18.4.2 IP Tab of the BHM

An example of an IP tab in a BHM is displayed in Figure 101.

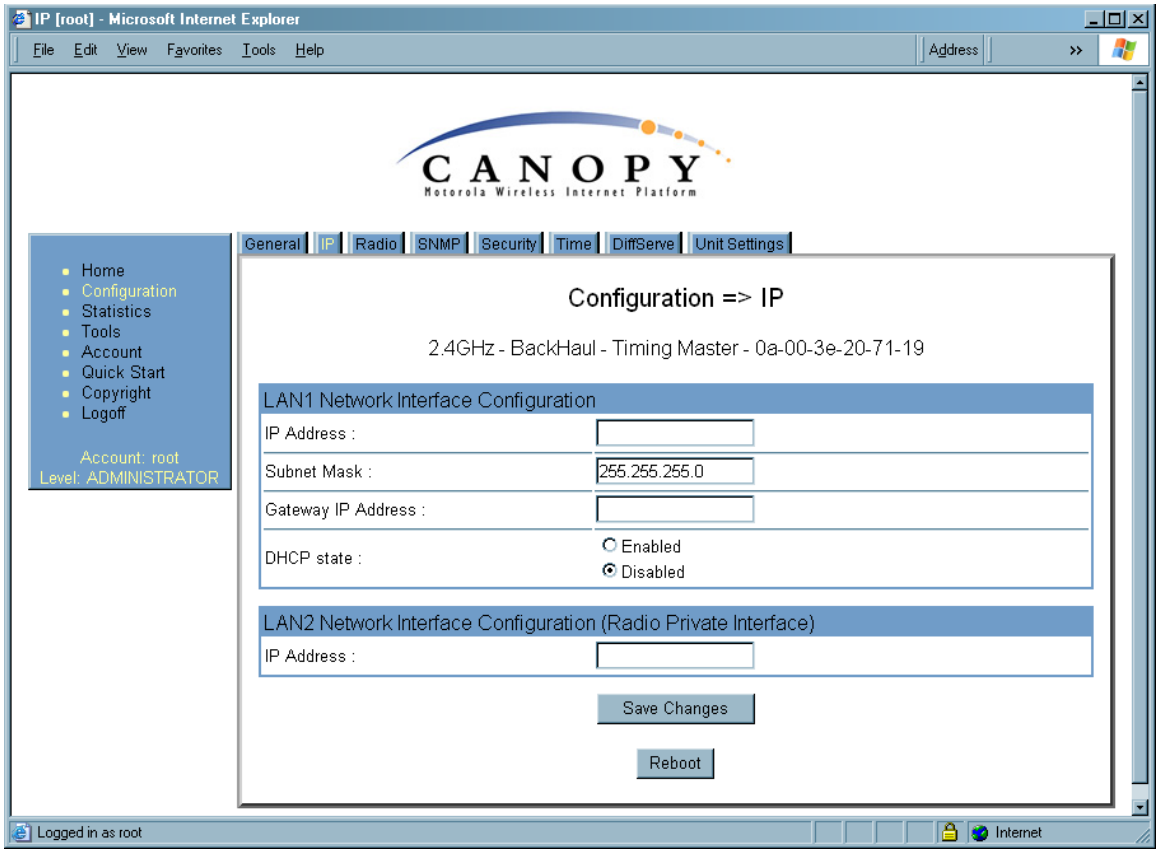


Figure 101: IP tab of BHM, example

You may set the following IP Configuration page parameters.

LAN1 Network Interface Configuration, IP Address

Enter the *non-routable* IP address to be associated with the Ethernet connection on this module. (The default IP address from the factory is 169.254.1.1.) If you set and then forget this parameter, then you must both

1. physically access the module.
2. use an override plug to electronically access the module configuration parameters at 169.254.1.1. See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 381.

RECOMMENDATION:
Note or print the IP settings from this page. Ensure that you can readily associate these IP settings both with the module and with the other data that you store about the module.

LAN1 Network Interface Configuration, Subnet Mask

Enter an appropriate subnet mask for the BHM to communicate on the network. The default subnet mask is 255.255.0.0. See Allocating Subnets on Page 162.

LAN1 Network Interface Configuration, Gateway IP Address

Enter the appropriate gateway for the BHM to communicate with the network. The default gateway is 169.254.0.0.

LAN1 Network Interface Configuration, DHCP State

If you select **Enabled**, 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, but not settable, in the Network Interface tab of the Home page.

LAN2 Network Interface Configuration (RF Private Interface), IP Address

Enter the IP address to be associated with this BHM for over-the-air access.

The IP tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the IP Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.4.3 Radio Tab of the BHM

An example of the Radio tab in a BHM is displayed in Figure 102.

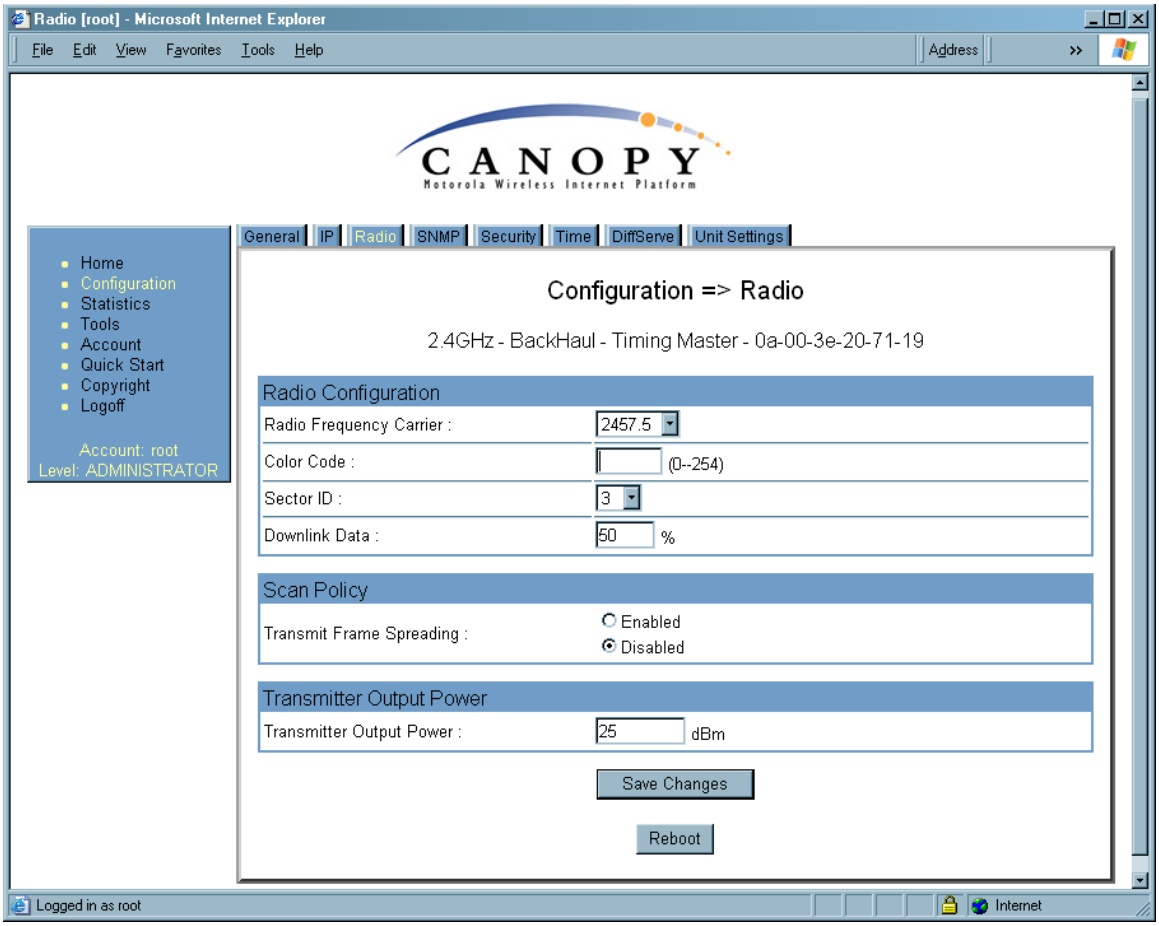


Figure 102: Radio tab of BHM, example

In the Radio tab of the BHM, you may set the following parameters.

Radio Frequency Carrier

Specify the frequency for the BHM to transmit. The default for this parameter is **None**. (The selection labeled **Factory** requires a special software key file for implementation.) In a 5.7-GHz BHM, this parameter displays both ISM and U-NII frequencies. In a 5.2-GHz BHM, this parameter displays only ISM frequencies. For a list of channels in the band, see Considering Frequency Band Alternatives on Page 136.

Color Code

Specify a value from 0 to 254. For registration to occur, the color code of the BHM and the BHS *must* match. On all Cyclone modules, the default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).

RECOMMENDATION:
Note the color code that you enter. Ensure that you can readily associate this color code both with the module and with the other data that you store about the module.

Sector ID

You can optionally enter an identifier to distinguish this link.

Downlink Data

The operator specifies the percentage of the aggregate (uplink and downlink total) throughput that is needed for the downlink. The default for this parameter is 50%.

Transmit Frame Spreading

If you select **Enable**, then a BHS between two BHMs can register in the assigned BHM (not the other BHM). Cyclone *strongly recommends* that you select this option. With this selection, the BHM does not transmit a beacon in each frame, but rather transmits a beacon in only pseudo-random frames in which the BHS expects the beacon. This allows multiple BHMs to send beacons to multiple BHSs in the same range without interference.

Transmitter Output Power

Nations and regions may regulate transmitter output power. For example

- Both 900-MHz and 5.7-GHz modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance. In addition to setting the power in the 5.7-GHz connectorized module, the operator must set the antenna gain/cable loss such that the module can accurately report received power at the antenna.
- Legal maximum allowable transmitter output power and EIRP (Equivalent Isotropic Radiated Power) in the 2.4-GHz frequency band varies by country and region. The output power of Series P9 2.4-GHz modules can be adjusted to meet these national or regional regulatory requirements.
- Countries and regions that permit the use of the 5.4-GHz frequency band (CEPT member states, for example), generally require equipment using the band to have adjustable power.

The professional installer of Cyclone 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.

For information on how to calculate the permissible transmitter output power to enter in this parameter, see Adjusting Transmitter Output Power on Page 330.

The Radio tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the IP Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.4.4 SNMP Tab of the BHM

An example of the SNMP tab in a BHM is displayed in Figure 103.

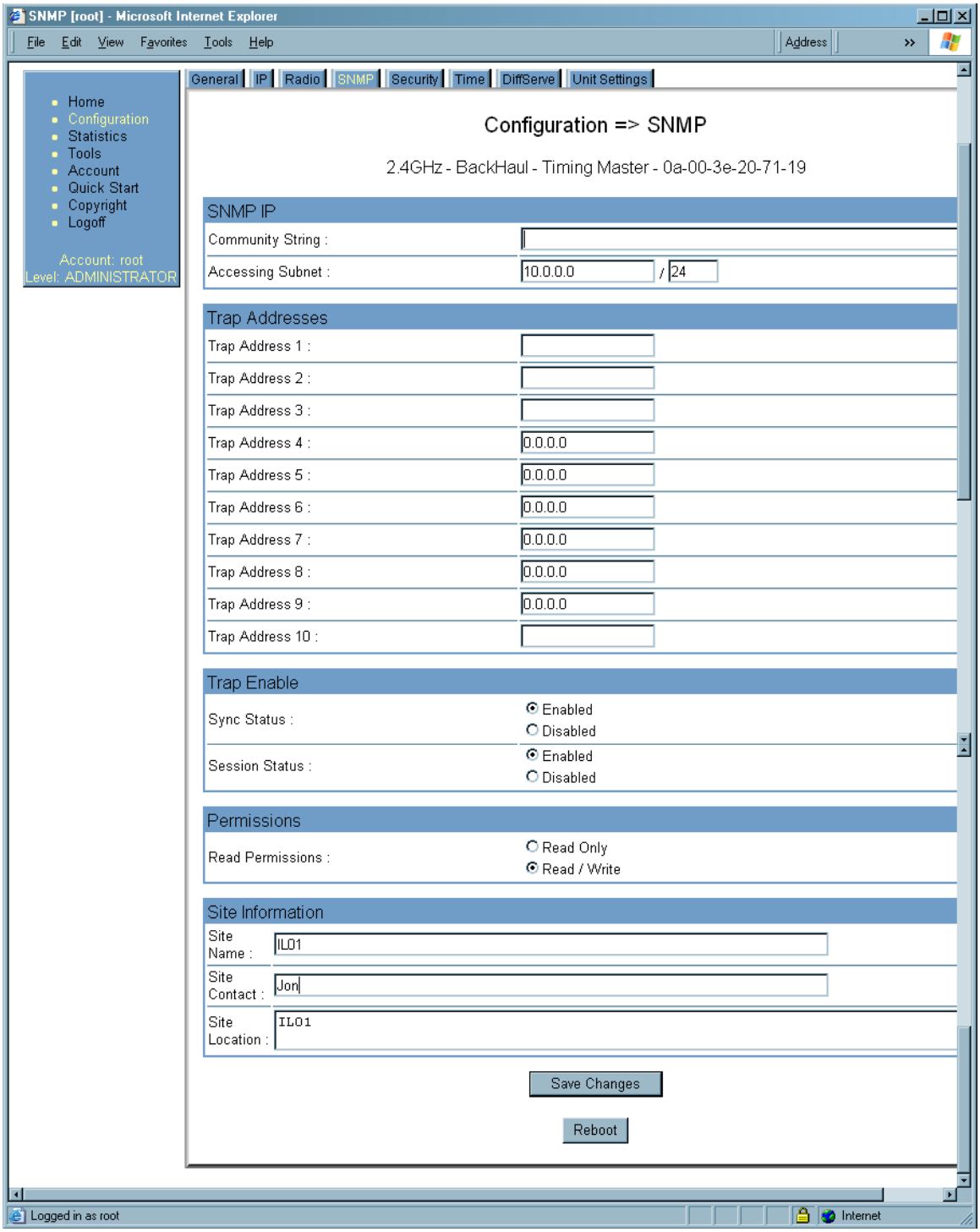


Figure 103: SNMP tab of BHM, example

In the SNMP tab of the BHM, you may set the following parameters.

Community String

Specify a control string that allows Prizm or a Network Management Station (NMS) to access the module through SNMP. No spaces are allowed in this string. The default string is **Cyclone**.

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.

Accessing Subnet

Specify the addresses that are allowed to send SNMP requests to this BHM. Prizm or 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 BHM, presuming that the device supplies the correct **Community String** value.

NOTE:
For more information on CIDR, execute an Internet search on “Classless Interdomain Routing.”

The default treatment is to allow all networks access.

Trap Address *1 to 10*

Specify ten or fewer IP addresses (xxx.xxx.xxx.xxx) to which trap information should be sent. Trap information informs Prizm or an NMS that something has occurred. For example, trap information is sent

- after a reboot of the module.
- when Prizm or 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

Select either **Sync Status** or **Session Status** to enable SNMP traps. If you select neither, then traps are disabled.

Read Permissions

Select **Read Only** if you wish to disallow any parameter changes by Prizm or an NMS.

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 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 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 an NMS. The buffer size for this field is 128 characters.

The SNMP tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.4.5 Security Tab of the BHM

An example of the Security tab in a BHM is displayed in Figure 104.

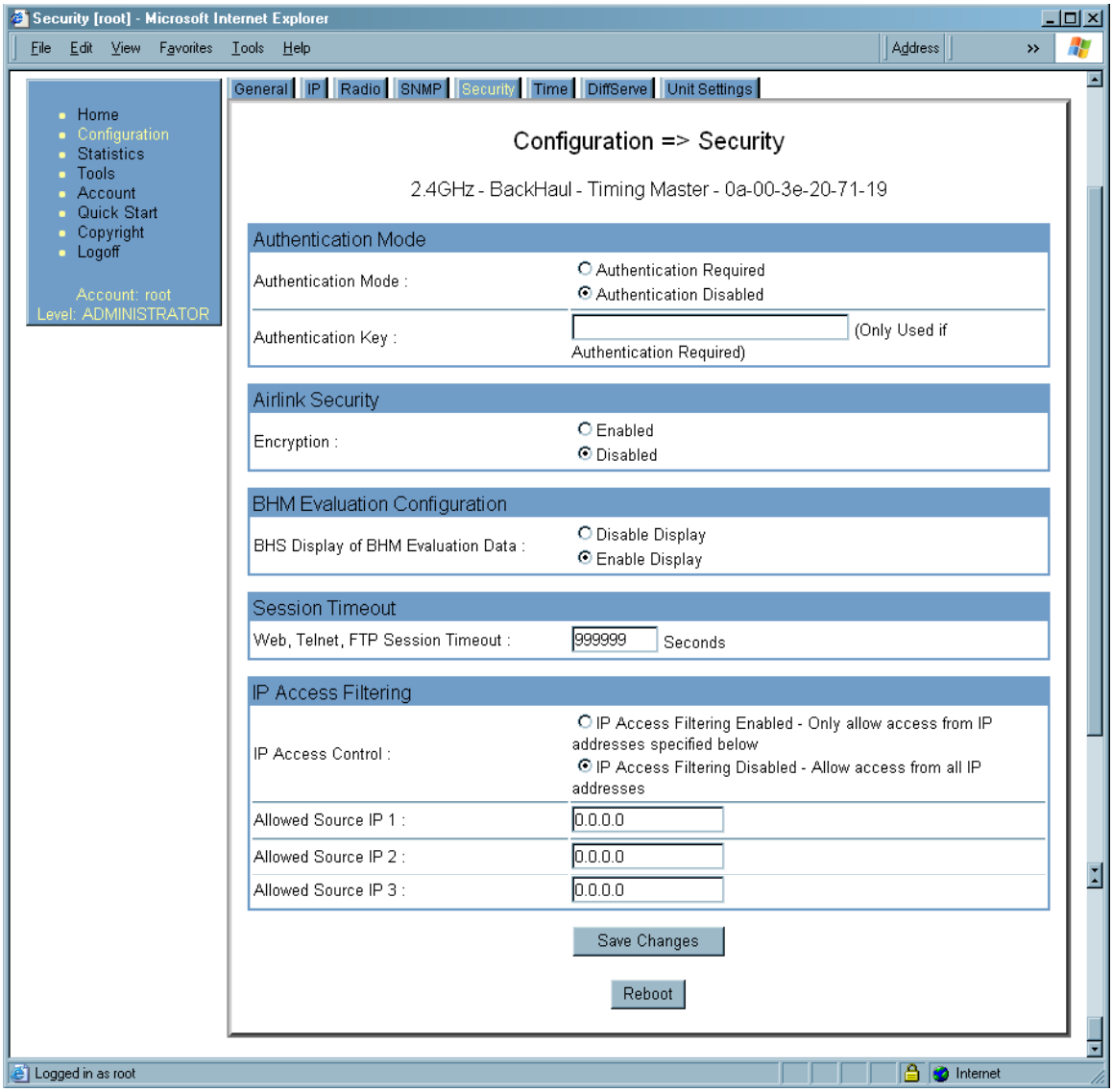


Figure 104: Security tab of BHM, example

In the Security tab of the BHM, you may set the following parameters.

Authentication Mode

Specify whether the BHM should require the BHS to authenticate.

Authentication Key

Only if you set the BHM in the previous parameter to require authentication, specify the key that the BHS should use when authenticating.

Encryption

Specify the type of air link security to apply to this BHM:

- **Encryption Disabled** provides no encryption on the air link. This is the default mode.
- **Encryption Enabled** provides encryption, using a factory-programmed secret key that is unique for each module.

NOTE:
In any BH link where encryption is enabled, the BHS briefly drops registration and re-registers in the BHM every 24 hours to change the encryption key.

BHS Display of BHM Evaluation Data

You can use this field to suppress the display of data (**Disable Display**) about this BHM on the BHM Evaluation tab of the Tools page in the BHS.

Web, Telnet, FTP Session Timeout

Enter the expiry in seconds for remote management sessions via HTTP, telnet, or ftp access to the BHM.

IP Access Control

You can permit access to the 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, including access and management by Prizm.

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 BHM 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.

The Security tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.4.6 DiffServe Tab of the BHM

An example of the DiffServe tab in a BHM is displayed in Figure 105.

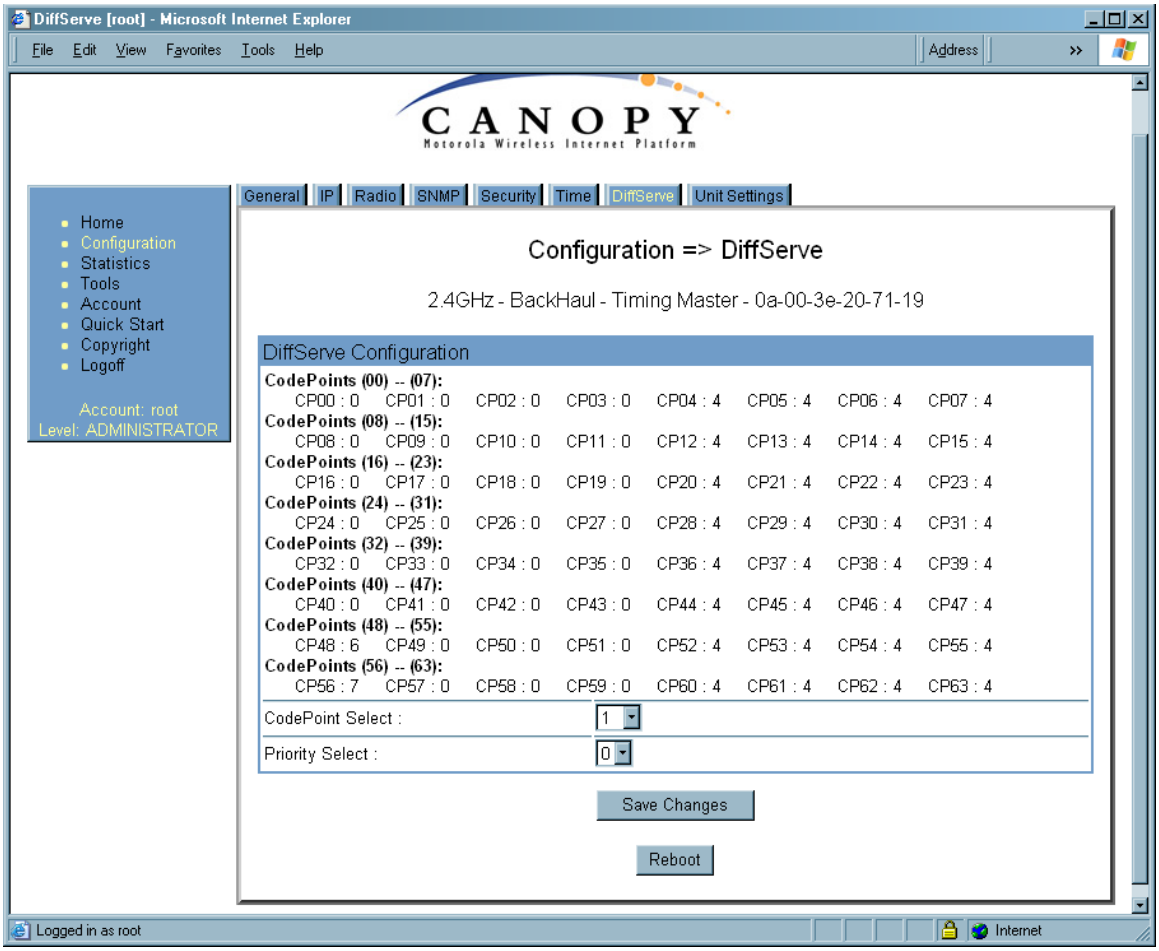


Figure 105: DiffServe tab of BHM, example

In the DiffServe tab of the BHM, you may set the following parameters.

CodePoint 1 through CodePoint 47	The default priority value for each settable CodePoint is shown in Figure 113. Priorities of 0 through 3 map to the low-priority channel; 4 through 7 to the high-priority channel. The mappings are the same as 802.1p VLAN priorities. Consistent with RFC 2474
CodePoint 49 through CodePoint 55	• **CodePoint 0** is predefined to a fixed priority value of **0** (low-priority channel). • **CodePoint 48** is predefined to a fixed priority value of **6** (high-priority channel). • **CodePoint 56** is predefined to a fixed priority value of **7** (high-priority channel).
CodePoint 57 through CodePoint 63	You cannot change any of these three fixed priority values. Among the settable parameters, the priority values (and therefore the handling of packets in the high- or low-priority channel) are set in the AP for all downlinks within the sector and in the SM for each uplink. See DSCP Field on Page 87.

The DiffServe tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.4.7 Unit Settings Tab of the BHM

An example of the Unit Settings tab of the BHM is displayed in Figure 106.

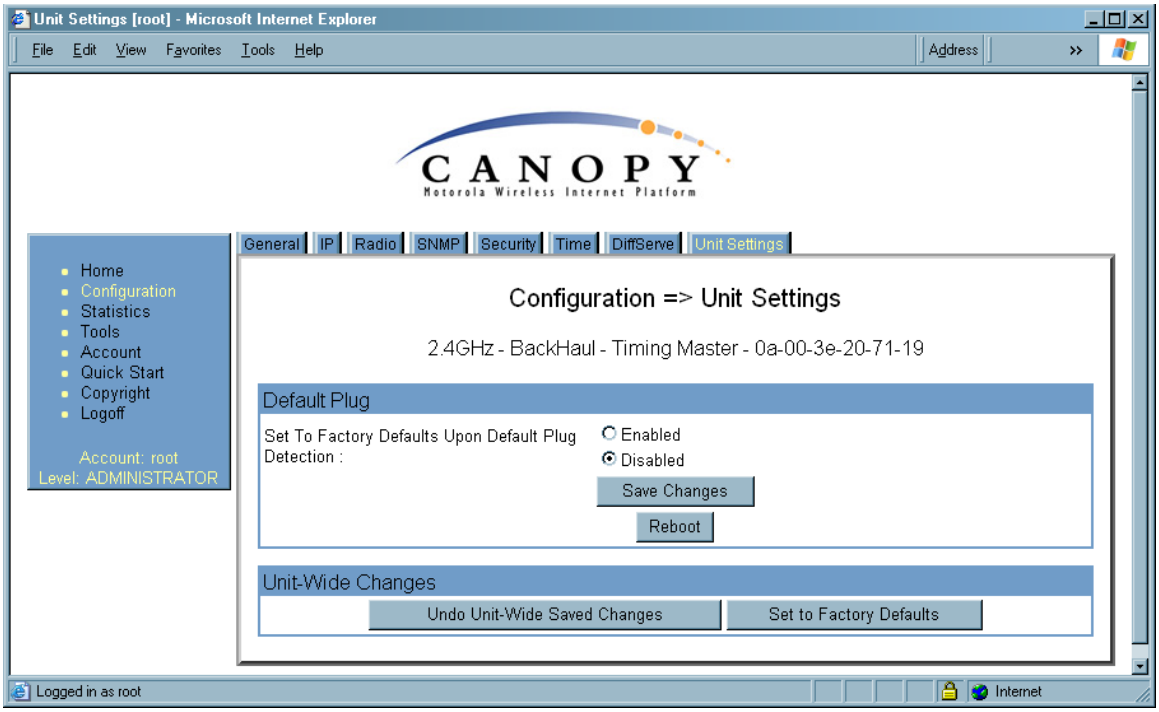


Figure 106: Unit Settings tab of BHM, example

The Unit Settings tab of the BHM contains an option for how the BHM should react when it detects a connected override plug. You may set this option as follows.

Set to Factory Defaults Upon Default Plug Detection

If **Enabled** is checked, then an override/default plug functions as a default plug. When the module is rebooted with the plug inserted, 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/default plug *cannot* see or learn the settings that were previously configured in it. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the default values for any that were not.

If **Disabled** is checked, then an override/default plug functions as an override plug. When the module is rebooted with the plug inserted, it can be accessed at the IP address 169.254.1.1 and no password, and all previously configured parameter values remain and are displayed. A subscriber, technician, or other person who gains physical access to the module and uses an override/default plug *can* see and learn the settings. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the previous values for any that were not.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 379.

The Unit Settings tab also contains the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5 CONFIGURING A BH TIMING SLAVE FOR THE DESTINATION

If an ADMINISTRATOR-level password has been set in the BHS, you must log into the module before you can configure its parameters. See Managing Module Access by Passwords on Page 377.

18.5.1 General Tab of the BHS

An example of the General tab in a BHS is displayed in Figure 107.

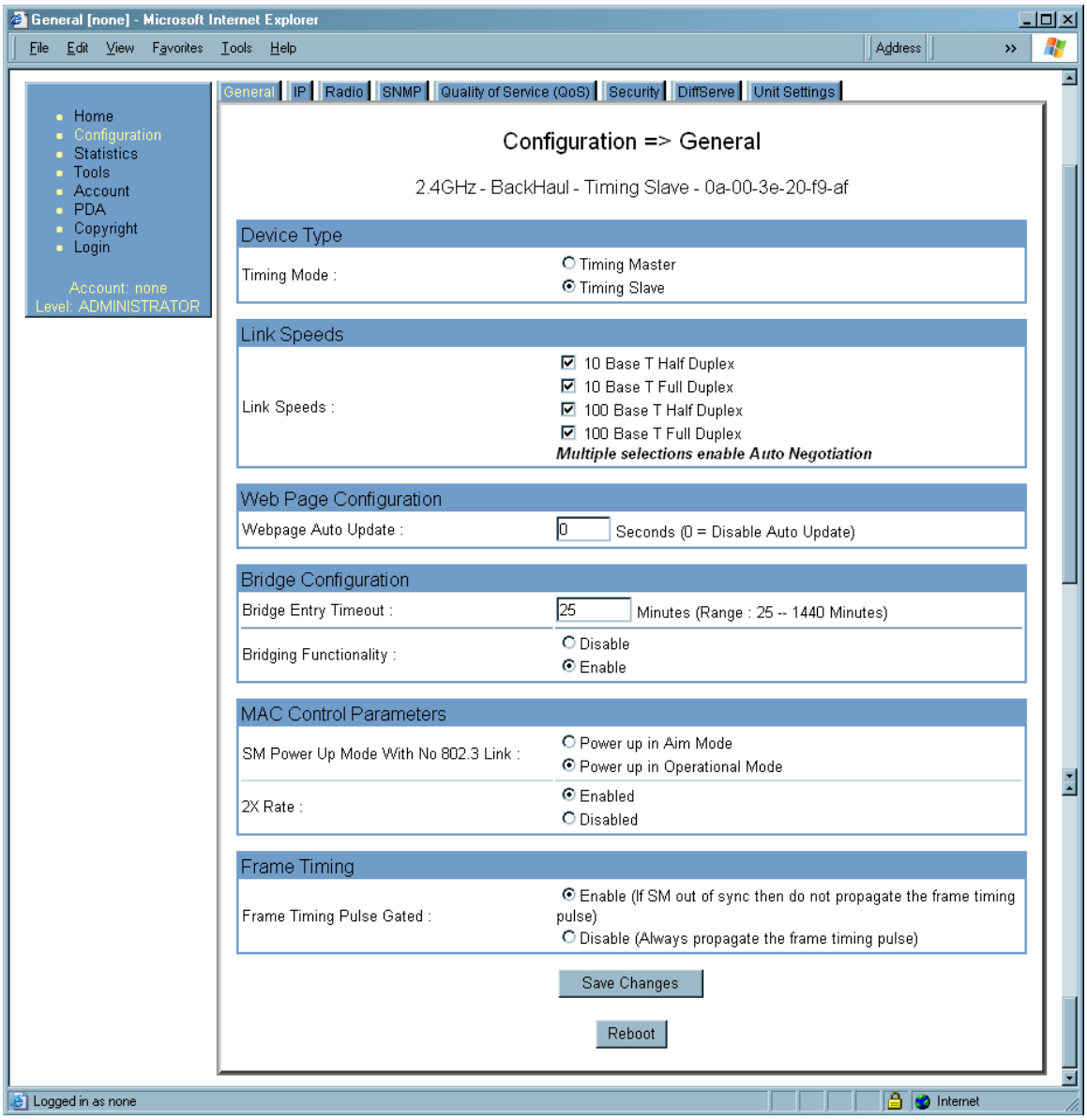


Figure 107: General tab of BHS, example

In the General tab of the BHS, you may set the following parameters.

Timing Mode

Select **Timing Slave**. This BH will receive sync from another source. Whenever you toggle this parameter to Timing Slave from Timing Master, you should also do the following:

1. Make no other changes in this or any other interface page.
2. Save this change of timing mode.
3. Reboot the BH.

RESULT: The set of interface web pages that is unique to a BHS is made available.

NOTE:
In a BHS that cannot be converted to a BHM, this parameter is not present (for example, in a BHS with Hardware Scheduling and Series P8 hardware.)

Link Speeds

Specify 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, BHs, and SMs in the operator network.

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 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 should be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

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.

CAUTION!
An inappropriately low Bridge Entry Timeout setting may lead to temporary loss of communication with some end users.

Bridging Functionality

Select whether you want bridge table filtering active (**Enable**) or not (**Disable**) on this BHS. Selecting **Disable** allows you to use redundant BHs without causing network addressing problems. Through a spanning tree protocol, this reduces the convergence time from 25 minutes to mere seconds. However, you should disable bridge table filtering as only a deliberate part of your overall network design. Otherwise, disabling it allows unwanted traffic across the wireless interface.

SM Power Up Mode With No 802.3 Link

Specify the default mode in which this BHS will power up when it senses no Ethernet link. Select either

- **Power Up in Aim Mode**—the BHS boots in an aiming mode. When the BHS senses an Ethernet link, this parameter is automatically reset to Power Up in Operational Mode. When the BHS senses no Ethernet link within 15 minutes after power up, the BHS carrier shuts off.
- **Power Up in Operational Mode**—the BHS boots in Operational mode and attempts registration. Unlike in previous releases, this is the default selection in Release 8.

2X Rate

See 2X Operation on Page 90.

Frame Timing Pulse Gated

If this BHS extends the sync pulse to a BHM or an AP behind it, select either

- **Enable**—If this BHS loses sync, then *do not* propagate a sync pulse to the BHM or AP. This setting prevents interference in the event that the BHS loses sync.
- **Disable**—If this BHS loses sync, then propagate the sync pulse anyway to the BHM or AP.

See Wiring to Extend Network Sync on Page 374.

The General tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.2 IP Tab of the BHS

An example of the IP tab in a BHS is displayed in Figure 108.

Figure 108: IP tab of BHS, example

In the IP tab of the BHS, you may set the following parameters.

LAN1 Network Interface Configuration, IP Address

Enter the *non-routable* IP address to associate with the Ethernet connection on this BHS. (The default IP address from the factory is 169.254.1.1.) If you set and then forget this parameter, then you must both

1. physically access the module.
2. use an override plug to electronically access the module configuration parameters at 169.254.1.1. See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 381.

RECOMMENDATION:
Note or print the IP settings from this page. Ensure that you can readily associate these IP settings both with the module and with the other data that you store about the module.

LAN1 Network Interface Configuration, Subnet Mask

Enter an appropriate subnet mask for the BHS to communicate on the network. The default subnet mask is 255.255.0.0. See Allocating Subnets on Page 162.

LAN1 Network Interface Configuration, Gateway IP Address

Enter the appropriate gateway for the BHS to communicate with the network. The default gateway is 169.254.0.0.

LAN1 Network Interface Configuration, DHCP State

If you select **Enabled**, 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, but not settable, in the Network Interface tab of the Home page.

The IP tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the IP Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.3 Radio Tab of the BHS

An example of the Radio tab in a BHS is displayed in Figure 109.

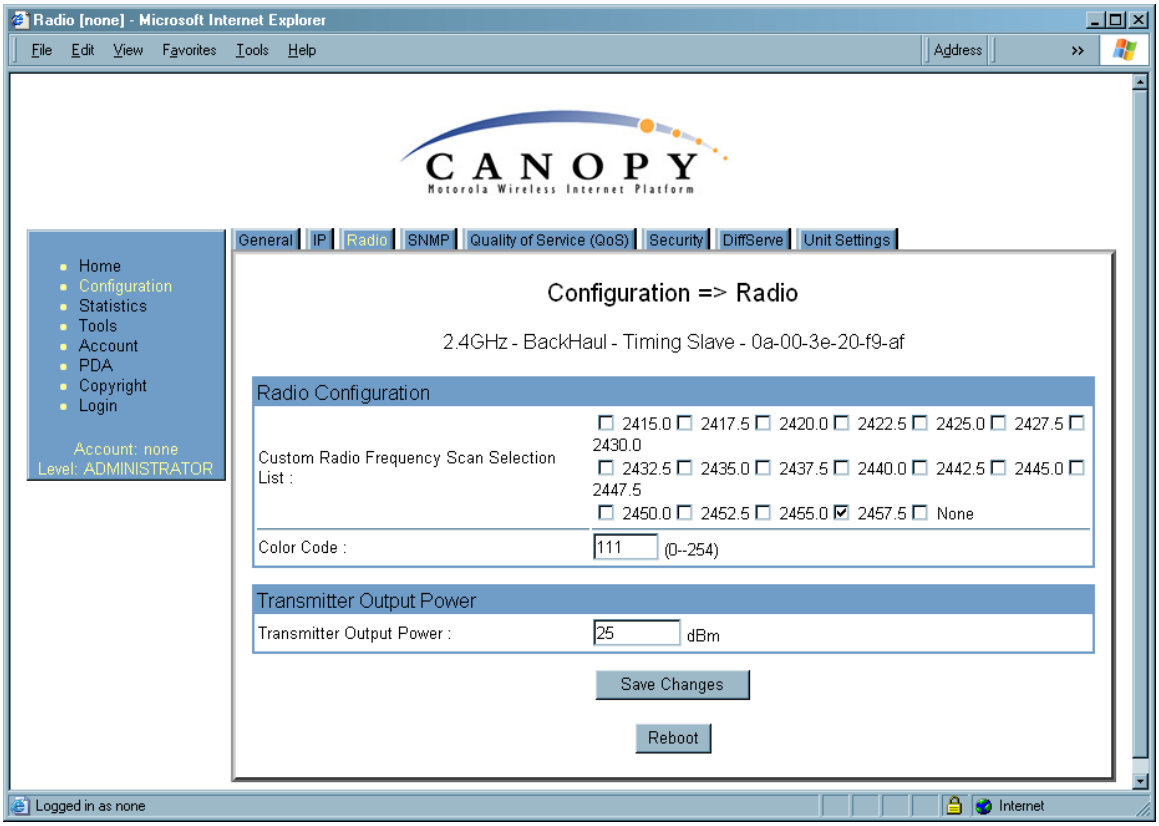


Figure 109: Radio tab of BHS, example

In the Radio tab of the BHS, you may set the following parameters.

Custom Radio Frequency Scan Selection List

Specify the frequency that the BHS should scan to find the BHM. The frequency *band* of the BHs affects what channels you select.

