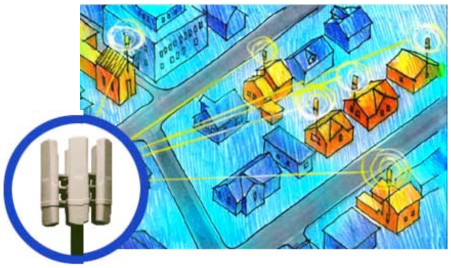

Canopy® System User Guide

Through Release 7.3.6

Sys-UG-en
Issue 2
September 2006

includes

Planning Guide

Installation and Configuration Guide

Operations Guide

Reference

Notices

See the following information:

- important regulatory and legal notices in Section 36 on Page 469.
- personal safety guidelines in Section 15 on Page 168.

Trademarks, Product Names, and Service Names

http://www.canopywireless.com

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LIST OF TABLES

LIST OF PROCEDURES

Guide To This User Guide

1 NEW IN THIS ISSUE

1.1 NEW PRODUCTS AND FEATURES DESCRIBED IN ISSUE 2

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- Table 3: Locations of screen captures and associated documentation on Page 39
- Table 6: Essential user guide elements for new backhaul network implementation on Page 47
- Advantage Subscriber Module on Page 50
- Canopy Lite Subscriber Module on Page 50
- OFDM Series Backhaul Module on Page 52
- Power Indoor Units for OFDM Series Backhaul Modules on Page 53
- Radio Adjustable Power Capabilities on Page 54
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1.2 NEW DESCRIPTIONS AND REVISIONS IN ISSUE 2

Issue 2 of this guide provides other new descriptions, as wells as clarifications and corrections, in the following elements:

- 900-MHz AP and SM on Page 51
- OFDM Series Backhaul Modules on Page 52
- T1/E1 Multiplexer on Page 54
- Cluster Management Module micro (Part 1070CK) on Page 56
- Passive Reflector Dish Assembly on Page 58
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- Downlink Burst Allocation on Page 239
- LAN2 Network Interface Configuration (RF Private Interface), IP Address on Page 251
- SM Power Up Mode With No 802.3 Link on Page 259
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- Downlink Burst Allocation on Page 262
- Configuration Page of the BHS on Page 305
- SM Power Up Mode With No 802.3 Link on Page 309
- Procedure 22: Installing the AP on Page 321
- Installing a Connectorized Flat Panel Antenna on Page 322
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- Czech Republic Notification on Page 472
- Norway Notification on Page 472
- Greece Notification on Page 473
- Brazil Notification on Page 473
- Australia Notification on Page 473

1.3 MOTOwi4 PORTFOLIO

Motorola has introduced the broad MOTOwi4™ portfolio of fixed, nomadic, and mobile wireless broadband solutions, among which Canopy® products are significant. The MOTOwi4 portfolio meets residential and enterprise data transport needs with the following present and future solutions:

- residential access fixed solutions
  - Canopy Access Point and Subscriber Modules in the following frequency band ranges:
    - 900 MHz
    - 2.4 GHz
    - 5.1 GHz
    - 5.2 GHz
    - 5.4 GHz
    - 5.7 GHz

  - WiMAX fixed and mobile solutions, based on the 802.16e (WiMAX) standard, in the following frequency band ranges:
    - 2.3 GHz
    - 2.5 GHz
    - 3.5 GHz
- Metro WiFi local area mesh network solutions, based on the 802.11 standard
- backhaul solutions, based on the 802.16e (WiMAX) standard or Canopy protocols, in the following frequency band ranges:
  - 2.4 GHz
  - 5.2 GHz
  - 5.4 GHz
  - 5.7 GHz

1.4 PRODUCTS COVERED BY THIS USER GUIDE

Most Canopy products are covered by this user guide:

- radio-networked modules in the following frequency band ranges:
  - 900 MHz
  - 2.4 GHz
  - 5.1 GHz
  - 5.2 GHz
  - 5.4 GHz
  - 5.7 GHz
- Cluster Management Module 2 (CMM2)
- Cluster Management Module micro (CMMmicro)
- Surge Suppressor

1.5 PRODUCTS NOT COVERED BY THIS USER GUIDE

Some specific-use Canopy products are referred to in this user guide but fully described in their own separate user guides:

- 30-Mbps Backhaul Module. See *Canopy 30 Mbps 60 Mbps Backhaul User Guide* and *Motorola Canopy OFDM Backhaul Quick Start Guide*.
- 30/60-Mbps Backhaul Module. See *Canopy 30 Mbps 60 Mbps Backhaul User Guide* and *Motorola Canopy OFDM Backhaul Quick Start Guide* for (30/60 Mbps).
- 150/300-Mbps Backhaul Module. See *Canopy 150 Mbps 300 Mbps Backhaul User Guide* and *Motorola Canopy OFDM Backhaul Quick Start Guide* (for 150/300 Mbps).
- Bandwidth and Authentication Manager. See *Canopy Bandwidth and Authentication Manager (BAM) Release 2.1 User Guide* (or *Canopy Bandwidth and Authentication Manager (BAM) User Guide* for earlier releases).
- License Manager. See *Canopy Networks License Manager User Guide*.
- Prizm. See *Motorola Canopy Prizm User Guide*.
- T1/E1 Multiplexer. See *Canopy T1/E1 Multiplexer User Guide*.

1.6 SOFTWARE COMPATIBILITY DESCRIBED IN THIS USER GUIDE

The following sections of this document provide details and caveats about the compatibility of Canopy products:

- Designations for Hardware and Firmware on Page 354
- Application, Boot, and FPGA Software Upgrades on Page 356
- System Release 6.1 Compatibility on Page 357
- BAM Software Compatibility on Page 358
- CMMmicro Software and Hardware Compatibility on Page 358
- MIB File Set Compatibility on Page 359

2 USING THIS USER GUIDE

This document should be used with Canopy features through Software Release 7.3.6 and CMMmicro Release 2.1.1. The audience for this document includes system operators, network administrators, and equipment installers.

2.1 FINDING THE INFORMATION YOU NEED

2.1.1 Becoming Familiar with This User Guide

This is a guide to the guide. A high-level overview of the guide and some examples of where to look provide insight into how information is arranged and labeled.

The Table of Contents provides not only a sequential index of topics but also a visual glance at the organization of topics in this guide. A few minutes spent with the Table of Contents in either the paper or the electronic version of this guide can save much more time in finding information now and in the future. The List of Procedures may be especially useful in the paper version of this guide, particularly where you mark those procedures that you wish to frequently see.

In contrast, the List of Figures and List of Tables are most useful for automated searches on key words in the electronic version of this guide. If a match is present, the match is the first instance that the search finds.

Quick Reference

The Canopy User Guide comprises six sections, as described in Table 1.

Table 1: Canopy User Guide organization scheme

Section	Purpose
Guide to This User Guide (this section)	Identifies ◦ products covered by this user guide. ◦ products covered by their own separate user guides. ◦ how this user guide is organized. ◦ where to find module web pages and parameter descriptions. ◦ what the various typefaces and admonitions indicate. ◦ how to contact Canopy.
Overview of Canopy Networks	Provides ◦ references to RF and networking theory. ◦ a list of sections to see if you are building only a backhaul network. ◦ overviews and comparisons of Canopy products and how they communicate. ◦ descriptions of data handling and synchronization. ◦ a review of Canopy optional features. ◦ resources for developing familiarity and proficiencies with Canopy networks.
Planning Guide	Provides essential information for ◦ evaluating an area for a Canopy network. ◦ specifying the IP addresses and frequency band ranges to use for each type of link.
Installation and Configuration Guide	Provides systematic approaches for ◦ avoiding hazards from RF and natural causes. ◦ testing, storing, and deploying Canopy equipment.
Operations Guide	Provides guidance for ◦ expanding network coverage. ◦ improving the security of Canopy wireless links. ◦ distributing bandwidth resources. ◦ monitoring and changing variables through SNMP.
Reference Information	Provides supplemental information such as ◦ authorizations, approvals, and notices. ◦ a bibliography of adjunctive information sources. ◦ a history of changes in Canopy documentation.
Glossary	Defines terms and concepts that are used in this user guide.

Examples

A list of common tasks and references to information that supports each task is provided in Table 2.

Table 2: Examples of where to find information in this user guide

If you want to know…	then see…	because…
what the Spectrum Analyzer in SM and BHS feature does	Avoiding Self Interference on Page 152	this topic is important to RF planning.
	Monitoring the RF Environment on Page 350	this topic is also important to managing the network.
what software releases support the Spectrum Analyzer in SM and BHS feature.	System Release 4.1 Features on Page 422	this section is where the feature sets are distinguished by release.
what types of slots compose the Canopy frame	Understanding Bandwidth Management on Page 83	this information is helpful for understanding Canopy networks.
how to set the acknowledgement and control slot parameters	Slot Specifications on Page 237	setting these parameters is part of configuring an AP for its destination.
how to calculate whether an object will interfere with a signal	Noting Possible Obstructions in the Fresnel Zone on Page 133	this topic is important to RF planning.
how long a cable you can use from the GPS antenna to the CMM	Cables on Page 36	cables are accessory components.
	Procedure 23 on Page 323 *or* Procedure 27 on Page 330	the advisory applies to mounting GPS antennas *and* CMMs.
how to react to a WatchDog Event Log message	Messages that Flag Abnormal Events on Page 399 *and* Messages that Flag Normal Events on Page 399	together, these two sections document all significant Event Log messages.
what beam angle the passive reflector dish produces	Specifications and Limitations on Page 73, then downward to a table for a Canopy Part Number that includes "RF."	the beam angle is a specification.
how to aim the passive reflector dish	Installing a Reflector Dish on Page 340	aiming is associated with Backhaul Module installation.
how to set Differentiated Services values so that traffic with original ToS byte formatting continues to be prioritized as it was before DSCP fields.	High-priority Bandwidth on Page 89	DSCP fields specify the level of priority that the device is requesting for the packet.

2.1.2 Searching This User Guide

To search this document and the software release notes of supported releases, look in the Table of Contents for the topic and in the Adobe Reader® search capability for keywords that apply.[1] These searches are most effective when you begin the search from the cover page because the first matches may be in titles of sections, figures, tables, or procedures.

2.1.3 Finding Parameter and Field Definitions for Module Web Pages

Because this user guide is sequentially arranged to support tasks, and various tasks require different settings and readings, parameter and field definitions are scattered according to the tasks that they support. The locations of these are provided in Table 3.

Table 3: Locations of screen captures and associated documentation

Module Web Page Screen Capture	Page
Advanced Network Configuration screen of SM with NAT disabled	276
Advanced Network Configuration screen, NAT with DHCP client and DHCP server	278
AP Eval Data screen	401
AP Evaluation screen for PDA access, Release 4.2	320
BER Results screen	412
Bridge Table screen	413
Configuration screen (top), Advantage AP	234
Configuration screen (middle), Advantage AP	239
Configuration screen (bottom), Advantage AP	244
Figure 86: Configuration screen, Advantage SM	256
Configuration screen, Advantage SM (continued)	261
Configuration screen, BHM	292
Configuration screen, BHM (continued)	297
Configuration screen, BHS	305
Configuration screen, BHS (continued)	311
Configuration screen, CMMmicro	223
Differentiated Services Configuration screen, AP	252
Differentiated Services Configuration screen, SM	286
Differentiated Services Configuration screen, BHM	303
Differentiated Services Configuration screen, BHS	315
Event Log page data	398

[1] Reader is a registered trademark of Adobe Systems, Incorporated.

2.2 INTERPRETING TYPEFACE AND OTHER CONVENTIONS

This document employs distinctive fonts to indicate the type of information, as described in Table 4.

Table 4: Font types

Font	Type of Information
variable width bold	Selectable option in a graphical user interface or settable parameter in the web-based interface to a Canopy component.
`constant width regular`	Literal system response in a command-line interface.
`constant width italic`	Variable system response in a command-line interface.
`constant width bold`	Literal user input in a command-line interface.
`constant width bold italic`	Variable user input in a command-line interface.

This document employs specific imperative terminology as follows:

- *Type* means press the following characters.
- *Enter* means type the following characters and then press Enter.

This document also employs a set of consistently used admonitions. Each of these types of admonitions has a general purpose that underlies the specific information in the box. These purposes are indicated in Table 5.

Table 5: Admonition types

Admonition Label	General Message
✍	***NOTE:*** informative content that may ◦ defy common or cursory logic. ◦ describe a peculiarity of the Canopy implementation. ◦ add a conditional caveat. ◦ provide a reference. ◦ explain the reason for a preceding statement or provide prerequisite background for what immediately follows.
ℹ	***RECOMMENDATION:*** suggestion for an easier, quicker, or safer action or practice.
❗	***IMPORTANT!*** informative content that may ◦ identify an indication that you should watch for. ◦ advise that your action can disturb something that you may not want disturbed. ◦ reiterate something that you presumably know but should always remember.
⚠	***CAUTION!*** a notice that the risk of harm to equipment or service exists.
🛑	***WARNING!*** a notice that the risk of harm to person exists.

2.3 GETTING ADDITIONAL HELP

Help is available for problems with supported products and features. Obtaining Technical Support on Page 454 provides the sequence of actions that you should take if these problems arise.

2.4 SENDING FEEDBACK

We welcome your feedback on Canopy system documentation. This includes feedback on the structure, content, accuracy, or completeness of our documents, and any other comments you have. Send your comments to technical-documentation@canopywireless.com.

OVERVIEW OF CANOPY NETWORKS

3 ADVANCING FROM RESEARCH TO IMPLEMENTATION

Before you begin to research a possible Canopy implementation, you should have both

- basic knowledge of RF theory. See
  - Understanding RF Fundamentals on Page 120.
  - Engineering Your RF Communications on Page 130.
- network experience. See
  - Canopy Link Characteristics on Page 83.
  - Understanding IP Fundamentals on Page 120.
  - Engineering Your IP Communications on Page 155.

4 REALIZING A WIRELESS BACKHAUL NETWORK

Canopy backhaul modules can connect Canopy access point clusters to the point of presence or be the backbone of a Metro WiFi mesh network. In other applications, the backhaul modules can be used to provide connectivity for

- cell sites, in lieu of leased T1/E1 telecommunications lines.
- buildings in corporate or institutional campuses.
- remote sites, including temporary sites set up for relief efforts.

For these and any other backhaul networks, Table 6 provides a quick reference to information that you would need to establish and maintain the Canopy wireless backhaul network.

Table 6: Essential user guide elements for new backhaul network implementation

Element	Title	Page
Section 1.5	Products Not Covered by This User Guide	34
Section 5.1.8	Backhaul Module	51
Section 5.1.9	OFDM Series Backhaul Module	52
Section 5.1.10	Power Indoor Units for OFDM Series Backhaul Modules	53
Section 5.1.12	T1/E1 Multiplexer	54
Section 5.1.13	Cluster Management Module 2 (Part 1008CK-2)	55
Section 5.1.14	Cluster Management Module micro (Part 1070CK)	56
Table 15	Products with encryption options available per frequency band, PTP links	65
Table 16	Typical range and throughput per frequency band, PTP links	66
Section 8.2	BH-BH Links	105
Figure 38	Typical multiple-BH network layout	110
Section 12.2	Analyzing the RF Environment	132
Section 12.5	Considering Frequency Band	137
Section 15	Avoiding Hazards	168
Section 16.4	Configuring a Point-to-Point Link for Test	199
Section 17	Preparing Components for Deployment	232
Section 18.4	Configuring a BH Timing Master for the Destination	292
Section 18.5	Configuring a BH Timing Slave for the Destination	305
Section 19.4	Installing a GPS Antenna	323
Section 19.5	Installing a CMM2	324
Section 19.6	Installing a CMMmicro	330
Section 19.9	Installing a Reflector Dish	340
Section 19.10	Installing a BH Timing Master	341

Section 19.11	Installing a BH Timing Slave	343
Section 19.13	Verifying a BH Link	345
Section 20	Verifying System Functionality	347
Section 21.2.5	CMMmicro Software and Hardware Compatibility	358
Section 22.2	Encrypting Canopy Radio Transmissions	361
Section 22.3	Managing Password Access	362
Section 24.6	Objects Supported in the Canopy 30/60-Mbps BH	391
Section 24.7	Objects Supported in the Canopy 150/300-Mbps BH	391
Section 24.10	Traps Provided in the Canopy 30/60-Mbps BH Module MIB	392
Section 24.11	Traps Provided in the Canopy 150/300-Mbps BH Module MIB	392
Section 25	Interpreting Data in the GPS Status Page (AP, BHM)	394
Section 27.3	Typical Contents of Release Notes	427
Section 27.4	Typical Upgrade Process	427
Section 29	Toggling Remote Access Capability	432
Section 30.2	Analyzing Traffic at an AP or BH with No CMM	434
Section 30.3	Analyzing Traffic at an AP or BH with a CMM	434
Section 31	Troubleshooting	444
Section 32	Obtaining Technical Support	454
Section 33	Getting Warranty	459

5 EXPLORING THE SCOPE OF SOLUTIONS

Canopy wireless broadband applications include:

- local area network (LAN) extensions
- Internet subscriber service
- high-bandwidth point-to-point connections
- multicast video (for instruction or training, for example)
- private branch exchange (PBX) extensions
- point-to-multipoint data backhaul
- redundant network backup
- video surveillance
- voice over IP (VoIP)
- TDM over Ethernet (for legacy voice and data)

5.1 COMPONENTS

Canopy networks use some or all of the following components. For the components that provide a graphical user interface (GUI), access to the GUI is through a web browser.

5.1.1 Canopy Access Point Module

The Canopy Access Point (AP) module distributes network or Internet services in a 60° sector to not more than 200 subscribers or fewer and 4,096 MAC addresses, which may be directly-connected PCs, IP appliances, gateways, Subscriber Modules (SMs), and the AP, except that *no limit* applies behind subscriber NAT gateways. The AP is configurable through a web interface. A Canopy AP can communicate with only a Canopy SM, *not also* an Advantage SM or a Canopy Lite SM.

5.1.2 Advantage Access Point Module

The Canopy Advantage AP distributes services as broadly as the Canopy AP. However, the Advantage AP provides greater throughput and less latency. Each page of the GUI for Canopy Advantage modules displays the distinctive branding shown in Figure 1.

Figure 1: Canopy Advantage Platform GUI logo

The Advantage AP communicates with all Canopy SMs in its frequency band range: Canopy SMs, Advantage SMs, and Canopy Lite SMs.

5.1.3 Access Point Cluster

The AP cluster consists of two to six APs that together distribute network or Internet services to a community of 1,200 or fewer subscribers. Each AP transmits and receives in a 60° sector. An AP cluster covers as much as 360°.

The variety of available APs and Advantage APs in frequency band range, power adjustability, and antenna configuration is shown under Acquiring a Canopy Demonstration Kit, beginning on Page 120.

An AP cluster is pictured in Figure 2.

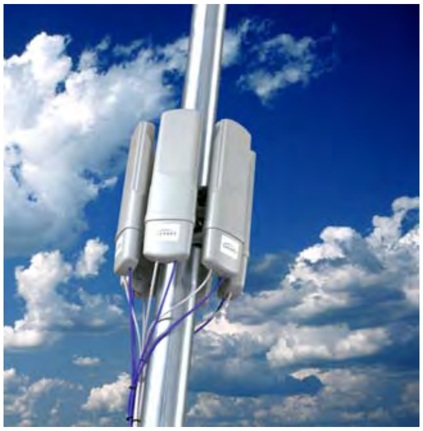


Figure 2: Pole-mounted AP cluster

5.1.4 Canopy Subscriber Module

The Subscriber Module (SM) is a customer premises equipment (CPE) device that extends network or Internet services by communication with an AP. The SM is configurable through a web interface.

The variety of available SMs and Advantage SMs in frequency band range, power adjustability, and antenna configuration is shown under Acquiring a Canopy Demonstration Kit, beginning on Page 120.

A Canopy SM can communicate with either a Canopy AP or an Advantage SP.

An SM mounted directly to a structure is pictured in Figure 3.

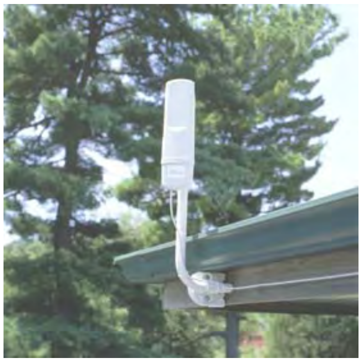


Figure 3: Structure-mounted SM

5.1.5 Advantage Subscriber Module

The Canopy Advantage SM provides the same configurability and services as the Canopy SM. However, in a link with the Advantage AP, the Advantage SM provides uncapped sustained throughput through the 2X operation feature. See 2X Operation on Page 94. An Advantage SM can communicate with only an Advantage AP.

5.1.6 Canopy Lite Subscriber Module

Canopy Lite SMs cost less and provide less throughput than regular Canopy SMs. They support the same radio frequencies, interference tolerance, and product reliability. They give operators the additional option to serve cost-sensitive customers who want standard services (web browsing, email, VoIP, and downloads), but do not require the higher throughput that is available with a regular Canopy SM. Canopy Lite SMs support an aggregate(uplink plus downlink) throughput of 512 kbps. Through purchased floating licenses that Prizm manages, they are upgradeable to 1, 2, 4, or 7 Mbps aggregate throughput. A Canopy Lite SM can communicate with only a Canopy Advantage AP.
A comparison of the Canopy Lite SM to the Canopy SM and Advantage SM is provided in Table 31 on Page 106.

5.1.7 900-MHz AP and SM

Canopy 900 MHz AP and SM modules operate at 3.3 Mbps (compared to 10 Mbps for other Canopy frequency bands). With Downlink Data set to 75% on the AP Configuration page, the AP supports high throughput to an SM.

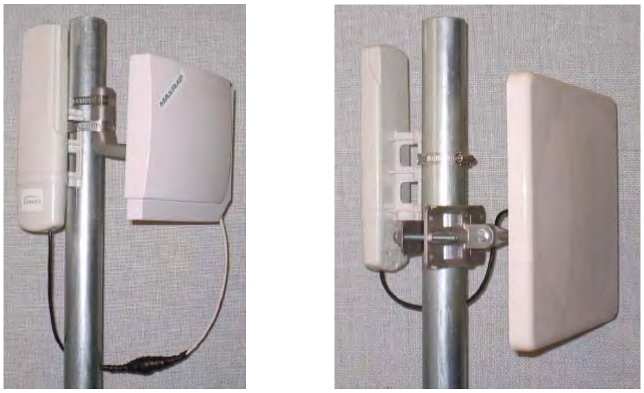


Figure 4: Examples of flat panel antennas with 900-MHz modules

These 900-MHz modules run the same software and provide the same parameters, network features, and connections as all other Canopy APs and SMs. The physics of longer-wavelength 900 MHz, the power allowed by regulatory authorities, and the low required level of Canopy Carrier-to-Interference (C/I) ratio combine to support

- line of sight (LOS) range of up to 40 miles (over 64 km)
- increased non-line of sight (NLOS) range, depending on RF considerations such as foliage, topography, and obstructions.

When collocated with a Canopy SM of another frequency band range, the 900-MHz AP may serve, without a tower or BH, as a *remote* AP (see Deploying a Remote AP on Page 148). 900-MHz AP/SM links are logical choices for extending radio networks where you wish to

- add subscriber-handling capacity to a tower that is either
  - fully used in the other frequency band ranges.
  - not available to any other frequency band range.
- reach sparsely populated areas.
- penetrate foliage.
- add a remote AP behind an SM that operates in another frequency band range.

5.1.8 Backhaul Module

A pair of Backhaul Modules (BHs) provide point-to-point connectivity as either

- a standalone link
- a link through a cluster management module to an AP cluster.

You must configure a BH as either a timing master (BHM) or timing slave (BHS). The BHM provides synchronization signal (sync) to the BHS.

A BH mounted to a passive reflector dish is pictured in Figure 5. Carrier applications for these modules include reaching remote AP clusters, interconnecting campus buildings or remote branch offices, extending private branch exchange (PBX) circuits, backhauling cell sites, and extending central office T1s/E1s.

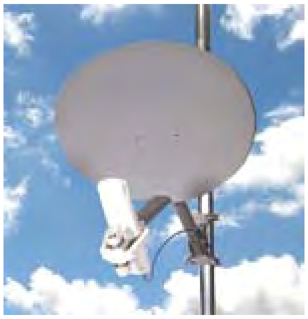


Figure 5: Dish-mounted 10- or 20-Mbps BH

These BHs are supported by this user guide. See Realizing a Wireless Backhaul Network on Page 47.

5.1.9 OFDM Series Backhaul Modules

These high-speed BHs provide point-to-point data connectivity via a 5.4- or 5.7-GHz wireless Ethernet bridge that operates at broadband data rates. They provide non-Line of Sight (NLOS) operation through the use of Orthogonal Frequency Division Multiplex (OFDM) modulation and Transmit Diversity. Transmissions penetrate foliage, such that almost universal coverage is typical at short range.

The link consists of a pair of identical BHs that transmit and receive on an automatically selected but configurable frequency. The installer sets up one unit as the master and the other as the slave. (Each unit is preconfigured as master or slave but can be reconfigured to the other.) These modules are available as either connectorized for an external antenna or equipped with an integrated antenna.

Each end of the link consists of both

- an outdoor transceiver (ODU) that contains all the radio and networking electronics (see Figure 6 and Figure 7)
- an indoor passive connection box (PIDU) that contains status indicators and network connection (see Figure 8 and Figure 9.

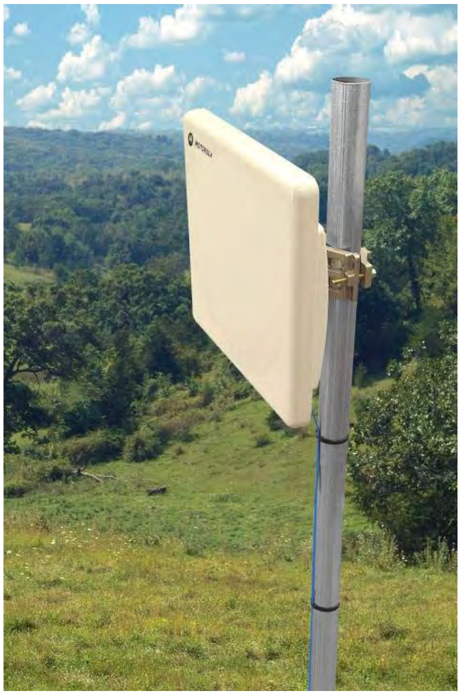


Figure 6: 30/60- or 150/300-Mbps Backhaul Module, integrated antenna

Available modulations are 30/60 Mbps and 150/300 Mbps. A 30-Mbps BH is software-upgradable to 60 Mbps, and a 150-Mbps BH is likewise software-upgradable to 300 Mbps. Products in this series are supported by dedicated user guides.

By default, these BHs use a proprietary data scrambling and encryption scheme. The 30/60-Mbps BHs have AES encryption available as a licensed option. The 150/300-Mbps BHs support virtual private networking (VPN).

Carrier applications for these modules include reaching remote AP clusters, interconnecting campus buildings or remote branch offices, extending private branch exchange (PBX) circuits, backhauling cell sites, and extending central office T1s/E1s.

(OFDM Series BHs were previously available in 45-Mbps modulation, which can be upgraded to 60 Mbps by software.)

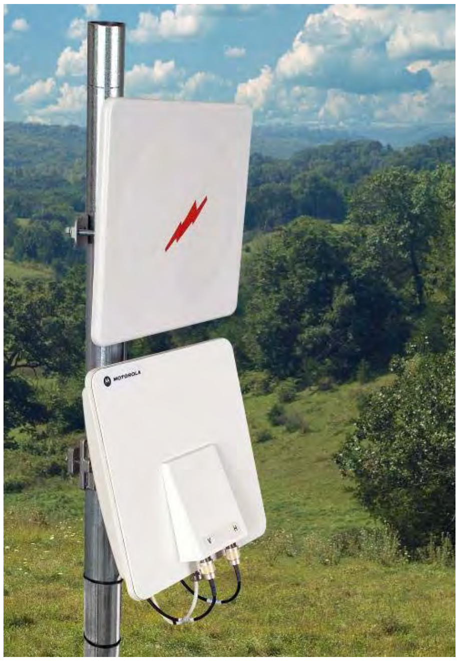


Figure 7: 30/60- or 150/300-Mbps Backhaul Module, connected to external antenna

5.1.10 Power Indoor Units for OFDM Series Backhaul Modules

Canopy also offers the required power indoor unit (PIDU) that generates the voltage for the 30/60- or 150/300-Mbps BHs. The PIDU provides status indicators for the ODU.

Examples of these PIDUs are shown in Figure 8 and Figure 9.

CAUTION!
The PIDU for the 30/60-Mbps BH and the PIDU for the 150/300-Mbps BH are clearly distinguished by their front labels. These units are unique and *are not* interchangeable under any circumstances. Their pinouts vary. Using any power unit other than the proper one of these two will destroy the module.

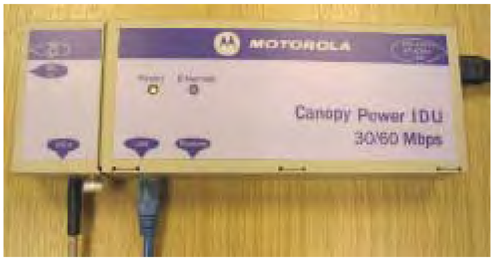


Figure 8: PIDU for 30/60-Mbps BH

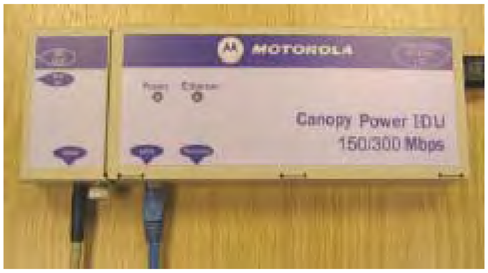


Figure 9: PIDU for 150/300-Mbps BH

5.1.11 Radio Adjustable Power Capabilities

To help network operators become or remain compliant with applicable regulations in their regions and nations, Canopy offers adjustable power radios in various frequency band ranges, as indicated in Table 7.

See also Adjusting Transmitter Output Power on Page 316 to ensure that your radios do not exceed the maximum permitted EIRP.

Table 7: Adjustable power radios

Frequency Band Range	Introduced in Canopy System Release
900 MHz[1]	7.0
2.4 GHz[1]	4.2.7
5.4 GHz[2]	4.2.7
5.7 GHz[1]	6.1

NOTES:

1. As a distinct part number.
2. In the base model.

5.1.12 T1/E1 Multiplexer

The Canopy T1/E1 Multiplexer converts the data stream from T1/E1 ports into Ethernet packets that are then transported over the Canopy BH link. This enables up to three T1 (or up to two E1) circuits to be extended over Ethernet networks. The T1/E1 Multiplexer is available in two power configurations:

- an external 3.3-v DC power source from a 120/240-v AC adapter (supplied by Canopy)
- an optional connection to an external −48 v DC supply for battery backup.

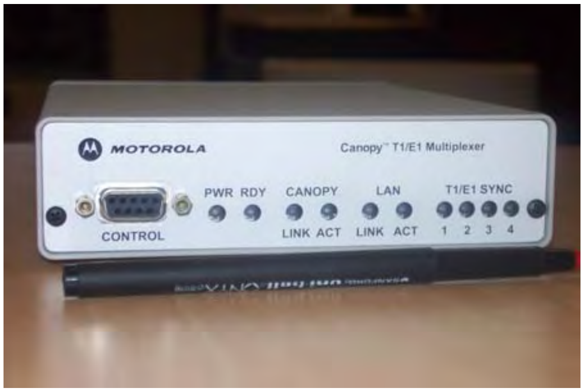


Figure 10: T1/E1 Multiplexer, front view

The T1/E1 Multiplexer supports

- synchronous TDM-based services over wireless Ethernet networks.
- CAS signaling transparent to all other signaling protocols on T1/E1.
- 10Base-T/100Base-TX uplink to the network.
- management interfaces.
- simplified troubleshooting through T1/E1 line loopback test.

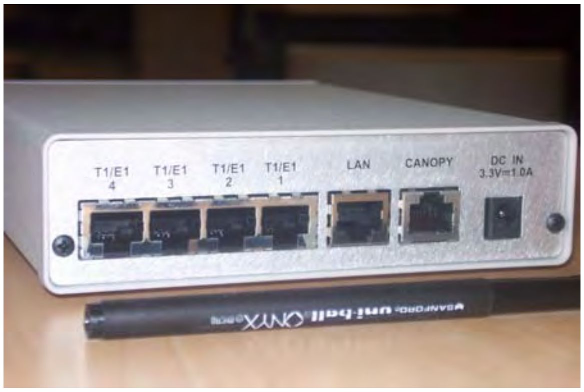


Figure 11: T1/E1 Multiplexer, rear view

Applications include

- obviating leased lines.
- implementing wireless PBX networking.
- establishing cellular backhaul links.
- providing homeland security backup or emergency voice networks.
- routing LAN/WAN data on excess bandwidth.

This product is supported by the dedicated document *Canopy T1/E1 Multiplexer User Guide*.

5.1.13 Cluster Management Module 2 (Part 1008CK-2)

The Cluster Management Module 2 (CMM2) provides power, GPS timing from an antenna that is included, and networking connections for an AP cluster. The CMM2 can also connect to a BH, in which case the CMM2 is the central point of connectivity for the entire site. The CMM2 can connect as many as eight collocated modules—APs, BHMs, BHSs—and an Ethernet feed.

The CMM2 requires two cables for each connected module:

- One provides Ethernet communications and power. This cable terminates in an RJ-45 connector.
- The other provides synchronization (sync), GPS status, and time and date in a serial interface. This cable terminates in an RJ-11 connector.

A CMM2 is pictured in Figure 12. A CMM2 as part of a mounted Canopy system is pictured in Figure 13.

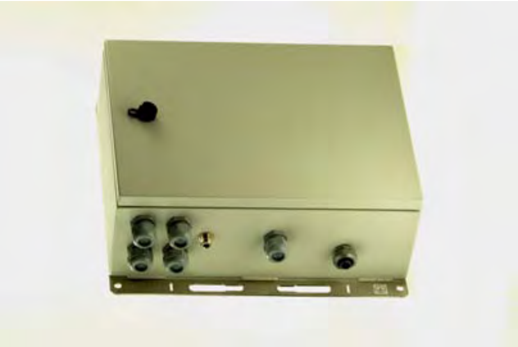


Figure 12: CMM2 enclosure

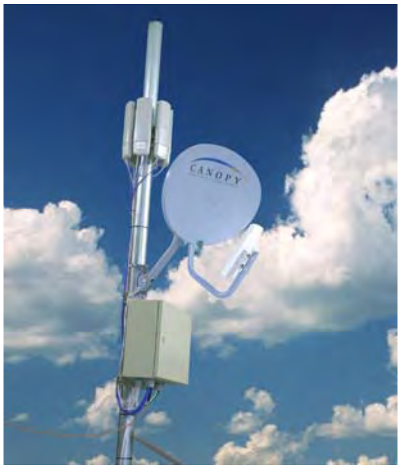


Figure 13: CMM2 pole-mounted

5.1.14 Cluster Management Module micro (Part 1070CK)

The Cluster Management Module micro (CMMmicro) provides power, GPS timing, and networking connections for an AP cluster. Unlike the CMM2, the CMMmicro is configurable through a web interface.

The CMMmicro contains an 8-port managed switch that supports Power over Ethernet (PoE)[2] on each port and connects any combination of APs, BHMs, BHSs, or Ethernet feed. The CMMmicro can auto-negotiate speed to match inputs that are either 100Base-TX or 10Base-T, and either full duplex or half duplex, where the connected device is set to auto-negotiate. Alternatively, these parameters are settable.

A CMMmicro requires only one cable, terminating in an RJ-45 connector, for each connected module to distribute

- Ethernet signaling.
- power to as many as 8 collocated modules—APs, BHMs, or BHSs. Through a browser interface to the managed switch, ports can be powered or not.
- sync to APs and BHMs. The CMMmicro receives 1-pulse per second timing information from Global Positioning System (GPS) satellites through an antenna (included) and passes the timing pulse embedded in the 24-V power to the connected modules.

GPS status information is available at the CMMmicro, however

- CMMmicro provides time and date information to BHMs and APs if both the CMMmicro is operating on CMMmicro Release 2.1 or later and the AP/BHM is operating on Canopy System Release 4.2 or later.
  See Time & Date Page of the AP on Page 186.
- CMMmicro *does not* provide time and date information to BHMs and APs if either the CMMmicro is operating on a release earlier than CMMmicro Release 2.1 or the AP/BHM is operating on a release earlier than Canopy System Release 4.2.

5.1.15 GPS Antenna

The Motorola GPS antenna provides either

- timing pulses to the CMMmicro.
- timing pulses and positioning information to the CMM2.

The GPS antenna is pictured in Figure 14.

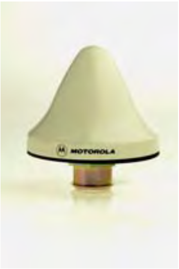


Figure 14: Motorola GPS antenna

[2] Through a proprietary scheme, different from IEEE Standard 803.af. Also, BHs in the OFDM Series use yet another proprietary scheme.

5.1.16 Surge Suppressor (Part 300SS)

The 300SS Surge Suppressor provides a path to ground (Protective Earth ⏚) that protects connected equipment from near-miss lightning strikes. A 300SS is pictured in Figure 15.

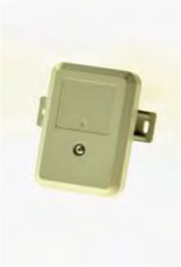


Figure 15: 300SS surge suppressor

5.1.17 Accessory Components

In addition to the above modules, the following accessories are available.

Power Supplies

The various power supplies available for Canopy modules are listed in Table 8.

