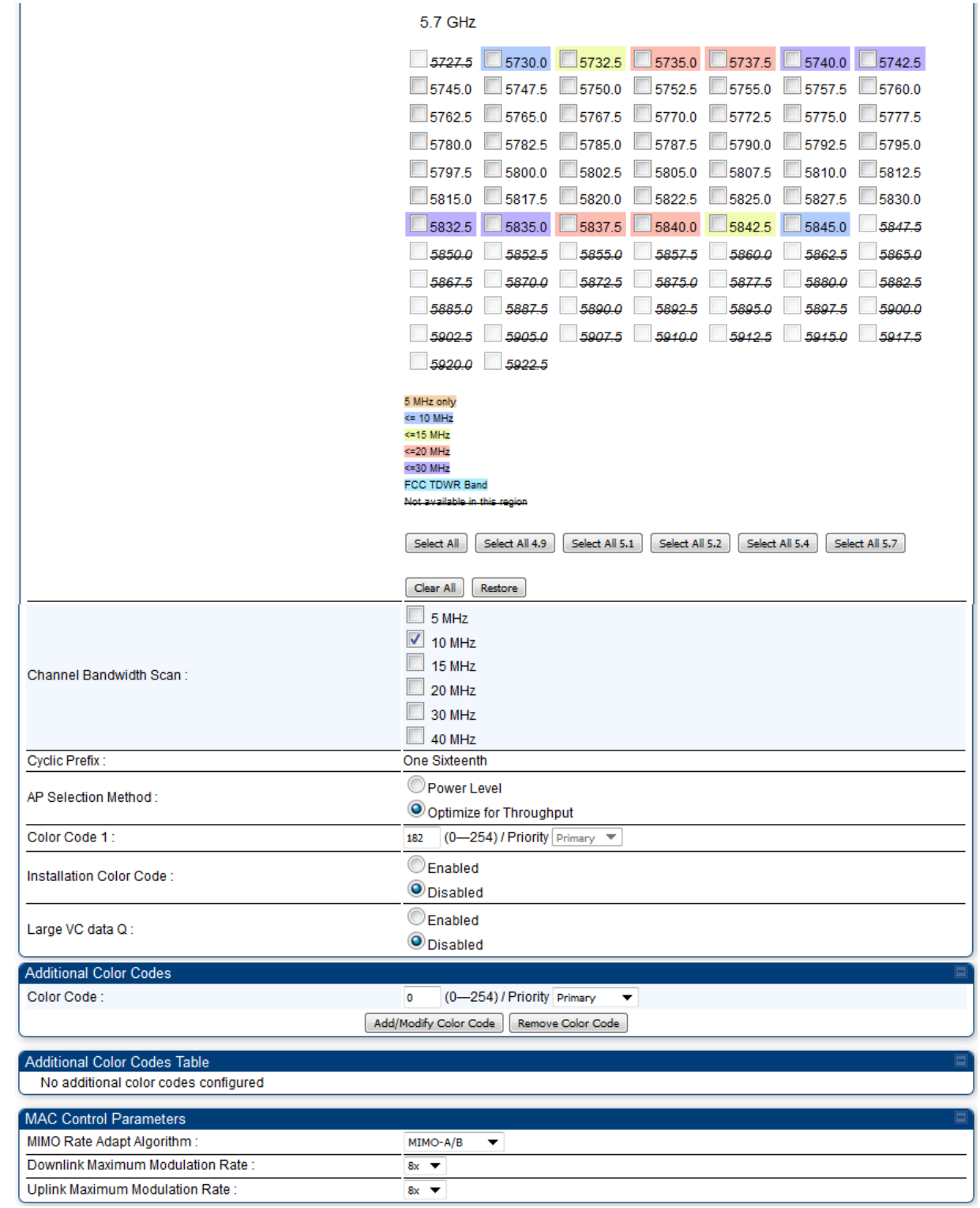
Large VC data Q	BHM and BHS have a configurable option used to prevent packet loss in the uplink due to bursting IP traffic. This is designed for IP burst traffic particular to video surveillance applications.
MIMO Rate Adapt Algorithm	This pull-down menu helps in configuring the Rate Adapt Algorithm to MIMO-A/B, MIMO-B only, or MIMO-A only.
Downlink Maximum Modulation Rate	This pull-down menu helps in configuring the Downlink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “8X”. The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.
Uplink Maximum Modulation Rate	This pull-down menu helps in configuring the Uplink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “8X”. The Rate Adapt Algorithm does not allow the modulation to go beyond this limit.
Minimum Modulation Rate	This pull-down menu helps in configuring the Minimum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is “1X”. If the Rate Adapt Algorithm is below this limit, then bridging is disabled. This is used if PTP network can route the traffic through another path.
Transmit Power	Refer Table 158 PTP 450i BHM Radio page attributes – 5 GHz on page 7-163
External Gain	
Receive Quality Debug	

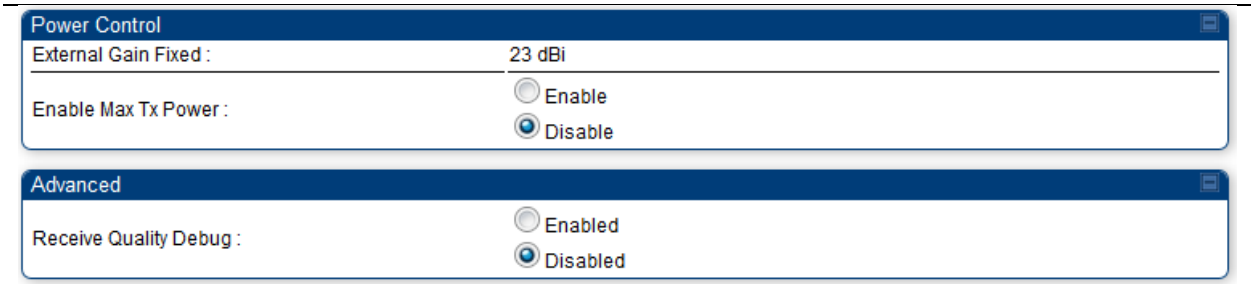
PMP 450b Series - configuring radio

Radio page – PMP 450b Mid-Gain/High Gain SM 5 GHz

The Radio page of PMP 450b Mid-Gain/High Gain SM is explained in Table 160.

Table 160 PMP 450b Mid-Gain/High Gain SM Radio attributes – 5 GHz


5.7 GHz
5727.5 5730.0 5732.5 5735.0 5737.5 5740.0 5742.5
5745.0 5747.5 5750.0 5752.5 5755.0 5757.5 5760.0
5762.5 5765.0 5767.5 5770.0 5772.5 5775.0 5777.5
5780.0 5782.5 5785.0 5787.5 5790.0 5792.5 5795.0
5797.5 5800.0 5802.5 5805.0 5807.5 5810.0 5812.5
5815.0 5817.5 5820.0 5822.5 5825.0 5827.5 5830.0
5832.5 5835.0 5837.5 5840.0 5842.5 5845.0 5847.5
5850.0 5852.5 5855.0 5857.5 5860.0 5862.5 5865.0
5867.5 5870.0 5872.5 5875.0 5877.5 5880.0 5882.5
5885.0 5887.5 5890.0 5892.5 5895.0 5897.5 5900.0
5902.5 5905.0 5907.5 5910.0 5912.5 5915.0 5917.5
5920.0 5922.5
5 MHz only
<= 10 MHz
<=15 MHz
<=20 MHz
<=30 MHz
FCC TDWR Band
Not available in this region
Select All
Select All 4.9
Select All 5.1
Select All 5.2
Select All 5.4
Select All 5.7
Clear All
Restore
Channel Bandwidth Scan :
5 MHz
10 MHz
15 MHz
20 MHz
30 MHz
40 MHz
Cyclic Prefix :
One Sixteenth
AP Selection Method :
Power Level
Optimize for Throughput
Color Code 1 :
182
(0—254) / Priority
Primary
Installation Color Code :
Enabled
Disabled
Large VC data Q :
Enabled
Disabled
Additional Color Codes
Color Code :
0
(0—254) / Priority
Primary
Add/Modify Color Code
Remove Color Code
Additional Color Codes Table
No additional color codes configured
MAC Control Parameters
MIMO Rate Adapt Algorithm :
MIMO-A/B
Downlink Maximum Modulation Rate :
8x
Uplink Maximum Modulation Rate :
8x



Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.
Channel Bandwidth Scan	The channel size used by the radio for RF transmission. **Note** Selecting multiple channel bandwidths will increase registration and re-registration times.
Cyclic Prefix Scan	The cyclic prefix for which AP scanning is executed.
AP Selection Method	Operators may configure the method by which a scanning SM selects an AP. By default, AP Selection Method is set to "Optimize for Throughput", which has been the mode of operation in releases prior to 12.0.3.1. **Power Level**: AP selection based solely on power level **Note** For operation with a PMP 450m AP, select the Power Level option *or* **Optimize for Throughput**: AP selection based on throughput optimization – the selection decision is based on power level (which affects the modulation state), channel bandwidth (which affects throughput) and number of SM registrations to the AP (which affects system contention performance).
Color Code 1	Color code allows you to force the SM to register to only a specific AP, even where the SM can communicate with multiple APs. For registration to occur, the color code of the SM and the AP *must* match. Specify a value from 0 to 254. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code. The default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).

	SMs may be configured with up to 20 color codes. These color codes can be tagged as **Primary**, **Secondary**, or **Tertiary**, or **Disable**. When the SM is scanning for APs, it will first attempt to register to an AP that matches one of the SM's primary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM's secondary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM's tertiary color codes. This is all done in the scanning mode of the SM and will repeat until a registration has occurred. Color codes in the same priority group are treated equally. For example, all APs matching one of the SM's primary color codes are analyzed equally. Likewise, this evaluation is done for the secondary and tertiary groups in order. The analysis for selecting an AP within a priority group is based on various inputs, including signal strength and number of SMs already registered to each AP. The first color code in the configuration is the pre-Release 9.5 color code. Thus, it is always a primary color code for legacy reasons. The color codes can be disabled, with the exception of the first color code.
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. 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.
Large VC data Queue	SM and BH have a configurable option used to prevent packet loss in the uplink due to bursting IP traffic. This is designed for IP burst traffic particular to video surveillance applications.
MIMO Rate Adapt Algorithm	This pull-down menu helps in configuring the Rate Adapt Algorithm to MIMO-A/B, MIMO-B only, or MIMO-A only.
Downlink Maximum Modulation Rate	This pull-down menu helps in configuring the Downlink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is "8X".
Uplink Maximum Modulation Rate	This pull-down menu helps in configuring the Uplink Maximum Modulation Rate at a configurable rate of 1X, 2X, 3X, 4X, 6X, or 8X. The default value is "8X".
External Gain Fixed	This value represents the fixed antenna gain. The fixed antenna gain for Mid-Gain is 16 dBi and High Gain is 23 dBi.

	For ODUs with integrated antenna, this is set at the correct value in the factory. For Connectorized ODUs with external antenna, the user must set this value to the overall antenna gain, including any RF cable loss between the ODU and the antenna.
Enable Max Tx Power	This field allows to enable or disable maximum transmission power.
Receive Quality Debug	To aid in link performance monitoring, the AP and SM now report the number of fragments received per modulation (i.e. QPSK, 16-QAM, 64-QAM) and per channel (polarization). **Note** Due to CPU load, this will slightly degrade packet per second processing.

Note

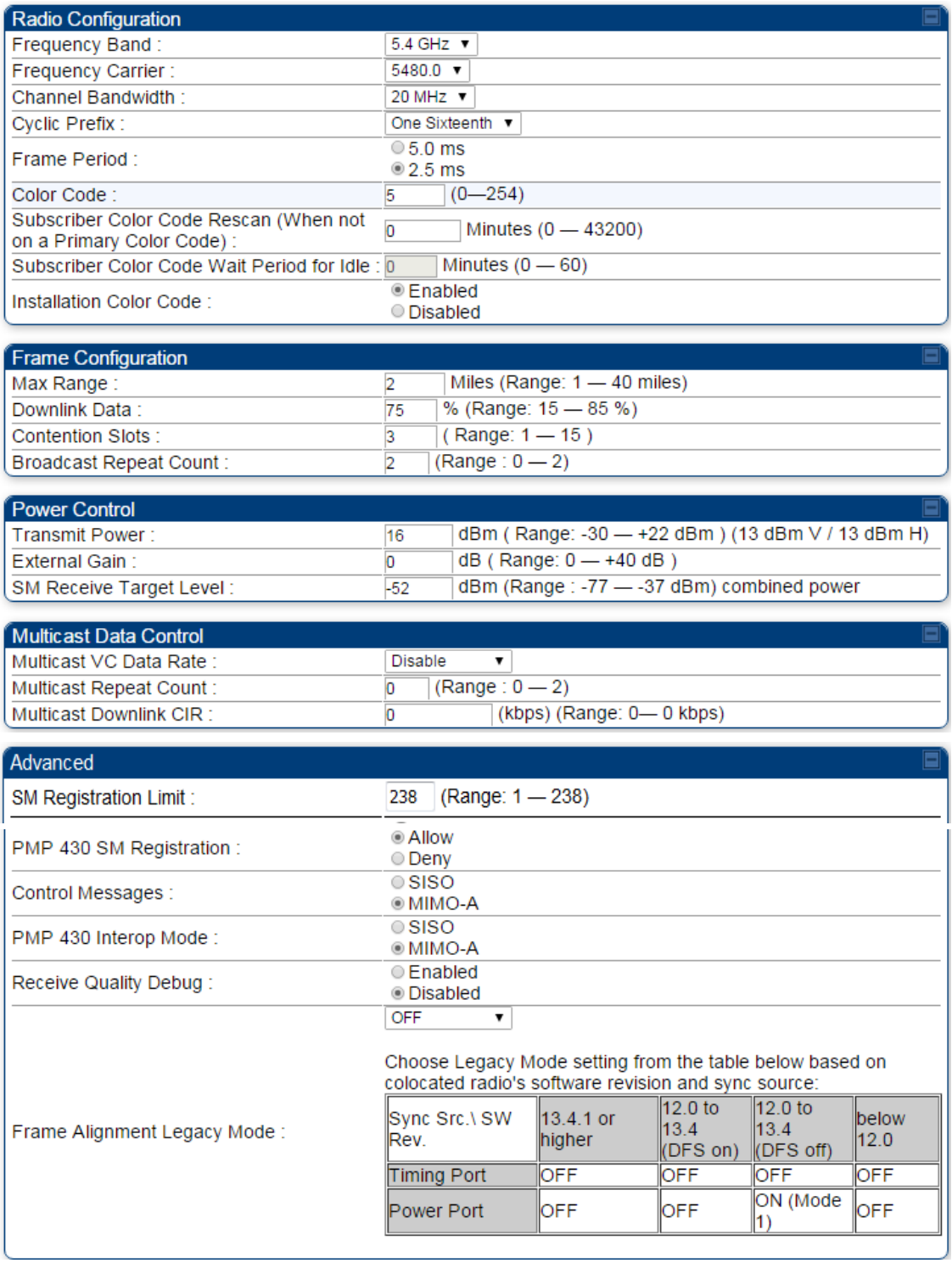
The frequencies that a user can select are controlled by the country or a region and the Channel Bandwidth selected. There can be a case where a user adds a custom frequency (from the Custom Frequencies page on page 7-192) and cannot see it in the pull-down menu.

PMP/PTP 450 Series – configuring radio

Radio page - PMP 450 AP 5 GHz

The **Radio** tab of the AP for 5 GHz is as shown in Table 161.