> ***IMPORTANT!***
> In the 2.4-GHz frequency band, the BHS can register to a BHM that transmits on a frequency 2.5 MHz higher than the frequency that the BHS receiver locks when the scan terminates as successful. This establishes a poor-quality link. To prevent this, select frequencies that are at least 5 MHz apart.

In a 2.4-GHz BHS, this parameter displays all available channels, but has only three recommended channels selected by default. See 2.4-GHz AP Cluster Recommended Channels on Page 137.

In a 5.2- or 5.4-GHz BHS, this parameter displays only ISM frequencies. In a 5.7-GHz BHS, this parameter displays both ISM and U-NII frequencies. If you select all frequencies that are listed (default selections), then the module scans for a signal on any

channel. If you select only one, then the module limits the scan to that channel. Since the frequencies that this parameter offers for each of these two bands are 5 MHz apart, a scan of *all* channels does not risk establishment of a poor-quality link as in the 2.4-GHz band. Nevertheless, this can risk establishment of a link to the wrong BHM.

A list of channels in the band is provided in Considering Frequency Band Alternatives on Page 136.

(The selection labeled **Factory** requires a special software key file for implementation.)

Color Code

Specify a value from 0 to 254. For registration to occur, the color code of the BHM and the BHS *must* match. On all Cyclone modules, the default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).

RECOMMENDATION:
Note the color code that you enter. Ensure that you can readily associate this color code both with the module and with the other data that you store about the module.

Transmitter Output Power

Nations and regions may regulate transmitter output power. For example

- Both 900-MHz and 5.7-GHz modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance. In addition to setting the power in the 5.7-GHz connectorized module, the operator must set the antenna gain/cable loss such that the module can accurately report received power at the antenna.
- Legal maximum allowable transmitter output power and EIRP (Equivalent Isotropic Radiated Power) in the 2.4-GHz frequency band varies by country and region. The output power of Series P9 2.4-GHz modules can be adjusted to meet these national or regional regulatory requirements.
- Countries and regions that permit the use of the 5.4-GHz frequency band (CEPT member states, for example), generally require equipment using the band to have adjustable power.

The professional installer of Cyclone 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.

For information on how to calculate the permissible transmitter output power to enter in this parameter, see Adjusting Transmitter Output Power on Page 330.

The Radio tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on this tab are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.4 SNMP Tab of the BHS

An example of the SNMP tab in a BHS is displayed in Figure 110.

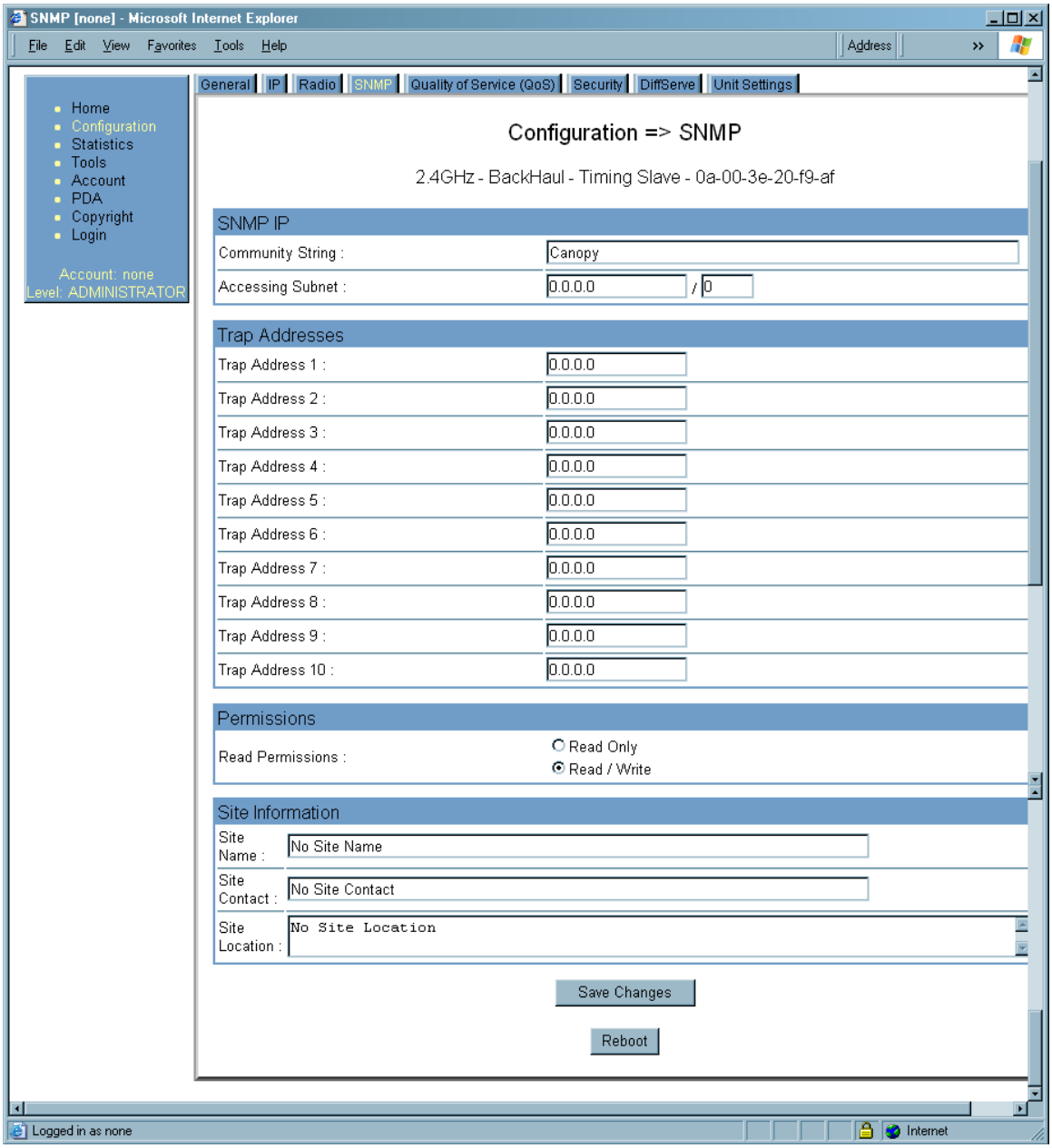


Figure 110: SNMP tab of BHS, example

In the SNMP tab of the BHS, you may set the following parameters.

Community String

Specify a control string that allows Prizm or an NMS (Network Management Station) to access MIB information about this BHS. No spaces are allowed in this string. The default string is **Cyclone**.

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.

Accessing Subnet

Specify the addresses that are allowed to send SNMP requests to this BHS. Prizm or 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 BHS, presuming that the device supplies the correct **Community String** value.

The default treatment is to allow all networks access (set to 0). For more information on CIDR, execute an Internet search on “Classless Interdomain Routing.”

Trap Address *1 to 10*

Specify ten or fewer IP addresses (xxx.xxx.xxx.xxx) to which trap information should be sent. Trap information informs Prizm or an NMS that something has occurred. For example, trap information is sent

- after a reboot of the module.
- when Prizm or 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.

Read Permissions

Select **Read Only** if you wish to disallow Prizm or NMS SNMP access to configurable parameters and read-only fields of the SM.

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 Prizm 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 Prizm 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 Prizm or an NMS. The buffer size for this field is 128 characters.

The SNMP tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.5 Quality of Service (QoS) Tab of the BHS

An example of the Quality of Service tab of the BHS is displayed in Figure 111.

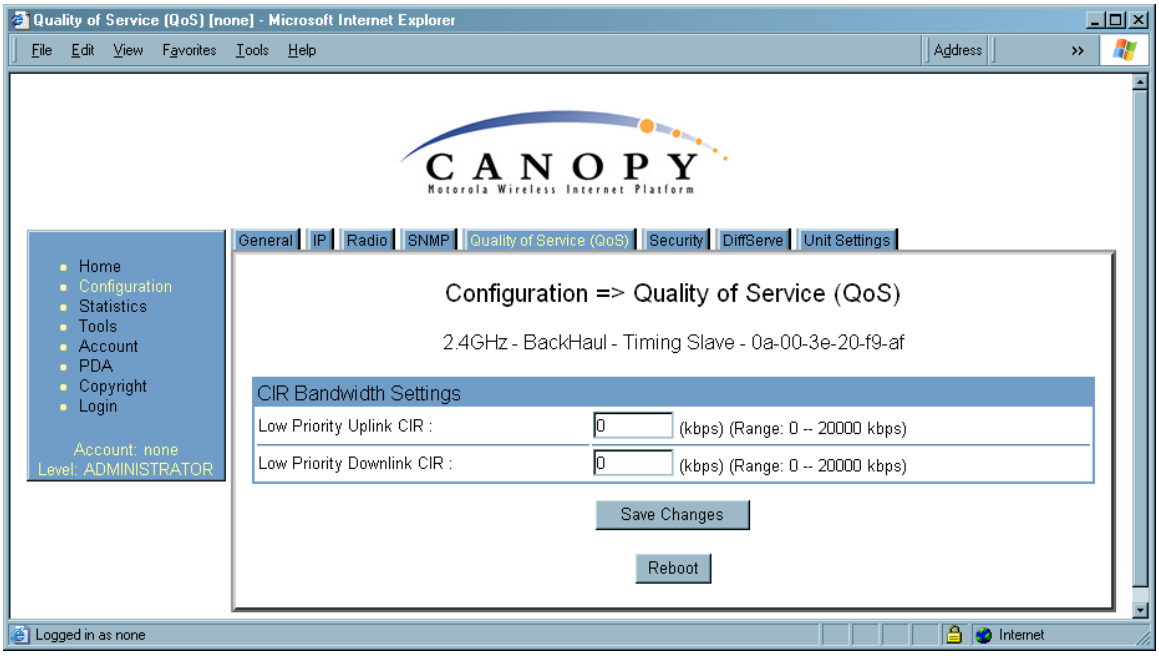


Figure 111: Quality of Service (QoS) tab of BHS, example

In the Quality of Service (QoS) tab of the BHS, you may set the following parameters.

Low Priority Uplink CIR

See

- Committed Information Rate on Page 86
- Setting the Configuration Source on Page 295.

Low Priority Downlink CIR

See

- Committed Information Rate on Page 86
- Setting the Configuration Source on Page 295.

18.5.6 Security Tab of the BHS

An example of the Security tab in a BHS is displayed in Figure 112.

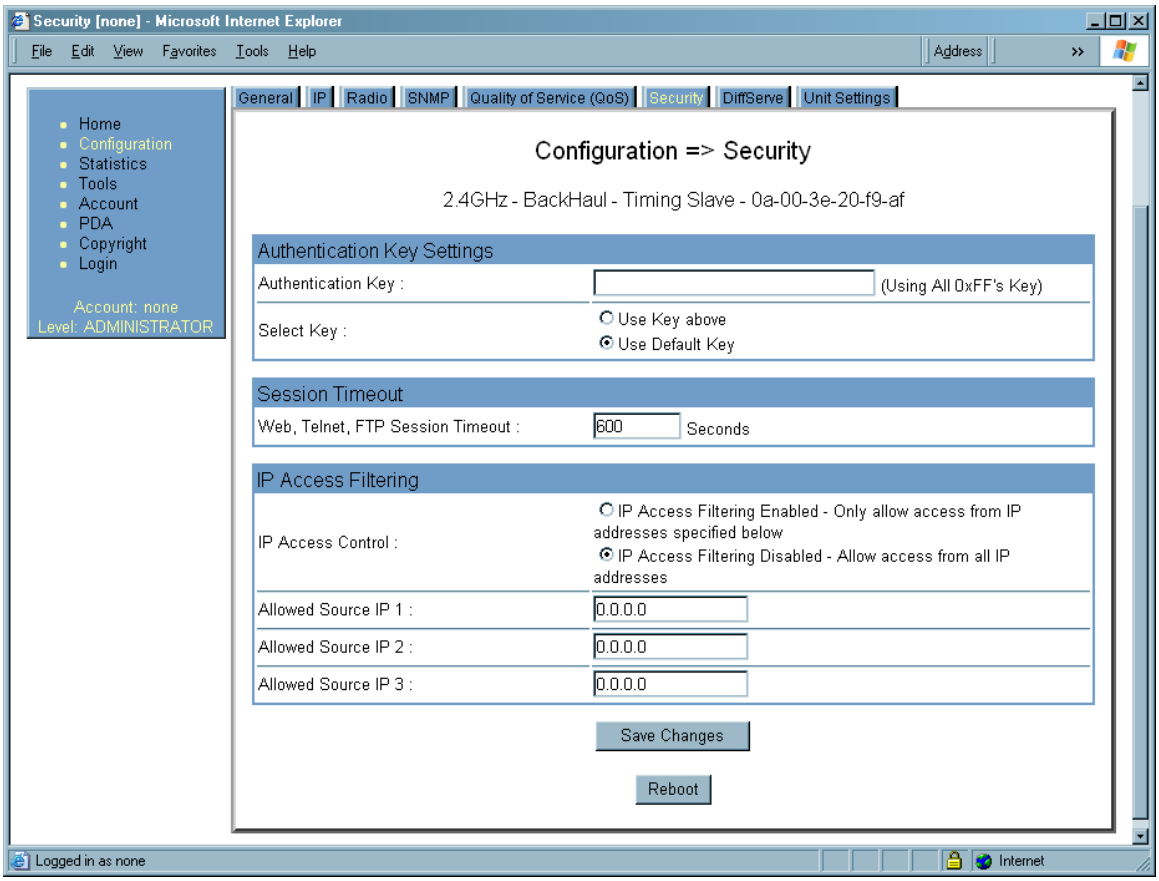


Figure 112: Security tab of BHS, example

In the Security tab of the BHS, you may set the following parameters.

Authentication Key

Only if the BHM to which this BHS will register requires authentication, specify the key that the BHS should use when authenticating. For alpha characters in this hex key, use only upper case.

NOTE:
Cyclone recommends that you enter 32 characters to achieve the maximal security from this feature.

Select Key

The **Use Default Key** selection specifies that the link should continue to use the automatically generated authentication key. See Authentication Manager Capability on Page 389.

The **Use Key above** selection specifies the 32-digit hexadecimal key that is permanently stored on both the BHS and the BHM.

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, including access and management by Prizm.

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.

The Security tab of the BHS also provides the following buttons.

Save Changes

When you click this button, any changes that you made on this tab are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.7 DiffServe Tab of the BHS

An example of the DiffServe tab in a BHS is displayed in Figure 113.

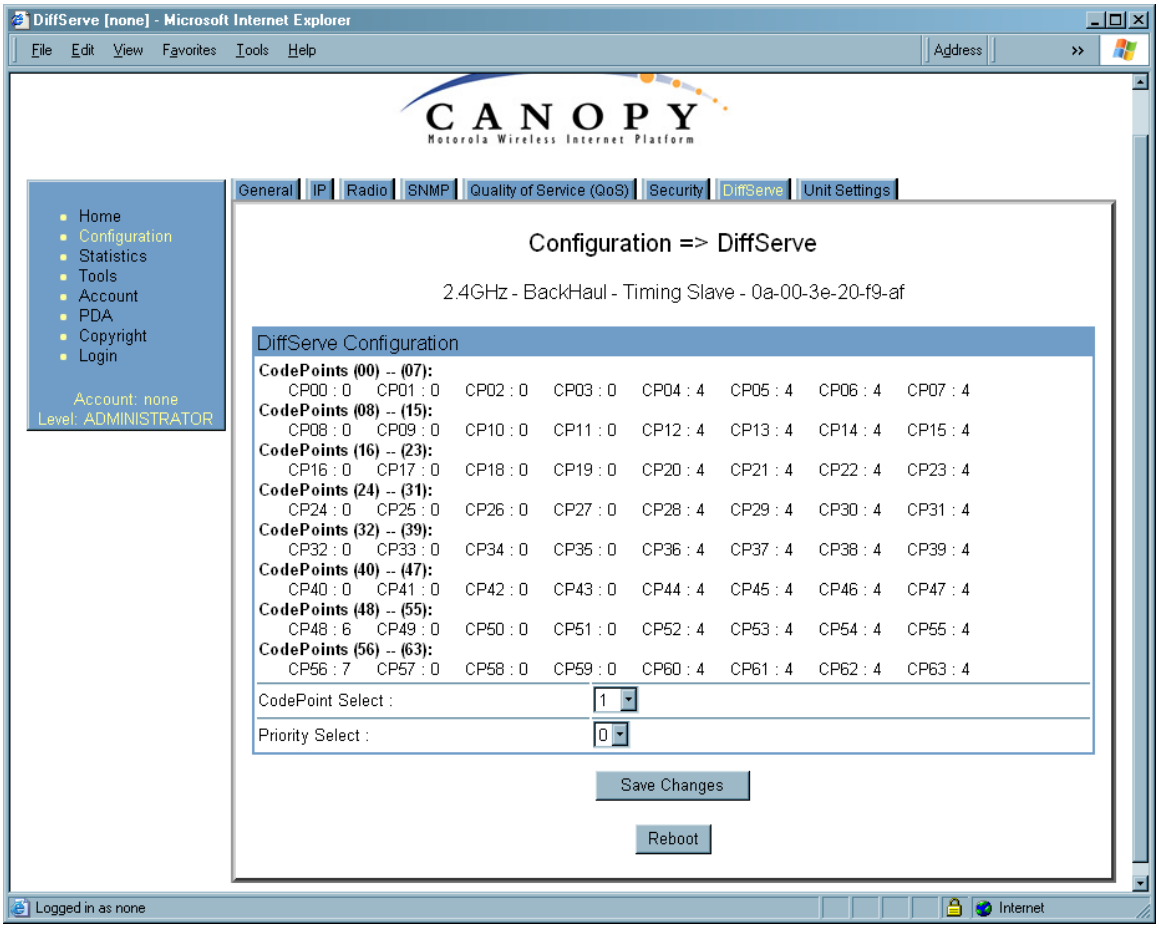


Figure 113: DiffServe tab of BHS, example

You may set the following Differentiated Services Configuration page parameters.

CodePoint 1 through CodePoint 47	The default priority value for each settable CodePoint is shown in Figure 113. Priorities of 0 through 3 map to the low-priority channel; 4 through 7 to the high-priority channel. The mappings are the same as 802.1p VLAN priorities. Consistent with RFC 2474
CodePoint 49 through CodePoint 55	• **CodePoint 0** is predefined to a fixed priority value of **0** (low-priority channel). • **CodePoint 48** is predefined to a fixed priority value of **6** (high-priority channel). • **CodePoint 56** is predefined to a fixed priority value of **7** (high-priority channel).
CodePoint 57 through CodePoint 63	You cannot change any of these three fixed priority values. Among the settable parameters, the priority values (and therefore the handling of packets in the high- or low-priority channel) are set in the BHM for the downlink and in the BHS for the uplink. See DSCP Field on Page 87.

18.5.8 Unit Settings Tab of the BHS

An example of the Unit Settings tab in a BHS is displayed in Figure 114.

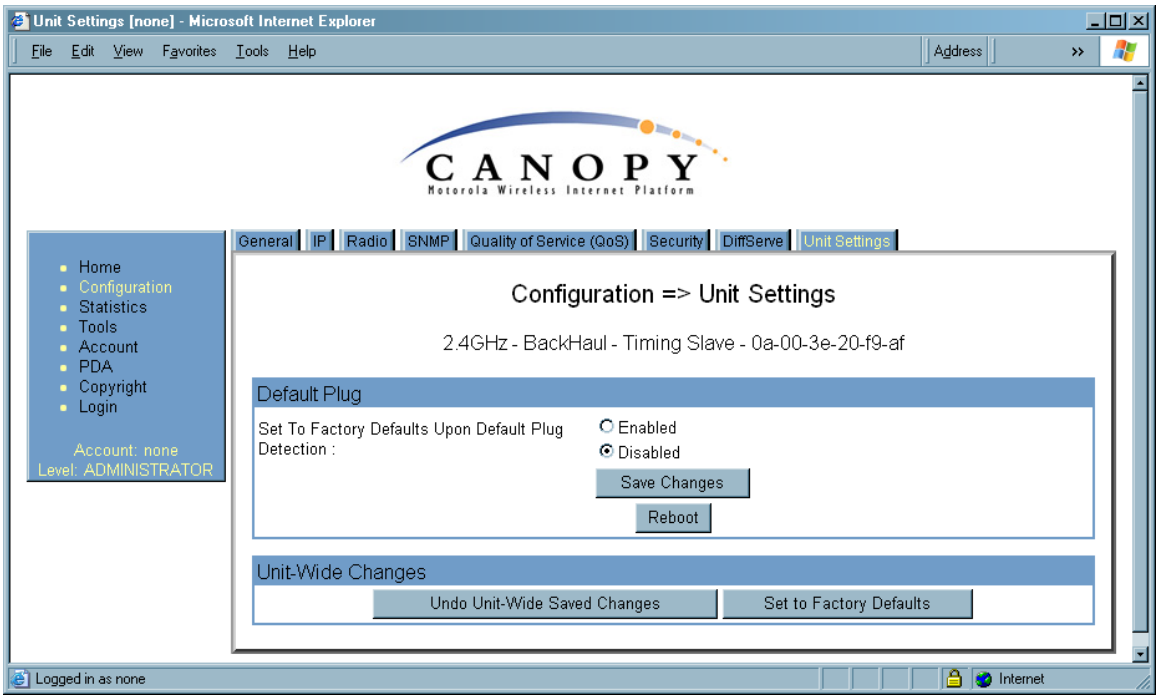


Figure 114: Unit Settings tab of BHS, example

The Unit Settings tab of the BHS contains an option for how the BHS should react when it detects a connected override plug. You may set this option as follows.

Set to Factory Defaults Upon Default Plug Detection

If **Enabled** is checked, then an override/default plug functions as a default plug. When the module is rebooted with the plug inserted, 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/default plug *cannot* see or learn the settings that were previously configured in it. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the default values for any that were not.

If **Disabled** is checked, then an override/default plug functions as an override plug. When the module is rebooted with the plug inserted, it can be accessed at the IP address 169.254.1.1 and no password, and all previously configured parameter values remain and are displayed. A subscriber, technician, or other person who gains physical access to the module and uses an override/default plug *can* see and learn the settings. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the previous values for any that were not.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 379.

The Unit Settings tab also contains the following buttons.

Save Changes

When you click this button, any changes that you made on all tabs are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

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.

18.6 ADJUSTING TRANSMITTER OUTPUT POWER

Authorities may require transmitter output power to be adjustable and/or lower than the highest that a module produces. Cyclone adjustable power modules include a Radio tab parameter to reduce power on an infinite scale to achieve compliance. If you set this parameter to lower than the supported range extends, the value is automatically reset to the lowest supported value.

The professional installer of Cyclone 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.
- confirm that the power setting is compliant following any reset of the module to factory defaults.

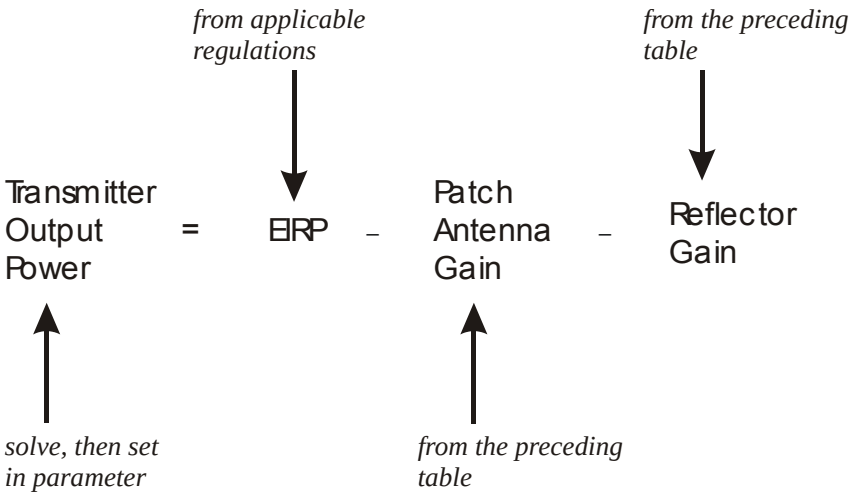
The total gain per antenna in 5.2 GHz and 5.4 GHz Cyclone radios is stated in Table 48.

Table 48: Total gain per antenna

Cyclone 5.2 GHz Access Points & Backhauls				
Model	**Antenna**	**Antenna Gain**	**Cable Loss**	**Net Gain**
Cyclone 52XX-60	TA-5204LM-8-60	16.5 dBi	0.5 dB	16.0 dBi
Cyclone 52XX-90	TA-5204LM-8-90	15.5 dBi	0.5 dB	15.0 dBi
Cyclone 52XX-120	TA-5204LM-8-120	14.5 dBi	0.5 dB	14.0 dBi
Cyclone 52XX-180	TA-5204LM-8-180	13.5 dBi	0.5 dB	13.0 dBi
Cyclone 52XX-60H	TA-5204LMH-8-60	16.0 dBi	0.5 dB	15.5 dBi
Cyclone 52XX-90H	TA-5204LMH-8-90	15.0 dBi	0.5 dB	14.5 dBi
Cyclone 52XX-120H	TA-5204LMH-8-120	13.0 dBi	0.5 dB	12.5 dBi
Cyclone 52XX-360	R380600204	10.0 dBi	0.5 dB	9.5 dBi
Cyclone 52XXBH	MT-485002	23 dBi	0.5 dB	22.5 dBi

Cyclone 5.4 GHz Access Points & Backhauls				
Model	**Antenna**	**Antenna Gain**	**Cable Loss**	**Net Gain**
Cyclone 54XX-60	TA-5204LM-8-60	16.5 dBi	0.5 dB	16.0 dBi
Cyclone 54XX-90	TA-5204LM-8-90	15.5 dBi	0.5 dB	15.0 dBi
Cyclone 54XX-120	TA-5204LM-8-120	14.5 dBi	0.5 dB	14.0 dBi
Cyclone 54XX-180	TA-5204LM-8-180	13.5 dBi	0.5 dB	13.0 dBi
Cyclone 54XX-60H	TA-5204LMH-8-60	16.0 dBi	0.5 dB	15.5 dBi
Cyclone 54XX-90H	TA-5204LMH-8-90	15.0 dBi	0.5 dB	14.5 dBi
Cyclone 54XX-120H	TA-5204LMH-8-120	13.0 dBi	0.5 dB	12.5 dBi
Cyclone 54XX-360	RO5410NM	10.0 dBi	0.5 dB	9.5 dBi
Cyclone 54XXBH	MT-485002	23 dBi	0.5 dB	22.5 dBi

The calculation of transmitter output power is as follows:



Transmitter output power is settable as dBm on the Radio tab of the module. Example cases of transmitter output power settings are shown in Table 49.

Table 49: Transmitter output power settings, example cases

Frequency Band Range and Antenna Scheme	Region	Maximum EIRP in Region	Transmitter Output Power Setting	
			AP, SM, or BH with No Reflector	SM or BH with Reflector
900 MHz Integrated	U.S.A. Canada	36 dBm (4 W)	24 dBm	
900 MHz Connectorized	U.S.A. Canada	36 dBm (4 W)	26 dBm[1]	
	Australia	30 dBm (1 W)	Depends on antenna	
2.4 GHz Integrated	U.S.A. Canada	Depends on antenna gain	25 dBm	25 dBm
	CEPT states	20 dBm (100 mW)	12 dBm	1 dBm
5.2 GHz Integrated	U.S.A. Canada	30 dBm (1 W)	23 dBm	
5.4 GHz Integrated	CEPT states	30 dBm (1 W)	23 dBm	5 dBm
5.7 GHz Connectorized	UK	33 dBm (2 W)	Depends on antenna	Depends on antenna

NOTES:

1. With Mars, MTI, or Maxrad antenna. This is the default setting, and 28 dBm is the highest settable value. The lower default correlates to 36 dBm EIRP where 10-dBi antennas are used. The default setting for this parameter is applied whenever **Set to Factory Defaults** is selected.

19 INSTALLING COMPONENTS

RECOMMENDATION:
Use *shielded* cable for all Cyclone infrastructure connections associated with BHs, APs, and CMMs. The environment that these modules operate in often has significant unknown or varying RF energy. Operator experience consistently indicates that the additional cost of shielded cables is more than compensated by predictable operation and reduced costs for troubleshooting and support.

19.1 PDA ACCESS TO CYCLONE MODULES

For RF spectrum analysis or module aiming on a roof or tower, a personal digital assistant (PDA) is easier to carry than, and as convenient to use as, a notebook computer. The PDA is convenient to use because no scrolling is required to view

- spectrum analysis results.
- RSSI and jitter.
- master module evaluation data.
- information that identifies the module, software, and firmware.

To access this data in a format the fits a 320 x 240 pixel PDA screen, the PDA must have all of the following:

- a Compact Flash card slot.
- any of several Compact Flash wired Ethernet cards.
- a wired Ethernet connection to the module.
- a browser directed to http://*ModuleIPAddress*/pda.html.

The initial PDA tab reports link status, as shown in Figure 115.

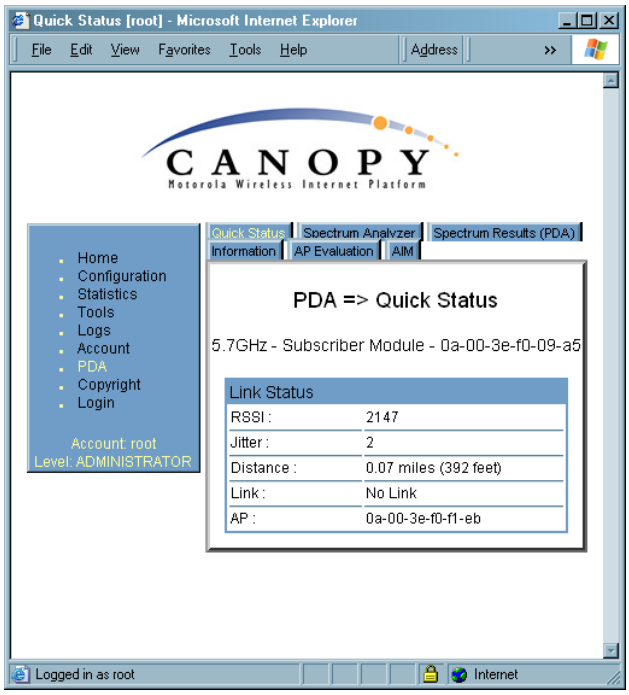


Figure 115: PDA Quick Status tab, example

An example of the Spectrum Analyzer tab for PDAs is displayed in Figure 116. For additional information about the Spectrum Analyzer feature, see Monitoring the RF Environment on Page 369.

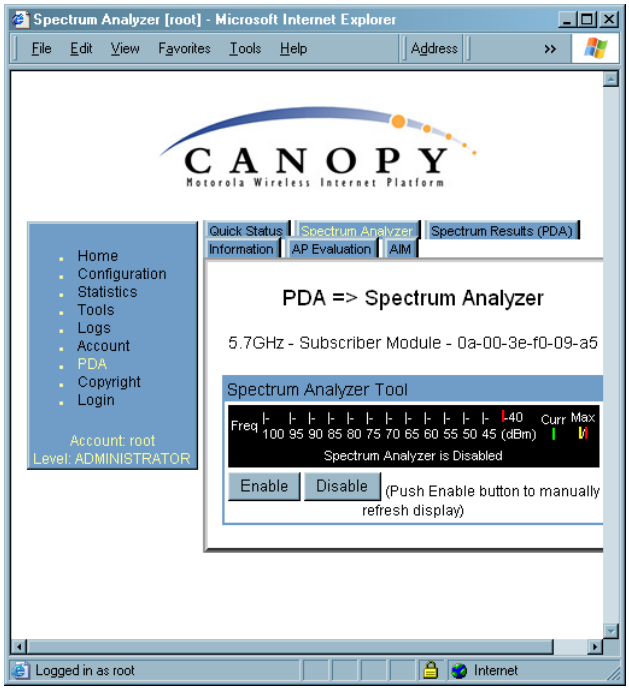


Figure 116: PDA Spectrum Analyzer tab of SM, example

Examples of the Spectrum Results and Information tabs for PDAs are shown in Figure 117 and Figure 118.

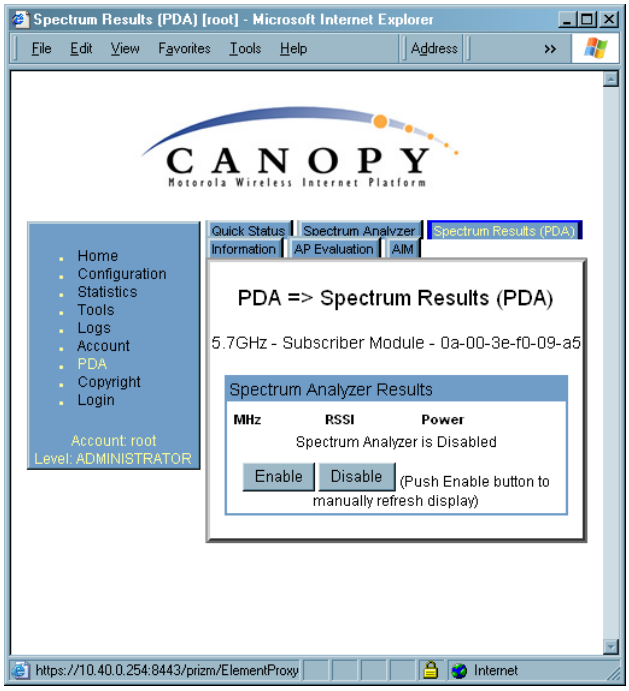


Figure 117: PDA Spectrum Results tab of SM, example

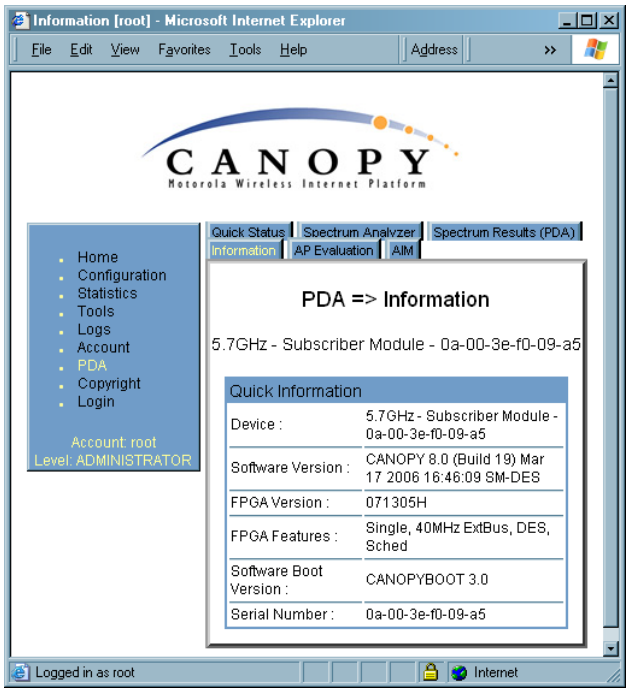


Figure 118: PDA Information tab of SM, example

Examples of the AP Evaluation and Aim tabs for PDAs are shown in Figure 119 and Figure 120.

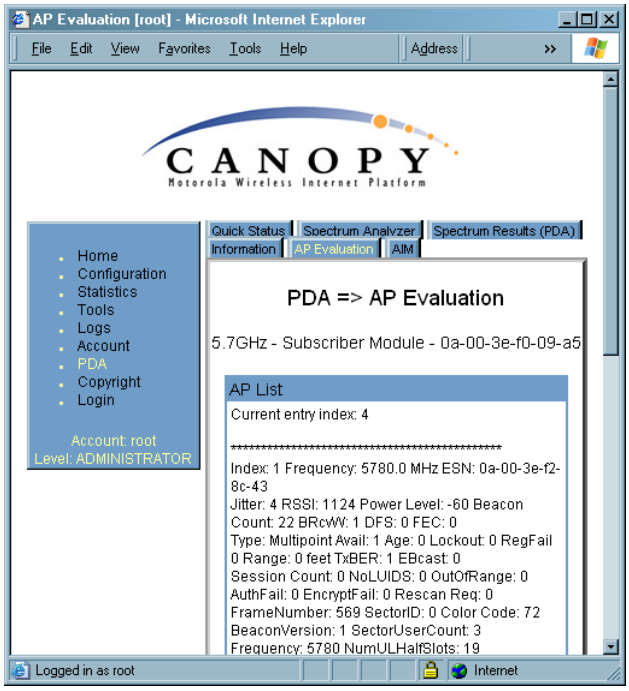


Figure 119: PDA AP Evaluation tab of SM, example

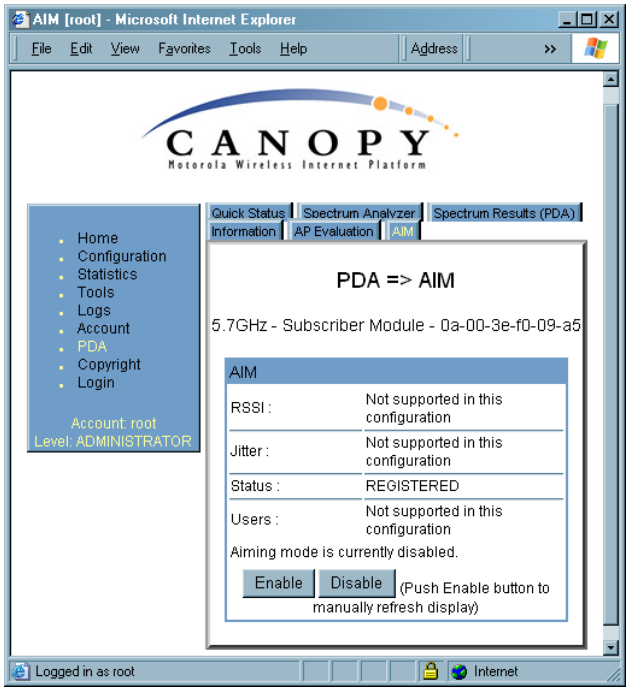


Figure 120: PDA Aim tab of SM, example

19.2 INSTALLING AN AP

To install the Cyclone AP, perform the following steps.

Procedure 19: Installing the AP

1. Begin with the AP in the powered-down state.
2. Choose the best mounting location for your particular application. Modules need not be mounted next to each other. They can be distributed throughout a given site. However, the 60° offset must be maintained. Mounting can be done with stainless steel hose clamps or another equivalent fastener.
3. Align the AP as follows:
   a. Move the module to where the link will be unobstructed by the radio horizon and no objects penetrate the Fresnel zone. (The Cyclone System Calculator page AntennaElevationCalcPage.xls automatically calculates the minimum antenna elevation that is required to extend the radio horizon to the other end of the link. The Cyclone System Calculator page FresnelZoneCalcPage.xls automatically calculates the Fresnel zone clearance that is required between the visual line of sight and the top of a high-elevation object.)
   b. Use a local map, compass, and/or GPS device as needed to determine the direction that one or more APs require to each cover the intended 60° sector.
   c. Apply the appropriate degree of downward tilt. (The Cyclone System Calculator page DowntiltCalcPage.xls automatically calculates the angle of antenna downward tilt that is required.)
   d. Ensure that the nearest and furthest SMs that must register to this AP are within the beam coverage area. (The Cyclone System Calculator page BeamwidthRadiiCalcPage.xls automatically calculates the radii of the beam coverage area.)
4. Using stainless steel hose clamps or equivalent fasteners, lock the AP in the proper direction and downward tilt.
5. Remove the base cover of the AP. (See Figure 46 on Page 178.)
6. Attach the cables to the AP.
   (See Procedure 5 on Page 184.)