Table 8: Power supply descriptions

For Use With	Part Number	Voltage (AC)	Cycles per Second (Hz)	Includes
CMMmicro	ACPS81WA	100 to 240	50 to 60	US IEC line cord
	ACPS81W-02A	100 to 240	50 to 60	no IEC line cord
Canopy radio[2] (except OFDM backhauls)	ACPS110-03A[1]	120	50 to 60	US plug
	ACPSSW-09A[3]	90 to 240	50 to 60	US, Euro, and UK adaptors
	ACPSSW-10A[3]	90 to 240	50 to 60	Argentina adaptor
	ACPSSW-11A[3]	90 to 240	50 to 60	Australia adaptor
	ACPSSW-12A[3]	90 to 240	50 to 60	China adaptor
30/60-Mbps OFDM BH	ACPSSW200-02A[4]	100 to 250 AC or −48 DC	47 to 63	US, Euro, and UK leads
	ACPSSW200-01A	100 to 250	47 to 63	
150/300-Mbps OFDM BH	ACPSSW200-03A[5]	100 to 250	47 to 63	

NOTES:

1. Pictured in Figure 16.
2. Single transceiver.
3. Pictured in Figure 17.
4. Pictured in Figure 8 on Page 53.
5. Pictured in Figure 9 on Page 53.

Figure 16: ACPS110-03A power supply

Figure 17: ACPSSW-09A power supply

Passive Reflector Dish Assembly

The 27RD Passive Reflector Dish on both ends of a BH link extends the distance range of the link and focuses the beam into a narrower angle to reduce interference. The 27RD on an SM only helps to reduce interference. The module support tube provides the proper offset focus angle. See Figure 18.

For 5.*n*-GHz radios, the reflector gain is 18dB and the beam width is 6° at 3 dB. For 2.4-GHz radios, the reflector gain is 11dB and the beam width is 17° at 3 dB. These beam width statements apply to both azimuth and elevation in each case.

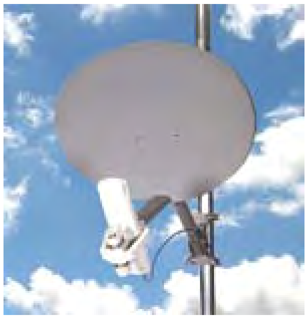


Figure 18: 27RD with mounted module

Module Support Brackets

The SMMB1 support bracket facilitates mounting the SM to various surfaces of a structure and has slots through which chimney straps can be inserted. An SMMB1 is pictured in Figure 19.

The SMMB2 is a heavy duty mounting bracket for the 900-MHz connectorized SM and its external antenna.

The BH1209 is a pole-mount bracket kit for Canopy backhaul modules.

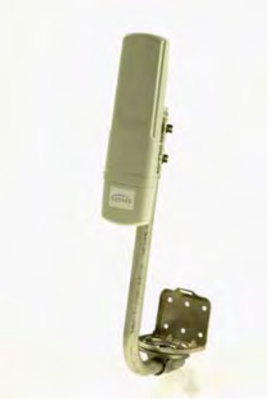


Figure 19: SMMB1 SM support bracket

Cables

Canopy modules that are currently or recently sold can auto-sense whether the Ethernet cable is wired as straight-through or crossover. Some modules that were sold earlier cannot. The MAC address, visible on the module, distinguishes whether the module can. See Table 48 on Page 180. All CMMmicros can auto-sense the cable scheme.

Where a non auto-sensing module is deployed

- a straight-through cable must be used for connection to a network interface card (NIC).
- a crossover cable must be used for connection to a hub, switch, or router.

Canopy-recommended Ethernet and sync cables can be ordered in lengths up to 328 ft (100 m) from Best-Tronics Manufacturing, Inc. at http://www.best-tronics.com/motorola.htm. These cables are listed in Table 9 and Table 10.

Table 9: Recommended outdoor UTP Category 5E cables

Best-Tronics Part #	Description
BT-0562	RJ-45 TO RJ-45; straight-through Ethernet cable
BT-0562S	RJ-45 TO RJ-45; shielded straight-through Ethernet cable
BT-0565	RJ-45 TO RJ-45; crossover Ethernet cable
BT-0565S	RJ-45 TO RJ-45; shielded crossover Ethernet cable
BT-0563	RJ-11 TO RJ-11; sync cable
BT-0563S	RJ-11 TO RJ-11; shielded sync cable

NOTE:
Shielded cable is strongly recommended for all AP cluster and BH installations.

Table 10: Recommended indoor UTP Category 5E cables

Best-Tronics Part #	Description
BT-0596	RJ-45 TO RJ-45; straight-through Ethernet cable
BT-0595	RJ-45 TO RJ-45; crossover Ethernet cable

Approved Ethernet cables can also be ordered as bulk cable:

- CA-0287
- CA-0287S (shielded)

Canopy-approved antenna cables can be ordered in lengths up to 100 ft (30.4 m), as listed in Table 11.

Table 11: Recommended antenna cables

Best-Tronics Part #	Description
BT-0564	N TO N GPS antenna cable for CMM2
BT-0716	BNC TO N GPS antenna cable for CMMmicro

Category 5 Cable Tester

For purchase within the U.S.A., the CTCAT5-01 Cable Tester is available.

Override Plug

An override plug (sometimes called a default plug) is available to provide access to a module whose password and/or IP address have been forgotten. This plug allows the AP, SM, or BH to be accessed using IP address 169.254.1.1 and no password. During the override session, you can assign any new IP address and set either or both user passwords (display-only and/or full access) as well as make other parameter changes.

This plug is available from Best-Tronics Manufacturing, Inc. at http://www.best-tronics.com/motorola.htm as Part BT-0583 (RJ-11 Default Plug). Alternatively if you wish, you can fabricate an override plug. For instructions, see Procedure 39 on Page 365 and the pinout in Figure 130 on Page 365.

Alignment Headset

The ACATHS-01 Alignment Headset facilitates the operation of precisely aiming an SM toward an AP (or a BHS toward a BHM). This device produces infinitely variable

- pitch, higher when the received signal is stronger.
- volume, louder when jitter is less.

An ACATHS-01 is pictured in Figure 20.

Figure 20: ACATHS-01 alignment headset

Pinouts for an alternative listening device are provided under Alignment Tone—Technical Details on Page 183.

Module Housing

The HSG-01 Canopy Plastic Housing is available for replacement of a damaged housing on a module that is otherwise functional. The HSG-01 is pictured in Figure 21.

The HSG-01 and all module housings of this design provide clearances for cable ties on the Ethernet and sync cables.

> *RECOMMENDATION:*
> Use 0.14” (40-lb tensile strength) cable ties to secure the Ethernet and sync cables to the cable guides on the module housing.

For the Ethernet cable tie, the Ethernet cable groove is molded lower at the top edge. For the sync cable tie, removal of a breakaway plug provides clearance for the sync cable, and removal of two breakaway side plates provides clearance for the sync cable tie.

Figure 21: HSG-01 Housing

5.2 FREQUENCY BAND RANGES

In the 2.4-, 5.2-, 5.1-, 5.4-, and 5.7-GHz frequency band ranges, Canopy APs, SMs, and BHs are available. Additionally, in the 900-MHz frequency band range, Canopy APs and SMs are available. National restrictions may apply. See Legal and Regulatory Notices on Page 469.

To avoid self-interference, a Canopy network typically uses two or more of these ranges. For example, where properly arranged, all AP clusters and their respective SMs can use the 2.4-GHz range where the BH links use the 5.7-GHz range. In this scenario, subscriber links can span as far as 5 miles (8 km) with no reflector dishes, and the BH links can span as far as 35 miles (56 km) with reflector dishes on both ends.

Within this example network, wherever the 2.4-GHz module is susceptible to interference from other sources, AP clusters and their linked SMs may use the 5.2-GHz range to span as far as 2 miles (3.2 km) with no reflector dishes. The network in this example takes advantage of frequency band range-specific characteristics of Canopy modules as follows:

- The 900-MHz modules cover a larger area, albeit with lower throughput, than modules of the other frequency bands. The 900-MHz modules can be used to
    - penetrate foliage
    - establish links that span greater distances
    - add subscribers
    - add overall throughput where modules of other frequency bands cannot be used (such as where interference would result or space on a tower is limited).
- The 2.4-GHz frequency band range supports AP/SM links of greater than 2-mile spans (with no reflectors).
- The 5.7-GHz frequency band range supports BH links that span as far as 35 miles.

5.3 CANOPY PRODUCT COMPARISONS

5.3.1 Canopy Product Applications

The product applications per frequency band range are is summarized in Table 12.

Table 12: Product applications per frequency band range

Product	Frequency Band Range					
	900 MHz	2.4 GHz	5.1 GHz	5.2 GHz	5.4 GHz	5.7 GHz
Access Point Module	●	●	●	●	●	●
Subscriber Module	●	●	●	●	●	●
Subscriber Module with Reflector[1]		●		●	●	●
Backhaul Module		●	●	●	●	●
Backhaul Module with Reflector[1]		●	●	●	●	●

Product	Frequency Band Range					
	900 MHz	2.4 GHz	5.1 GHz	5.2 GHz	5.4 GHz	5.7 GHz
OFDM Series Backhaul Module					●	●
CMM2	●	●	●	●	●	●
CMMmicro	●	●	●	●	●	●
T1/E1 Multiplexer		●	●	●	●	●
Power supply	●	●	●	●	●	●
Surge suppressor	●	●	●	●	●	●

NOTES:

1. National or regional regulations may limit EIRP to the same as without a reflector, and therefore require Transmit Output Power to be reduced. See National and Regional Regulatory Notices on Page 469. In these cases
   - the reflector used with an SM reduces beamwidth to reduce interference, but *does not* increase the range of the link.
   - the reflector on both ends of a BH link reduces beamwidth to reduce interference and also increases the range of the link.

5.3.2 Link Performance and Encryption Comparisons

The encryption options on Canopy *point-to-multipoint* (PTMP) products are summarized in Table 13. Typical Line-of-Site (LOS) range and aggregate useful throughput for Canopy PTMP links are summarized in Table 14.

Table 13: Products with encryption options available per frequency band, PTMP links

Frequency Band	Products available with the following encryption options	
	DES or none	AES or none
2.4 GHz @100 mW (ETSI)	●	●
2.4 GHz @ 1W	●	●
5.1 GHz	●	
5.2 GHz	●	●
5.4 GHz	●	●
5.7 GHz	●	●
900 MHz	●	●

Table 14: Typical range and throughput per frequency band, PTMP links

	Advantage AP				Canopy AP			
	Range		Aggregate Throughput Mbps	Round-trip Latency msec	Range		Aggregate Throughput[3] Mbps	Round-trip Latency msec
Frequency Band	no SM Reflector mi (km)	with SM Reflector mi (km)			no SM Reflector mi (km)	with SM Reflector mi (km)		
2.4 GHz ETSI	0.3 (0.5)	0.3 (0.5) [1]	14	6	0.6 (1)	0.6 (1) [1]	7	20
	0.6 (1)	0.6 (1) [1]	7	6				
2.4 GHz	2.5 (4)	7.5 (12)	14	6	5 (8)	15 (24)	7	20
	5 (8)	15 (24)	7	6				
5.1 GHz	1 (1.6)	na	14	6	2 (3.2)	na	7	20
	2 (3.2)	na	7	6				
5.2 GHz	1 (1.6)	na[2]	14	6	2 (3.2)	na[2]	7	20
	2 (3.2)	na[2]	7	6				
5.4 GHz	1 (1.6)	1 (1.6) [1]	14	6	2 (3.2)	2 (3.2)[1]	7	20
	2 (3.2)	2 (3.2) [1]	7	6				
5.7 GHz	1 (1.6)	5 (8)	14	6	2 (3.2)	10 (16)	7	20
	2 (3.2)	10 (16)	7	6				
900 MHz[4]	40 (64)	na	4	15				

NOTES:

1. In Europe, 2.4-GHz ETSI and 5.4-GHz SMs can have a reflector added to focus the antenna pattern and reduce interference, but transmit output power must be reduced to maintain the same EIRP as without a reflector, so the throughput and range specs for PTMP links remain the same.
2. In the USA and Canada, the use of a reflector with a full power radio in the 5.2-GHz frequency band is not allowed.
3. These values assume a hardware series P9 AP running “hardware scheduler”. When running “software scheduler” on a series P7, P8, or P9 AP, aggregate throughput drops to 6.2 Mbps, and only 4 Mbps is available to any one SM. (Series P7 and P8 APs can only run software scheduler.)
4. All 900-MHz APs are Advantage APs.

GENERAL NOTES:

Range is affected by RF conditions, terrain, obstacles, buildings, and vegetation.

An Advantage AP in other than 900 MHz has an aggregate (sum of uplink plus downlink) throughput or capacity of 14 Mbps, if RF conditions, range, and SM hardware version permit.

An Advantage SM in other than 900 MHz has an aggregate sustained throughput of 14 Mbps if RF conditions and range permit.

A regular SM can burst to 14 Mbps if RF conditions and range permit, then run at 7 Mbps sustained throughput.

The encryption options on Canopy *point-to-point* (PTP) products are summarized in Table 15. Typical Line-of-Site (LOS) range and aggregate useful throughput for Canopy PTP links are summarized in Table 16.

Table 15: Products with encryption options available per frequency band, PTP links

Frequency Band	Modulation Rate (Mbps)	Products available with the following encryption options			
		DES or none	AES or none	Proprietary	Proprietary or AES licensed upgrade
2.4 GHz @100 mW (ETSI)	10	●	●		
	20	●	●		
2.4 GHz @ 1W	10	●	●		
	20	●	●		
5.1 GHz	10	●			
	20	●			
5.2 GHz	10	●	●		
	20	●	●		
5.2 GHz ER	10	●	●		
	20	●	●		
5.4 GHz	10	●	●		
	20	●	●		
	30 60				●
5.7 GHz	10	●	●		
	20	●	●		
	30 60				●
	150 300			●	

Table 16: Typical range and throughput per frequency band, PTP links

Frequency Band	Modulation Rate (Mbps)	Throughput	
		No Reflectors	Both Reflectors
2.4 GHz @100 mW (ETSI)	10	7.5 Mbps to 2 km	7.5 Mbps to 16 km
	20	14 Mbps to 1 km	14 Mbps to 8 km
2.4 GHz @ 1W	10	7.5 Mbps to 5 mi (8 km)	7.5 Mbps to 35 mi (56 km)
	20	14 Mbps to 3 mi (5 km)	14 Mbps to 35 mi (56 km)
5.1 GHz	10	7.5 Mbps to 2 mi (3.2 km)	
	20	14 Mbps to 2 mi (3.2 km)	
5.2 GHz	10	7.5 Mbps to 2 mi (3.2 km)	
	20		
5.2 GHz ER	10		7.5 Mbps to 10 mi (16 km)
	20		14 Mbps to 5 mi (8 km)
5.4 GHz	10	7.5 Mbps to 2 mi (3.2 km)	7.5 Mbps to 10 mi (16 km)[1]
	20	14 Mbps to 1 mi (1.6 km)	14 Mbps to 5 mi (8 km)[1]
	30	dynamically variable from 1.5 to 21 Mbps aggregate[2]	
	60	dynamically variable from 3 to 43 Mbps aggregate[2]	
5.7 GHz	10	7.5 Mbps to 2 mi (3.2 km)	7.5 Mbps to 35 mi (56 km)
	20	14 Mbps to 1 mi (1.6 km)	14 Mbps to 35 mi (56 km)
	30	dynamically variable from 1.5 to 21 Mbps aggregate[2]	
	60	dynamically variable from 3 to 43 Mbps aggregate[2]	
	150	dynamically variable from 7 to 150 Mbps aggregate[2]	
	300	dynamically variable from 14 to 300 Mbps aggregate[2]	

NOTES:

1. These ranges are with power reduced to within 1 W (30 dBm) EIRP.
2. Use the Link Estimator tool to estimate throughput for a given link.

5.3.3 Cluster Management Product Comparison

Canopy offers a choice between two products for cluster management: CMM2 and CMMmicro. Your choice should be based on the installation environment and your requirements. The similarities and differences between these two products are summarized in Table 17.

Table 17: Cluster management product similarities and differences

Characteristic	CMM2	CMMmicro
Approximate size	17” H x 13” W x 6.5” D (43 cm H x 33 cm W x 7 cm D)	12” H x 10” W x 3” D (30 cm H x 25 cm W x 8 cm D)
Approximate weight	25 lb (11.3 kg)	8 lb (3.5 kg)
Cabling	◦ one Ethernet/power cable per radio. ◦ one sync cable per radio.	one Ethernet/power/sync cable per radio.
Canopy network interconnection	8 Ethernet ports	8 Ethernet ports
Data throughput	auto-negotiates to full or half duplex	auto-negotiates to full or half duplex
Ethernet operating speed standard	auto-negotiates to 10Base-T or 100Base-TX	auto-negotiates to 10Base-T or 100Base-TX
Additional Ethernet ports	one for data feed one for local access (notebook computer)	none
Power supply	integrated 24-V DC to power APs, BHs, and GPS receiver	external 24-V DC to power APs, BHs, and GPS receiver
SNMP management capability	none	provided
Sync (to prevent self-interference)	carried by the additional serial cable to each AP and BHM	embedded in power-over-Ethernet cable
Time & Date	carried by the additional serial cable to each AP and BHM	provided by NTP (Network Time Protocol). CMMmicro can be an NTP server.
Weatherized	enclosure and power supply	only the enclosure (not the power supply)
Web interface	none	web pages for status, configuration, GPS status, and other purposes
NOTE: Auto-negotiation of data throughput and Ethernet operating speed depend on the connected device being set to auto-negotiate as well.		

5.4 ANTENNAS FOR CONNECTION TO 900-MHz MODULES

Like the 2.4-, 5.2-, 5.4-, and 5.7-GHz module, the 900-MHz connectorized module has

- the same housing.
- a covered Ethernet port.
- a utility port for alignment headset, sync cable to CMM2, or override plug.

The 900-MHz AP or SM is available either

- as a connectorized unit with a 16-inch (approximately 40-cm) cable with a male N-type connector for connection to the antenna.
- with an integrated antenna in a different form factor.

5.4.1 Certified Connectorized Flat Panel Antennas

Motorola has certified through regulatory agencies four connectorized flat panel antenna options. Motorola offers one of these, whose attributes include

- gain—10 dBi
- dimensions—8.8 x 8.1 x 1.6 inches (22.4 x 20.6 x 4.06 cm)
- weight—1.2 lbs (0.54 kg)
- polarization—vertical or horizontal
- cable—12-inch (30.5 cm)
- connector—female N-type
- beamwidth—approximately 60° vertical and 60° horizontal at 3 dBm

Motorola has certified three other antennas, which are available through Canopy resellers. The attributes of one of these other certified antennas include

- gain—10 dBi
- dimensions—12 x12 x 1 inches (30.5 x 30.5 x 2.5 cm)
- weight—3.3 lbs (1.5 kg)
- polarization—vertical or horizontal
- connector—female N-type
- beamwidth—approximately 60° vertical and 60° horizontal at 3 dBm

Examples of these antennas are pictured in Figure 4 on Page 51.

5.4.2 Third-party Certified Connectorized Flat Panel Antenna

A third party may certify additional antennas for use with the Canopy connectorized 900-MHz module.

5.5 ADJUNCTIVE SOFTWARE PRODUCTS

The capabilities of available applications and tools are summarized for comparison in Table 18.

Table 18: Canopy applications and tools

Capability	Application or Tool			
	Prizm	**CNUT**[1]	**SM Autoupdate**	**BAM**[2]
authenticates SMs	●			●
controls **authentication** in APs	●	●		
manages **Committed Information Rate** (CIR)	●			●
has **dependency** on another application[3]		●		
automatically **discovers** elements	●	●		
exports network information with hierarchy	●	●		
supports user-defined **folder**-based operations	●	●		
senses **FPGA version** on an element	●	●	●	
upgrades **FPGA version** on an element		●	●	
enables/disables **hardware scheduling**		●		
manages the **high-priority channel**	●			●
imports network information with hierarchy	●	●		
interface to a higher-level network management system (NMS)	●			
interface to an operations support system (OSS)	●			
manages **Maximum Information Rate** (MIR)	●			●
automatically works from **root** (highest) level		●		
element **selection** can be individual or multiple	●	●		●
element **selection** can be criteria based	●			
element **selection** can be user-defined branch	●	●		
senses **software release** on an element	●	●	●	
upgrades **software release** on an element		●	●	

Capability	Application or Tool			
	Prizm	CNUT[1]	SM Autoupdate	BAM[2]
manages **VLAN** parameters	●			●
provides access to element **web interface**	●			

NOTES:

1. Canopy Network Updater Tool, Release 1.1 or later.
2. Bandwidth and Authentication Manager, Release 2.0 or later.
3. CNUT requires SM Autoupdate.

5.6 BANDWIDTH AND AUTHENTICATION MANAGER

Canopy Bandwidth and Authentication Manager (BAM) software allows you to use

- a primary server to distribute bandwidth resources per subscriber, require SMs to authenticate per AP, and deny service to unauthorized SMs.
- a secondary server to redundantly store identical SM bandwidth and authentication data and become governing if the primary server goes out of service.
- an optional tertiary server to do the same if both the primary and secondary servers go out of service.

In BAM Release 2.1, subscriber administration for an SM or batch of SMs is performed as follows:

- Insert the ESNs.
- Specify MIR and Security attributes.
- Specify CIR attributes.
- Specify whether BAM should send its stored CIR attributes.
- Specify VLAN attributes.
- Specify whether BAM should send its stored VLAN attributes.
- Specify VLAN IDs to associate with the SM(s).

This product is supported by the dedicated document *Canopy Bandwidth and Authentication Manager Release 2.1 User Guide* and associated release notes.

The upgrade path from BAM Release 2.1 is Prizm Release 2.0. See *Motorola Canopy Prizm User Guide*, Issue 3, and *Motorola Canopy Prizm Release 2.0 Release Notes*.

5.7 Prizm

The product name PrizmEMS is changed to Prizm in Release 2.0 and later, to reflect that the product capabilities are expanded beyond those of the element management system (EMS). Throughout this user guide, the name change applies to text for Release 2.0 and for multiple releases that include 2.0. It does not apply to text that is for a previous release. Case by case, software elements such as the GUI in the client application and XML files on the server may retain the PrizmEMS syntax.

5.7.1 Network Definition and Element Discovery

Prizm allows the user to partition the entire Canopy network into criteria-based subsets that can be independently managed. To assist in this task of defining networks, Prizm auto discovers Canopy network elements that are in

- user-defined IP address ranges
- SM-to-AP relationships with APs in the user-defined range
- BHS-to-BHM relationships with BHMs in the user-defined range.
- PLV Modem-to-PLV Bridge relationships with PLV Bridges in the user-defined range.

For a Canopy AP, SM, BHM, BHS, PLV Bridge, PLV Modem, or CMMmicro, Prizm

- auto discovers the element to the extent possible.
- includes the element in the network tree.
- shows general information.
- shows Canopy information.
- supports Canopy-specific operations.

For a generic element, Prizm

- auto discovers the element as only a generic network element.
- includes the element in the network tree.
- shows general information.
- shows events and alerts.
- charts port activity.

For passive elements (such as CMM2 or a non-manageable switch or hub), Prizm allows you to enter into the network tree a folder/group with name, asset/owner information, and descriptive information.

Supported element types include

- Canopy Access Point Module
- Canopy Backhaul Master Module
- Canopy Backhaul Slave Module
- Canopy Cluster Management Module
- Canopy PrizmEMS
- Canopy Subscriber Module
- Generic Group
- Generic SNMP Device
- Generic SNMP Device (08 Port)
- Generic SNMP Device (16 Port)
- Generic SNMP Device (24 Port)
- Generic SNMP Device (26 Port)
- High-Speed Backhaul Master Module
- High-Speed Backhaul Slave Module
- Powerline LV Bridge Unit
- Powerline LV Modem Unit

5.7.2 Monitoring and Fault Management

Prizm receives the traps that Canopy elements send and generates an alert for each of these. Prizm also allows the user to establish sets of criteria that would generate other alerts and trigger email notifications. Optionally, the user can specify a trap template. In this case, Prizm receives traps for non-Canopy elements in the network.

For any individual element that the user selects, Prizm offers text and graphed displays of element configuration parameters and performance statistics from an interval that the user specifies.

5.7.3 Element Management

Prizm allows the user to perform any of the following operations on any specified element or group of elements:

- Manage
  - large amounts of SNMP MIB data.
  - module passwords.
  - IP addresses.
  - other communications setup parameters.
  - site information: Site Name, Site Location, and Site Contact parameters.
- Reset the element.

5.7.4 BAM Subsystem in Prizm

Prizm Release 2.0 and later integrates Canopy Bandwidth and Authentication Manager (BAM) functionality and supports simple migration of a pre-existing BAM data into the Prizm database. These releases also support the maintenance of authentication and bandwidth data on a RADIUS server, to the same extent that BAM Release 2.1 (the final release of BAM) did.

Either of the following modes is available for the Prizm server, subject to licensing:

- BAM-only functionality, which manages only
  - authentication, bandwidth service plans, and VLAN profiles of SMs.
  - authentication of Powerline LV modems.
- Full Prizm functionality, which manages attributes for all elements and authentication of SMs and Powerline LV modems.

One difference between a service plan (or VLAN profile) and a configuration template that has the identical set of attributes is that the former is a long-term association whereas the latter is a one-time push to the element. When a service plan or VLAN profile is modified, the change is automatically applied to all elements that have the association. Another difference is that a configuration template cannot overwrite any values that a service plan or VLAN profile has set in an element.

5.7.5 Northbound Interface

In Release 1.1 and later, Prizm provides three interfaces to higher-level systems:

- a Simple Network Management Protocol (SNMP) agent for integration with a network management system (NMS).
- a Simple Object Access Protocol (SOAP) XML-based application programming interface (API) for web services that supports integration with an operations support systems (OSS) such as a customer relationship management (CRM), billing, or provisioning system.
- console automation that allows such higher-level systems to launch and appropriately display the Prizm management console in GUI that is custom developed, using the *PrizmEMS™ Software Development Kit (SDK)*, which Canopy provides for this purpose.

Together these interfaces constitute the Northbound Interface feature. Prizm server administrator tasks and GUI developer information are provided in the *PrizmEMS™ Software Development Kit (SDK)*. This SDK also describes the how to define new element types and customize the Details views.

All other features of the Prizm product are supported by the dedicated document *Motorola Canopy Prizm User Guide* and associated release notes.

5.8 LICENSE MANAGEMENT

Under the original licensing regime for Canopy networks, licenses were permanently tied to the Media Access Control (MAC) address of the equipment that was licensed or that used the licensed feature. Thus, they were not transferable. Under server-based license management, for some functionalities, Canopy offers licenses that

- float upon demand within the network.
- are tied to only the hostID (MAC address) of the license management server for which they were ordered.

In Release 4.2.3 and later, server-based license management adds flexibility and makes available licenses that previously would have been held by de-commissioned equipment. License management technology from Macrovision, based on a FLEXnet™ Publisher license management model, provides the platform for Canopy server-based licensing. Canopy capabilities that are authorized by licenses on this platform are *FLEXenabled* products.

In this platform, the license management server checks and then either assigns or declines to assign a license in real time. See the *Canopy Networks License Manager User Guide*.

The total number of floating license keys that you need for any feature is the highest number that you will ever want to have simultaneously in use. The proper placement of these keys and the number and placement of fixed Canopy licenses are listed in Table 19.

Table 19: Correct placement of license keys

In This Release	License Key	Must Be in Directory	If This Platform	On This Server Device
LM 1.0	License Manager Server	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM Server
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	
BAM 2.0	BAM Server, AP Auth Server (APAS), Cap 2	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM Server[1]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	
		/usr/local/canopy/include	Enterprise Linux	BAM Server[2]
BAM 2.1	BAM Server, AP Auth Server (APAS), Cap 2	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM Server[1]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	BAM Server[2]
PrizmEMS 1.0	PrizmEMS Server, Element Pack	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM Server[3]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	
		C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	PrizmEMS Server[4]
		/usr/local/Canopy/Prizm/license_files	Enterprise Linux	
PrizmEMS 1.1	PrizmEMS Server, Element Pack	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM Server[3]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	

In This Release	License Key	Must Be in Directory	If This Platform	On This Server Device
Prizm 2.0 for full mgmt	PrizmEMS Server, Element Pack BAM Server, AP Auth Server (APAS), Cap 2 Canopy Lite	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM server[5]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	
Prizm 2.0 for BAM-only or redundant BAM	BAM Server, AP Auth Server (APAS), Cap 2 Canopy Lite	C:\Program Files\Motorola\Canopy\FLEXnet\license_files	Windows	LM server[1]
		/usr/local/Canopy/FLEXnet/license_files	Enterprise Linux	

NOTES:

1. One key required per each deployed BAM server.
2. Copied here so that BAM can find License Manager. No additional charge for using this copy.
3. One key required per each deployed PrizmEMS server.
4. Copied here so that PrizmEMS can find License Manager. No additional charge for using this copy.
5. One BAMServer key and one PrizmEMSServer key required per each full management Prizm server.

5.9 SPECIFICATIONS AND LIMITATIONS

5.9.1 Radios

Canopy radio specifications are provided at http://motorola.canopywireless.com/products.

5.9.2 Cluster Management Products

Table 20: CMM2 specifications and limitations

Specification or Limitation	Canopy System Range
Max length from Cluster Management Module to any radio	328 cable feet (100 meters)
Max length from Cluster Management Module to GPS antenna	100 cable feet (30.5 meters)
Dimensions	17.00” H x 12.88” W x 6.50” D (43.18 cm H x 32.72 cm W x 16.51 cm D)

Specification or Limitation	Canopy System Range
Weight	25.0 lbs. (11.3 kg)
Operation Temperature	-40°F to +131°F (-40°C to +55°C)
Overall	Meets CE IP44 according to EN60529:2000
AC Input Voltage and Frequency	100 V – 240 V~, 0.7 A – 0.35 A, settable to either 230 V or 115 V nominal input. 50 Hz – 60 Hz Note: Applying 230 V to a unit that is set to 115 V may damage the unit.
AC Input Power	Nominal 66 watts, max 92 watts with 8 modules connected to the CMM at max cable length.
24-V DC Input Voltage	18 to 32 V DC, measured at CMM
24-V DC Input Power	Nominal 60 watts. Maximum 84 watts with 8 modules connected to the CMM at maximum cable length. 9A inrush upon start-up.
24-V DC Usage	If using a typical “24V +/-5%” power supply, ensure that CMM is within 400 cable feet (120 m) of the power supply. Use minimum 12 AWG (4 mm^2) copper wire.
12-V DC Input Voltage	11.5 to 32 VDC, measured at CMM
12-V DC Usage	If using a 12V power source (typically an automobile battery in a test or emergency situation), use 12 AWG (4 mm^2) wire between the power supply and the CMM, ensure that the CMM is within 10 cable feet (3 m) of the power supply, and ensure the modules are within 20 cable feet (6 m) of the CMM.
Ethernet, GPS Sync, and GPS Coax Cables	The use of cables that conform to the operational temperature of the product as well as being UV light protected is mandatory.

Table 21: CMMmicro specifications and limitations

Specification or Limitation	Canopy System Range
Enclosure Size	Approximately 12” H x 10” W x 3” D (Approximately 30 cm H x 25 cm W x 7.5 cm D)
CMMmicro Weight (without DC power supply)	Approximately 8 lb (Approximately 3.5 k)
Max length from Cluster Management Module to any radio	328 cable feet (100 meters)
Max length from Cluster Management Module to GPS antenna	100 cable feet (30.5 meters)
Operating Temperature	-40°F to +131°F (-40°C to +55°C)

Specification or Limitation	Canopy System Range
Provided DC Power Converter Input Voltage	100 – 240 V~
Provided DC Power Converter Input Frequency	50 – 60 Hz
CMMmicro Power Input Voltage	21.5 – 26.5 V DC
CMMmicro Power Current	3.36 A @ 24 V DC (3.75 – 3.0 A over voltage range)
Ethernet, GPS sync, and GPS coax cables	The use of cables that conform to the operational temperature of the product as well as having UV light protection is mandatory. Cables can be ordered from Best-Tronics Manufacturing, Inc. at http://www.best-tronics.com/motorola.htm.

5.9.3 300SS Surge Suppressor

Canopy Surge Suppressor specifications are provided at http://motorola.canopywireless.com/products.

6 DIFFERENTIATING AMONG COMPONENTS

6.1 INTERPRETING MODEL (PART) NUMBER

The part number of a module typically represents

- the model number, which may indicate
  - radio frequency band range.
  - link distance range.
  - whether the module is Canopy Advantage.
  - the factory-set encryption standard.
- the module type.
- whether the reflector dish is included.
- the antenna scheme of the module.
- whether adjustable power in the module is preset to low.
- the modulation capability.

Radio Frequency Band Range

The leading digits usually indicate the frequency band range in which the module can operate. For example, if the part number is 5700BH, then the frequency band range of the module is 5.7 GHz.

$$\overset{\downarrow}{\boxed{5\ \ 7}}\ 0\ \ 0\ \ \mathrm{B}\ \ \mathrm{H}$$

An exception to this general rule is that the leading digits in the part number of 5.1-GHz modules are 52. These modules are differentiated from 5.2-GHz modules by the leading four digits (5202 for 5.1 GHz, 5200 for 5.2 GHz).

You cannot change the frequency band range of the module.

Link Distance Range or Canopy Advantage

The third digit in the part number may indicate whether the module is an extended range, Canopy Advantage, or Canopy model. 1 indicates extended range. For example, if the part number is 5210BH, then the module *is* an extended range module. If the part number is 5200BH, then the module is not an extended range model.

$$5\ \ 2\ \overset{\downarrow}{\boxed{0}}\ 0\ \ \mathrm{B}\ \ \mathrm{H}$$

6 in the third position (5760SM, for example) indicates Canopy Lite. 5 in the third position (5250AP, for example) indicates that the module is Canopy Advantage. 0 in the third position (5200AP, for example) indicates that the module is Canopy. However, *part numbering for 900-MHz APs and SMs differs from this general rule*. All APs and SMs in this frequency band range are Canopy Advantage, but none of their part numbers use 5 in the third position.

You cannot change the link distance range of the module. However, you can license a Canopy SM to uncap its aggregate throughput (a capability of the Advantage SM).

Encryption Standard or Frequency Band Range

The fourth digit in the part number usually indicates the encryption standard that was preset at the factory. 1 indicates the Advanced Encryption Standard (AES). 0 indicates the Data Encryption Standard (DES) standard. For example, if the part number is 5201BH, then transmissions from the module are encrypted according to AES. If the part number is 5200BH, then transmissions from the module are encrypted according to DES.

$$\begin{array}{cccccc} & & & \downarrow & & \\ 5 & 7 & 0 & \boxed{0} & B & H \end{array}$$

An exception to this general rule is that the fourth digit in the part number of 5.1-GHz modules is 2. These modules are differentiated from 5.2-GHz modules by the leading four digits (5202 for 5.1 GHz, 5200 for 5.2 GHz).

You cannot change the encryption basis (from DES to AES, for example), but you can enable or disable the encryption.

Module Type

The next two alpha characters indicate the module type. For example, CK indicates that the module is a Cluster Management Module.

$$\begin{array}{cccccc} & & & & \downarrow & \\ 1 & 0 & 0 & 8 & \boxed{C\ \ K} \end{array}$$

The module type cannot be changed.

Reflector Added

In specifications tables and price lists, the trailing characters RF or RF20 indicate that the associated information applies to the module being

- mounted to the 27RD Passive Reflector Dish, in the case of specifications.
- ordered with the 27RD Passive Reflector Dish, in the case of price lists.

$$\begin{array}{cccccccc} & & & & & & \downarrow & & \\ 2 & 4 & 0 & 0 & B & H & \boxed{R\ \ F} & 2 & 0 \end{array}$$

However, this designation is not shown on either label of the module, and a module ordered with the dish can be deployed without the dish.

Antenna Scheme

In specifications tables and price lists, the trailing character C indicates that the module is connectorized for an external antenna.

$$9\ 0\ 0\ 0\ \text{S}\ \text{M}\ \overset{\downarrow}{\boxed{\text{C}}}$$

An F in this position indicates that the module has an internal antenna with a band-pass filter (for example, 9000APF).

You cannot transform a module from connectorized to internal antenna or from internal antenna to connectorized, but you may have flexibility in what external antenna you deploy with it.

Adjustable Power Preset to High or Low

A trailing WL can indicate that the module had adjustable power that is preset to low.

$$2\ 4\ 0\ 0\ \text{A}\ \text{P}\ \overset{\downarrow}{\boxed{\text{W}\ \ \text{L}}}$$

However, the 5700SMC and 5700APC are connectorized, but also have adjustable power preset to low. No special designation is made for adjustable power that is set to high (no trailing letters are used; for example, 5252AP).

You can reset power to higher in a module with adjustable power that is preset to low, but you are constrained by applicable regulations in your region and or nation.

Modulation Capability

A trailing 20 indicates that the module is capable of being set to either

- 20-Mbps modulation (aggregate throughput of 14 Mbps)
- 10-Mbps modulation (aggregate throughput of 7 Mbps).

$$2\ 4\ 0\ 0\ \text{B}\ \text{H}\ \text{R}\ \text{F}\ \overset{\downarrow}{\boxed{2\ \ 0}}$$

The absence of a trailing 20 indicates that the module is capable of only 10-Mbps modulation.

6.2 SORTED MODEL (PART) NUMBERS

The various model/part numbers of Canopy products are categorically listed in Table 22.