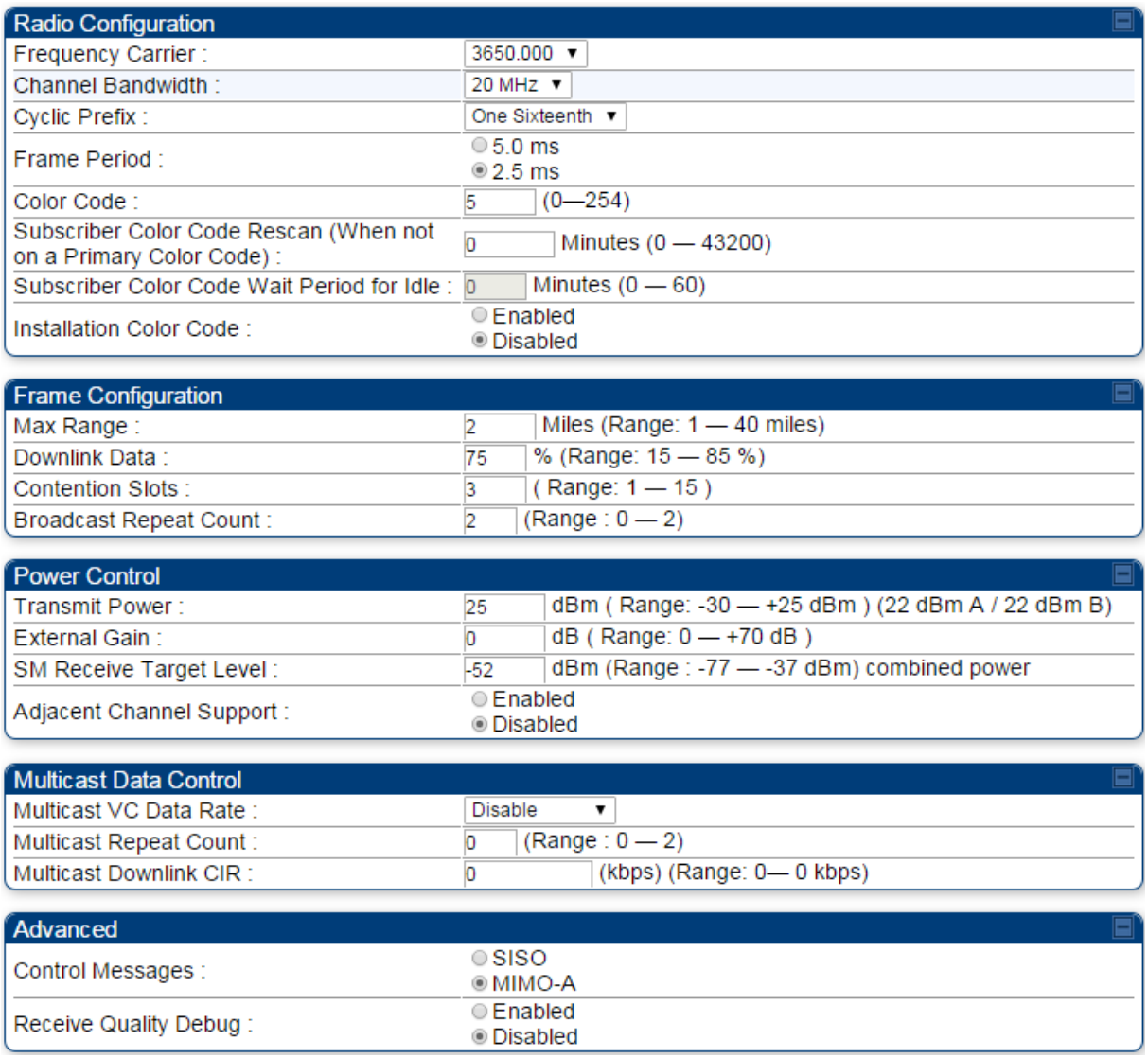
Table 161 PMP 450 AP Radio attributes - 5 GHz



Attribute	Meaning
Radio Configuration, Frame Configuration, Power Control, Multicast Data Control and Advance tab	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.
SM Registration Limit	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.
PMP 430 SM Registration	
PMP 450/430 Legacy Mode	
Control Messages	
PMP 430 Interop Mode	
Receive Quality Debug	
Frame Alignment Legacy Mode	

Radio page - PMP 450 AP 3.65 GHz

Table 162 PMP 450 AP Radio attributes - 3.65 GHz



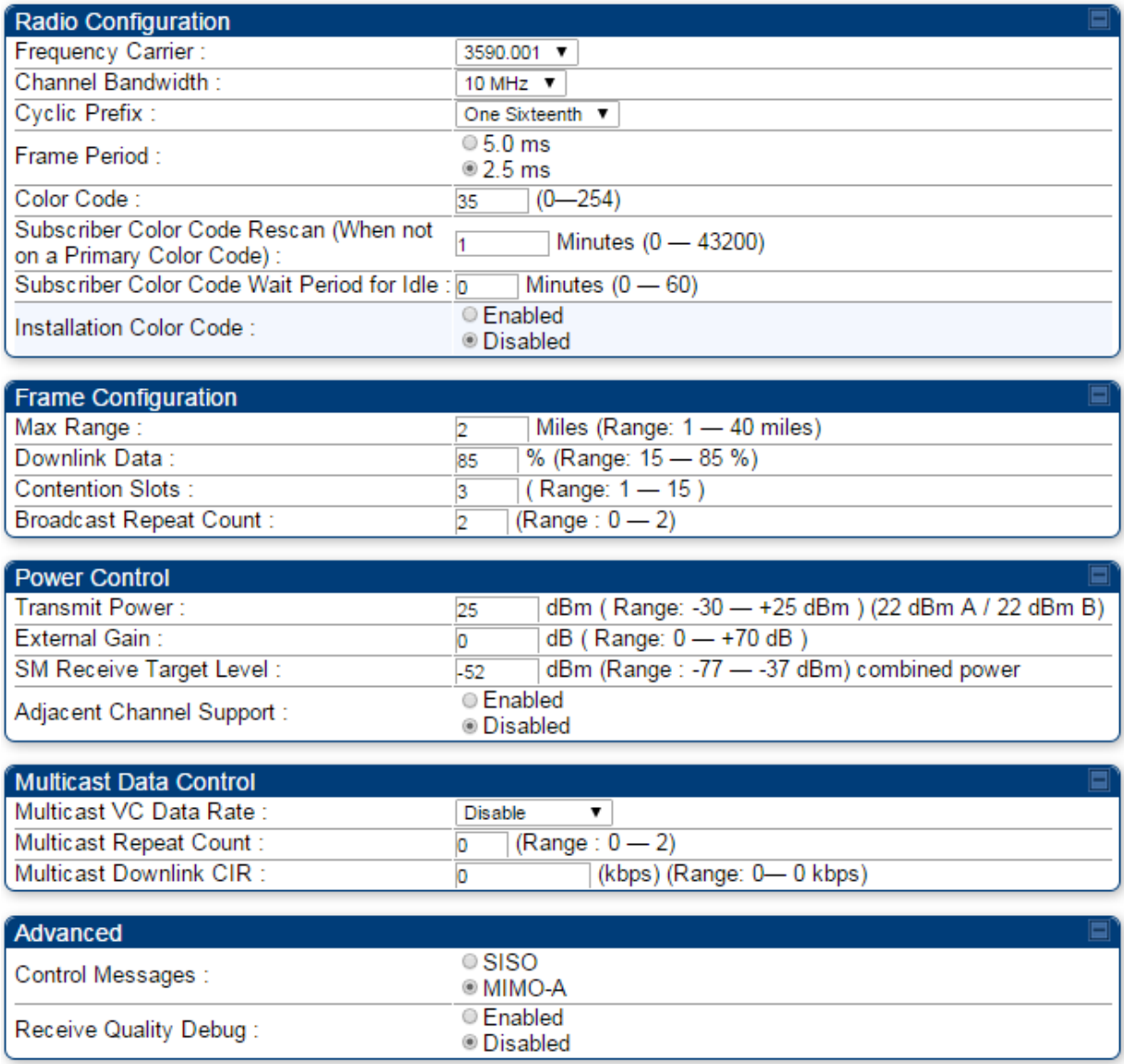
Attribute	Meaning
Radio Configuration, Frame Configuration, Power Control, Multicast Data Control and Advance tab	See Table 155 PMP 450i AP Radio attributes - 5 **GHz** on page 7-145.

Note

When the Channel bandwidth is updated from 20 MHz to 30 MHz not more than 59 subscribers can be registered.

Radio page - PMP 450 AP 3.5 GHz

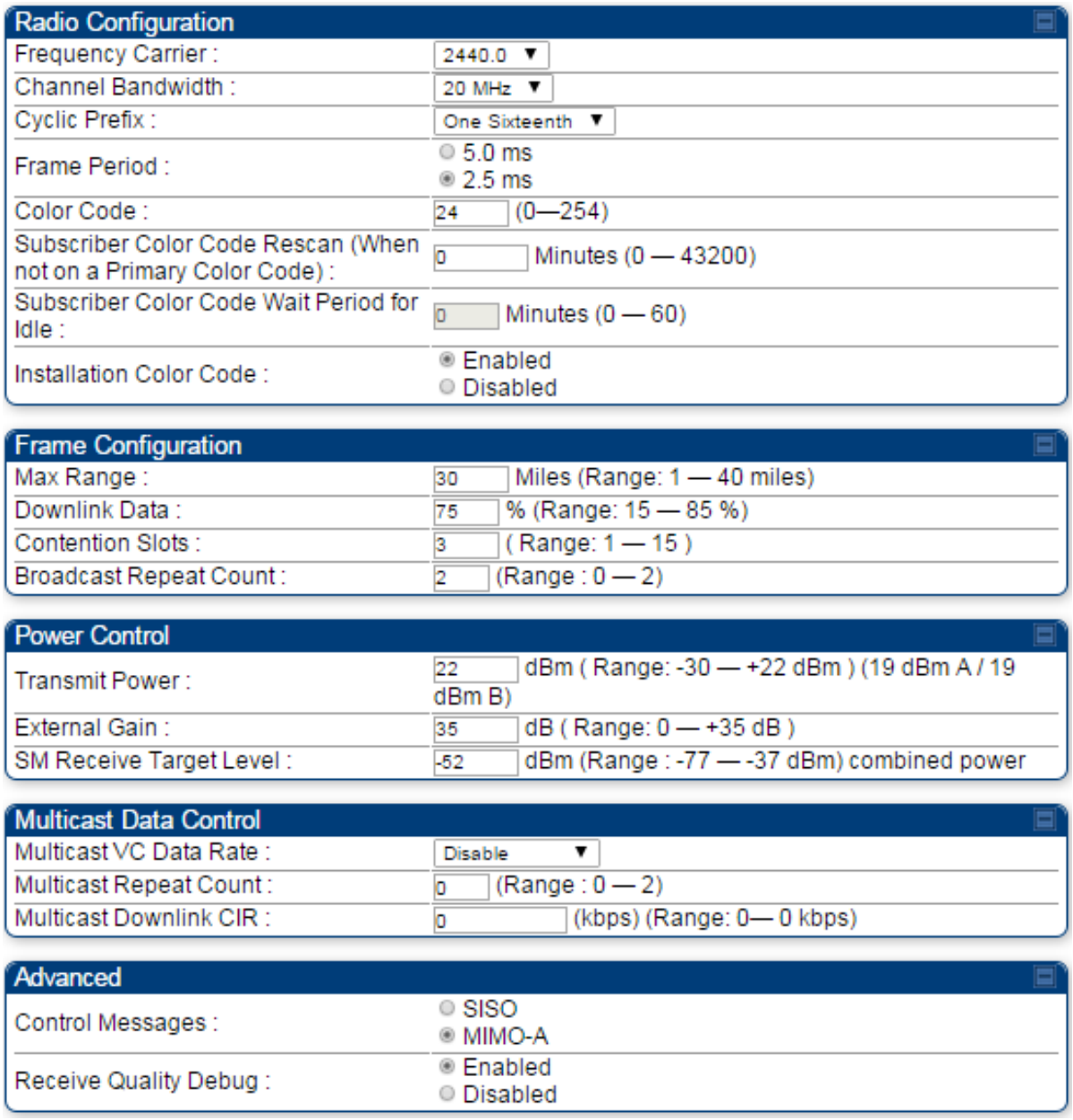
Table 163 PMP 450 AP Radio attributes - 3.5 GHz



Attribute	Meaning
Radio Configuration, Frame Configuration, Power Control, Multicast Data Control and Advance tab	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 AP 2.4 GHz

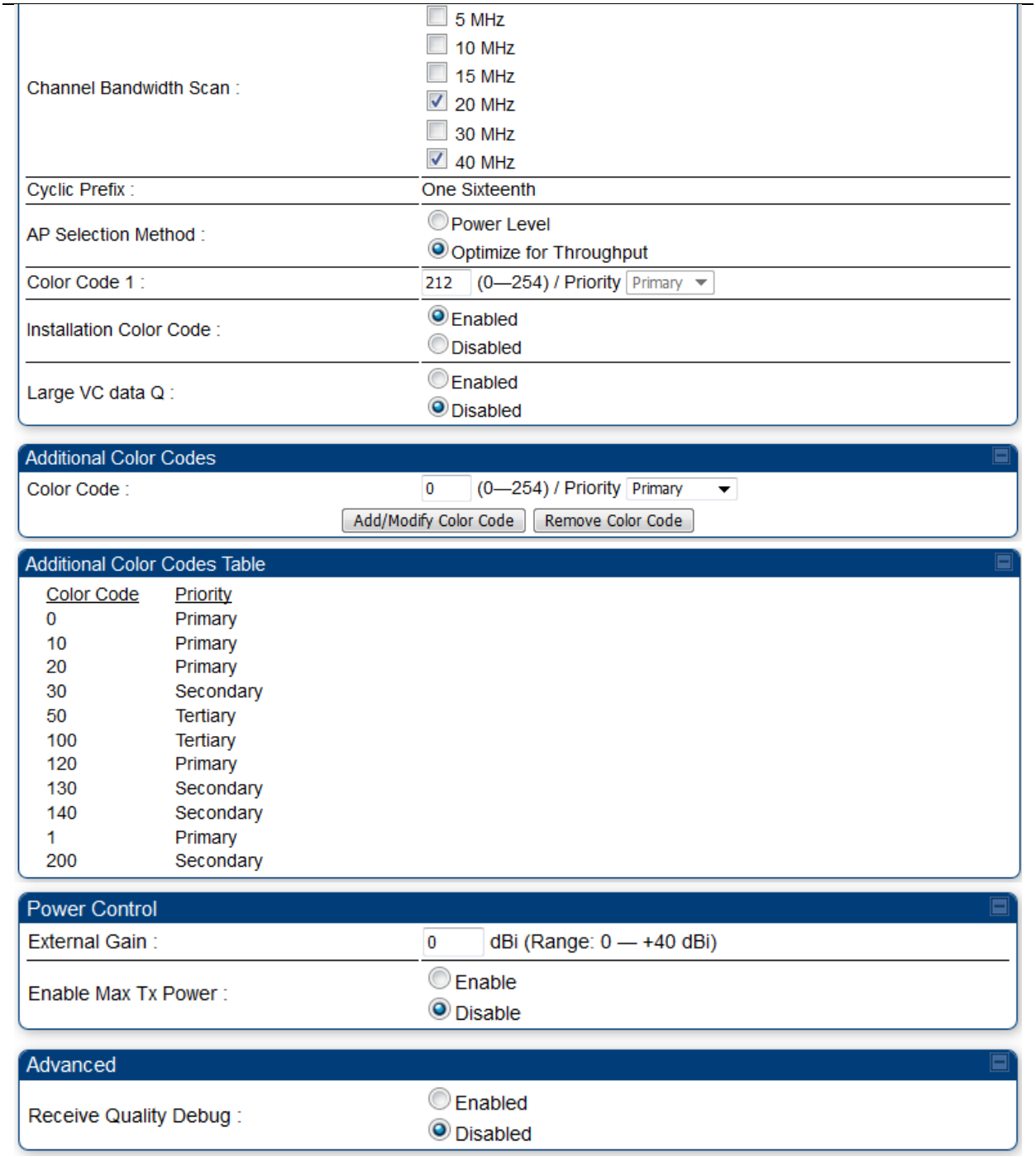
Table 164 PMP 450 AP Radio attributes - 2.4 GHz



Attribute	Meaning
Radio Configuration, Frame Configuration, Power Control, Multicast Data Control and Advance tab	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 SM 5 GHz

Table 165 PMP 450 SM Radio attributes – 5 GHz

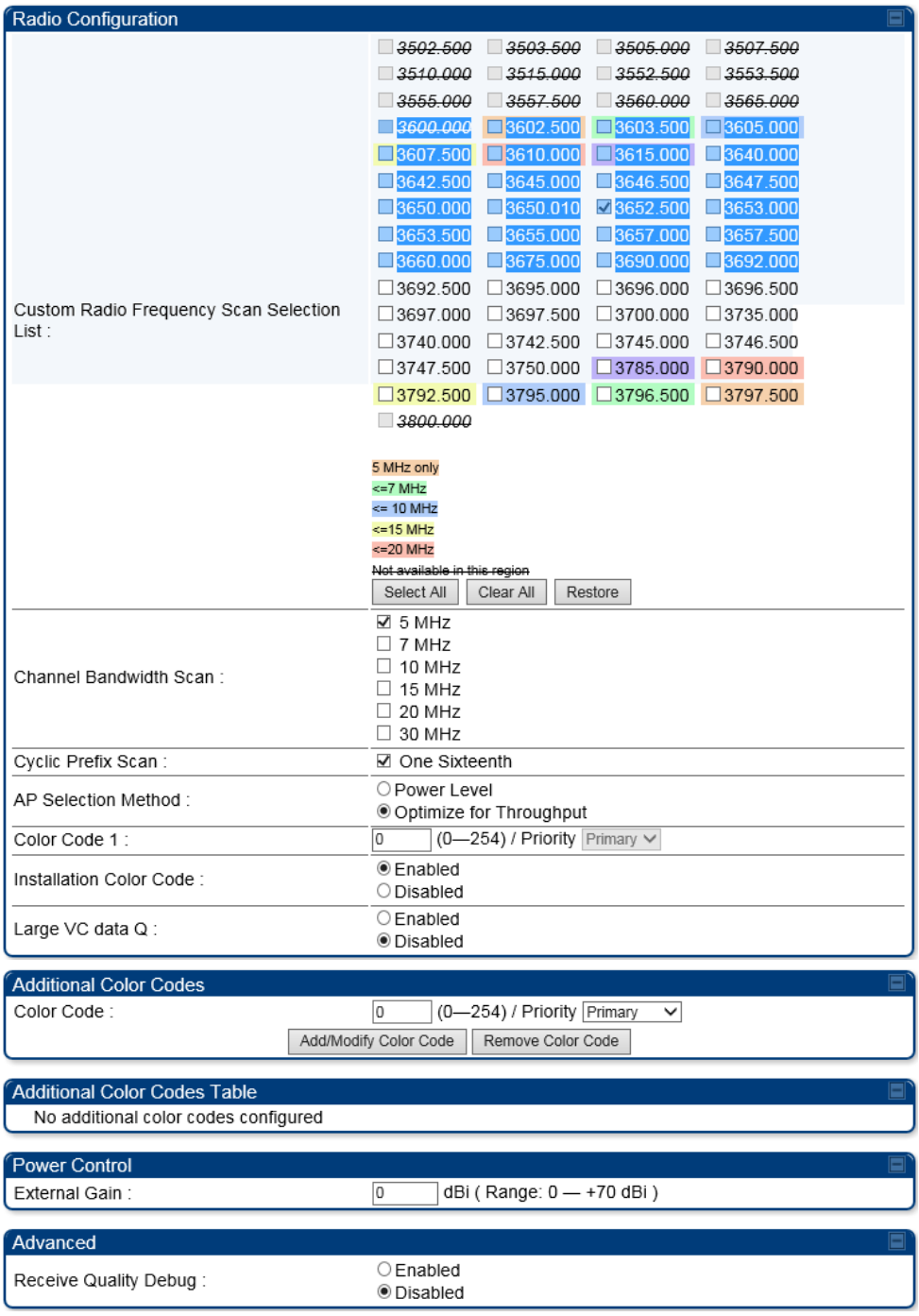


Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.