NOTE: When power is applied to a Cyclone module or the unit is reset on the web-based interface, the module requires approximately 25 seconds to boot. During this interval, self-tests and other diagnostics are being performed. See Table 40 on Page 179.

end of procedure

19.3 INSTALLING A CONNECTORIZED FLAT PANEL ANTENNA

To install a connectorized flat panel antenna to a mast or structure, follow instructions that the manufacturer provides. Install the antenna safely and securely, consistent with industry practices.

The Universal Mounting Bracket available from Last Mile Gear (Part Number SMMB-1 and consisting of a mounting bracket and L-shaped aluminum tube) holds one Cyclone module, but cannot hold both the module and a connectorized antenna. The SMMB-2 is a heavy duty bracket that can hold both a 900-MHz module and its connectorized antenna. See Module Support Brackets on Page 57.

IMPORTANT!
Connectorized antennas *require* professional installation.

The professional installer is responsible for

- selection of an antenna that the regulatory agency has approved for use with the Cyclone 900-MHz AP and SM.
- setting of the gain consistent with regulatory limitations and antenna specifications.
- ensuring that the polarity—horizontal or vertical—is identical on both ends of the link. (This may be less obvious where an integrated antenna is used on one end and a connectorized on the other.)
- use of moisture sealing tape or wrap to provide long-term integrity for the connection.

19.4 INSTALLING A GPS ANTENNA

The following information describes the recommended tools and procedures to mount the GPS antenna.

Recommended Tools for GPS Antenna Mounting

The following tools may be needed for mounting the GPS antenna:

- 3/8” nut driver
- 12” adjustable wrench
- 7/16” wrench
- Needle-nose pliers

Mounting a GPS Antenna

Perform the following procedure to mount a GPS antenna.

Procedure 20: Mounting the GPS antenna

1. Ensure that the mounting position
   - has an unobstructed view of the sky to 20º above the horizon.
   - *is not* the highest object at the site. (This is important for lightning protection.)
   - *is not* further than 100 feet (30.4 meters) of cable from the CMM2 or CMMmicro.
2. Select a pole that has an outside diameter of 1.25 to 1.5 inches (3 to 4 cm) to which the GPS antenna bracket can be mounted.
3. Place the U-bolts (provided) around the pole as shown in Figure 121.
4. Slide the GPS antenna bracket onto the U-bolts.
5. Slide the ring washers (provided) onto the U-bolts.

6. Slide the lock washers (provided) onto the U-bolts.
7. Use the nuts (provided) to securely fasten the bracket to the U-bolts.

========== **end of procedure** ==========

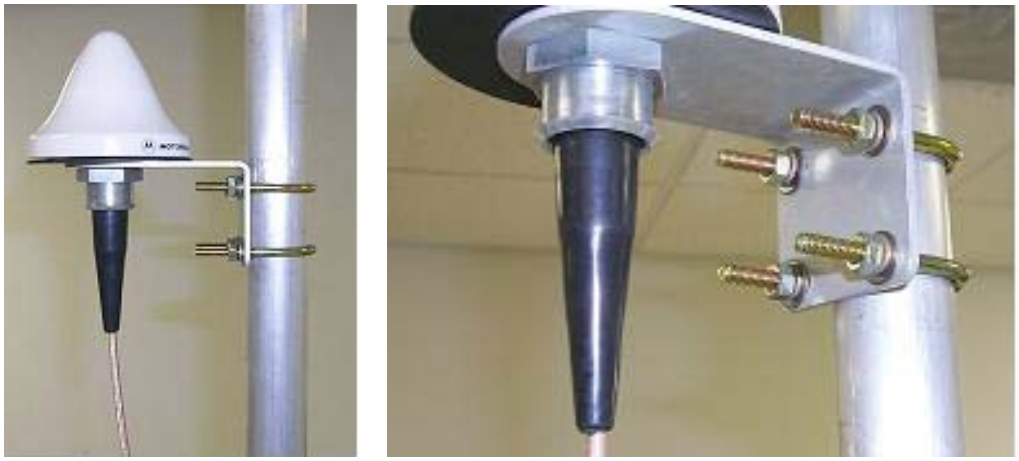


Figure 121: Detail of GPS antenna mounting

19.4.1 Recommended Materials for Cabling the GPS Antenna

The following materials are required for cabling the GPS antenna:

- up to 100 feet (30.4 meters) of LMR200 coaxial cable
- 2 Times Microwave N-male connectors (Times Microwave P/N TC-200-NM) or equivalent connectors.

19.4.2 Cabling the GPS Antenna

Connect the GPS coax cable to the female N-connector on the GPS antenna.

19.5 INSTALLING A CMM2

Ensure that you comply with standard local or national electrical and climbing procedures when you install the CMM2.

19.5.1 CMM2 Installation Temperature Range

Install the CMM2 outside only when temperatures are above –4° F (–20° C). The bulkhead connector and the bushings and inserts in the bulkhead connector are rated for the full –40° to +131° F (–40° to +55° C) range of the CMM2. However, for dynamic operations (loosening, tightening, and inserting), they are compliant at, and rated for, only temperatures at or above –4° F (–20° C).

19.5.2 Recommended Tools for Mounting a CMM2

The following tools may be needed for mounting the CMM2:

- 3/8” nut driver
- 12” adjustable wrench
- 14-mm wrench for pole-mounting
- needle-nose pliers

19.5.3 Mounting a CMM2

Perform the following procedure to mount the CMM2.

Procedure 21: Mounting the CMM2

1. Ensure that the mounting position
   - *is not* further than 328 feet (100 meters) of cable from the furthest AP or BH that the CMM2 will serve.
   - *is not* closer than 10 feet (3 meters) to the nearest AP or BH.
   - *is not* further than 100 feet (30.4 meters) of cable from the intended mounting position of the GPS antenna.
   - allows you to fully open the door of the CMM2 for service.
2. Select a support structure to which the flanges of the CMM2 can be mounted.
3. If the support structure is a wall, use screws or bolts (neither is provided) to attach the flanges to the wall.
4. If the support structure is an irregular-shaped object, use adjustable stainless steel bands (provided) to attach the CMM2 to the object.
5. If the support structure is a pole that has an outside diameter of 3 to 8 cm, or 1.25 to 3 inches, use a toothed V-bracket (provided) to
   a. attach the V-bracket to the pole as shown in Figure 122.
   b. attach the CMM2 flanges to the V-bracket.

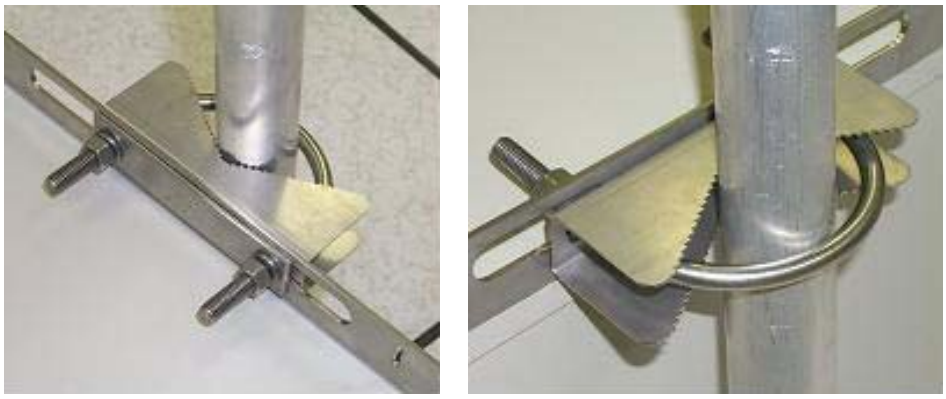


Figure 122: Detail of pole mounting

========== **end of procedure** ==========

19.5.4 Cabling a CMM2

> ***IMPORTANT!***
> Where you deploy CMM2s, one AP in each AP cluster must be connected to the master port on the CMM2, and each module connected to a CMM2 must be configured to **Sync to Received Signal (Timing Port)**. If either is not done, then the GPS receiver sends no sync pulse to the remaining ports.

Perform the following procedure to attach the CMM2 cables on both ends:

Procedure 22: Cabling the CMM2

1. Carefully review the practices recommended in Best Practices for Cabling on Page 182.
2. Remove the base cover from any AP or BH that is to be connected to this CMM2. See Figure 46 on Page 178.
3. Remove the GPS sync cable knockout from the base cover.
4. For any AP that is to be connected to this CMM2, set the AP **Sync Input** Configuration Page parameter to the **Sync to Received Signal (Timing Port)** selection.
5. Review the schematic drawing inside the CMM2.
6. Set the 115-/230-volt switch in the CMM2 consistent with the power source. See Figure 123.

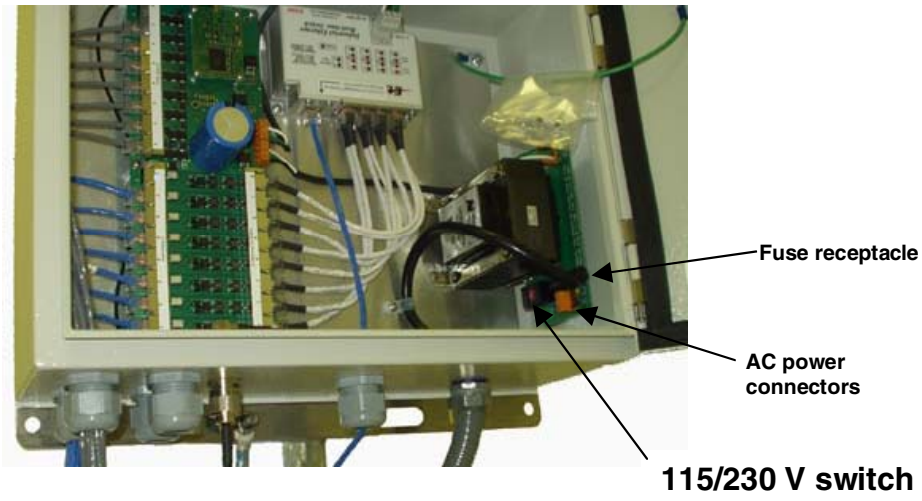


Figure 123: Location of 115-/230-volt switch

CAUTION!
Failure to set the 115-/230-volt switch correctly can result in damage to equipment.

IMPORTANT!
The AC power connectors are labeled **N** for Neutral, **L** for Line, and **PE** for Protective Earth (PE) ⏚ or ground. The maximum thickness of wire to be used is 4 mm^2 or 12 AWG.

7. Route the Ethernet cables from the APs and or BHs to the CMM2.

   The strain relief plugs on the CMM2 have precut holes. Each hole of the strain relief is designed to hold two CAT 5 UTP cables or one shielded cable. The Ethernet cables have RJ-45 (standard Ethernet) connectors that mate to corresponding ports inside the CMM2.

   These ports are labeled **J3**. Eight J3 ports are available on the CMM2 to accommodate any combination of APs and BHs.

   The logical connections in the CMM2 are displayed in Figure 124.

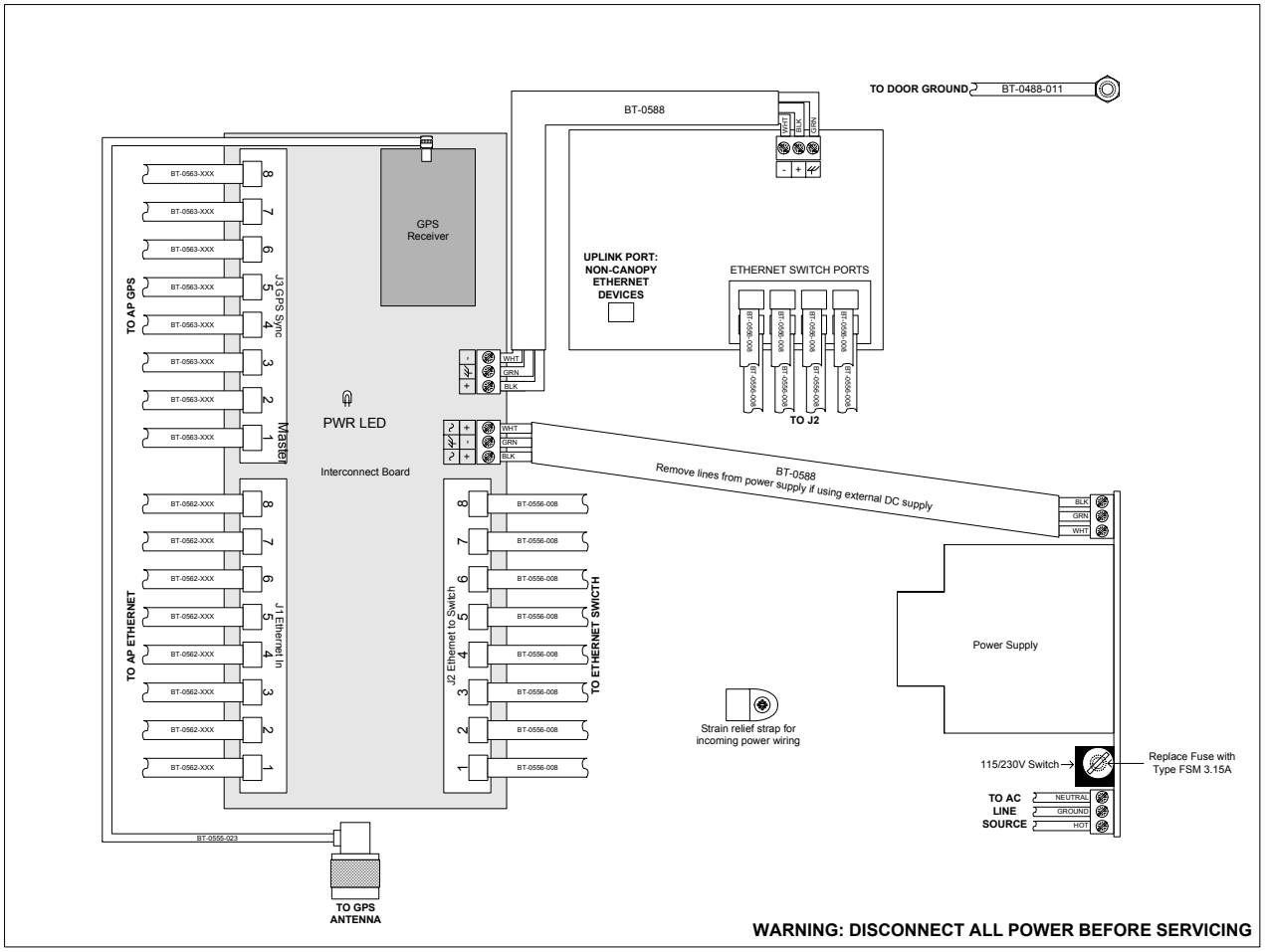


Figure 124: Layout of logical connections in CMM2

8. Connect the Ethernet cable from the first AP or BH to the **Port 1** in the J3 ports in the CMM2. This port is the *master* Ethernet port for the CMM2 and should be connected first in all cases. Figure 125 on Page 344 is a photograph of a properly wired CMM2.

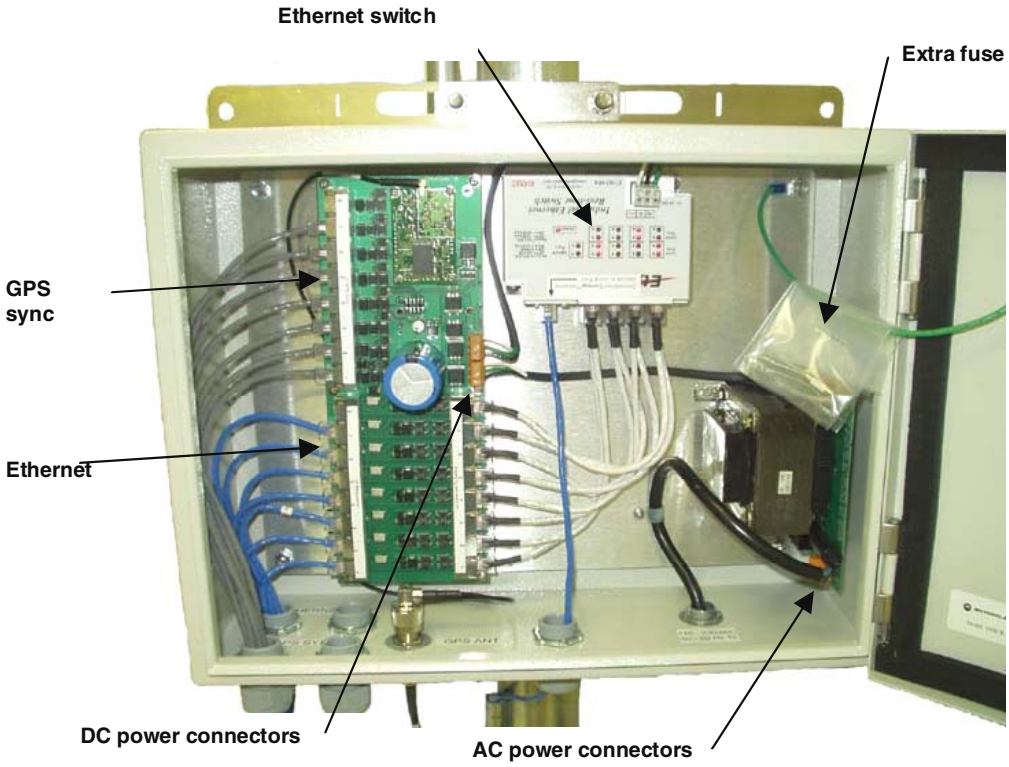


Figure 125: Cyclone CMM2, front view

9. Connect the remaining Ethernet cables to the remaining J3 ports.
10. Route the GPS sync (serial) cables from the APs to the CMM2.

    The GPS sync cables have 6-conductor RJ-11 connectors that mate to corresponding ports inside the CMM2.

    These ports are labeled **J1**. Eight J1 ports are available on the CMM2 to accommodate any combination of APs and BHs.
11. Connect the GPS sync cable from the first AP or BH to the **Port 1** in the J1 ports in the CMM2. See Figure 125 on Page 344.

    This port is the *master* GPS sync port for the CMM2 and should be connected first in all cases. This is necessary to initialize the GPS on the CMM2.
12. Connect the remaining GPS sync cables to the remaining J1 ports.
13. If this CMM2 requires network connection, perform the following steps:
    a. Route a network cable into the CMM2.
    b. Connect to the uplink port on the switch.
    c. Properly ground (connect to Protective Earth [PE] ⏚) the Ethernet cable. The Cyclone Surge Suppressor provides proper grounding for this situation.
    NOTE: Instructions for installing a Cyclone Surge Suppressor are provided in Procedure 28 on Page 349.

14. Connect GPS coaxial cable to the N-connector on the outside of the CMM2. See Figure 47 on Page 180.
15. Connect AC or DC power to the CMM2, consistent with Figure 124 on Page 343.
    NOTE: When power is applied, the following indicators are lighted:
    - the power LED on the Ethernet switch
    - the green LED on the circuit board, as shown in Figure 126.

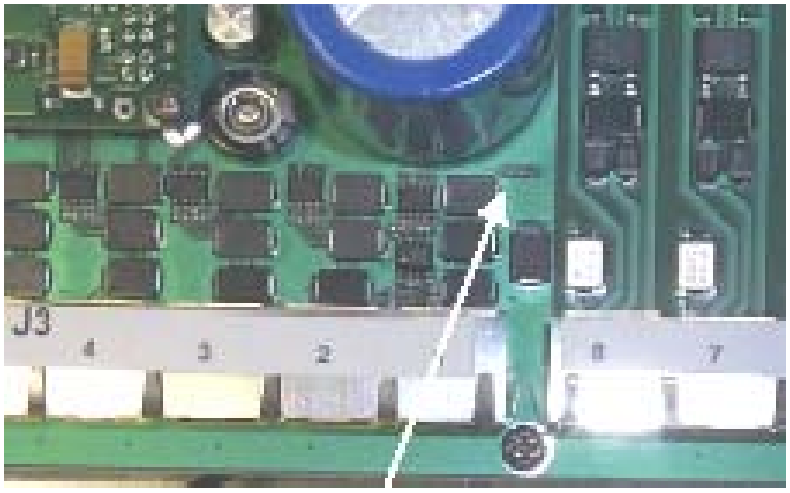


Figure 126: Port indicator LED on Ethernet switch

16. Verify that each port indicator LED on the Ethernet switch is lit (each AP or BH is reliably connected to the Ethernet switch).
17. Replace the base cover on each AP or BH.
18. Close and lock the CMM2.

========== **end of procedure** ==========

19.5.5 Verifying CMM2 Connections

To verify the CMM2 connections after the APs and or BHs have been installed, perform the following steps:

Procedure 23: Verifying CMM2 connections

1. Access the web-based interface for each AP or BHM by opening http://<ip-address>, where the <*ip-address*> is the address of the individual module.
2. In the General Status tab of the Home page, verify that the System Time field displays the time in GMT.

========== **end of procedure** ==========

19.6 INSTALLING A CMMmicro

Ensure that you comply with standard local or national electrical and climbing procedures when you install the CMMmicro.

19.6.1 CMMmicro Temperature Range

Install the CMMmicro outside only when temperatures are above –4° F (–20° C). The bulkhead connector and the bushings and inserts in the bulkhead connector are rated for the full –40° to +131° F (–40° to +55° C) range of the CMMmicro. However, for dynamic operations (loosening, tightening, and inserting), they are compliant at, and rated for, only temperatures at or above –4° F (–20° C).

19.6.2 Recommended Tools for Mounting a CMMmicro

The following tools may be needed during installation:

- 3/8” nut driver
- 12” adjustable wrench
- 14-mm wrench for installation of pole-mounting brackets
- needle-nose pliers

19.6.3 Mounting a CMMmicro

Perform the following procedure to mount the CMMmicro.

Procedure 24: Mounting the CMMmicro

1. Ensure that the mounting position
   - *is not* further than 328 feet (100 meters) from the furthest AP or BH that the CMMmicro will serve.
   - *is not* closer than 10 feet (3 meters) to the nearest AP or BH.
   - *is not* further than 100 feet (30.5 meters) of cable from the intended mounting position of the GPS antenna.
   - allows you to fully open the door for service.
2. Select a support structure to which the flanges can be mounted.
3. If the support structure is a wall, use screws or bolts (neither is provided) to attach the flanges to the wall.

   If the support structure is an irregular-shaped object, use adjustable stainless steel bands (provided) to attach the CMMmicro to the object.
4. If the support structure is a pole that has an outside diameter of 1.25 to 3 inches (3 to 8 cm), use a toothed V-bracket (provided) to
   d. attach the V-bracket to the pole as shown in Figure 122 on Page 340.
   e. attach the CMMmicro flanges to the V-bracket.

end of procedure

19.6.4 Installing the Power Supply for the CMMmicro

Install the CMMmicro power converter in only a hut, wiring closet, or weatherized NEMA-approved enclosure. This is imperative to keep moisture away from the power converter, not to shield it from harsh temperatures.

WARNING!
Although the output of the power converter is 24 V, the 100-W power rating classifies the converter as a Class 2 electric device. For this reason, whenever you work on power in the CMMmicro, you must *first* disconnect the DC converter from the AC power source.

Perform the following procedure to install the provided power supply.

Procedure 25: Installing the Power Supply for the CMMmicro

1. Connect the 6-ft (2-m) AC power cord to the power converter (but not yet to an AC receptacle).
2. Select the length of power cord as follows:
   a. If either mounting the unit inside with the power converter or outside within 9 ft (2.8 m) of the power converter, select the 10-ft (3-m) DC power cord (rated for outdoor use).
   b. If mounting the unit outside and further than 9 ft (2.8 m) from the power converter, ensure that this additional length of cord is either UV-resistant or shielded from UV rays.
      - use a terminal block, connector, or splice to add the additional length.
      - protect the terminal block, connector, or splice (as inside a weatherized enclosure, for example).

Table 50: Wire size for CMMmicro power runs of longer than 9 feet (2.8 m)

DC Power Cord Length	Proper Wire Size
9−90 ft (3−25 m)	12 AWG (4 mm^2)
91−145 ft (26−45 m)	10 AWG (6 mm^2)
146−230 ft (46−70 m)	8 AWG (10 mm^2)
>230 ft (>70 m)	6 AWG (16 mm^2)

3. Refer to Figure 70: CMMmicro connections on Page 221.
4. Feed the power cord through the bulkhead connector of the CMMmicro.
5. Connect the converter lead whose insulation has a white stripe to +V on the CMMmicro terminal block.
6. Connect the converter lead whose insulation is solid black to −V on the CMMmicro terminal block.

end of procedure

19.6.5 Cabling a CMMmicro

Perform the following procedure to attach the CMMmicro cables on both ends:

Procedure 26: Cabling the CMMmicro

1. Remove the base cover from any AP or BH that is to be connected to this CMMmicro. See Figure 46 on Page 178.
2. Review the schematic drawing inside the CMMmicro and see Figure 70: CMMmicro connections on Page 221.
3. Note that the inserts in the bulkhead connector bushings have precut holes.
4. Remove the hard silicon spacer.
5. Route the Ethernet cables from the APs through the bulkhead connectors to the Ethernet switch inside the CMMmicro.
6. If the BH at this site is a 30/60- or 150/300-Mbps BH
   a. connect the BH outdoor unit (ODU) to the ODU port of the power indoor unit (PIDU).
   b. connect the PIDU to an unpowered port of the CMMmicro.

   If the BH is of another modulation rate, route the Ethernet cables from the BH through the bulkhead connectors to the Ethernet switch in the CMMmicro.
7. If the site has a wired network feed, route the cable into the CMMmicro and connect it to an *unpowered* port on the switch.
8. Mount a Cyclone surge suppressor at a low point of the network feed and connect the surge suppressor to solid ground.
9. On the door label, record the MAC and IP addresses of the CMMmicro and all connected equipment.
10. Consistent with practices in your company, note the above information to add later to the company equipment database.
11. Connect the GPS coax cable from the GPS antenna to the female BNC connector in the CMMmicro.
12. If this CMMmicro requires network connection, perform the following steps:
    a. Route a network cable into the CMMmicro.
    b. Connect to the uplink port on the switch.
    c. Properly ground (connect to Protective Earth [PE] ⏚) the Ethernet cable. The Cyclone Surge Suppressor provides proper grounding for this situation.
    NOTE: Instructions for installing a Cyclone Surge Suppressor are provided as part of Procedure 28 on Page 349.
13. Connect the DC power cable to the CMMmicro.
14. Plug the DC converter into an AC receptacle.
15. Verify that the LEDs light.

end of procedure

19.6.6 Verifying CMMmicro Connections

To verify the CMMmicro connections after the APs and or BHs have been installed, perform the following steps.

Procedure 27: Verifying CMMmicro connections

1. Access the web-based interface for each AP or BH by opening http://<ip-address>, where the <*ip-address*> is the address of the individual module.
2. In the Status page, verify that the time is expressed in GMT.
3. In the menu on the left-hand side of the web page, click on **GPS Status**.
4. Verify that the AP or BH is seeing and tracking satellites. (To generate the timing pulse, the module must track at least 4 satellites.)

========== **end of procedure** ==========

19.7 INSTALLING AN SM

Installing a Canopy SM consists of two procedures:

- Physically installing the SM on a residence or other location and performing a course alignment using the alignment tone (Procedure 28).
- Verifying the AP to SM link and finalizing alignment using review of power level and jitter, link tests, and review of registration and session counts (Procedure 29 on Page 353).

Procedure 28: Installing the SM

1. Choose the best mounting location for the SM.
2. Select the type of mounting hardware appropriate for this location. (For mounting 2.4, 5.2, 5.4, and 5.7 GHz SMs, Last Mile Gear offers the SMMB-1 mounting bracket. For mounting 900 MHz SMs, Last Mile Gear offers the SMMB-2 mounting bracket.)
3. Remove the base cover of the SM. (See Figure 46 on Page 178.)
4. Terminate the UV outside grade Category 5 Ethernet cable with an RJ-45 connector, and connect the cable to the SM. (See Procedure 8 on Page 192.)
5. Optionally, attach the SM to the arm of the Cyclone Passive Reflector dish assembly as shown in Figure 127.

RECOMMENDATION:
A reflector in this instance reduces the beamwidth to reduce interference. The arm is molded to receive and properly aim the module relative to the aim of the dish. Use stainless steel hose clamps for the attachment.

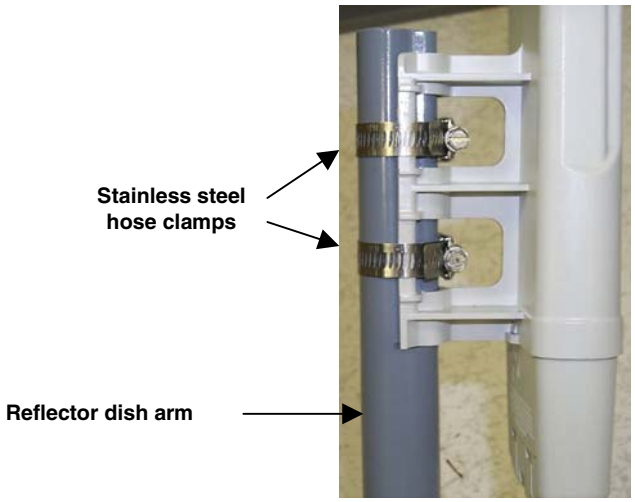


Figure 127: SM attachment to reflector arm

6. Use stainless steel hose clamps or equivalent fasteners to lock the SM into position.
   NOTE: The SM grounding method is shown in Figure 128.

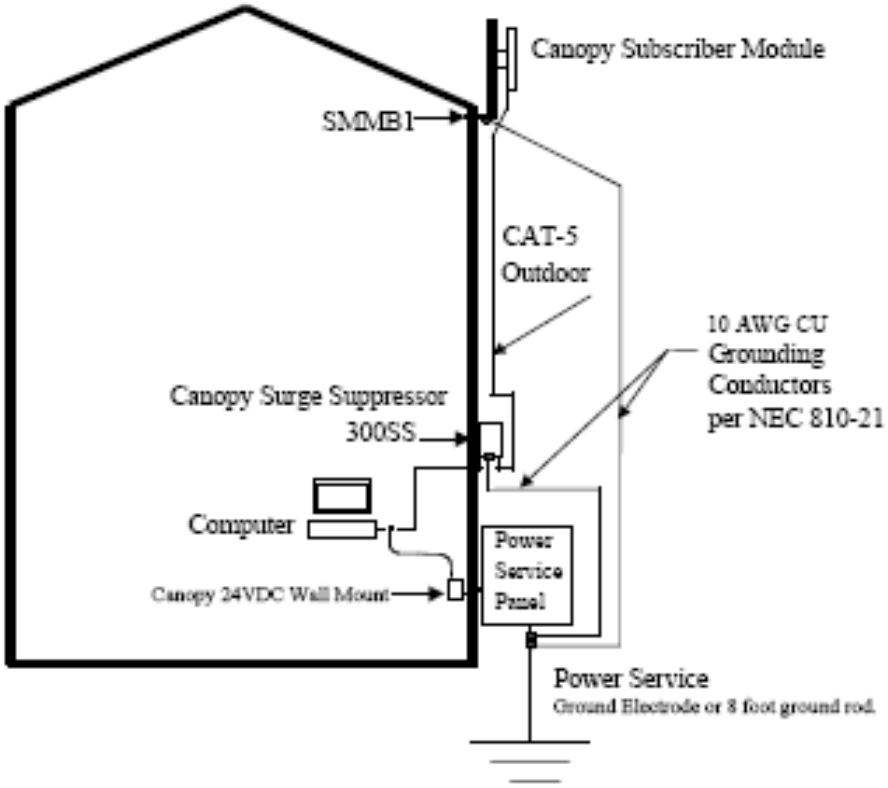
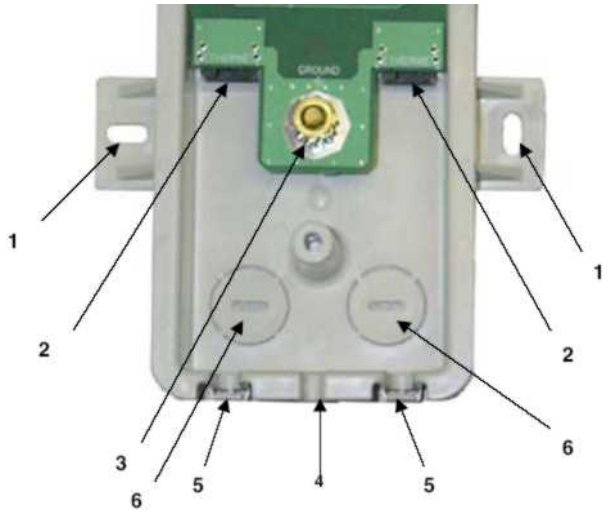


Figure 128: SM grounding per NEC specifications

7. Remove the cover of the 300SS Surge Suppressor.



KEY TO CALLOUTS

1 Holes—for mounting the Surge Suppressor to a flat surface (such as an outside wall). The distance between centers is 4.25 inches (108 mm).

2 RJ-45 connectors—One side (neither side is better than the other for this purpose) connects to the Cyclone product (AP, SM, BHM, BHS, or cluster management module). The other connects to the AC adaptor's Ethernet connector.

3 Ground post—use heavy gauge (10 AWG or 6 mm^2) copper wire for connection. Refer to local electrical codes for exact specifications.

4 Ground Cable Opening—route the 10 AWG (6 mm^2) ground cable through this opening.

5 CAT-5 Cable Knockouts—route the two CAT-5 cables through these openings, or alternatively through the Conduit Knockouts.

6 Conduit Knockouts—on the back of the case, near the bottom. Available for installations where cable is routed through building conduit.

Figure 129: Internal view of Cyclone 300SS Surge Suppressor

8. With the cable openings facing downward, mount the 300SS to the *outside* of the subscriber premises, as close to the point where the Ethernet cable penetrates the residence or building as possible, and as close to the grounding system (Protective Earth) as possible.
9. Using diagonal cutters or long nose pliers, remove the knockouts that cover the cable openings to the 300SS.
10. Connect an Ethernet cable from the power adapter (located inside the residence or building, outward through the building penetration) to either RJ-45 port of the 300SS.

11. Connect another Ethernet cable from the other RJ-45 port of the 300SS to the Ethernet port of the SM.
12. Refer to Grounding SMs on Page 172.
13. Wrap an AWG 10 (or 6mm^2) copper wire around the Ground post of the 300SS.
14. Tighten the Ground post locking nut in the 300SS onto the copper wire.
15. Securely connect the copper wire to the grounding system (Protective Earth) according to applicable regulations.
16. Connect a ground wire to the 300SS.
17. Replace the cover of the 300SS surge suppressor.
18. For coarse alignment of the SM, use the Audible Alignment Tone feature as follows:
    a. Set the **2X Rate** parameter in the SM to **Disable**.
    b. At the SM, connect the RJ-11 6-pin connector of the Alignment Tool Headset to the RJ-11 utility port of the SM.

       Alternatively, instead of using the Alignment Tool Headset, use an earpiece or small battery-powered speaker connected to Pin 5 (alignment tone output) and Pin 6 (ground) of an RJ-11 connector.

    c. Listen to the alignment tone for
       - pitch, which indicates greater signal power (RSSI/dBm) by higher pitch.
       - volume, which indicates better signal quality (lower jitter) by higher volume.

Figure 130: Audible Alignment Tone kit, including headset and connecting cable

    d. Adjust the module slightly until you hear the highest pitch and highest volume.
    e. If the Configuration web page of the SM contains a **2X Rate** parameter, set it back to **Enable**.
19. When you have achieved the best signal (highest pitch, loudest volume), lock the SM in place with the mounting hardware.

========== **end of procedure** ==========

19.8 VERIFYING AN AP-SM LINK

To verify the AP-SM link after the SM has been installed, perform the following steps.

Procedure 29: Verifying performance for an AP-SM link

1. Using a computer (laptop, desktop, PDA) connected to the SM, open a browser and access the SM using the default IP address of http://169.254.1.1 (or the IP address configured in the SM, if one has been configured.)
2. On the General Status tab of the Home page in the SM (shown in Figure 60 on Page 198), look for **Power Level** and **Jitter**.
   IMPORTANT: The received **Power Level** is shown in dBm and should be maximized. **Jitter** should be minimized. However, better/lower jitter should be favored over better/higher dBm. For example, if coarse alignment gives an SM a power level of −75 dBm and a jitter measurement of 5, and further refining the alignment drops the power level to −78 dBm and the jitter to 2 or 3, the latter would be better, with the following caveats:
   - When the receiving link is operating at 1X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 4.
   - When the receiving link is operating at 2X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 9.

NOTE:
For historical reasons, **RSSI** is also shown and is the unitless measure of power. The best practice is to use **Power Level** and ignore **RSSI**, which implies more accuracy and precision than is inherent in the measurement.

3. Fine-adjust the SM mounting, if needed, to improve **Jitter** or **Power Level**.
4. Click the Link Capacity Test tab of the Tools web page in the SM.
   NOTE: Use of this tool is described under Using the Link Capacity Test Tool (All) on Page 438.
5. Perform several link tests of 10-second duration as follows:
   a. Type into the **Duration** field how long (in seconds) the RF link should be tested.
   b. Leave the **Packet Length** field (when present) set to the default of 1522 bytes or type into that field the packet length at which you want the test conducted.
   c. Leave the **Number of Packets** field set to 0 (to flood the link).
   d. Click the **Start Test** button.
   e. View the results of the test.

6. If these link tests fail to consistently show 90% or greater efficiency in 1X operation or 50 to 60% efficiency in 2X, troubleshoot the link, using the data as follows:
   - If the downlink is consistently 90% efficient, but the uplink is only 40%, this indicates trouble for the SM transmitting to the AP. Have link tests performed for nearby SMs. If their results are similar, investigate a possible source of interference local at the AP.
   - If the uplink is consistently 90% efficient, but the downlink is only 40%, this indicates trouble for the AP transmitting to the SM. Investigate a possible source of interference near the SM.

   If these link tests consistently show 90% or greater efficiency in 1X operation, or 50 to 60% efficiency in 2X operation, in both uplink and downlink, continue this procedure.
7. Open the Session Status tab in the Home page of the AP.
   NOTE: An example of this page is shown in Figure 131.