Table 22: Canopy model numbers (part numbers) for AES and DES encryption modules

Range	Integrated Antenna				Connectorized for Antenna			
	Canopy		Advantage		Canopy		Advantage	
	DES	AES	DES	AES	DES	AES	DES	AES
5.7 GHz	5700AP 5700BH 5700BH20 5700BHRF 5700BHRF20 5700SM 5760SM	5701AP 5701BH 5701BH20 5701BHRF 5701BHRF20 5701SM	5750AP 5750SM	5751AP 5751SM	5700APC 5700BHC 5700BHC20 5700SMC	5701APC 5701BHC 5701BHC20 5701SMC	5750APC 5750SMC	5751APC 5751SMC
5.4 GHz	5400AP 5400BH 5400BH20 5400BHRF 5400BHRF20 5400SM	5401AP 5401BH 5401BH20 5401BHRF 5401BHRF20 5401SM	5450AP 5450SM	5451AP 5451SM				
5.1 GHz	5202AP 5202BH 5202SM 5212BH20 5212BHRF20		5252AP 5252SM					
5.2 GHz	5200AP 5200BH 5200SM 5210BHRF 5210BHRF20	5201AP 5201BH 5201SM 5211BH20 5211BHRF 5211BHRF20	5250AP 5250SM	5251AP 5251SM				
2.4 GHz	2400AP 2400APWL 2400BH 2400BH20 2400BHRF 2400BHRF20 2400BHWL 2400BHWL20 2400BHWLRF 2400BHWLRF20 2400SM 2400SMWL	2401AP 2401APWL 2401BH 2401BH20 2401BHRF 2401BHRF20 2401BHWL 2401BHWL20 2401BHWLRF 2401BHWLRF20 2401SM 2401SMWL	2450AP 2450APWL 2450SM 2450SMWL	2451AP 2451APWL 2451SM 2451SMWL				
900 MHz			9000AP 9000APF 9000SM 9000SMF	9001AP 9001APF 9001SM 9001SMF			9000APC 9000SMC	9001APC 9001SMC

Table 23: Canopy model numbers (part numbers) for proprietary encryption modules

Range	Integrated Antenna	Connectorized for Antenna
5.7 GHz	5830BH 5830BH15 5730BH 5730BH20	5830BHC 5830BHC15 5730BHC 5730BHC20
5.4 GHz	5430BH 5430BH20	5430BHC 5430BHC20

6.3 INTERPRETING ELECTRONIC SERIAL NUMBER (ESN)

Canopy module labels contain a product serial number that could be significant in your dealings with Motorola or your supply chain. This is the electronic serial number (ESN), also known as the Media Access Control (MAC) address, of the module. This hexadecimal number identifies the module in

- communications between modules.
- the data that modules store about each other (for example, in the **Registered To** field).
- the data that the BAM software applies to manage authentication and bandwidth.
- Prizm auto discovery of SMs through the AP (or BHS through the BHM).
- software upgrades performed by the Canopy Network Updater Tool (CNUT).
- information that CNUT passes to external tools.

6.4 FINDING THE MODEL (PART) NUMBER AND ESN

The labels and locations of Canopy module model (part) numbers and ESNs are shown in Table 24.

Table 24: Labels and locations of model (part) numbers and ESNs

Numeric String	Label and Location	
	Older Modules	Newer Modules
Model (part) number	**PN** outside	**Model #** outside
ESN/MAC address	**S/N** inside	**ESN** outside

7 CANOPY LINK CHARACTERISTICS

7.1 UNDERSTANDING BANDWIDTH MANAGEMENT

7.1.1 Downlink Frame Contents

The AP broadcasts downlink frames that contain control information, allocating slots in succeeding or future uplink frames to SMs that have requested service. The downlink frame also contains a beacon frame, control information, and data that specific SMs have requested. Each SM

- examines the downlink frame to distinguish whether data is addressed to that SM.
- retrieves data addressed to that SM.
- directs such data to the appropriate user.

7.1.2 Uplink Frame Contents

Uplink frames contain control information from each SM that request service on succeeding uplink frames. SMs insert data into the uplink frames in an amount that the AP has established.

For non 900-MHz modules with software scheduling, in a scenario in which 200 SMs (the maximum number of SMs that an AP can support) simultaneously request to pass data to the AP in the uplink frame, the AP acknowledges all of these requests within 80 msec. This interval is based on the frame size 2.5 msec, 400 frames per second, and 3 SMs per frame.

7.1.3 Default Frame Structures

Structure in Software Scheduling

With a 64-byte slot size, the default Canopy frame in software scheduling consists of

- 33 data slots, subject to the following variables:
  - Maximum range decreases the number of available slots to 32.
  - Background bit error rate (BER) mode decreases the number of available data slots by one (and bandwidth by 200 kbps).
  - Every two control slots that are allocated decrease the number of available data slots by one.
- 6 control slots
  - 3 uplink control slots
  - 3 downlink control slots
- 6 acknowledgement slots
  - 3 uplink ACK slots
  - 3 downlink ACK slots

- 1 beacon slot, which identifies the
  - timing and distribution for the SMs
  - ratio of uplink to downlink allocation
  - ESN of the AP
  - color code
  - protocol (point-to-point or point-to-multipoint)
  - number of registered SMs
  - frame number
  - control slot information

Structure in Hardware Scheduling

With a 64-byte slot size, the default Canopy frame in hardware scheduling consists of

- variable numbers of uplink and downlink data slots, subject to the following factors:
  - Maximum range decreases the number of available slots to 32.
  - Background bit error rate (BER) mode decreases the number of available data slots by one (and bandwidth by 200 kbps).
  - Every two control slots that are allocated decrease the number of available data slots by one.
- 0 to 10 control slots, subject to operator setting
- 0 to 9 downlink acknowledgement slots, dynamically assigned
- 0 to 9 uplink acknowledgement slots, dynamically assigned
- 1 uplink schedule slot
- 1 beacon slot, which identifies the
  - timing and distribution for the SMs
  - ratio of uplink to downlink allocation
  - ESN of the AP
  - color code
  - protocol (point-to-point or point-to-multipoint)
  - number of registered SMs
  - frame number
  - control slot information
- air delay, subject to the value of the **Max Range** parameter in the AP

Control Slots

When the AP Status page is displayed and **Expanded Stats** has been selected, the Status page displays the total of control slots (default 3, maximum 7 in the 900-MHz frequency band range[3] and 16 in all others). These control slots are contention slots.

[3] In the 900-MHz frequency band range, the frame size is 16,667 bits. In all others, the frame size is 25,000 bits. The smaller frame does not provide enough space to allocate more than 7 control slots.

If too many SMs contend for these slots, then the number of control slots may be increased.

ACK Slots

When the AP Status page is displayed and **Expanded Stats** has been selected, the Status page displays the total of ACK slots (1 through 7). In an ACK slot, the AP or SM sends to the other a bitmap, which tracks packet fragments.

Frame Scheduling

When an SM boots, the following sequence occurs:

1. The SM finds this beacon slot from an AP.
2. The SM synchronizes with the AP.
3. If BAM is configured on the AP and the AP is licensed for authentication, then
    a. the AP sends a Registration Request message to the BAM server for authentication.
    b. following a successful challenge, the BAM server or the BAM subsystem in Prizm returns an Authentication Grant message to the AP.
    c. the AP sends a Registration Grant to the SM.

    If BAM *is not* configured on the AP or the AP is not licensed for authentication, then the AP simply returns the Registration Grant to the SM.

This Registration Grant includes the distance between the AP and SM. The SM uses the distance to distinguish when to transmit data in the uplink frame. The AP performs advance scheduling of up to 1024 frames that each SM will be permitted to use in the uplink frame.

7.1.4 Media Access Control and AP Capacity

Regardless of whether the maximum number of SMs (200) all request service at the same time, the reservation Media Access Control (MAC) system allows the AP to give a reservation slot to each SM that requests service.

Regardless of the distance between any SM and the AP, the reservation MAC system ensures that all SM data slots are free of contention. For this reason

- all SMs are equally able to compete for uplink and downlink bandwidth.
- the capacity of the AP is not degraded by distance from the SMs.

7.1.5 Canopy Slot Usage

The frame illustrated in Figure 22 shows both packet fragments (yellow) and unused slot space (red) typical of uplink traffic. Packet sizes smaller than 64 bytes cause unused slot spaces.

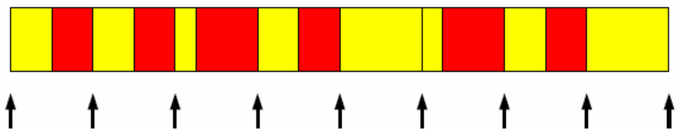


Figure 22: Uplink data slot usage

The following statistics apply to Canopy frame slot usage:

- Slot capacity is 64 bytes.
- The optimum Ethernet packet size is 1518 bytes.
- The maximum downlink throughput for one AP to one SM is 1800 packets per second (pps).
- The maximum uplink throughput for one AP to one SM is 300 pps.
- The maximum backhaul throughput is 3000 pps.

7.1.6 Data Transfer Capacity

Canopy modules use Time Division Duplex (TDD) on a common frequency to divide frames for uplink (orange) and downlink (green) usage, as shown in Figure 23.

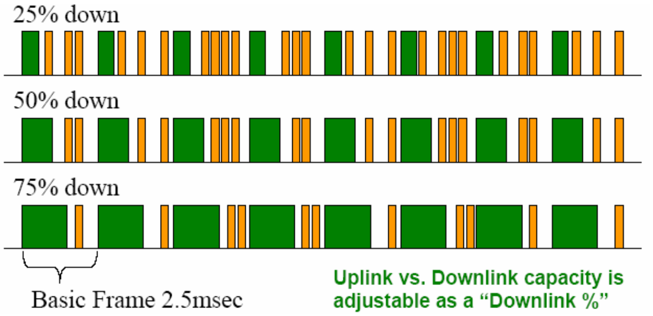

25% down
50% down
75% down
Basic Frame 2.5msec
Uplink vs. Downlink capacity is adjustable as a "Downlink %"

Figure 23: TDD dividing Canopy frames

7.1.7 Maximum Information Rate (MIR) Parameters

Canopy point-to-multipoint links use the following four MIR parameters for bandwidth management:

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

You can independently set each of these parameters per AP or per SM.

Token Bucket Concept

The Canopy software uses a theoretical *token bucket* that

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

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

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

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

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

Which set of these MIR parameters are applicable depends on the interactions of other parameter values. These interactions are described under Setting the Configuration Source on Page 287. Also, where the **Configuration Source** parameter setting in the AP specifies that BAM values should be used, they are used only if BAM is configured to send the values that it stores for the MIR parameters.

MIR Data Entry Checking

Uplink and downlink MIR is enforced as shown in Figure 24.

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

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

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

Figure 24: Uplink and downlink rate caps adjusted to apply aggregate cap

For example, in the Canopy SM, if you set the **Sustained Uplink Data Rate** parameter to 2,000 kbps and the **Sustained Downlink Data Rate** parameter to 10,000 kbps, then the uplink and downlink MIR that will be enforced for the SM can be calculated as shown in Figure 25.

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

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

Figure 25: Uplink and downlink rate cap adjustment example

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

The sustained data rate and burst allocation parameters can be set either

- in the AP to apply to all SMs in the sector.
- in the SM (in Canopy System Release 6.1 and later).

7.1.8 Committed Information Rate

The Committed Information Rate (CIR) capability feature enables the service provider to guarantee to any subscriber that bandwidth will never decrease to below a specified minimum, unless CIR is oversubscribed. Bandwidth can be, and typically will be, higher than the minimum, but this guarantee helps the WISP to attract and retain subscribers.

In BAM Release 2.1 and in Prizm Release 2.0, CIR configuration is supported as follows:

- The GUI allows you to view and change CIR configuration parameters per SM.
- When an SM successfully registers and authenticates, if BAM or Prizm has CIR configuration data for the SM, then messages make the CIR configuration available to the SM, depending on the Configuration Source setting. (See Setting the Configuration Source on Page 287.)
- The operator can disable the CIR feature in the SM without deleting the CIR configuration data.

7.1.9 Bandwidth from the SM Perspective

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

Example download times for various arbitrary tiers of service are shown in Table 69 on Page 371 and Table 70 on Page 372.

7.1.10 Interaction of Burst Allocation and Sustained Data Rate Settings

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

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

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

7.1.11 High-priority Bandwidth

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

NOTE:
To enable the high-priority channel, you must configure *all* high-priority parameters.

The high-priority channel is enabled by configuration of four parameters in the Configuration web page of the AP. These parameters are

- **High Priority Uplink Percentage**
- **UAcks Reserved High**
- **DAcks Reserved High**
- **NumCtrlSlots Reserved High**

IMPORTANT!
See High Priority Uplink Percentage and Slot Specifications on Page 236.

Where the high-priority channel is enabled, a Canopy module prioritizes traffic by

- reading the Low Latency bit (Bit 3) in the IPv4 Type of Service (ToS) byte in a received packet.
- reading the 802.1p field of the 80-2.1Q header in a received packet, where VLAN is enabled on the module.
- comparing the 6-bit Differentiated Services Code Point (DSCP) field in the ToS byte of a received packet to a corresponding value in the Differentiated Services Configuration page of the module.

Low Latency Bit

Bit 3 is set by a device outside the Canopy system. In the uplink frame, the SM monitors Bit 3. If this bit is set, then

- the SM prioritizes this traffic in its high-priority queue according to AP configuration settings for the high-priority channel.
- the system sends the packet on the high-priority channel and services this channel before any normal traffic.

802.1P Field

See Priority on VLANs (802.1P) on Page 165.

DSCP Field

Like Bit 3 of the original IPv4 ToS byte, the DSCP field (Bits 0 through 5) in the redefined ToS byte is set by a device outside the Canopy system. A packets contains no flag that indicates whether the encoding is for the Low Latency bit or the DSCP field. For this reason, you must ensure that all elements in your trusted domain, including routers and endpoints, set and read the ToS byte with the same scheme.

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

- The 6-bit length of the field allows it to specify one of 64 service differentiations.
- These correlate to 64 individual (**CodePoint**) parameters in the Differentiated Services Configuration page, in Canopy System Release 7.2.9 and later.
- Per RFC 2474, 3 of these 64 are preset and cannot be changed. (See http://www.faqs.org/rfcs/rfc1902.html.)
- For any or all of the remaining 61 CodePoint parameters, you can specify a value of
  - 0 through 3 for low-priority handling.
  - 4 through 7 for high-priority handling.

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

An example of the Differentiated Services Configuration page and parameter descriptions are provided under Differentiated Services Configuration Page of the AP on Page 252. This page and its rules are identical from module type to module type in Canopy. However, any of the 61 configurable Code Points can be set to a different value from module to module, thus defining unique per-hop behavior for some traffic.

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

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

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

7.1.12 Allocations to Downlink and Uplink

The standard and high-priority channels in Canopy PTMP communications are contrasted in Figure 26 and Figure 27.

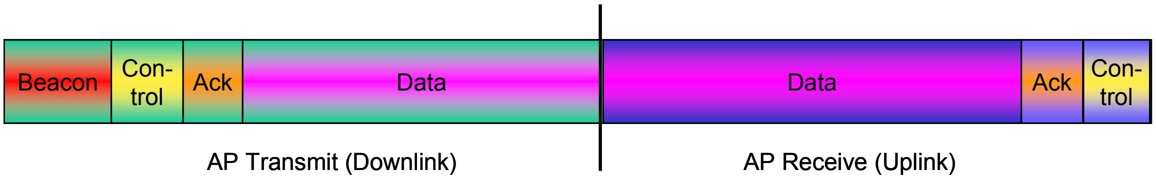


Figure 26: Canopy channel, 75% downlink, 0% high priority in uplink

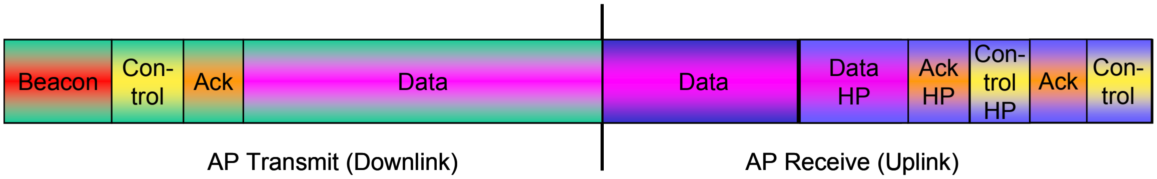


Figure 27: Canopy channel, 75% downlink, 35% high priority (HP) uplink, software scheduling

7.1.13 Software and Hardware Scheduling

In Release 6.0 and later, Canopy provides an alternative to software scheduling for control of the links in a sector. Hardware scheduling increases throughput and reduces latency in the link between the SM and AP.

With software scheduling and AP default downlink-to-uplink settings (75% downlink and 25% uplink), if High Priority is set to 35%, then

- in the uplink, 3 slots are reserved for high priority (35% of the 25%) and
  - the bandwidth is 64 bytes per slot, repeated 400 times each second.
  - [3 slots/instance] x [64 bytes/slot] x [8 bits/byte] x [400 instances/second] = 614,400 bps ≈ 614 kbps of uplink bandwidth

- in the downlink, the AP
  - monitors DSCP fields and Bit 3 of the ToS byte in the Ethernet frame.
  - does not reserve slots, but will service all high-priority bandwidth requests before servicing low-priority bandwidth requests (unless you have allocated some bandwidth in the **Low Priority Downlink CIR** parameter, so that some low-priority traffic is passed regardless of the volume of high-priority).
  - can become saturated by attempting to service too much high-priority traffic.

Hardware scheduling always sends high-priority traffic first, even to the exclusion of other traffic.

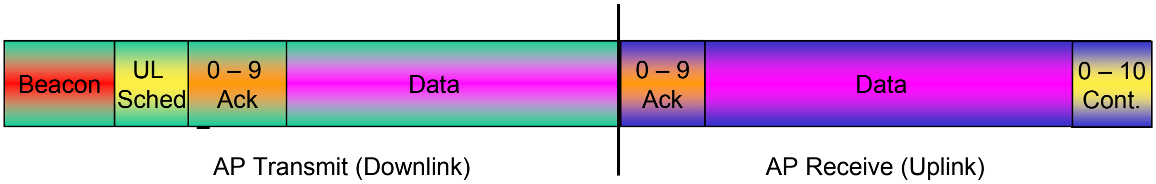


Figure 28: Canopy channel, 75% downlink, hardware scheduling

IMPORTANT!
With Hardware Scheduling, the number of channels available to the AP is reduced by the number of SMs configured for the High Priority channel. With this feature enabled on all SMs, an AP can support only 100 SMs (instead of 200).

IMPORTANT!
In a Canopy BH link with Canopy T1/E1 Multiplexers, the BHs must be configured for an uplink/downlink ratio of 50% uplink/50% downlink. The Canopy T1/E1 Multiplexers are full duplex.

The differences between hardware and software scheduling in a Canopy sector are summarized in Table 25.

Table 25: Differences between software and hardware scheduling

Category	Factor	Difference	
		Software Scheduling	**Hardware Scheduling**
Throughput	Aggregate throughput, less additional overhead	6.8 Mbps	14 Mbps
	ACK slots in downlink used for data except when request for uplink is present	No	Yes
Latency	Number of frames required for the scheduling process	5	1
	Round-trip latency[1]	≈ 15 ms	≈ 6 ms
	AP broadcast the download schedule	Yes	No
High-priority Channel	Allocation for *uplink* high-priority traffic on amount of high-priority traffic	Static, based on fixed percentage	Dynamic, based on amount of high-priority traffic
	Allocation for *downlink* high-priority traffic on amount of high-priority traffic	Dynamic, based on amount of high-priority traffic	Dynamic, based on amount of high-priority traffic
	Order of transmission	1. Any high-priority 2. Any low-priority	1. CIR high-priority 2. CIR low-priority 3. Other high-priority 4. Other low-priority
Transmit Frame Spreading	Support for Transmit Frame Spreading feature	In all releases	In Release 7.0 and later
CIR	Capability	None	In all releases

NOTES:

1. For 2.4- and 5.*n*-GHz modules.

CAUTION!
Hardware scheduling requires approximately 10% more power than software scheduling. This additional power affects the recommended maximums for power cord length feeding the CMMmicro. See Table 59 on Page 331. However, this *does not* affect the maximums for the CMM2.

7.1.14 Hardware Scheduling Mistakes to Avoid

Canopy does not prevent you from making a mistake that costs you inconvenience or even a truck roll to overcome. Enabling hardware scheduling on the wrong module or at the wrong time is one such mistake. Examples are provided in Table 26.

Table 26: Hardware scheduling mistakes

Management Connection	To Module Type	Mistake	Result	Remedy[1]
Ethernet	Advantage AP	Enabling HWS[2] before any of the registered SMs have HWS enabled	AP cannot communicate with any of the SMs.	Enable SWS[3] on the AP.
	Canopy AP	Enabling HWS on a single SM	AP cannot communicate with this SM.	Send technician to the customer premises to enable SWS (via Ethernet) on the SM.
Air interface	Advantage AP	Enabling HWS before any of the registered SMs have HWS enabled	AP cannot communicate with any of the SMs.	Enable HWS on one SM, enable SWS on the AP, then enable SWS on the SM.

NOTES:

1. When you have changed the value of a configurable parameter, you must click **Save Changes** and then **Reboot** before the change is implemented.
2. In this table, HWS indicates hardware scheduling.
3. In this table, SWS indicates software scheduling.

7.1.15 2X Operation

A Configuration page option in both Advantage SMs and some Canopy SMs provides double the aggregate throughput for SMs that are nearer than half of the distance range from the AP (the nearest one-fourth of the SMs in the sector). The requirements of this feature are as follows:

- Both the AP and the SM must be operating on Canopy System Release 7.0 or later.
- The AP must be an Advantage AP enabled for hardware scheduling and 2X operation.
- The SM must be near the AP, as described above.
- The SM must be of the P9 hardware series and enabled for hardware scheduling. See Designations for Hardware and Firmware on Page 354.
- The **2X Rate** parameter in the SM must be set to enabled. This is the default setting.
- The amount of noise and multipath must be low enough to allow the receiver in the 6-dB less sensitive (2X) state to maintain a high carrier-to-interference (C/I) ratio.

The flexibility of this feature is as follows:

- At the time of registration, signaling is at the 1X rate. However, if the above requirements are all met, then the SM switches to 2X.
- Thereafter, whenever RF conditions are unfavorable for 2X operation, the SM switches to 1X. When favorable RF conditions allow, the SM switches back to 2X, if user data is present at that time.
- Similarly, whenever no user data is present, the SM switches to 1X. When user data flow resumes, the SM switches back to 2X, if RF conditions allow.
- Both links for the SM (uplink and downlink) are independent for this feature. (One can be operating at 2X operation while the other is operating at 1X.)
- Other SMs in the sector can be communicating with the AP at the other modulation rate.
- Although subscribers with Canopy SMs realize higher bursts, and subscribers with Advantage SMs realize both higher burst and higher sustained throughput, the network operator realizes higher sector throughput capacity in the AP.

The effect of 2X operation on aggregate throughput for the SM is indicated in Table 27.

Table 27: Effect of 2X operation on throughput for the SM

Type of SM		**Typical Aggregate Rates**[1]	
		Sustained[2]	**Burst**[2]
Advantage	900 MHz[3]	4 Mbps	4 Mbps
	Any other frequency band range	14 Mbps	14 Mbps
Canopy P9	Any frequency band range except 900 MHz	7 Mbps	14 Mbps

NOTES:

1. Subject to competition among all SMs in the sector.
2. Can be less if limited by the value of **Downlink Data %** set in the Configuration page of the AP.
3. All 900-MHz modules are Advantage.

Competition for Bandwidth

When multiple SMs vie for bandwidth, the AP divides its bandwidth among them, considering their effective CIR and MIR values. However, 2X operation uses bandwidth twice as efficiently as 1X, even where MIR values apply. This is because, in 2X operation, the modules transmit their data in 4-level frequency shift keying (FSK), not 2-level as they would in 1X operation. This moves twice the data per slot. Thus, for the sum of all bandwidth that 2X-eligible customers use, the bandwidth available to the remaining customers increases by half of that sum when these eligible customers are transmitting and receiving in 2X operation.

Engineering for 2X Operation

The following priorities should guide your implementation of 2X operation:

- In the near half of the distance range of the AP
  - identify the customers who use the most bandwidth.
  - enable their SMs first for 2X operation.
- When you have deployable Canopy P7 and P8 SMs, *do not* deploy Canopy Advantage SMs or Canopy P9 SMs beyond half the distance range of the AP. At this distance, steady and reliable 2X operation typically is not achievable. Deploy the Canopy P7 and P8 SMs here.
- Wherever practical, implement 25 MHz of channel separation for 2X operation.

Checking Link Efficiencies in 2X Operation

Unlike in 1X operation, efficiencies below 90% on the Link Test page of the SM do not necessarily indicate a poor quality link. Efficiency of 45% in 2X operation is equivalent to efficiency of 90% in 1X. If you read efficiency between 45% and 90%, check the status of 2X operation (as described below) to confirm that the link is operating at 2X.

Since received signal strength typically varies over time, you should perform link tests at various times of day and on various days of the week. Efficiencies should consistently be 45% or greater for 2X operation. Where readings are lower, you are unlikely to solve the RF problem by enabling 1X operation. (For example, if you read 40% at 2X, you can expect 80% at 1X.) In these cases, you may be able to achieve better efficiencies by re-aiming the SM, mounting it elsewhere, or retrofitting it with a reflector dish.

Checking the Status of 2X Operation

When the Expanded Stats navigation link has been selected in the SM GUI, the Status page provides operation status information about the *SM-to-AP* link. Under **Session Status** area, this page displays a line such as the following:

```
REGISTERED VC 19 Rate 2X/2X VC 255 Rate 2X/1X
```

Interpret this information is as follows:

- VC means virtual channel. If one VC is displayed, the high-priority channel is disabled. If two are displayed, the high-priority channel is indicated by the higher number (255 in the above example).
- 2X/2X indicates that the SM-to-AP link is in 2X operation.
- 2X/1X indicates that the SM is capable of 2X operation but the SM-to-AP link is in 1X operation. This can be for either of the following reasons:
  - The received signal presently is not strong enough for 2X operation.
  - The SM has not sent data on the channel yet.
- 1X/1X indicates that the SM is capable of only 1X operation. This can be for either of the following reasons:
  - The SM does not support 2X operation (SM is of the hardware series P7 or P8).
  - The **2X Rate** parameter in the Configuration page is disabled.

When the Status page is displayed in the Advantage AP GUI, each LUID shows an associated **Rate**. In the same syntax as described above, the information here provides operation status information about the *AP-to-SM* link.

CAUTION!
2X operation requires approximately

- 3 to 5% more power than 1X operation with hardware scheduling.
- 13 to 15% more power than 1X operation with software scheduling.

This additional power affects the recommended maximums for power cord length feeding the CMMmicro. See Table 59 on Page 331. However, this *does not* affect the maximums for the CMM2.

Disabling 2X Operation

Disabling 2X operation for an SM can be helpful for alignment, troubleshooting, or preventing frequent automatic switches between 2X and 1X, where RF conditions are only marginally favorable to 2X. The ability to disable 2X for an SM is inherent since the 2X Operation feature was introduced.

Disabling 2X operation for a sector can be helpful for identifying a baseline for 1X-to-2X comparison, broader troubleshooting activities, or forcing all SMs to 1X rather than disabling 2X in each SM. Release 7.1.4 and later provides a **2X Rate** parameter in the Configuration page of the AP:

- If you click **Disable**, then **Save Changes** and **Reboot**, 2X operation is disabled for the sector.
- If you later click **Enable**, then **Save Changes** and **Reboot**, 2X operation is enabled in the sector for links where the SM *is not* set for disabled 2X operation.

7.1.16 Settable AP Broadcast Repeat Count

In Release 4.2 and later, a settable parameter controls how many times, in addition to the original broadcast, the AP repeats each broadcast. However, this parameter is available only when Software Scheduling is enabled. You can set this parameter to achieve high reliability or high throughput, or a compromise between these, based on the type and amount of traffic that the AP broadcasts. For a description of conditions where each allowed setting can be best, see Broadcast Repeat Count on 246.

7.2 UNDERSTANDING SYNCHRONIZATION

Although Canopy modules are band selective, they are not channel selective. For this reason, the receiver of a module can receive too much signal from unsynchronized modules that are operating in the same spectrum (frequency band range, such as 5.2 GHz). This would overload the front end of the receiver, which would cancel the advantage of Canopy modules being able to successfully operate with a low carrier-to-interference (C/I) ratio in the signal.

Moreover, Canopy modules must be synchronized so that they transmit and receive in the proper cycles. An unsynchronized module that transmits during the receive cycle of another module can render the other module insensitive to the desired signal (desensed).

7.2.1 GPS Synchronization

The Navigation Satellite Timing and Ranging (NAVSTAR) Global Positioning System (GPS) uses 24 satellites to relay information for precise derivation of position and time.

The Canopy Cluster Management Module (CMM) contains a Motorola Oncore GPS Receiver. The CMM is a critical element in the operation of the Canopy system. At one AP cluster site or throughout an entire wireless system, the CMM provides a GPS timing pulse to each module, synchronizing the network transmission cycles.

The Oncore GPS Receiver tracks eight or more satellites. The CMM uses the signal from at least four of these satellites to generate a one-second interval clock that has a rise time of 100 nsec. This clock directly synchronizes APs and BHMs which, in turn, synchronize the SMs and BHSs in the Canopy network.

The Oncore GPS Receiver also provides

- the latitude and longitude of the GPS antenna (collocated with the CMM)
- the number of satellites that are being tracked
- the number of satellites that are available
- the date
- the time in Universal Coordinated Time (UCT)
- the altitude of the GPS antenna
- other information that can be used to diagnose network problems.

Alternative to GPS Sync

A Canopy link can operate without *GPS* sync, but cannot operate without sync. The alternative to GPS sync is to configure the AP or BHM in the link to generate a sync pulse to pass to the SM or BHS, respectively. Depending on the RF environment in which the link operates, this latter alternative may or may not be plausible.

For example, in Figure 29, AP4

- is not synchronized with any of the other APs.
- is transmitting nearby the other APs while they are expecting to receive SM transmissions from a maximum distance.

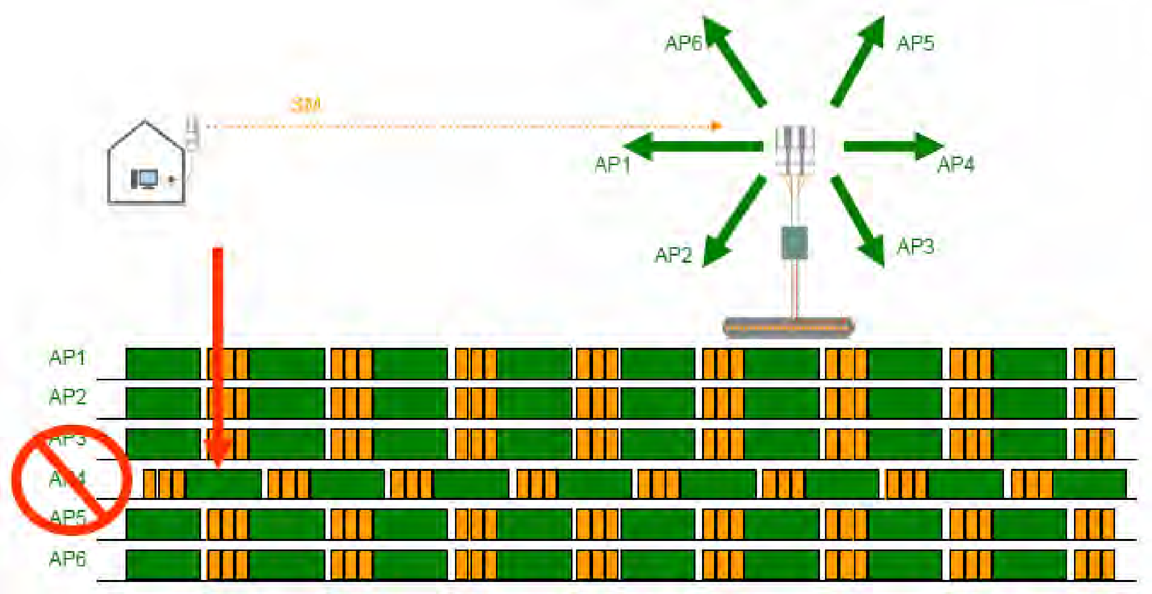


Figure 29: One unsynchronized AP in cluster

The result is self-interference. In this scenario, the self-interference can be avoided only by synchronizing the TDD transmit cycles of all APs that operate in the same frequency band.

An AP that is isolated by at least 5 miles (8 km) from any other Canopy equipment, or a BHM in an isolated standalone BH link can generate and pass sync pulse without GPS timing and not risk that interference will result from the generated sync. In any other type of Canopy link, sync should be derived from GPS timing.

NOTE:
The OFDM Series BHMs generate their own sync. For more information about these modules, see the user guides that support them. Titles are listed under Products Not Covered by This User Guide on Page 34.

Advantage of GPS Sync

Although the embedded timing generation capability of the Canopy AP and BHM keeps a precise clock, no trigger exists to start the clock at the same moment in each AP of a cluster. So, the individual AP can synchronize communications between itself and registered SMs, but cannot synchronize itself with other Canopy modules, except by GPS timing (shown in Figure 30).

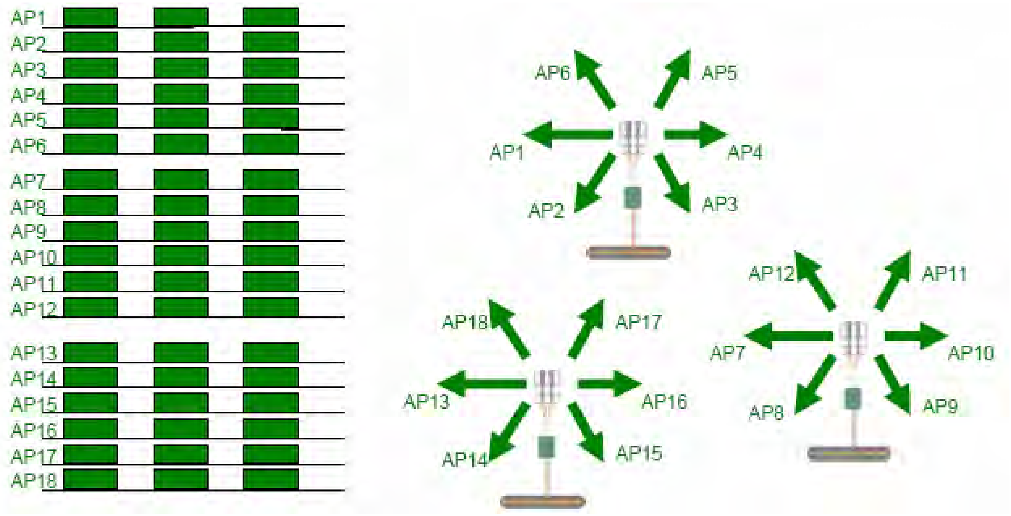


Figure 30: GPS timing throughout the Canopy network

7.2.2 Passing Sync in a Single Hop

In releases earlier than Release 4.0, network sync can be delivered only over the air link in the following network designs:

- Design 1
  1. A CMM provides sync to a collocated AP.
  2. This AP sends the sync over the air to SMs.
- Design 2
  1. A CMM provides sync to a collocated BH timing master.
  2. This BH timing master sends the sync over the air to a BH timing slave.

7.2.3 Passing Sync in an Additional Hop

In Release 4.0 and later, network sync can be either delivered as described above or extended by one additional link in any of the following network designs:

> *NOTE:*
> In each of these following designs, Link 2 *is not* on the same frequency band as Link 4. (For example, Link 2 may be a 5.2-GHz link while Link 4 is a 5.7- or 2.4-GHz link.)

- Design 3
  1. A CMM provides sync to a collocated AP.
  2. This AP sends the sync over the air to an SM.
  3. This SM delivers the sync to a collocated AP.
  4. This AP passes the sync in the additional link over the air to SMs.

This design is illustrated in Figure 31.

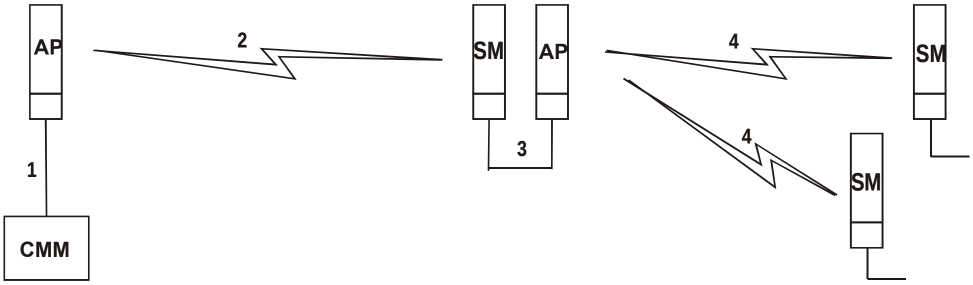


Figure 31: Additional link to extend network sync, Design 3

- Design 4
  1. A CMM provides sync to a collocated AP.
  2. This AP sends the sync over the air to an SM.
  3. This SM delivers the sync to a collocated BHM.
  4. This BHM passes the sync in the additional link over the air to a BHS.

This design is illustrated in Figure 32.

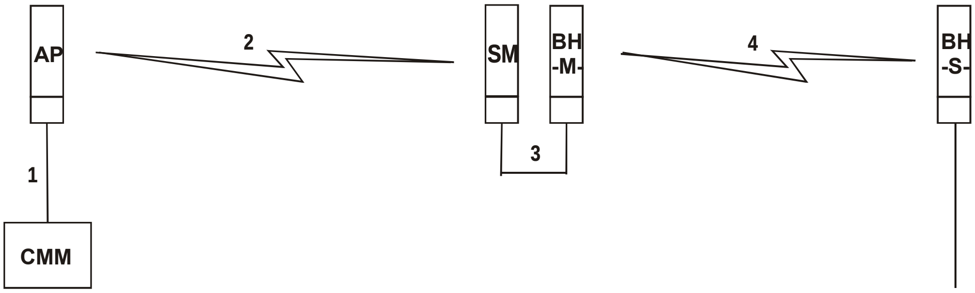


Figure 32: Additional link to extend network sync, Design 4

- Design 5
  1. A CMM provides sync to a collocated BHM or the BHM generates timing.
  2. This BHM sends the sync over the air to a BHS.
  3. This BHS delivers the sync to a collocated AP.
  4. This AP passes the sync in the additional link over the air to SMs.