See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 SM 3.65 GHz

Table 166 PMP 450 SM Radio attributes – 3.65 GHz

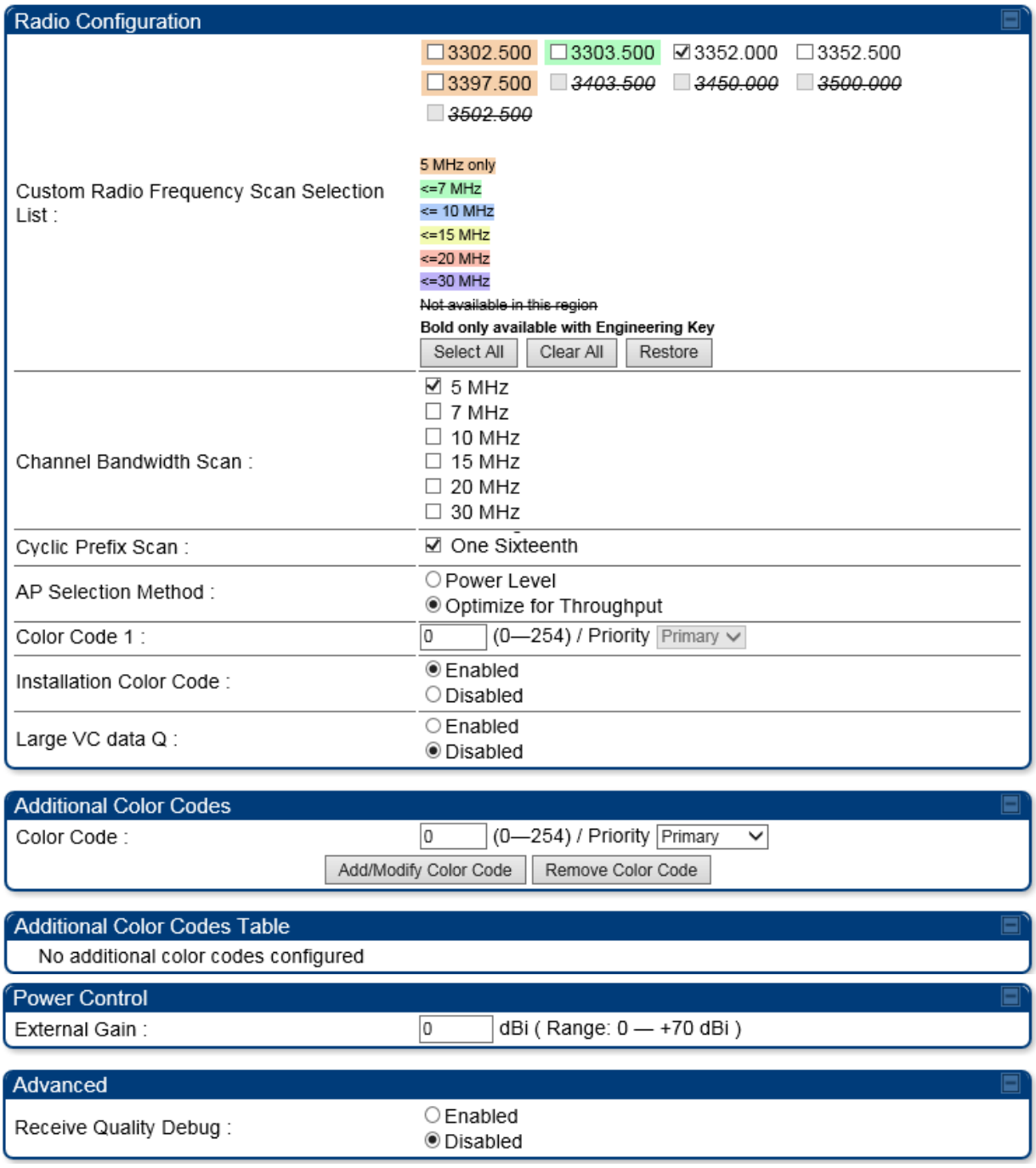


Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.

See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 SM 3.5 GHz

Table 167 PMP 450 SM Radio attributes – 3.5 GHz

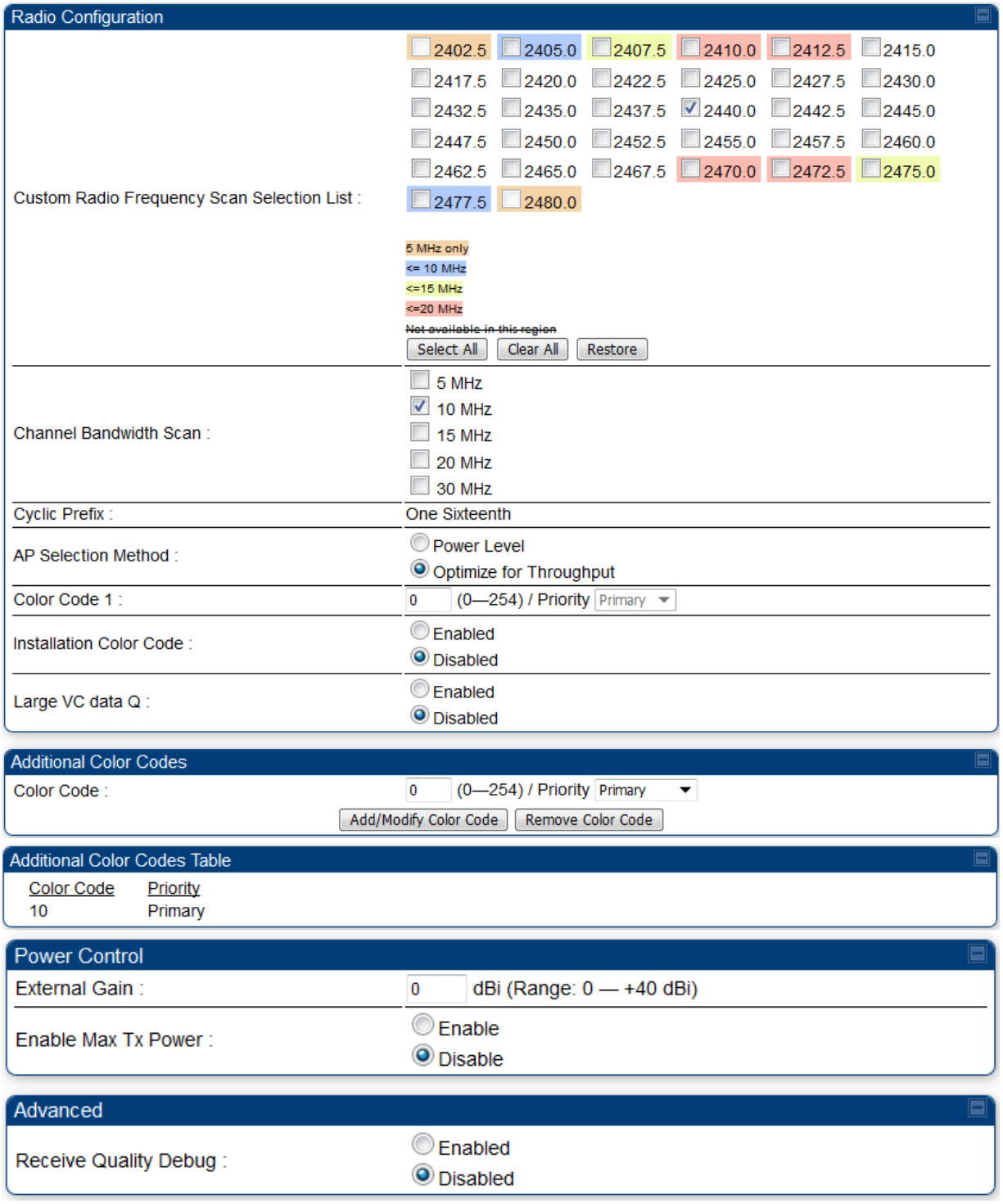


Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.

See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 SM 2.4 GHz

Table 168 PMP 450 SM Radio attributes – 2.4 GHz

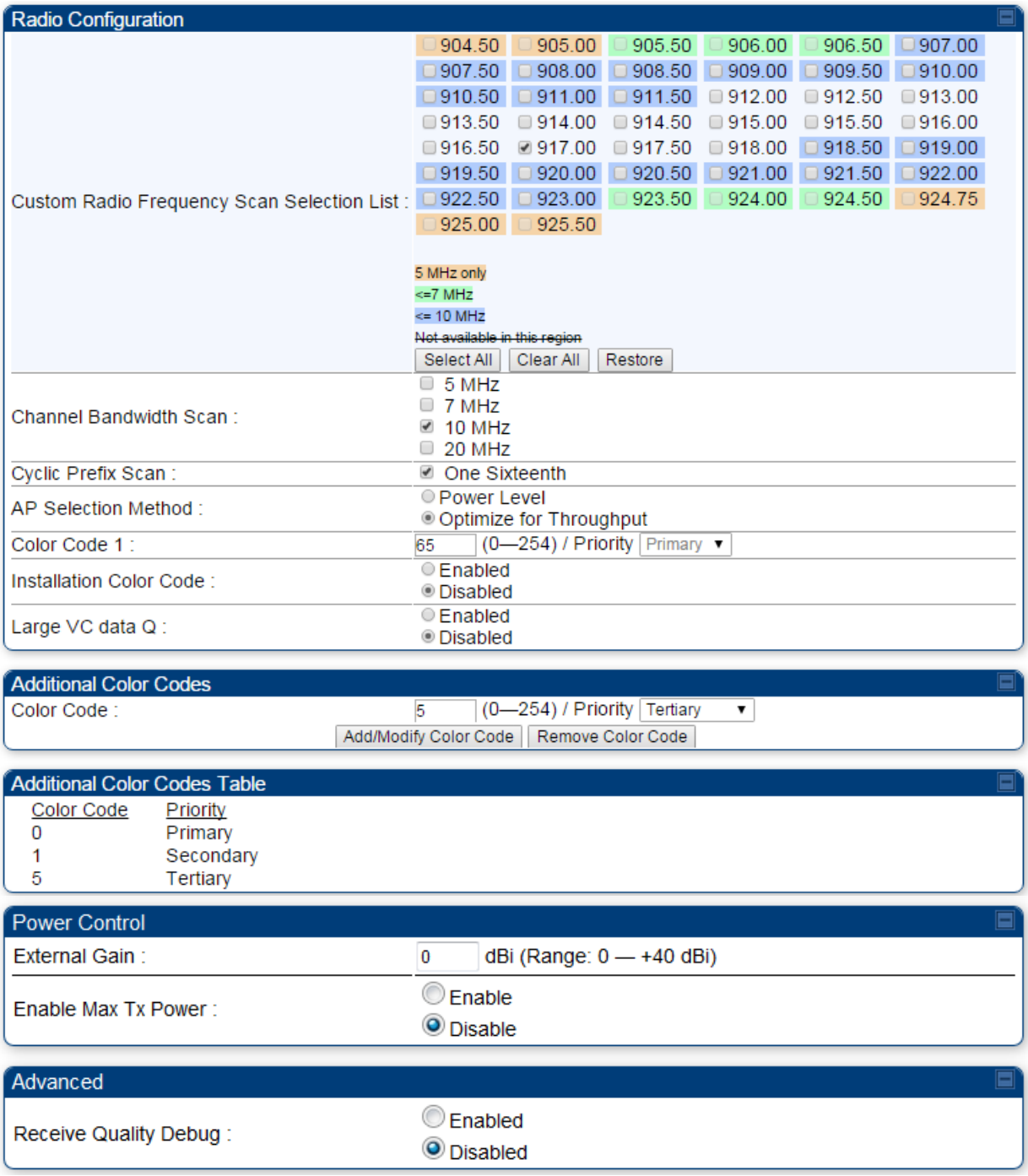


Attribute	Meaning
Custom Radio Frequency Scan Selection List	Check the frequencies that SM has to scan for AP transmissions. See Radio Frequency Scan Selection List on page 7-189.

See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Radio page - PMP 450 SM 900 MHz

Table 169 PMP 450 SM Radio attributes –900 MHz



Attribute	Meaning

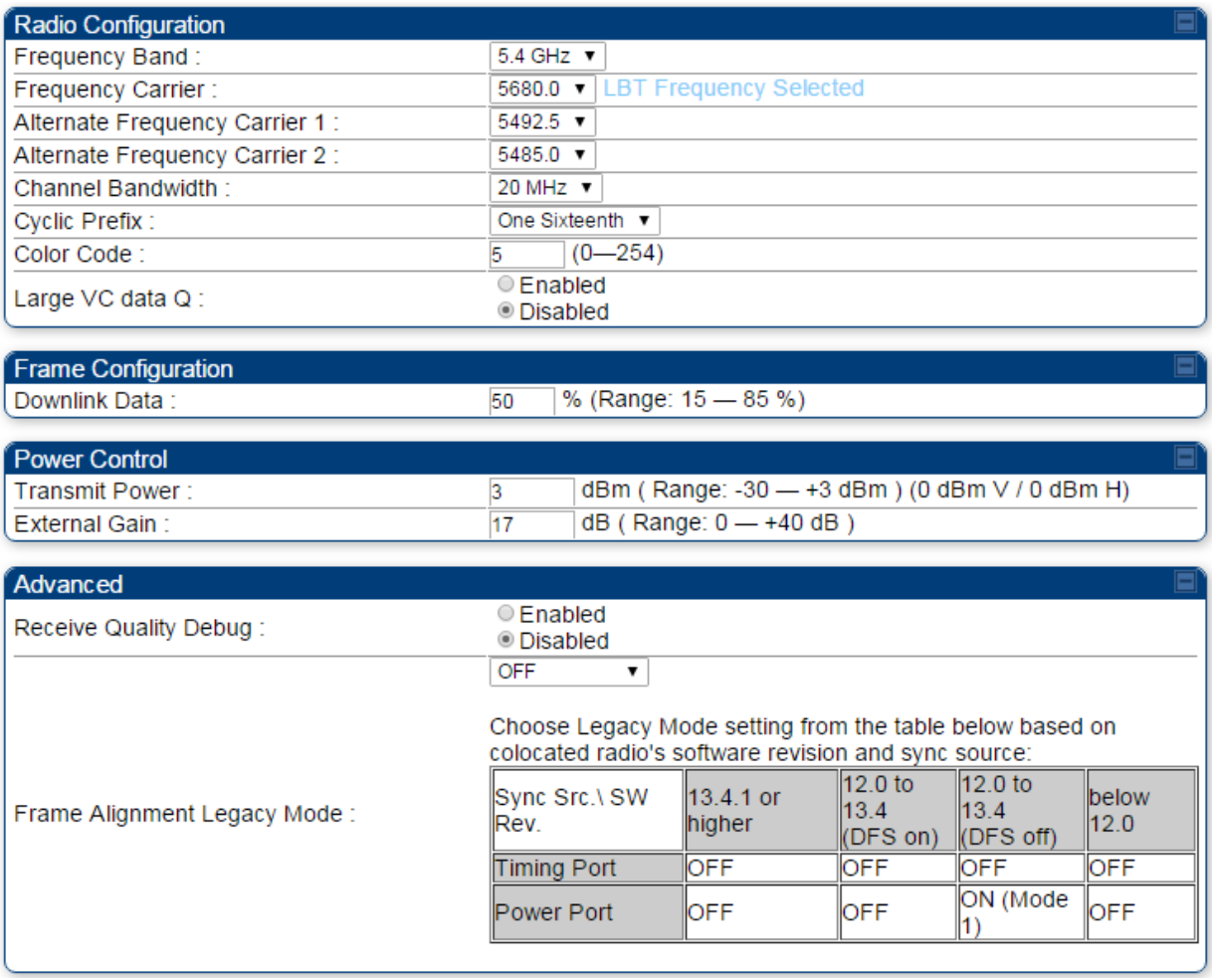
Custom Radio Frequency Scan Selection List	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.
Channel Bandwidth Scan	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.
Cyclic Prefix Scan	
AP Selection Method	
Color Code 1	
Installation Color Code	
Large VC data Queue	
Color Code	
External Gain	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145
Enable Max Tx Power	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145
Receive Quality Debug	See Table 155 PMP 450i AP Radio attributes - 5 GHz on page 7-145.

Note

The frequencies that a user can select are controlled by the country or a region and the Channel Bandwidth selected. There can be a case where a user adds a custom frequency (from the Custom Frequencies page on page 7-192) and cannot see it in the pull down menu.