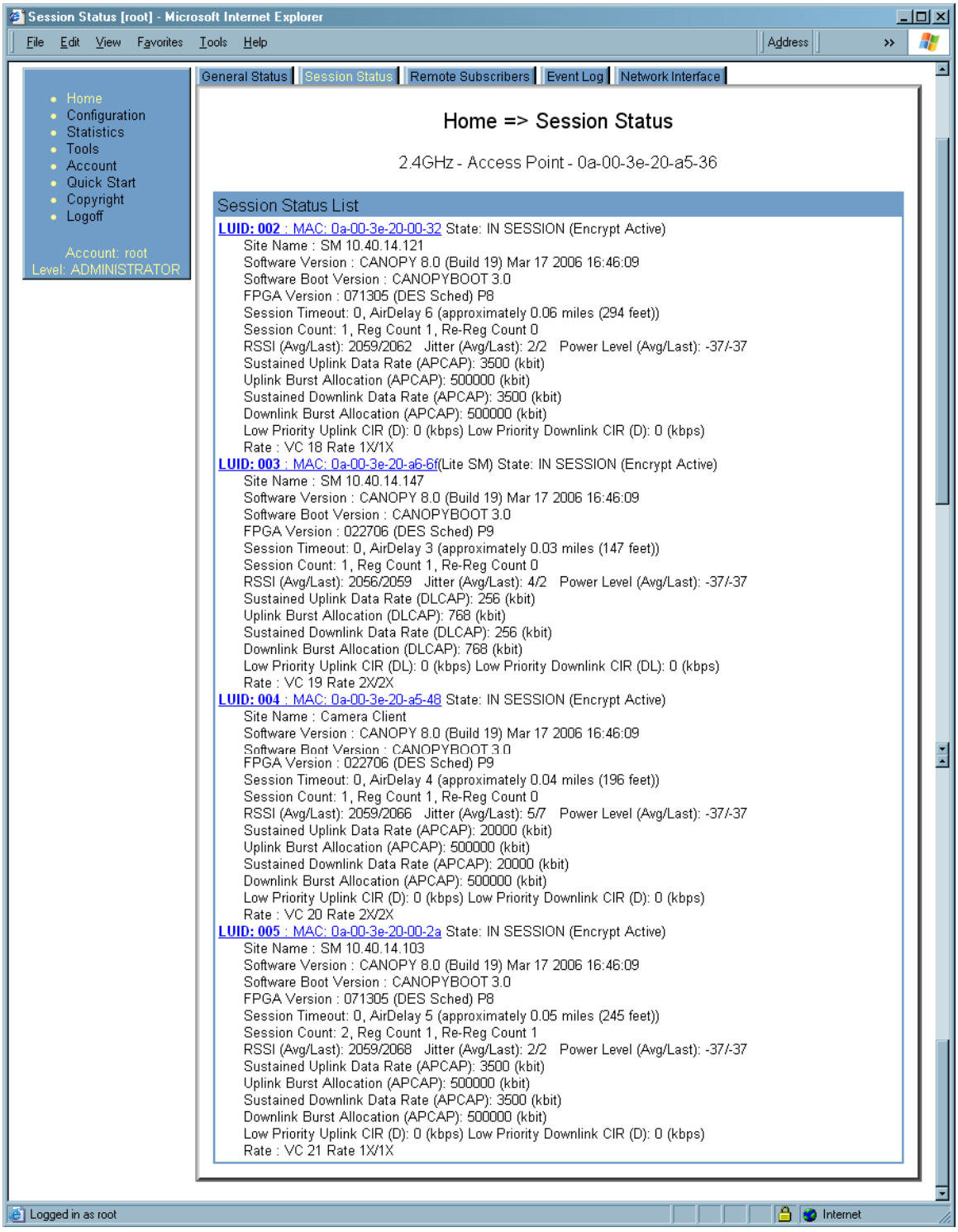


Figure 131: AP/SM link status indications in the AP Session Status tab

8. Find the Session Count line under the MAC address of the SM.
9. Check and note the values for Session Count, Reg Count, and Re-Reg Count.

10. Briefly monitor these values, occasionally refreshing this page by clicking another tab and then the Session Status tab again.
11. If these values are low (for example, 1, 1, and 0, respectively, meaning that the SM registered and started a stable session once) and not changing
    a. consider the installation successful.
    b. 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, recheck jitter as described in Procedure 28: Installing the SM or recheck link efficiency as described in this procedure, then look for sources of RF interference or obstructions.)

========== **end of procedure** ==========

19.9 INSTALLING A REFLECTOR DISH

The internal patch antenna of the module illuminates the Cyclone Passive Reflector Dish from an offset position. The module support tube provides the proper angle for this offset.

19.9.1 Both Modules Mounted at Same Elevation

For cases where the other module in the link is mounted at the same elevation, fasten the *mounting hardware leg* of the support tube vertical for each module. When the hardware leg is in this position

- the reflector dish has an obvious downward tilt.
- the *module leg* of the support tube *is not* vertical.

For a mount to a non-vertical structure such as a tapered tower, use a plumb line to ensure that the hardware leg is vertical when fastened. Proper dish, tube, and module positions for a link in this case are illustrated in Figure 132. The dish is tipped forward, not vertical, but the focus of the signal is horizontal.

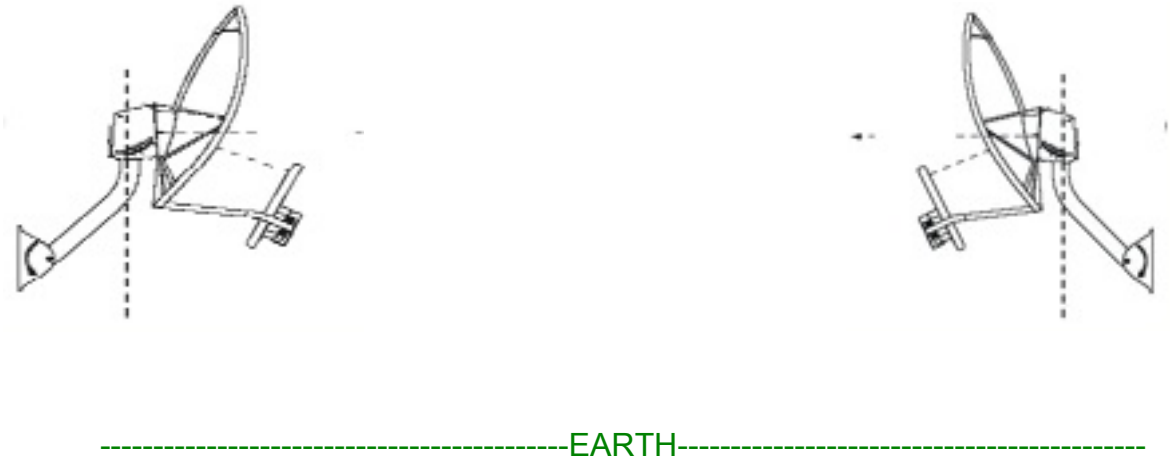


Figure 132: Correct mount with reflector dish

Improper dish, tube, and module positions for this case are illustrated in Figure 133.

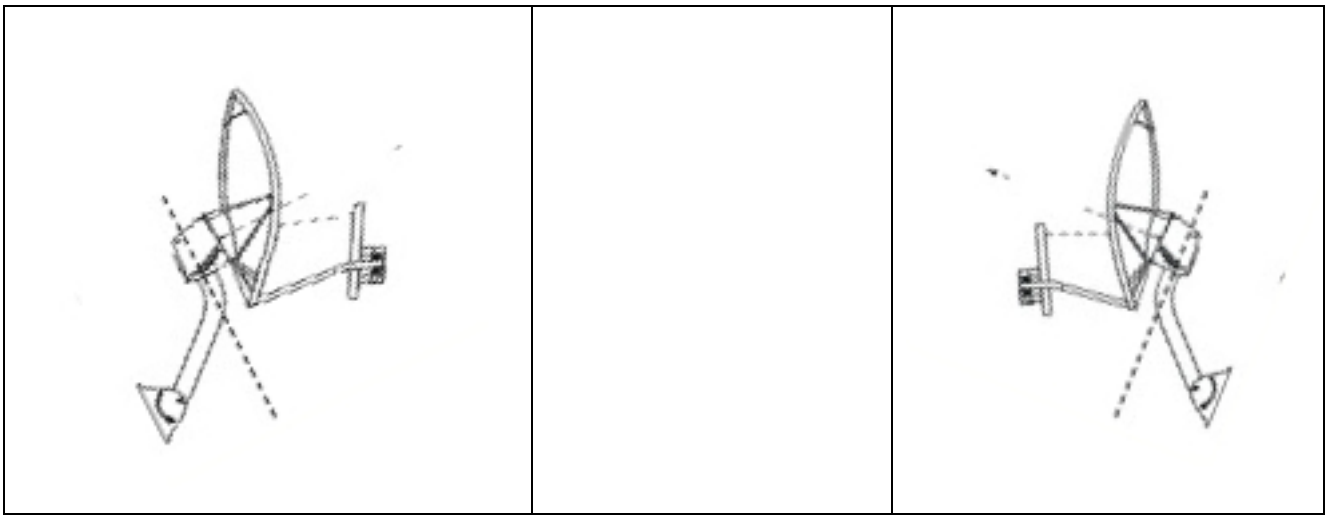


Figure 133: Incorrect mount with reflector dish

19.9.2 Modules Mounted at Different Elevations

For cases where the other module in the link is mounted at a different elevation, the assembly hardware allows tilt adjustment. The proper angle of tilt can be calculated as a factor of both the difference in elevation and the distance that the link spans. Even in this case, a plumb line and a protractor can be helpful to ensure the proper tilt. This tilt is typically minimal.

The number of degrees to offset (from vertical) the mounting hardware leg of the support tube is equal to the angle of elevation from the lower module to the higher module (b in the example provided in Figure 34 on Page 146).

19.9.3 Mounting Assembly

Both the hardware that Mounting Assembly 27RD provides for adjustment and the relationship between the offset angle of the module and the direction of the beam are illustrated in Figure 134.

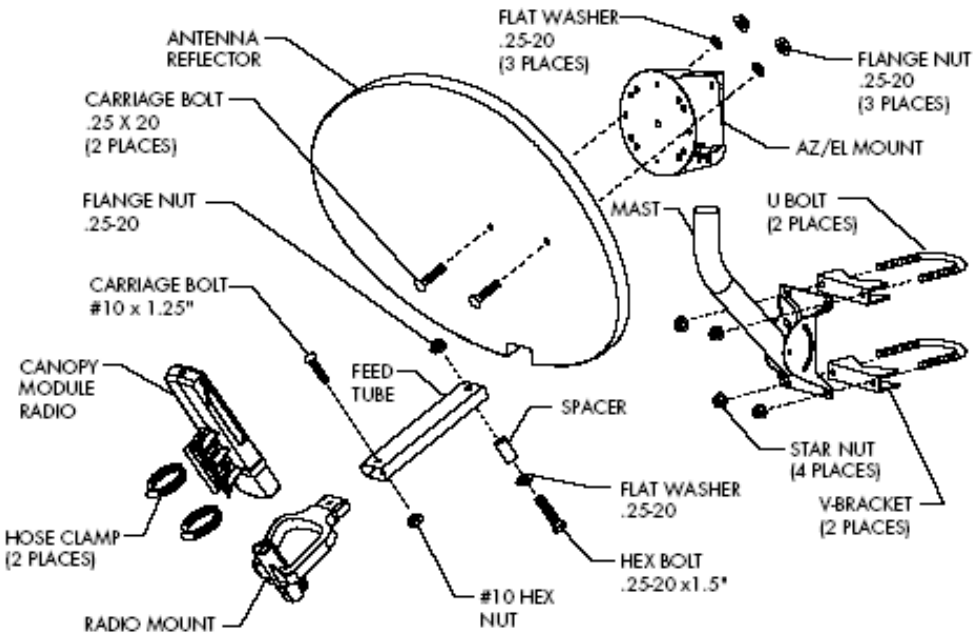


Figure 134: Mounting assembly, exploded view

19.10 INSTALLING A BH TIMING MASTER

To install the Cyclone BHM, perform the following steps:

Procedure 30: Installing the BHM

1. Access the General tab of the Configuration page in the BHM.
2. If this is a 20-Mbps BH, set the **2X Rate** parameter to **Disabled** (temporarily for easier course aiming).
3. Click the **Save Changes** button.
4. Click the **Reboot** button.
5. After the reboot is completed, remove power from the BHM.
6. Choose the best mounting location for your particular application.
7. Attach the BHM to the arm of the Cyclone Passive Reflector dish assembly as shown in Figure 135.

RECOMMENDATION:
The arm is molded to receive and properly aim the module relative to the aim of the dish. (See Figure 132 on Page 356.) Stainless steel hose clamps should be used for the attachment.

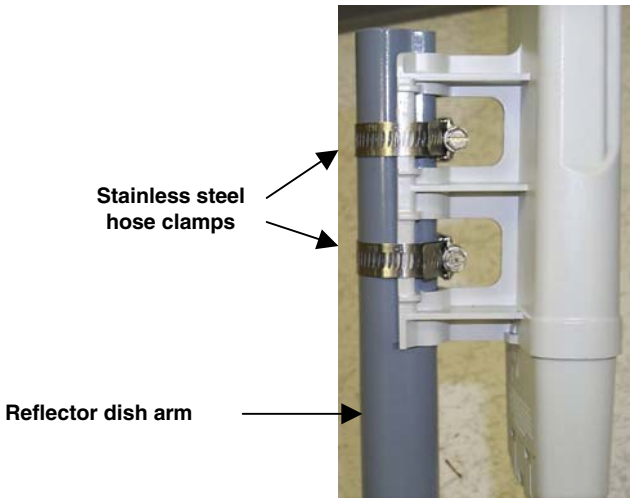


Figure 135: BH attachment to reflector arm

8. Align the BHM as follows:
   a. Move the module to where the link will be unobstructed by the radio horizon and no objects penetrate the Fresnel zone. (The Cyclone System Calculator page AntennaElevationCalcPage.xls automatically calculates the minimum antenna elevation that is required to extend the radio horizon to the other end of the link. The Cyclone System Calculator page FresnelZoneCalcPage.xls automatically calculates the Fresnel zone clearance that is required between the visual line of sight and the top of a high-elevation object.)
   b. Use a local map, compass, and/or GPS device as needed to determine the direction to the BHS.
   c. Apply the appropriate degree of downward or upward tilt. (The Cyclone System Calculator page DowntiltCalcPage.xls automatically calculates the angle of antenna downward tilt that is required.)
   d. Ensure that the BHS is within the beam coverage area. (The Cyclone System Calculator page BeamwidthRadiiCalcPage.xls automatically calculates the radii of the beam coverage area.)
9. Using stainless steel hose clamps or equivalent fasteners, lock the BHM into position.
10. Remove the base cover of the BHM. (See Figure 46 on Page 178.)
11. If this BHM *will not* be connected to a CMMmicro, optionally connect a utility cable to a GPS timing source and then to the RJ-11 port of the BHM.
12. Either connect the BHM to the CMM or connect the DC power converter to the BHM and then to an AC power source.
    RESULT: When power is applied to a Cyclone module or the unit is reset on the web-based interface, the module requires approximately 25 seconds to boot. During this interval, self-tests and other diagnostics are being performed.
13. Access the General tab of the Configuration page of this BHM.

14. If the CMM is a CMMmicro, set the **Sync Input** parameter to the **Sync to Received Signal (Power Port)** selection.

    If the CMM is a CMM2, set the **Sync Input** parameter to the **Sync to Received Signal (Timing Port)** selection.

========== **end of procedure** ==========

19.11 INSTALLING A BH TIMING SLAVE

Installing a Cyclone BHS consists of two procedures:

- Physically installing the BHS and performing a course alignment using the alignment tone (Procedure 31).
- Verifying the BH link and finalizing alignment using review of power level and jitter, link tests, and review of registration and session counts (Procedure 32 on Page 361).

Procedure 31: Installing the BHS

1. Choose the best mounting location for the BHS.
2. Remove the base cover of the BHS. (See Figure 46 on Page 178.)
3. Terminate the UV outside grade Category 5 Ethernet cable with an RJ-45 connector, and connect the cable to the BHS. (See Procedure 8 on Page 192.)
4. Attach the BHS to the arm of the Cyclone Passive Reflector dish assembly as shown in Figure 127 on Page 350.

RECOMMENDATION:
The arm is molded to receive and properly aim the BH relative to the aim of the dish. Use stainless steel hose clamps for the attachment.

5. Use stainless steel hose clamps or equivalent fasteners to lock the BHS into position.
6. Remove the cover of the 300SS Surge Suppressor.
7. With the cable openings facing downward, mount the 300SS as close to the grounding system (Protective Earth) as possible.
8. Using diagonal cutters or long nose pliers, remove the knockouts that cover the cable openings to the 300SS.
9. Connect an Ethernet cable from the power adapter to either RJ-45 port of the 300SS.
10. Connect another Ethernet cable from the other RJ-45 port of the 300SS to the Ethernet port of the BHS.
11. Refer to Grounding SMs on Page 172.
12. Wrap an AWG 10 (or 6mm^2) copper wire around the Ground post of the 300SS.
13. Tighten the Ground post locking nut in the 300SS onto the copper wire.
14. Securely connect the copper wire to the grounding system (Protective Earth) according to applicable regulations.

15. Connect a ground wire to the 300SS.
16. Replace the cover of the 300SS surge suppressor.
17. For coarse alignment of the BHS, use the Audible Alignment Tone feature as follows:
    a. If the Configuration web page of the BHS contains a **2X Rate** parameter, set it to **Disable**.
    b. At the BHS, connect the RJ-11 6-pin connector of the Alignment Tool Headset (shown in Figure 130 on Page 352) to the RJ-11 utility port of the SM.

       Alternatively, instead of using the Alignment Tool Headset, use an earpiece or small battery-powered speaker connected to Pin 5 (alignment tone output) and Pin 6 (ground) of an RJ-11 connector.

    c. Listen to the alignment tone for
       - pitch, which indicates greater signal power (RSSI/dBm) by higher pitch.
       - volume, which indicates better signal quality (lower jitter) by higher volume.

    d. Adjust the module slightly until you hear the highest pitch and highest volume.
    e. If the Configuration web page of the BHS contains a **2X Rate** parameter, set it back to **Enable**.
18. When you have achieved the best signal (highest pitch, loudest volume), lock the BHS in place with the mounting hardware.

========== **end of procedure** ==========

19.12 UPGRADING A BH LINK TO BH20

To replace a pair of 10-Mbps BHs with 20-Mbps BHs, you can minimize downtime by temporarily using the 10-Mbps capability in the faster modules. However, both interference and differences in receiver sensitivity can make alignment and link maintenance more difficult than in the previous 10-Mbps link. The effects of these factors are greater at greater link distances, particularly at 5 miles or more.

In shorter spans, these factors may not be prohibitive. For these cases, set the first replacement module to **1X Rate** and establish the link to the 10-Mbps BH on the far end. Similarly, set the second replacement module to **1X Rate** and re-establish the link. With both of the faster modules in place and with an operational link having been achieved, reset their modulation to **2X Rate** (20 Mbps).

19.13 VERIFYING A BH LINK

To verify the backhaul link after the BHS has been installed, perform the following steps.

Procedure 32: Verifying performance for a BH link

1. Using a computer (laptop, desktop, PDA) connected to the BHS, open a browser and access the BHS using the default IP address of http://169.254.1.1 (or the IP address configured in the BHS, if one has been configured.)
2. On the General Status tab of the Home page in the BHS (shown in Figure 65 on Page 211), look for **Power Level** and **Jitter**.

IMPORTANT: The received **Power Level** is shown in dBm and should be maximized. **Jitter** should be minimized. However, better/lower jitter should be favored over better/higher dBm. For example, if coarse alignment gives a BHS a power level of −75 dBm and a jitter measurement of 5, and further refining the alignment drops the power level to −78 dBm and the jitter to 2 or 3, the latter would be better, with the following caveats:

- When the receiving link is operating at 1X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 4.
- When the receiving link is operating at 2X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 9.

NOTE:
For historical reasons, **RSSI** is also shown and is the unitless measure of power. The best practice is to use **Power Level** and ignore **RSSI**, which implies more accuracy and precision than is inherent in its measurement.

3. Fine-adjust the BHS mounting, if needed, to improve **Jitter** or **Power Level**.
4. Click the Link Capacity Test tab of the Tools web page in the BHS.
   NOTE: Use of this tool is described under Using the Link Capacity Test Tool (All) on Page 438.
5. Perform several link tests of 10-second duration as follows:
   a. Type into the **Duration** field how long (in seconds) the RF link should be tested.
   b. Leave the **Packet Length** field (when present) set to the default of 1522 bytes or type into that field the packet length at which you want the test conducted.
   c. Leave the **Number of Packets** field set to 0 (to flood the link).
   d. Click the **Start Test** button.
   e. View the results of the test.
6. If these link tests fail to consistently show 90% or greater efficiency in 1X operation or 50 to 60% efficiency in 2X, troubleshoot the link, using the data as follows:
   - If the downlink is consistently 90% efficient, but the uplink is only 40%, this indicates trouble for the BHS transmitting to the BHM. Investigate a possible source of interference near the BHM.
   - If the uplink is consistently 90% efficient, but the downlink is only 40%, this indicates trouble for the BHM transmitting to the BHS. Investigate a possible source of interference near the BHS.

   If these link tests consistently show 90% or greater efficiency in 1X operation, or 50 to 60% efficiency in 2X operation, in both uplink and downlink, continue this procedure.
7. Open the Session Status tab in the Home page of the BHM.
   NOTE: An example of this page is shown in Figure 136.

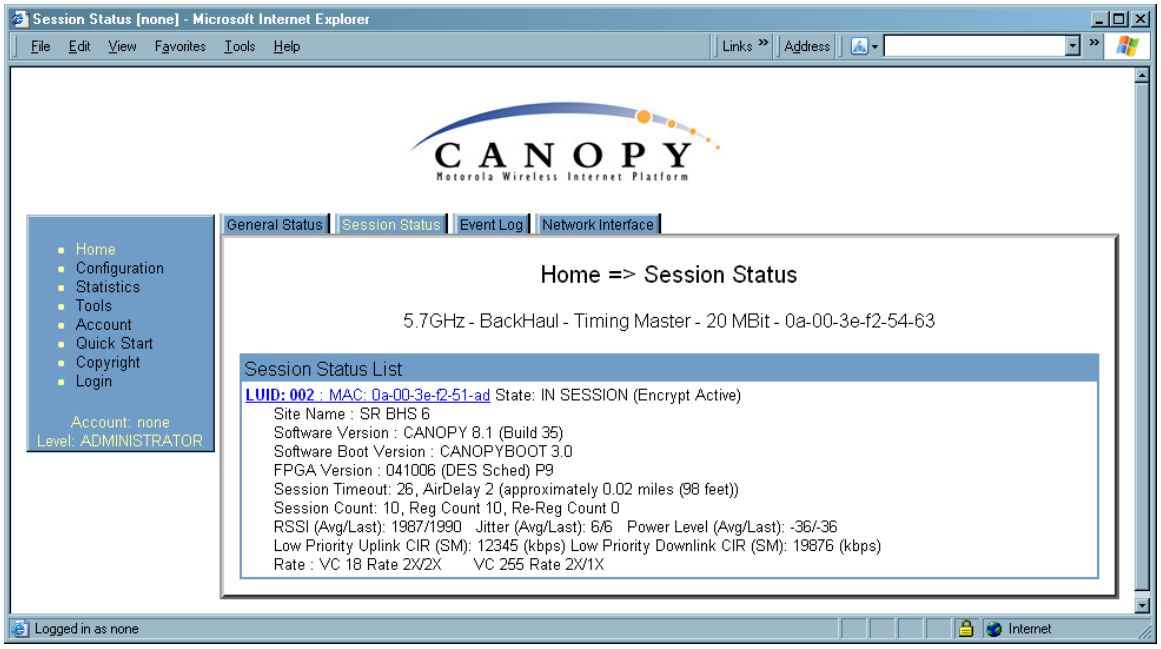


Figure 136: Session Status tab of BHM

8. Find the **Session Count** line under the MAC address of the BHS.
9. Check and note the values for **Session Count**, **Reg Count**, and **Re-Reg Count**.
10. Briefly monitor these values, occasionally refreshing this page by clicking another tab and then the Session Status tab again.
11. If these values are low (for example, 1, 1, and 0, respectively, meaning that the BHS registered and started a stable session once) and not changing
    a. consider the installation successful.
    b. 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, recheck jitter as described in Procedure 28: Installing the SM or recheck link efficiency as described in this procedure, then look for sources of RF interference or obstructions.)

end of procedure

20 VERIFYING SYSTEM FUNCTIONALITY

To verify system functionality after the APs and or BHs have been installed, perform the following steps.

Procedure 33: Verifying system functionality

1. For each installed AP, use a computer or PDA connected to an SM set to a compatible configuration (frequency and color code, for example) and verify link functionality.
2. For each BH installed, use a notebook computer connected to a BH (BHM or BHS, as appropriate) set to a compatible configuration and verify link functionality.
3. If a network data feed is present and operational, use an SM or BHS to verify network functionality.

end of procedure

OPERATIONS GUIDE

21 GROWING YOUR NETWORK

Keys to successfully growing your network include

- monitoring the RF environment.
- considering software release compatibility.
- redeploying modules appropriately and quickly.

21.1 MONITORING THE RF ENVIRONMENT

Regardless of whether you are maintaining or growing your network, you may encounter new RF traffic that can interfere with your current or planned equipment. Regularly measuring *over a period of time* and logging the RF environment, as you did before you installed your first equipment in an area, enables you to recognize and react to changes.

21.1.1 Spectrum Analyzer (Not available for Cyclone OFDM)

IMPORTANT!

When you enable the Spectrum Analyzer on a module, it enters a scan mode and drops any RF connection it may have had. Scanning mode ends when either you click **Disable** on the Spectrum Analyzer page, or it times out after 15 minutes and returms to operational mode.

For this reason

- *do not* enable the spectrum analyzer on a module you are connected to via RF. The connection will drop for 15 minutes, and when the connection is re-established no readings will be displayed.
- be advised that, if you enable the spectrum analyzer by Ethernet connection, the RF connection to that module drops.

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

RECOMMENDATION:

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

Temporarily deploy an SM or BHS for *each* frequency band range that you need to monitor and access the Spectrum Analyzer tab in the Tools web page of the module. (For access from a PDA, see PDA Access to Cyclone Modules on Page 333.) To enter the scan mode and view readings, click **Enable**.

After clicking the **Enable** button on the Spectrum Analyzer page, the first “painting” may not display bars for all frequencies, especially on frequency bands with a large number of center channels, like the 5.4 GHz band. Clicking **Enable** again will display the entire spectrum bar graph. Alternatively, you can set the “Auto Refresh” time on the Configuration => General page to a few seconds to have the Spectrum Analyzer

automatically fully displayed and refreshed. (Setting the “Auto Refresh” time back to 0 will disable refresh.)

21.1.2 Graphical Spectrum Analyzer Display (Not available for Cyclone OFDM)

An SM/BHS displays the graphical spectrum analyzer. An example of the Spectrum Analyzer tab is shown in Figure 137.

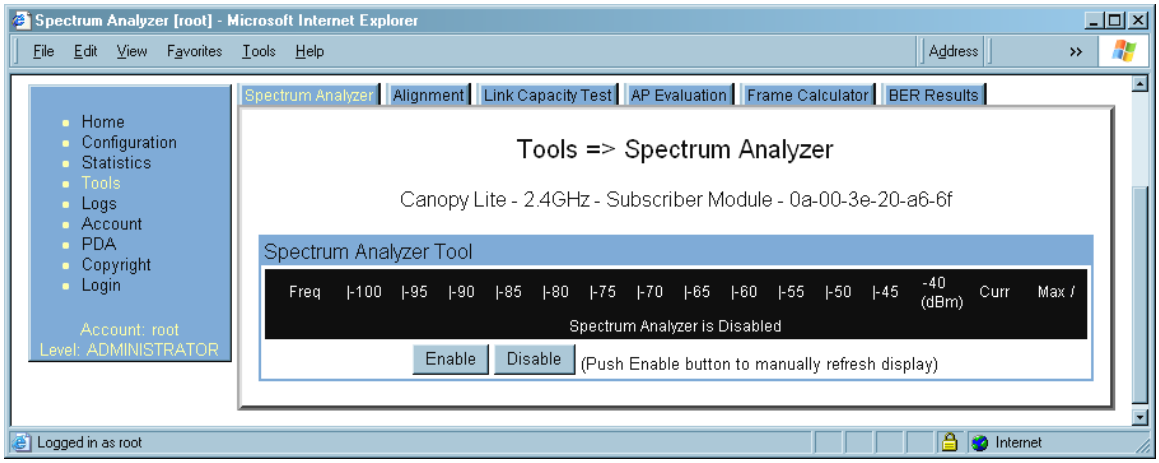


Figure 137: Spectrum Analyzer tab of SM, example

Colors in the display have the following meanings:

- Green bars show the most recent measurements.
- Yellow ticks show the maximum measurements from the current spectrum analysis session.
- Red ticks show measurements of −40 dBm or stronger.

To keep the displayed data current, either set “Auto Refresh” on the module’s Configuration => General page to a few seconds, or repeatedly click the **Enable** button. When you are finished analyzing the spectrum, click the **Disable** button to return the module to normal operation.

21.1.3 Using the AP as a Spectrum Analyzer (Not available for Cyclone OFDM)

You can temporarily change an AP into an SM and thereby use the spectrum analyzer functionality. This is the only purpose supported for the transformation.

CAUTION!

When you change an AP into an SM, any connections to SMs off that AP are lost. Therefore, you should ensure you are connected to the AP through its *Ethernet* side (not RF side) before changing it into an SM.

For example, if you are connected to an AP through one of its SMs and mistakenly change the AP into an SM, you will lose connectivity and will need to gain access to the Ethernet side of the AP through another part of your network to change it back into an AP.

To transform the AP into an SM for spectrum analysis and then return the device to an AP, perform the following steps.

Procedure 34: Using the Spectrum Analyzer in AP feature

1. Connect to the wired Ethernet interface of the AP.
2. Access the General tab of the Configuration page in the AP.
3. Set the **Device Setting** parameter to **SM**.
4. Click the **Save Changes** button.
5. Click the **Reboot** button.
6. When the module has rebooted as an SM, click the Tools navigation link on the left side of the Home page.
7. Click the Spectrum Analyzer tab.
8. Either set this page to automatically refresh or repeatedly click the **Enable** button.
   RESULT: The SM enters the scan mode.
9. When you are finished analyzing the spectrum, click the **Disable** button.
10. In the left-side navigation links, click Configuration.
11. Click the General tab.
12. Set the **Device Setting** parameter to **AP**.
13. Click the **Save Changes** button.
14. Click the **Reboot** button.
    RESULT: The AP boots with its previous frequency setting.

end of procedure

21.2 CONSIDERING SOFTWARE RELEASE COMPATIBILITY

Within the same Cyclone network, modules can operate on multiple software releases. However, the features that can be enabled are limited to those that the earliest software supports.

21.2.1 Designations for Hardware in Radios

Cyclone documentation refers to hardware series (for example, Series P9). Cyclone Release 8 requires APs, BHs, and AES SMs to be Series P9 or later hardware. The correlation between hardware series and the MAC addresses of the radio modules is provided in Table 51.

Table 51: Hardware series by MAC address

Radio Frequency Band Range	Hardware Series	
	P7 or P8 in These MAC Addresses	P9 or Later in These MAC Addresses
900	None	All
2.4	≤ 0A003E20672B	≥ 0A003E20672C
5.2	≤ 0A003E00F4E3	≥ 0A003E00F4E4
5.4	None	All
5.7	≤ 0A003EF12AFE	≥ 0A003EF12AFF

Differences in capabilities among these hardware series are summarized in Table 52.

Table 52: Hardware series differences

Capability	Availability per Hardware Series		
	P7	P8	P9
Auto-sense Ethernet cable scheme	no	yes	yes
Support CMMmicro	no	yes	yes
Support hardware scheduling in APs[1]	no	no	yes
Support 2X operation in APs and SMs	no	no	yes

NOTES:

1. An SM of P7 or P8 series requires an FPGA load through CNUT for access to hardware scheduling, and then only at 1X operation. An AP of P7 or P8 series cannot perform hardware scheduling.

Advantage Series P9 APs provide higher throughput and lower latency than earlier series Advantage APs and support configuring the high-priority channel per SM. Regular Cyclone Series P9 APs *do not* provide the higher throughput and lower latency, but they do support configuring the high-priority channel per SM.

21.2.2 CMMmicro Software and Hardware Compatibility

The CMMmicro contains both a programmable logic device (PLD) and software. These must be compatible. For example, the PLD that is compatible with CMMmicro Release 2.0.8 is PLD 5. Further, the CMMmicro must be compatible with both the application software release and the hardware of attached APs and BHs. These attached modules must have been manufactured in October 2002 or later.

APs and BHs that were manufactured earlier do not support sync on the power leads of the Ethernet port. To determine whether the AP or BH hardware is compatible with the CMMmicro, see Table 53.

Table 53: AP/BH compatibility with CMMmicro

Frequency Band Range	Range of MAC Addresses (ESNs)	
	Incompatible with CMMmicro	Compatible with CMMmicro
900 MHz AP	none	all
2.4 GHz	none	all
5.2 GHz	≤ 0A003E0021C8	≥ 0A003E0021C9
5.4 GHz	none	all
5.7 GHz	≤ 0A003EF00F79	≥ 0A003EF00F7A

21.2.3 MIB File Set Compatibility

Although MIB files are text files (not software), they define objects associated with configurable parameters and indicators for the module and its links. In each release, some of these parameters and indicators are not carried forward from the previous release, and some parameters and indicators are introduced or changed.

For this reason, use the MIB files from your download to replace previous MIB files in conjunction with your software upgrades, even if the file names are identical to those of your previous files. Date stamps on the MIB files distinguish the later set.

21.3 REDEPLOYING MODULES

Successfully redeploying a module may involve

- maintaining full and accurate records of modules being redeployed from warehouse stock.
- exercising caution about
  - software compatibility. For example, whether desired features can be enabled with the redeployed module in the network.
  - procedural handling of the module. For example
    - whether to align the SM or BHS by power level and jitter or by only jitter.
    - whether the module auto-senses the Ethernet cable connector scheme.
  - hardware compatibility. For example, where a CMMmicro is deployed.
  - the value of each configurable parameter. Whether all are compatible in the new destination.

- remembering to use auto discovery to add the redeployed SM to the network in Prizm.

21.3.1 Wiring to Extend Network Sync

The following procedure can be used to extend network sync by one additional hop, as described under Passing Sync in an Additional Hop on Page 95. Where a collocated module receives sync over the air, the collocated modules can be wired to pass the sync as follows:

Procedure 35: Extending network sync

1. Connect the GPS Utility ports of the collocated modules using a sync cable with RJ-11 connectors.
2. Set the **Sync Input** parameter on the Configuration page of the collocated AP or BH timing master to **Sync to Received Signal (Timing Port)**.
3. Set the **Frame Timing Pulse Gated** parameter on the Configuration page of the collocated SM or BH timing slave to **Enable**.

   NOTE: This setting prevents interference in the event that the SM or BH timing slave loses sync.

========== **end of procedure** ==========

22 SECURING YOUR NETWORK

22.1 ISOLATING APS FROM THE INTERNET

Ensure that the IP addresses of the APs in your network

- are not routable over the Internet.
- do not share the subnet of the IP address of your user.

RFC 1918, *Address Allocation for Private Subnets*, reserves for private IP networks three blocks of IP addresses that are not routable over the Internet:

- /8 subnets have one reserved network, 10.0.0.0 to 10.255.255.255.
- /16 subnets have 16 reserved networks, 172.16.0.0 to 172.31.255.255.
- /24 subnets have 256 reserved networks, 192.168.0.0 to 192.168.255.255.

22.2 ENCRYPTING CYCLONE RADIO TRANSMISSIONS

Cyclone systems employ the following forms of encryption for security of the wireless link:

- BRAID–a security scheme that the cellular industry uses to authenticate wireless devices.
- DES–Data Encryption Standard, an over-the-air link option that uses secret 56-bit keys and 8 parity bits.
- AES–Advanced Encryption Standard, an extra-cost over-the-air link option that provides extremely secure wireless connections. AES uses 128-bit secret keys as directed by the government of the U.S.A. AES is not exportable and requires a special AP to process the large keys.

BRAID is a stream cipher that the TIA (Telecommunications Industry Association) has standardized. Standard Cyclone APs and SMs use BRAID encryption to

- calculate the per-session encryption key (independently) on each end of a link.
- provide the digital signature for authentication challenges.

22.2.1 DES Encryption

Standard Cyclone modules provide DES encryption. DES performs a series of bit permutations, substitutions, and recombination operations on blocks of data. DES Encryption does not affect the performance or throughput of the system.

22.2.2 AES Encryption

Last Mile Gear also offers Cyclone products that provide AES encryption. AES uses the Rijndael algorithm and 128-bit keys to establish a higher level of security than DES. Because of this higher level of security, the government of the U.S.A. controls the export of communications products that use AES (among which the Cyclone AES feature activation key is one) to ensure that these products are available in only certain regions and by special permit.

The Cyclone distributor or reseller can advise service providers about current regional availability. Cyclone AES products are certified as compliant with the Federal Information Processing Standards (FIPS) in the U.S.A. The National Institute of Standards and Technology (NIST) in the U.S.A. has specified AES for significantly greater security than that which DES provides. NIST selected the AES algorithm for providing the best combination of security, performance, efficiency, implementation, and flexibility. NIST collaborates with industry to develop and apply technology, measurements, and standards.

22.2.3 AES-DES Operability Comparisons

This section describes the similarities and differences between DES and AES products, and the extent to which they may interoperate.

The DES AP and the DES BHM modules are factory-programmed to enable or disable *DES* encryption. Similarly, the AES AP and the AES BHM modules are factory-programmed to enable or disable *AES* encryption. In either case, the authentication key entered in the Configuration page establishes the encryption key. For this reason, the authentication key must be the same on each end of the link. See Authentication Key on Page 286.

Feature Availability

Cyclone AES products run the same software as DES products. Thus feature availability and functionality are and will continue to be the same, regardless of whether AES encryption is enabled. All interface screens are identical. However, when encryption is enabled on the Configuration screen

- the AES product provides AES encryption.
- the DES product provides DES encryption.

Cyclone AES products and DES products use different FPGA (field-programmable gate array) loads. However, the AES FPGA will be upgraded as needed to provide new features or services similar to those available for DES products.

Cyclone DES products cannot be upgraded to AES. To have the option of AES encryption, the operator must purchase AES products.

Interoperability

Cyclone AES products and DES products do not interoperate when enabled for encryption. For example, An AES AP with encryption enabled cannot communicate with DES SMs. Similarly, an AES Backhaul timing master module with encryption enabled cannot communicate with a DES Backhaul timing slave module.