This design is illustrated in Figure 33.

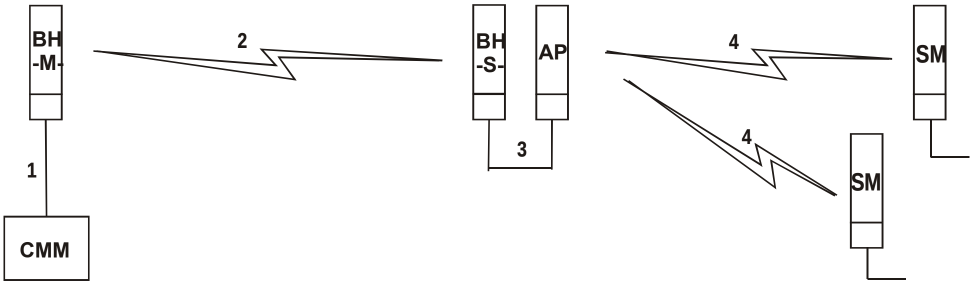


Figure 33: Additional link to extend network sync, Design 5

Wiring and configuration information for this sync extension is described under Wiring to Extend Network Sync on Page 360.

All Canopy radios support the remote AP functionality. The BHS and the SM can reliably pass the sync pulse, and the BHM and AP can reliably receive it. The sync is passed in a cable that connects Pins 1 and 6 of the RJ-11 timing ports of the two modules. (The sync cable is described under Cables on Page 59.) When you connect modules in this way, you must also adjust configuration parameters to ensure that

- the AP is set to properly receive sync.
- the SM will not propagate sync to the AP if the SM itself ceases to receive sync.

8 MEETING LINK REQUIREMENTS

8.1 AP-SM LINKS

APs communicate with SMs using a point-to-multipoint protocol. An AP-SM link has lower throughput and higher latency than a backhaul link for two reasons:

- Many endpoints are involved.
- The bandwidth request and reservation process consumes bandwidth.

In the 900-MHz frequency band range, round-trip latency is typically

- 40 msec with software scheduling.
- 15 msec with hardware scheduling.

In all other Canopy frequency band ranges, round-trip latency is typically

- 15 msec with software scheduling.
- 6 msec with hardware scheduling.

At range settings of greater than 40 miles (64 km) in the 900-MHz AP, more time elapses between transmit and receive cycles to compensate for greater air delay. In each frame, this reduces the number of data slots, which slightly reduces the aggregate throughput of the link. However, the throughput is as predictable as in other Canopy point-to-multipoint links.

Throughput is a factor of the **Max Range** parameter in the AP and is effective for all SMs, regardless of their distance from the AP. The aggregate useful throughput for each AP in the other Canopy frequency band ranges is 6.2 Mbps with software scheduling, regardless of the downlink percentage setting. This throughput includes all downlink data to all SMs and all uplink data from all SMs that link to the AP. For throughput with hardware scheduling, see Table 14 on Page 64.

With software scheduling, the downlink throughput to a single SM can be greater than 4 Mbps. The uplink throughput to an AP can be as great as approximately 2 Mbps, depending on the uplink/downlink ratio. However, setting the ratio to 50% for a point-to-mulitpoint Canopy link does not yield an even division of bandwidth between uplink and downlink traffic. This is evident in the throughput values that are quoted in Table 28 and Table 29.

NOTE:
These values were derived from the Link Test web pages of Canopy modules. For the link tests, the **Total NumUAckSlots**, **NumDAckSlots**, and **NumCtlSlots** parameters were each set to the default value of 3.

Table 28: Downlink and uplink PTMP throughput, 2-mile link, software scheduling

Downlink Percent	Data Slots Down	Data Slots Up	Downlink Throughput (Mbps)	Uplink Throughput (Mbps)	Aggregate Throughput (Mbps)
95	31	2	4.9	0.4	5.3
90	30	3	5.1	0.5	5.6
85	28	5	5.6	0.8	6.4
80	26	7	4.9	1.1	6.0
75	25	8	4.9	1.2	6.1
70	23	9	4.4	1.3	5.7
65	21	11	3.9	1.5	5.4
60	20	12	3.9	1.6	5.5
55	18	14	3.6	1.7	5.3
50	16	16	3.3	1.9	5.2
45	15	17	3.0	2.0	5.0
40	13	19	2.6	2.1	4.7
35	11	21	2.2	2.3	4.5
30	10	22	2.0	2.2	4.2
25	8	23	1.6	2.4	4.0
20	6	25	1.2	2.4	3.6
15	5	26	1.0	2.6	3.6
10	3	28	0.6	2.5	3.1
5	2	29	0.4	2.7	3.1
0	1	29	0.4	2.7	3.1

Table 29: Downlink and uplink PTMP throughput, 15-mile link, software scheduling

Downlink Percent	Data Slots Down	Data Slots Up
95	29	2
90	28	3
85	26	4
80	25	5
75	23	7
70	21	9

Downlink Percent	Data Slots Down	Data Slots Up
65	20	10
60	18	12
55	17	13
50	15	15
45	14	16
40	12	18
35	10	19
30	9	20
25	7	22
20	6	23
15	4	25
10	3	26
5	2	27
0	2	27

Changing Network Conditions

The effects of changing network conditions on PTMP throughput are indicated in Table 30.

Table 30: Effects of network conditions on PTMP throughput

Changing Network Condition	Effect on AP Aggregate Throughput
Increasing the **Max Range** parameter setting[1] in the AP	somewhat decreased[2]
Increasing the number of SMs that register in the AP	no effect
Increase in downlink traffic	
Increase in uplink traffic	
Increasing the average bandwidth allotted to the SMs that register in the AP	no effect, even when the additional bandwidth is used.

NOTES:

1. In Release 7.1.4 for non 900-MHz APs (and earlier for non-ETSI 2.4-GHz APs), the AP accepts a **Max Range** value of up to 30 miles (48 km). See Max Range on Page 240.
2. To avoid a decrease of unnecessary proportion, set to not much further than the distance between the AP and the furthest SM that registers in the AP.

A comparison of SM products in link with a Canopy Advantage AP is shown in Table 31.

Table 31: Comparison of SM products with Canopy Advantage AP

Product	Maximum Sustained Aggregate Throughput to a Single SM	Burst	Cap on Committed Information Rate	Upgradability	VoIP Channels Supported
Canopy Advantage SM	14 Mbps	14 Mb	none	none	multiple
Canopy SM	7 Mbps	14 Mb	none	to Advantage SM capabilities	multiple
Canopy Lite SM as purchased	512 kbps	768 kb	100 kbps	to 1, 2, 4, or 7 Mbps	1
Canopy Lite SM upgraded to 1 Mbps	1 Mbps	1.5 Mb	100 kbps	none	1
Canopy Lite SM upgraded to 2 Mbps	2 Mbps	3 Mb	100 kbps	none	1
Canopy Lite SM upgraded to 4 Mbps	4 Mbps	7 Mb	200 kbps	none	2
Canopy Lite SM upgraded to 7 Mbps	7 Mbps	7 Mb	200 kbps	none	2

8.2 BH-BH LINKS

Canopy BHs communicate with each other using a point-to-point protocol. This point-to-point protocol uses a 2.5-msec frame. A BH link has higher throughput and lower latency (typically 5 msec, 2.5 msec in each direction) for two reasons:

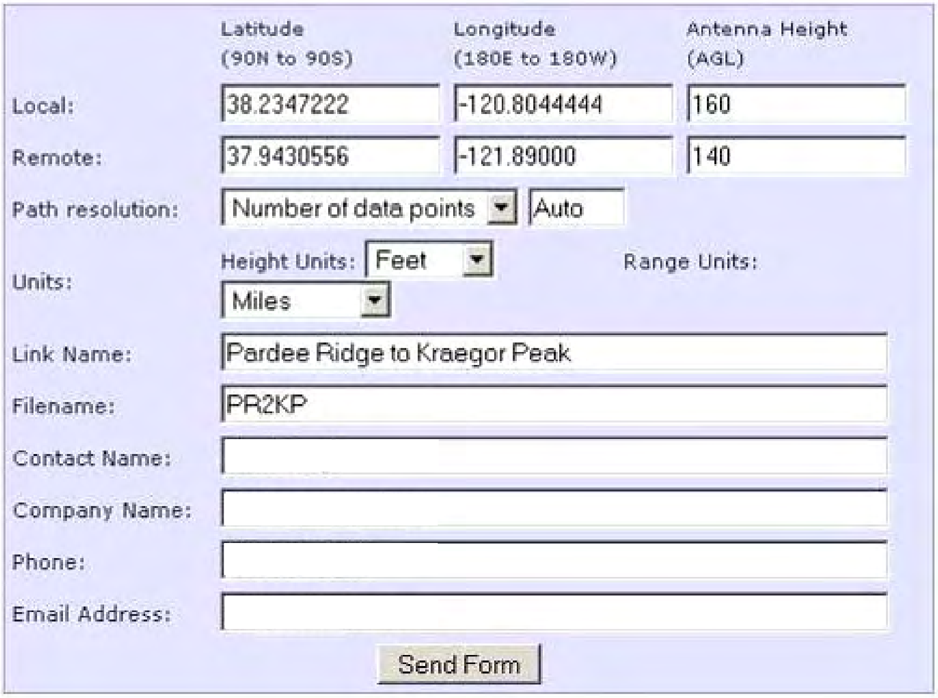
- Only two endpoints are involved.
- No bandwidth request and reservation process is involved.

For 10-Mbps BHs, the aggregate throughput on the channel is 7.5 Mbps. For 20-Mbps BHs, the aggregate throughput on the channel is 14 Mbps. If a BH is set to a downlink ratio of 50%, then the bandwidth in each direction is half of the total BH link bandwidth.

In the Canopy OFDM series of BHs

- aggregate throughput rates are dynamically variable, as listed in Table 16 on Page 66.
- the 150/300-Mbps BH features a TDM mode and two T1/E1 ports (one at 150 Mbps) to support telecommunications traffic (for example, to haul traffic between a cell site and its mobile switching center).
- a Link Estimator tool is available. This tool accepts input from the Path Profiler tool at http://motorola.canopywireless.com/support/linkestimator. The Path Profiler is a form that, when you populate and click **Send Form**, returns a text file that you can then save as a `.dat` file to input into the Link Estimator tool.

  An example of a populated Path Profiler tool is shown in Figure 34.



	Latitude (90N to 90S)	Longitude (180E to 180W)	Antenna Height (AGL)
Local:	38.2347222	-120.8044444	160
Remote:	37.9430556	-121.89000	140

Path resolution: Number of data points Auto

Units: Height Units: Feet Range Units: Miles

Link Name: Pardee Ridge to Kraegor Peak

Filename: PR2KP

Contact Name:

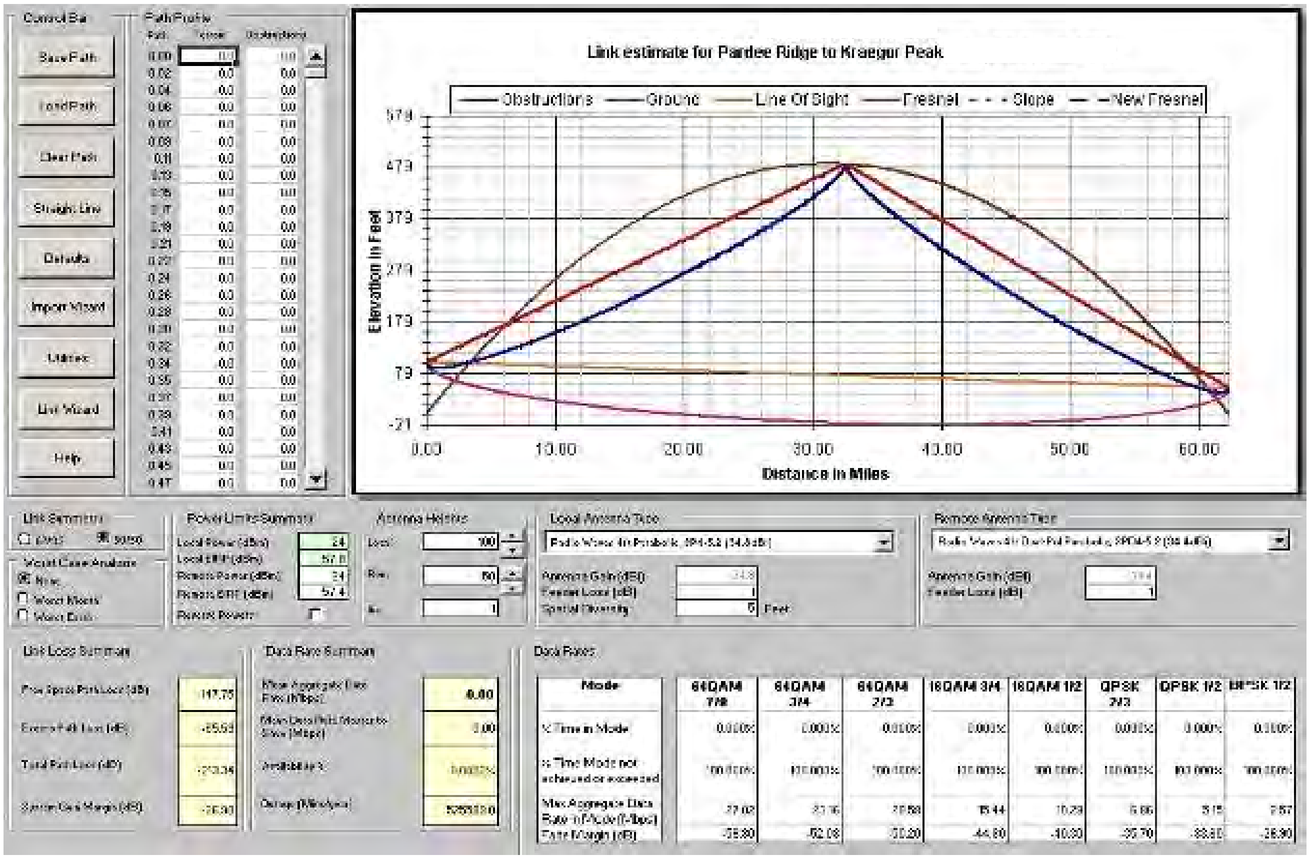
Company Name:

Phone:

Email Address:

Figure 34: Canopy Path Profiler tool

An example of calculated link characteristics in the Link Estimator tool is shown in Figure 35.



Path Profile

Path	Terrain	Obstructions
0.00	0.0	0.0
0.02	0.0	0.0
0.04	0.0	0.0
0.06	0.0	0.0
0.07	0.0	0.0
0.09	0.0	0.0
0.11	0.0	0.0
0.13	0.0	0.0
0.15	0.0	0.0
0.17	0.0	0.0
0.19	0.0	0.0
0.21	0.0	0.0
0.22	0.0	0.0
0.24	0.0	0.0
0.26	0.0	0.0
0.28	0.0	0.0
0.30	0.0	0.0
0.32	0.0	0.0
0.34	0.0	0.0
0.35	0.0	0.0
0.37	0.0	0.0
0.39	0.0	0.0
0.41	0.0	0.0
0.43	0.0	0.0
0.45	0.0	0.0
0.47	0.0	0.0

Link Symmetry
○ 1:3 ● 50/50

Worst Case Analysis
☒ None
☐ Worst Month
☐ Worst Busy

Power Limits Summary

Local Power (dBm)	24
Local EIRP (dBm)	57.8
Remote Power (dBm)	24
Remote EIRP (dBm)	57.4
Remote Readers	☐

Antenna Heights

Local	100
Rem	80
Inc	1

Local Antenna Type
Radio Waves 4ft Parabolic, SP4-5.2 (34.8dBi)

Antenna Gain (dBi)	34.8
Feeder Loss (dB)	1
Spatial Diversity	5 Feet

Remote Antenna Type
Radio Waves 4ft Dual Pol Parabolic, SPD4-5.2 (34.4dBi)

Antenna Gain (dBi)	34.4
Feeder Loss (dB)	1

Link Loss Summary

Free Space Path Loss (dB)	147.75
Excess Path Loss (dB)	-65.59
Total Path Loss (dB)	-213.34
System Gain Margin (dB)	-26.90

Data Rate Summary

Mean Aggregate Data Rate (Mbps)	0.00
Mean Data Rate Available to Each (Mbps)	0.00
Availability %	0.0000%
Outage (Mins/year)	525600.0

Data Rates

Mode	64QAM 7/8	64QAM 3/4	64QAM 2/3	16QAM 3/4	16QAM 1/2	QPSK 2/3	QPSK 1/2	BPSK 1/2
% Time in Mode	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
% Time Mode not achieved or exceeded	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
Max Aggregate Data Rate in Mode (Mbps)	27.02	23.16	20.58	15.44	10.29	6.86	5.15	2.57
Fade Margin (dB)	-55.80	-52.08	-50.20	-44.80	-40.30	-35.70	-33.80	-28.90

Figure 35: OFDM series BH Link Estimator tool

The Link Estimator tool is available for you to download with documentation at http://motorola.canopywireless.com/support/software/index.php?catid=9. Given the inputs, this tool calculates achievable throughput and link availability, expressed as a percentage.

9 PREVIEWING NETWORK CONFIGURATIONS

The following are examples of network layouts. Customer experience case studies are also available.

9.1 VIEWING TYPICAL LAYOUTS

The following layouts are typical of Canopy system implementations:

- Figure 36: Typical network layout with no BH
- Figure 37: Typical network layout with BH
- Figure 38: Typical multiple-BH network layout

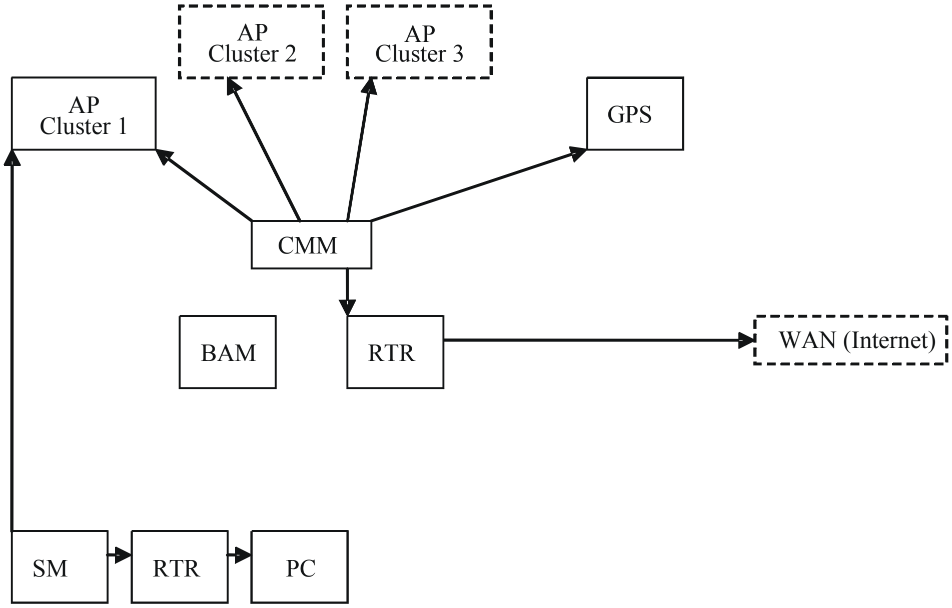


Figure 36: Typical network layout with no BH

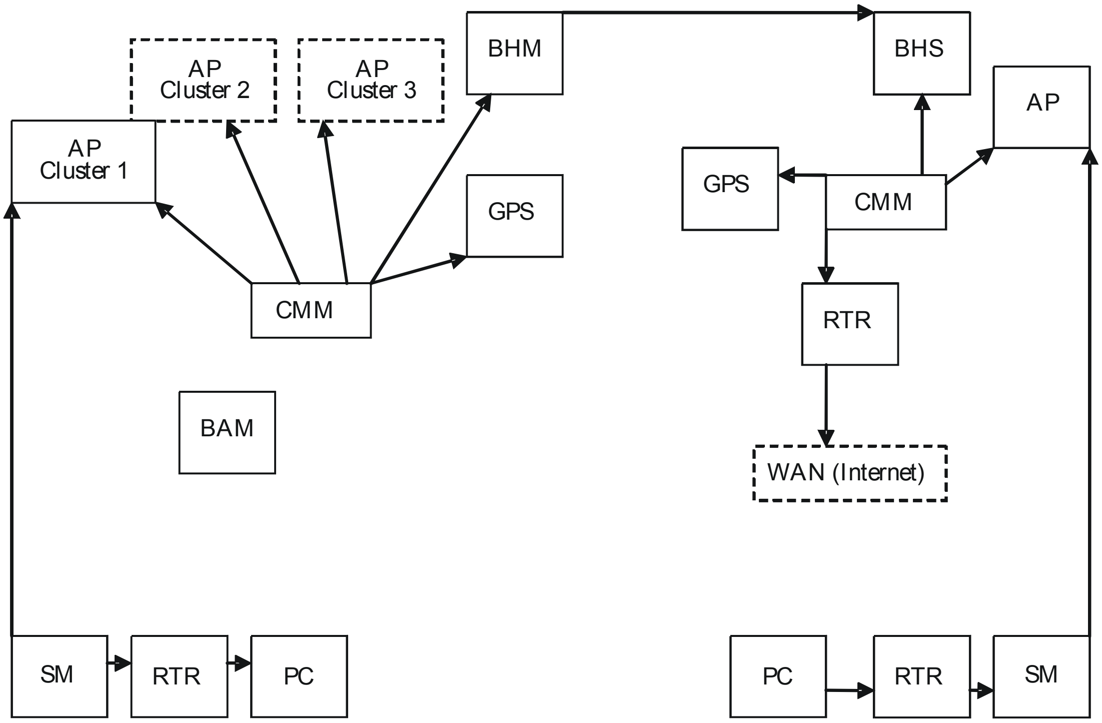


Figure 37: Typical network layout with BH

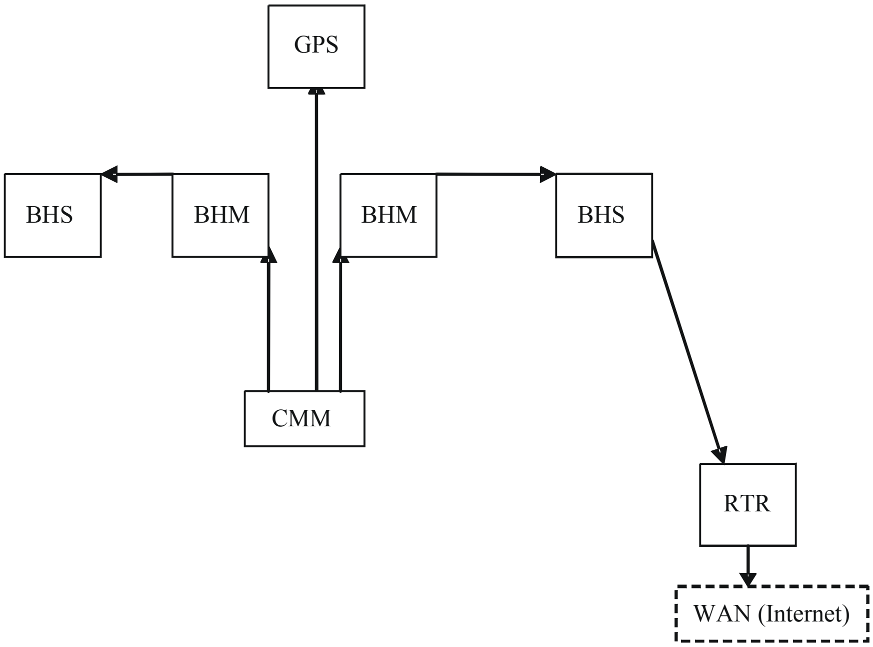


Figure 38: Typical multiple-BH network layout

9.2 VIEWING CASE STUDIES

Case studies of Canopy implementations are available as “Feature Articles” for download from http://www.connectwithcanopy.com/index.cfm?canopy=menu.case.

10 ACCESSING FEATURES

In successive software releases, Canopy includes new features that improve aspects such as cost, efficiency, flexibility, installation, interference avoidance, security, throughput, and troubleshooting. Improvements that Canopy features offer are indicated in Table 32.

Table 32: Canopy features and their benefits

Feature Name	**Initial Software Release**	**Category of Improvement**								
		Cost	**Efficiency**	**Fix**	**Flexibility**	**Installation**	**Interference**	**Security**	**Throughput**	**Troubleshooting**
Bus Bandwidth Limitation Causing **20-Mbps BH** Errors Fix	4.0.1			●						
2X Operation	7.0								●	
Per-sector Disabling of **2X Operation**	7.1.4				●					●
Canopy SMs Display 1X or **2X Operation** Status	7.1.4		●	●						
Immediate **2X Operation** for SMs That Register with 2X Disabled	7.1.4		●	●						
Software Limit Increase on **2.4-GHz Module** (from 15 to 30 Miles)	4.2.1	●			●					
2.4-GHz Module P9 Support	4.2.7				●					
5.2-GHz Module P9 Support	4.2.7				●					
5.4-GHz Module P9 Support	7.0				●					
5.7-GHz Module Support	3.1.5				●					
5.7-GHz Module ISM Frequencies Support	4.0				●		●			
5.7-GHz Module P9 Support	4.2.3				●					
900-MHz Module (all P9) Support	4.2.2				●					
Release 6.0 Compatibility Mode for **900-MHz Module**	6.1				●					
High Incidence of Re-registrations Fixed for **900-MHz Module**	7.2			●						
Advanced Encryption Standard (**AES**) Encryption	4.0							●		
Enhanced **Alignment** Mode	3.1.5					●				
Audible **Alignment Tone**	4.0					●				
Audible **Alignment Tone** on Only SMs and BHSs Fix	4.0.2			●						

Feature Name	**Initial Software Release**	**Category of Improvement**								
		Cost	**Efficiency**	**Fix**	**Flexibility**	**Installation**	**Interference**	**Security**	**Throughput**	**Troubleshooting**
New **Alignment Tone** for P9 Boards	4.2.3					●				
Alignment Tone Fix	6.1			●						
Alignment Tone with Hardware Scheduler	7.2			●						
Hardware Scheduler on Canopy (non-Advantage) Series P9 **AP**	7.3.6				●					
AP Eval Data Page with Correct SectorUserCount	7.1.4			●						
AP Reboot No Longer Caused by SM Reboot	7.1.4			●						
AP Reboot No Longer Caused by >100 SMs Registering	7.1.4			●						
Expanded Information on **AP** Sessions page	7.3.6		●							
Network **Archive** Maintenance	CNUT 1.0		●							
BH 64-byte Packet **Asynchronicity** Fix	4.2.1			●						
BH **Authentication**	4.0							●		
Floating Licenses for APs with **Authentication**	4.2.3	●	●			●				
Shorter than 32 Hex **Authentication** Keys Accepted	4.2.3		●		●					
Auto Detection of SMs, Versions, and States	CNUT 1.0		●							
SM **Auto Update**	4.1		●							
Batch **Auto Updates**	CNUT 1.0		●							
CANOPY**BOOT** Version 3.0 Fix (Replaces Version 2.5)	4.2.3			●						
BHM **Bridge** Changes	3.1.5							●		
Bridge Table from 256 to 4096 Entries	3.1.5				●					
Configurable **Bridge Table** Timeout	3.1.5				●					
Disable **Bridge Table** Filtering in BHs	7.2		●							
Settable AP **Broadcast Repeat** Count	4.2.1								●	
Committed Information Rate (**CIR**) with Hardware Scheduler	6.1				●					
Committed Information Rate (**CIR**) Settable for SM	BAM 2.1 and Prizm 2.0				●					

Feature Name	Initial Software Release	Category of Improvement								
		Cost	**Efficiency**	**Fix**	**Flexibility**	**Installation**	**Interference**	**Security**	**Throughput**	**Troubleshooting**
Configuration Source Parameter at AP for VLAN, MIR, and CIR	6.1		●							
BAM+SM **Configuration Source**	7.0		●							
Configuration Source on AP Sessions Page	7.2		●							
Data Encryption Standard (**DES**) Encryption	3.1.5							●		
Dynamic Frequency Selection (**DFS**) for 5.7-GHz Module	4.2.3				●					
5.4-GHz Module Dynamic Frequency Selection (**DFS**) for Radar	4.2.7				●					
Improved Dynamic Frequency Selection (**DFS**)	7.0				●					
Antenna Gain Parameter for Input to **DFS** Sensitivity	7.1.4				●					
DHCP Server and Client in SM	4.1		●							
DHCP Client Sends Lease Renewals as Unicast Fix	4.2.3								●	
Differentiated Services	7.2				●					
Demilitarized Zone (**DMZ**) in SM	4.1				●			●		
Wrongly Reported **DMZ** IP Conflict with DHCP Server IP Range Fix	4.2.1			●						
DMZ Host as FTP Client Fix	4.2.3			●						
Default **Downlink** Percentages: AP 75%, BH 50%	3.1.5								●	
Encrypted **Downlink** Broadcast	4.2.1							●		
Disable SM **Ethernet Interface**	3.2		●					●		●
Ethernet Port Lockup Fix	7.1.4			●						
Protocol and Port **Filtering**	4.2.1							●		
Improved Protocol and Port **Filtering**	4.2.3							●		
Consistent Display of **FPGA** as 6 digits	4.2.3			●						
Oversized (Up to 1532 Bytes) Ethernet **Frame** Fix	3.2			●						
Frame Calculator for Tuning Mixed Clusters	6.1						●			
Transmit **Frame Spreading**	4.0						●			

Feature Name	Initial Software Release	Category of Improvement								
		Cost	Efficiency	Fix	Flexibility	Installation	Interference	Security	Throughput	Troubleshooting
Transmit **Frame Spreading** with Hardware Scheduling	7.0						●			
All **Frames** Adjusted for Cross-release Communications	6.1				●					
GPS Antenna Connection Status	4.0									●
Telnet Corrupting **GPS** Information Fix	4.0.4			●						
BH **Hash Table** Fix	3.2			●						
900-MHz Module Dynamic per-SM **High-priority Channel** with Hardware Scheduler	6.0				●					
Dynamic per-SM **High-priority Channel** with Hardware Scheduler	6.1				●					
High-priority Channel with Hardware Scheduler	7.2			●						
Prevention of Low-priority Traffic from Sporadically Blocking **High-priority** Traffic	7.3.6			●						
Public **IP Access** for SM	3.1.5				●					
Public **IP Access** for BHS	3.1.5				●					
ISM State Preserved through Reset to Factory Defaults Fix	4.0.2			●						
Improved **Jitter** Control	4.0						●			
20-Mbps BH **Jitter** Measurement Fix	4.0.1			●						
900-MHz Module Hardware Scheduler Reduced **Latency**	6.0				●					
Reduced **Latency** with Hardware Scheduler	6.1				●					
Server-based **License** Management	License Mgr 1.0	●	●			●				
Packet Length Settable via SNMP for **Link Test**	7.2			●						
Customer **Logo** on Web-based Interface	3.1.5				●					
Configurable Hyperlinked **Logo**	4.2.1		●							
BH Configurable for **Master or Slave**	3.1.5				●					
AP **Max Range** Parameter Accepts Greater Distances	7.1.4				●					
AP **Max Range** Parameter Accepts Greater Distances via SNMP	7.2			●						

Feature Name	Initial Software Release	Category of Improvement								
		Cost	Efficiency	Fix	Flexibility	Installation	Interference	Security	Throughput	Troubleshooting
Canopy Enterprise **MIB**	3.2, 4.0, 4.1, 4.2.1, 4.2.3, 6.0, 6.1, 7.0, 7.1.4, 7.2.9, 7.3.6		●							●
Accurate linkOutOctets **MIB** Object Value in AP with Hardware Scheduler	7.3.6			●						
Maximum Information Rate (**MIR**) Settable at SM	6.1, BAM 2.1 and Prizm 2.0				●					
20-Mbps BH to 10-Mbps BH **Modulation**	4.0					●				
Automatic **Modulation** Rate Adaption for 20-Mbps BH	7.2		●		●					
MySQL Database Support	BAM 1.0 and PrizmEMS 1.0				●					
Network Address Translation (**NAT**) in SM	4.1				●			●		
NAT Support for VPNs—L2TP Over IPSec	4.2.1							●		
Use of **Override Plug** for Resetting to Factory Defaults	7.3.6							●		
Passwords on FTP and Telnet Sessions	3.1.5							●		
PostgreSQL Database Support	BAM 2.0 and PrizmEMS 1.0		●		●					
Low **Power** Mode (18-dB Reduction)	4.1				●		●			
5.4-GHz Module Adjustable **Power**	4.2.7				●		●			
2.4-GHz Module Adjustable **Power**	4.2.7				●		●			
5.7-GHz Module Adjustable **Power** with Connectorized Antenna	6.1				●		●			
900-MHz Module Adjustable **Power**	7.0				●					
Out-of-range Low Transmitter Output Power Value Sets Lowest Supported **Power Level**	7.1.4			●						
Power Level Settable via SNMP for 900-MHz Module	7.2			●						
Power Level Measurement	4.0					●				●

Feature Name	**Initial Software Release**	**Category of Improvement**								
		Cost	**Efficiency**	**Fix**	**Flexibility**	**Installation**	**Interference**	**Security**	**Throughput**	**Troubleshooting**
RADIUS Database Support	BAM 2.0 and Prizm 2.0				●					
Display **Registered AP**	4.0					●				●
Registration Failed SM List	4.0									●
No **Remote Access**	4.0							●		
Default **Router** Change for BHS	3.1.5				●					
Default **Router** Change for SM	3.1.5				●					
Improved Received Signal Strength Indicator (**RSSI**)	4.0					●				
SM **Scan** Privacy	4.0							●		
Correct Per-LUID Records in AP **Sessions Page**	7.1.4			●						
SM and BHS **Site Names** in AP or BHM Sessions Page	4.2.1		●							
SNMP Manager and SM Subnet Address Fix	4.2.1			●						
10 **SNMP** Trap Destinations	7.2				●					
Spectrum Analyzer in SM and BHS	4.1		●			●	●			
Graphical **Spectrum Analyzer** in SM and BHS	4.2.1		●							
PDA Info and **Spectrum Analyzer** Pages	4.2.1		●			●	●			
900-MHz Module **Spectrum Analyzer** in AP	6.0					●	●			
Spectrum Analyzer in AP	6.1					●	●			
Only Contiguous **Subnet Masks** Allowed	7.2		●							
Suspend or reinstate SM through the application GUI	BAM 2.0 and Prizm 2.0		●							
GPS **Sync** Protection	3.1.5						●			
Extended Network with **Sync**	4.0	●			●		●			
Telnet Commands Defined	4.2.1		●		●					
900-MHz Module Hardware Scheduler Increased **Throughput**	6.0								●	
Increased **Throughput** with Hardware Scheduler	6.1								●	

Feature Name	Initial Software Release	Category of Improvement								
		Cost	Efficiency	Fix	Flexibility	Installation	Interference	Security	Throughput	Troubleshooting
Time & Date for APs or BHMs Connected to CMMmicro	4.2.1 and CMMmicro 2.1									●
VLAN (802.1Q)	6.1				●			●		
Priority on **VLANs** (802.1P)	7.0				●					
VLAN Membership Page for SM Not Registered to VLAN-enabled AP	7.1.4			●						
VLAN Filtering for SMs from the application	BAM 2.1 and Prizm 2.0				●			●		
VLAN Filtering Enhancement in SMs	7.2							●		
Web Pages Remain Scrolled	4.2.1		●							

10.1 ACTIVATING FEATURES

A Canopy feature is active if the software that allows the feature to be turned on or off (enabled or disabled) is present.

10.1.1 Fixed License Keys

Some features are activated by loading a fixed license key into the radio. Such a key arrives from Motorola as a *filename*.url file. When you double-click on this file, your browser opens and the location bar is populated by a lengthy string. This URL string begins with http://<*ModuleIPAddress*>/. If you need to load a key into a module whose IP address has changed since Motorola issued the key, perform the following steps.

Procedure 1: Modifying a fixed license key for a module IP address

1. Right-click on the license key filename.
2. Select **Properties**.
3. Select the **Web Document** tab.
4. At **URL**, substitute the current IP address for the original IP address in the URL.
5. Click **OK**.
6. Double-click on the license key filename.
   RESULT: The key loads into the module.
7. Open the Configuration web page of the module.
8. Review parameter settings and enable the feature if you wish to do so at this time (see next section).

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

10.2 ENABLING FEATURES

A Canopy feature is enabled (functioning) if the feature is both active and enabled. For example, Transmit Frame Spreading is active (*can be* enabled) in any AP or BHM that operates on Release 4.0 or later and software scheduling, or Release 7.0 or later and hardware scheduling. However, Transmit Frame Spreading functions only if the **Enable** selection for the **Transmit Frame Spreading** parameter is checked in the Configuration web page of the module.

11 ACQUIRING PROFICIENCIES

Designing and operating a Canopy network requires fundamental knowledge of radio frequency transmission and reception, Internet Protocol addressing schemes, experimentation with Canopy equipment, and for most operators participation in some forms of Canopy training.

11.1 UNDERSTANDING RF FUNDAMENTALS

Canopy training and user interfaces presume an understanding of RF fundamentals. Excellent written sources for these fundamentals are available. One such source is *Deploying License-Free Wireless Wide-Area Networks* by Jack Unger (ISBN 1-58705-069-2), published by Cisco Press.

11.2 UNDERSTANDING IP FUNDAMENTALS

Canopy training and user interfaces also presume an understanding of Internet Protocol (IP) fundamentals. Excellent written sources for these fundamentals are available. One such source is *Sams Teach Yourself TCP/IP in 24 Hours* by Joe Casad (ISBN 0-672-32085-1), published by Sams Publishing.