Radio page - PTP 450 BHM 5 GHz

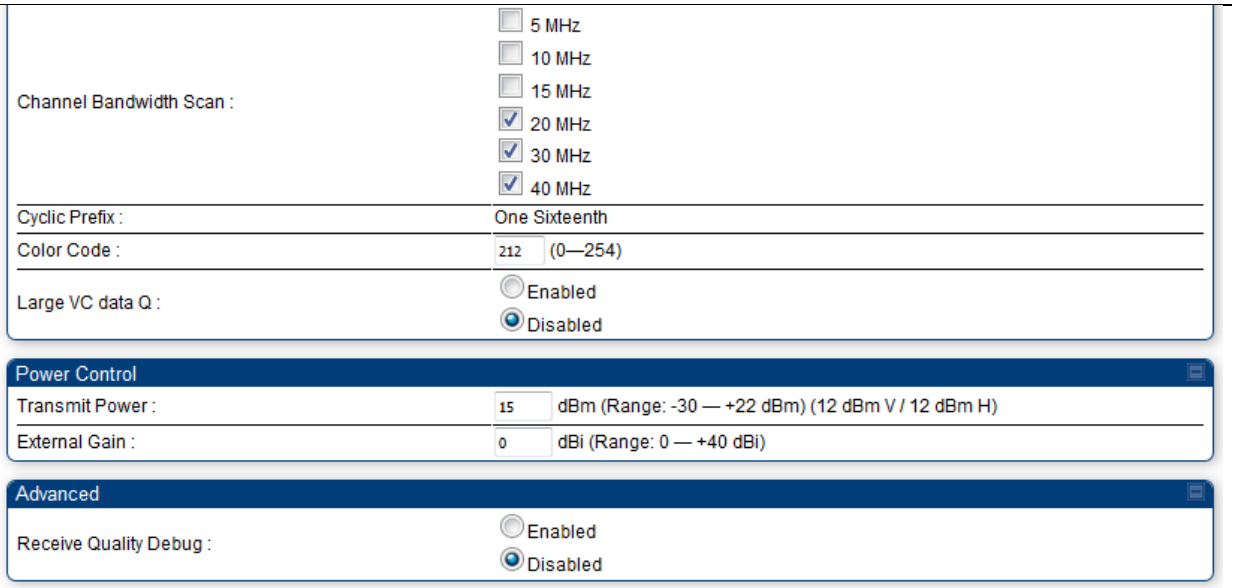
Table 170 PTP 450 BHM Radio attributes –5 GHz



Attribute	Meaning
Refer Table 158 PTP 450i BHM Radio page attributes – 5 GHz on page 7-163 for all parameters details.	

Radio page - PTP 450 BHS 5 GHz

Table 171 PTP 450 BHM Radio attributes –5 GHz



Attribute	Meaning
Refer Table 159 PTP 450i BHS Radio attributes – 5 GHz on page 7-166 for all parameters details.	

Radio Frequency Scan Selection List

The SM or BHS scans complete spectrum as per Full Spectrum Band Scan feature. SMs or BHS first boot into the smallest selected channel bandwidth (10 MHz, if selected) and scan all selected frequencies across both the 5.4 GHz and 5.7 GHz frequency bands.

After this scan, if a wider channel bandwidth is selected (20 MHz), the SM/BHS automatically changes to 20 MHz channel bandwidth and then scans for APs/BHSs. After the SM/BHS finishes this final scan it will evaluate the best AP/BHM with which to register. If required for registration, the SM/BHS changes its channel bandwidth back to 10 MHz to match the best AP/BHM.

The SM/BHS will attempt to connect to an AP/BHM based on power level (which affects the modulation state), channel bandwidth (which affects throughput) and number of SM/BHS registrations to the AP/BHM (which affects system contention performance).

If it is desired to prioritize a certain AP/BHM over other available APs/BHMs, operators may use the Color Code Priority feature on the SM/BHS. Utilization of the Color Code feature on the AP/BHM is recommended to further constrain the AP selection.

If the SM does not find any suitable APs/BHMs for registration after scanning all channel bandwidths, the SM restarts the scanning process beginning with the smallest configured channel bandwidth.

Selecting multiple frequencies and multiple channel bandwidths impacts the SM/BHS scanning time. The biggest consumption of time is in the changing of the SM/BHS channel bandwidth setting.

The worst case scanning time is approximately two minutes after boot up (SM/BHS with all frequencies and channel bandwidths selected and registering to an AP/BHM at 10 MHz). If only one channel bandwidth is selected the time to scan all the available frequencies and register to an AP/BHM is approximately one minute after boot up.

Other scanning features such as Color Code, Installation Color Code, and RADIUS authentication are unaffected by the Full Band Scan feature.

Dedicated Multicast Virtual Circuit (VC)

A Multicast VC allows to configure multicast packets to be transmitted over a dedicated channel at a configurable rate of 1X, 2X, 4X or 8X. This feature is available only for the PMP 450 and PMP 450i and is not backward compatible with PMP 430 series of radios.

To configure Multicast VC, the AP must have this enabled. This can be enabled in the "Multicast Data Control" section (under **Configuration > Radio** page). The default value is "Disable". If set to the *default* value, all multicast packets are transmitted over the Broadcast VC data path. To enable, select the data rate that is desired for the Multicast VC Data Rate parameter and click **Save Changes** button. The radio requires no reboot after any changes to this parameter.

The multicast VC allows three different parameters to be configured on the AP. These can be changed on the fly and are saved on the flash memory.

Note

If the Multicast VC Data Rate is set to a modulation that the radio is not currently capable of or operates in non-permitted channel conditions, multicast data is sent but not received.

Ex: If Multicast VC Data Rate is set to 6x and the channel conditions only permit 4x mode of operation, then multicast data is sent at 6x modulation but the SM will not receive the data.

Note

The PMP 450 AP supports up to 119 VCs (instead of 238 VCs) when configured for 30 MHz channel bandwidth or 5 ms Frame Period. This limitation is not applicable for PMP 450i/450m Series.

Note

- Actual Multicast CIR honored by the AP = Configured Multicast CIR/ (Multicast Repeat Count + 1).
- Increasing the Multicast data rate has no impact on the Unicast data rate.
- For multicast and unicast traffic mix scenario examples, see Table 172.

Table 172 Example for mix of multicast and unicast traffic scenarios

Repeat Count	Multicast Data Rate (Mbps)	Unicast Data Rate (Mbps)	Aggregate DL Data Rate (Mbps)
0	10	40	50
1	5	40	45
2	3.33	40	43.33

The statistics have been added to the **Data VC** page (under **Statistics > Data VC**). The table displays the multicast row on the PMP 450 Platform Family AP. The SM displays the multicast row if it is a PMP 450 Platform Family.

Figure 151 Multicast VC statistics

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		
Site Name - LUID: 002	018	00	2144887	6558	1121	0	0	5649 2098	3378 1656	2019 1607	1950 1199	2060928	7088	63	0	0	0	3972
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	592059	16	8523	0	0	NA	NA

The AP and SM display Transmit and Receive Multicast Data Count (under the **Statistics > Scheduler** page), as shown in Figure 152.

Figure 152 Multicast scheduler statistics

Radio Statistics

Transmit Unicast Data Count :	20778
Transmit Broadcast Data Count :	13
Transmit Multicast Data Count :	0
Receive Unicast Data Count :	20828
Receive Broadcast Data Count :	206042
Receive Multicast Data Count :	0
Transmit Control Count :	160
Receive Control Count :	39
In Sync Count :	62
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
Unsupported Feature Beacon Received :	0
Unknown Feature Beacon Received :	0
Old Version Beacon Received :	0
Wrong Frequency Beacon Received :	0
Non Lite Beacon Received :	0
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

Custom Frequencies page

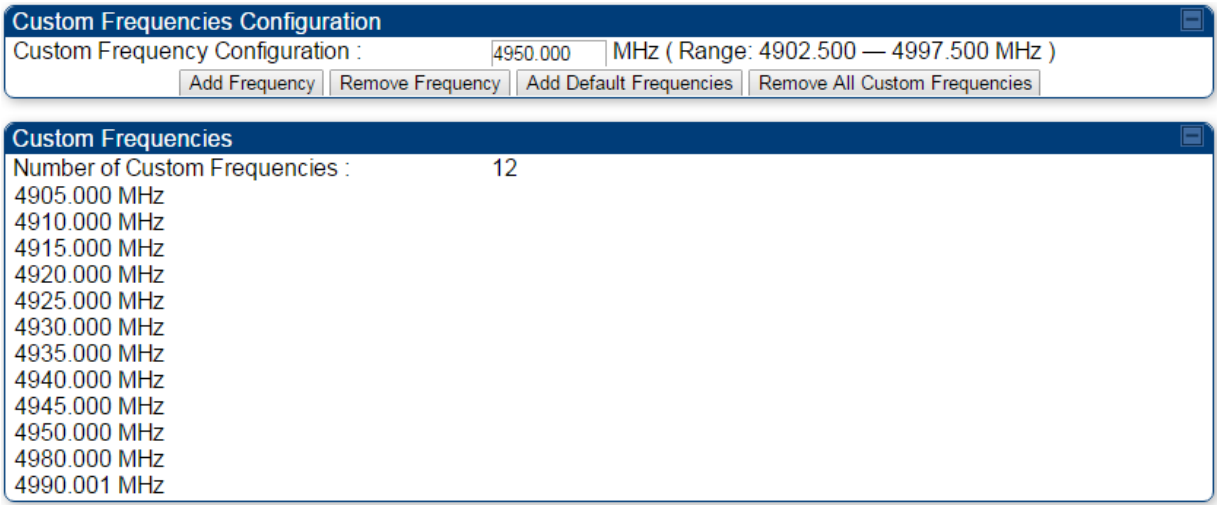
In addition to the **Radio** tab, AP/SM/BH has another tab called **Custom Frequencies** as shown in Table 173.

The custom frequency tab allows to configure custom frequency at 1 KHz raster. It means that the custom frequencies can be at granularity of 1 KHz e.g. 4910.123 MHz, 4922.333 MHz, 4933.421 MHz etc.

Note

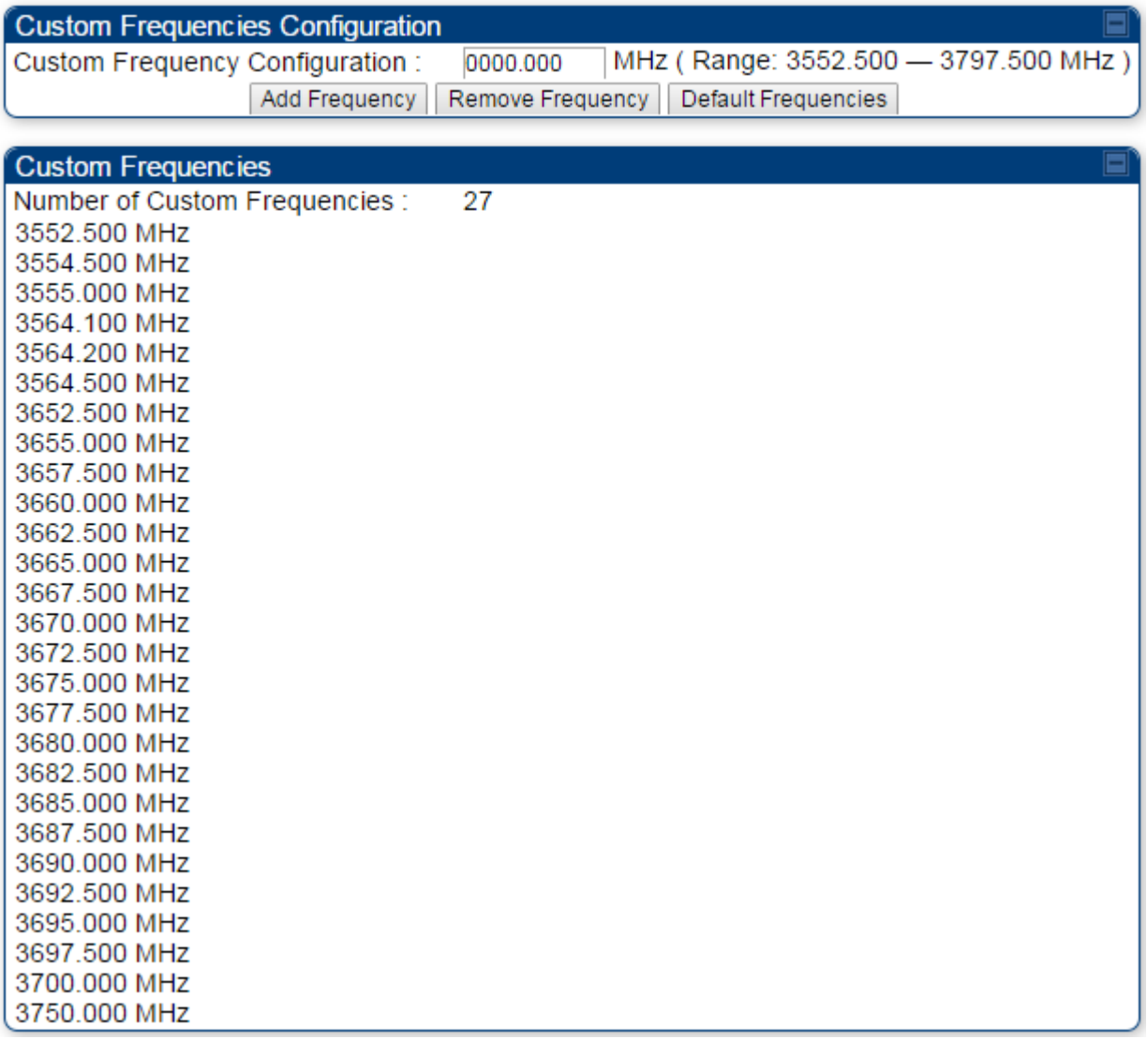
Ensure that a customer frequency exists before using SNMP to set the radio to a Custom Frequency.

Table 173 450 Platform Family AP/SM/BH Custom Frequencies page – 5 GHz



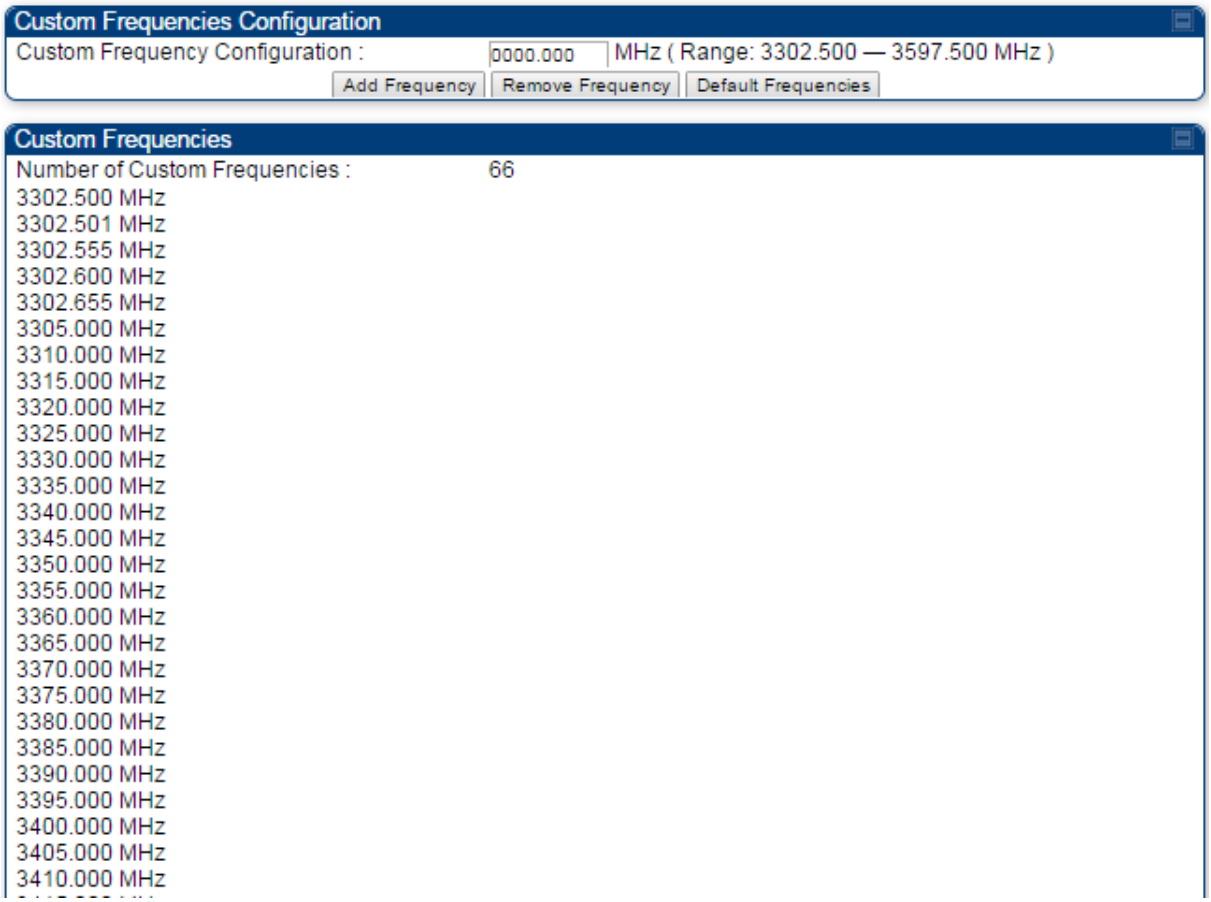
Attribute	Meaning
Custom Frequency Configuration	Custom frequencies with a channel raster of 1 KHz can be added from the available range by keying in the frequency and then clicking the **Add Frequency** button. Click **Remove Frequency** button to delete a specific frequency keyed in the text box. Click **Default Frequencies** button to add a pre-defined list of frequencies that can be used in this band. This list can be reduced or increased by manually removing or adding other custom frequencies.
Custom Frequencies	Displays the complete list of user configured custom frequencies.

Table 174 PMP/PTP 450 SM/BH Custom Frequencies page – 3.65 GHz



Attribute	Meaning
Custom Frequency Configuration	Custom frequencies with a channel raster of 1 KHz can be added from the available range by keying in the frequency and then clicking the **Add Frequency** button. Click **Remove Frequency** button to delete a specific frequency keyed in the text box. Click **Default Frequencies** button to add a pre-defined list of frequencies that can be used in this band. This list can be reduced or increased by manually removing or adding other custom frequencies.
Custom Frequencies	Displays the complete list of user configured custom frequencies.