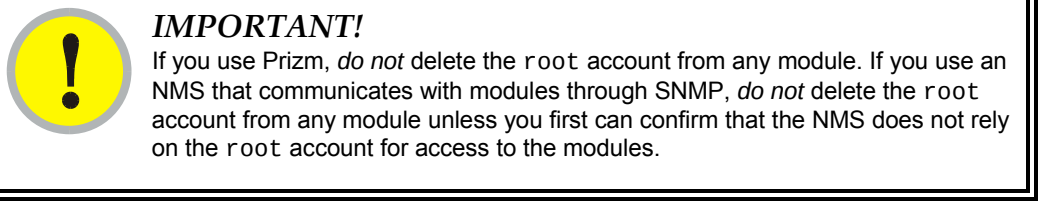
However, if encryption is disabled, AES modules can communicate with DES modules.

22.3 MANAGING MODULE ACCESS BY PASSWORDS

22.3.1 Adding a User for Access to a Module

From the factory, each Cyclone module has a preconfigured administrator-level account in the name `root`, which initially requires no associated password. This is the same `root` account that you may have used for access to the module by `telnet` or `ftp`.
If you upgrade a module to Release 8

- an account is created in the name `admin`.
- both `admin` and `root` inherit the password that was previously used for access to the module:
  - the **Full Access** password, if one was set.
  - the **Display-Only Access** password, if one was set and no Full Access password was set.



Each module supports four or fewer user accounts, regardless of account levels. The available levels are

- ADMINISTRATOR, who has full read and write permissions. This is the level of the `root` and `admin` users, as well as any other administrator accounts that one of them creates.
- INSTALLER, who has permissions identical to those of ADMINISTRATOR except that the installer cannot add or delete users or change the password of any other user.
- GUEST, who has no write permissions and only a limited view of General Status tab, as shown in Figure 138, and can log in as a user.

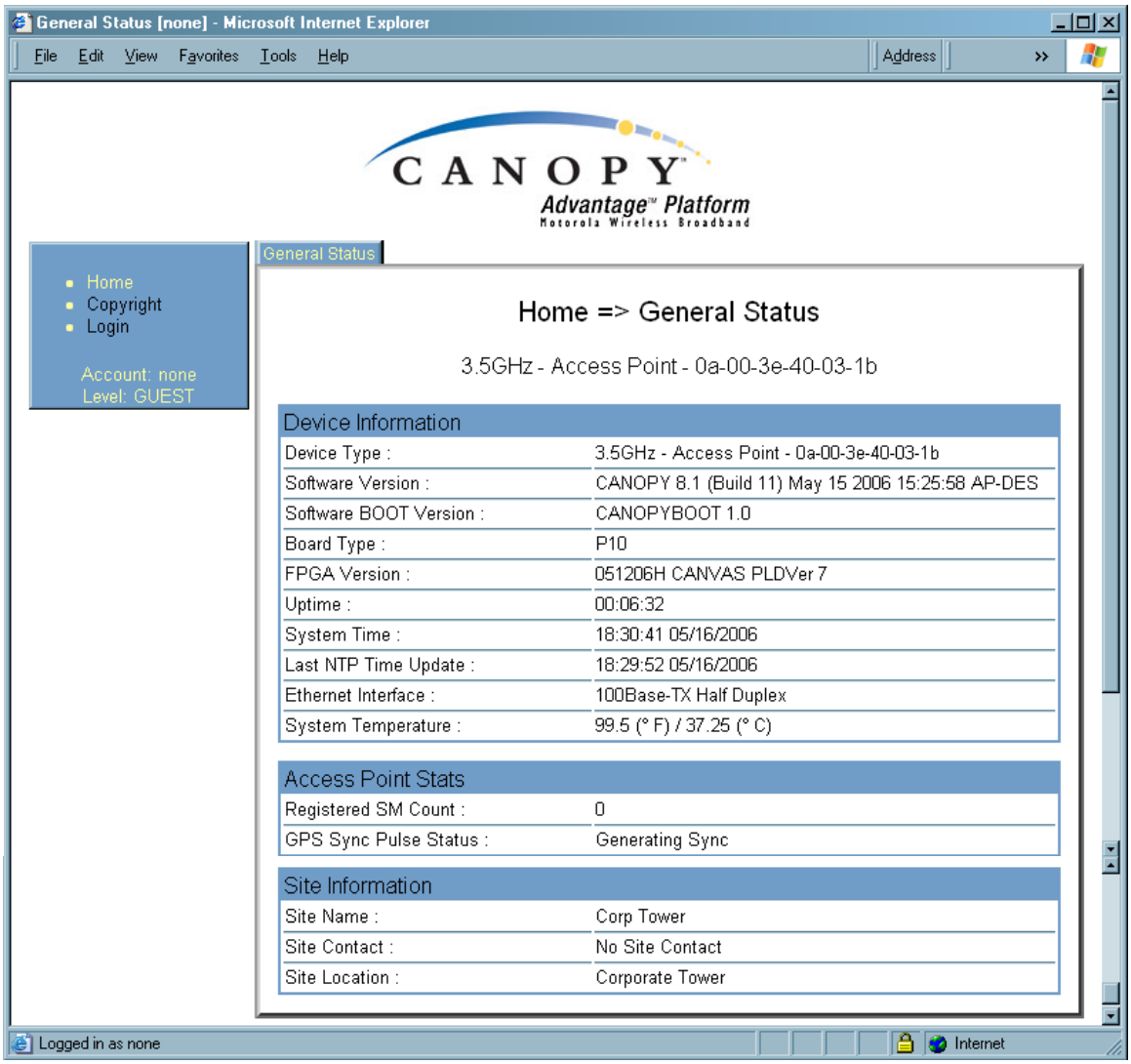


Figure 138: General Status tab view for GUEST-level account

An example of the Add User tab is displayed in Figure 139.

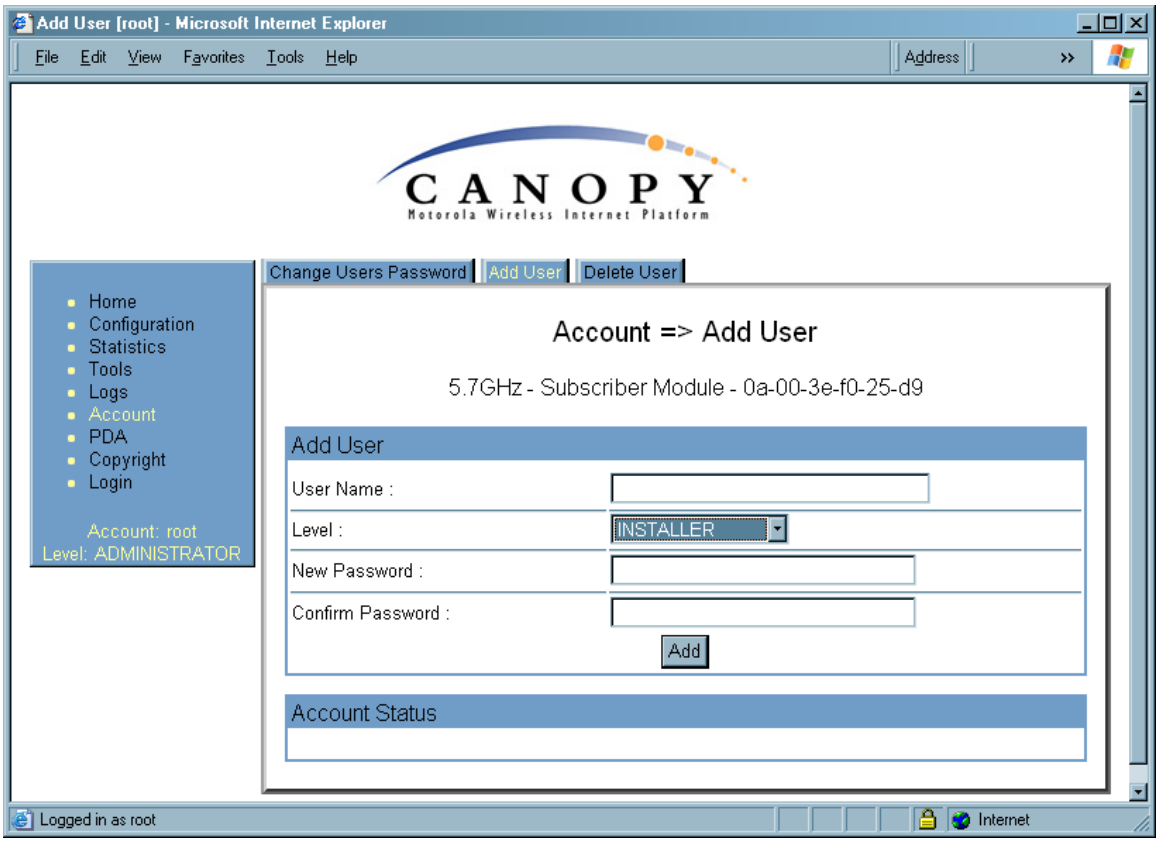


Figure 139: Add User tab of SM, example

After a password has been set for any ADMINISTRATOR-level account, initial access to the module GUI opens the view of GUEST level (Figure 138).

Accounts that cannot be deleted are

- the current user's own account.
- the last remaining account of ADMINISTRATOR level.

22.3.2 Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH

Cyclone systems offer a plug that allows you to temporarily override some AP/SM/BH settings and thereby regain control of the module. This plug is needed for access to the module in any of the following cases:

- You have forgotten either
  - the IP address assigned to the module.
  - the password that provides access to the module.
- The module has been locked by the No Remote Access feature. (See Denying All Remote Access on Page 457 and Reinstating Remote Access Capability on Page 457.)
- You want local access to a module that has had the 802.3 link disabled in the Configuration page.

You can configure the module such that, when it senses the override plug, it responds by either

- resetting the LAN1 IP address to 169.254.1.1, allowing access through the default configuration without *changing* the configuration, whereupon you will be able to view and reset any non-default values as you wish.
- resetting all configurable parameters to their factory default values.

Acquiring the Override Plug

You can either purchase or fabricate an override plug as follows. To purchase an override plug for a nominal fee, order the plug at http://www.best-tronics.com/Last Mile Gear.htm. To fabricate an override plug, perform the following steps.

Procedure 36: Fabricating an override plug

1. Install an RJ-11 6-pin connector onto a 6-inch length of CAT 5 cable.
2. Pin out all 6-pins.
3. Short (solder together) Pins 4 and 6 on the other end. Do not connect any other wires to anything. The result should be as shown in Figure 140.

end of procedure

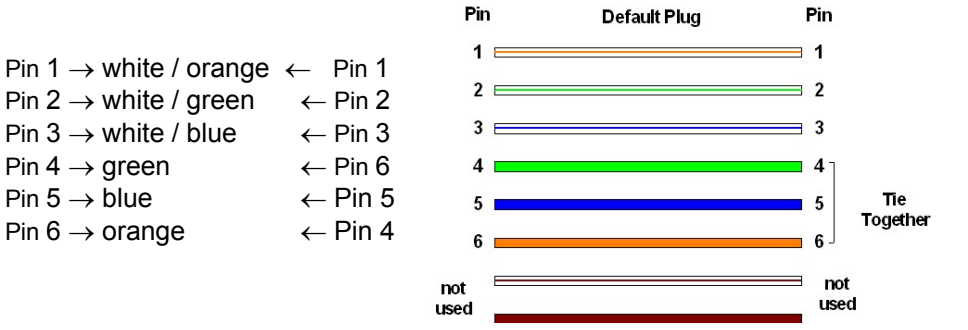


Figure 140: RJ-11 pinout for the override plug

Using the Override Plug

IMPORTANT!
While the override plug is connected to a module, the module can neither register nor allow registration of another module.

To regain access to the module, perform the following steps.

Procedure 37: Regaining access to a module

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

========== **end of procedure** ==========

22.3.3 Overriding Forgotten IP Addresses or Passwords on CMMmicro

By using an override toggle switch on the CMMmicro circuit board, you can temporarily override a lost or unknown IP address or password as follows:

- Up is the override position in which a power cycle causes the CMMmicro to boot with the default IP address (169.254.1.1) and no password required.
- Down is the normal position in which a power cycle causes the CMMmicro to boot with your operator-set IP address and password(s).

To override a lost or unknown IP address or password, perform the following steps.

Procedure 38: Using the override switch to regain access to CMMmicro

IMPORTANT!

In override mode

- a CMMmicro provides no power on its ports.
- any APs or BHs connected to the CMMmicro are not powered.
- you cannot gain browser access to the CMMmicro through any connected APs or BHs.

1. Gain physical access to the inside of the CMMmicro enclosure.
2. Establish direct Ethernet connectivity to the CMMmicro (not through an AP or BH).
3. Flip the toggle switch up (toward you).
4. Power cycle the CMMmicro.
   RESULT: The module reboots with the default IP address of 169.254.1.1, password fields blank, and all other configuration values as previously set.
5. Set passwords as desired, or enter a blank space to set no password.
6. Change configuration values if desired.
7. Click the **Save Changes** button.

8. Flip the toggle switch down (away from you).
9. Click the **Reboot** button.

========== **end of procedure** ==========

22.4 REQUIRING SM AUTHENTICATION

Through the use of Prizm Release 2.0 or later, or BAM Release 2.1, you can enhance network security by requiring SMs to authenticate when they register. Three keys and a random number are involved in authentication as follows:

- factory-set key in each SM. Neither the subscriber nor the network operator can view or change this key.
- authentication key, also known as authorization key and skey. This key matches in the SM and AP as the **Authentication Key** parameter, and in the Prizm database.
- random number, generated by Prizm or BAM and used in each attempt by an SM to register and authenticate. The network operator can view this number.
- session key, calculated separately by the SM and Prizm or BAM, based on both the authentication key (or, by default, the factory-set key) and the random number. Prizm or BAM sends the session key to the AP. The network operator cannot view this key.

None of the above keys is ever sent in an over-the-air link during an SM registration attempt. However, with the assumed security risk, the operator can create and configure the **Authentication Key** parameter. See Authentication Key on Page 286.

22.5 FILTERING PROTOCOLS AND PORTS

You can filter (block) specified protocols and ports from leaving the SM and entering the Cyclone 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.

Protocol and port filtering is set per SM. Except for filtering of SNMP ports, filtering occurs as packets leave the SM. If an SM is configured to filter SNMP, then SNMP packets are blocked from entering the SM and, thereby, from interacting with the SNMP portion of the protocol stack on the SM.

22.5.1 Port Filtering with NAT Enabled

Where NAT is enabled, you can filter only the three user-defined ports. The following are example situations in which you can configure port filtering where NAT is enabled.

- To block a subscriber from using FTP, you can filter Ports 20 and 21 (the FTP ports) for both the TCP and UDP protocols.
- To block a subscriber from access to SNMP, you can filter Ports 161 and 162 (the SNMP ports) for both the TCP and UDP protocols.
  NOTE: In only the SNMP case, filtering occurs before the packet interacts with the protocol stack.

22.5.2 Protocol and Port Filtering with NAT Disabled

Where NAT is disabled, you can filter both protocols and the three user-defined ports. Using the check boxes on the interface, you can either

- allow all protocols except those that you wish to block.
- block all protocols except those that you wish to allow.

You can allow or block any of the following protocols:

- PPPoE (Point to Point Protocol over Ethernet)
- Any or all of the following IPv4 (Internet Protocol version 4) protocols:
  - SMB (Network Neighborhood)
  - SNMP
  - Up to 3 user-defined ports
  - All other IPv4 traffic (see Figure 141)
- Uplink Broadcast
- ARP (Address Resolution Protocol)
- All others (see Figure 141)

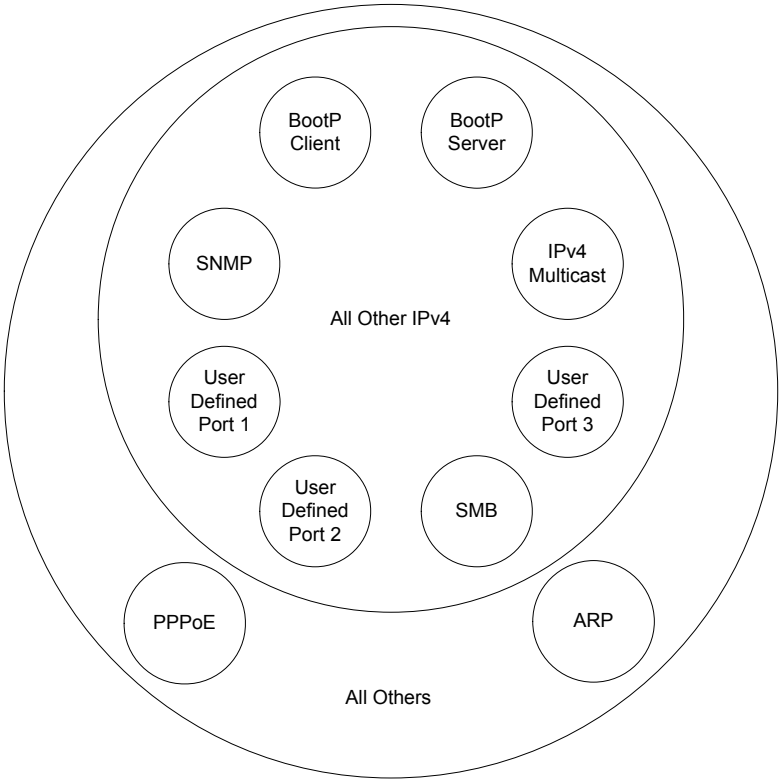


Figure 141: Categorical protocol filtering

The following are example situations in which you can configure protocol filtering where NAT is disabled:

- If you block a subscriber from only PPoE and SNMP, then the subscriber retains access to all other protocols and all ports.
- If you block PPoE, IPv4, and Uplink Broadcast, and you also check the **All others** selection, then only Address Resolution Protocol is not filtered.

The ports that are filtered as a result of protocol selections in the Protocol Filtering tab of the SM are listed in Table 54. Further information is provided under Protocol Filtering Tab of the SM on Page 292.

Table 54: Ports filtered per protocol selections

Protocol Selected	Port Filtered (Blocked)
SMB	Destination Ports 137 TCP and UDP, 138 UDP, 139 TCP, 445 TCP
SNMP	Destination Ports 161 TCP and UDP, 162 TCP and UDP
Bootp Client	Source Port 68 UDP
Bootp Server	Source Port 67 UDP

22.6 ENCRYPTING DOWNLINK BROADCASTS

An AP can be enabled to encrypt downlink broadcast packets such as the following:

- ARP
- NetBIOS
- broadcast packets containing video data on UDP.

The encryption used is DES for a DES module, and AES for an AES module. Before the Encrypt Downlink Broadcast feature is enabled on the AP, air link security should be enabled on the AP.

22.7 ISOLATING SMs

In the Release 8 or later AP, you can prevent SMs in the sector from directly communicating with each other. In CMMmicro Release 2.2 or later, you can prevent connected APs from directly communicating with each other, which prevents SMs that are in different sectors of a cluster from communicating with each other.

In the AP, the **SM Isolation** parameter is available in the General tab of the Configuration web page. In the drop-down menu for that parameter, you can configure the SM Isolation feature by any of the following selections:

- **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 would have been handled SM to SM, through the Ethernet port of the AP.

In the CMMmicro, SM isolation treatment is the result of how you choose to manage the port-based VLAN feature of the embedded switch, where you can switch all traffic from any AP or BH to an uplink port that you specify. However, this is not packet level switching. It is not based on VLAN IDs. See the **VLAN Port Configuration** parameter in Figure 72: Configuration page of CMMmicro, example on Page 225.

22.8 FILTERING MANAGEMENT THROUGH ETHERNET

You can configure the SM to disallow any device that is connected to its Ethernet port from accessing the IP address of the SM. If you set the **Ethernet Access Control** parameter to **Enabled**, then

- no attempt to access the SM management interface (by http, SNMP, telnet, ftp, or tftp) through Ethernet can succeed.
- any attempt to access the SM management interface over the air (by IP address, presuming that **LAN1 Network Interface Configuration, Network Accessibility** is set to **Public**, or by link from the Session Status or Remote Subscribers tab in the AP) is unaffected.

22.9 ALLOWING MANAGEMENT FROM ONLY SPECIFIED IP ADDRESSES

The Security tab of the Configuration web page in the AP, SM, and BH includes the **IP Access Control** parameter. You can specify one, two, or three IP addresses that should be allowed to access the management interface (by http, SNMP, telnet, ftp, or tftp).

If you select

- **IP Access Filtering Disabled**, then management access is allowed from any IP address, even if the **Allowed Source IP *1 to 3*** parameters are populated.
- **IP Access Filtering Enabled**, and specify at least one address in the **Allowed Source IP *1 to 3*** parameter, then management access is limited to the specified address(es). If you intend to use Prizm to manage the element, then you must ensure that the IP address of the Prizm server is listed here.

22.10 CONFIGURING MANAGEMENT IP BY DHCP

The IP tab in the Configuration web page of every Cyclone radio contains a **LAN1 Network Interface Configuration, DHCP State** parameter that, if enabled, causes the IP configuration (IP address, subnet mask, and gateway IP address) to be obtained through DHCP instead of the values of those individual parameters. The setting of this DHCP state parameter is also viewable, but not settable, in the Network Interface tab of the Home page.

In the SM, this parameter is settable

- in the NAT tab of the Configuration web page, but only if NAT is enabled.
- in the IP tab of the Configuration web page, but only if the **Network Accessibility** parameter in the IP tab is set to **Public**.

23 MANAGING BANDWIDTH AND AUTHENTICATION

This section provides a high-level description of bandwidth and authentication management in a Cyclone network. For more specific information, see *Cyclone Bandwidth and Authentication Manager (BAM) User Guide* or the *Last Mile Gear Cyclone Prizm User Guide*.

23.1 MANAGING BANDWIDTH WITHOUT BAM

Unless Prizm or BAM is deployed and is configured in the AP, bandwidth management is limited to applying a single sustained data rate value (for uplink and for downlink) and a single burst allocation value (for uplink and for downlink) to every SM that registers in the AP.

23.2 BANDWIDTH AND AUTHENTICATION MANAGER (BAM) SERVICES AND FEATURES

Prizm or BAM enables you to perform the following management operations on SMs:

- Change the key that the SMs need for authenticating.
- Temporarily suspend or reinstate a subscriber.
- Set burst size and data transfer rate caps for an SM or group of SMs.
- Use licensing to uncap an SM or group of SMs.
- List all ESNs that are associated with a specified VLAN ID.
- Associate or dissociate an SM or group of SMs with a specified VLAN ID.
- Set VLAN parameters.
- Toggle whether to send those VLAN parameters to the SMs.
- Set CIR parameters for low-priority and high-priority channel rates.
- Toggle whether to send those CIR parameters to the SMs.
- Toggle whether to enable the high-priority channel in the SMs.

23.2.1 Bandwidth Manager Capability

Prizm or BAM allows you to set bandwidth per SM for sustained rates and burst rates. With this capability, the Cyclone system allows both

- burst rates beyond those of many other broadband access solutions.
- control of average bandwidth allocation to prevent excessive bandwidth usage by a subscriber.

All packet throttling occurs in the SMs and APs based on Quality of Service (QoS) data that the Prizm or BAM server provides. No server processing power or network messages are needed for packet throttling.

QoS management also supports marketing of broadband connections at various data rates, for operator-defined groups of subscribers, and at various price points. This allows you to meet customer needs at a price that the customer deems reasonable and affordable.

When BAM *is* enabled in the AP Configuration page, bandwidth management is expanded to apply uniquely specified sustained data rate and burst allocation values to each registered SM. Thus, you can define differently priced tiers of subscriber service.

Designing Tiered Subscriber Service Levels

Examples of levels of service that vary by bandwidth capability are provided in Table 55 and Table 56.

NOTE:
The speeds that these tables correlate to service levels are comparative examples. Actual download times may be greater due to use of the bandwidth by other SMs, congestion on the local network, congestion on the Internet, capacity of the serving computer, or other network limitations.

Table 55: Example times to download for typical tiers of service with Cyclone AP

Equipment	**AP**	**Cyclone**		
	SM	**Cyclone**		
	Operation	**1X**		
	Max burst speed	**4.4 Mbps**		
Example Settings	**Service Type**	Premium	Regular	Basic
	Sustained Downlink Data Rate	5250 Kbps	1000 Kbps	256 Kbps
	Sustained Uplink Data Rate	1750 Kbps	500 Kbps	128 Kbps
	Downlink and Uplink Burst Allocations	500000 Kb	80000 Kb	40000 Kb
Download (sec)	**Web page**	<1	<1	<1
	5 MB	9	9	9
	20 MB	36	80	470
	50 MB	91	320	1400
	300 MB	545	2320	9220

Table 56: Example times to download for typical tiers of service with Advantage AP

Equipment	**AP**	**Advantage**						**Advantage**
	SM	**Cyclone**						**Advantage**
	Operation	**1X**			**2X**			**2X**
	Max burst speed	**5 Mbps**			**10 Mbps**			**10 Mbps**
Example Settings	**Service Type**	Premium	Regular	Basic	Premium	Regular	Basic	Premium
	Sustained Downlink Data Rate	5250 Kbps	1000 Kbps	256 Kbps	5250 Kbps	1000 Kbps	256 Kbps	2000 Kbps
	Sustained Uplink Data Rate	1750 Kbps	500 Kbps	128 Kbps	1750 Kbps	500 Kbps	128 Kbps	20000 Kbps
	Downlink and Uplink Burst Allocations	500000 Kb	80000 Kb	40000 Kb	500000 Kb	80000 Kb	40000 Kb	500000 Kb
Download (sec)	**Web page**	<1	<1	<1	<1	<1	<1	<1
	5 MB	8	8	8	4	4	4	4
	20 MB	32	80	470	16	80	470	16
	50 MB	80	320	1400	40	320	1400	40
	300 MB	480	2320	9220	362	2320	9220	240

23.2.2 Authentication Manager Capability

Prizm or BAM allows you to set per AP a requirement that each SM registering to the AP must authenticate. When AP Authentication Server (APAS) is enabled in the AP, any SM that attempts to register to the AP is denied service if authentication fails, such as (but not limited to) when no Prizm or BAM server is operating or when the SM is not listed in the database.

If a Prizm or BAM server drops out of service where no redundant server exists

- an SM that attempts to register is denied service.
- an SM that is already in session remains in session

In a typical Cyclone network, some SMs re-register daily (when subscribers power down the SMs, for example), and others do not re-register in a period of several weeks. Whenever an authentication attempt fails, the SM locks out of any other attempt to register itself to the same AP for the next 15 minutes.

24 MANAGING THE NETWORK FROM A MANAGEMENT STATION (NMS)

SNMPv2 (Simple Network Management Protocol Version 2) can be used to manage and monitor the Cyclone modules under SMI (Structure of Management Information) specifications. SMI specifies management information definitions in ASN.1 (Abstract Syntax Notation One) language. SNMPv2 supports both 32-bit and 64-bit counters. The SMI for SNMPv2 is defined in RFC 1902 at http://www.faqs.org/rfcs/rfc1902.html.

24.1 ROLES OF HARDWARE AND SOFTWARE ELEMENTS

24.1.1 Role of the Agent

In SNMP, software on each managed device acts as the *agent*. The agent collects and stores management information in ASN.1 format, in a structure that a MIB (management information base) defines. The agent responds to commands to

- send information about the managed device.
- modify specific data on the managed device.

24.1.2 Role of the Managed Device

In SNMP, the managed device is the network element that operates on the agent software. In the Cyclone network, this managed device is the module (AP, SM, or BH). With the agent software, the managed device has the role of server in the context of network management.

24.1.3 Role of the NMS

In SNMP, the NMS (network management station) has the role of client. An application (manager software) operates on the NMS to manage and monitor the modules in the network through interface with the agents.

24.1.4 Dual Roles for the NMS

The NMS can simultaneously act as an agent. In such an implementation, the NMS acts as

- client to the agents in the modules, when polling for the agents for information and sending modification data to the agents.
- server to another NMS, when being polled for information gathered from the agents and receiving modification data to send to the agents.

24.1.5 Simple Network Management Protocol (SNMP) Commands

To manage a module, SNMPv2 supports the `set` command, which instructs the agent to change the data that manages the module.

To monitor a network element (Cyclone module), SNMPv2 supports

- the `get` command, which instructs the agent to send information about the module to the manager in the NMS.
- traversal operations, which the manager uses to identify supported objects and to format information about those objects into relational tables.

In a typical Cyclone network, the manager issues these commands to the agents of more than one module (to all SMs in the operator network, for example).

24.1.6 Traps from the Agent

When a specified event occurs in the module, the agent initiates a trap, for which the agent sends an unsolicited asynchronous message to the manager.

24.1.7 AP SNMP Proxy to SMs

When the AP receives from Prizm or an NMS an SNMP request for an SM, it is capable of sending that request via proxy to the SM. In this case, the SM responds directly to Prizm or the NMS. (The AP performs no processing on the response.)

24.2 MANAGEMENT INFORMATION BASE (MIB)

The MIB, the SNMP-defined data structure, is a tree of standard branches that lead to optional,
non-standard positions in the data hierarchy. The MIB contains both

- objects that SNMP is allowed to control (bandwidth allocation or access, for example)
- objects that SNMP is allowed to monitor (packet transfer, bit rate, and error data, for example).

The path to each object in the MIB is unique to the object. The endpoint of the path is the object identifier.

24.2.1 Cascading Path to the MIB

The standard MIB hierarchy includes the following cascading branch structures:

- the top (standard body) level:
  - ccitt (0)
  - **iso (1)**
  - iso-ccitt (2)
- under iso (1) above:
  - standard (0)
  - registration-authority (1)
  - member-body (2)
  - **identified-organization (3)**
- under identified-organization (3) above:
  - dod (6)
  - other branches

- under dod (6) above:
  - internet (1)
  - other branches
- under internet (1) above:
  - mgmt (2)
  - private (4)
  - other branches
- under mgmt (2) above: **mib-2 (1)** and other branches. (See MIB-II below.)

  under private (4) above: **enterprise (1)** and other branches. (See Cyclone Enterprise MIB below.)

  Beneath this level are non-standard branches that the enterprise may define.

Thus, the path to an object that is managed under MIB-II begins with the decimal string **1.3.6.1.2.1** and ends with the object identifier and instance(s), and the path to an object that is managed under the Cyclone Enterprise MIB begins with **1.3.6.1.4.1**, and ends with the object identifier and instance(s).

24.2.2 Object Instances

An object in the MIB can have either only a single instance or multiple instances, as follows:

- a scalar object has only a single instance. A reference to this instance is designated by `.0`, following the object identifier.
- a tabular object has multiple instances that are related to each other. Tables in the MIB associate these instances. References to these instances typically are designated by `.1`, `.2`, and so forth, following the object identifier.

24.2.3 Management Information Base Systems and Interface (MIB-II)

The standard MIB-II (Management Information Base systems and interface) objects are programmed into the Cyclone modules. To read this MIB, see *Management Information Base for Network Management of TCP/IP-based Internets: MIB II*, RFC 1213 at http://www.faqs.org/rfcs/rfc1213.html.

The MIB-II standard categorizes each object as one of the types defined in Table 57.

Table 57: Categories of MIB-II objects

Objects in category…	Control or identify the status of…
system	system operations in the module.
interfaces	the network interfaces for which the module is configured.
ip	Internet Protocol information in the module.
icmp	Internet Control Message Protocol information in the module. (These messages flag IP problems and allow IP links to be tested.)

Objects in category…	Control or identify the status of…
tcp	Transport Control Protocol information in the module (to control and ensure the flow of data on the Internet).
udp	User Datagram Protocol information in the module (for checksum and address).

24.2.4 Cyclone Enterprise MIB

The Cyclone Enterprise MIB provides additional reporting and control, extending the objects for any NMS that uses SNMP interaction. This MIB comprises five text files that are formatted in standard ASN.1 (Abstract Syntax Notation One) language.

To use this MIB, perform the following steps.

Procedure 39: Installing the Cyclone Enterprise MIB files

1. On the NMS, immediately beneath the `root` directory, create directory *`mibviewer`*.
2. Immediately beneath the *`mibviewer`* directory, create directory *`Cyclonemibs`*.
3. Download the following three standard MIB files from the Internet Engineering Task Force at http://www.simpleweb.org/ietf/mibs into the *`mibviewer/Cyclonemibs`* directory on the NMS:
   - SNMPv2-SMI.txt, which defines the Structure of Management Information specifications.
   - SNMPv2-CONF.txt, which allows macros to be defined for object group, notification group, module compliance, and agent capabilities.
   - SNMPv2-TC.txt, which defines general textual conventions.
4. Move the following five files from your Cyclone software package directory into the *`mibviewer/Cyclonemibs`* directory on the NMS (if necessary, first download the software package from http://www.Last Mile Gear.com/Cyclone):
   - `whisp-tcv2-mib.txt` (Textual Conventions MIB), which defines Cyclone system-specific textual conventions
   - `WHISP-GLOBAL-REG-MIB.txt` (Registrations MIB), which defines registrations for global items such as product identities and product components.
   - `WHISP-BOX-MIBV2-MIB.txt` (Box MIB), which defines module-level (AP, SM, and BH) objects.
   - `WHISP-APS-MIB.txt` (APs MIB), which defines objects that are specific to the AP or BH timing master.
   - `WHISP-SM-MIB.txt` (SM MIB), which defines objects that are specific to the SM or BH timing slave.
   - `CMM3-MIB.txt` (CMM3 MIB), which defines objects that are specific to the CMMmicro.

IMPORTANT!

Do not edit these MIB files in ASN.1. These files are intended for manipulation by only the NMS. However, you can view these files through a commercially available MIB viewer. Such viewers are listed under MIB Viewers on Page 411.

5. Download a selected MIB viewer into directory *mibviewer*.
6. As instructed by the user documentation that supports your NMS, import the eight MIB files that are listed above.

========== **end of procedure** ==========

24.3 CONFIGURING MODULES FOR SNMP ACCESS

Cyclone modules provide the following Configuration web page parameters in the SNMP tab. These govern SNMP access from the manager to the agent:

- **Community String**, which specifies the password for security between managers and the agent.
- **Accessing Subnet**, which specifies the subnet mask that allows managers to poll the agents.

Cyclone modules can also be configured to send traps to specified IP addresses, which can be those of Prizm or NMS servers, for example. The parameter for this address is named **Trap Address**.

24.4 OBJECTS DEFINED IN THE CYCLONE ENTERPRISE MIB

The Cyclone Enterprise MIB defines separate sets of objects for

- all radio modules
- APs and BH timing masters
- SMs and BH timing slaves
- CMMmicros

NOTE:

The PTP 400 and PTP 600 series bridges (previously known as 30/60 Mbps and 150/300 Mbps Backhauls) do not support these objects. The MIBs that they support are listed under Objects Defined in the PTP 400 and PTP 600 series Bridges MIB on Page 408.

24.4.1 AP, SM, and BH Objects

The objects that the Cyclone Enterprise MIB defines for all APs, SMs, and BHs are listed in Table 58.

Table 58: Cyclone Enterprise MIB objects for APs, SMs, and BHs

AP, SM, BH Object Name	Value Syntax	Operation Allowed
addVlanMember	Integer	manage
agingTimeout	Integer	manage
allowVIDAccess	Integer	manage
antennaGain[1]	Integer	manage
bridgeEnable	Integer	manage
clearEventLog	Integer	manage
codePoint*n*[2]	Integer	manage
commString	DisplayString	manage
deleteUser	DisplayString	manage
dynamicLearning	Integer	manage
eirp[3]	Integer	manage
extFilterDelay	Integer	manage
fecEnable	Integer	manage
lanDhcpState	Integer	manage
managementVID	Integer	manage
mngtIP	IpAddress	manage
powerControl	Integer	manage
reboot	Integer	manage
removeVlanMember	Integer	manage
scheduling	Integer	manage
sessionTimeout	Integer	manage
setDefaultPlug	Integer	manage
subnetMask	Integer	manage
taggedFrame[4]	Integer	manage
transmitterOP	Integer	manage
trapIP*n*[5]	IpAddress	manage
twoXRate	Integer	manage
userAccessLevel	Integer	manage
userName	DisplayString	manage
userPassword	DisplayString	manage

AP, SM, BH Object Name	Value Syntax	Operation Allowed
vlanMemberSource	Integer	manage
accessLevel	Integer	monitor
boxDeviceType	DisplayString	monitor
boxDeviceTypeID	DisplayString	monitor
boxEncryption	DisplayString	monitor
boxFrequency	DisplayString	monitor
boxTemperature[6]	DisplayString	monitor
dhcpLanIP	IpAddress	monitor
dhcpLanGateway	IpAddress	monitor
dhcpLanSubnetMask	IpAddress	monitor
dhcpRfPublicIP	IpAddress	monitor
dhcpRfPublicGateway	IpAddress	monitor
dhcpRfPublicSubnetMask	IpAddress	monitor
etherLinkStatus	DisplayString	monitor
inSyncCount	Integer	monitor
lanDhcpStatus	DisplayString	monitor
outSyncCount	Integer	monitor
platformType	Integer	monitor
platformVer	Integer	monitor
pllOutLockCount	Integer	monitor
rfPublicDhcpStatus	DisplayString	monitor
txCalFailure	Integer	monitor
userLoginName	DisplayString	monitor
userPswd	DisplayString	monitor
whispBoxBoot	DisplayString	monitor
whispBoxEsn	WhispMACAddress	monitor
whispBoxEvntLog	EventString	monitor
whispBoxFPGAVer	DisplayString	monitor
whispBridgeAge	Integer	monitor
whispBridgeDesLuid	WhispLUID	monitor
whispBridgeExt	Integer	monitor
whispBridgeHash	Integer	monitor
whispBridgeMacAddr	MacAddress	monitor
whispBridgeTbErr	Integer	monitor

AP, SM, BH Object Name	Value Syntax	Operation Allowed
whispBridgeTbFree	Integer	monitor
whispBridgeTbUsed	Integer	monitor
whispVAge	Integer	monitor
whispVID	Integer	monitor
whispVType	DisplayString	monitor

NOTES:

1. For only 5.7-GHz radios.
2. Where *n* is any number, 0 through 63. codePoint0, codePoint48, and codePoint56 can be only monitored.
3. Deprecated.
4. Replaced by frameType.
5. Where *n* is any number, 1 through 10.
6. The value of this object *does not* accurately reflect the temperature inside the module for comparison with the operating range. However, it can be helpful as one of many troubleshooting indicators. Although modules no longer report the Temperature field in the GUI, the agent in the modules continues to support this object.

24.4.2 AP and BH Timing Master Objects

The objects that the Cyclone Enterprise MIB defines for each AP and BH Timing Master are listed in Table 59. The traps provided in this set of objects are listed under Traps Provided in the Cyclone Enterprise MIB on Page 410.