> *NOTE:*
> The default IP address of each Canopy component is 169.254.1.1.

11.3 ACQUIRING A CANOPY DEMONSTRATION KIT

Canopy Demonstration Kits are available through your Canopy representative.

11.3.1 900-MHz with Integrated Antenna and Band-pass Filter Demonstration Kit

Each 900-MHz with integrated antenna and band-pass filter Demonstration Kit contains

- 2 9000SM SMs
- 1 9000APF AP
- 1 300SS Surge Suppressor
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.2 900-MHz with Connectorized Antenna Demonstration Kit

Each 900-MHz with connectorized (external) antenna Demonstration Kit contains

- 2 9000SMC SMs
- 1 9000APC AP
- 3 AN900 60° 9-dBi Antennas
- 1 300SS Surge Suppressor
- 1 SMMB2 Universal Heavy Duty Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.3 2.4-GHz with Adjustable Power Set to Low Demonstration Kit

Each 2.4-GHz with adjustable power set to low Demonstration Kit contains

- 1 2400SMWL SM
- 1 2450SMWL Advantage SM
- 1 2450APWL Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.4 2.4-GHz with Adjustable Power Set to High Demonstration Kit

Each 2.4-GHz with adjustable power set to high Demonstration Kit contains

- 1 2400SM SM
- 1 2450SM Advantage SM
- 1 2450AP Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide

- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.5 5.1-GHz Demonstration Kit

Each 5.1-GHz Demonstration Kit contains

- 1 5202SM SM
- 1 5252SM Advantage SM
- 1 5252AP Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.6 5.2-GHz Demonstration Kit

Each 5.2-GHz Demonstration Kit contains

- 1 5200SM SM
- 1 5250SM Advantage SM
- 1 5250AP Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.7 5.4-GHz Demonstration Kit

Each 5.4-GHz Demonstration Kit contains

- 1 5400SM SM
- 1 5450SM Advantage SM
- 1 5450AP Advantage AP

- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.8 5.7-GHz with Integrated Antenna Demonstration Kit

Each 5.7-GHz with integrated antenna Demonstration Kit contains

- 1 5700SM SM
- 1 5750SM Advantage SM
- 1 5750AP Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB1 Universal Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.9 5.7-GHz with Connectorized Antenna and Adjustable Power Set to Low

Each 5.7-GHz with connectorized antenna and adjustable power set to low Demonstration Kit contains

- 1 5700SMC SM
- 1 5750SMC Advantage SM
- 1 5750APC Advantage AP
- 1 300SS Surge Suppressor
- 1 SMMB2 Universal Heavy Duty Mounting Bracket
- 3 ACPSSW-02 90- to 230-V AC 50- to 60-Hz Power Supplies
- 3 CBL-0562 Straight-through Category 5 Cables
- 1 UGTK-0002 Trial Kit Quick Start Guide
- 1 CPT001-CD02EN Sales Overview on CD
- 1 CPT002-CD03EN Technical Overview on CD
- 1 CPT003-CD03EN Canopy User Guides on CD

Part numbers for Demonstration Kits are provided in Table 33.

11.3.10 Demonstration Kit Part Numbers

The part numbers for ordering Canopy demonstration kits are provided in Table 33.

Table 33: Demonstration Kit part numbers

Frequency Band Range	Part Number
900 MHz integrated antenna with band-pass filter	TK10290
900 MHz connectorized antenna	TK10290C
2.4 GHz adjustable power set to low	TK10250
2.4 GHz adjustable power set to high	TK10251
5.1 GHz	TK10253
5.2 GHz	TK10252
5.4 GHz	TK10254
5.7 GHz	TK10257
5.7 GHz connectorized adjustable power set to low	TK10257C

11.4 ACQUIRING A CANOPY STARTER KIT

Canopy Starter Kits are also available through your Canopy representative.

11.4.1 900-MHz with Integrated Antenna and Band-pass Filter Starter Kit

Each 900-MHz with integrated antenna and band-pass filters Starter Kit contains

- 20 9000SM SMs
- 3 9000APF Advantage APs
- 1 1070CK CMMmicro
- 21 300SS Surge Suppressors
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies and SM mounting brackets *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.2 900-MHz with Connectorized Antenna Starter Kit

Each 900-MHz with connectorized (external) antenna Starter Kit contains

- 20 9000SMC SMs
- 3 9000APC Advantage APs
- 23 AN900 60° 9-dBi Antennas
- 1 1070CK CMMmicro
- 21 300SS Surge Suppressors
- 20 SMMB2 Universal Heavy Duty Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.3 2.4-GHz with Adjustable Power Set to Low Starter Kit

Each 2.4-GHz with adjustable power set to low Starter Kit contains

- 30 2400SMWL SMs
- 6 2450APWL Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.4 2.4-GHz with Adjustable Power Set to High Starter Kit

Each 2.4-GHz adjustable power set to high Starter Kit contains

- 30 2400SM SMs
- 6 2450AP Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.5 5.1-GHz Starter Kit

Each 5.1-GHz adjustable power set to high Starter Kit contains

- 30 5202SM SMs
- 6 5252AP Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.6 5.2-GHz Starter Kit

Each 5.2-GHz Starter Kit contains

- 30 5200SM SMs
- 6 5250AP Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.7 5.4-GHz Starter Kit

Each 5.4-GHz Starter Kit contains

- 30 5400SM SMs
- 6 5450AP Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD02EN Canopy System User Guide on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.8 5.7-GHz with Integrated Antenna Starter Kit

Each 5.7-GHz with integrated antenna Starter Kit contains

- 30 5700SM SMs
- 6 5750AP Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.9 5.7-GHz with Connectorized Antenna and Adjustable Power Set to Low

Each 5.7-GHz with connectorized antenna and adjustable power set to low Starter Kit contains

- 30 5700SMC SMs
- 6 5750APC Advantage APs
- 1 1070CK CMMmicro
- 31 300SS Surge Suppressors
- 30 SMMB1 Universal Mounting Brackets
- 1 UGSK-0003 Quick Start Guide
- 1 CPT003-CD03EN Canopy User Guides on CD

Power supplies *are not* included in this kit. Part numbers for Starter Kits are provided in Table 34.

11.4.10 Starter Kit Part Numbers

The part numbers for ordering Canopy Starter kits are provided in Table 34.

Table 34: Starter Kit part numbers

Frequency Band Range	**Part Number**
900 MHz integrated antenna with band-pass filter	TK10190
900 MHz connectorized	TK10190C
2.4 GHz adjustable power set to low	TK10150
2.4 GHz adjustable power set to high	TK10151
5.1 GHz	TK10153
5.2 GHz	TK10152
5.4 GHz	TK10154

Frequency Band Range	Part Number
5.7 GHz	TK10157
5.7 GHz connectorized adjustable power set to low	TK10157C

11.5 EVALUATING CANOPY TRAINING OPTIONS

Canopy and its distributors make technical training available to customers. For information on this training, either

- send email inquiries to training@canopywireless.com.
- visit http://www.canopywireless.com. Under Contact Us, select **Request Product Info**, select **Product Info**, then under Support, select **Training**.

11.6 ATTENDING ON-LINE KNOWLEDGE SESSIONS

Irregularly but often, Canopy presents a knowledge session over the Internet about a new product offering. Some of these knowledge sessions provide the opportunity for participants to interact in real time with the leader of the session.

The knowledge session

- provides a high-level understanding of the technology that the new product introduces.
- announces any subtleties and caveats.
- typically includes a demonstration of the product.
- is usually recorded for later viewing by those who could not attend in real time.

To participate in upcoming knowledge sessions, ask your Canopy representative to ensure that you receive email notifications.

PLANNING GUIDE

12 ENGINEERING YOUR RF COMMUNICATIONS

Before diagramming network layouts, the wise course is to

- anticipate the correct amount of signal loss for your fade margin calculation (as defined below).
- recognize all permanent and transient RF signals in the environment.
- identify obstructions to line of sight reception.

12.1 ANTICIPATING RF SIGNAL LOSS

The C/I (Carrier-to-Interference) ratio defines the strength of the intended signal relative to the collective strength of all other signals. Canopy modules typically do not require a C/I ratio greater than

- 3 dB or less at 10-Mbps modulation and −65 dBm for 1X operation. The C/I ratio that you achieve must be even greater as the received power approaches the nominal sensitivity (−85 dBm for 1X operation).
- 10 dB or less at 10-Mbps modulation and −65 dBm for 2X operation. The C/I ratio that you achieve must be even greater as the received power approaches the nominal sensitivity (−79 dBm for 2X operation).
- 10 dB or less at 20-Mbps modulation.

12.1.1 Understanding Attenuation

An RF signal in space is attenuated by atmospheric and other effects as a function of the distance from the initial transmission point. The further a reception point is placed from the transmission point, the weaker is the received RF signal.

12.1.2 Calculating Free Space Path Loss

The attenuation that distance imposes on a signal is the free space path loss. PathLossCalcPage.xls calculates free space path loss.

12.1.3 Calculating Rx Signal Level

The Rx sensitivity of each module is provided at http://motorola.canopywireless.com/prod_specs.php. The determinants in Rx signal level are illustrated in Figure 39.

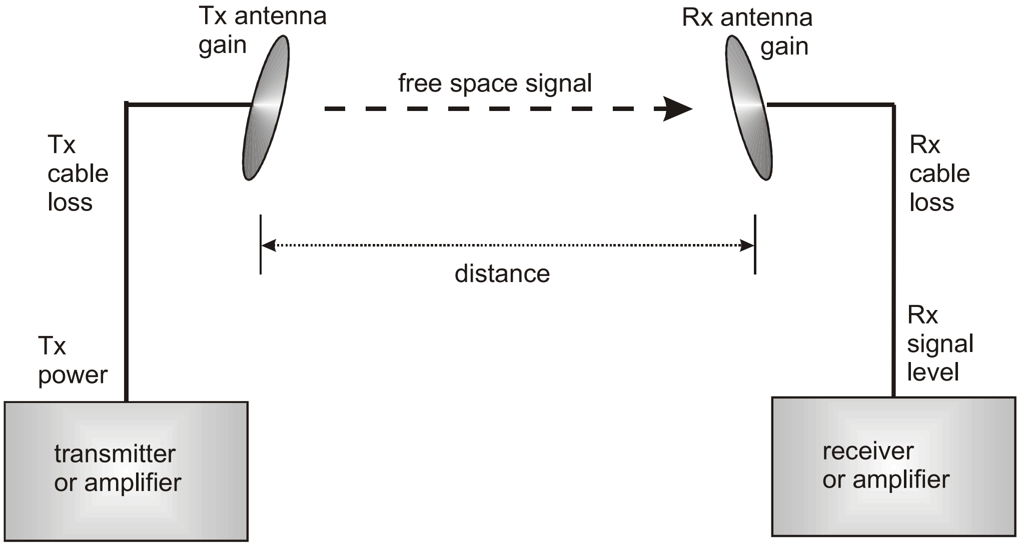


Figure 39: Determinants in Rx signal level

Rx signal level is calculated as follows:

Rx signal level dB = *Tx power* − *Tx cable loss* + *Tx antenna gain* − *free space path loss* + *Rx antenna gain* − *Rx cable loss*

NOTE:
This Rx signal level calculation presumes that a clear line of sight is established between the transmitter and receiver and that no objects encroach in the Fresnel zone.

12.1.4 Calculating Fade Margin

Free space path loss is a major determinant in Rx (received) signal level. Rx signal level, in turn, is a major factor in the system operating margin (fade margin), which is calculated as follows:

***system operating margin (fade margin)* dB =*Rx signal level* dB − *Rx sensitivity* dB**

Thus, fade margin is the difference between strength of the received signal and the strength that the receiver requires for maintaining a reliable link. A higher fade margin is characteristic of a more reliable link.

12.2 ANALYZING THE RF ENVIRONMENT

An essential element in RF network planning is the analysis of spectrum usage and the strength of the signals that occupy the spectrum you are planning to use. Regardless of how you measure and log or chart the results you find (through the Spectrum Analyzer in SM and BHS feature or by using a spectrum analyzer), you should do so

- at various times of day.
- on various days of the week.
- periodically into the future.

As new RF neighbors move in or consumer devices in your spectrum proliferate, this will keep you aware of the dynamic possibilities for interference with your network.

12.2.1 Mapping RF Neighbor Frequencies

In Release 4.1 and later, you can

- use an SM or BHS (or a BHM reset to a BHS), or an AP in Release 6.1 or later, as a spectrum analyzer.
- view a table (or graphical display in Release 4.2 or later) that shows power level in RSSI and dBm at 5-MHz increments throughout the frequency band range, regardless of limited selections in the **Custom RF Frequency Scan Selection List** field of the SM Configuration page.
- select an AP channel that minimizes interference from other RF equipment.

You can use this functionality during the alignment of an SM, but you may find it especially helpful for frequency selection during site planning. The Spectrum Analyzer in SM and BHS feature provides this functionality.

The SM measures only the spectrum of its manufacture. So if, for example, you wish to analyze an area for both 2.4- and 5.7-GHz activity, take both a 2.4- and 5.7-GHz SM to the area. To enable this functionality, perform the following steps:

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

Procedure 2: Analyzing the spectrum

1. Predetermine a power source and interface that will work for the SM or BHS in the area you want to analyze.
2. Take the SM or BHS, power source, and interface device to the area.
3. Access the Expanded Stats page of the SM or BHS.
4. On the Expanded Stats page, click **Spectrum Analyzer**.

5. On the Spectrum Analyzer page, click **Enable**.
   RESULT: The feature is enabled.
6. Click **Enable** again.
   RESULT: The system measures RSSI and dBm for each frequency in the spectrum.
7. Travel to another location in the area.
8. Click **Enable** again.
   RESULT: The system provides a new measurement of RSSI and dBm for each frequency in the spectrum.
   NOTE: Spectrum analysis mode times out 15 minutes after the mode was invoked in Step 5.
9. Repeat Steps 7 and 8 until the area has been adequately scanned and logged.

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

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

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

12.2.2 Anticipating Reflection of Radio Waves

In the signal path, any object that is larger than the wavelength of the signal can reflect the signal. Such an object can even be the surface of the earth or of a river, bay, or lake. The wavelength of the signal is approximately

- 2 inches for 5.2- and 5.7-GHz signals.
- 5 inches for 2.4-GHz signals.
- 12 inches for 900-MHz signals.

A reflected signal can arrive at the antenna of the receiver later than the non-reflected signal arrives. These two or more signals cause the condition known as multipath. When multipath occurs, the reflected signal cancels part of the effect of the non-reflected signal so, overall, attenuation beyond that caused by link distance occurs. This is problematic at the margin of the link budget, where the standard operating margin (fade margin) may be compromised.

12.2.3 Noting Possible Obstructions in the Fresnel Zone

The Fresnel (pronounced *fre·NEL*) Zone is a theoretical three-dimensional area around the line of sight of an antenna transmission. Objects that penetrate this area can cause the received strength of the transmitted signal to fade. Out-of-phase reflections and absorption of the signal result in signal cancellation.

The foliage of trees and plants in the Fresnel Zone can cause signal loss. Seasonal density, moisture content of the foliage, and other factors such as wind may change the amount of loss. Plan to perform frequent and regular link tests if you must transmit though foliage.

12.2.4 Radar Signature Detection and Shutdown

In Release 4.2.3 and later, the Dynamic Frequency Selection (DFS) feature in the 5.7-GHz AP and BHM senses radar and shuts down the radio. The 5.4-GHz AP and BHM likewise sense radar and shut down. The shutdown of an AP/BHM effectively shuts down the SMs/BHS, which transmit only while receiving the beacon of the AP/BHM.

When an AP or BHM in this frequency band range is enabled for DFS, the radio scans for a radar signature throughout the first minute after a boot. During this or any later scan, if the radio detects radar, then the radio

1. shuts down for the next 30 minutes.
2. re-scans for one minute.

However, the scan delay is unfavorable where regulations do not require radar signature detection and shutdown. For this reason

- the default state of the **DFS** parameter in the Configuration page of the AP/BHM is **Disabled**.
- the network operator where radar signature detection and shutdown is required must toggle the **DFS** parameter to **Enabled**
  - when the module is first deployed.
  - if ever the parameters have been reset to factory defaults.

> ***RECOMMENDATION:***
> Where regulations require that radar sensing and radio shutdown is enabled, you can most effectively share the spectrum with satellite services if you perform spectrum analysis and select channels that are distributed evenly across the frequency band range.

Before Release 7.0, the Canopy DFS feature satisfied regulatory requirements but could generate false positives, identifying radar and moving off the frequency when no radar was present. Release 7.0 used an improved algorithm that greatly reduced the potential for false positives, but assumed maximum antenna gain.

In Release 7.1.4 and later, the Configuration web page of a connectorized 5.7-GHz module provides an **Antenna Gain** parameter. When you indicate the gain of your antenna in this field, the algorithm more precisely calculates the appropriate sensitivity to radar signals, and this further reduces the occurrence of false positives (wherever the antenna gain is less than the maximum). Operators who are required to use DFS are strongly urged to upgrade to Release 7.1.4 for this improvement.

12.3 USING JITTER TO CHECK RECEIVED SIGNAL QUALITY

Regardless of whether the Expanded Stats link has been selected, the Status pages of the Canopy SM and BHS display current values for **Jitter**. This is an index of overall received signal quality. Interpret the jitter value as indicated in Table 35.

Table 35: Signal quality levels indicated by jitter

Signal Modulation	Correlation of Highest Seen Jitter to Signal Quality		
	High Quality	Questionable Quality	Poor Quality
2-level FSK (1X operation)	0 to 4	5 to 14	15
4-level FSK (2X operation)	0 to 9	10 to 14	15

In your lab, an SM whose jitter value is constant at 14 may have an incoming packet efficiency of 100%. However, a deployed SM whose jitter value is 14 is likely to have even higher jitter values as interfering signals fluctuate in strength over time. So, *do not* consider 14 to be acceptable. Avoiding a jitter value of 15 should be the highest priority in establishing a link. At 15, jitter causes fragments to be dropped and link efficiency to suffer.

Canopy modules calculate jitter based on both interference and the modulation scheme. For this reason, values on the low end of the jitter range that are significantly higher in 2X operation can still be indications of a high quality signal. For example, where the amount of interference remains constant, an SM with a jitter value of 3 in 1X operation can display a jitter value of 7 when enabled for 2X operation.

However, on the high end of the jitter range, *do not* consider the higher values in 2X operation to be acceptable. This is because 2X operation is much more susceptible to problems from interference than is 1X. For example, where the amount of interference remains constant, an SM with a jitter value of 6 in 1X operation can display a jitter value of 14 when enabled for 2X operation. As indicated in Table 35, these values are unacceptable.

12.4 USING LINK EFFICIENCY TO CHECK RECEIVED SIGNAL QUALITY

A link test, available in the Link Test web page of an AP or BH, provides a more reliable indication of received signal quality, particularly if you launch tests of varying duration. However, a link test interrupts traffic and consumes system capacity, so *do not* routinely launch link tests across your networks.

12.4.1 Comparing Efficiency in 1X Operation to Efficiency in 2X Operation

Efficiency of at least 98 to 100% indicates a high quality signal. Check the signal quality numerous times, at various times of day and on various days of the week (as you checked the RF environment a variety of times by spectrum analysis before placing radios in the area). Efficiency less than 90% in 1X operation or less than 60% in 2X operation indicates a link with problems that require action.

12.4.2 When to Switch from 2X to 1X Operation Based on 60% Link Efficiency

In the above latter case (60% in 2X operation), the link experiences worse latency (from packet resends) than it would in 1X operation, but still greater capacity, if the link remains stable at 60% Efficiency. Downlink Efficiency and Uplink Efficiency are measurements produced by running a link test from either the SM or the AP. Examples of what action should be taken based on Efficiency in 2X operation are provided in Table 36.

Table 36: Recommended courses of action based on Efficiency in 2X operation

Module Types	Further Investigation	Result	Recommended Action
Advantage AP with Advantage SM	Check the expanded Status page of the Advantage SM.[1] See Checking the Status of 2X Operation on Page 96.	Uplink and downlink are both ≥60% Efficiency.[2]	Rerun link tests.
	Rerun link tests.	Uplink and downlink are both ≥60% Efficiency.	Optionally, re-aim SM, add a reflector, or otherwise mitigate interference. In any case, continue 2X operation up and down.
Advantage AP with Canopy SM	Check the expanded Status page of the Advantage SM.[1] See Checking the Status of 2X Operation on Page 96.	Uplink and downlink are both ≥60% Efficiency.[2]	Rerun link tests.
	Rerun link tests.	Uplink and downlink are both ≥60% Efficiency.	Optionally, re-aim SM, add a reflector, or otherwise mitigate interference. In any case, continue 2X operation up and down.
		Results are inconsistent and range from 20% to 80% Efficiency.	Monitor the Sessions page in the Advantage AP.
	Monitor the Sessions page in the Advantage AP.	Link fluctuates between 2X and 1X operation.[3]	Optionally, re-aim SM, add a reflector, or otherwise mitigate interference. Then rerun link tests.
	Rerun link tests.	No substantial improvement with consistency is seen.	On the Configuration page of the SM, disable 2X operation. Then rerun link tests.
	Rerun link tests.	Uplink and downlink are both ≥90% Efficiency.	Continue 1X operation up and down.

NOTES:

1. Or check Sessions page of the Advantage AP, where a sum of greater than 7,000,000 bps for the up- and downlink indicates 2X operation up and down (for 2.4- or 5.x-GHz modules.
2. For throughput to the SM, this is equivalent to 120% Efficiency in 1X operation, with less capacity used at the AP.
3. This link is problematic.

12.5 CONSIDERING FREQUENCY BAND ALTERNATIVES

For 5.2-, 5.4-, and 5.7-GHz modules, 20-MHz wide channels are centered every 5 MHz. For 2.4-GHz modules, 20-MHz wide channels are centered every 2.5 MHz. This allows the operator to customize the channel layout for interoperability where other Canopy equipment is collocated.

Cross-band deployment of APs and BH is the recommended alternative (for example, a 5.2-GHz AP collocated with 5.7-GHz BH).

> *IMPORTANT!*
> Regardless of whether 2.4-, 5.2-, 5.4-, or 5.7-GHz modules are deployed, channel separation between modules should be at least 20 MHz for 1X operation or 25 MHz for 2X.

12.5.1 900-MHz Channels

900-MHz Single AP Available Channels

A single 900-MHz AP can operate with the 8-MHz wide channel centered on any of the following frequencies:

(All Frequencies in MHz)

906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
922
923
924

900-MHz AP Cluster Recommended Channels

Three non-overlapping channels are recommended for use in a 900-MHz AP cluster:

(All Frequencies in MHz)

906 915 924

This recommendation allows 9 MHz of separation between channel centers. You can use the Spectrum Analysis feature in an SM, or use a standalone spectrum analyzer, to evaluate the RF environment. In any case, ensure that the 8-MHz wide channels you select *do not* overlap.

12.5.2 2.4-GHz Channels

2.4-GHz BH and Single AP Available Channels

A BH or a single 2.4-GHz AP can operate in the following channels, which are separated by only 2.5-MHz increments.

(All Frequencies in GHz)

2.4150
2.4175
2.4200
2.4225
2.4250
2.4275
2.4300
2.4325
2.4350
2.4375
2.4400
2.4425
2.4450
2.4475
2.4500
2.4525
2.4550
2.4575

The channels of *adjacent* 2.4-GHz APs should be separated by at least 20 MHz.

> *IMPORTANT!*
> In the 2.4-GHz frequency band, an SM can register to an AP that transmits on a frequency 2.5 MHz higher than the frequency that the SM 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.

2.4-GHz AP Cluster Recommended Channels

Three non-overlapping channels are recommended for use in a 2.4-GHz AP cluster:

(All Frequencies in GHz)

2.4150	2.4350	2.4575

This recommendation allows 20 MHz of separation between one pair of channels and 22.5 MHz between the other pair. You can use the Spectrum Analysis feature in an SM or BHS, or use a standalone spectrum analyzer, to evaluate the RF environment. Where spectrum analysis identifies risk of interference for any of these channels, you can compromise this recommendation as follows:

- Select 2.4375 GHz for the middle channel
- Select 2.455 GHz for the top channel
- Select 2.4175 GHz for the bottom channel

In any case, ensure that your plan allows at least 20 MHz of separation between channels.

12.5.3 5.2-GHz Channels

Channel selections for the AP in the 5.2-GHz frequency band range depend on whether the AP is deployed in cluster.

5.2-GHz BH and Single AP Available Channels

A BH or a single 5.2-GHz AP can operate in the following channels, which are separated by 5-MHz increments.

(All Frequencies in GHz)

5.275	5.290	5.305	5.320
5.280	5.295	5.310	5.325
5.285	5.300	5.315	

The channels of *adjacent* APs should be separated by at least 20 MHz. However, 25 MHz of separation is advised.

5.2-GHz AP Cluster Recommended Channels

Three non-overlapping channels are recommended for use in a 5.2-GHz AP cluster:

(All Frequencies in GHz)

5.275	5.300	5.325

12.5.4 5.4-GHz Channels

Channel selections for the AP in the 5.4-GHz frequency band range depend on whether the AP is deployed in cluster.

5.4-GHz BH and Single AP Available

A BH or single 5.4-GHz AP can operate in the following channels, which are separated by 5-MHz.

(All Frequencies in GHz)

5495	5515	5535	5555	5575	5595	5615	5635	5655	5675	5695
5500	5520	5540	5560	5580	5600	5620	5640	5660	5680	5700
5505	5525	5545	5565	5585	5605	5625	5645	5665	5685	5705
5510	5530	5550	5570	5590	5610	5630	5650	5670	5690	

The channels of *adjacent* APs should be separated by at least 20 MHz.

5.4-GHz AP Cluster Recommended Channels

The fully populated cluster requires only three channels, each reused by the module that is mounted 180° opposed. In this frequency band range, the possible sets of three non-overlapping channels are numerous. As many as 11 non-overlapping 20-MHz wide channels are available for 1X operation. Fewer 25-MHz wide channels are available for 1X operation, where this greater separation is recommended for interference avoidance.

5.4-GHz AP Cluster Limit Case

In the limit, the 11 channels could support all of the following, vertically stacked on the same mast:

- 3 full clusters, each cluster using 3 channels
- a set of 4 APs, the set using the 2 channels that no AP in any of the 3 full clusters is using

> ***IMPORTANT!***
>
> Where regulations require you to have Dynamic Frequency Selection (DFS) enabled, analyze the spectrum, then spread your channel selections as evenly as possible throughout this frequency band range, appropriately sharing it with satellite services.

12.5.5 5.7-GHz Channels

Channel selections for the AP in the 5.7-GHz frequency band range depend on whether the AP is deployed in cluster.

5.7-GHz BH and Single AP Available ISM/U-NII Channels

A BH or a single 5.7-GHz AP enabled for ISM/U-NII frequencies can operate in the following channels, which are separated by 5-MHz increments.

(All Frequencies in GHz)

5.735	5.765	5.795	5.825
5.740	5.770	5.800	5.830
5.745	5.775	5.805	5.835
5.750	5.780	5.810	5.840
5.755	5.785	5.815	
5.760	5.790	5.820	

The channels of *adjacent* APs should be separated by at least 20 MHz. However, 25 MHz of separation is advised.

5.7-GHz AP Cluster Recommended ISM/U-NII Channels

Six non-overlapping ISM/U-NII channels are recommended for use in a 5.7-GHz AP cluster:

(All Frequencies in GHz)

5.735	5.775	5.815
5.755	5.795	5.835

The fully populated cluster requires only three channels, each reused by the module that is mounted 180° offset. The six channels above are also used for backhaul point-to-point links.

As noted above, a 5.7-GHz AP enabled for ISM/U-NII frequencies can operate on a frequency as high as 5.840 GHz. Where engineering plans allow, this frequency can be used to provide an additional 5-MHz separation between AP and BH channels.

12.5.6 Channels Available for OFDM Backhaul Modules

Channel selections for BHs in the OFDM series are quoted in the user guides that are dedicated to those products. However, these BHs dynamically change channels when the signal substantially degrades. Since the available channels are in the 5.4- and 5.7-GHz frequency band ranges, carefully consider the potential effects of deploying these products into an environment where traffic in this range pre-exists.

12.5.7 Example Channel Plans for AP Clusters

Examples for assignment of frequency channels and sector IDs are provided in the following tables. Each frequency is reused on the sector that is at a 180° offset. The entry in the Symbol column of each table refers to the layout in Figure 40 on Page 143.

NOTE:
The operator specifies the sector ID for the module as described under Sector ID on Page 402.

Table 37: Example 900-MHz channel assignment by sector

Direction of Access Point Sector	Frequency	Sector ID	Symbol
North (0°)	906 MHz	0	A
Northeast (60°)	915 MHz	1	B
Southeast (120°)	924 MHz	2	C
South (180°)	906 MHz	3	A
Southwest (240°)	915 MHz	4	B
Northwest (300°)	924 MHz	5	C

Table 38: Example 2.4-GHz channel assignment by sector

Direction of Access Point Sector	Frequency	Sector ID	Symbol
North (0°)	2.4150 GHz	0	A
Northeast (60°)	2.4350 GHz	1	B
Southeast (120°)	2.4575 GHz	2	C
South (180°)	2.4150 GHz	3	A
Southwest (240°)	2.4350 GHz	4	B
Northwest (300°)	2.4575 GHz	5	C

Table 39: Example 5.2-GHz channel assignment by sector

Direction of Access Point Sector	Frequency	Sector ID	Symbol
North (0°)	5.275 GHz	0	A
Northeast (60°)	5.300 GHz	1	B
Southeast (120°)	5.325 GHz	2	C
South (180°)	5.275 GHz	3	A
Southwest (240°)	5.300 GHz	4	B
Northwest (300°)	5.325 GHz	5	C

Table 40: Example 5.4-GHz channel assignment by sector

Direction of Access Point Sector	Frequency	Sector ID	Symbol
North (0°)	5.580 GHz	0	A
Northeast (60°)	5.620 GHz	1	B
Southeast (120°)	5.660 GHz	2	C
South (180°)	5.580 GHz	3	A
Southwest (240°)	5.620 GHz	4	B
Northwest (300°)	5.660 GHz	5	C

Table 41: Example 5.7-GHz channel assignment by sector

Direction of Access Point Sector	Frequency	Sector ID	Symbol
North (0°)	5.735 GHz	0	A
Northeast (60°)	5.755 GHz	1	B
Southeast (120°)	5.775 GHz	2	C
South (180°)	5.735 GHz	3	A
Southwest (240°)	5.755 GHz	4	B
Northwest (300°)	5.775 GHz	5	C

12.5.8 Multiple Access Points Clusters

When deploying multiple AP clusters in a dense area, consider aligning the clusters as shown in Figure 40. However, this is only a recommendation. An installation may dictate a different pattern of channel assignments.

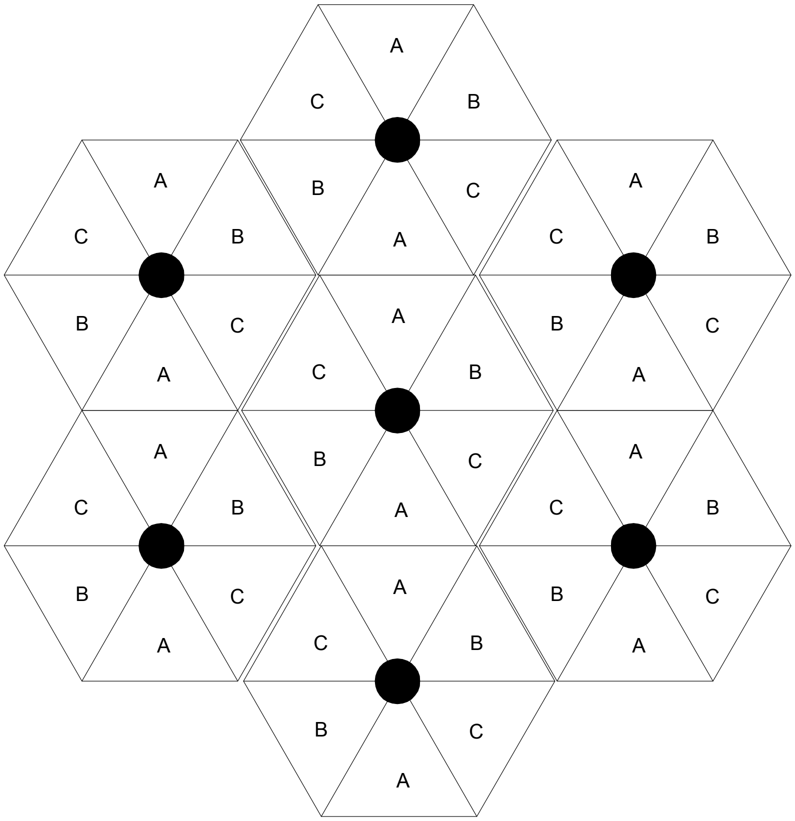


Figure 40: Example layout of 7 Access Point clusters

12.6 SELECTING SITES FOR NETWORK ELEMENTS

The Canopy APs must be positioned

- with hardware that the wind and ambient vibrations cannot flex or move.
- where a tower or rooftop is available or can be erected.
- where a grounding system is available.
- with lightning arrestors to transport lightning strikes away from equipment.
- at a proper height:
  - higher than the tallest points of objects immediately around them (such as trees, buildings, and tower legs).
  - at least 2 feet (0.6 meters) below the tallest point on the tower, pole, or roof (for lightning protection).
- away from high-RF energy sites (such as AM or FM stations, high-powered antennas, and live AM radio towers).
- in line-of-sight paths
  - to the SMs and BH.
  - that will not be obstructed by trees as they grow or structures that are later built.

NOTE:
Visual line of sight does not guarantee radio line of sight.

12.6.1 Resources for Maps and Topographic Images

Mapping software is available from sources such as the following:

- http://www.microsoft.com/streets/default.asp
  - Microsoft Streets & Trips (with Pocket Streets)
- http://www.delorme.com/software.htm
  - DeLorme Street Atlas USA
  - DeLorme Street Atlas USA Plus
  - DeLorme Street Atlas Handheld

Topographic maps are available from sources such as the following:

- http://www.delorme.com/software.htm
  - DeLorme Topo USA
  - DeLorme 3-D TopoQuads
- http://www.usgstopomaps.com
  - Timely Discount Topos, Inc. authorized maps

Topographic maps with waypoints are available from sources such as the following:

- http://www.topografix.com
  - TopoGrafix EasyGPS
  - TopoGrafix Panterra
  - TopoGrafix ExpertGPS

Topographic images are available from sources such as the following:

- http://www.keyhole.com/body.php?h=products&t=keyholePro
  - keyhole PRO
- http://www.digitalglobe.com
  - various imagery

12.6.2 Surveying Sites

Factors to survey at potential sites include

- what pre-existing wireless equipment exists at the site. (Perform spectrum analysis.)
- whether available mounting positions exist near the lowest elevation that satisfies line of site, coverage, and other link criteria.
- whether you will always have the right to decide who climbs the tower to install and maintain your equipment, and whether that person or company can climb at any hour of any day.

- whether you will have collaborative rights and veto power to prevent interference to your equipment from wireless equipment that is installed at the site in the future.
- whether a pre-existing grounding system (path to Protective Earth) exists, and what is required to establish a path to it.
- who is permitted to run any indoor lengths of cable.

12.6.3 Assuring the Essentials

In the 2.4-, 5.2-, 5.4-, and 5.7-GHz frequency band ranges, an unobstructed line of sight (LOS) must exist and be maintainable between the radios that are involved in each link.

Line of Sight (LOS) Link

In these ranges, a line of sight link is both

- an unobstructed straight line from radio to radio.
- an unobstructed zone surrounding that straight line.

Fresnel Zone Clearance

An unobstructed line of sight is important, but is not the *only* determinant of adequate placement. Even where the path has a clear line of sight, obstructions such as terrain, vegetation, metal roofs, or cars may penetrate the Fresnel zone and cause signal loss. Figure 41 illustrates an ideal Fresnel zone.

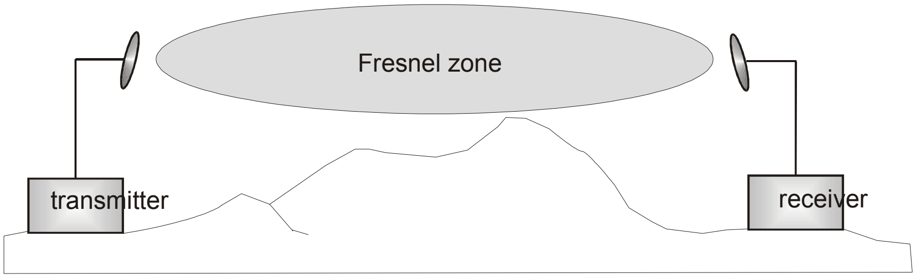


Figure 41: Fresnel zone

FresnelZoneCalcPage.xls calculates the Fresnel zone clearance that is required between the visual line of sight and the top of an obstruction that would protrude into the link path.

Non-Line of Sight (NLOS) Link

The Canopy 900-MHz modules have a line of sight (LOS) range of 40 miles (more than 64 km) and greater non-line of sight (NLOS) range than Canopy modules of other frequency bands. NLOS range depends on RF considerations such as foliage, topography, obstructions.

12.6.4 Finding the Expected Coverage Area

The transmitted beam in the vertical dimension covers more area beyond than in front of the beam center. BeamwidthRadiiCalcPage.xls calculates the radii of the beam coverage area.