Table 175 PMP/PTP 450 SM/BH Custom Frequencies page – 3.5 GHz



Attribute	Meaning
Custom Frequency Configuration	Custom frequencies with a channel raster of 1 KHz can be added from the available range by keying in the frequency and then clicking the **Add Frequency** button. Click **Remove Frequency** button to delete a specific frequency keyed in the text box. Click **Default Frequencies** button to add a pre-defined list of frequencies that can be used in this band. This list can be reduced or increased by manually removing or adding other custom frequencies.

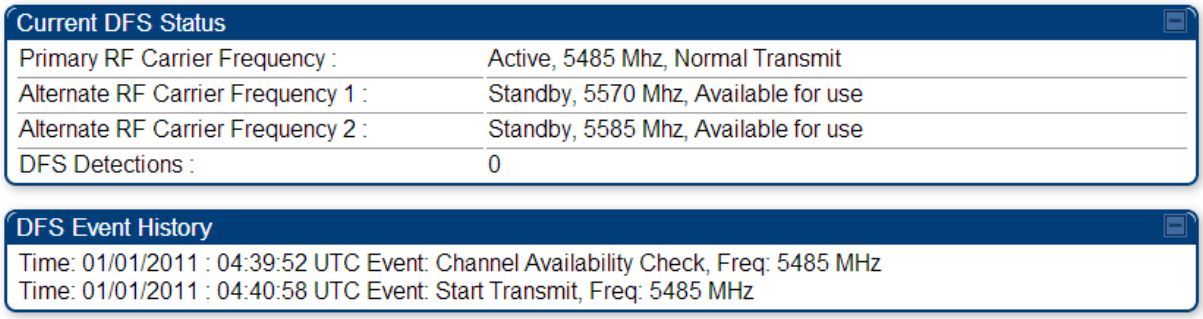
DFS for 5 GHz Radios

Dynamic Frequency Selection (DFS) is a requirement in several countries and regions for 5 GHz unlicensed systems to detect radar systems and avoid co-channel operation. DFS and other regulatory requirements drive the settings for the following parameters, as discussed in this section:

- Country Code
- Primary Frequency
- Alternate 1 and Alternate 2 Frequencies
- External Antenna Gain

On the AP, the **Home > DFS Status** page shows current DFS status of all three frequencies and a DFS log of past DFS events.

Figure 153 AP DFS Status



DFS operation

The ODUs use region-specific DFS based on the **Country Code** selected on the module's Configuration, General page. By directing installers and technicians to set the Country Code correctly, the operator gains confidence the module is operating according to national or regional regulations without having to deal with the details for each region.

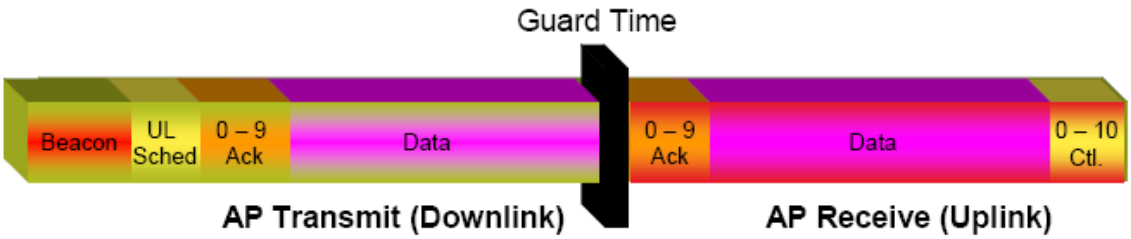
The details of DFS operation for each Country Code, including whether DFS is active on the AP, SM, and which DFS regulations apply is shown in Table 277 on page 10-59.

Contention slots

Contention slots are symbols at the end of the uplink subframe that are reserved for random access (network entry and bandwidth requests) and cannot be used for data transmission. These symbols form the contention space.

The frame is 2.5 ms or 5 ms long, and it is divided into a downlink subframe (data transmitted from the AP to the SM) and an uplink subframe (data transmitted from the SM to the AP).

Figure 154 Frame structure



The symbols in the uplink subframe can be scheduled or unscheduled. All scheduled symbols come before all unscheduled symbols. The number of scheduled and unscheduled symbols changes frame by frame depending on the amount of uplink requests received by the AP.

The contention slots number is selected by the operator and indicates the number of symbols that are reserved in the unscheduled portion of the uplink. The total number of unscheduled symbols in each frame is the sum of the contention slots and any additional symbol that was not used in uplink data transmission. This means that the unscheduled portion of the uplink can be as small as the number of contention slots, or as big as the whole uplink. This allows SMs in sectors with a small number of contention slots configured to still successfully transmit bandwidth requests using unused data slots.

Random access

When an SM needs to send an unscheduled message (for network entry or a bandwidth request), it randomly selects one symbol out of the unscheduled portion of the uplink subframe and uses that symbol for transmission. The higher the number of unscheduled symbols, the lower the probability two or more SMs will select the same symbol for transmission and their messages will collide. When two messages collide at the AP receiver, most likely neither will be decoded correctly, and both SMs need to start the random-access process one more time. If this happens frequently, the latency of the system increases.

A higher number of contention slots give higher probability that an SM's bandwidth request will be correctly received when the system is heavily loaded, but with the tradeoff that sector capacity is reduced, so there will be less capacity to handle the request. The sector capacity reduction is about 200 kbps for each contention slot configured in a 20 MHz channel at QPSK SISO modulation, for 2.5 ms frame sizes. The reduction in sector capacity is proportionally higher at MIMO modulations, as shown in the following table.

Table 176 Throughput penalty per modulation

Modulation mode	Throughput penalty for each additional contention slot	
	2.5 ms frame	5 ms frame
QPSK SISO (1X)	204 kbps	102 kbps
QPSK MIMO (2X)	409 kbps	204 kbps
16-QAM MIMO (4X)	819 kbps	409 kbps
64-QAM MIMO (6X)	1.22 Mbps	614 kbps
256-QAM MIMO (8X)	1.63 Mbps	819 kbps

Table 176 shows that the throughput penalty for each additional contention slot increases with modulation mode. The reason is that at higher modulation modes more fragments can be transmitted in a symbol. If additional symbols are reserved for random access, the number of fragments that cannot be sent in these symbols is higher at higher modulations, and therefore the throughput penalty is higher. However, the penalty expressed as a percentage of the throughput is the same for each modulation mode. For example, if a frame has 80 total symbols, each additional symbol reserved for random access reduces the sector throughput by 1.25%, regardless of the modulation mode.

○ Selection of contention slots parameter

The number of contention slots has to be selected according to the specific deployment parameters in each sector. If the number of contention slots is too small, then latency increases in high traffic periods. If the number of contention slots is too high, then the maximum capacity is unnecessarily reduced.

The two main contributing factors to the selection of the number of contention slots are the number of SMs in a sector, and the type of traffic in the sector.

Appendix A: Number of SMs in a sector

If the number of SMs in a sector is large, it is recommended to increase the number of contention slots, in order to reduce the probability of two or more requests colliding. The suggested contention slot settings as a function of the number of active Data channels in the sector are shown in Table 177.

Table 177 Contention slot settings

Number of SMs	Recommended Number of Contention slots
1 to 10	3
11 to 50	4
51 to 150	6
151 and above	8

Appendix B: Type of traffic in a sector

Besides the number of SMs, the other main factor in contention slots selection is the type of traffic. If the sector experiences a lot of uplink traffic composed of small packets, for example in a sector that serves several VoIP streams, the average number of bandwidth requests transmitted by each SM is high. Another scenario with constant uplink traffic is video surveillance, which also generate a large number of uplink bandwidth requests.

In these cases, the probability of two or more SMs transmitting a request in the same symbol is high. When this happens, the latency of the system increases, and it is recommended to increase the number of contention slots from the number in Table 177. If an AP is experiencing latency or SM-servicing issues, increasing the number of contention slots may increase system performance, depending on traffic mix over time.

Appendix C: Recommendation on Contention Slots number selection

1. Calculate the number of active SMs in the sector.
2. Evaluate the traffic mix that is expected in the sector, more specifically the expected percentage of real-time traffic (ex. VoIP, gaming, video conferencing, and video surveillance).
3. If the expected amount of real-time traffic is small, select the number of contention slots according to Table 177.
4. If the expected amount of real-time traffic is large, select a number of contention slots larger than the number in Table 177.
5. Monitor latency in your system. If the percentage of real-time traffic increases and the sector experiences increasing latency and SM-servicing issues, increase the number of contention slots from the current setting.
   This is the reason why the maximum number of contention slots is 15, even if Table 2 shows 8 contention slots for more than 150 data channels. If the number of data channels is more than 150 and a significant portion of the traffic is real-time, the frequency with which bandwidth request messages are transmitted requires a higher number of contention slots, potentially as high as 15. A sector with a high number of video surveillance cameras would also require a larger number of contention slots to reduce the probability of collision between requests.
6. Monitor the percentage of BW requests successfully received and the UL frame utilization: if the frame utilization is high (close to 100%), then it is not recommended to change the number of contention slots, even if the percentage success rate of BW requests is low. However, if the percentage success rate of BW requests is low and the frame utilization is also low, then increasing the number of contention slots is recommended.

- **Cluster of APs**

It is recommended to use care when changing the contention slots configuration of only some APs in a cluster, because changes affect the effective downlink/uplink ratio and can cause co-location issues.
In a typical cluster, each AP should be configured with the same number of contention slots to assure proper timing in the send and receive cycles. The number of contention slots is used by the frame calculator to define the downlink and uplink times, which should not overlap from one AP to another. However, if the traffic experienced by two APs in the same cluster is different (for example, one supports significantly more VoIP traffic), the number of contention slots selected for each AP may not be the same. For APs in a cluster of mismatched contention slots setting, it is recommended to use the frame calculator to verify that send and receive times do not overlap (see the Frame calculator for co-location).

Note: Change contention slot configuration in an operating, stable system cautiously and with a back-out plan. After changing a contention slot configuration, monitor the system closely for problems as well as improvements in system performance.

Frame calculator for co-location

The frame calculator is a tool available for the PMP 450 series systems, that calculates the length of the transmit and receive times, together with the number of downlink and uplink symbols, for a given set of configuration parameters. The frame calculator can be used to verify that co-location of APs using different contention slots settings does not create overlapping transmit and receive times.

Appendix D: Basic rules

For co-location of AP1 and AP2, we want to ensure that AP1 stops transmitting before AP2 starts receiving, and that AP2 stops transmitting before AP1 starts receiving.

These are the rules that have to be satisfied for a correct co-location of the two APs:

- AP1 Receive Start > AP2 Transmit End
- AP2 Receive Start > AP1 Transmit End

Appendix E: Steps for co-location

Let us assume that in a cluster of multiple APs with all the same settings, one AP's settings are modified with a different number of contention slots.

1. Obtain all configuration settings for the APs that do not change parameters (duty cycle, contention slots, max distance)
2. Input these configuration parameters into the OFDM Frame Calculator tool found under "Tools".
3. Click "Calculate"
4. Note the following values from the results:

   AP Antenna Transmit End: _____

   AP Antenna Receive Start: _____
5. Access the AP that needs to have a different contention slots setting and use the frame calculator tool found under "Tools"
6. Input the configuration parameters for this AP (same duty cycle and max distance as the other APs, different contention slots)
7. Click "Calculate"
8. Note the following values from the results:

   AP Antenna Transmit End: _____

   AP Antenna Receive Start: _____
9. Check that the two following equations are both true:

   AP1 Receive Start > AP2 Transmit End

   AP2 Receive Start > AP1 Transmit End
10. If one or both equations are not true, adjust the duty cycle until they become true (or the max distance if possible).

Appendix F: Example

Let us assume that all APs in a cluster have the same Max range settings, a 2.5 ms frame length and a 20 MHz channel BW, but the operator has fine-tuned the DL duty % per AP as follows:

AP1:

Max range: 2 miles

Contention slots: 3

DL duty cycle = 75%

AP2:

Max range: 2 miles

Contention slots: 3

DL duty cycle = 80%

Running the frame calculator as explained in the Steps for co-location, the AP1 Antenna Transmit End and Antenna Receive start times are:

- AP1 Antenna Transmit End = 1.6440 ms
- AP1 Antenna Receive Start = 1.7972 ms

AP2's Antenna Transmit End and Antenna Receive start times are:

- AP2 Antenna Transmit End = 1.7411 ms
- AP2 Antenna Receive Start = 1.8943 ms

The settings in AP1 in the cluster are now modified by changing the number of contention slots from 3 to 7, for example because this sector is constantly experiencing a higher volume of VoIP traffic.

Running the frame calculator again, the new AP1 Antenna Transmit End and Antenna Receive start times are:

- AP1 Antenna Transmit End = 1.5711 ms
- AP1 Antenna Receive Start = 1.7243 ms

The two equations above have to be checked for correct co-location:

- AP1 Antenna Receive Start > AP2 Antenna Transmit End → 1.7243 ms >1.7411 ms NOT OK
- AP2 Antenna Receive Start > AP1 Antenna Transmit End → 1.8943 ms >1.5711ms OK

The first of the two equations are not true. AP2 is still transmitting when AP1 has already started receiving. This creates interference at the AP1 receiver.

To avoid this interference scenario, the duty cycle of AP2 can be further adjusted slightly. For example, changing the duty cycle of AP2 from 80% to 79% changes the AP2 Antenna Transmit End and Antenna Receive start times as follows:

- AP2 Antenna Transmit End = 1.7168 ms
- AP2 Antenna Receive Start = 1.8700 ms

The two equations have to be checked again for co-location:

- AP1 Antenna Receive Start > AP2 Transmit End → 1.7243 ms >1.7168 ms OK
- AP2 Receive Start > AP1 Transmit End → 1.8700 ms >1.5711 ms OK

Now both equations are true and the APs can be co-located.

Cambium co-location tool

As an alternative to using the frame calculator on the AP GUI, cambium provides a co-location tool for these calculations. This tool is a free download available on the Cambium website:

https://support.cambiumnetworks.com/files/colocationtool/#r2

PMP/PTP 450/450i/450m CO-LOCATION TOOL AND THROUGHPUT CALCULATOR

Release 15.1.1

Device 1 Configuration	
Mode	PMP
Channel Bandwidth (MHz)	20
Max Range (mi)	2
Dowlink Data	75%
Contention slots	3
Frame Period (ms)	2.5

Device 1 Timing (ms)	
DL end	1.644
UL start	1.797
DL/UL symbols	61/20
DL/UL/Total Throughput (Mbps)	98.3/31.1/129.4

Device 2 Configuration	
Mode	PMP
Channel Bandwidth (MHz)	20
Max Range (mi)	2
Downlink Data	80%
Contention Slots	3
Frame Period (ms)	2.5

Device 2 Timing (ms)	
DL end	1.741
UL start	1.894
DL/UL symbols	65/16
DL/UL/Total Throughput (Mbps)	104.9/24.6/129.5

CHECKS					
Device 1 DL end	1.644	<	Device 2 UL start	1.894	OK
Device 2 DL end	1.741	<	Device 1 UL start	1.797	OK

MIMO-A mode of operation

450 Platform Family supports MIMO-B mode using the following modulation levels: QPSK, 16-QAM, 64-QAM and 256-QAM. System Release 13.2 introduces MIMO-A mode of operation using the same modulation levels as the MIMO-B mode. With MIMO-B, the radio sends different streams of data over the two antennas whereas with MIMO-A, the radio uses a scheme that tries to optimize coverage by transmitting the same data over both antennas. This redundancy improves the signal to noise ratio at the receiver making it more robust, at the cost of throughput.

In addition to introducing MIMO-A modes, improvements have been made to the existing rate adapt algorithm to switch between MIMO-A and MIMO-B seamlessly without any intervention or added configuration by the operator. The various modulation levels used by the 450 Platform Family are shown in Table 178.

Table 178 450 Platform Family Modulation levels

Rate	MIMO-B	MIMO-A
QPSK	2X MIMO-B	1X MIMO-A
16-QAM	4X MIMO-B	2X MIMO-A
64-QAM	6X MIMO-B	3X MIMO-A

256-QAM	8X MIMO-B	4X MIMO-A

System Performance

For System Performance details of all the 450 Platform Family ODUs, refer to the tools listed below:

- Link Capacity Planner for PMP/PTP 450 and 450i:

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

- LINKPlanner for PMP/PTP 450/450i and PMP 450m:

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

Table 179 Co-channel Interference per (CCI) MCS

MCS of Victim	MCS of Interferer	Channel BW (MHz)	CCI
1X (QPSK SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	10 dB
2X (16-QAM SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	17 dB
3X (64-QAM SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	25 dB
1X (QPSK MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	7 dB
2X (16-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	14 dB
3X (64-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	22 dB
4X (256-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	30 dB
2X (QPSK MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	10 dB
4X (16-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	17 dB
6X (64-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	25 dB
8X (256-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	33 dB

Table 180 Adjacent Channel Interference (ACI) per MCS

MCS of Victim	MCS of Interferer	Channel BW (MHz)	ACI	Guard Band

1X (QPSK SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
2X (16-QAM SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
3X (64-QAM SISO)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
1X (QPSK MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-13 dB	None
2X (16-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-13 dB	None
3X (64-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-13 dB	None
4X (256-QAM MIMO-A)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-10 dB	None
2X (QPSK MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
4X (16-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
6X (64-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-16 dB	None
8X (256-QAM MIMO-B)	6X (64-QAM MIMO-B)	5, 7, 10, 15, 20, 30, or 40	-10 dB	None

Guard Band

When synchronized, no Guard Bands are needed for the 450*, 450i, and 450m Series.

* For PMP 450 AP (3.6 GHz) and 450 series APs with 450b SM (5 GHz) connected, Configuration -> Radio -> Power Control -> Adjacent Channel Support must be enabled.

Improved PPS performance of 450 Platform Family

The 450m, 450i, and 450b Series provides improved packets per second (PPS) performance compared to 450 Series.