Table 59: Cyclone Enterprise MIB objects for APs and BH timing masters

AP, BHM Object Name	Value Syntax	Operation Allowed
allowedIPAccess1	IpAddress	manage
allowedIPAccess2	IpAddress	manage
allowedIPAccess3	IpAddress	manage
apBeaconInfo	Integer	manage
apTwoXRate	Integer	manage
asIP1	IpAddress	manage
asIP2	IpAddress	manage
asIP3	IpAddress	manage
authKey	DisplayString	manage
authMode	Integer	manage
configSource	Integer	manage
dAcksReservHigh	Integer	manage

AP, BHM Object Name	Value Syntax	Operation Allowed
defaultGw	IpAddress	manage
dfsConfig	Integer	manage
dwnLnkData	Integer	manage
dwnLnkDataRate	Integer	manage
dwnLnkLimit	Integer	manage
encryptDwBroadcast	Integer	manage
encryptionMode	Integer	manage
gpsInput	Integer	manage
gpsTrap	Integer	manage
highPriorityUpLnkPct	Integer	manage
ipAccessFilterEnable	Integer	manage
lanIp	IpAddress	manage
lanMask	IpAddress	manage
limitFreqBand900	Integer	manage
linkTestAction[1]	Integer	manage
linkTestDuration	Integer	manage
linkTestLUID	Integer	manage
maxRange	Integer	manage
ntpServerIP	IpAddress	manage
numCtlSlots	Integer	manage
numCtlSlotsHW	Integer	manage
numCtlSlotsReserveHigh	Integer	manage
numDAckSlots	Integer	manage
numUAckSlots	Integer	manage
privateIp	IpAddress	manage
regTrap	Integer	manage
rfFreqCarrier	Integer	manage
sectorID	Integer	manage
sesHiDownCIR	Integer	manage
sesHiUpCIR	Integer	manage
sesLoDownCIR	Integer	manage
sesHiDownCIR	Integer	manage
smIsolation	Integer	manage
tslBridging	Integer	manage

AP, BHM Object Name	Value Syntax	Operation Allowed
txSpreading	Integer	manage
uAcksReservHigh	Integer	manage
untranslatedArp	Integer	manage
updateAppAddress	IpAddress	manage
upLnkDataRate	Integer	manage
upLnkLimit	Integer	manage
vlanEnable	Integer	manage
actDwnFragCount	Gauge32	monitor
actDwnLinkIndex	Integer	monitor
actUpFragCount	Gauge32	monitor
adaptRate	DisplayString	monitor
avgPowerLevel	DisplayString	monitor
dataSlotDwn	Integer	monitor
dataSlotUp	Integer	monitor
dataSlotUpHi	Integer	monitor
dfsStatus	DisplayString	monitor
downLinkEff	Integer	monitor
downLinkRate	Integer	monitor
dwnLnkAckSlot	Integer	monitor
dwnLnkAckSlotHi	Integer	monitor
expDwnFragCount	Gauge32	monitor
expUpFragCount	Gauge32	monitor
fpgaVersion	DisplayString	monitor
gpsStatus	DisplayString	monitor
lastPowerLevel	DisplayString	monitor
linkAirDelay	Integer	monitor
linkAveJitter	Integer	monitor
linkDescr	DisplayString	monitor
linkESN	PhysAddress	monitor
linkInDiscards	Counter32	monitor
linkInError	Counter32	monitor
linkInNUcastPkts	Counter32	monitor
linkInOctets	Counter32	monitor
linkInUcastPkts	Counter32	monitor

AP, BHM Object Name	Value Syntax	Operation Allowed
linkInUnknownProtos	Counter32	monitor
linkLastJitter	Integer	monitor
linkLastRSSI	Integer	monitor
linkLUID	Integer	monitor
linkMtu	Integer	monitor
linkOutDiscards	Counter32	monitor
linkOutError	Counter32	monitor
linkOutNUcastPkts	Counter32	monitor
linkOutOctets	Counter32	monitor
linkOutQLen	Gauge32	monitor
linkOutUcastPkts	Counter32	monitor
linkRegCount	Integer	monitor
linkReRegCount	Integer	monitor
linkRSSI	Integer	monitor
linkSessState	Integer	monitor
linkSiteName	DisplayString	monitor
linkSpeed	Gauge32	monitor
linkTestError	DisplayString	monitor
linkTestStatus	DisplayString	monitor
linkTimeOut	Integer	monitor
maxDwnLinkIndex	Integer	monitor
numCtrSlot	Integer	monitor
numCtrSlotHi	Integer	monitor
PhysAddress	PhysAddress	monitor
radioSlicing	Integer	monitor
radioTxGain	Integer	monitor
regCount	Integer	monitor
sesDownlinkLimit	Integer	monitor
sesDownlinkRate	Integer	monitor
sesUplinkLimit	Integer	monitor
sesUplinkRate	Integer	monitor
sessionCount	Integer	monitor
softwareBootVersion	DisplayString	monitor
softwareVersion	DisplayString	monitor

AP, BHM Object Name	Value Syntax	Operation Allowed
testDuration	Integer	monitor
testLUID	Integer	monitor
upLinkEff	Integer	monitor
upLinkRate	Integer	monitor
upLnkAckSlot	Integer	monitor
upLnkAckSlotHi	Integer	monitor
whispGPSStats	Integer	monitor
NOTES: 1. You can set to 1 to initiate a link test, but not 0 to stop. The value 0 is only an indication of the idle link test state.		

24.4.3 SM and BH Timing Slave Objects

The objects that the Cyclone Enterprise MIB defines for each SM and BH Timing Slave are listed in Table 60.

Table 60: Cyclone Enterprise MIB objects for SMs and BH timing slaves

SM, BHS Object Name	Value Syntax	Operation Allowed
allOtherIPFilter	Integer	manage
allOthersFilter	Integer	manage
allowedIPAccess1	IpAddress	manage
allowedIPAccess2	IpAddress	manage
allowedIPAccess3	IpAddress	manage
alternateDNSIP	IpAddress	manage
arpCacheTimeout	Integer	manage
arpFilter	Integer	manage
authKey	DisplayString	manage
authKeyOption	Integer	manage
bootpcFilter	Integer	manage
bootpsFilter	Integer	manage
defaultGw	IpAddress	manage
dhcpClientEnable	Integer	manage
dhcpIPStart	IpAddress	manage
dhcpNumIPsToLease	Integer	manage
dhcpServerEnable	Integer	manage
dhcpServerLeaseTime	Integer	manage

SM, BHS Object Name	Value Syntax	Operation Allowed
dmzEnable	Integer	manage
dmzIP	IpAddress	manage
dnsAutomatic	Integer	manage
enable8023link	Integer	manage
ethAccessFilterEnable	Integer	manage
hiPriorityChannel	Integer	manage
hiPriorityDownlinkCIR	Integer	manage
hiPriorityUplinkCIR	Integer	manage
ingressVID	Integer	manage
ip4MultFilter	Integer	manage
ipAccessFilterEnable	Integer	manage
lanIp	IpAddress	manage
lanMask	IpAddress	manage
localIP	IpAddress	manage
lowPriorityDownlinkCIR	Integer	manage
lowPriorityUplinkCIR	Integer	manage
naptEnable	Integer	manage
naptPrivateIP	IpAddress	manage
naptPrivateSubnetMask	IpAddress	manage
naptPublicGatewayIP	IpAddress	manage
naptPublicIP	IpAddress	manage
naptPublicSubnetMask	IpAddress	manage
naptRFPublicGateway	IpAddress	manage
naptRFPublicIP	IpAddress	manage
naptRFPublicSubnetMask	IpAddress	manage
networkAccess	Integer	manage
port	Integer	manage
port1TCPFilter	Integer	manage
port2TCPFilter	Integer	manage
port3TCPFilter	Integer	manage
port1UDPFilter	Integer	manage
port2UDPFilter	Integer	manage
port3UDPFilter	Integer	manage
powerUpMode	Integer	manage

SM, BHS Object Name	Value Syntax	Operation Allowed
pppoeFilter	Integer	manage
prefferedDNSIP	IpAddress	manage
protocol	Integer	manage
radioDbmInt	Integer	manage
rfDhcpState	Integer	manage
rfScanList	DisplayString	manage
smbFilter	Integer	manage
snmpFilter	Integer	manage
tcpGarbageCollectTmout	Integer	manage
timingPulseGated	Integer	manage
twoXRate	Integer	manage
udpGarbageCollectTmout	Integer	manage
uplinkBCastFilter	Integer	manage
userDefinedPort1	Integer	manage
userDefinedPort2	Integer	manage
userDefinedPort3	Integer	manage
userP1Filter	Integer	manage
userP2Filter	Integer	manage
userP3Filter	Integer	manage
adaptRate	DisplayString	monitor
airDelay	Integer	monitor
calibrationStatus	DisplayString	monitor
dhcpcdns1	IpAddress	monitor
dhcpcdns2	IpAddress	monitor
dhcpcdns3	IpAddress	monitor
dhcpCip	IpAddress	monitor
dhcpClientLease	TimeTicks	monitor
dhcpCSMask	IpAddress	monitor
dhcpDfltRterIP	IpAddress	monitor
dhcpDomName	DisplayString	monitor
dhcpServerTable	DhcpServerEntry	monitor
dhcpSip	IpAddress	monitor
hostIp	IpAddress	monitor
hostLease	TimeTicks	monitor

SM, BHS Object Name	Value Syntax	Operation Allowed
hostMacAddress	PhysAddress	monitor
jitter	Integer	monitor
radioDbm	DisplayString	monitor
radioSlicing	Integer	monitor
radioTxGain	Integer	monitor
registeredToAp	DisplayString	monitor
rssi	Integer	monitor
sessionStatus	DisplayString	monitor

24.4.4 CMMmicro Objects

The objects that the Cyclone Enterprise MIB defines for each CMMmicro are listed in Table 61.

Table 61: Cyclone Enterprise MIB objects for CMMmicros

CMMmicro Object Name	Value Syntax	Operation Allowed
clearEventLog	Integer	manage
defaultGateWay	IpAddress	manage
displayOnlyAccess	DisplayString	manage
fullAccess	DisplayString	manage
gpsTimingPulse	Integer	manage
lan1Ip	IpAddress	manage
lan1SubnetMask	IpAddress	manage
port1Config	Integer	manage
port1Description	DisplayString	manage
port1PowerCtr	Integer	manage
port2Config	Integer	manage
port2Description	DisplayString	manage
port2PowerCtr	Integer	manage
port3Config	Integer	manage
port3Description	DisplayString	manage
port3PowerCtr	Integer	manage
port4Config	Integer	manage
port4Description	DisplayString	manage
port4PowerCtr	Integer	manage

CMMmicro Object Name	Value Syntax	Operation Allowed
port5Config	Integer	manage
port5Description	DisplayString	manage
port5PowerCtr	Integer	manage
port6Config	Integer	manage
port6Description	DisplayString	manage
port6PowerCtr	Integer	manage
port7Config	Integer	manage
port7Description	DisplayString	manage
port7PowerCtr	Integer	manage
port8Config	Integer	manage
port8Description	DisplayString	manage
port8PowerCtr	Integer	manage
reboot	Integer	manage
webAutoUpdate	Integer	manage
deviceType	DisplayString	monitor
displayOnlyStatus	DisplayString	monitor
duplexStatus	Integer	monitor
eventLog	EventString	monitor
fullAccessStatus	DisplayString	monitor
gpsAntennaConnection	DisplayString	monitor
gpsDate	DisplayString	monitor
gpsHeight	DisplayString	monitor
gpsInvalidMsg	DisplayString	monitor
gpsLatitude	DisplayString	monitor
gpsLongitude	DisplayString	monitor
gpsReceiverInfo	DisplayString	monitor
gpsRestartCount	Integer	monitor
gpsSatellitesTracked	DisplayString	monitor
gpsSatellitesVisible	DisplayString	monitor
gpsTime	DisplayString	monitor
gpsTrackingMode	DisplayString	monitor
height	DisplayString	monitor
latitude	DisplayString	monitor
linkSpeed	Integer	monitor

CMMmicro Object Name	Value Syntax	Operation Allowed
linkStatus	Integer	monitor
longitude	DisplayString	monitor
macAddress	DisplayString	monitor
pkts1024to1522Octets	Counter32	monitor
pkts128to255Octets	Counter32	monitor
pkts256to511Octets	Counter32	monitor
pkts512to1023Octets	Counter32	monitor
pkts64Octets	Counter32	monitor
pkts65to127Octets	Counter32	monitor
pldVersion	DisplayString	monitor
portIndex	Integer	monitor
portNumber	Integer	monitor
powerStatus	Integer	monitor
rxAlignmentErrors	Counter32	monitor
rxBroadcastPkts	Counter32	monitor
rxDropPkts	Counter32	monitor
rxExcessSizeDisc	Counter32	monitor
rxFCSErrors	Counter32	monitor
rxFragments	Counter32	monitor
rxGoodOctets	Counter64	monitor
rxJabbers	Counter32	monitor
rxMulticastPkts	Counter32	monitor
rxOctets	Counter64	monitor
rxOversizePkts	Counter32	monitor
rxPausePkts	Counter32	monitor
rxSAChanges	Counter32	monitor
rxSymbolErrors	Counter32	monitor
rxUndersizePkts	Counter32	monitor
rxUnicastPkts	Counter32	monitor
satellitesTracked	DisplayString	monitor
satellitesVisible	DisplayString	monitor
softwareVersion	DisplayString	monitor
syncStatus	DisplayString	monitor
systemTime	DisplayString	monitor

CMMmicro Object Name	Value Syntax	Operation Allowed
trackingMode	DisplayString	monitor
txBroadcastPkts	Counter32	monitor
txCollisions	Counter32	monitor
txDeferredTransmit	Counter32	monitor
txDropPkts	Counter32	monitor
txExcessiveCollision	Counter32	monitor
txFrameInDisc	Counter32	monitor
txLateCollision	Counter32	monitor
txMulticastPkts	Counter32	monitor
txMultipleCollision	Counter32	monitor
txOctets	Counter64	monitor
txPausePkts	Counter32	monitor
txSingleCollision	Counter32	monitor
txUnicastPkts	Counter32	monitor
upTime	DisplayString	monitor

24.5 OBJECTS DEFINED IN THE PTP 400 AND PTP 600 SERIES BRIDGES MIB

The objects that the PTP 400 and PTP 600 series bridges' MIB defines are listed in Table 63.

Table 62: PTP 400 and PTP 600 series bridge MIB objects

Object Name	Value Syntax	Operation Allowed
iPAddress	IpAddress	manage
subnetMask	IpAddress	manage
gatewayIPAddress	IpAddress	manage
targetMACAddress[1]	DisplayString	manage
masterSlaveMode	Integer	manage
maximumTransmitPower	Integer	manage
receivePower[2]	Integer	manage
vectorError[2]	Integer	manage
transmitPower[2]	Integer	manage
range	Integer	manage
linkLoss[2]	Integer	manage

Object Name	Value Syntax	Operation Allowed
receiveChannel	Integer	manage
transmitChannel	Integer	manage
receiveModulationMode	Integer	manage
transmitModulationMode	Integer	manage
receiveSnr[2]	Integer	manage
systemReset	Integer	monitor
softwareVersion	DisplayString	monitor
hardwareVersion	DisplayString	monitor

NOTES:

1. Of the other BH in the link.
2. *max*, *mean*, *min*, *last* during the past hour.

24.6 OBJECTS SUPPORTED IN THE CYCLONE 30/60-Mbps BH

The 30/60-Mbps BH supports the following MIBs:

- MIB II, RFC 1213, System Group
- MIB II, RFC 1213, Interfaces Group
- WiMAX 802.16 WMAN-IF-MIB
- Bridge MIB, RFC 1493, dot1dBaseGroup
- Bridge MIB, RFC 1493, dot1dBasePortTableGroup
- 30/60-Mbps Backhaul Cyclone proprietary MIB

24.7 OBJECTS SUPPORTED IN THE CYCLONE 150/300-Mbps BH

The 150/300-Mbps BH supports the following MIBs:

- MIB II, RFC 1213, System Group
- MIB II, RFC 1213, Interfaces Group
- WiMAX 802.16 WMAN-IF-MIB
- Bridge MIB, RFC 1493, dot1dBaseGroup
- Bridge MIB, RFC 1493, dot1dBasePortTableGroup
- High-capacity counter MIB, RFC 2233
- 150/300-Mbps Backhaul Cyclone proprietary MIB

24.8 INTERFACE DESIGNATIONS IN SNMP

SNMP identifies the ports of the module as follows:

- Interface 1 represents the Ethernet interface of the module. To monitor the status of Interface 1 is to monitor the traffic on the Ethernet interface.

- Interface 2 represents the RF interface of the module. To monitor the status of Interface 2 is to monitor the traffic on the RF interface.

These interfaces can be viewed on the NMS through definitions that are provided in the standard MIB files.

24.9 TRAPS PROVIDED IN THE CYCLONE ENTERPRISE MIB

Cyclone modules provide the following SNMP traps for automatic notifications to the NMS:

- whispGPSInSync, which signals a transition from not synchronized to synchronized.
- whispGPSOutSync, which signals a transition from synchronized to not synchronized.
- whispRegComplete, which signals registration completed.
- whispRegLost, which signals registration lost.
- whispRadarDetected, which signals that the one-minute scan has been completed, radar has been detected, and the radio will shutdown.
- whispRadarEnd, which signals that the one-minute scan has been completed, radar *has not* been detected, and the radio will resume normal operation.

NOTE:
The PTP 400 and PTP 600 series bridges do not support the traps listed above.

24.10 TRAPS PROVIDED IN THE PTP 400 SERIES BRIDGE MIB

PTP 400 series bridges (previously known as 30/60-Mbps Backhauls) provide the following SNMP traps for automatic notifications to the NMS:

- coldStart
- linkUp
- linkDown
- dfsChannelChange, which signals that the channel has changed.
- dfsImpulsiveInterferenceDetected, which signals that impulsive interference has been detected.

24.11 TRAPS PROVIDED IN THE PTP 600 SERIES BRIDGE MIB

PTP 600 series bridges (previously known as 150/300-Mbps Backhauls) provide the following SNMP traps for automatic notifications to the NMS:

- coldStart
- linkUp
- linkDown

- dfsChannelChange, which signals that the channel has changed.
- dfsImpulsiveInterferenceDetected, which signals that impulsive interference has been detected.

24.12 MIB VIEWERS

Any of several commercially available MIB viewers can facilitate management of these objects through SNMP. Some are available as open source software. The Cyclone division does not endorse, support, or discourage the use of any these viewers.

To assist end users in this area, Cyclone offers a starter guide for one of these viewers—MRTG (Multi Router Traffic Grapher). This starter guide is titled *Cyclone Network Management with MRTG: Application Note*, and is available in the Document Library section under Support at http://www.Last Mile Gear.com/Cyclone. MRTG software is available at http://mrtg.hdl.com/mrtg.html.

Other MIB viewers are available and/or described at the following web sites:

http://ns3.ndgsoftware.com/Products/NetBoy30/mibbrowser.html

http://www.adventnet.com/products/snmputilities/

http://www.dart.com/samples/mib.asp

http://www.edge-technologies.com/webFiles/products/nvision/index.cfm

http://www.ipswitch.com/products/whatsup/monitoring.html

http://www.koshna.com/products/KMB/index.asp

http://www.mg-soft.si/mgMibBrowserPE.html

http://www.mibexplorer.com

http://www.netmechanica.com/mibbrowser.html

http://www.networkview.com

http://www.newfreeware.com/search.php3?q=MIB+browser

http://www.nudesignteam.com/walker.html

http://www.oidview.com/oidview.html

http://www.solarwinds.net/Tools

http://www.stargus.com/solutions/xray.html

http://www.totilities.com/Products/MibSurfer/MibSurfer.htm

25 USING THE CYCLONE NETWORK UPDATER TOOL (CNUT)

The Cyclone Network Updater Tool manages and automates the software and firmware upgrade process for Cyclone radio and CMMmicro modules across the network. This eliminates the need for an administrator to visit each radio in the network (or each AP while using the Autoupdate feature) to upgrade the modules.

25.1 CNUT FUNCTIONS

The Cyclone Network Updater Tool

- automatically discovers all Cyclone network elements
- executes a UDP command that initiates and terminates the Autoupdate mode within APs. This command is both secure and convenient:
  - For security, the AP accepts this command from only the IP address that you specify in the Configuration page of the AP.
  - For convenience, Network Updater automatically sets this Configuration parameter in the APs to the IP address of the Network Updater server when the server performs any of the update commands.
- allows you to choose 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.
  - Cyclone supplies.

25.2 NETWORK ELEMENT GROUPS

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

- organizes the display of elements (for example, by region or by AP cluster).
- allows you to
  - perform an operation on all elements in the group simultaneously.
  - set group-level defaults for telnet or ftp password access and SNMP Community String (defaults that can be overridden in an individual element when necessary).

25.3 NETWORK LAYERS

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

IMPORTANT!
Correct layer information ensures that Network Updater does not command an AP that is behind another AP/SM pair (such as in a remote AP installation) to perform an upgrade at the same time as the SM that is feeding the AP. If this occurs, then the remote AP loses network connection during the upgrade (when the SM in front of the AP completes its upgrade and reboots).

25.4 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 Cyclone 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:

- AP Data Import from BAM
- AP Data Export to BAM
- Set Autoupdate Address on APs
- Set SNMP Accessibility
- Reset Unit

25.5 SOFTWARE DEPENDENCIES FOR CNUT

CNUT functionality requires

- one of the following operating systems
  - Windows® 2000
  - Windows XP
  - Red Hat Linux 9
  - Red Hat Enterprise Linux Version 3
- Java™ Runtime Version 1.4.2 or later
- Perl 5.8.0 or ActivePerl 5.8.3 software or later

25.6 CNUT DOWNLOAD

CNUT can be downloaded together with each Cyclone system release that supports CNUT. Software for these Cyclone system releases is packaged on the Cyclone Support web page as either

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

26 USING INFORMATIONAL TABS IN THE GUI

26.1 VIEWING GENERAL STATUS (ALL)

See

- General Status Tab of the AP on Page 202.
- General Status Tab of the SM on Page 198.
- General Status Tab of the BHM on Page 214.
- Beginning the Test of Point-to-Point Links on Page 211.

26.2 VIEWING SESSION STATUS (AP, BHM)

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

An example of the Session Status tab is displayed in Figure 142.

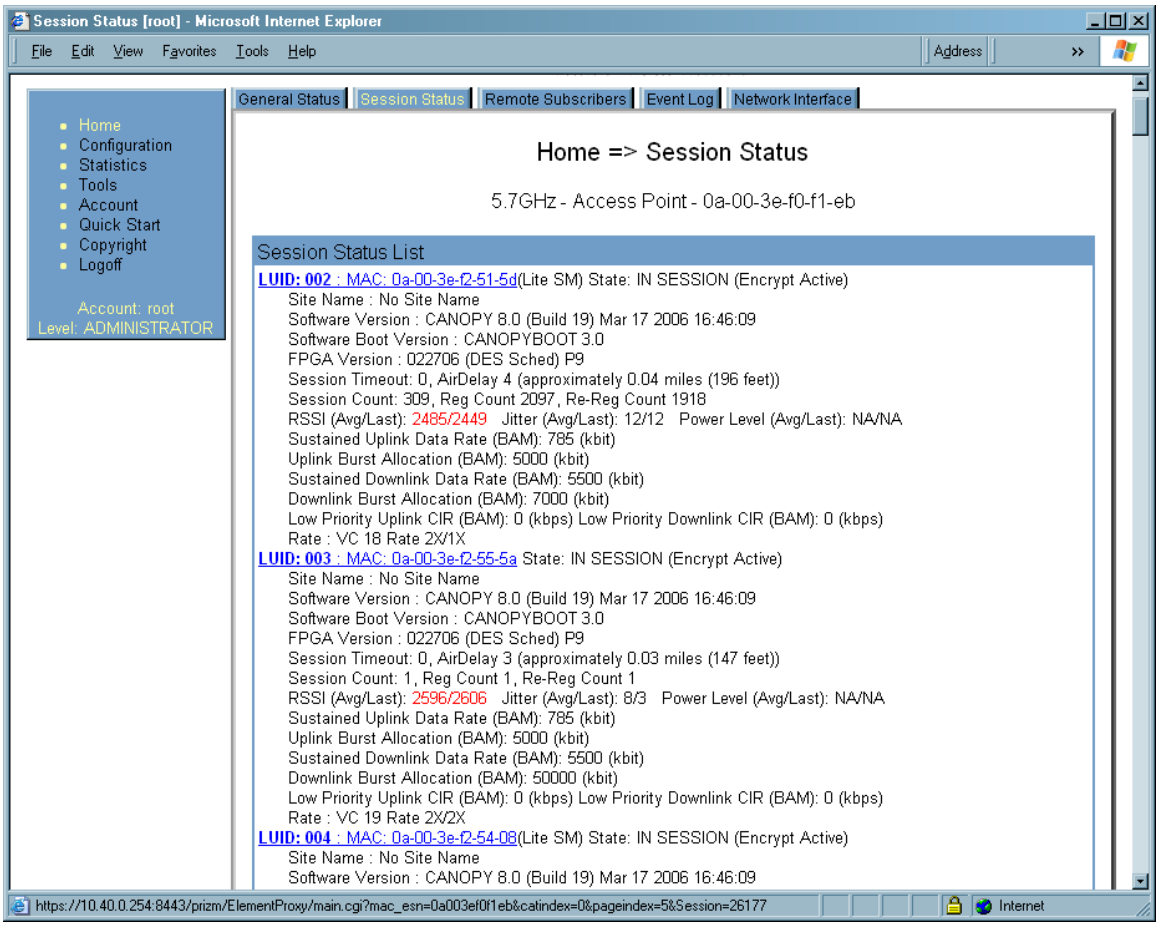


Figure 142: Session Status tab data, example

An additional example and explanations of the fields on this tab are provided in Session Status Tab of the AP on Page 193.

26.3 VIEWING REMOTE SUBSCRIBERS (AP, BHM)

See

- Remote Subscribers Tab of the AP on Page 197.
- Continuing the Test of Point-to-Point Links on Page 213.

26.4 INTERPRETING MESSAGES IN THE EVENT LOG (ALL)

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

26.4.1 Time and Date Stamp

The time and date stamp reflect either

- GPS time and date directly or indirectly received from the CMM.
- the running time and date that you have set in the Time & Date web page.

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

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

26.4.2 Event Log Data Collection

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

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

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

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

An example portion of Event Log data is displayed in Figure 143. In this figure (unlike in the Event Log web page)

- lines are alternately highlighted to show the varying length of wrapped lines.
- the types of event messages (which follow the time and date stamps and the file and line references) are underscored as quoted in Table 63 and Table 64.

Figure 143: Event Log tab data, example

26.4.3 Messages that Flag Abnormal Events

The messages listed in Table 63 flag abnormal events and, case by case, may signal the need for corrective action or technical support. See Troubleshooting on Page 469.

Table 63: Event Log messages for abnormal events

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

26.4.4 Messages that Flag Normal Events

The messages listed in Table 64 record normal events and typically *do not* signal a need for any corrective action or technical support.

Table 64: Event Log messages for normal events

Event Message	Meaning
Acquired GPS Sync Pulse.	Module has acquired GPS sync signal.
FPGA Features	Type of encryption.
FPGA Version	FPGA (JBC) version in the module.
GPS Date/Time Set	Module is now on GPS time.
PowerOn reset from Telnet command line	Reset command was issued from a `telnet` session.
Reboot from Webpage	Module was rebooted from management interface.
Software Boot Version	Boot version in the module.
Software Version	Cyclone release version and authentication method for the unit.
System Log Cleared	Event log was manually cleared.

26.5 VIEWING THE NETWORK INTERFACE TAB (ALL)

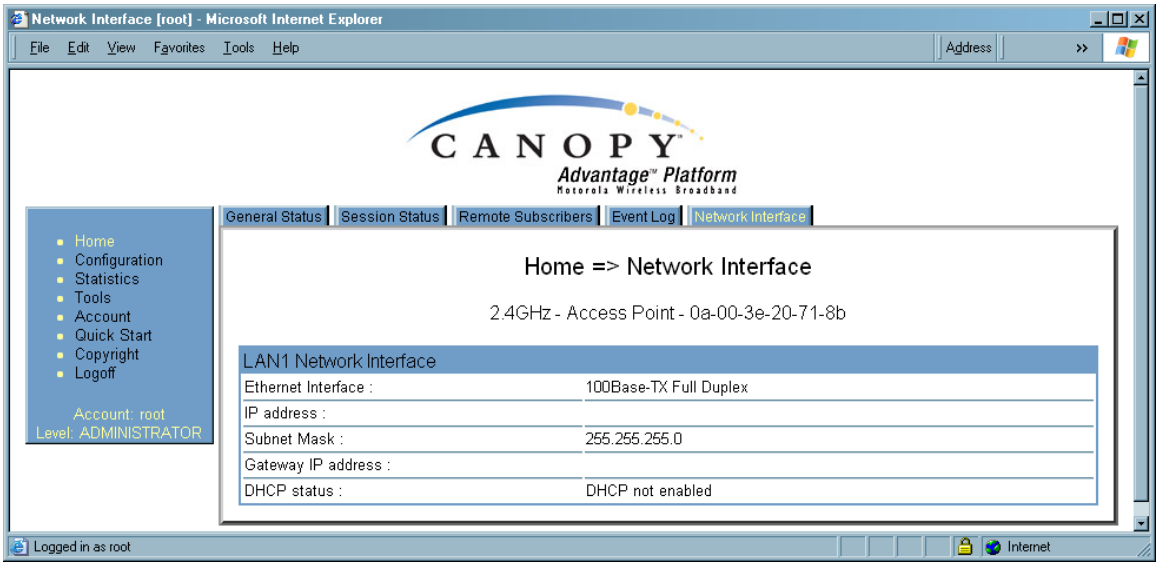


Figure 144: Network Interface tab of AP, example

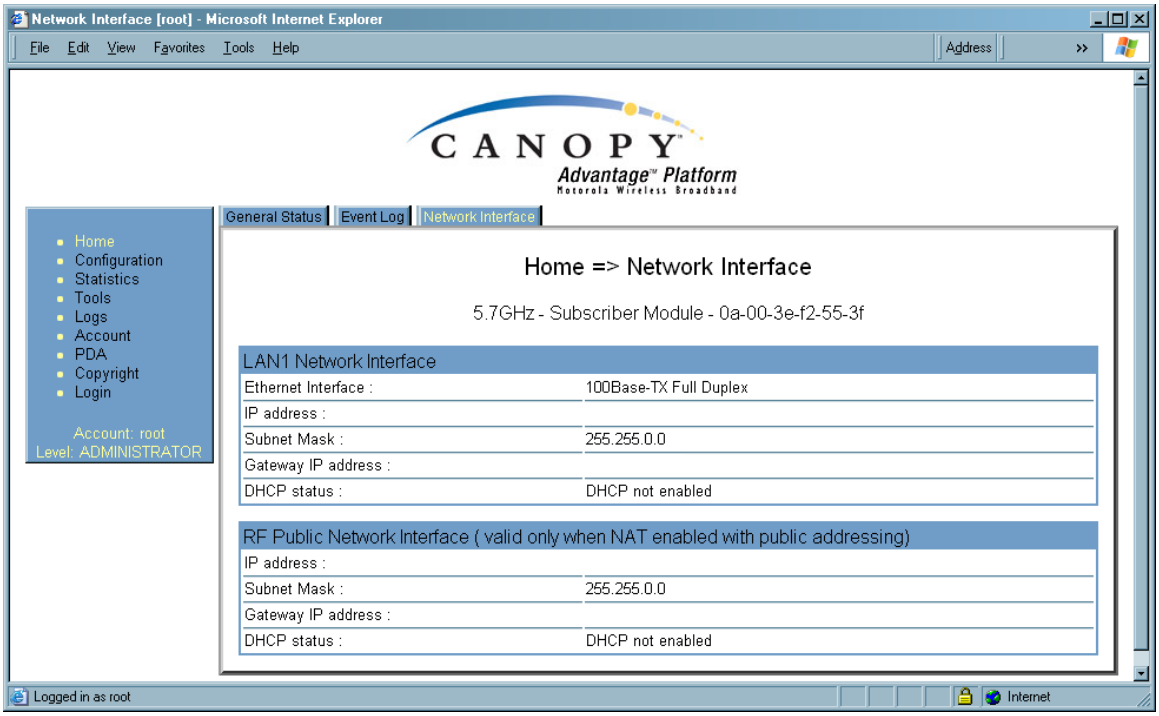
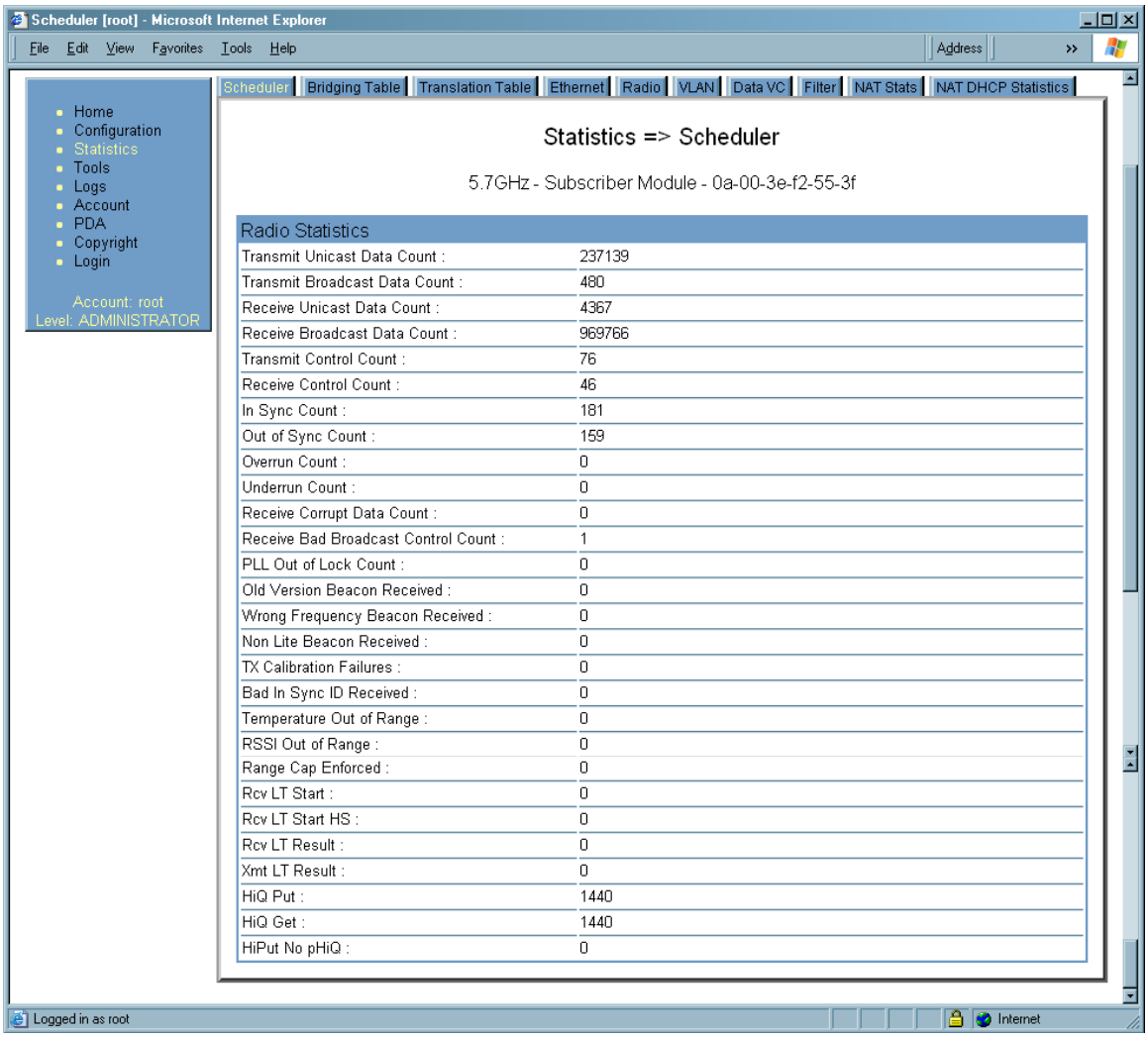


Figure 145: Network Interface tab of SM, example

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

26.6 INTERPRETING RADIO STATISTICS IN THE SCHEDULER TAB (ALL)



Radio Statistics	
Transmit Unicast Data Count :	237139
Transmit Broadcast Data Count :	480
Receive Unicast Data Count :	4367
Receive Broadcast Data Count :	969766
Transmit Control Count :	76
Receive Control Count :	46
In Sync Count :	181
Out of Sync Count :	159
Overrun Count :	0
Underrun Count :	0
Receive Corrupt Data Count :	0
Receive Bad Broadcast Control Count :	1
PLL Out of Lock Count :	0
Old Version Beacon Received :	0
Wrong Frequency Beacon Received :	0
Non Lite Beacon Received :	0
TX Calibration Failures :	0
Bad In Sync ID Received :	0
Temperature Out of Range :	0
RSSI Out of Range :	0
Range Cap Enforced :	0
Rcv LT Start :	0
Rcv LT Start HS :	0
Rcv LT Result :	0
Xmt LT Result :	0
HiQ Put :	1440
HiQ Get :	1440
HiPut No pHiQ :	0

Figure 146: Scheduler tab of SM, example

Statistics for the Scheduler are displayed as shown in Figure 146.

26.7 VIEWING THE LIST OF REGISTRATION FAILURES (AP, BHM)

An example of the SM Registration Failures tab is displayed in Figure 147.

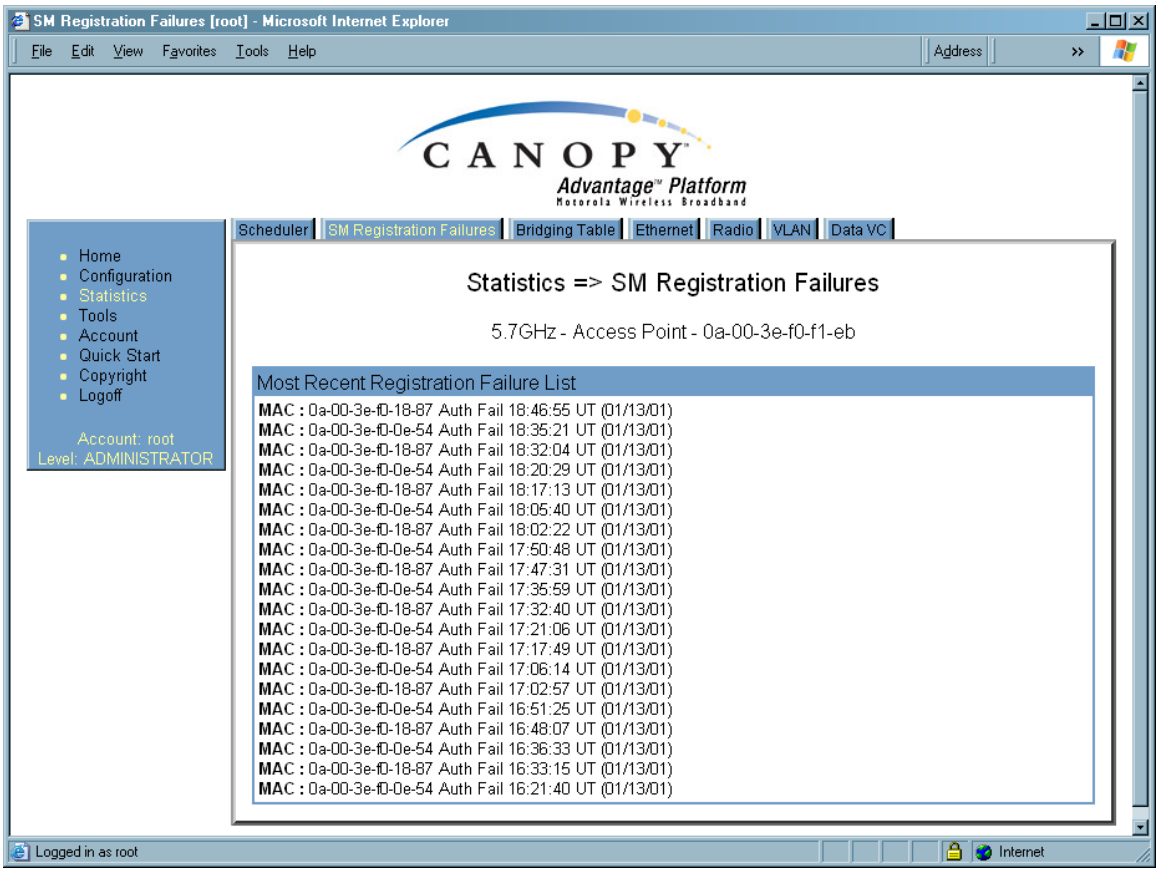


Figure 147: SM Registration Failures tab of AP, example

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

26.8 INTERPRETING DATA IN THE BRIDGING TABLE (ALL)

An example of the Bridging Table tab is displayed in Figure 148.