12.6.5 Clearing the Radio Horizon

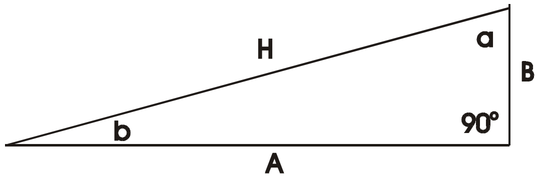
Because the surface of the earth is curved, higher module elevations are required for greater link distances. This effect can be critical to link connectivity in link spans that are greater than 8 miles (12 km). AntennaElevationCalcPage.xls calculates the minimum antenna elevation for these cases, presuming no landscape elevation difference from one end of the link to the other.

12.6.6 Calculating the Aim Angles

The appropriate angle of AP downward tilt is derived from both the distance between transmitter and receiver and the difference in their elevations. DowntiltCalcPage.xls calculates this angle.

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 42).



LEGEND

b **Angle of elevation.**

B **Vertical difference in elevation.**

A **Horizontal distance between modules.**

Figure 42: Variables for calculating angle of elevation (and depression)

Calculating the Angle of Elevation

To use metric units to find the angle of elevation, use the following formula:

$$\tan b = \frac{B}{1000A}$$

where
B is expressed in meters
A is expressed in kilometers.

To use English standard units to find the angle of elevation, use the following formula:

$$\tan b = \frac{B}{5280A}$$

where
B is expressed in feet
A is expressed in miles.

The angle of depression from the higher module is identical to the angle of elevation from the lower module.

12.7 COLLOCATING CANOPY MODULES

A BH and an AP or AP cluster on the same tower require a CMM. The CMM properly synchronizes the *transmit start* times of all Canopy modules to prevent interference and desensing of the modules. At closer distances without sync from a CMM, the frame structures cause self interference.

Furthermore, a BH and an AP on the same tower require that the effects of their differing *receive start* times be mitigated by either

- 100 vertical feet (30 meters) or more and as much spectral separation as possible within the same frequency band range.
- the use of the frame calculator to tune the Downlink Data % parameter in each, so that the receive start time in each is the same. See Frame Calculator Page on Page 414.

Canopy APs and a BHS can be collocated at the same site only if they operate in different frequency band ranges.

Where a single BH air link is insufficient to cover the distance from an AP cluster to your point of presence (POP), you can deploy two BHSs, connected to one another by Ethernet, on a tower that is between a BHM collocated with the AP cluster and another BHM collocated with the POP. This deployment is illustrated in Figure 43.

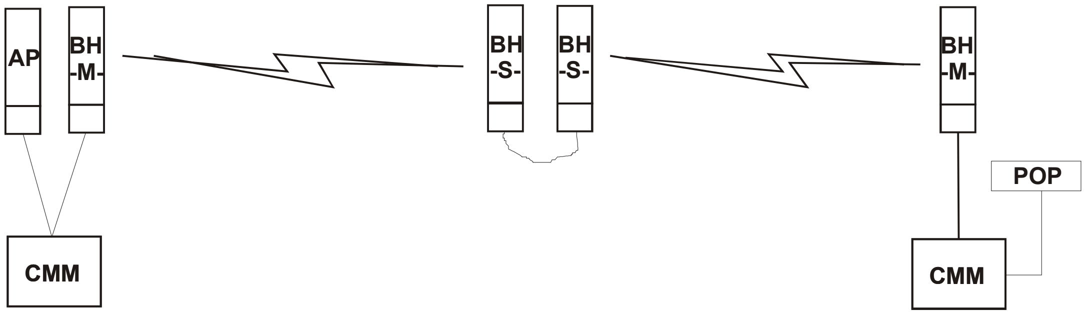


Figure 43: Double-hop backhaul links

However, the BHSs can be collocated at the same site *only if* one is on a different frequency band range from that of the other or one of the following conditions applies:

- They are vertically separated on a structure by at least 100 feet (30 m).
- They are vertically separated on a structure by less distance, but either
  - an RF shield isolates them from each other.
  - the uplink and downlink data parameters and control channels match (the **Downlink Data** parameter is set to **50%**).

The constraints for collocated modules in the same frequency band range are to avoid self-interference that would occur between them. Specifically, unless the uplink and downlink data parameters match, intervals exist when one is transmitting while the other is receiving, such that the receiving module cannot receive the signal from the far end.

The interference is less a problem during low throughput periods and intolerable during high. Typically, during low throughput periods, sufficient time exists for the far end to retransmit packets lost because of interference from the collocated module.

12.8 DEPLOYING A REMOTE AP

In cases where the subscriber population is widely distributed, or conditions such as geography restrict network deployment, you can add a Remote AP to

- provide high-throughput service to near LoS business subscribers.
- reach around obstructions or penetrate foliage with non-LoS throughput.
- reach new, especially widely distributed, residential subscribers with broadband service.
- pass sync to an additional RF hop.

In the remote AP configuration, a Canopy AP is collocated with a Canopy SM. The remote AP distributes the signal over the last mile to SMs that are logically behind the collocated SM. A remote AP deployment is illustrated in Figure 44.

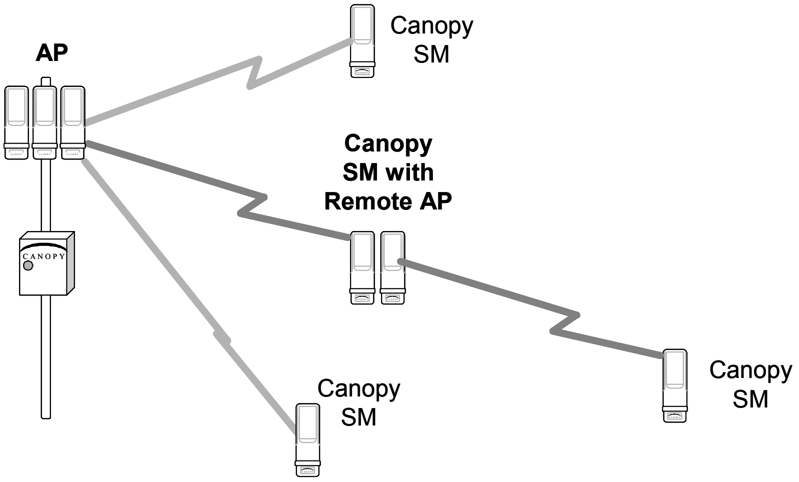


Figure 44: Remote AP deployment

The collocated SM receives data in one frequency band, and the remote AP must redistribute the data in a different frequency band. Base your selection of frequency band ranges on regulatory restrictions, environmental conditions, and throughput requirements.

IMPORTANT!
Each relay hop (additional daisy-chained remote AP) adds latency to the link as follows:

- approximately 6 msec where hardware scheduling is enabled.
- approximately 15 msec where software scheduling is enabled.

12.8.1 Remote AP Performance

The performance of a remote AP is identical to the AP performance in cluster. Throughputs, ranges, and patch antenna coverage are identical. Canopy Advantage and Canopy modules can be deployed in tandem in the same sector to meet customer bandwidth demands.

As with all equipment operating in the unlicensed spectrum, Motorola *strongly* recommends that you perform site surveys before you add network elements. These will indicate that spectrum is available in the area where you want to grow. Keep in mind that

- non-LoS ranges heavily depend on environmental conditions.
- in most regions, not all frequencies are available.
- your deployments must be consistent with local regulatory restrictions.

12.8.2 Example Use Case for RF Obstructions

A remote AP can be used to provide last-mile access to a community where RF obstructions prevent SMs from communicating with the higher-level AP in cluster. For example, you may be able to use 900 MHz for the last mile between a remote AP and the outlying SMs where these subscribers cannot form good links to a higher-level 2.4-GHz AP. In this case, the short range of the 900-MHz remote AP is sufficient, and the ability of the 900-MHz wavelength to be effective around foliage at short range solves the foliage penetration problem.

An example of this use case is shown in Figure 45.

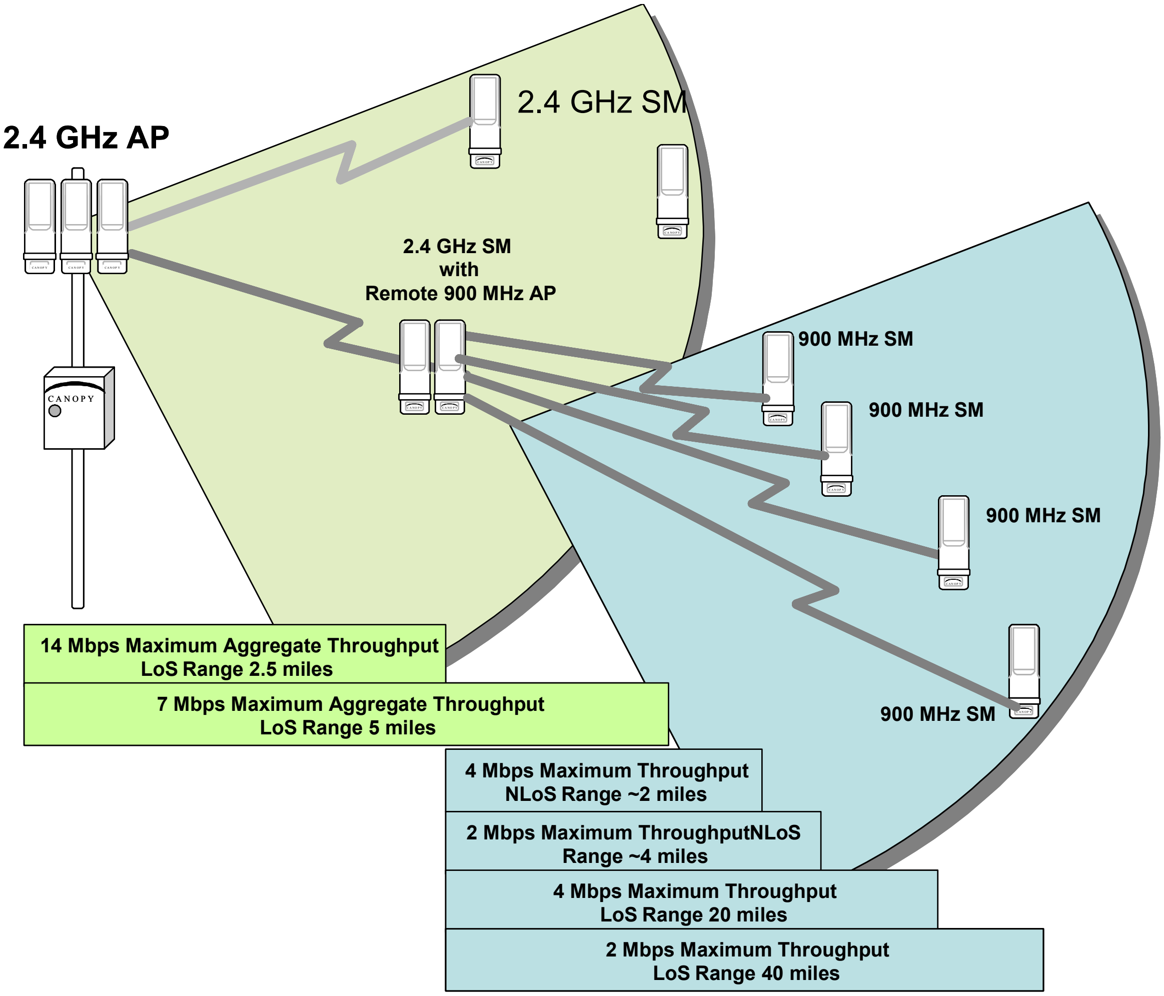


Figure 45: Example 900-MHz remote AP behind 2.4-GHz SM

The 2.4 GHz modules provide a sustained aggregate throughput of up to 14 Mbps to the sector. One of the SMs in the sector is wired to a 900-MHz remote AP, which provides NLoS sustained aggregate throughput[4] of

- 4 Mbps to 900-MHz SMs up to 2 miles away in the sector.
- 2 Mbps to 900-MHz SMs between 2 and 4 miles away in the sector.

12.8.3 Example Use Case for Passing Sync

All Canopy radios support the remote AP functionality. The BHS and the SM can reliably pass the sync pulse, and the BHM and AP can reliably receive it. Examples of passing sync over cable are shown under Passing Sync in an Additional Hop on Page 100. The sync cable is described under Cables on Page 59.

[4] NLoS ranges depend on environmental conditions. Your results may vary from these.

The sync is passed in a cable that connects Pins 1 and 6 of the RJ-11 timing ports of the two modules. When you connect modules in this way, you must also adjust configuration parameters to ensure that

- the AP is set to properly receive sync.
- the SM will not propagate sync to the AP if the SM itself ceases to receive sync.

Perform Procedure 38: Extending network sync on Page 360.

12.8.4 Physical Connections Involving the Remote AP

The SM to which you wire a remote AP can be either an SM that serves a customer or an SM that simply serves as a relay. Where the SM serves a customer, wire the remote AP to the SM as shown in Figure 46.

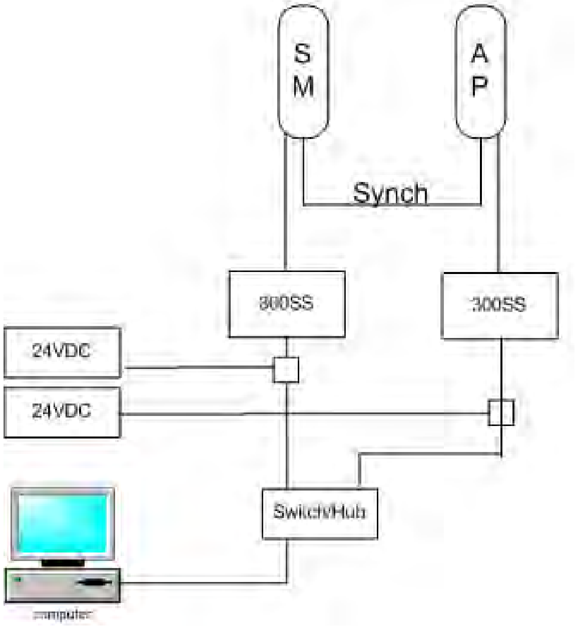


Figure 46: Remote AP wired to SM that also serves a customer

Where the SM simply serves as a relay, you must use a straight-through RJ-45 female-to-female coupler, and wire the SM to the remote AP as shown in Figure 47.

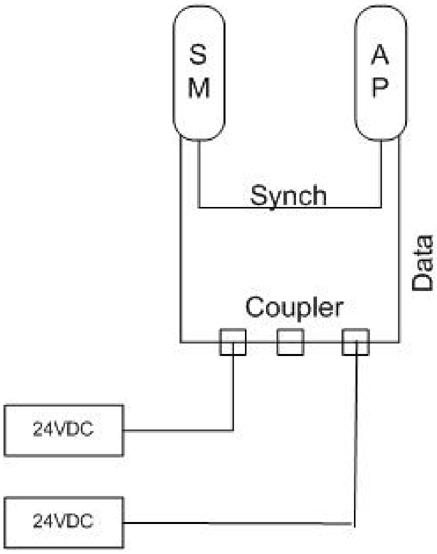


Figure 47: Remote AP wired to SM that serves as a relay

12.9 DIAGRAMMING NETWORK LAYOUTS

12.9.1 Accounting for Link Ranges and Data Handling Requirements

For aggregate throughput correlation to link distance in both point-to-multipoint and point-to-point links, see

- Link Performance and Encryption Comparisons on Page 63.
- all regulations that apply in your region and nation(s).

12.9.2 Avoiding Self Interference

For 5.2-, 5.4-, and 5.7-GHz modules, 20-MHz wide channels are centered every 5 MHz. For 2.4-GHz modules, 20-MHz wide channels are centered every 2.5 MHz. This allows you to customize the channel layout for interoperability where other Canopy equipment is collocated.

> ***CAUTION!***
> Regardless of whether 2.4-, 5.2-, 5.4-, or 5.7-GHz modules are deployed, channel separation between modules should be at least 20 MHz for 1X operation or 25 MHz for 2X.

Physical Proximity

A BH and an AP on the same tower require a CMM. The CMM properly synchronizes the *transmit start* times of all Canopy modules to prevent interference and desensing of the modules. At closer distances without sync from a CMM, the frame structures cause self interference.

Furthermore, a BH and an AP on the same tower require that the effects of their differing *receive start* times be mitigated by either

- 100 vertical feet (30 meters) or more and as much spectral separation as possible within the same frequency band range.
- the use of the frame calculator to tune the Downlink Data % parameter in each, so that the receive start time in each is the same. See Frame Calculator Page on Page 414.

Spectrum Analysis

In Release 4.1 and later, you can use an SM or BHS as a spectrum analyzer. See Mapping RF Neighbor Frequencies on Page 132. In Release 6.1 and later, through a toggle of the **Device Type** parameter, you can temporarily transform an AP into an SM to use it as a spectrum analyzer.

Power Reduction to Mitigate Interference

In Release 4.1 and later, where any module (SM, AP, BH timing master, or BH timing slave) is close enough to another module that self-interference is possible, the operator can set the SM to operate at 18 dB less than full power. The Power Control feature provides this functionality. To enable this functionality, perform the following steps.

> ***CAUTION!***
> Selection of **Low** can cause a link to a distant module to drop. If a link drops when Power Control is set to low, the link can be re-established by only Ethernet access.

Procedure 3: Invoking the low power mode

1. Access the Configuration page of the module.
2. In the **Power Control** parameter, click **Low**.
3. Click **Save Changes**.
4. Click **Reboot**.
5. Access the Alignment page of the SM.
6. Assess whether the desired links for this module achieve
    - RSSI greater than 700.
    - jitter value between 0 and 4 in Release 4.0 and later or between 5 and 9 in any earlier release.
7. Access the Link Test page of the module.
8. Assess whether the desired links for this module achieve
    - uplink efficiency greater than 90%.
    - downlink efficiency greater than 90%.
9. If the desired links fail to achieve any of the above measurement thresholds, then
    a. access the module by direct Ethernet connection.
    b. access the Configuration page of the module.
    c. in the **Power Control** parameter, click **Full**.

d. click **Save Changes**.

e. click **Reboot**.

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

12.9.3 Avoiding Other Interference

Where signal strength cannot dominate noise levels, the network experiences

- bit error corrections.
- packet errors and retransmissions.
- low throughput and high latency (because so much bandwidth is consumed by retransmissions).

Be especially cognitive of these symptoms for 900-MHz links. Where you see these symptoms, attempt the following remedies:

- Adjust the position of the SM.
- Deploy a band-pass filter at the AP.
- Consider adding a remote AP closer to the affected SMs. (See Deploying a Remote AP on Page 148.)

Certain other actions, which may seem to be potential remedies, *do not* resolve high noise level problems:

- *Do not* deploy an omnidirectional or vertically polarized antenna.
- *Do not* set the antenna gain above the recommended level.
- *Do not* deploy a band-pass filter in the expectation that this can mitigate interband interference.

13 ENGINEERING YOUR IP COMMUNICATIONS

13.1 UNDERSTANDING ADDRESSES

A basic understanding of Internet Protocol (IP) address and subnet mask concepts is required for engineering your IP network.

13.1.1 IP Address

The IP address is a 32-bit binary number that has four parts (octets). This set of four octets has two segments, depending on the class of IP address. The first segment identifies the network. The second identifies the hosts or devices on the network. The subnet mask marks a boundary between these two sub-addresses.

13.2 DYNAMIC OR STATIC ADDRESSING

For any computer to communicate with a Canopy module, the computer must be configured to either

- use DHCP (Dynamic Host Configuration Protocol). In this case, when not connected to the network, the computer derives an IP address on the 169.254 network within two minutes.
- have an assigned static IP address (for example, 169.254.1.5) on the 169.254 network.

> *IMPORTANT!*
> If an IP address that is set in the module is not the 169.254.x.x network address, then the network operator must assign the computer a static IP address in the same subnet.

13.2.1 When a DHCP Server is Not Found

To operate on a network, a computer requires an IP address, a subnet mask, and possibly a gateway address. Either a DHCP server automatically assigns this configuration information to a computer on a network or an operator must input these items.

When a computer is brought on line and a DHCP server is not accessible (such as when the server is down or the computer is not plugged into the network), Microsoft and Apple operating systems default to an IP address of 169.254.x.x and a subnet mask of 255.255.0.0 (169.254/16, where /16 indicates that the first 16 bits of the address range are identical among all members of the subnet).

13.3 NETWORK ADDRESS TRANSLATION (NAT)

13.3.1 NAT, DHCP Server, DHCP Client, and DMZ in SM

In Release 4.1 and later, the Canopy system provides NAT (network address translation) for SMs in the following combinations of NAT and DHCP (Dynamic Host Configuration Protocol):

- NAT Disabled (as in earlier releases)
- NAT with DHCP Client and DHCP Server
- NAT with DHCP Client
- NAT with DHCP Server
- NAT without DHCP

NAT

NAT isolates devices connected to the Ethernet/wired side of an SM from being seen directly from the wireless side of the SM. With NAT enabled, the SM has an IP address for transport traffic (separate from its address for management), terminates transport traffic, and allows the operator to assign a range of IP addresses to devices that are connected to the Ethernet/wired side of the SM.

In the Canopy system, NAT supports many protocols, including HTTP, ICMP (Internet Control Message Protocols), and FTP (File Transfer Protocol). For virtual private network (VPN) implementation, L2TP over IPSec (Level 2 Tunneling Protocol over IP Security) is supported, but PPTP (Point to Point Tunneling Protocol) *is not* supported. See NAT and VPNs on Page 162.

DHCP

DHCP enables a device to be assigned a new IP address and TCP/IP parameters, including a default gateway, whenever the device reboots. Thus DHCP reduces configuration time, conserves IP addresses, and allows modules to be moved to a different network within the Canopy system.

In conjunction with the NAT features, each SM provides

- a DHCP server that assigns IP addresses to computers connected to the SM by Ethernet protocol.
- a DHCP client that receives an IP address for the SM from a network DHCP server.

DMZ

In conjunction with the NAT features, a DMZ (demilitarized zone) allows the assignment of one IP address behind the SM for a device to logically exist outside the firewall and receive network traffic. The first three octets of this IP address must be identical to the first three octets of the NAT private IP address.

NAT Disabled

The NAT Disabled implementation is illustrated in Figure 48.

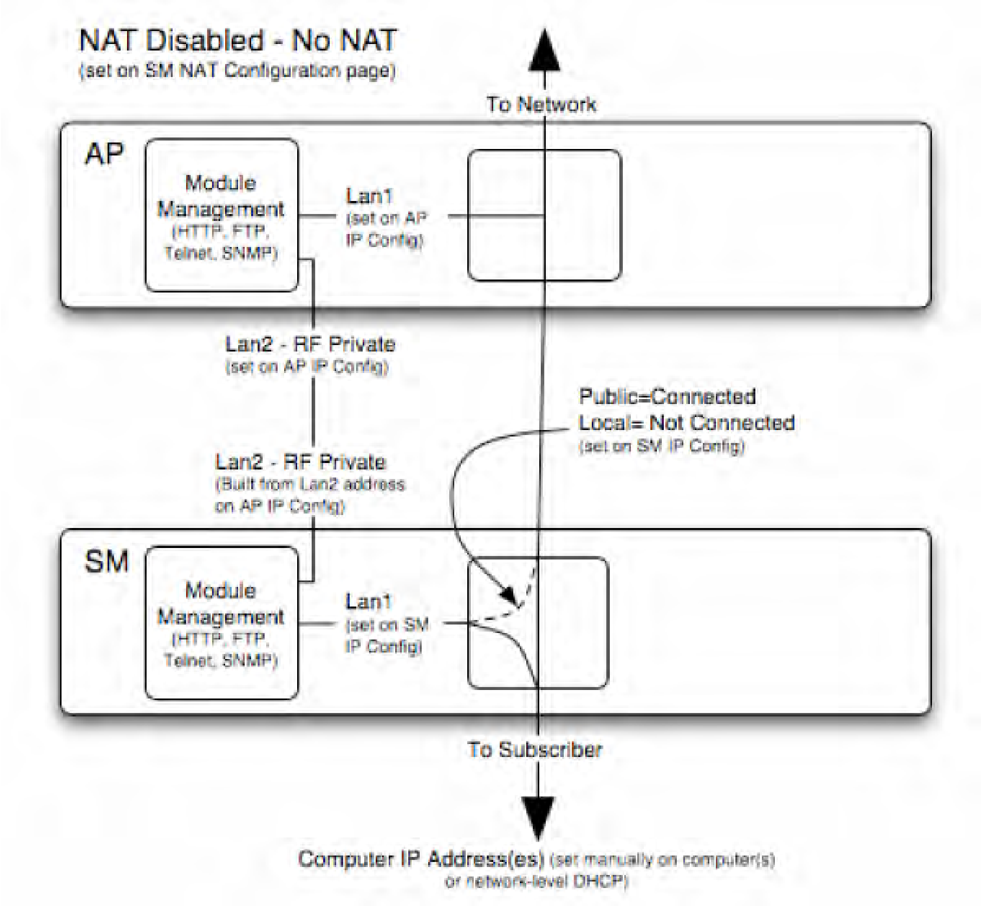

NAT Disabled - No NAT
(set on SM NAT Configuration page)
To Network
AP
Module Management (HTTP, FTP, Telnet, SNMP)
Lan1 (set on AP IP Config)
Lan2 - RF Private (set on AP IP Config)
Public=Connected
Local= Not Connected
(set on SM IP Config)
Lan2 - RF Private (Built from Lan2 address on AP IP Config)
SM
Module Management (HTTP, FTP, Telnet, SNMP)
Lan1 (set on SM IP Config)
To Subscriber
Computer IP Address(es) (set manually on computer(s) or network-level DHCP)

Figure 48: NAT Disabled implementation

This implementation is provisioned as displayed in

- Figure 88 on Page 267
- Figure 89 on Page 267
- Figure 94 on Page 274.

NAT with DHCP Client and DHCP Server

The NAT with DHCP Client and DHCP Server implementation is illustrated in Figure 49.

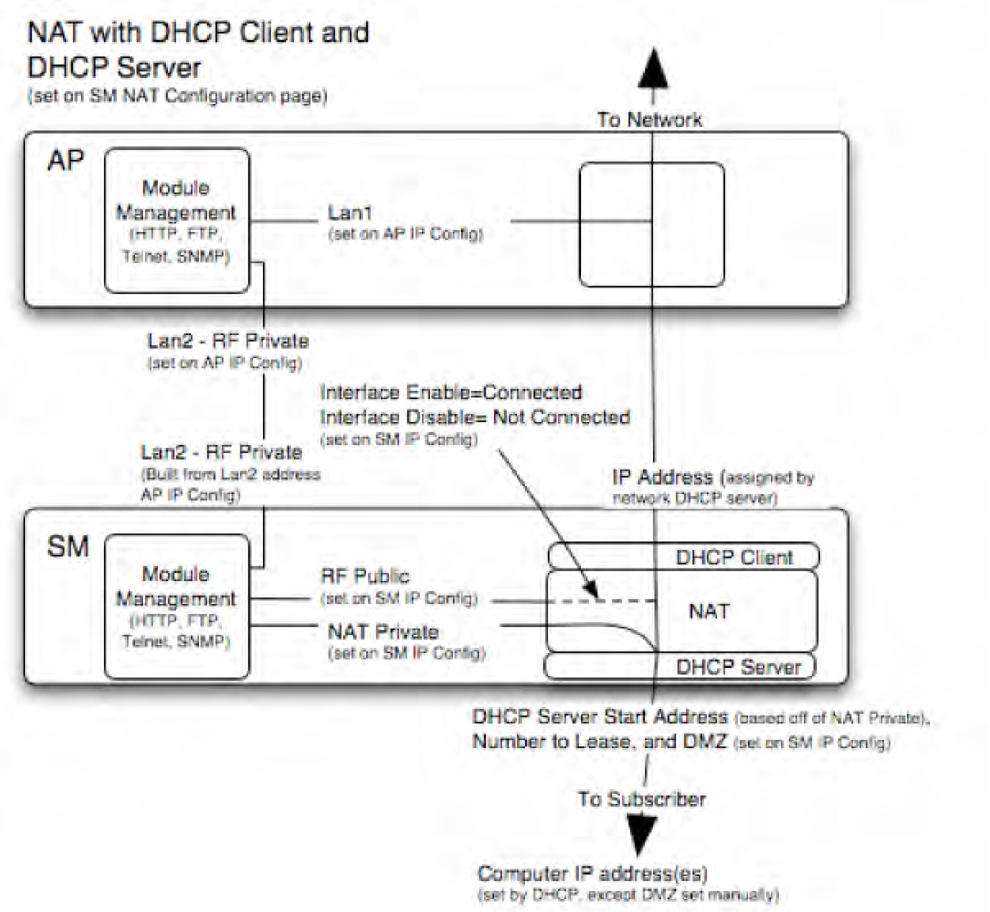

NAT with DHCP Client and DHCP Server
(set on SM NAT Configuration page)
To Network
AP
Module Management (HTTP, FTP, Telnet, SNMP)
Lan1 (set on AP IP Config)
Lan2 - RF Private (set on AP IP Config)
Interface Enable=Connected
Interface Disable= Not Connected
(set on SM IP Config)
Lan2 - RF Private (Built from Lan2 address AP IP Config)
IP Address (assigned by network DHCP server)
SM
Module Management (HTTP, FTP, Telnet, SNMP)
RF Public (set on SM IP Config)
NAT Private (set on SM IP Config)
DHCP Client
NAT
DHCP Server
DHCP Server Start Address (based off of NAT Private), Number to Lease, and DMZ (set on SM IP Config)
To Subscriber
Computer IP address(es) (set by DHCP, except DMZ set manually)

Figure 49: NAT with DHCP Client and DHCP Server implementation

This implementation is provisioned as displayed in

- Figure 90 on Page 269
- Figure 96 on Page 278.

NAT with DHCP Client

The NAT with DHCP Client implementation is illustrated in Figure 50.

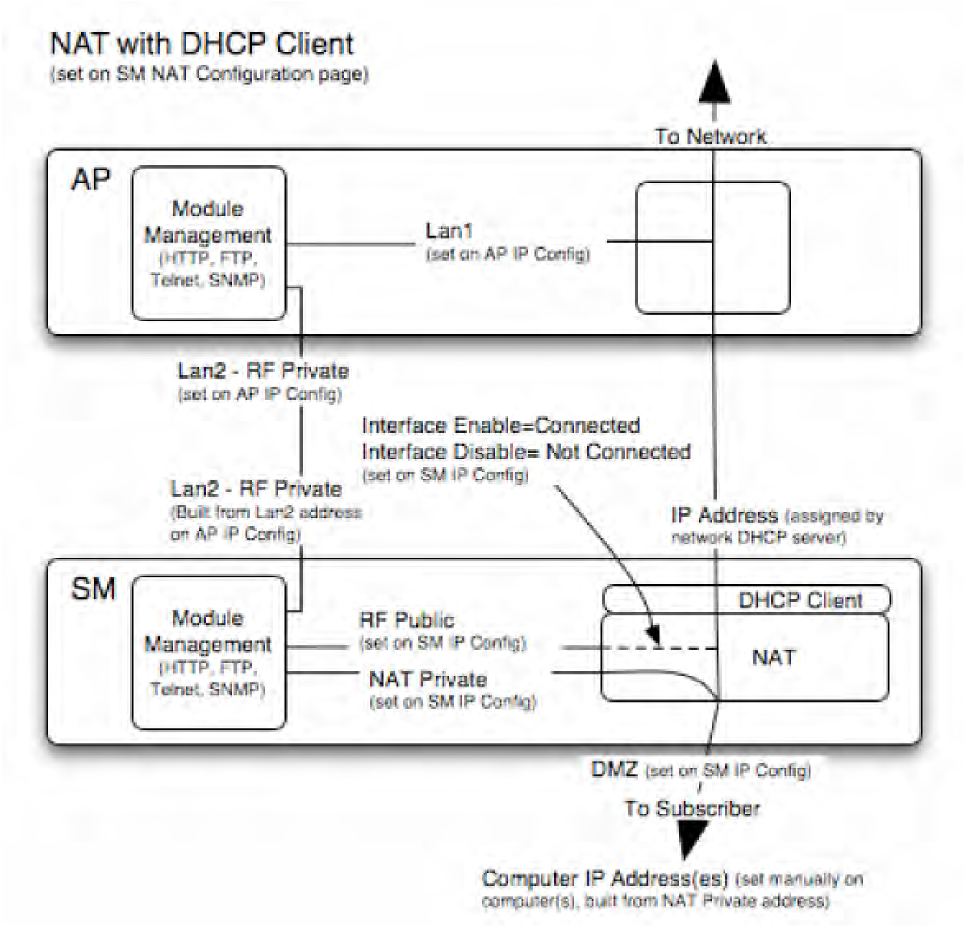

NAT with DHCP Client
(set on SM NAT Configuration page)
To Network
AP
Module Management (HTTP, FTP, Telnet, SNMP)
Lan1 (set on AP IP Config)
Lan2 - RF Private (set on AP IP Config)
Interface Enable=Connected
Interface Disable= Not Connected
(set on SM IP Config)
Lan2 - RF Private (Built from Lan2 address on AP IP Config)
IP Address (assigned by network DHCP server)
SM
Module Management (HTTP, FTP, Telnet, SNMP)
RF Public (set on SM IP Config)
NAT Private (set on SM IP Config)
DHCP Client
NAT
DMZ (set on SM IP Config)
To Subscriber
Computer IP Address(es) (set manually on computer(s), built from NAT Private address)

Figure 50: NAT with DHCP Client implementation

This implementation is provisioned as displayed in

- Figure 91 on Page 270
- Figure 97 on Page 279.

NAT with DHCP Server

The NAT with DHCP Server implementation is illustrated in Figure 51.

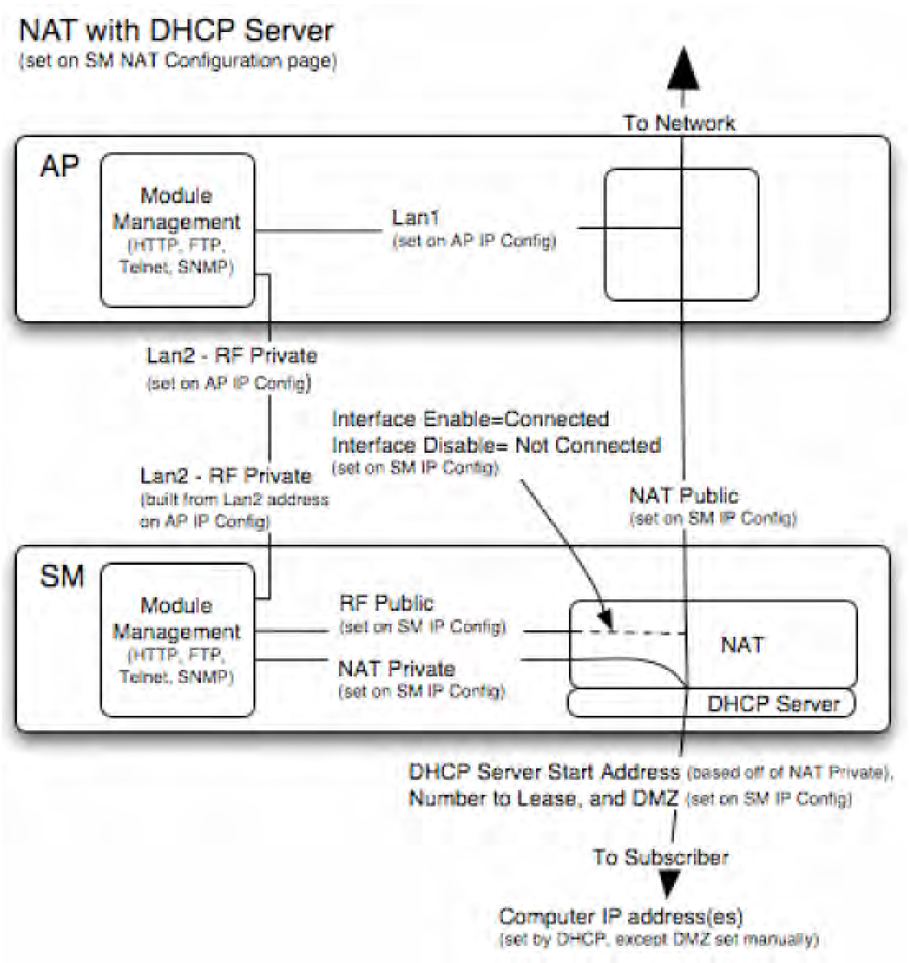

NAT with DHCP Server
(set on SM NAT Configuration page)
To Network
AP
Module Management (HTTP, FTP, Telnet, SNMP)
Lan1
(set on AP IP Config)
Lan2 - RF Private
(set on AP IP Config)
Interface Enable=Connected
Interface Disable= Not Connected
(set on SM IP Config)
Lan2 - RF Private
(built from Lan2 address on AP IP Config)
NAT Public
(set on SM IP Config)
SM
Module Management (HTTP, FTP, Telnet, SNMP)
RF Public
(set on SM IP Config)
NAT Private
(set on SM IP Config)
NAT
DHCP Server
DHCP Server Start Address (based off of NAT Private),
Number to Lease, and DMZ (set on SM IP Config)
To Subscriber
Computer IP address(es)
(set by DHCP, except DMZ set manually)

Figure 51: NAT with DHCP Server implementation

This implementation is provisioned as displayed in

- Figure 92: IP Configuration screen, NAT with DHCP server on Page 271
- Figure 98: NAT Configuration screen, NAT with DHCP server on Page 280.

NAT without DHCP

The NAT without DHCP implementation is illustrated in Figure 52.