Through hardware and software enhancements, the PPS performance of the PMP 450i Series AP and PMP 450b SM has been improved to 40k packets/second, measured through a standard RFC2544 test using 64 bytes packets. With this enhancement, operators are able to provide higher bandwidth including better VoIP and video services to end customers using existing SM deployments.

PMP 450m supports 100k packets/second.

Setting up SNMP agent

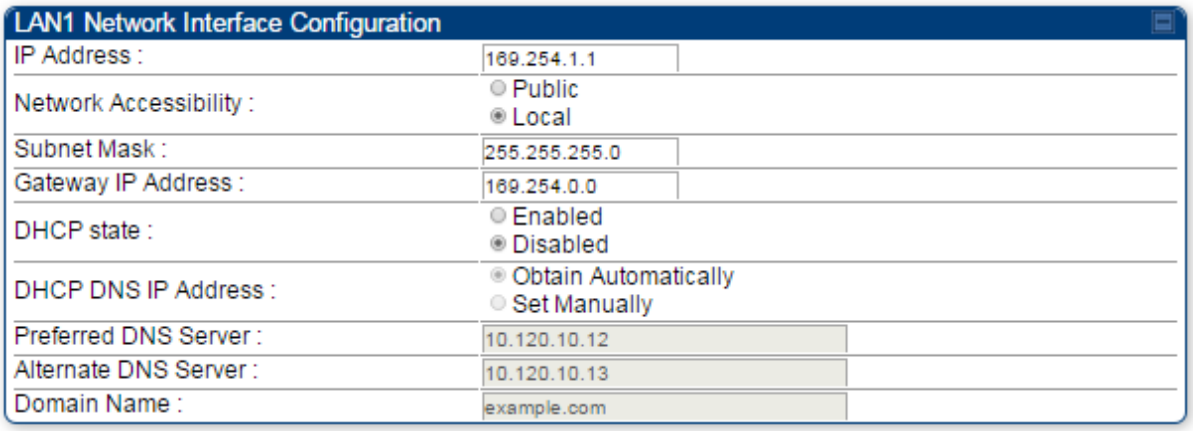
Operators may use SNMP commands to set configuration parameters and retrieve data from the AP and SM modules. Also, if enabled, when an event occurs, the SNMP agent on the 450 Platform Family sends a trap to whatever SNMP trap receivers configured in the management network.

- SNMPv2c
- SNMPv3

Configuring SM/BHS's IP over-the-air access

To access the SM/BHS management interface from a device situated above the AP, the SM/BHS's **Network Accessibility** parameter (under the web GUI at **Configuration > IP**) may be set to **Public**.

Table 181 LAN1 Network Interface Configuration tab of IP page attributes



Attribute	Meaning
IP Address	Internet Protocol (IP) address. This address is used by family of Internet protocols to uniquely identify this unit on a network.
Network Accessibility	Specify whether the IP address of the SM/BHS must be visible to only a device connected to the SM/BHS by Ethernet (**Local**) or be visible to the AP/BHM as well (**Public**).
Subnet Mask	If **Static IP** is set as the **Connection Type** of the WAN interface, then this parameter configures the subnet mask of the SM/BHS for RF management traffic.
Gateway IP Address	If **Static IP** is set as the **Connection Type** of the WAN interface, then this parameter configures the gateway IP address for the SM/BHS for RF management traffic.
DHCP state	If **Enabled** is selected, the DHCP server automatically assigns the IP configuration (IP address, subnet mask, and gateway IP address) and the values of those individual parameters (above) are not used. The setting of this DHCP state parameter is also viewable (read only), in the Network Interface tab of the Home page.
DNS IP Address	Canopy devices allow for configuration of a preferred and alternate DNS server IP address either automatically or manually. Devices must set DNS server IP address manually when DHCP is disabled for the management interface of the device. The default DNS IP addresses are 0.0.0.0 when configured manually.
Preferred DNS Server	The first address used for DNS resolution.

Alternate DNS Server	If the Preferred DNS server cannot be reached, the Alternate DNS Server is used.
Domain Name	The operator's management domain name may be configured for DNS. The domain name configuration can be used for configuration of the servers in the operator's network. The default domain name is example.com, and is only used if configured as such.

Configuring SNMP

The SNMP page configuration is explained below.

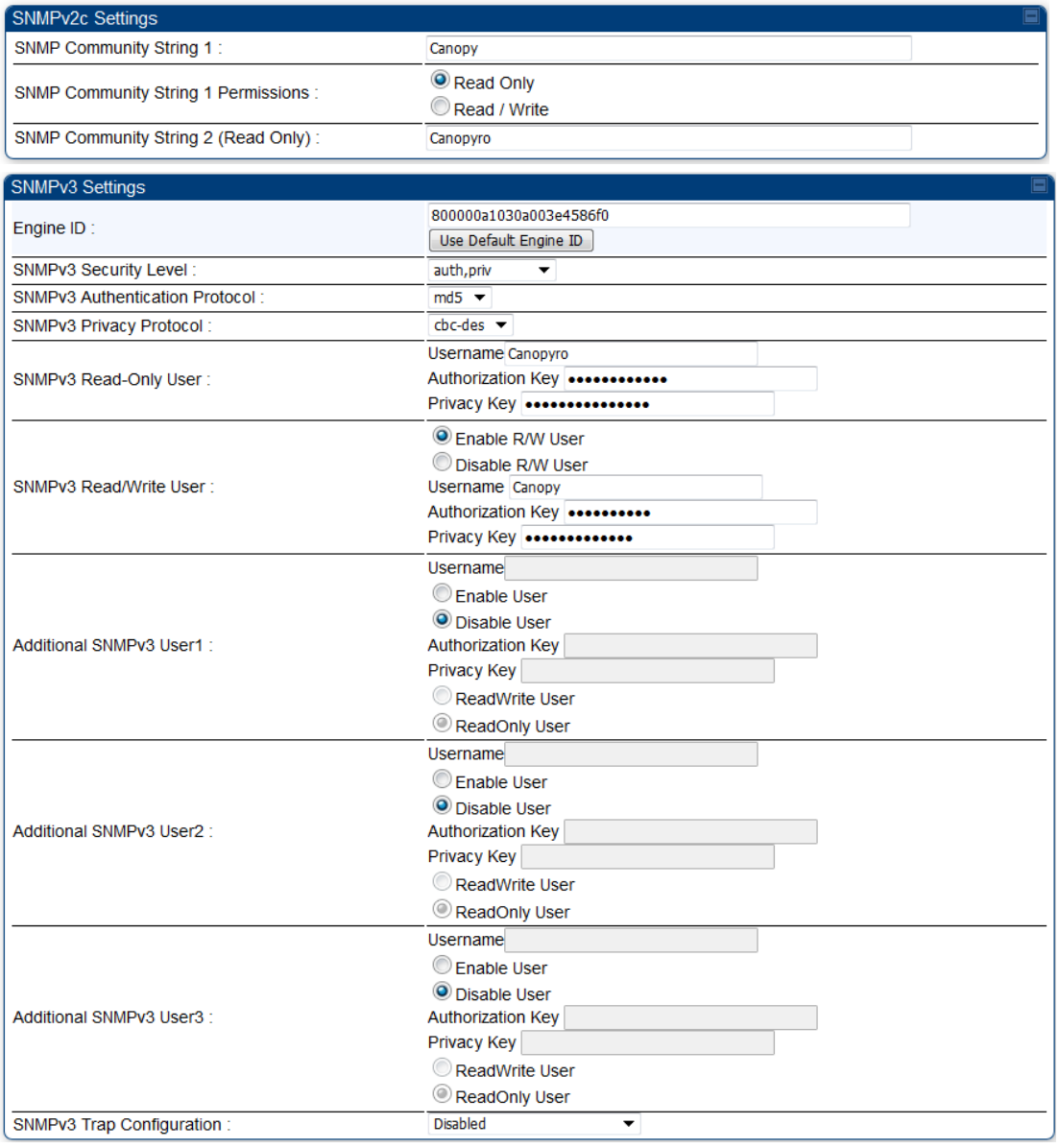
Note

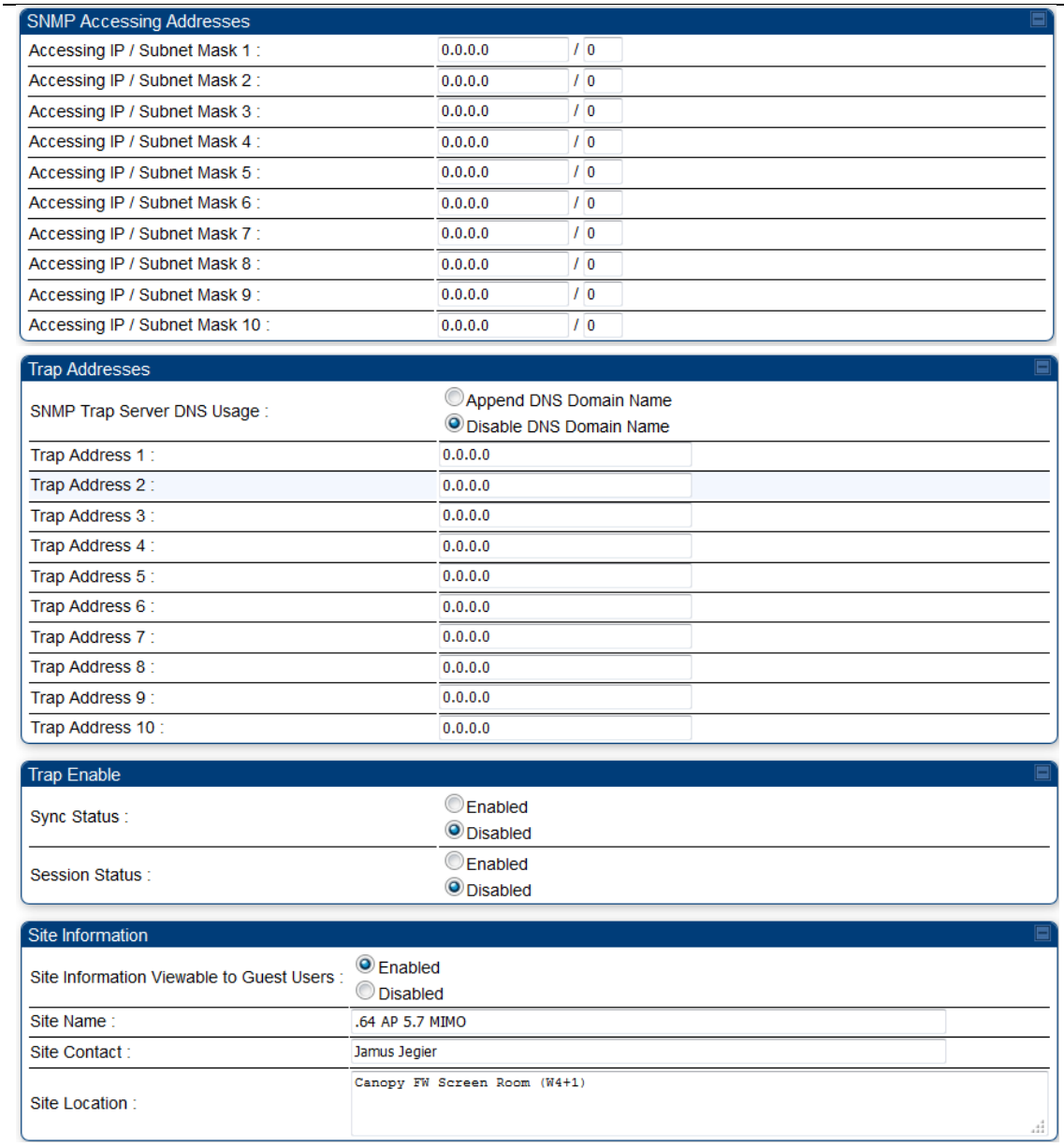
The SNMP page for AP, SM, BHM and BHS has the same parameter attributes.

SNMP page – AP/SM/BHM/BHS

The SNMP page is explained in Table 182.

Table 182 SNMP page attributes





Attribute	Meaning
SNMP Community String 1	Specify a control string that can allow a Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string. The default string is **Canopy**.
SNMP Community String 1 Permissions	You can designate the **SNMP Community String 1** to be the password for WM, for example, to have **Read / Write** access to the module via SNMP or for all SNMP access to the module to be **Read Only**.
SNMP Community String 2 (Read Only)	Specify an additional control string that can allow a Network Management Station (NMS) to read SNMP information. No spaces are allowed in this string. The default string is **Canopyro**. This password will never authenticate a user or an NMS to read/write access.

	The **Community String** value is clear text and is readable by a packet monitor. Additional security derives from the configuration of the **Accessing Subnet**, **Trap Address**, and **Permission** parameters.
Engine ID	The Engine ID may be between 5 and 32 hex characters. The hex character input is driven by RFC 3411 recommendations on the Engine ID. The default Engine ID is the MAC address of the device
SNMPv3 Security Level	Specify security model where users are defined and authenticated before granting access to any SNMP service. Each device can configure the security level of SNMPv3 to No authentication/No privacy, Authentication/No privacy, or Authentication/Privacy.
SNMPv3 Authentication Protocol	Currently, the SNMPv3 authentication protocol **MD5** is supported.
SNMPv3 Privacy Protocol	Currently, the SNMPv3 privacy protocol **CBC-DES** is supported.
SNMPv3 Read-Only User	This field allows for a read-only user per devices. The default values for the Read-Only users is: • Username = Canopyro • Authentication Password = authCanopyro • Privacy Password = privacyCanopyro
SNMPv3 Read/Write User	Read-write user by default is disabled. The default values for the Read/Write users is : • Username = Canopy • Authentication Password = authCanopy • Privacy Password = privacyCanopy
Additional SNMP v3 User 1	This field allows to configure the Additional SNMP v3 User 1. The configurations include: • Enable/Disable User: These fields allow to enable or disable the user using the Enable User or Disable User radio buttons. • Authorizaton Key: This field allows to configure an authorization key for the user. • Privacy Key: This field allows to configure a privacy key for the user. **Note:** Set SNMP v3 Security Level field to :auth,priv to enable the Authorization Key and Privacy Key fields. Enabled User can be set with following privacy settings: • ReadWrite User • ReadOnly User

Additional SNMP v3 User 2	This field allows to configure the Additional SNMP v3 User 2. The configurations include: • Enable/Disable User: These fields allow to enable or disable the user using the Enable User or Disable User radio buttons. • Authorizaton Key: This field allows to configure an authorization key for the user. • Privacy Key: This field allows to configure a privacy key for the user. NOTE Set SNMP v3 Security Level field to :auth,priv to enable the Authorization Key and Privacy Key fields. Enabled User can be set with following Privacy settings: • ReadWrite User • ReadOnly User
Additional SNMP v3 User 3	This field allows to configure the Additional SNMP v3 User 3. The configurations include: • Enable/Disable User: These fields allow to enable or disable the user using the Enable User or Disable User radio buttons. • Authorizaton Key: This field allows to configure an authorization key for the user. • Privacy Key: This field allows to configure a privacy key for the user. NOTE Set SNMP v3 Security Level field to :auth,priv to enable the Authorization Key and Privacy Key fields. Enabled User can be set with following Privacy settings: • ReadWrite User • ReadOnly User
SNMPv3 Trap Configuration	When enabling transmission of SNMPv3 traps the read-only or read-write user credentials must be used and selected properly in order for the SNMP manager to correctly interpret the traps. By default transmission of SNMPv3 traps is disabled and all traps sent from the radios are in SNMPv2c format.
Accessing IP / Subnet Mask *1 to 10*	Specify the addresses that are allowed to send SNMP requests to this AP. The NMS has an address that is among these addresses (this subnet). You must enter both • The network IP address in the form xxx.xxx.xxx.xxx • The CIDR (Classless Interdomain Routing) prefix length in the form /xx For example: • the /16 in 198.32.0.0/16 specifies a subnet mask of 255.255.0.0 (the first 16 bits in the address range are identical among all members of the subnet).

	• 192.168.102.0 specifies that any device whose IP address is in the range 192.168.102.0 to 192.168.102.254 can send SNMP requests to the AP, presuming that the device supplies the correct **Community String** value. The default treatment is to allow all networks access. For more information on CIDR, execute an Internet search on "Classless Interdomain Routing." You are allowed to specify as many as 10 different accessing IP address, subnet mask combinations. **RECOMMENDATION:** The subscriber can access the SM/BHS by changing the subscriber device to the accessing subnet. This hazard exists because the **Community String** and **Accessing Subnet** are both visible parameters. To avoid this hazard, configure the SM/BHS to filter (block) SNMP requests.
SNMP Trap Server DNS Usage	The management DNS domain name may be toggled such that the name of the trap server only needs to be specified and the DNS domain name is automatically appended to that name. The default SNMP trap server addresses for all 10 available servers is 0.0.0.0 with the appending of the DNS domain name disabled.
Trap Address *1 to 10*	Specify ten or fewer IP addresses (xxx.xxx.xxx.xxx) or DNS names to which SNMP traps must be sent. Traps inform Wireless Manager or an NMS that something has occurred. For example, trap information is sent • after a reboot of the module. • when an NMS attempts to access agent information but either • supplied an inappropriate community string or SNMP version number. • is associated with a subnet to which access is disallowed.
Trap Enable, Sync Status	If the sync status traps (sync lost and sync regained) have to be sent to Wireless Manager or an NMS, select **Enabled**. If these traps have to be suppressed, select **Disabled**.
Trap Enable, Session Status	If you want session status traps sent to Wireless Manager or an NMS, select **Enabled**.
Site Information Viewable to Guest Users	Operators can enable or disable site information from appearing when a user is in GUEST account mode.
Site Name	Specify a string to associate with the physical module. This parameter is written into the *sysName* SNMP MIB-II object and can be polled by Wireless Manager or an NMS. The buffer size for this field is 128 characters.
Site Contact	Enter contact information for the module administrator. This parameter is written into the *sysContact* SNMP MIB-II object and can be polled by Wireless Manager or an NMS. The buffer size for this field is 128 characters.