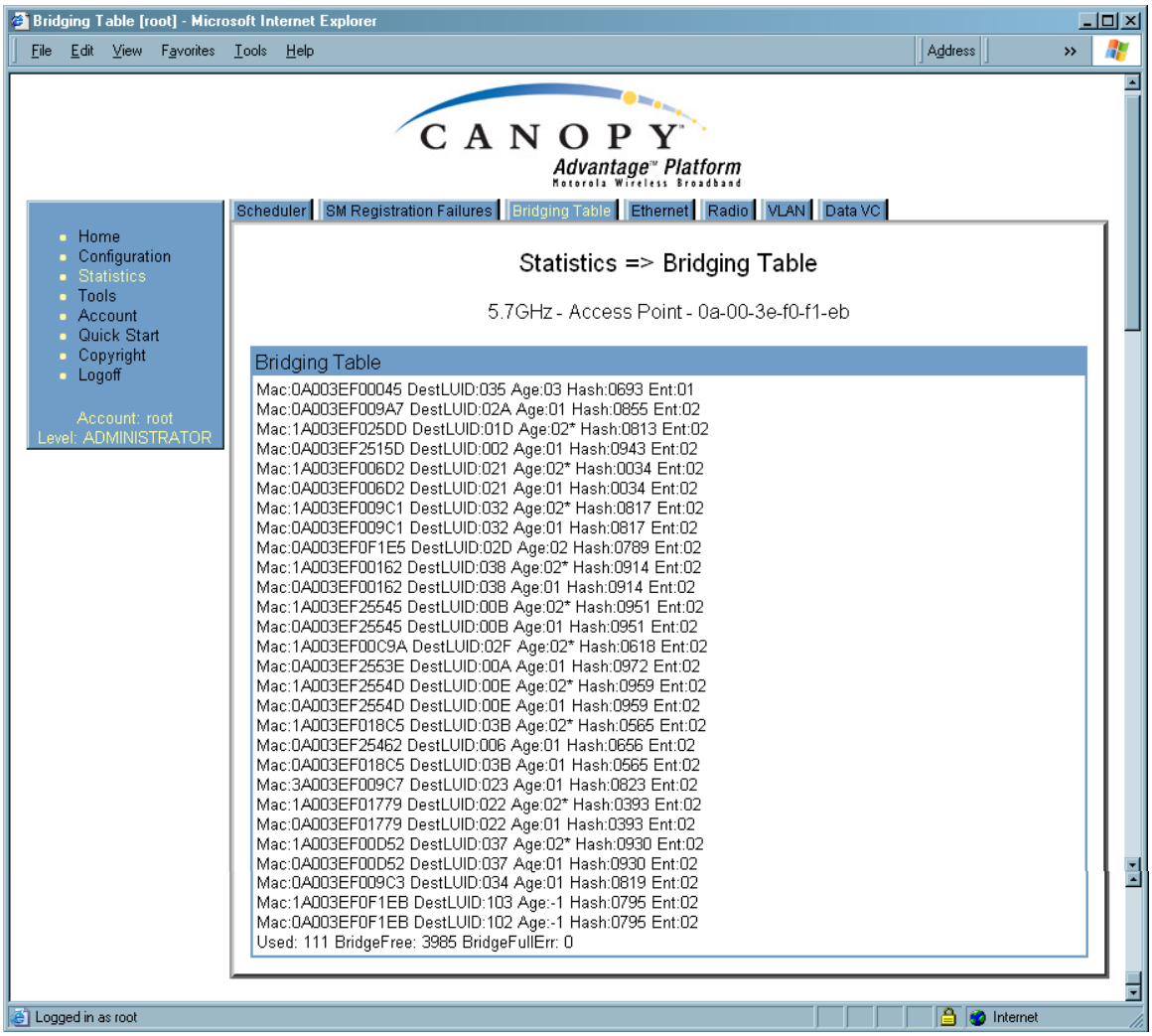


Figure 148: Bridging Table tab of AP, example

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

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

26.9 TRANSLATION TABLE (SM)

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

An example of the Translaton Table is displayed in Figure 149.

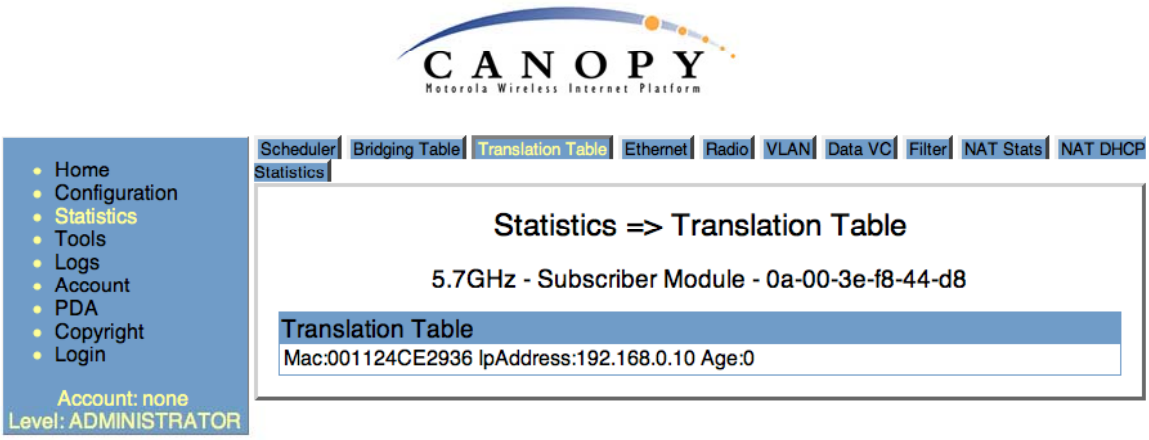


Figure 149: Translation Table tab of SM, example

26.10 INTERPRETING DATA IN THE ETHERNET TAB (ALL)

The Ethernet tab of the Statistics web page reports TCP throughput and error information for the Ethernet connection of the module.

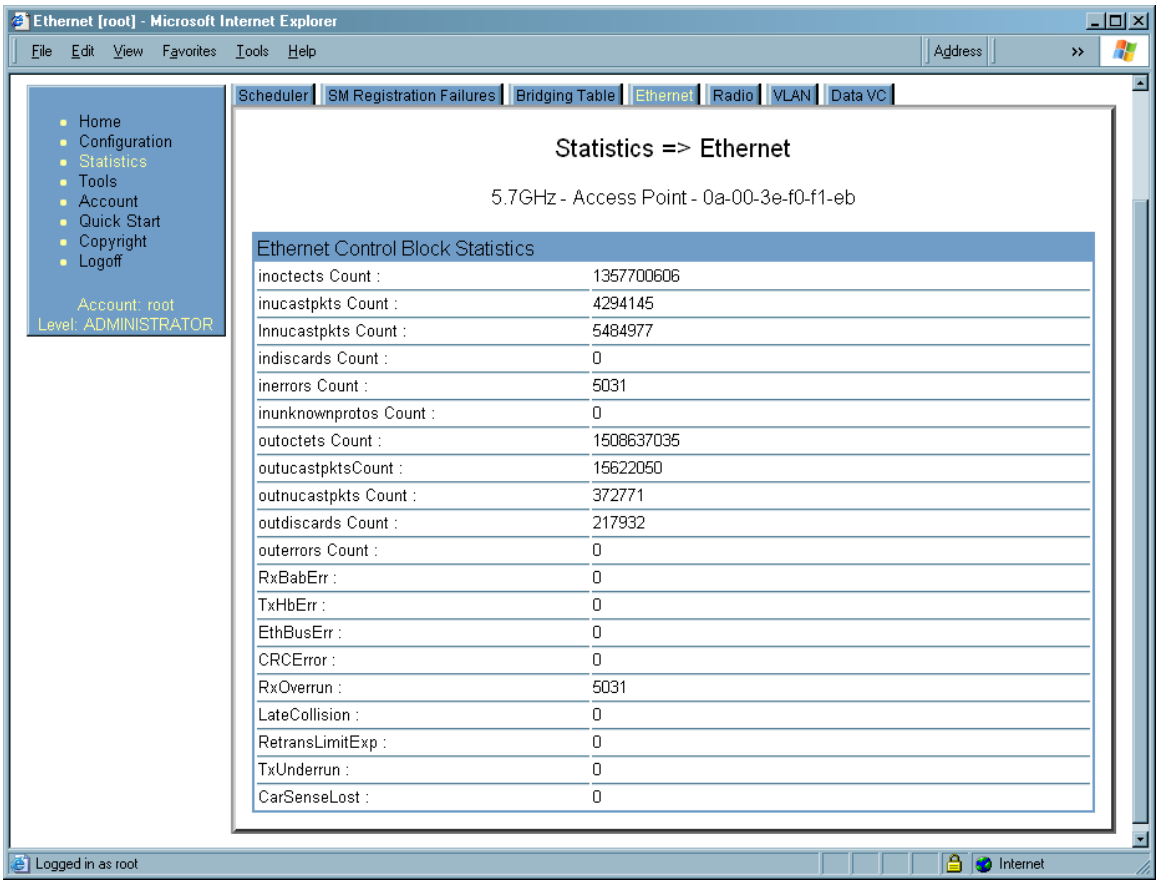


Figure 150: Ethernet tab of AP, example

The Ethernet tab displays the following fields.

inoctets Count

This field displays how many octets were received on the interface, including those that deliver framing information.

inucastpkts Count

This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.

Innucastpkts Count

This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.

indiscards Count

This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)

inerrors Count

This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.

inunknownprotos Count

This field displays how many inbound packets were discarded because of an unknown or unsupported protocol.

outoctets Count

This field displays how many octets were transmitted out of the interface, including those that deliver framing information.

outucastpkts Count

This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.

outnucastpkts Count

This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.

outdiscards Count

This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)

outerrrors Count

This field displays how many outbound packets contained errors that prevented their transmission.

RxBabErr

This field displays how many receiver babble errors occurred.

EthBusErr

This field displays how many Ethernet bus errors occurred on the Ethernet controller.

CRCError

This field displays how many CRC errors occurred on the Ethernet controller.

RxOverrun

This field displays how many receiver overrun errors occurred on the Ethernet controller.

Late Collision

This field displays how many late collisions occurred on the Ethernet controller. A normal collision occurs during the first 512 bits of the frame transmission. A collision that occurs after the first 512 bits is considered a late collision.

IMPORTANT!

A late collision is a serious network problem because the frame being transmitted is discarded. A late collision is most commonly caused by a mismatch between duplex configurations at the ends of a link segment.

RetransLimitExp

This field displays how many times the retransmit limit has expired.

TxUnderrun

This field displays how many transmission-underrun errors occurred on the Ethernet controller.

CarSenseLost

This field displays how many carrier sense lost errors occurred on the Ethernet controller.

26.11 INTERPRETING RF CONTROL BLOCK STATISTICS IN THE RADIO TAB (ALL)

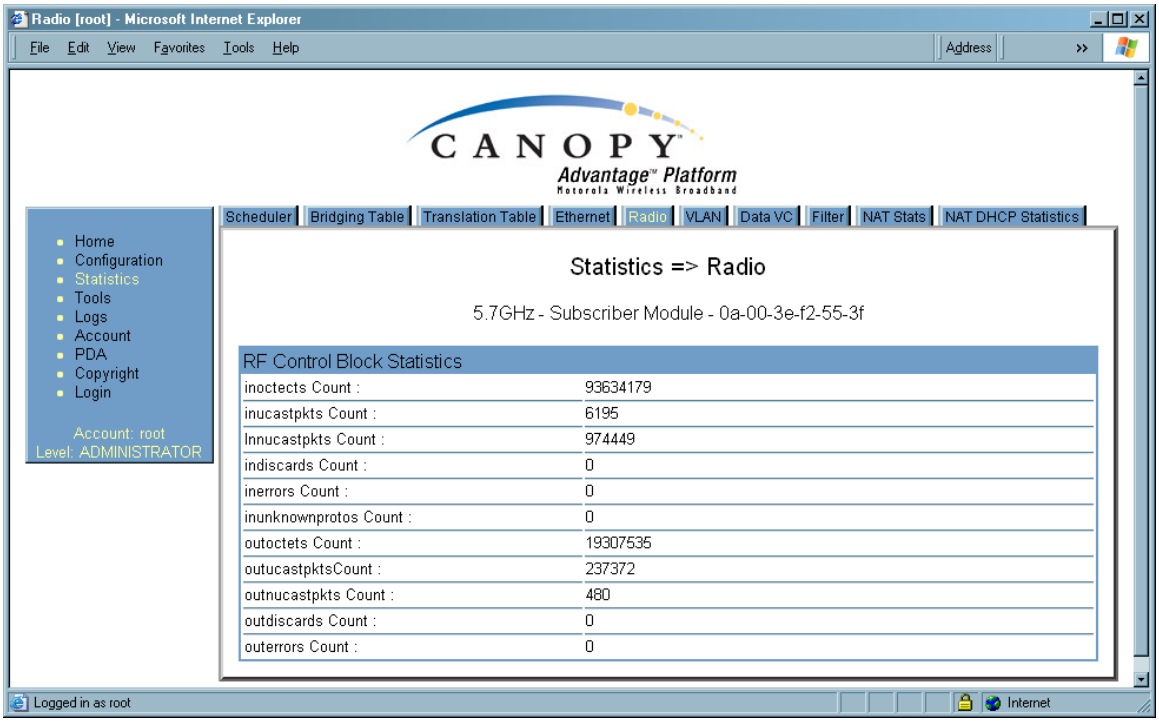


Figure 151: Radio tab of Statistics page in SM, example

The Radio tab of the Statistics page displays the following fields.

inoctets Count

This field displays how many octets were received on the interface, including those that deliver framing information.

inucastpkts Count

This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.

Innucastpkts Count

This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.

indiscards Count

This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)

inerrors Count

This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.

inunknownprotos Count

This field displays how many inbound packets were discarded because of an unknown or unsupported protocol.

outoctets Count

This field displays how many octets were transmitted out of the interface, including those that deliver framing information.

outucastpkts Count

This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.

outnucastpkts Count

This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.

outdiscards Count

This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)

outerrrors Count

This field displays how many outbound packets contained errors that prevented their transmission.

26.12 INTERPRETING DATA IN THE VLAN TAB (AP, SM)

The VLAN tab in the Statistics web page provides a list of the most recent packets that were filtered because of VLAN membership violations. An example of the VLAN tab is shown in Figure 152.

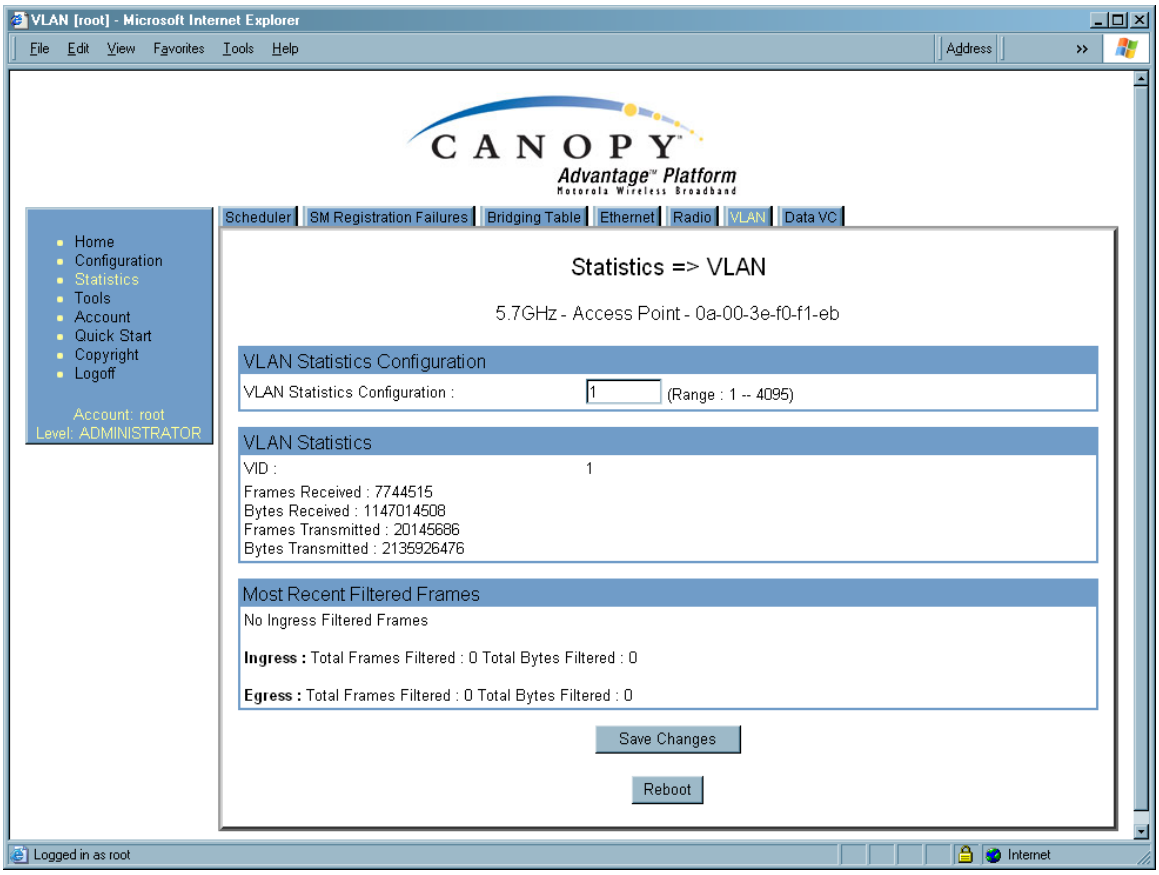


Figure 152: VLAN tab of AP, example

Interpret entries under **Most Recent Filtered Frames** as follows:

- **Unknown**—This should not occur. Contact Cyclone Technical Support.
- **Only Tagged**—The packet was filtered because the configuration is set to accept only packets that have an 802.1Q header, and this packet did not.
- **Ingress**—When the packet entered through the wired Ethernet interface, the packet was filtered because it indicated an incorrect VLAN membership.
- **Local Ingress**—When the packet was received from the local TCP/IP stack, the packet was filtered because it indicated an incorrect VLAN membership. This should not occur. Contact Cyclone Technical Support.
- **Egress**—When the packet attempted to leave through the wired Ethernet interface, the packet was filtered because it indicated an incorrect VLAN membership.
- **Local Egress**—When the packet attempted to reach the local TCP/IP stack, the packet was filtered because it indicated an incorrect VLAN membership.

26.13 DATA VC (ALL)

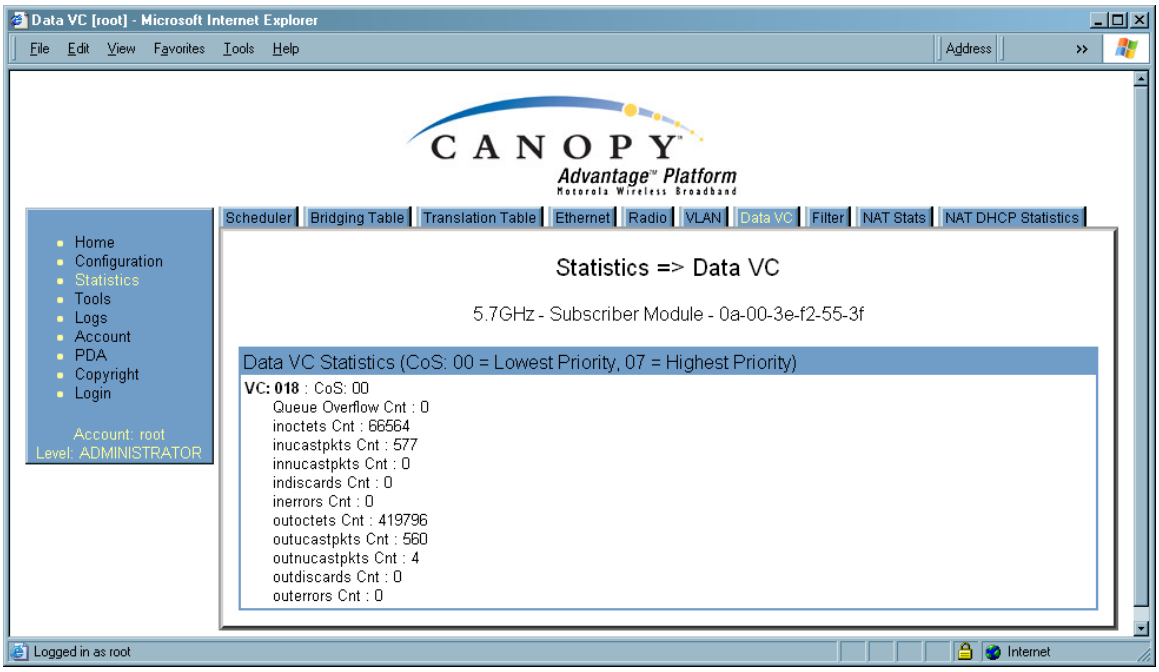


Figure 153: Data VC tab of SM, example

The Data VC tab page displays the following fields.

VC

This field displays the virtual channel number. Low priority channels start at VC18 and count up. High priority channels start at VC255 and count down. If one VC is displayed, the high-priority channel is disabled. If two are displayed, the high-priority channel is enabled

CoS

This field displays the Class of Service for the virtual channel. The low priority channel is a CoS of 00, and the high priority channel is a CoS of 01. CoS of 02 through 07 are not currently used.

Queue Overflow Cnt

This is a count of packets that were discarded because the queue for the VC was already full.

inoctets Cnt

This field displays how many octets were received on the interface, including those that deliver framing information.

inucastpkts Cnt

This field displays how many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.

Innucastpkts Cnt

This field displays how many inbound non-unicast (subnetwork-broadcast or subnetwork-multicast) packets were delivered to a higher-layer protocol.

indiscards Cnt

This field displays how many inbound packets were discarded without errors that would have prevented their delivery to a higher-layer protocol. (Some of these packets may have been discarded to increase buffer space.)

inerrors Cnt

This field displays how many inbound packets contained errors that prevented their delivery to a higher-layer protocol.

outoctets Cnt

This field displays how many octets were transmitted out of the interface, including those that deliver framing information.

outucastpkts Cnt

This field displays how many packets for which the higher-level protocols requested transmission to a subnetwork-unicast address. The number includes those that were discarded or not sent.

outnucastpkts Cnt

This field displays how many packets for which the higher-level protocols requested transmission to a non-unicast (subnetwork-broadcast or subnetwork-multicast) address. The number includes those that were discarded or not sent.

outdiscards Cnt

This field displays how many outbound packets were discarded without errors that would have prevented their transmission. (Some of these packets may have been discarded to increase buffer space.)

outerrrors Cnt

This field displays how many outbound packets contained errors that prevented their transmission.

26.14 FILTER (SM)

The Filter tab displays statistics on packets that have been filtered (dropped) due to the filters set on the SM's Protocol Filtering tab. An example of the Filter tab is shown in Figure 154.

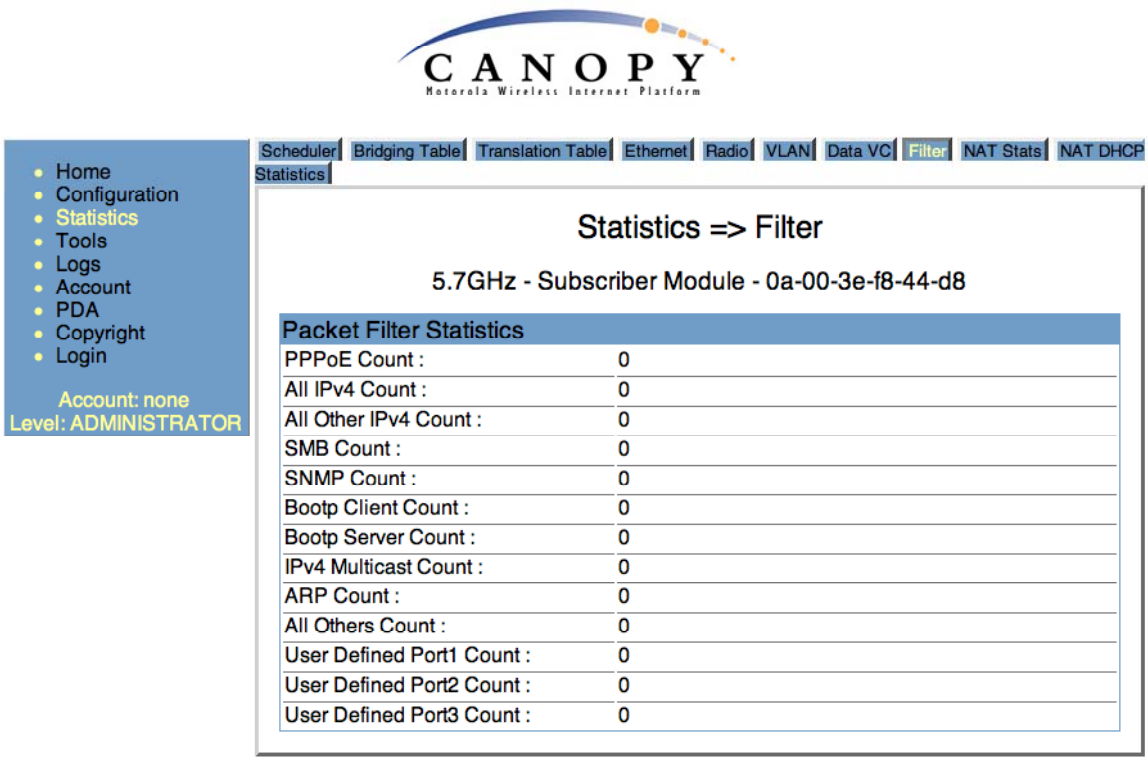


Figure 154: Filter tab on SM, example

26.15 NAT STATS (SM)

When NAT is enabled on an SM, statistics are kept on the Public and Private (WAN and LAN) sides of the NAT, and displayed on the NAT Stats tab. An example of the NAT Stats tab is shown in Figure 155.

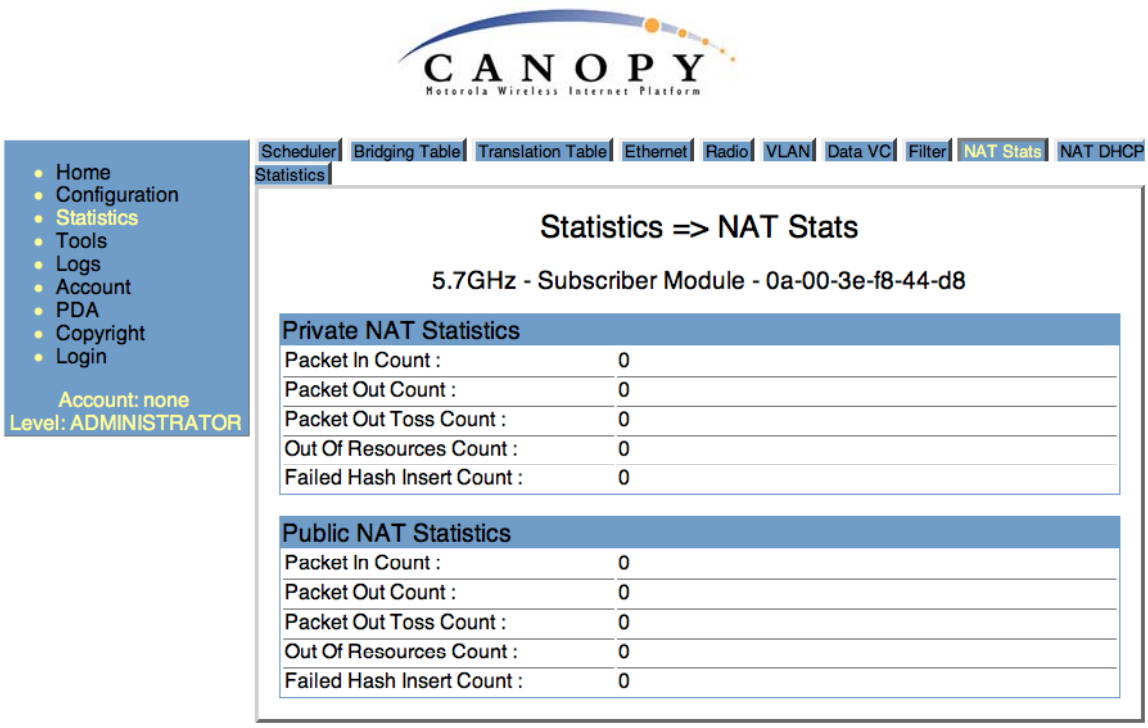


Figure 155: Nat Stats tab on SM, example

26.15.1 NAT DHCP Statistics (SM)

When NAT is enable on an SM with DHCP client and/or Server, statistics are kept for packets transmitted, received, and tossed, as well as a table of lease information for the DHCP server (Assigned IP Address, Hardware Address, and Lease Remained/State). An example of the NAT DHCP Statistics tab is shown in Figure 156.

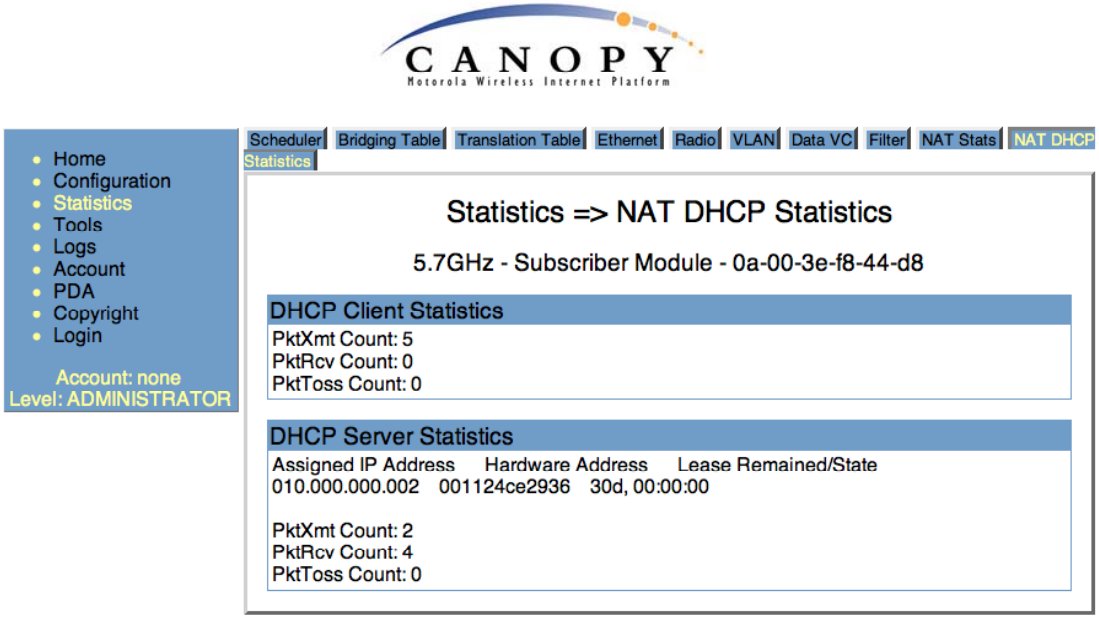


Figure 156: NAT DHCP Statistics tab in SM, example

26.15.2 Interpreting Data in the GPS Status Page (AP, BHM)

The GPS Status tab is only displayed when the Sync Input is set to Sync to Received Signal (Timing Port), which is the configuration desired when connecting an AP or BHM to a CMM2. See Sync Input on Page 239.

The page displays information similar to that available on the web pages of a CMM3, including Pulse Status, GPS Time and Date, Satellites Tracked, Available Satellites, Height, Lattitude and Longitude. This page also displays the state of the antenna in the **Antenna Connection** field as

- Unknown—Shown for early CMM2s.
- OK—Shown for later CMM2s where no problem is detected in the signal.
- Overcurrent—Indicates a coax cable or connector problem.
- Undercurrent—Indicates a coax cable or connector problem.

IMPORTANT!
If **Unknown** is displayed where a later CMM2 is deployed, then the connection is not working but the reason is unknown.

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

27 USING TOOLS IN THE GUI

27.1 USING THE SPECTRUM ANALYZER TOOL (SM, BHS)

See Monitoring the RF Environment on Page 369.

27.2 USING THE ALIGNMENT TOOL (SM, BHS)

An example of the Alignment tab in an SM or BHS is displayed in Figure 157.

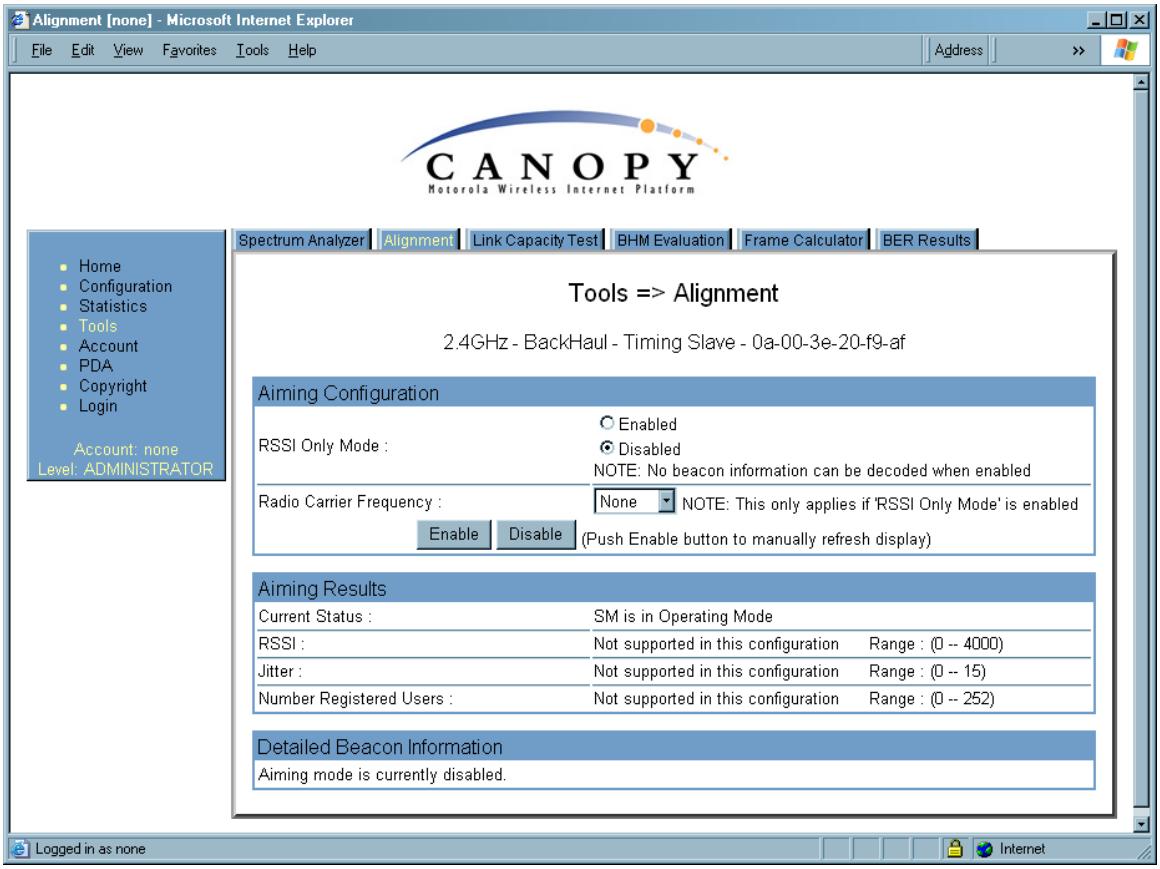


Figure 157: Alignment tab of BHS, example

Proper alignment must achieve all of the following indications for an acceptable link between the modules:

- RSSI typically at least 10 dBM above receiver sensitivity
- jitter value between 0 and 4
- uplink and downlink efficiency greater than 90%, except as described under Comparing Efficiency in 1X Operation to Efficiency in 2X Operation on Page 135.

IMPORTANT!
If any of these values is not achieved, a link can be established but will manifest occasional problems.

In the Alignment tab, you may set the following parameters.

RSSI Only Mode

In the RSSI Only Mode, the screen displays the signal strength based on the amount of energy in the selected frequency, regardless of whether the module has registered. This mode simplifies the aiming process for long links. To invoke the RSSI Only Mode, select **Enabled**.

Radio Carrier Frequency

If you enabled the RSSI Only Mode, select the frequency (in MHz) for the aiming operation.

The Alignment tab also provides the following buttons.

Enable

A click of this button launches the slave device into alignment mode. Each further click refreshes the data in the tab to display the latest measurements collected.

Disable

A click of this button changes the slave device from alignment mode back to operating mode.

The Alignment tab also provides the following read-only fields.

Current Status

This field indicates either `SM is in Alignment Mode` or `SM is in Operating Mode`. This syntax is used in an SM and in a BHS.

RSSI

This field displays the Radio Signal Strength Indicator units and, in parentheses, the current power level, of the signal received from the AP or BHM.

Jitter

This field displays the jitter level of the signal received from the AP or BHM.

Number Registered Users

This field displays how many slave devices are currently registered to the master device whose beacon is being received during the aiming period.

In addition, the Alignment tab includes the following Detailed Beacon Information where it is available.