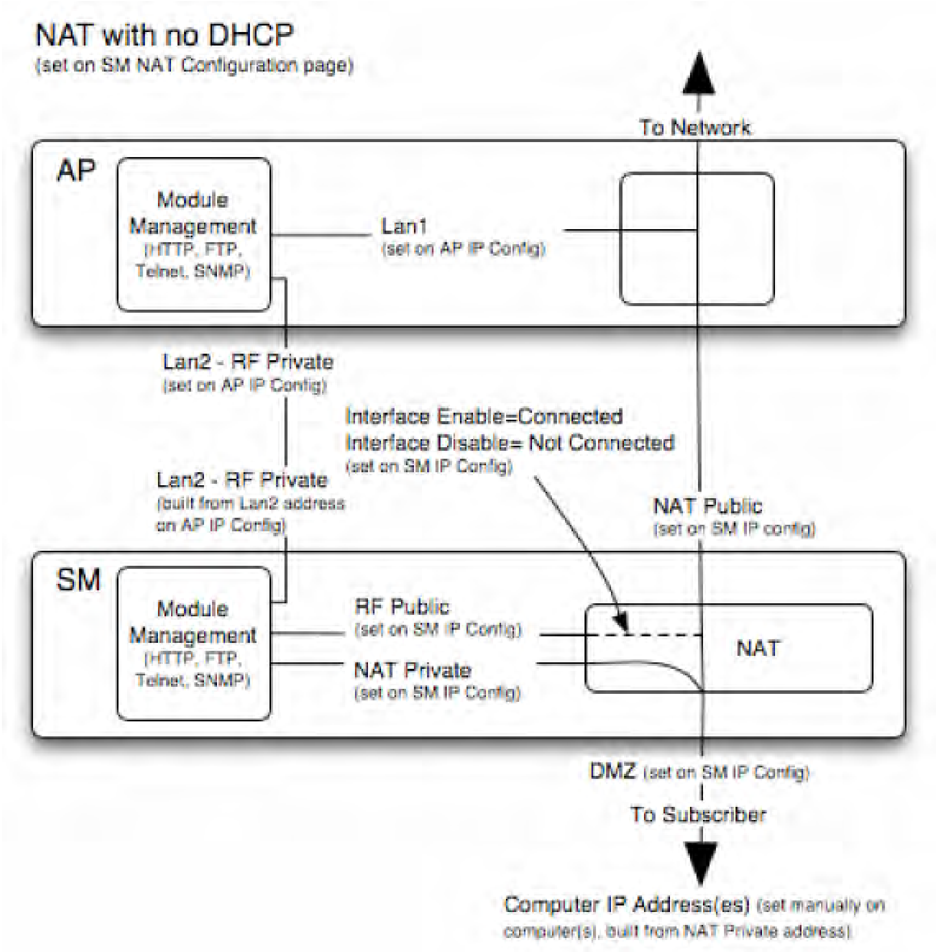

NAT with no DHCP
(set on SM NAT Configuration page)
To Network
AP
Module Management
(HTTP, FTP, Telnet, SNMP)
Lan1
(set on AP IP Config)
Lan2 - RF Private
(set on AP IP Config)
Interface Enable=Connected
Interface Disable= Not Connected
(set on SM IP Config)
Lan2 - RF Private
(built from Lan2 address on AP IP Config)
NAT Public
(set on SM IP config)
SM
Module Management
(HTTP, FTP, Telnet, SNMP)
RF Public
(set on SM IP Config)
NAT Private
(set on SM IP Config)
NAT
DMZ (set on SM IP Config)
To Subscriber
Computer IP Address(es) (set manually on computer(s), built from NAT Private address)

Figure 52: NAT without DHCP implementation

This implementation is provisioned as displayed in

- Figure 93: IP Configuration screen, NAT without DHCP on Page 272
- Figure 99: NAT Configuration screen, NAT without DHCP on Page 281.

13.3.2 NAT and VPNs

VPN technology provides the benefits of a private network during communication over a public network. One typical use of a VPN is to connect remote employees, who are at home or in a different city, to their corporate network over the public Internet. Any of several VPN implementation schemes is possible. By design, NAT translates or changes addresses, and thus interferes with a VPN that is not specifically supported by a given NAT implementation.

With NAT enabled, SMs on Canopy System Release 4.2 or later support L2TP over IPSec (Level 2 Tunneling Protocol over IP Security) VPNs, but *do not* support PPTP (Point to Point Tunneling Protocol) VPNs. With NAT disabled, SMs support all types of VPNs.

13.4 DEVELOPING AN IP ADDRESSING SCHEME

Canopy network elements are accessed through IP Version 4 (IPv4) addressing. A proper IP addressing method is critical to the operation and security of a Canopy network.

Each Canopy module requires an IP address on the network. This IP address is for only management purposes. For security, you should either

- assign an unroutable IP address.
- assign a routable IP address only if a firewall is present to protect the module.

You will assign IP addresses to computers and network components by either *static* or *dynamic* IP addressing. You will also assign the appropriate subnet mask and network gateway to each module.

13.4.1 Address Resolution Protocol

As previously stated, the MAC address identifies a Canopy module in

- communications between modules.
- the data that modules store about each other.
- the data that BAM or Prizm applies to manage authentication and bandwidth.

The IP address is essential for data delivery through a router interface. Address Resolution Protocol (ARP) correlates MAC addresses to IP addresses.

For communications to outside the network segment, ARP reads the network gateway address of the router and translates it into the MAC address of the router. Then the communication is sent to MAC address (physical network interface card) of the router.

For each router between the sending module and the destination, this sequence applies. The ARP correlation is stored until the ARP cache times out.

13.4.2 Allocating Subnets

The subnet mask is a 32-bit binary number that filters the IP address. Where a subnet mask contains a bit set to 1, the corresponding bit in the IP address is part of the network address.

Example IP Address and Subnet Mask

In Figure 53, the first 16 bits of the 32-bit IP address identify the network:

	Octet 1	Octet 2	Octet 3	Octet 4
IP address 169.254.1.1	10101001	11111110	00000001	00000001
Subnet mask 255.255.0.0	11111111	11111111	00000000	00000000

Figure 53: Example of IP address in Class B subnet

In this example, the network address is 169.254, and 2^{16} (65,536) hosts are addressable.

13.4.3 Selecting Non-routable IP Addresses

The factory default assignments for Canopy network elements are

- unique MAC address
- IP address of 169.254.1.1, except for an OFDM series BHM, whose IP address is 169.254.1.2 by default
- subnet mask of 255.255.0.0
- network gateway address of 169.254.0.0

For each Canopy radio and CMMmicro, assign an IP address that is both consistent with the IP addressing plan for your network and cannot be accessed from the Internet. IP addresses within the following ranges are not routable from the Internet, regardless of whether a firewall is configured:

- 10.0.0.0 – 10.255.255.255
- 172.16.0.0 – 172.31.255.255
- 192.168.0.0 – 192.168.255.255

You can also assign a subnet mask and network gateway for each CMMmicro.

14 ENGINEERING VLANS

In Canopy System Release 6.0 and later, Canopy radios support VLAN functionality as defined in the 802.1Q (*Virtual LANs*) specification, except for the following aspects of that specification:

- the following protocols:
    - Generic Attribute Registration Protocol (GARP) GARV
    - Spanning Tree Protocol (STP)
    - Multiple Spanning Tree Protocol (MSTP)
    - GARP Multicast Registration Protocol (GMRP)
- priority encoding (802.1P) before Release 7.0
- embedded source routing (ERIF) in the 802.1Q header
- multicast pruning
- flooding unknown unicast frames in the downlink

As an additional exception, the Canopy AP *does not* flood downward the unknown unicast frames to the Canopy SM.

A VLAN configuration in Layer 2 establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data. For the network operator, this provides flexibility in network segmentation, simpler management, and enhanced security.

14.1 SM MEMBERSHIP IN VLANS

With the supported VLAN functionality, Canopy radios determine bridge forwarding on the basis of not only the destination MAC address, but also the VLAN ID of the destination. This provides flexibility in how SMs are used:

- Each SM can be a member in its own VLAN, whose other members can be APs in other sectors. This case would allow movement of the SM from sector to sector without requiring a reconfiguration of the VLAN.
- Each SM can be in its own broadcast domain, such that only the radios that are members of the VLAN can see multicast traffic to and from the SM. In most cases, this can significantly conserve bandwidth at the SMs.
- The network operator can define a work group of SMs, regardless of the AP(s) to which they register.

In Release 7.2.9 and later, Canopy point-to-multipoint modules provide the VLAN frame filters that are described in Table 42.

Table 42: VLAN filters in point-to-multipoint modules

Where VLAN is active, if this parameter value is selected …	**then a frame is discarded if…**		**because of this VLAN filter in the Canopy software:**
	***entering* the bridge/ NAT switch through…**		
	Ethernet…	**TCP/IP…**	
any combination of VLAN parameter settings	with a VID not in the membership table		Ingress
any combination of VLAN parameter settings		with a VID not in the membership table	Local Ingress
Allow Frame Types: Tagged Frames Only	with no 802.1Q tag		Only Tagged
Allow Frame Types: Untagged Frames Only	with an 802.1Q tag, regardless of VID		Only Untagged
Local SM Management: Disable in the SM, or **All Local SM Management: Disable** in the AP	with an 802.1Q tag and a VID in the membership table		Local SM Management
	***leaving* the bridge/NAT switch through…**		
	Ethernet…	**TCP/IP…**	
any combination of VLAN parameter settings	with a VID not in the membership table		Egress
any combination of VLAN parameter settings		with a VID not in the membership table	Local Egress

14.2 PRIORITY ON VLANS (802.1P)

Canopy radios can prioritize traffic based on the eight priorities described in the IEEE 802.1p specification. When the high-priority channel is enabled on an SM, regardless of whether VLAN is enabled on the AP for the sector, packets received with a priority of 4 through 7 in the 802.1p field are forwarded onto the high-priority channel.

VLAN settings in a Canopy module can also cause the module to convert received non-VLAN packets into VLAN packets. In this case, the 802.1p priority in packets leaving the module is set to the priority established by the DiffServ configuration.

If you enable VLAN, *immediately* monitor traffic to ensure that the results are as desired. For example, if software scheduling is enabled, some high-priority traffic may be denied. If hardware scheduling is enabled, high-priority traffic may block low-priority.

For more information on the Canopy high priority channel, see

- High-priority Bandwidth on Page 89.
- Allocations to Downlink and Uplink on Page 91.
- High Priority Uplink Percentage on Page 236 through NumCtlSlots Reserved High on Page 238.

For more information on hardware and software scheduling, see

- Software and Hardware Scheduling on Page 91.
- AP-SM Links on Page 103.
- Setting the Configuration Source on Page 287.

INSTALLATION AND CONFIGURATION GUIDE

15 AVOIDING HAZARDS

Use simple precautions to protect staff and equipment. Hazards include exposure to RF waves, lightning strikes, and power surges. This section specifically recommends actions to abate these hazards.

15.1 PREVENTING OVEREXPOSURE TO RF ENERGY

To protect from overexposure to RF energy, install Canopy radios so as to provide and maintain the minimum separation distances from all persons shown in Table 43.

Table 43: Exposure separation distances

Canopy module	Minimum separation distance from all persons	
Antenna of 900-MHz AP or SM	60 cm	24 in
2.4-, 5.2-, 5.4-, or 5.7-GHz radio with no reflector	20 cm	8 in
2.4-, 5.4-, or 5.7-GHz radio with a reflector	1.5 m	60 in (5 ft)

At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

NOTE:
These are conservative distances that include compliance margins. In the case of the reflector, the distance is even more conservative because the equation used models the reflector as a point source and ignores its physical dimensions.

15.1.1 Details of Calculations for Separation Distances and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/rpb and Safety Code 6.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

The applicable power density exposure limits from the documents referenced above are

- 6 W/m^2 for RF energy in the 900-MHz frequency band in the US and Canada.
- 10 W/m^2 for RF energy in the 2.4-, 5.2-, 5.4-, and 5.7-GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{P \cdot G}{4 \pi d^2}$$

where
S = power density in W/m^2
P = RMS transmit power capability of the radio, in W
G = total Tx gain as a factor, converted from dB
d = distance from point source, in m

Rearranging terms to solve for distance yields

$$d = \sqrt{\frac{P \cdot G}{4 \pi S}}$$

Calculated Distances and Power Compliance Margins

Table 44 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 44: Power compliance margins

Frequency Band	Antenna	Variable			d^1	Recom-mended Distance	Power Compliance Margin
		P	*G*	S			
900 MHz	external	0.4 W (26 dBm)	10.0 (10 dB)	6 W/m^2	0.23 m	60 cm (24 in)	7
2.4 GHz	internal	0.34 W (25 dBm)	6.3 (8 dB)	10 W/m^2	0.13 m	20 cm (8 in)	2.3
	internal + reflector	0.34 W (25 dBm)	79.4 (19 dB)	10 W/m^2	0.46 m	1.5 m (5 ft)	10
5.2 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal + reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	0.09 m	1.5 m (5 ft)	280

Frequency Band	Antenna	Variable			*d*[1]	Recom-mended Distance	Power Compliance Margin
		P	*G*	S			
5.4 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal + reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	0.09 m	1.5 m (5 ft)	280
5.7 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal + reflector	0.2 W (23 dBm)	316 (25 dB)	10 W/m^2	0.71 m	1.5 m (5 ft)	4.5

NOTES:

[1] Calculated.

15.2 GROUNDING CANOPY EQUIPMENT

Effective lightning protection diverts lightning current safely to ground, Protective Earth (PE) ⏚. It neither attracts nor prevents lightning strikes.

> *WARNING!*
> Lightning damage *is not* covered under the Canopy warranty. The recommendations in Canopy guides give the installer the knowledge to protect the installation from the harmful effects of ESD and lightning. These recommendation must be thoroughly and correctly performed. However, complete protection is neither implied or possible.

15.2.1 Grounding Infrastructure Equipment

To protect both your staff and your infrastructure equipment, implement lightning protection as follows:

- Observe all local and national codes that apply to grounding for lightning protection.
- Before you install your Canopy modules, perform the following steps:
  - Engage a grounding professional if you need to do so.
  - Install lightning arrestors to transport lightning strikes away from equipment. For example, install a lightning rod on a tower leg other than the leg to which you mount your module.
  - Connect your lightning rod to ground.
  - Use a Canopy 300SS Surge Suppressor (or Transtector ALPU-ORTs for OFDM BH installations) on the Ethernet cable where the cable enters any structure. (Instructions for installing a Canopy 300SS Surge Suppressor are provided in Procedure 31: Installing the SM on Page 333.)

- Install your modules at least 2 feet (0.6 meters) below the tallest point on the tower, pole, or roof.

15.2.2 Grounding Canopy 30/60- and 150/300-Mbps Backhaul Modules

For grounding the Canopy OFDM series backhaul modules, see the details, caveats, and wiring schemes provided in the following documents:

- *Canopy 30 Mbps 60 Mbps Backhaul User Guide*
- *Lightning Arrestor Alert Notice*
- *Canopy 30/60 & 150/300 Mbps OFDM Backhaul Lightning Arrestor Guide*.

15.2.3 Grounding SMs

This section provides lightning protection guidelines for SMs to satisfy the National Electrical Code (NEC) of the United States. The requirements of the NEC focus on the safety aspects of electrical shock to personnel and on minimizing the risk of fire at a dwelling. The NEC does not address the survivability of electronic products that are exposed to lightning surges.

The statistical incidence of current levels from lightning strikes is summarized in Table 45.

Table 45: Statistical incidence of current from lightning strikes

Percentage of all strikes	Peak Current (amps)
<2	>140,000
25	>35,000
>50	>20,000
>80	>8,500

At peak, more than one-half of all surges due to direct lightning strikes exceed 20,000 amps. However, only one-quarter exceed 35,000 amps, and less than two percent exceed 140,000 amps. Thus, the recommended Surge Suppressor (300SS) provides a degree of lightning protection to electronic devices inside a dwelling.

Summary of Grounding Recommendations

Motorola recommends that you ground each SM as follows:

- Extend the SM mounting bracket extend to the top of the SM or higher.
- Ground the SM mounting bracket via a 10-AWG copper wire connected by the most direct path either to an eight foot-deep ground rod or to the ground bonding point of the AC power service utility entry. This provides the best assurance that
    - lightning takes the ground wire route.
    - the ground wire does not fuse open.
    - your grounding system complies with NEC 810-15.
- Ground the Canopy Surge Suppressor 300SS ground lug to the same ground bonding point as above, using at least a 10-AWG copper wire. This provides the best assurance that your grounding system complies with NEC 810-21.

Grounding Scheme

The proper overall antenna grounding scheme per the NEC is illustrated in Figure 120 on Page 334. In most television antenna or dish installations, a coaxial cable connects the outdoor electronics with the indoor electronics. To meet NEC 810-20, one typically uses a coaxial cable feed-through block that connects the outdoor coax to the indoor coax and also has a screw for attaching a ground wire. This effectively grounds the outer shield of the coax. The block should be mounted on the outside of the building near the AC main panel such that the ground wire of the block can be bonded to the primary grounding electrode system of the structure.

In Canopy technology, Motorola uses an outdoor rated *un*shielded twisted pair (UTP) cable. To comply with the NEC, Motorola provides the antenna discharge unit, 300SS, for each conductor of the cable. This 300SS must be

- positioned
  - outside the building.
  - as near as practicable to the power service entry panel of the building and attached to the AC main power ground electrode, or attached to a grounded water pipe.[5]
  - far from combustible material.
- grounded in accordance with NEC 810-21, with the grounding wire attached to the screw terminal.

The metal structural elements of the antenna mast also require a separate grounding conductor. Section 810-15 of the NEC states:

> *Masts and metal structures supporting antennas shall be grounded in accordance with Section 810-21.*

As shown in Figure 120 on Page 334, the Motorola recommendation for grounding the metal structural element of the Canopy mounting bracket (SMMB1) is to route the grounding wire from the SMMB1 down to the same ground attachment point as is used for the 300SS discharge unit.

10-AWG Copper Grounding Wire

According to NEC 810-21 3(h), either a 17-AWG copper clad steel wire or a 10-AWG copper wire may be used. This specification appears to be based on mechanical strength considerations and *not* on lightning current handling capabilities.

For example, analysis shows that the two wire types are not equivalent when carrying a lightning surge that has a 1-microsecond rise by 65-microsecond fall:

- The 16-AWG copper clad steel wire has a peak fusing current of 35,000 amps and can carry 21,000 amps peak, at a temperature just below the ignition point for paper (454° F or 234° C).
- The 10-AWG copper wire has a peak fusing current of 220,000 amps and can carry 133,000 amps peak, at the same temperature.

[5] It is *insufficient* to merely use the green wire ground in a duplex electrical outlet box for grounding of the antenna discharge unit.

Based on the electrical/thermal analysis of these wires, Motorola recommends 10-AWG copper wire for *all* grounding conductors. Although double the cost of 16-AWG copper clad steel wire, 10-AWG copper wire handles six times the surge current from lightning.

Unshielded Grounding Wire

In part, NEC 810-21 states:

> *A lightning arrester is not required if the lead-in conductors are enclosed in a continuous metal shield, such as rigid or intermediate metal conduit, electrical metallic tubing, or any metal raceway or metal-shielded cable that is effectively grounded. A lightning discharge will take the path of lower impedance and jump from the lead-in conductors to the metal raceway or shield rather than take the path through the antenna coil of the receiver.*

Nevertheless, Motorola recommends *un*shielded twisted pair cable. The case against shielded alternatives permitted by the NEC is as follows:

- Braid-shielded 10Base-T cable is uncommon, if existent, and may be unsuitable anyway.
- At a cost of about two-thirds more than 10-AWG copper UTP, CAT 5 100Base-TX foil-shielded twisted pair (FTP) cable provides a 24-AWG drain wire. If this wire melts open during a lightning surge, then the current may follow the twisted pair into the building.

  More than 80 percent of all direct lightning strikes have current that exceeds 8,500 amps (see Table 45 on Page 171). A 24-AWG copper wire melts open at 8,500 amps from a surge that has a 1-microsecond by 70-microsecond waveform. Hence, reliance on 24-AWG drain wire to comply with the intent of NEC 810-21 is questionable.

NEC Reference

NEC Article 810, *Radio and Television Equipment*, and associated documents and discussions are available from http://www.neccode.com/index.php?id=homegeneral, http://www.constructionbook.com/xq/ASP/national-electrical-code-2005/id.370/subID.746/qx/default2.htm, and other sources.

15.3 CONFORMING TO REGULATIONS

For all electrical purposes, ensure that your network conforms to applicable country and local codes, such as the NEC (National Electrical Code) in the U.S.A. If you are uncertain of code requirements, engage the services of a licensed electrician.

15.4 PROTECTING CABLES AND CONNECTIONS

Cables that move in the wind can be damaged, impart vibrations to the connected device, or both. At installation time, prevent these problems by securing all cables with cable ties, cleats, or PVC tape.

Over time, moisture can cause a cable connector to fail. You can prevent this problem by

- using cables that are filled with a dielectric gel or grease.
- including a drip loop where the cable approach to the module (typically a CMM2 or CMMmicro) is from above.
- wrapping the cable with weather-resistant tape.

On a module with an external antenna, use accepted industry practices to wrap the connector to prevent water ingress. Although the male and female N-type connectors form a gas-tight seal with each other, the point where the cable enters each connector can allow water ingress and eventual corrosion. Wrapping and sealing is critical to long-term reliability of the connection.

Possible sources of material to seal that point include

- the antenna manufacturer (material may have been provided in the package with the antenna).
- Universal Electronics (whose web site is http://www.coaxseal.com), who markets a weather-tight wrap named Coax-Seal.

Perform the following steps to wrap the cable.

Procedure 4: Wrapping the cable

1. Start the wrap on the cable 0.5 to 2 inches (about 1.5 to 5 cm) from the connection.
2. Wrap the cable to a point 0.5 to 2 inches (about 1.5 to 5 cm) above the connection.
3. Squeeze the wrap to compress and remove any trapped air.
4. Wrap premium vinyl electrical tape over the first wrap where desired for abrasion resistance or appearance.
5. Tie the cable to minimize sway from wind.

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

16 TESTING THE COMPONENTS

Before you install any component into your Canopy network, allow yourself the opportunity to discover that the component is defective. If you always follow the preliminary steps in this section, you will save

- installation and removal costs for a component that will not function.
- time in the process of replacing the defective component.

The best practice is to connect all the components—BHs, APs, GPS antenna, and CMM2 or CMMmicro—in a test setting and initially configure and verify them before deploying them to an installation. However, circumstances or local practice may require a different practice. In this case, appropriately modify the following procedures.

16.1 UNPACKING COMPONENTS

When you receive Canopy products, carefully inspect all shipping boxes for signs of damage. If you find damage, immediately notify the transportation company.

As you unpack the equipment, verify that all the components that you ordered have arrived. Save all the packing materials to use later, as you transport the equipment to and from installation sites.

16.2 CONFIGURING FOR TEST

You can use either of two methods to configure an AP or BHM:

- Use the Quick Start feature of the product. For more information on Quick Start, see Quick Start Page of the AP on Page 184.
- Manually set each parameter.

After you change any configuration parameter, to put the change into effect, you must do both of the following:

1. Click the **Save** button to temporarily save the change(s).
2. Click the **Reboot** button to reboot the module and implement the change(s).

16.2.1 Configuring the Computing Device for Test

If your computer is configured for Dynamic Host Configuration Protocol (DHCP), disconnect the computer from the network. If your computer is instead configured for static IP addressing

- set the static address in the 169.254 network
- set the subnet mask to 255.255.0.0.

16.2.2 Default Module Configuration

From the factory, the Canopy AP, SM, and BH are all configured to *not transmit* on any frequency. This configuration ensures that you do not accidentally turn on an unsynchronized module. Site synchronization of modules is required because

- Canopy modules
  - cannot transmit and receive signals at the same time.
  - use TDD (Time Division Duplexing) to distribute signal access of the downlink and uplink frames.
- when one module transmits while an unintended module nearby receives signal, the transmitting module may interfere with or desense the receiving module. In this context, interference is self-interference (within the same Canopy network).

16.2.3 Component Layout

As shown in Figure 54, the base cover of the module snaps off when you depress a lever on the back of the base cover. This exposes the Ethernet and GPS sync connectors and diagnostic LEDs.

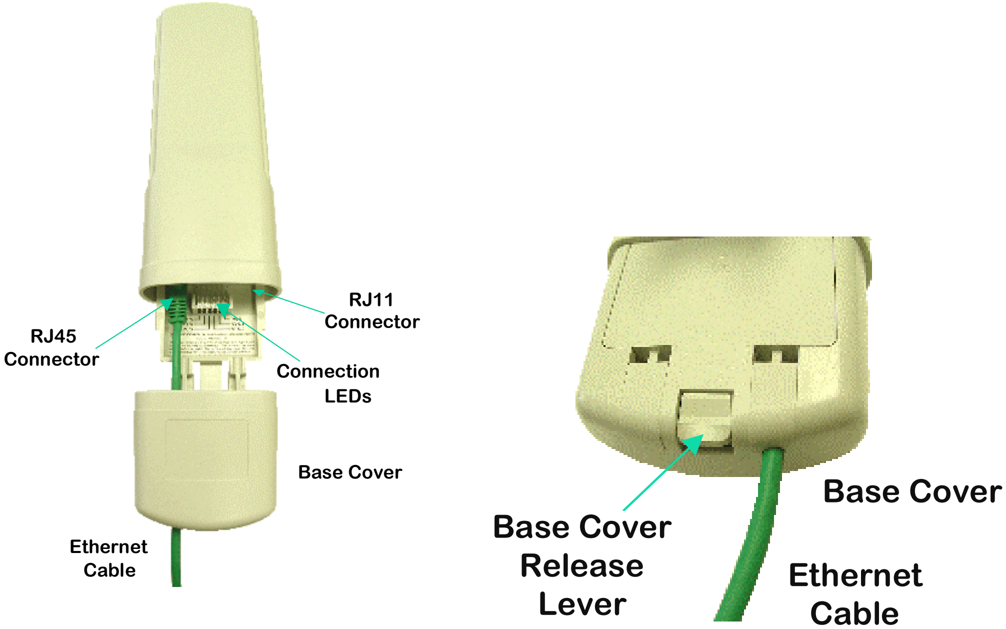


Figure 54: Canopy base cover, attached and detached

16.2.4 Diagnostic LEDs

The diagnostic LEDs report the following information about the status of the module. Table 46 and Table 47 identify the LEDs in order of their left-to-right position as the cable connections face downward.

> *NOTE:*
> The LED color helps you distinguish position of the LED. The LED color *does not* indicate any status.

Table 46: LEDs in AP and BHM

Label	Color when Active	Status Information Provided	Notes
LNK/5	green	Ethernet link	Continuously lit when link is present.
ACT/4	orange	Presence of data activity on the Ethernet link	Flashes during data transfer. Frequency of flash is not a diagnostic indication.
GPS/3	red	Pulse of sync	Continuously lit as pulse as AP receives pulse.
SES/2	green	*Unused on the AP*	SES is the session indicator on the CMM.
SYN/1	orange	Presence of sync	Always lit on the AP.
PWR	red	DC power	Always lit when power is correctly supplied.

Table 47: LEDs in SM and BHS

Label	Color when Active	Status if Registered	Notes	
			Operating Mode	**Aiming Mode**
LNK/5	green	Ethernet link	Continuously lit when link is present.	These five LEDs act as a bar graph to indicate the relative quality of alignment. As RSSI (received signal strength indicator) and jitter improve during alignment, more of these LEDs are lit.
ACT/4	orange	Presence of data activity on the Ethernet link	Flashes during data transfer. Frequency of flash is not a diagnostic indication.	
GPS/3	red	*Unused*	If this module is not registered to another, then these three LEDs cycle on and off from left to right.	
SES/2	green	*Unused*		
SYN/1	orange	Presence of sync		
PWR	red	DC power	Always lit when power is correctly supplied.	Always lit when power is correctly supplied.

16.2.5 CMM2 Component Layout

As shown in Figure 117 on Page 328, the CMM2 comprises four assemblies:

- Ethernet switch
- Power transformer
- Interconnect board
- GPS receiver.

Some CMM2s that were sold earlier had four openings in the bottom plate, as shown in Figure 55. Currently available CMM2s have two *additional* Ethernet cable and GPS sync cable openings to allow use of thicker, shielded cables.

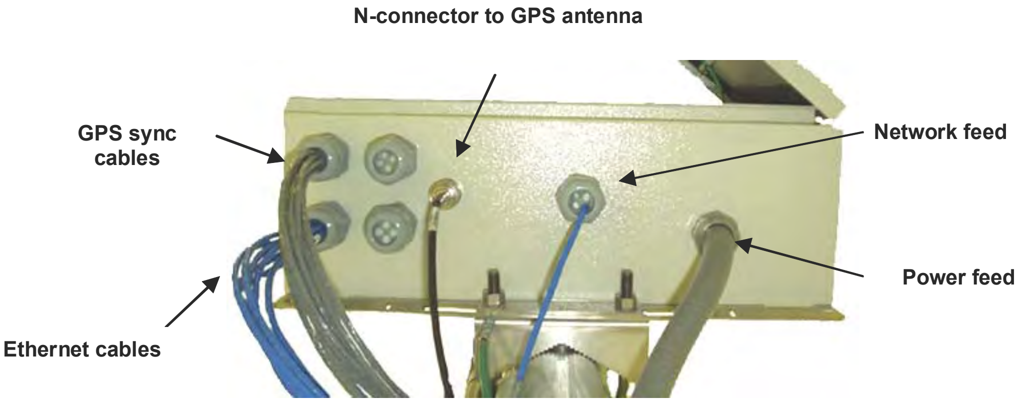
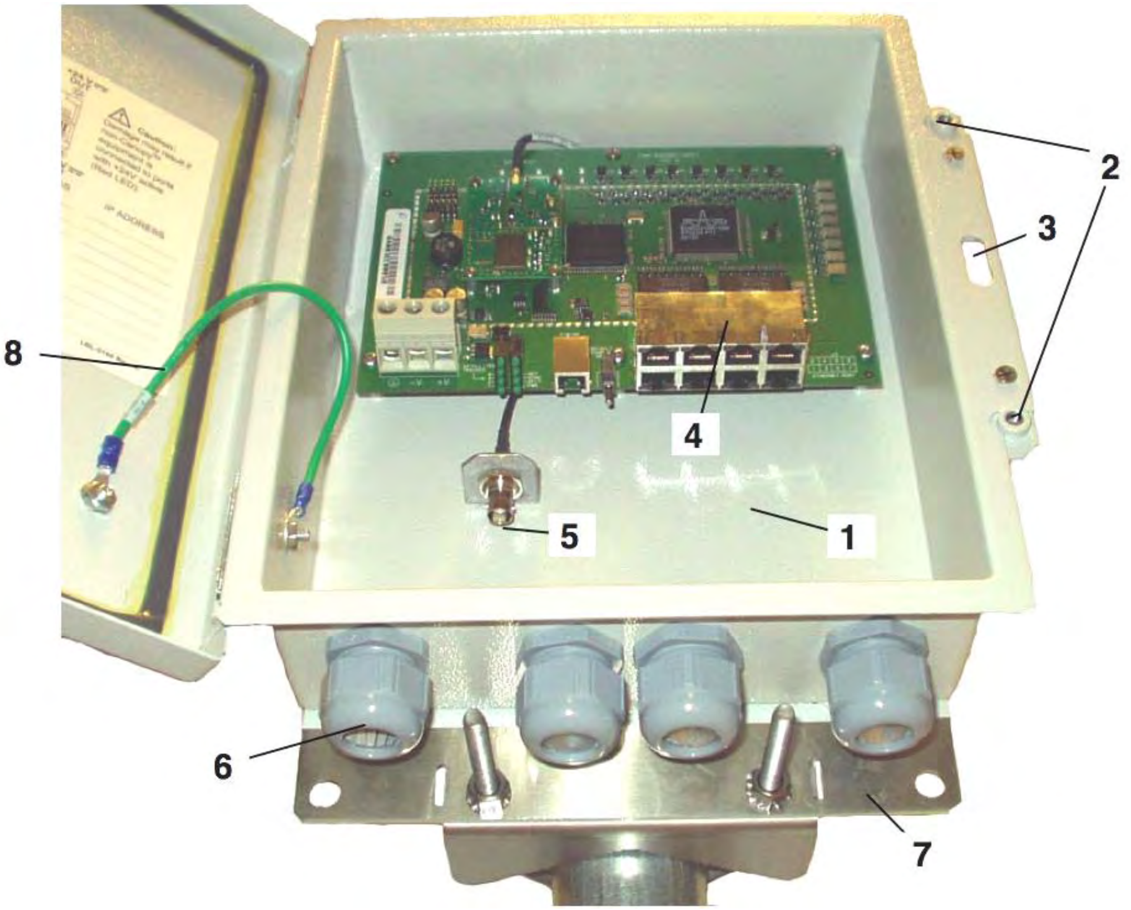


Figure 55: Canopy CMM2, bottom view

16.2.6 CMMmicro Component Layout

The layout of the CMMmicro is shown in Figure 56.



LEGEND

1. Weatherized enclosure
2. Thumb-screw/slot-screwdriver door fasteners
3. Punch-out for padlock
4. Ethernet switch and power module
5. Female BNC connector
6. Water-tight bulkhead connectors
7. Flange for attachment (stainless steel for grounding to tower or building) using U bolts (provided) or other hardware such as screws, lag bolts, or attachment straps (not provided)
8. Ground strap (for grounding door to enclosure)
9. 100-W 115/230-V AC to 24-V DC power converter, with 10 ft (3 m) of DC power cable (not shown)
10. 6-ft (1.8-m) AC power cord for 24 V power converter (not shown)

Figure 56: Cluster Management Module micro

16.2.7 Standards for Wiring

Canopy modules that are currently available automatically sense whether the Ethernet cable in a connection is wired as straight-through or crossover. You may use either straight-through or crossover cable to connect a network interface card (NIC), hub, router, or switch to these modules. For a straight-through cable, use the EIA/TIA-568B wire color-code standard on both ends. For a crossover cable, use the EIA/TIA-568B wire color-code standard on one end, and the EIA/TIA-568A wire color-code standard on the other end.

Some modules that were sold earlier do not automatically sense the wiring scheme. To identify whether an older module senses the Ethernet cable type, compare the ESN of the module to the ESNs listed in Table 48.

Table 48: Cable scheme auto-sensing per MAC address

Module Type	MAC Address (ESN) of Non Auto-sensing Module	MAC Address (ESN) of Auto-Sensing Module
900-MHz, 2.4-GHz, and 5.4-GHz modules	(no ESNs)	(all ESNs)
5.2-GHz Modules	≤ 0A003E0021C8	≥ 0A003E0021C9
5.7-GHz Modules	≤ 0A003EF00F79	≥ 0A003EF00F79A

CAUTION!

Where you use a *non* auto-sensing module

- use a straight-through cable to connect to a NIC (network interface card).
- use a crossover cable to connect to a hub, switch, or router.

Where you use the Canopy AC wall adapter

- the power supply output is +24 VDC.
- the power input to the SM is +11.5 VDC to +30 VDC.
- the maximum Ethernet cable run is 328 feet (100 meters).

16.2.8 Best Practices for Cabling

The following practices are essential to the reliability and longevity of cabled connections:

- Use only shielded cables to resist interference.
- For vertical runs, provide cable support and strain relief.
- Include a 2-ft (0.6-m) service loop on each end of the cable to allow for thermal expansion and contraction and to facilitate terminating the cable again when needed.

- Include a drip loop to shed water so that most of the water does not reach the connector at the device.
- Properly crimp all connectors.
- Use dielectric grease on all connectors to resist corrosion.
- Use only shielded connectors to resist interference and corrosion.

16.2.9 Recommended Tools for Wiring Connectors

The following tools may be needed for cabling the AP:

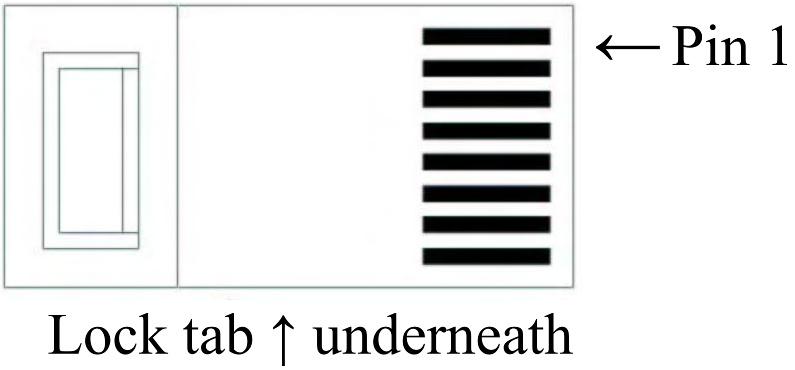
- RJ-11 crimping tool
- RJ-45 crimping tool
- electrician scissors
- wire cutters
- cable testing device.

16.2.10 Wiring Connectors

The following diagrams correlate pins to wire colors and illustrate crossovers where applicable.

Location of Pin 1

Pin 1, relative to the lock tab on the connector of a straight-through cable is located as shown below.



RJ-45 Pinout for Straight-through Ethernet Cable

Pin 1 →	white / orange	← Pin 1
Pin 2 →	orange	← Pin 2
Pin 3 →	white / green	← Pin 3
Pin 4 →	blue	← Pin 4
Pin 5 →	white / blue	← Pin 5
Pin 6 →	green	← Pin 6
Pin 7 →	white / brown	← Pin 7
Pin 8 →	brown	← Pin 8

Pins 7 and 8 carry power to the modules.

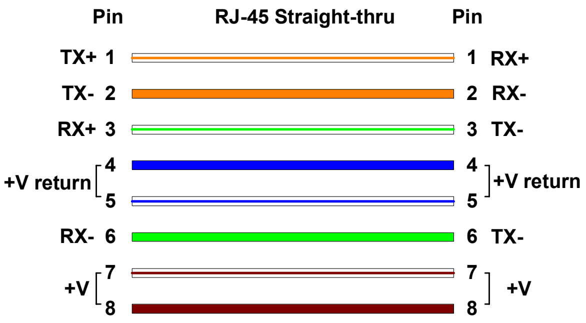


Figure 57: RJ-45 pinout for straight-through Ethernet cable

RJ-45 Pinout for Crossover Ethernet Cable

Pin 1 →	white / orange	← Pin 3
Pin 2 →	orange	← Pin 6
Pin 3 →	white / green	← Pin 1
Pin 4 →	blue	← Pin 4
Pin 5 →	white / blue	← Pin 5
Pin 6 →	green	← Pin 2
Pin 7 →	white / brown	← Pin 7
Pin 8 →	brown	← Pin 8

Pins 7 and 8 carry power to the modules.