Site Location	Enter information about the physical location of the module. This parameter is written into the *sysLocation* SNMP MIB-II object and can be polled by Wireless Manager or an NMS. The buffer size for this field is 128 characters.

Configuring syslog

450 Platform Family includes:

- Syslog event logging
- Configuring system logging

Syslog event logging

Following events are logged in syslog as explained in Table 183.

Table 183 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.

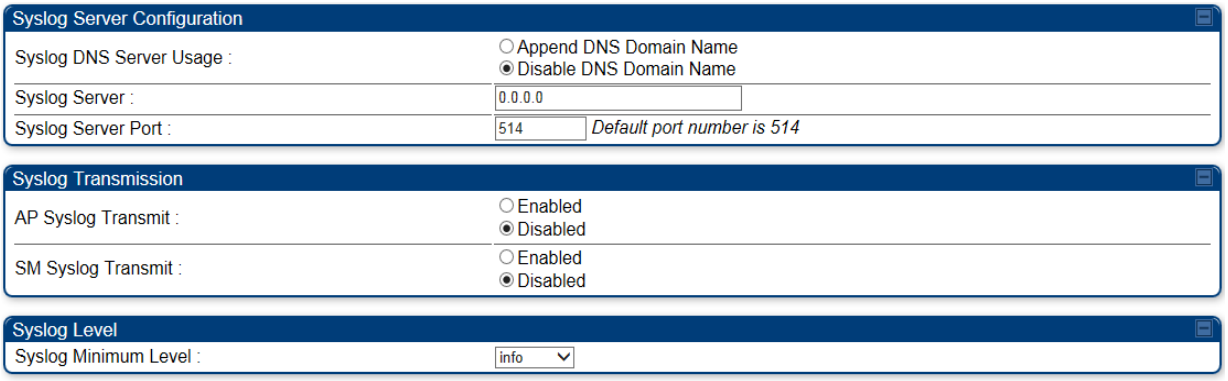
Configuring system logging

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 184.

Table 184 Syslog Configuration attributes - AP

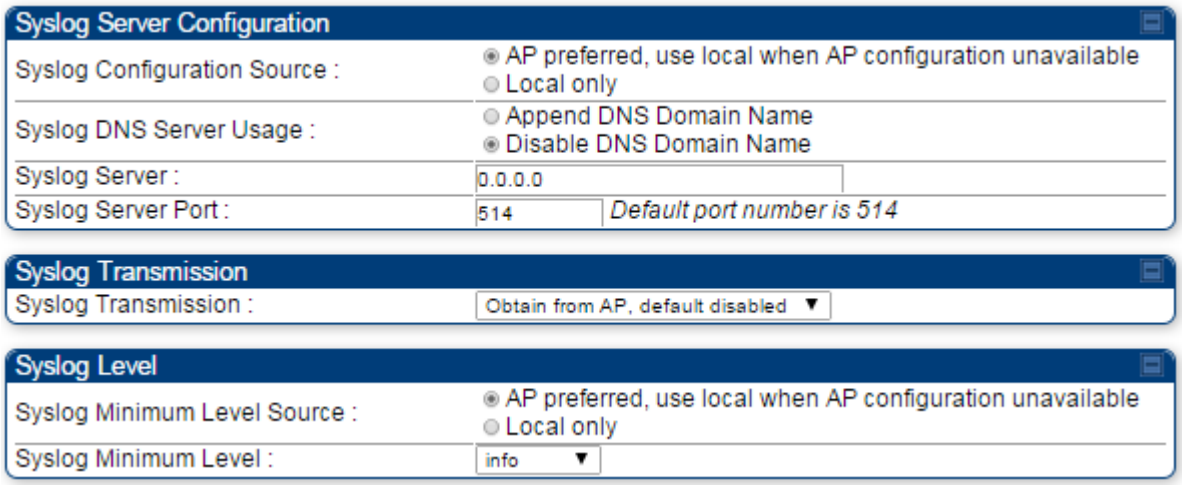


Attribute	Meaning
Syslog DNS Server Usage	To configure the AP/BHM to append or not append the DNS server name to the syslog server name.
Syslog Server	The dotted decimal or DNS name of the syslog server address.
Syslog Server Port	The syslog server port (default 514) to which syslog messaging is sent.
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 185.

Table 185 Syslog Configuration attributes - SM



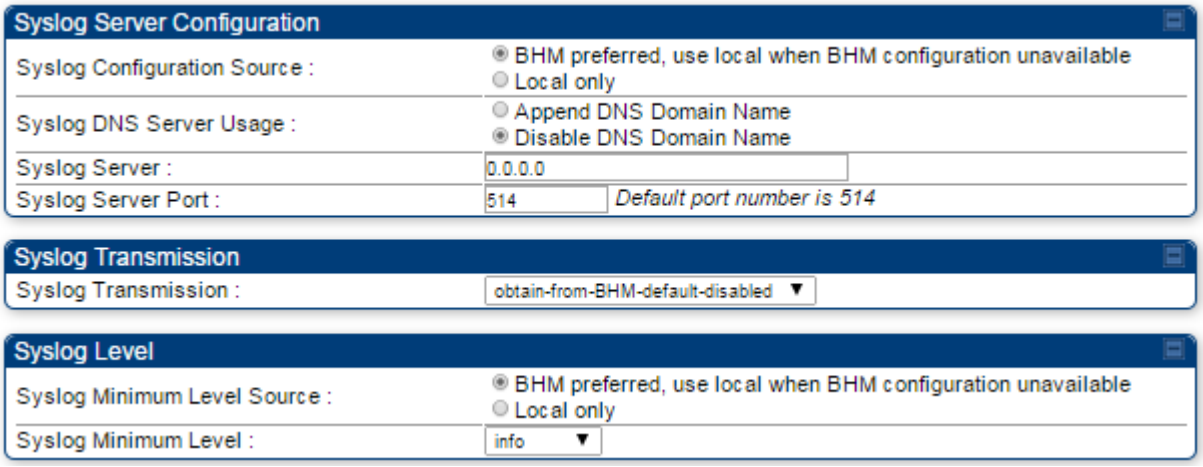
Attribute	Meaning
Syslog Configuration Source	This control determines whether the SM will attempt to use the syslog server definition from the AP, or whether it will use a local server definition. When set to **AP preferred, use local when AP configuration unavailable**, and if the SM can register with 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 186.

Table 186 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.

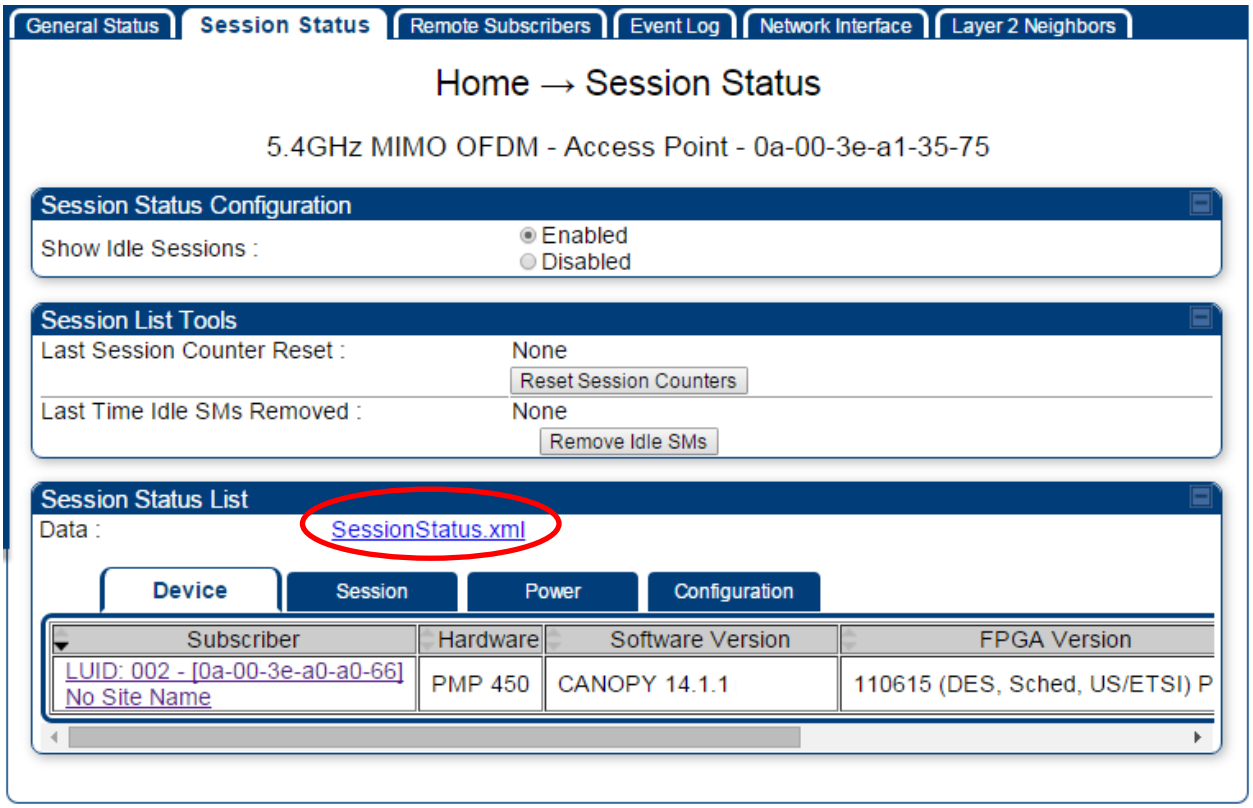
Configuring remote access

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 155.

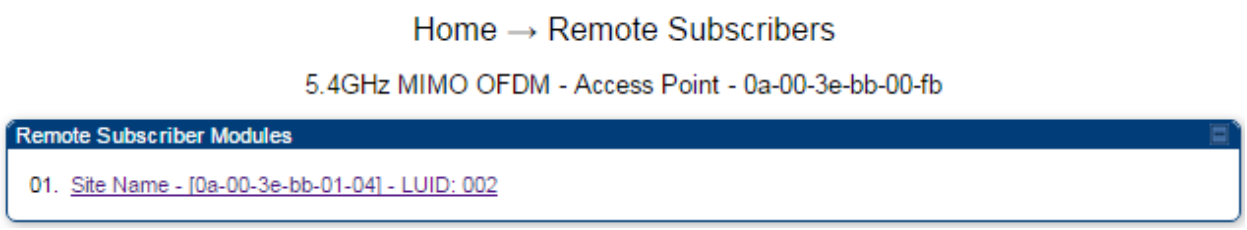
Figure 155 AP Session Status page



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 450 Platform Family - SM hyperlink, as shown in Figure 156.

Figure 156 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:

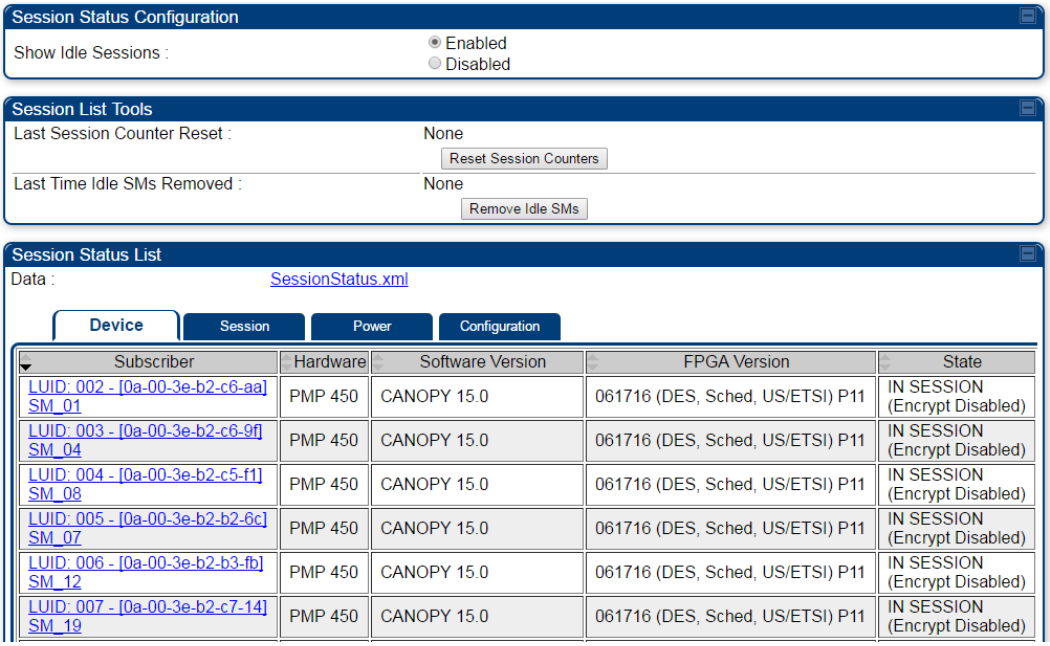
Procedure 22 Monitoring the AP-SM link

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 157 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 session database to see whether it was registered earlier. If the AP/BHM concludes that the SM/BHS is not currently in session database and it is valid Registration Request, then the request increments the value of this field.
- **Re-Reg Count**: When a SM/BHS makes a Registration Request, the AP/BHM checks its local session database to see whether it was registered earlier. If the AP/BHM concludes that the SM/BHS is currently in session database, then the request increments the value of this field.
- 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.

See Session tab on page 9-26

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

See Power tab on page 9-27

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)

See

Configuration tab on page 9-29

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.

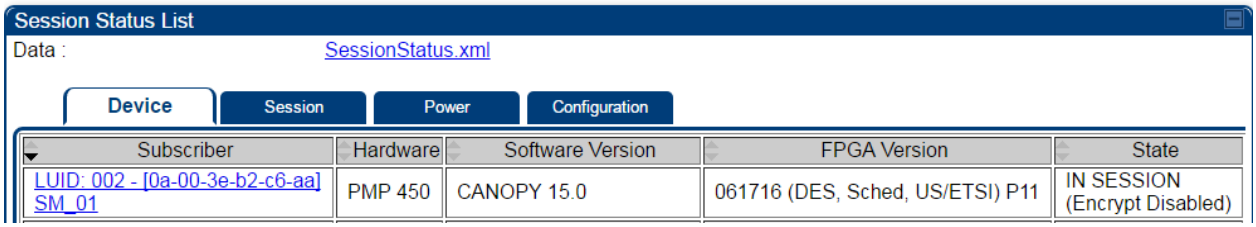
If these values are greater than 1, 1, and 0, or they increase while you are monitoring them, troubleshoot the link. (For example, Use **Receive Power Level** for aiming and then use Link Tests to confirm alignment).

Refer Viewing Session Status on page 9-24 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 158 Exporting Session Status page of PMP 450m 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.

Note

You can refer below whitepaper for 450 Platform Family Max Burst MIR:

http://www.cambiumnetworks.com/resources/pmp-450-maxburst/

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 159.

Note

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

Figure 159 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 160.

Figure 160 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 low priority traffic, medium priority traffic, high priority traffic, and ultra high priority traffic.

CIR parameters may be configured in the following ways:

- Web-based management GUI
- SNMP

- Authentication Server (RADIUS) - when an 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.

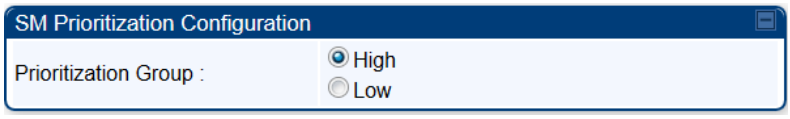
If the Burst Allocation is set to 128 kb and the Sustained Data Rate is set to 256 kbps, the actual rate is the burst allocation (but in kbps). As above, this configuration does not take advantage of the settable Burst Allocation.

SM Prioritization

SM Prioritization provides a way to designate a subset of a PMP sector's SMs with a guaranteed portion of air interface resources - slots, which are handled first during scheduling. SMs by default are configured in the SM Prioritization Low Group, and can be configured for the SM Prioritization High Group if desired.

The selection of which prioritization group each SM is configured in **Configuration** -> **Quality of Service** tab -> **SM Prioritization Configuration** on the SM GUI, as shown in Figure 161.

Figure 161 SM Prioritization on SM



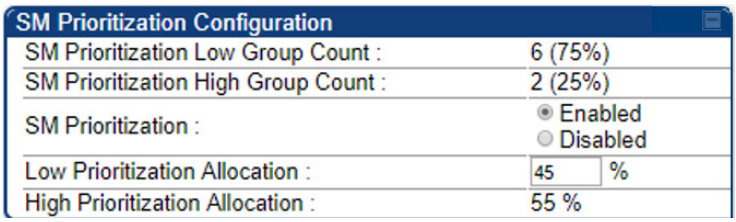
The feature does not take effect, however, until SM Prioritization is enabled on the AP, because the scheduler runs on the AP. Prioritization Allocation percentages per group are configured on the AP to determine how many timeslot resources are dedicated to each priority group.

Enabling of the feature and allocation percentages per group are configured in **Configuration** -> **Quality of Service** tab -> **SM Prioritization Configuration** on the AP GUI as shown in Figure 162.