Average measured RSSI

This field displays the Radio Signal Strength Indicator units and, in parentheses, the power level as an average of the measurements that were collected throughout the aiming period. Try for the highest power level that you can achieve at the least amount of jitter. For example, if you achieve a power level of −75 dBm with a jitter level of 5, and further refine the alignment to achieve a power level of −78 dBm with a jitter level of 2 or 3, the link is better because of the further refinement.

Average measured Jitter

This field displays Jitter as an average of the measurements that were collected throughout the aiming period. In 1X operation, jitter values of 0 to 4 are acceptable. In 2X operation, jitter values 0 to 9 are acceptable. In either mode, 0 to 15 is the range of possible values that the **Jitter** field reports. Within the acceptable range, incremental improvements in the jitter level achieved can significantly improve link quality where power level is not significantly diminished by re-aiming.

Users

This is a count of the number of SMs registered to the AP you are aligning to.

Frequency

This field displays the frequency in MHz of the signal that was being received during the aiming period.

ESN

This field displays the MAC address of the AP or BHM you are aligning to.

Color Code

This field displays the color code of the AP or BHM you are aligning to.

Backhaul

This field displays a 1 if the device you are aligning to is a BHM, and a 0 if the device you are aligning to is an AP.

27.3 USING THE LINK CAPACITY TEST TOOL (ALL)

An example of the Link Capacity Test tab is displayed in Figure 158.

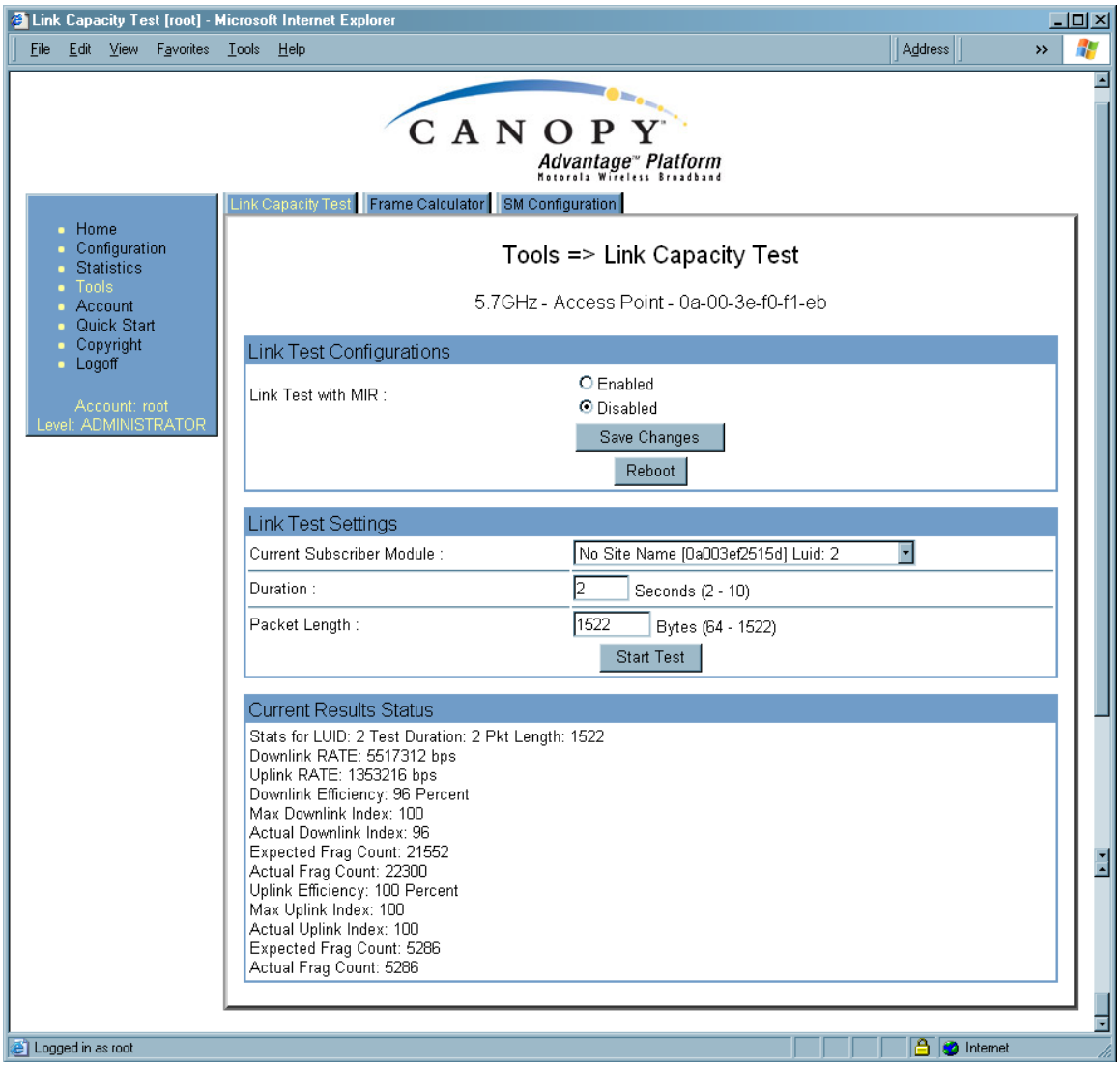


Figure 158: Link Capacity Test tab with 1522-byte packet length, example

The Link Capacity Test page allows you to measure the throughput and efficiency of the RF link between two Cyclone modules. Many factors, including packet length, affect throughput. The Link Capacity Test tab contains the settable parameter **Packet Length** with a range of 64 to 1522 bytes. This allows you to compare throughput levels that result from various packet sizes.

For example, the same link was measured in the same time frame at a packet length of 64 bytes. The results are shown in Figure 159.

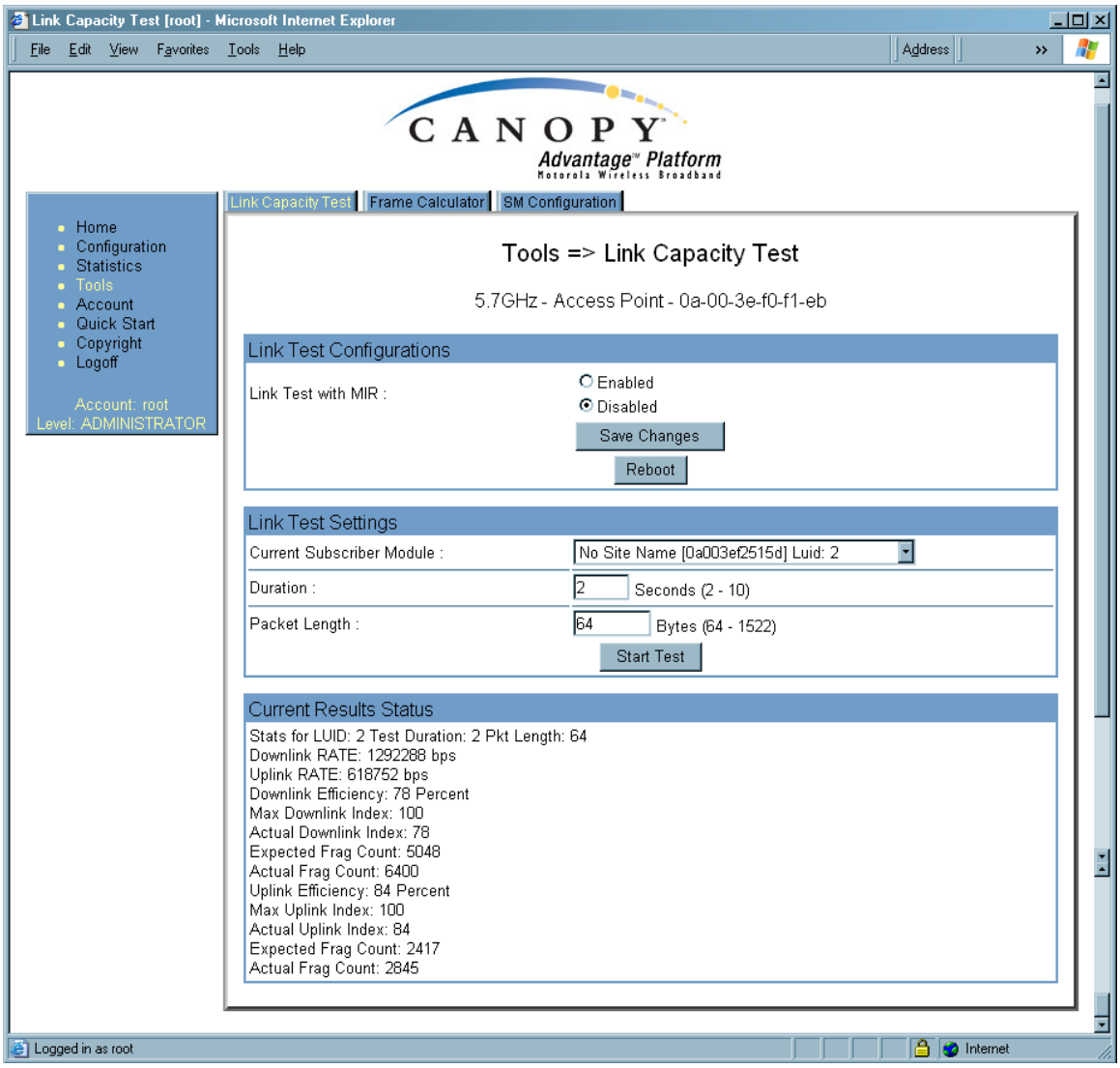


Figure 159: Link Capacity Test tab with 64-byte packet length, example

To test a link, perform the following steps.

Procedure 40: Performing a Link Capacity Test

1. Access the Link Capacity Test tab in the Tools web page of the module.
2. If you are running this test from an AP
   a. and you want to see Maximum Information Rate (MIR) data for the SM whose link you will be testing, then perform the following steps:
      (1) For **Link Test with MIR**, select **Enabled**.
      (2) Click the **Save Changes** button.
      (3) Click the **Reboot** button.
   b. use the drop-down list to select the SM whose link you want to test.

3. Type into the **Duration** field how long (in seconds) the RF link should be tested.
4. Type into the **Packet Length** field the packet length at which you want the test conducted.
5. Type into the **Number of Packets** field either
   - the number of packets (1 to 64) for the test.
   - **0** to flood the link for as long as the test is in progress.
6. Click the **Start Test** button.
7. In the Current Results Status block of this tab, view the results of the test.
8. Optionally
   a. change the packet length.
   b. repeat Steps 5 and 6.
   c. compare the results to those of other tests.

========== **end of procedure** ==========

The key fields in the test results are

- **Downlink RATE** and **Uplink RATE**, expressed in bits per second
- **Downlink Efficiency** and **Uplink Efficiency**, expressed as a percentage

A Cyclone system link is acceptable only if the efficiencies of the link test are greater than 90% in both the uplink and downlink direction, except during 2X operation. See Using Link Efficiency to Check Received Signal Quality on Page 135. Whenever you install a new link, execute a link test to ensure that the efficiencies are within recommended guidelines.

The AP downlink data percentage, slot settings, other traffic in the sector, and the quality of the RF environment all affect throughput. However, a Maximum Information Rate (MIR) throttle or cap on the SM does not affect throughput.

27.4 USING THE AP EVALUATION OR BHM EVALUATION TOOL (SM, BHS)

The AP Evaluation tab in the Tools web page of the SM provides information about the AP that the SM sees. Similarly, the BHM Evaluation tab of the BHS provides information about the BHM. An example of the AP Evaluation tab is shown in Figure 160.

NOTE:
The data for this page can be suppressed by the **SM Display of AP Evaluation Data** selection in the Security tab of the Configuration page in the AP.

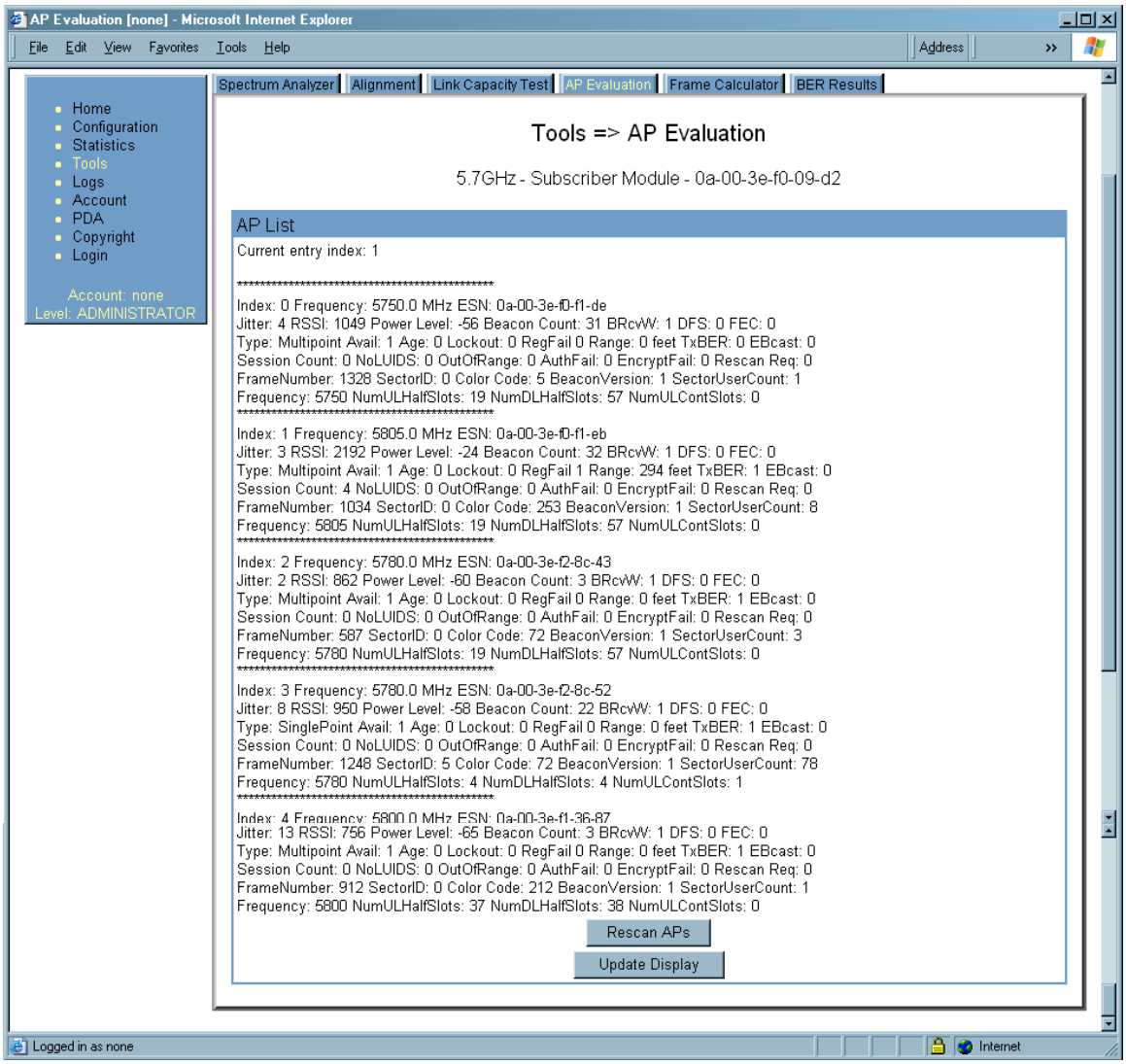


Figure 160: AP Evaluation tab of SM, example

The AP Evaluation tab provides the following fields that can be useful to manage and troubleshoot a Cyclone system:

Index

This field displays the index value that the Cyclone system assigns (for only this page) to the AP where this SM is registered (or to the BHM to which this BHS is registered).

Frequency

This field displays the frequency that the AP or BHM transmits.

ESN

This field displays the MAC address (electronic serial number) of the AP or BHM.

Jitter, RSSI, and Power Level

The AP Evaluation tab shows the received **Power Level** in dBm and **Jitter**. Proper alignment maximizes **Power Level** and minimizes **Jitter**. As you refine alignment, you should favor lower jitter over higher dBm. For example, if coarse alignment gives an SM a power level of −75 dBm and a jitter measurement of 5, and further refining the alignment drops the power level to −78 dBm and the jitter to 2 or 3, use the refined alignment, with the following caveats:

- When the receiving link is operating at 1X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 4.
- When the receiving link is operating at 2X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 9.

For historical relevance, the AP Evaluation tab also shows the **RSSI**, the unitless measure of power. Use **Power Level** and ignore **RSSI**. **RSSI** implies more accuracy and precision than is inherent in its measurement.

NOTE:
Unless the page is set to auto-refresh, the values displayed are from the instant the General Status tab was selected. To keep a current view of the values, refresh the browser screen or set to auto-refresh.

Beacon Count

A count of the beacons seen in a given time period.

BRcvW

DFS

FEC

Type

Multipoint indicates an AP, not a BHM.

Age

Lockout

This field displays how many times the SM or BHS has been temporarily locked out of making registration attempts.

RegFail

This field displays how many registration attempts by this SM or BHS failed.

Range

This field displays the distance in feet for this link. To derive the distance in meters, multiply the value of this parameter by 0.3048.

TxBER

A 1 in this field indicates the AP or BHM is sending Radio BER.

EBcast

A 1 in this field indicates the AP or BHM is encrypting broadcasst packets. A 0 indicates it is not.

Session Count

This field displays how many sessions the SM (or BHS) has had with the AP (or BHM). Typically, this is the sum of Reg Count and Re-Reg Count. However, the result of internal calculation may display here as a value that slightly differs from the sum.

In the case of a multipoint link, if the number of sessions is significantly greater than the number for other SMs, then this may indicate a link problem or an interference problem.

NoLUIDs

OutOfRange

AuthFail

This field displays how many times authentication attempts from this SM have failed in the AP.

EncryptFail

This field displays how many times an encryption mismatch has occurred between the SM and the AP.

Rescan Req

FrameNumber

Sector ID

This field displays the value of the **Sector ID** field that is provisioned for the AP or BHM.

Color Code

This field displays the value of the **Color Code** field that is provisioned for the AP or BHM.

BeaconVersion

Sector User Count

This field displays how many SMs are registered on the AP.

Frequency

This field displays the frequency of the received signal, expressed in MHz.

NumULHalfSlots

This is the number of uplink half slots in this AP or BHM's frame. To get slots, just divide by 2.

NumDLHalfSlots

This is the number of downlink half slots in this AP or BHM's frame. To get slots, just divide by 2.

NumULContSlots

This field displays how many control slots are being used in the uplink portion of the frame.

The AP Evaluation tab also provides the following buttons.

Rescan APs

You can click this button to force the SM or BHS to rescan the frequencies that are selected in the Radio tab of the Configuration page. (See Custom Radio Frequency Scan Selection List on Page 276.) This module will then register to the AP or BHM that provides the best results for power level, jitter, and—in an SM—the number of registered SMs.

Update Display

You can click this button to gather updated data without causing the SM or BHS to rescan and re-register.

27.5 USING THE FRAME CALCULATOR TOOL (ALL)

Cyclone avoids self-interference by syncing collocated APs (so they begin each transmission cycle at the same time) and requiring that collocated APs have the same transmit/receive ratio (so they stop transmitting and start receiving at the same time). This ensures that, at any instant, they are either all receiving or all transmitting.

This avoids, for example, the problem of one AP attempting to receive from a distant SM, while a nearby AP is transmitting and overpowering the signal from the distant SM. Parameters that affect transmit/receive ratio include range, slots, downlink data percentage, and high priority uplink percentage. All collocated APs must have the same transmit/receive ratio. Additional engineering is needed for setting the parameters in a mixed cluster – one with APs on hardware scheduler and APs on software scheduler.

A frame calculator helps to do this. The operator inputs various AP settings into the calculator, and the calculator outputs many details on the frame including the **Uplink Rcv SQ Start**. This calculation should be done for each AP that has different settings. Then the operator varies the **Downlink Data** percentage in each calculation until the calculated **Uplink Rcv SQ Start** for all collocated APs is within 300 time bits. The frame calculator is accessed by clicking on Expanded Stats in the navigation column, then clicking on Frame Calculator (at the bottom of the expanded navigation column).

The calculator does not use data on the module or populate new data. It is merely a convenience application running on the module. For this reason, you can use any module to do the calculations for any AP. Running the calculator on the AP in question is not necessary.

IMPORTANT!

APs with slightly mismatched transmit/receive ratios and low levels of data traffic may see little effect on throughput. As the data traffic increases, the impact of mismatched transmit/receive ratios will increase. This means that a system that was not tuned for collocation may work fine at low traffic levels, but encounter

problems at higher traffic level. The conservative practice is to tune for collocation from the beginning, and prevent future problems as sectors are built out and traffic increases.

An example of the Frame Calculator tab is shown in Figure 161.

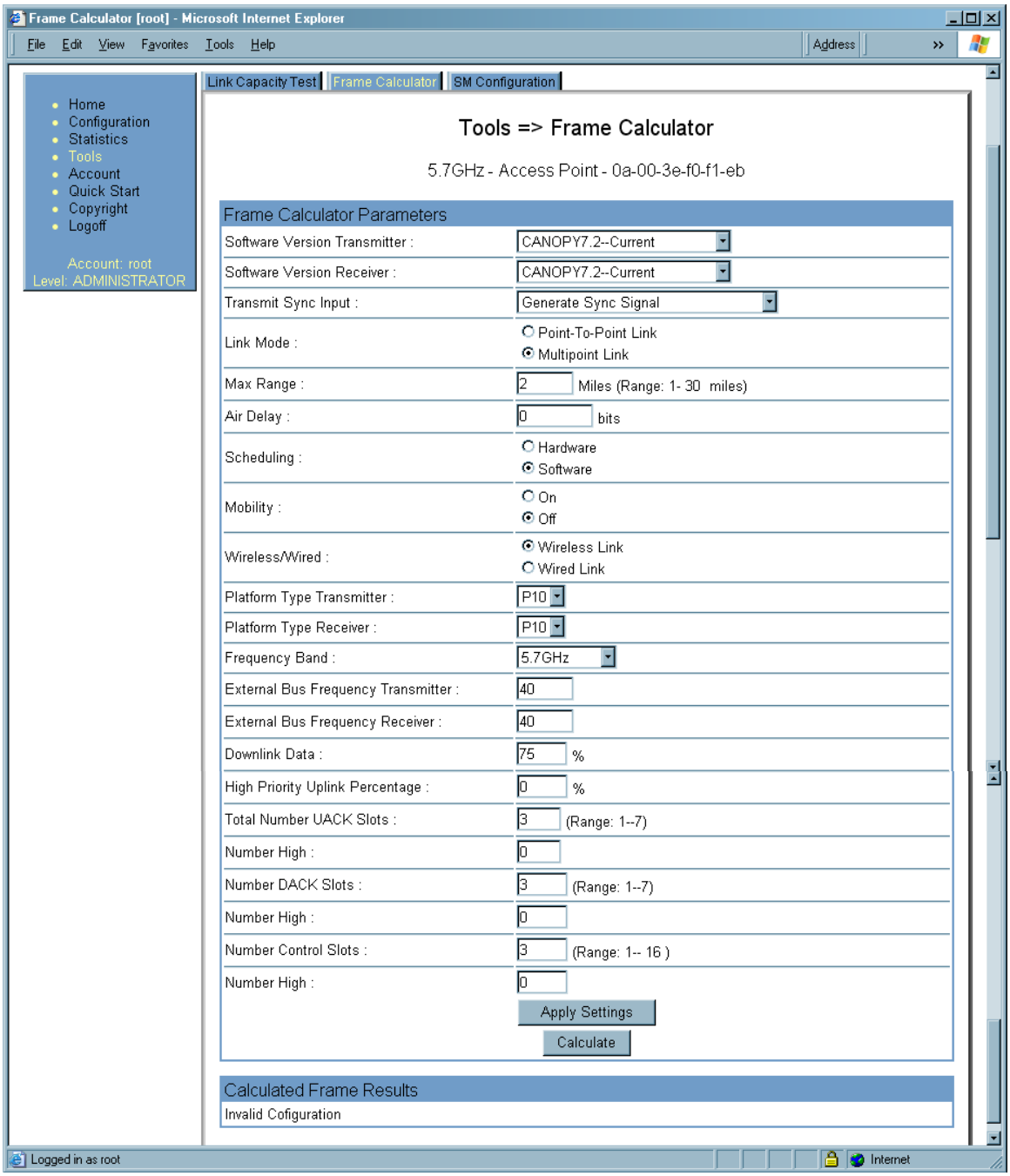


Figure 161: Frame Calculator tab, example

In the Frame Calculator tab, you may set the following parameters.

Software Version Transmitter
From the drop-down menu, select the Cyclone software release that runs on the AP(s).

Software Version Receiver
From the drop-down menu, select the Cyclone software release that runs on the SM(s).

Transmit Sync Input
If the APs in the cluster

- receive sync from a CMMmicro, select **Sync to Received Signal (Power Port)**.
- receive sync from a CMM2, select **Sync to Received Signal (Timing Port)**.
- are self timed, select **Generate Sync Signal**.

Link Mode
For AP to SM frame calculations, select **Multipoint Link**.

Max Range
Set to the same value as the **Max Range** parameter is set in the AP(s).

Air Delay
Leave this parameter set to the default value of **0** bits.

Scheduling
Initially select **Software**.

Mobility
Leave the default value of **Off** selected.

Wireless/Wired
Leave the default value of Wireless Link selected.

Platform Type Transmitter
Use the drop-down list to select the hardware series (board type) of the AP.

Platform Type Receiver
Use the drop-down list to select the hardware series (board type) of the SM.

Frequency Band
Use the drop-down list to select the radio frequency band of the AP and SM.

External Bus Frequency Transmitter
Leave this parameter set to the default value of **40**.

External Bus Frequency Receiver
Leave this parameter set to the default value of **40**.

Downlink Data

Initially set this parameter to the same value that the AP has for its **Downlink Data** parameter (percentage). Then, as you use the Frame Calculator tool in Procedure 41, you will vary the value in this parameter to find the proper value to write into the **Downlink Data** parameter of all APs in the cluster.

High Priority Uplink Percentage

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **High Priority Uplink Percentage** parameter in the AP.

Total Number UACK Slots

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **Total NumUAckSlots** parameter in the AP.

Number High

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **Num High** parameter associated with **Total NumUAckSlots** in the AP.

Number DACK Slots

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **NumDAckSlots** parameter in the AP.

Number High

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **Num High** parameter associated with **NumDAckSlots** in the AP.

Number Control Slots

Set this parameter to the current value of the **Control Slots** (for Release 8) or **NumCtlSlots** (for earlier releases) parameter in the AP. In Release 8, the **Control Slots** parameter is present in the Radio tab of the Configuration web page.

Number High

If the AP is running Cyclone software earlier than Release 8, set this parameter to the current value of the **Num High** parameter associated with **NumCtlSlots** in the AP.

To use the Frame Calculator, perform the following steps.

Procedure 41: Using the Frame Calculator

1. Populate the Frame Calculator parameters with appropriate values as described above.
2. Click the **Apply Settings** button.
3. Click the **Calculate** button.
4. Scroll down the tab to the Calculated Frame Results section.
   NOTE: An example of the Calculated Frame Results section is displayed in Figure 162.

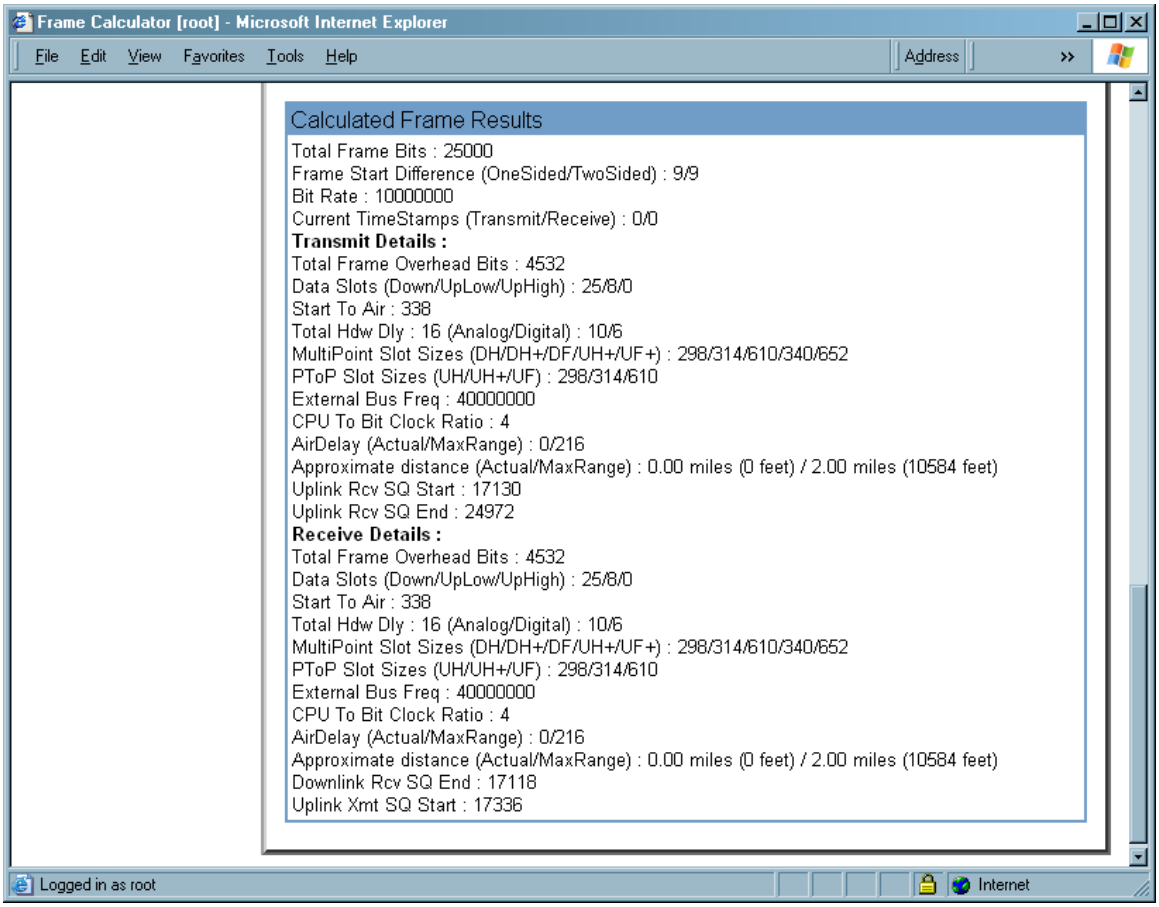


Figure 162: Calculated Frame Results section of Frame Calculator tab, example

5. Record the value of the **Uplink Rcv SQ Start** field.
6. Scroll up to the **Scheduling** parameter.
7. Select **Hardware**.
8. Click the **Apply Settings** button.
   RESULT: The values in the Calculated Frame Results section are updated for hardware scheduling.
9. In the **Number Control Slots** parameter, type in the number needed.
10. Click the **Apply Settings** button.
11. Click the **Calculate** button.
12. Scroll down the tab to the Calculated Frame Results section. If “Invalid Configuration” is displayed, check and change values and settings, with special attention to the **Platform Type** parameters (P7, P8, and so on).
13. Record the value of the **Uplink Rcv SQ Start** field.
14. If the recorded values of the **Uplink Rcv SQ Start** field are within 150 time bits of each other, skip the next step.
15. Repeat this procedure, changing the value of the **Downlink Data** parameter until the values that this tool calculates for the **Uplink Rcv SQ Start** field are within 150 time bits of each other regardless of the selection in the **Scheduling** parameter.

16. When they are within 150 time bits, access the Radio tab in the Configuration web page of each AP in the cluster and change its **Downlink Data** parameter (percentage) to the last value that you used in the Frame Calculator.
See Figure 77: Radio tab of AP (900 MHz), example on Page 243.

========== **end of procedure** ==========

27.6 USING THE SM CONFIGURATION TOOL (AP, BHM)

The SM Configuration tab in the Tools page of the AP or BHM displays

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

An example of the SM Configuration tab is displayed in Figure 163.

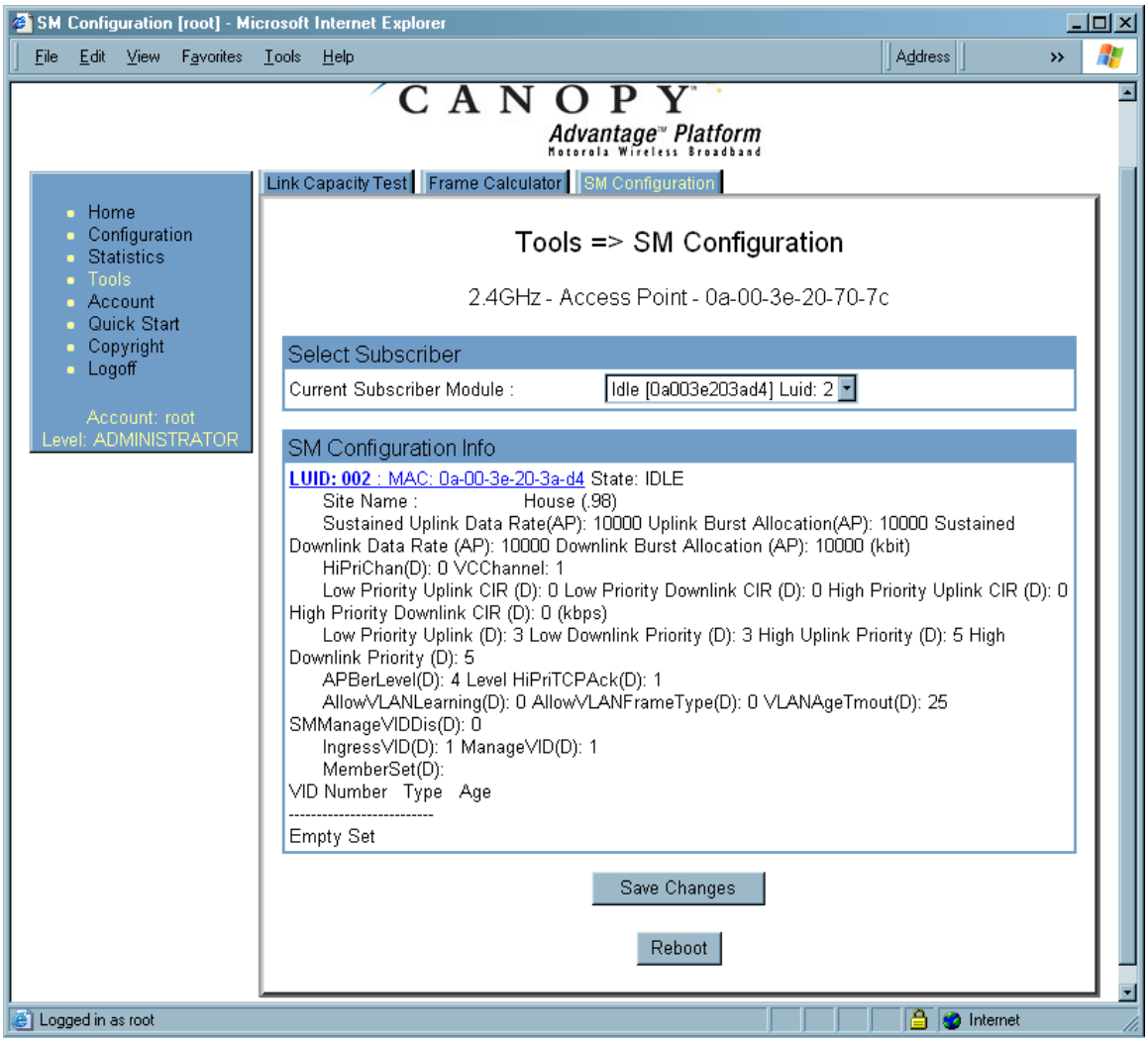


Figure 163: SM Configuration tab of AP, example

Indicators for configuration source are explained under Session Status Tab of the AP on Page 193.

27.7 USING THE BER RESULTS TOOL (SM, BHS)

Radio BER is now supported on hardware scheduling. When looking at Radio BER data it is important to note that it represents bit errors at the RF link level. Due to CRC checks on fragments and packets and ARQ (Automatic Repeat reQuest), the BER of customer data is essentially zero. Radio BER gives one indication of link quality, along with received power level, jitter, and link tests.

BER is only instrumented on the downlink, and can be read on each SM's Tools>BER Results page. Each time the tab is clicked, the current results are read, and counters are reset to zero. An example of the BER Results tab is displayed in Figure 164.

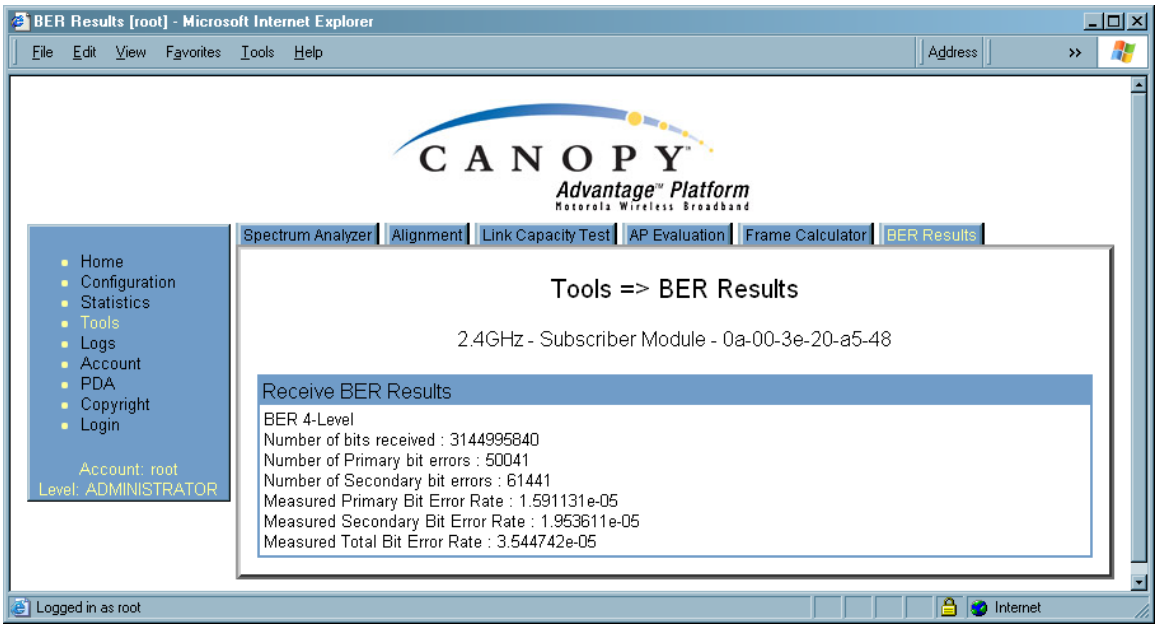


Figure 164: BER Results tab of SM, example

The BER Results tab can be helpful in troubleshooting poor link performance. The value in the **Measured Total Bit Error Rate** field represents the bit error rate (BER) in the RF link since the last time the BER Results tab was clicked.

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

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