With Cambium's SM prioritization feature, we guarantee a percentage of slot resources to each prioritization group. If the resource allocation demands of the SMs in the High Priority allocation group are met without allocating all of that group's allocation percentage, the remaining resources can be used for any unmet demands for SMs in the Low Group. Similarly, if the resource allocation demands of the SMs in the Low Priority allocation group are met without allocating all of that group's allocation percentage, the remaining resources can be used for any unmet demands for SMs in the High Group. If the sector has 100% utilization, the resource allocation per group will equal the percentages configured on the AP. This feature can be used to provide guaranteed frame allocation to high priority clients, such as business customers. Although SM Prioritization Group 1 is called the "High Priority" group, and SM Prioritization Group 2 is called the "Low Priority" group, this does not mean that 1 group is scheduled resources before the other group. The intention is, by adjusting the number of SMs in the High Priority group and the allocation percentages per group, the SMs in the High Priority group will have a higher "slots/SMs" ratio.

The following figure shows the SM Prioritization configuration at the AP with this feature enabled.

Figure 162 SM Prioritization on AP



In the example shown in Figure 162, 2 of the 8 SMs have been configured for the High Priority Group. The other 6 are in the Low Priority group. 45% of the air interface timeslot resources have been allocated to the Low Priority group. If, for example, all SMs are fully active and all resources in this sector are fully utilized, then 55% of the air interface slot resources will be shared between the 2 High Priority SMs, per direction, and the remaining 45% of the resources will be shared between the other 6 SMs.

If, on the other hand, only 40% of the resources are needed to meet the scheduling demands of the 2 High Priority SMs, the additional 15% that was pre-allocated to the High Priority group can then be used for the Low Priority group, maintaining 100% slot utilization in the sector.

SM Prioritization with CIR

When the SM Prioritization feature is used with CIR, Cambium's scheduler will first prioritize scheduling of data channels configured with a CIR, but only within the limits of that SMs Prioritization Group allocation. In the example configuration shown in Figure 162, there are 6 SMs in the Low Prioritization group. If 3 of those 6 SMs each have a 1Mbps CIR configured, the Cambium scheduler will attempt to meet this 1Mbps CIR per SM before scheduling the other 3 SMs. But if both prioritization groups are overloaded, this 3Mbps committed load on these 3 SMs will only be achieved if it can be done with 55% of the resources or less – per direction.

Weighted Fair Queuing (WFQ)

This feature lets the user assign a percentage of air interface resources to each of the Data Channel levels. The WFQ apply both to the DL and the UL. Note that there is no BC/MC traffic in the UL direction.

One of the benefits of WFQ is that the configuration can be accomplished at the AP rather than at each individual SMs. This feature can be used with or in place of existing CIR settings. Unlike CIR, which is set in kbps independent of the modulation rate, the WFQ feature operates on a percentage of air interface resources, or timeslots.

Figure 163 is an example of a WFQ configuration on the AP. This can be found in **Configuration** -> **Quality of Service** tab -> **Weighted Fair Queuing Configuration** on the AP GUI.

In this particular sector, we have 30 Data channels spread across 8 registered SM's. 4 levels of QoS have been configured on 7 of the SM's, 2 levels of QoS have been configured on 1 of the SM's.

Figure 163 Weighted Fair Queuing Configuration

Weighted Fair Queuing Configuration	
Data Channel Count - Low Priority :	8 (26%)
Data Channel Count - Medium Priority :	7 (23%)
Data Channel Count - High Priority :	8 (26%)
Data Channel Count - Ultra High Priority :	7 (23%)
Weighted Fair Queuing :	(•) Enabled ( ) Disabled
WFQ Configuration :	**Valid**
Data Channel Allocation - Broadcast/Multicast :	4 %
Data Channel Allocation - Low Priority :	22 %
Data Channel Allocation - Medium Priority :	22 %
Data Channel Allocation - High Priority :	26 %
Data Channel Allocation - Ultra High Priority :	26 %

The above figure shows that 4% of the air interface resources have been reserved for Broadcast/Multicast traffic, 22% of the available air interface timeslot have been reserved for the lowest priority traffic, 22% for medium priority traffic, 26% for high priority traffic, and 26% for the highest priority traffic (Ultra High Priority).

If, at any point in the time, the aggregate traffic load across all SMs on 1 QoS level is less than that level's Weighted Fair Queue allocation, then those unused slots will be allocated for traffic in other QoS levels, based on strict priority.

For example, if, during peak traffic hours, the Ultra High, High, and Low priority Data channels were experiencing heavy traffic loads, but the medium priority aggregate traffic load was light and only used 10% of the scheduling slots in a particular direction, the remaining unused 12% of the slots would be allocated first to the Ultra High priority traffic in queue. When all the Ultra High priority traffic has been scheduled, then any remaining unused slots would be used for High Priority traffic. Finally, after High Priority traffic has been serviced, any remaining slots would be used for Low Priority traffic. The "Low Priority" in the sub-heading "Low Priority SM's WFQ Configuration" shown above simply indicates that the SM Prioritization feature is turned off in this example above. The "Valid" indication in this screenshot is a simple software check to make sure that the configured percentages add up to 100%.

WFQ with CIR

The WFQ feature can be used with, or as a replacement for, configuring Committed Information Rates (CIR) per data channel. When the WFQ feature is used with CIR's, Cambium's scheduler will first prioritize scheduling of the Data channels configured with a CIR, but only within the limits of that QoS level's WFQ allocation.

Using the example configuration show in Figure 163, there are 8 high priority Data channels. If 5 of those 8 Data channels have a CIR configured, then the Cambium scheduler will prioritize traffic on those 5 Data channels up to their CIR limits, for those 26% of the timeslots allocated to that QoS level. Operators should try to avoid oversubscription of CIR's. But if CIR's have been oversubscribed at any 1 QoS level such that the desired CIR rates cannot be met within the limits of that level's WFQ allocation, the scheduler will use unallocated slots from another QoS level in strict priority order.

From the prior example, if there is less than 22% of timeslots worth of traffic on the medium priority Data channels, those unused slots would be allocated to Ultra High Priority traffic on Data channels that had not met their CIR commitment within the WFQ allocation, then on High Priority Data channels that had not met their CIR commitment within WFQ allocation, then on Low Priority Data channels that had not met their CIR commitment with WFQ allocation, then on Ultra High Priority traffic above and beyond any CIR configurations, and so on.

WFQ with SM Prioritization

Figure 164 shows a WFQ configuration with the SM Prioritization feature also enabled.

Figure 164 WFQ with SM Prioritization

SM Prioritization Configuration	
SM Prioritization Low Group Count :	6 (75%)
SM Prioritization High Group Count :	2 (25%)
SM Prioritization :	◉ Enabled ○ Disabled
Low Prioritization Allocation :	45 %
High Prioritization Allocation :	55 %

Weighted Fair Queuing Configuration	
Data Channel Count - Low Priority :	8 (26%)
Data Channel Count - Medium Priority :	7 (23%)
Data Channel Count - High Priority :	8 (26%)
Data Channel Count - Ultra High Priority :	7 (23%)
Weighted Fair Queuing :	◉ Enabled ○ Disabled
WFQ Configuration (SM Prioritization Low Group) :	**Valid**
Data Channel Allocation - Broadcast/Multicast :	4 %
Data Channel Allocation - Low Priority :	22 %
Data Channel Allocation - Medium Priority :	22 %
Data Channel Allocation - High Priority :	26 %
Data Channel Allocation - Ultra High Priority :	26 %
WFQ Configuration (SM Prioritization High Group) :	**Valid**
Data Channel Allocation - Low Priority :	25 %
Data Channel Allocation - Medium Priority :	25 %
Data Channel Allocation - High Priority :	25 %
Data Channel Allocation - Ultra High Priority :	25 %

In the example shown in Figure 164, 2 of the 8 SMs have been configured for the High Priority Group. The other 6 are in the Low Priority group. 45% of air interface timeslot resources have been allocated to the Low priority group. The same allocation rules described above still apply to the WFQ allocation, but now these allocations are done within the confines of each Prioritization group. So, in this configuration shown in Figure 164, the 2 Medium Priority QoS level Data channels in the High Priority SM Prioritization Group together share 12% of the committed air interface resources per direction. (.55 x .22 = .12) The same CIR allocation rules apply. The Cambium scheduler will attempt to meet those CIR allocations within the confines of that 12% allocation. If the traffic load on those 2 data channels is light, for example using only 5% of the available slots, then the remaining 7% of resources can be used for other traffic in a strict priority manner. (i.e. attempt to honor CIR's first, then Ultra High Priority traffic, then High Priority traffic, and so on, as described previously).

High-priority Bandwidth

To support low-latency traffic such as VoIP (Voice over IP) or video, or critical traffic such as control packets, the system implements priority data channels. Prior to PMP 450 Release 15.2, the system allowed for a single High Priority Channel to be configured per SM and per direction, in addition to the default low priority channel. This channel did not affect the inherent latencies in the system but allowed 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.

From system release 15.2, the system supports up to 4 QoS levels, or data channels, per SM. These are called Low, Medium, High, and Ultra High data channels.

The number of data channels available on the AP is still limited to 238 in release 15.2 This could be 238 SM's each configured with a single Low Priority channel, or, for example, 59 SMs with 4 data channels configured and 1 SM with 2 data channels configured.

A module prioritizes traffic by:

- 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.

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.
- The 8 Class Selector code points are fixed in code and not user settable.
- For any or all of the remaining 56 CodePoint parameters, you can specify a value of
  - 0, 1 for low-priority handling.
  - 2, 3 for medium-priority handling.
  - 4,5 for high-priority handling.
  - 6, 7 for ultra-high-priority handling.

The above mapping applies if 4 QoS levels are configured. If fewer than that are configured, see the mapping table in the IPv4 and IPv6 Prioritization of this document.

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 7-62. 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 187.

Table 187 Characteristics of traffic scheduling

Category	Factor	Treatment
Throughput	Aggregate throughput, less additional overhead	132 Mbps for 20 MHz Higher for 30 MHz or 40 MHz and lower for smaller bandwidths.
Latency	Number of frames required for the scheduling process	1
	Round-trip latency	≈ 6 ms
	AP broadcast the download schedule	No
Priority Data Channels	Allocation for *uplink* high-priority data channel traffic on amount of traffic at these higher QoS levels.	Dynamic, based on amount of high-priority traffic
	Allocation for *downlink* high-priority data channel traffic on amount of traffic at these higher QoS levels	Dynamic, based on amount of high-priority traffic
	Order of transmission	1- Ultra High Priority data channels below CIR limit 2- High Priority data channel's below CIR limit 3- Medium Priority data channels below CIR limit 4- Low Priority data channels below CIR limit 5- Ultra High Priority data channels above CIR limit 6- High Priority data channels above CIR limit 7- Medium Priority data channels above CIR limit 8- Low Priority data channels above CIR limit

Note

This strict priority transmission order is only true in all cases if the SM Prioritization and Weighted Fair Queue features are disabled. If either feature is enabled, see the description of those features in this document for how they impact and interact with this transmission order.

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.

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
  - Medium Priority Uplink CIR
  - Medium Priority Downlink CIR
  - High Priority Uplink CIR
  - High Priority Downlink CIR
  - Ultra High Priority Uplink CIR
  - Ultra High Priority Downlink CIR
- all SM VLAN settings
  - Dynamic Learning
  - Allow Only Tagged Frames
  - VLAN Aging Timeout
  - Untagged Ingress VID
  - Management VID
  - VLAN Membership
- the High Priority Channel setting

Table 188 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 189 Where feature values are obtained for an SM registered under an AP with Authentication Mode set to something other than "DISABLED"

Configuration Source Setting in the AP	Values are obtained from		
	MIR Values	VLAN Values	Data Channel Count per SM
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

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 is operating on an 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 registered under an AP with Authentication Mode set to something other than "DISABLED", the listed settings are derived as shown in Table 190.

Table 190 MIR, VLAN, HPC, and CIR Configuration Sources, Authentication Disabled

Configuration Source Setting in the AP	Values are obtained from			
	MIR Values	VLAN Values	Data Channel Count per SM	CIR Values
Authentication Server	AP	AP		
SM	SM	SM	SM	SM

Authentication Server+SM	SM	SM	SM	SM

Note

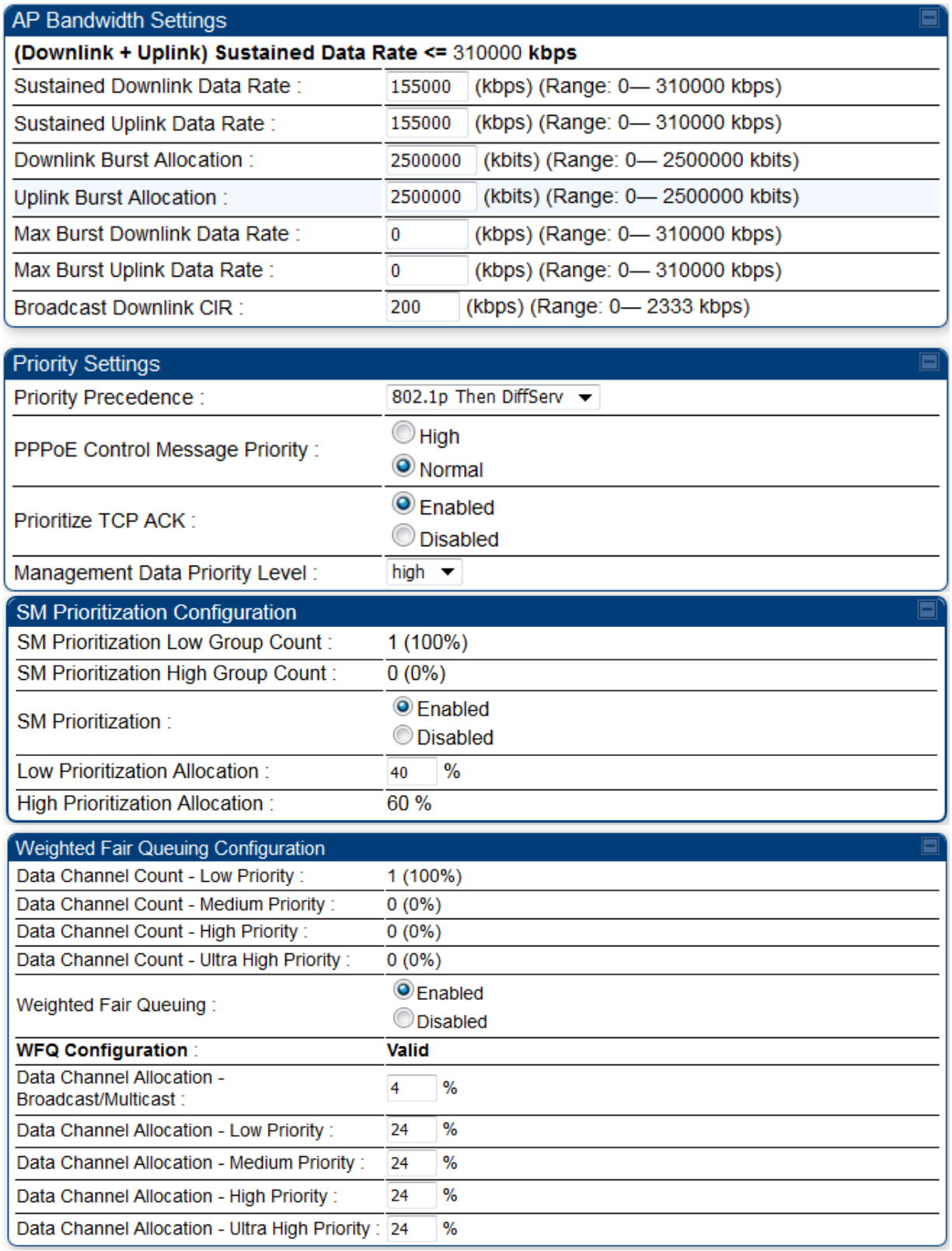
For the case where configuration source is set to Authentication Server, the Data Channel Count per SM, and the CIR values for those data channels, is defaulted to Low Priority data Channel only with no CIR's configured.

Configuring Quality of Service (QoS)

Quality of Service (QoS) page of AP

The QoS page of AP is explained in Table 191.

Table 191 QoS page attributes - AP



AP Bandwidth Settings

(Downlink + Uplink) Sustained Data Rate <= 310000 **kbps**	
Sustained Downlink Data Rate :	155000 (kbps) (Range: 0— 310000 kbps)
Sustained Uplink Data Rate :	155000 (kbps) (Range: 0— 310000 kbps)
Downlink Burst Allocation :	2500000 (kbits) (Range: 0— 2500000 kbits)
Uplink Burst Allocation :	2500000 (kbits) (Range: 0— 2500000 kbits)
Max Burst Downlink Data Rate :	0 (kbps) (Range: 0— 310000 kbps)
Max Burst Uplink Data Rate :	0 (kbps) (Range: 0— 310000 kbps)
Broadcast Downlink CIR :	200 (kbps) (Range: 0— 2333 kbps)

Priority Settings

Priority Precedence :	802.1p Then DiffServ
PPPoE Control Message Priority :	High Normal
Prioritize TCP ACK :	Enabled Disabled
Management Data Priority Level :	high

SM Prioritization Configuration

SM Prioritization Low Group Count :	1 (100%)
SM Prioritization High Group Count :	0 (0%)
SM Prioritization :	Enabled Disabled
Low Prioritization Allocation :	40 %
High Prioritization Allocation :	60 %

Weighted Fair Queuing Configuration

Data Channel Count - Low Priority :	1 (100%)
Data Channel Count - Medium Priority :	0 (0%)
Data Channel Count - High Priority :	0 (0%)
Data Channel Count - Ultra High Priority :	0 (0%)
Weighted Fair Queuing :	Enabled Disabled
WFQ Configuration :	**Valid**
Data Channel Allocation - Broadcast/Multicast :	4 %
Data Channel Allocation - Low Priority :	24 %
Data Channel Allocation - Medium Priority :	24 %
Data Channel Allocation - High Priority :	24 %
Data Channel Allocation - Ultra High Priority :	24 %