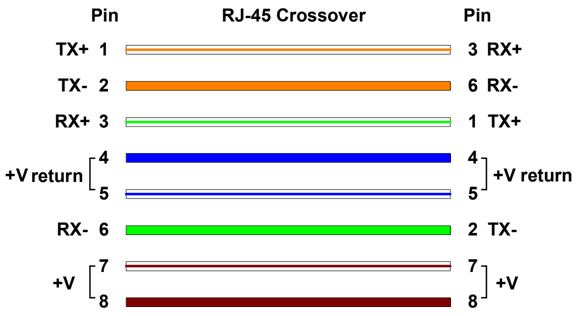


Figure 58: RJ-45 pinout for crossover Ethernet cable

RJ-11 Pinout for Straight-through Sync Cable

The Canopy system uses a utility cable with RJ-11 connectors between the AP or BH and synchronization pulse. Presuming CAT 5 cable and 6-pin RJ-11 connectors, the following diagram shows the wiring of the cable for sync.

Pin 1 →	white / orange	← Pin 1
Pin 2 →	white / green	← Pin 2
Pin 3 →	white / blue	← Pin 3
Pin 4 →	green	← Pin 4
Pin 5 →	blue	← Pin 5
Pin 6 →	orange	← Pin 6

NOTE: The fourth pair is not used.

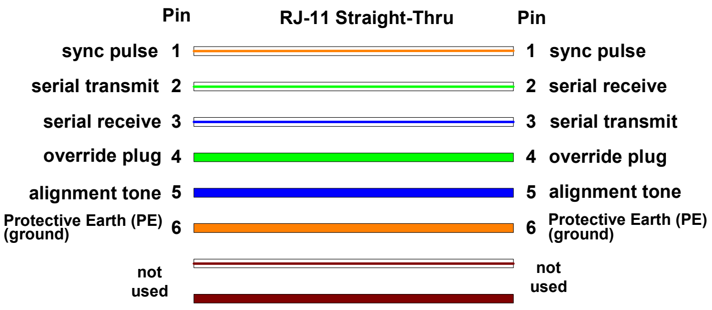


Figure 59: RJ-11 pinout for straight-through sync cable

16.2.11 Alignment Tone—Technical Details

The alignment tone output from a Canopy module is available on Pin 5 of the RJ-11 connector, and ground is available on Pin 6. Thus the load at the listening device should be between Pins 5 and 6. The listening device may be a headset, earpiece, or battery-powered speaker.

16.3 CONFIGURING A POINT-TO-MULTIPOINT LINK FOR TEST

Perform the following steps to begin the test setup.

Procedure 5: Setting up the AP for Quick Start

1. In one hand, securely hold the top (larger shell) of the AP. With the other hand, depress the lever in the back of the base cover (smaller shell). Remove the base cover.
2. Plug one end of a CAT 5 Ethernet cable into the AP.
3. Plug the Ethernet cable connector labeled To Radio into the jack in the pig tail that hangs from the power supply.

> ***WARNING!***
> From this point until you remove power from the AP, stay at least as far from the AP as the minimum separation distance specified under Preventing Overexposure to RF on Page 168.

4. Plug the other connector of the pig tail (this connector labeled To Computer) into the Ethernet jack of the computing device.
5. Plug the power supply into an electrical outlet.
6. Power up the computing device.
7. Start the browser in the computing device.

end of procedure

The Canopy AP interface provides a series of web pages to configure and monitor the unit. These screens are subject to change by subsequent software releases.

You can access the web-based interface through a computing device that is either directly connected or connected through a network to the AP. If the computing device is not connected to a network when you are configuring the module in your test environment, and if the computer has used a proxy server address and port to configure a Canopy module, then you may need to first disable the proxy setting in the computer.

Perform the following procedure to toggle the computer to *not* use the proxy setting.

Procedure 6: Bypassing proxy settings to access module web pages

1. Launch Microsoft Internet Explorer.
2. Select **Tools→Internet Options→Connections→LAN Settings**.

3. Uncheck the **Use a proxy server…** box.
   NOTE: If you use an alternate web browser, the menu selections differ from the above.

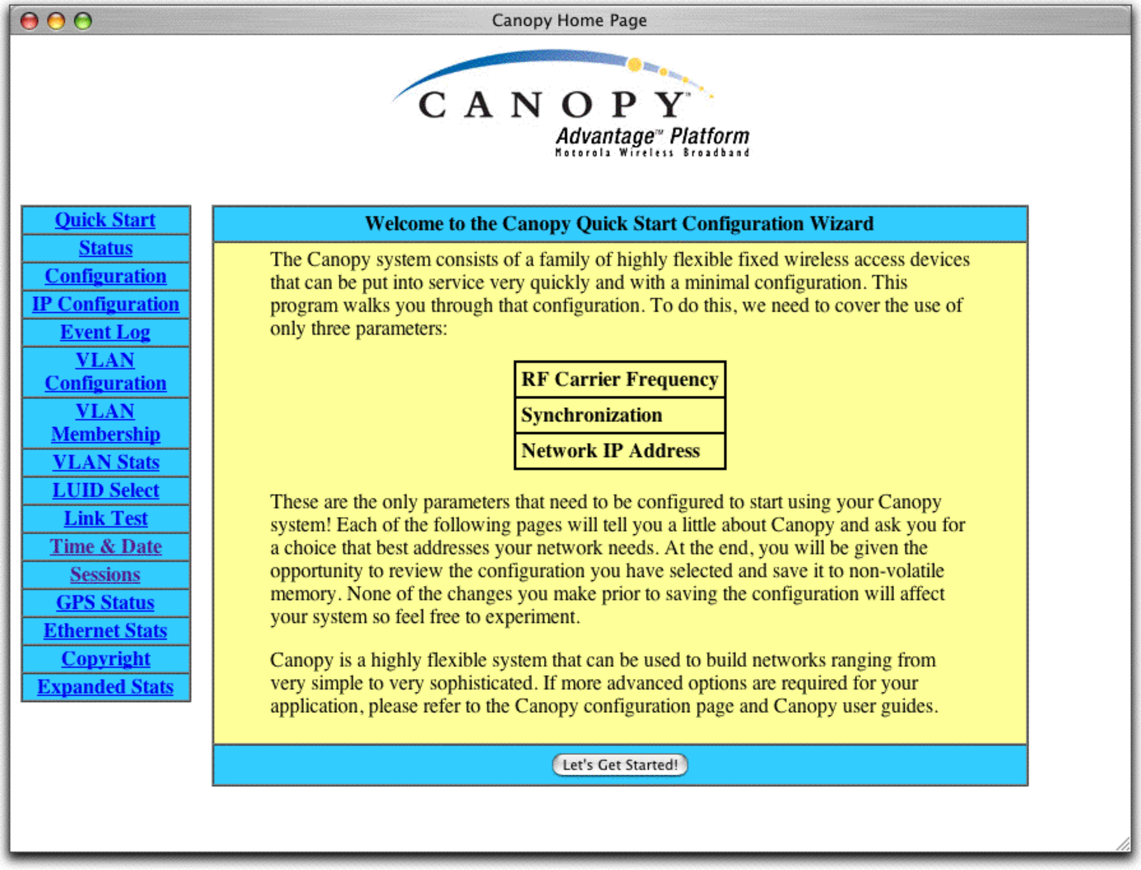
============================== **end of procedure** ==============================

In the address bar of your browser, enter the IP address of the AP. (For example, enter `http://169.254.1.1` to access the AP through its default IP address). The AP responds by opening the Status page.

16.3.1 Quick Start Page of the AP

To proceed with the test setup, click the **Quick Start** button on the left side of the Status page. The AP responds by opening the Quick Start page. The standard Quick Start screen is displayed in Figure 60.

> *NOTE:*
> If you cannot find the IP address of the AP, see Override Plug on Page 60.



Welcome to the Canopy Quick Start Configuration Wizard

The Canopy system consists of a family of highly flexible fixed wireless access devices that can be put into service very quickly and with a minimal configuration. This program walks you through that configuration. To do this, we need to cover the use of only three parameters:

RF Carrier Frequency
Synchronization
Network IP Address

These are the only parameters that need to be configured to start using your Canopy system! Each of the following pages will tell you a little about Canopy and ask you for a choice that best addresses your network needs. At the end, you will be given the opportunity to review the configuration you have selected and save it to non-volatile memory. None of the changes you make prior to saving the configuration will affect your system so feel free to experiment.

Canopy is a highly flexible system that can be used to build networks ranging from very simple to very sophisticated. If more advanced options are required for your application, please refer to the Canopy configuration page and Canopy user guides.

Figure 60: Quick Start screen, AP

Quick Start is a wizard that helps you to perform a basic configuration that places an AP into service. Only the following parameters must be configured:

- **RF Carrier Frequency**
- **Synchronization**
- **Network IP Address**

In each page under Quick Start, you can

- specify the settings to satisfy the requirements of the network.
- review the configuration selected.
- save the configuration to non-volatile memory.

Proceed with the test setup as follows.

Procedure 7: Using Quick Start to configure a standalone AP for test

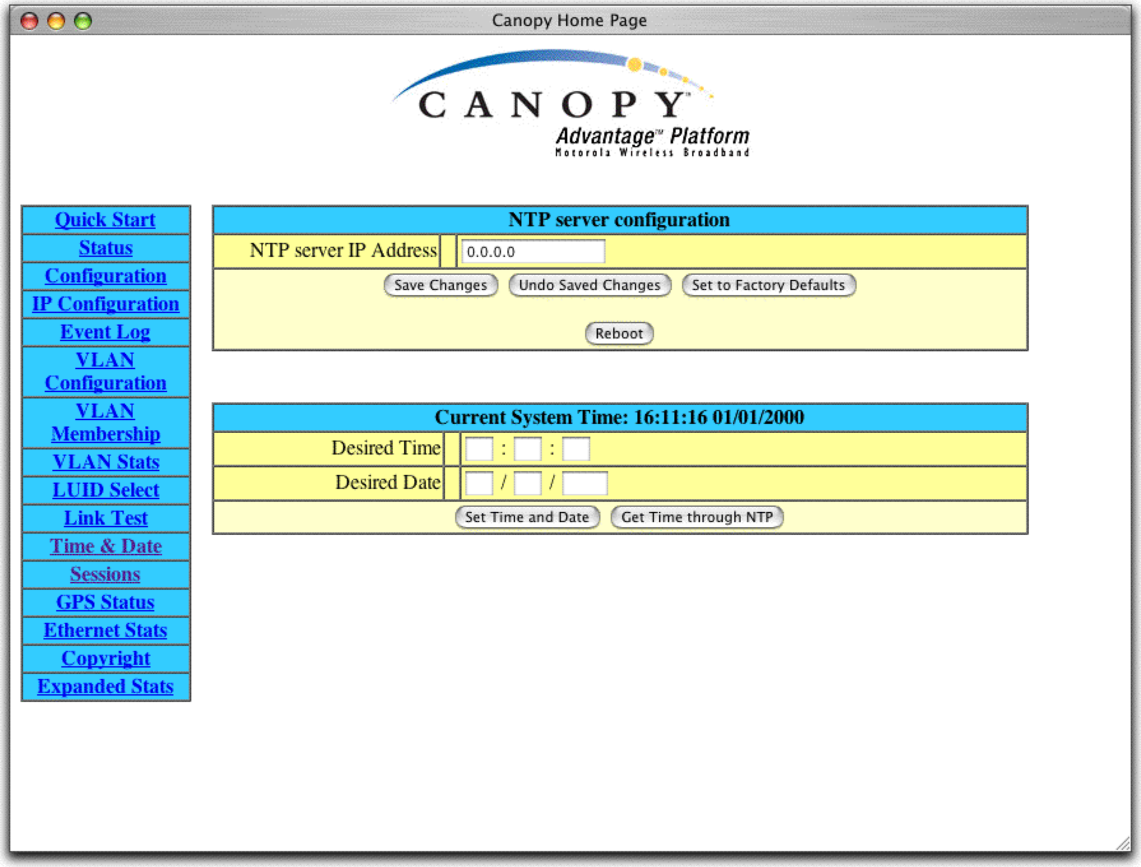
1. At the bottom of the Quick Start page, click the **Let's Get Started!** button.
   RESULT: The AP responds by opening the RF Carrier Frequency page.
2. From the pull-down menu in the lower left corner of this page, select a frequency for the test.
3. Click the **Go To Next Page =>** button.
   RESULT: The AP responds by opening the Synchronization page.
4. At the bottom of this page, select **Generate Sync Signal**.
5. Click the **Go To Next Page =>** button.
   RESULT: The AP responds by opening the Lan IP Address page.
6. At the bottom of this page, specify
   a. a **Lan IP Address**.
   b. a **Lan Subnet Mask**.
   c. a **Default Gateway**.
7. Click the **Go To Next Page =>** button.
   RESULT: The AP responds by opening the Review and Save Configuration page.
8. Ensure that the initial parameters for the AP are set as you intended.
9. Click the **Save Changes** button.
10. Click the **Reboot** button.
    RESULT: The AP responds with the message **Reboot Has Been Initiated…**
11. Wait until the indicator LEDs are not red.
12. Trigger your browser to refresh the page until the AP redisplays the Status page.
13. Wait until the red indicator LEDs are not lit.

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

Canopy encourages you to experiment with the interface. Unless you save a configuration and reboot the AP after you save the configuration, none of the changes are effected.

16.3.2 Time & Date Page of the AP

To proceed with the test setup, click the **Time & Date** button on the left side of the Quick Start page. The AP responds by opening the Time & Date page. An example of the AP Time & Date web page is displayed in Figure 61.



NTP server configuration

NTP server IP Address: 0.0.0.0

Current System Time: 16:11:16 01/01/2000

Desired Time: __ : __ : __

Desired Date: __ / __ / __

Figure 61: Time & Date screen, AP

To have each log in the AP correlated to a meaningful time and date, either a reliable network element must pass time and date to the AP or you must set the time and date whenever a power cycle of the AP has occurred. A network element passes time and date in any of the following scenarios:

- A connected CMM2 passes time and date (GPS time and date, if received).
- A connected CMMmicro passes the time and date (GPS time and date, if received), but only if both
  - the CMMmicro is operating on CMMmicro Release 2.1 or later release. (These releases include an NTP server functionality.)
  - the AP is operating on Canopy System Release 4.2 or later release. (These releases include an NTP client functionality.)

- ◦ A separate NTP server is addressable from the AP, and the AP is operating on Canopy System Release 4.2 or later release.

If the AP should derive time and date from either a CMMmicro or a separate NTP server, enter the IP address of the CMMmicro or NTP server on this web page. To force the AP to derive time and date before the first (or next) 15-minute interval query of the NTP server, click **Get Time through NTP**.

The format for entry is

Desired Time		*hh*	:	*mm*	:	*ss*	
Desired Date		*MM*	/	*dd*	/	*yyyy*	

where

hh represents the two-digit hour in the range 00 to 24
mm represents the two-digit minute
ss represents the two-digit second
MM represents the two-digit month
dd represents the two-digit day
yyyy represents the four-digit year

Proceed with the test setup as follows.

1. Enter the appropriate information in the format shown above.
2. Click the **Set Time and Date** button.
   NOTE: The time displayed at the top of this page is static unless your browser is set to automatically refresh.

Procedure 8: Setting up the SM for test

1. In one hand, securely hold the top (larger shell) of the SM. With the other hand, depress the lever in the back of the base cover (smaller shell). Remove the base cover.
2. Plug one end of a CAT 5 Ethernet cable into the SM RJ-45 jack.
3. Plug the other end of the Ethernet cable into the jack in the pig tail that hangs from the power supply.
4. Roughly aim the SM toward the AP.

> *WARNING!*
> From this point until you remove power from the SM, stay at least as far from the SM as the minimum separation distance specified under Preventing Overexposure to RF on Page 168.

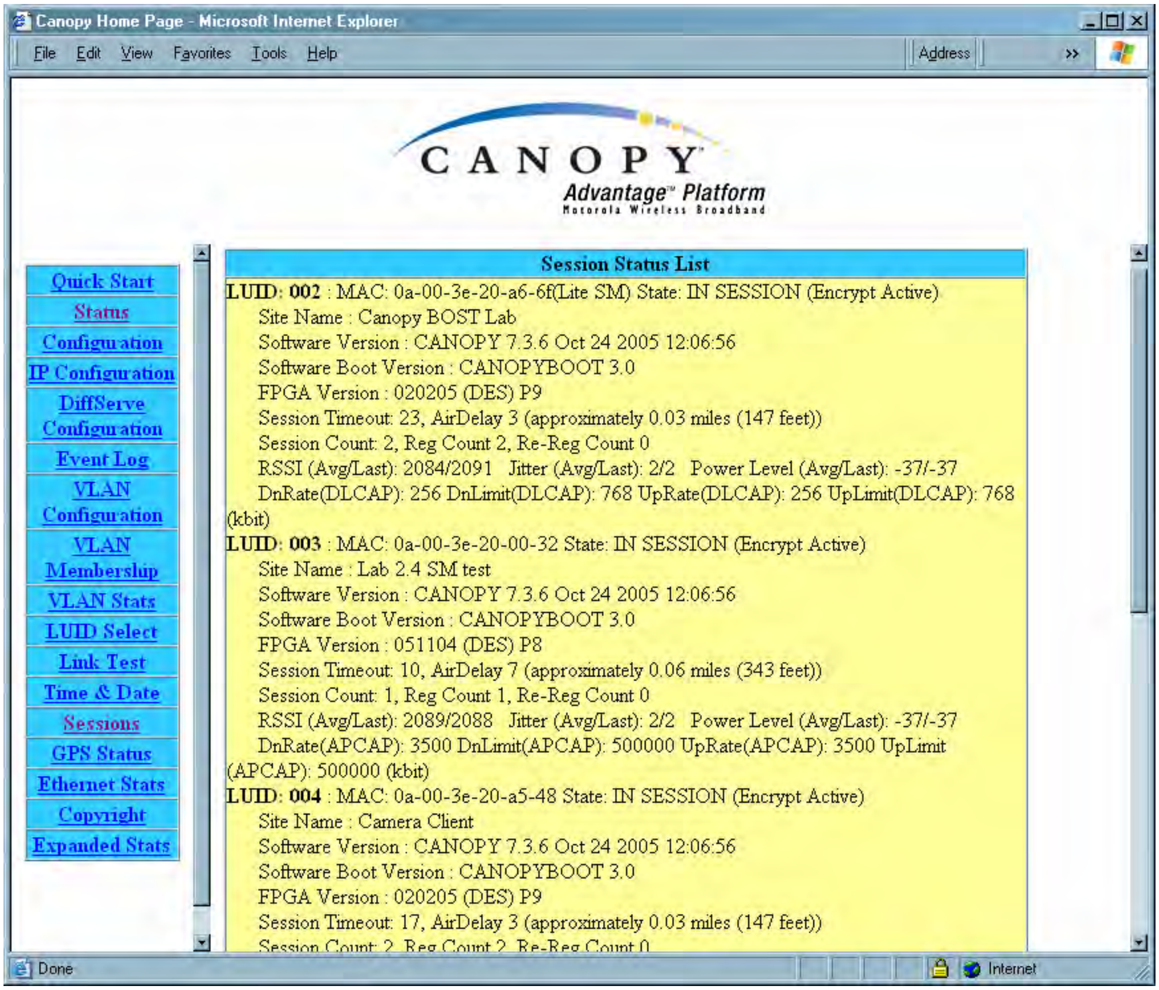
5. Plug the power supply into an electrical outlet.
6. Repeat the foregoing steps for each SM that you wish to include in the test.

7. Back at the computing device, on the left side of the AP Time & Date page, click the **Sessions** button.
   RESULT: The AP responds by opening the Sessions page.

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

16.3.3 Sessions Page of the AP

An example of the AP Sessions page is displayed in Figure 62.



```
Session Status List
LUID: 002 : MAC: 0a-00-3e-20-a6-6f(Lite SM) State: IN SESSION (Encrypt Active)
     Site Name : Canopy BOST Lab
     Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
     Software Boot Version : CANOPYBOOT 3.0
     FPGA Version : 020205 (DES) P9
     Session Timeout: 23, AirDelay 3 (approximately 0.03 miles (147 feet))
     Session Count: 2, Reg Count 2, Re-Reg Count 0
     RSSI (Avg/Last): 2084/2091   Jitter (Avg/Last): 2/2   Power Level (Avg/Last): -37/-37
     DnRate(DLCAP): 256 DnLimit(DLCAP): 768 UpRate(DLCAP): 256 UpLimit(DLCAP): 768
(kbit)
LUID: 003 : MAC: 0a-00-3e-20-00-32 State: IN SESSION (Encrypt Active)
     Site Name : Lab 2.4 SM test
     Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
     Software Boot Version : CANOPYBOOT 3.0
     FPGA Version : 051104 (DES) P8
     Session Timeout: 10, AirDelay 7 (approximately 0.06 miles (343 feet))
     Session Count: 1, Reg Count 1, Re-Reg Count 0
     RSSI (Avg/Last): 2089/2088   Jitter (Avg/Last): 2/2   Power Level (Avg/Last): -37/-37
     DnRate(APCAP): 3500 DnLimit(APCAP): 500000 UpRate(APCAP): 3500 UpLimit
(APCAP): 500000 (kbit)
LUID: 004 : MAC: 0a-00-3e-20-a5-48 State: IN SESSION (Encrypt Active)
     Site Name : Camera Client
     Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
     Software Boot Version : CANOPYBOOT 3.0
     FPGA Version : 020205 (DES) P9
     Session Timeout: 17, AirDelay 3 (approximately 0.03 miles (147 feet))
     Session Count: 2, Reg Count 2, Re-Reg Count 0
```

Figure 62: Sessions page data, AP

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

Procedure 9: Retrying to establish a point-to-multipoint link

1. More finely aim the SM or SMs toward the AP.
2. Recheck the Sessions page of the AP for the presence of LUIDs.

3. If still no LUIDs are reported on the Sessions page, click the **Configuration** button on the left side of the page.
   RESULT: The AP responds by opening the AP Configuration page.
4. Scroll down to the **Color Code** parameter and note the setting.
5. In the same sequence as you did for the AP directly under Configuring a Point-to-Multipoint Link for Test on Page 183, connect the SM to a computing device and to power.
6. On the left side of the SM Status page, click the **Configuration** button. The Configuration page of the SM opens.
7. If the transmit frequency of the AP is not selected in the **Custom RF Frequency Scan Selection List** parameter, select the frequency that matches.
8. If the **Color Code** parameter on this page is not identical to the **Color Code** parameter you noted from the AP, change one of them so that they match.
9. At the bottom of the SM Configuration page, click **Save Changes**.
10. Click **Reboot**.
11. Allow several minutes for the SM to reboot and register to the AP.
12. Return to the computing device that is connected to the AP.
13. Recheck the Sessions page of the AP for the presence of LUIDs.

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

The Sessions web page provides information about each SM that has registered to the AP. This information is useful for managing and troubleshooting a Canopy system. In Release 4.2 and later, all information that you have entered in the **Site Name** field of the SM displays in the Sessions page of the linked AP.

In Release 7.3.6 and later, the Sessions page includes the current active values on each SM (LUID) for MIR, CIR, and VLAN, as well as the source of these values (representing the SM itself, BAM, or the AP and cap, if any—for example, APCAP as shown in Figure 62 above). As an SM registers to the AP, the configuration source that this page displays for the associated LUID may change. After registration, however, the displayed source is stable and can be trusted.

The Sessions page provides the following parameters.

LUID

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

> *NOTE:*
> The LUID association is lost when a power cycle of the AP occurs.

MAC

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

State

This field displays the current status of the SM as either

- **IN SESSION** to indicate that the SM is currently registered to the AP.
- **IDLE** to indicate that the SM was registered to the AP at one time, but now is not.

Site Name

This field indicates the name of the physical module. You can assign or change this name on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Software Version

This field displays the software release that operates on the SM, the release date of the software, the time, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

An unpopulated **Software Version** parameter indicates a version earlier than Version 3.1.

Software Boot Version

This field indicates the CANOPYBOOT version number.

FPGA Version

This field displays the version of FPGA that runs on the SM. An unpopulated **FPGA Version** parameter indicates that a version earlier than Version 082002 runs on the SM.

Session Timeout

This field indicates the maximum interval in hours that the SM may sustain a single session with this AP.

AirDelay

This field displays the distance of the SM from the AP. To derive the distance in meters, multiply the displayed number by 0.3048. To derive the distance in feet, multiply the displayed number by 49. However, at close distances, the value in this field is unreliable. For example, at a distance of 12 feet, the **AirDelay** field may display a value of 7 (343 feet).

Session Count

This field displays how many sessions the SM has had with the AP. If the number of sessions is far greater than the number that other SMs registered to the AP have had, then this SM may have an installation problem.

Reg Count

This field displays how many registration request messages the AP has received from the SM. If the number of these messages is far greater than the number from other SMs registered to the AP, then this SM may have an installation problem.

Re-Reg Count

This field displays how many registration request messages the AP has received from the SM that is already in session. If the number of these messages is far greater than the number from other SMs that are both registered to the AP and in session, then this SM may have an installation problem.

RSSI (Avg/Last)

This field displays the average and the latest RSSI (received signal strength indicator) value for the SM.

Jitter (Avg/Last)

This field displays the average and the latest jitter value for the SM.

Power Level (Avg/Last)

This field displays the average and the latest power level set for the SM.

DnRate

This field displays the value of the **Sustained Downlink Data Rate** currently effective for the SM. This is the specified the rate at which the AP should be replenished with credits (tokens) for transmission to each of the SMs in its sector. The configuration source of the value is indicated in parentheses. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

DnLimit

This field displays the value of the **Downlink Burst Allocation** currently effective for the SM. This is the maximum amount of data to allow the AP to transmit to any registered SM before the AP is replenished with transmission credits at the **Sustained Downlink Data Rate**. The configuration source of the value is indicated in parentheses. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

UpRate

This field displays the value of the **Sustained Uplink Data Rate** currently effective for the SM. This is the specified rate at which each SM registered to this AP is replenished with credits for transmission. The configuration source of the value is indicated in parentheses. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

UpLimit

This field displays the value of the **Uplink Burst Allocation** currently effective for the SM. This is the specified maximum amount of data that each SM is allowed to transmit before being recharged at the **Sustained Uplink Data Rate** with credits to transmit more. The configuration source of the value is indicated in parentheses. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

LoUpCIR

This field displays the value of the **Low Priority Uplink CIR** parameter currently effective for the SM. The configuration source of the value is indicated in parentheses. See

- Committed Information Rate on Page 88
- Setting the Configuration Source on Page 287.

LoDnCIR

This field displays the value of the **Low Priority Downlink CIR** parameter currently effective for the SM. The configuration source of the value is indicated in parentheses. See

- Committed Information Rate on Page 88
- Setting the Configuration Source on Page 287.

Rate

This field displays whether the high-priority channel is enabled in the SM and the status of 1X or 2X operation in the SM. See Checking the Status of 2X Operation on Page 96.

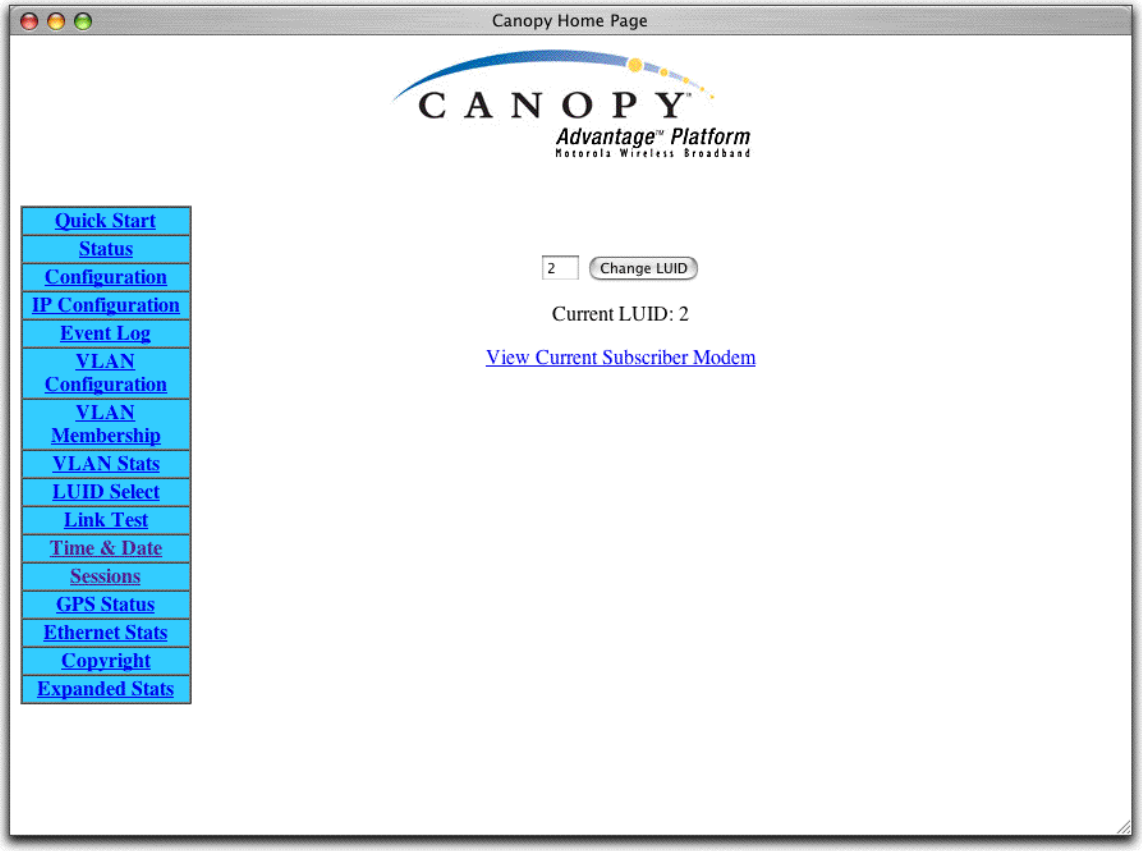
16.3.4 Beginning the Test of Point-to-Multipoint Links

To begin the test of links, perform the following steps:

1. Note the LUID associated with the MAC address of any SM you wish to involve in the test.
2. On the left side of the Sessions page, click the **LUID Select** button.
   RESULT: The AP responds by opening the LUID Select page.

16.3.5 LUID Select Page of the AP

An example of an AP LUID Select screen is displayed in Figure 63.



2

Current LUID: 2

Figure 63: LUID Select screen, AP

This web page allows you to view the web pages of registered SMs over the RF link.

To view the pages for a selected SM, perform the following steps.

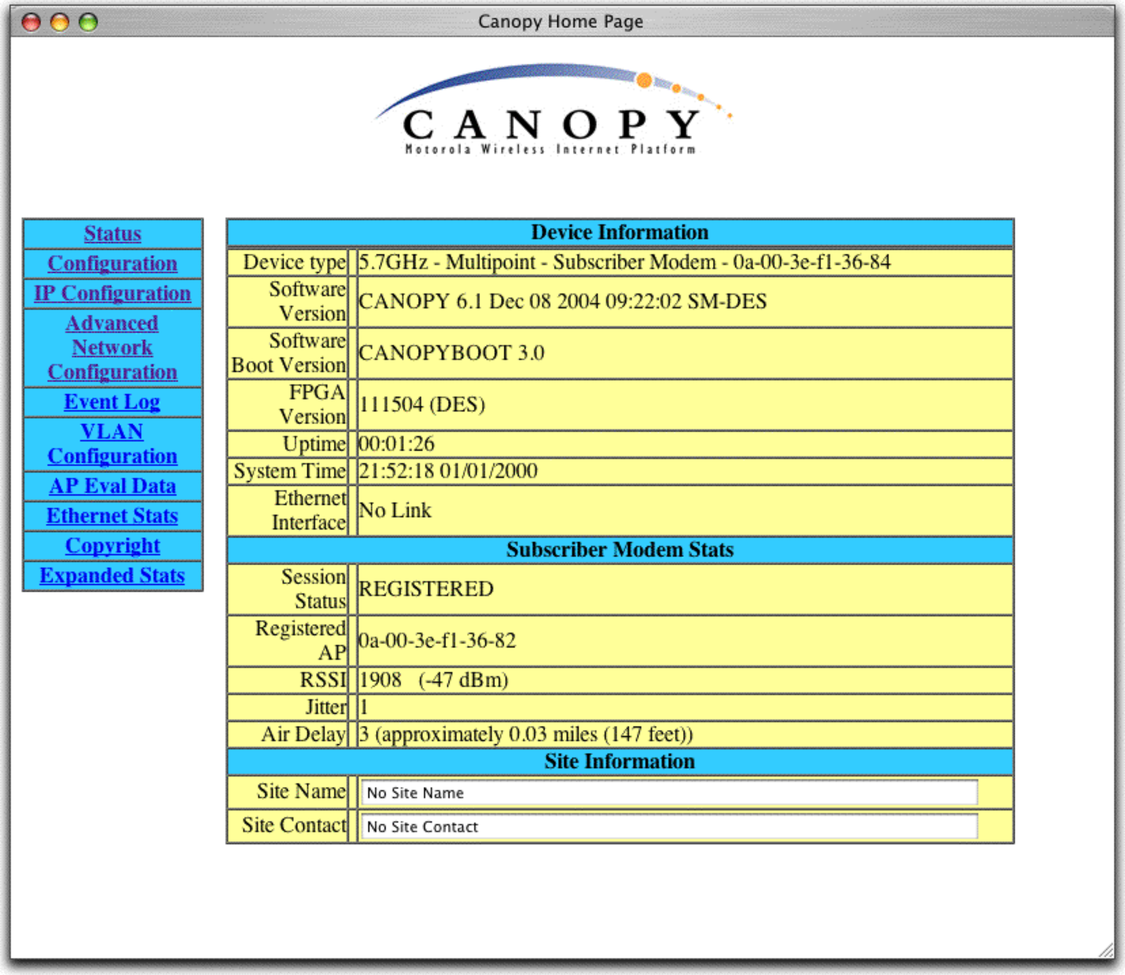
Procedure 10: Viewing SM pages through the AP

1. If the LUID differs from the LUID shown on the **Current LUID** line, enter the LUID into the **Change LUID** field.
2. Click the **Change LUID** button so that the LUID you entered in the previous step is shown on the **Current LUID** line.
3. Click **View Current Subscriber Modem**.
   RESULT: The Status page of the SM is displayed.

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

16.3.6 Status Page of the SM

Examples of SM Status screens are displayed in Figure 64.



Device Information	
Device type	5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84
Software Version	CANOPY 6.1 Dec 08 2004 09:22:02 SM-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	111504 (DES)
Uptime	00:01:26
System Time	21:52:18 01/01/2000
Ethernet Interface	No Link
Subscriber Modem Stats	
Session Status	REGISTERED
Registered AP	0a-00-3e-f1-36-82
RSSI	1908 (-47 dBm)
Jitter	1
Air Delay	3 (approximately 0.03 miles (147 feet))
Site Information	
Site Name	No Site Name
Site Contact	No Site Contact

Figure 64: Status screen, SM

The Status page provides information on the operation of this SM. This is the default web page for the SM. The Status page provides the following fields.

Device Type

This field indicates the type of the Canopy module. Values include the frequency band of the module, the protocol that is used, and the MAC address of the module.

Software Boot Version

This field indicates the version of the software that is operated on the module, the date and time of boot, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

FPGA Version

This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.

Uptime

This field indicates how long the module has operated since power was applied.

System Time

This field provides the current time. Any SM that registers to an AP inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).

Ethernet Interface

This field indicates the configuration of the Ethernet interface on the module.

Session Status

This field displays the following information about the current session:

- **Scanning** indicates that this SM currently cycles through the RF frequencies that are selected in the Configuration page. (See Custom RF Frequency Scan Selection List on Page 257.
- **Syncing** indicates that this SM currently attempts to receive sync.
- **Registering** indicates that this SM has sent a registration request message to the AP and has not yet received a response.
- **Registered** indicates that this SM is both
  - registered to an AP.
  - ready to transmit and receive data packets.
- **Alignment** indicates that this SM is in an aiming mode. See Table 47 on Page 177.

Registered AP

This field displays the IP address of the AP to which this SM is registered.

RSSI

This field displays the current RSSI (Radio Signal Strength Indicator)

- for the signal from the AP to which the SM is registered if the SM is registered.
- from any beacon if the SM is scanning.

An acceptable link has an RSSI of greater than 700. However, to achieve the best link possible, the alignment of the module should balance good RSSI values against good jitter values.

NOTE:
Unless the page is set to auto-refresh, the value displayed is the RSSI value at the instant the Status page was called. To keep a current view of the RSSI, refresh the browser screen or set to auto-refresh.

Jitter

This field displays the current overall quality of reception

- for the signal from the AP to which the SM is registered if the SM is registered.
- from any beacon if the SM is scanning.

An acceptable link has a jitter value between 0 and 4 in Release 4.0 and later or between 5 and 9 in any earlier release. However, to achieve the best link possible, the alignment of the module should balance good jitter values against good RSSI values.

> *NOTE:*
> Unless the page is set to auto-refresh, the value displayed is the jitter value at the instant the Status page was called. To keep a current view of the jitter, refresh the browser screen or set to auto-refresh.

Air Delay

This field displays the distance in feet between this SM and the AP. To derive the distance in meters, multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.

Site Name

This field indicates the name of the physical module. You can assign or change this name on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Site Contact

This field indicates contact information for the physical module. You can provide or change this information on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

16.3.7 Continuing the Test of Point-to-Multipoint Links

To resume the test of links, perform the following steps.

Procedure 11: Verifying and recording information from SMs

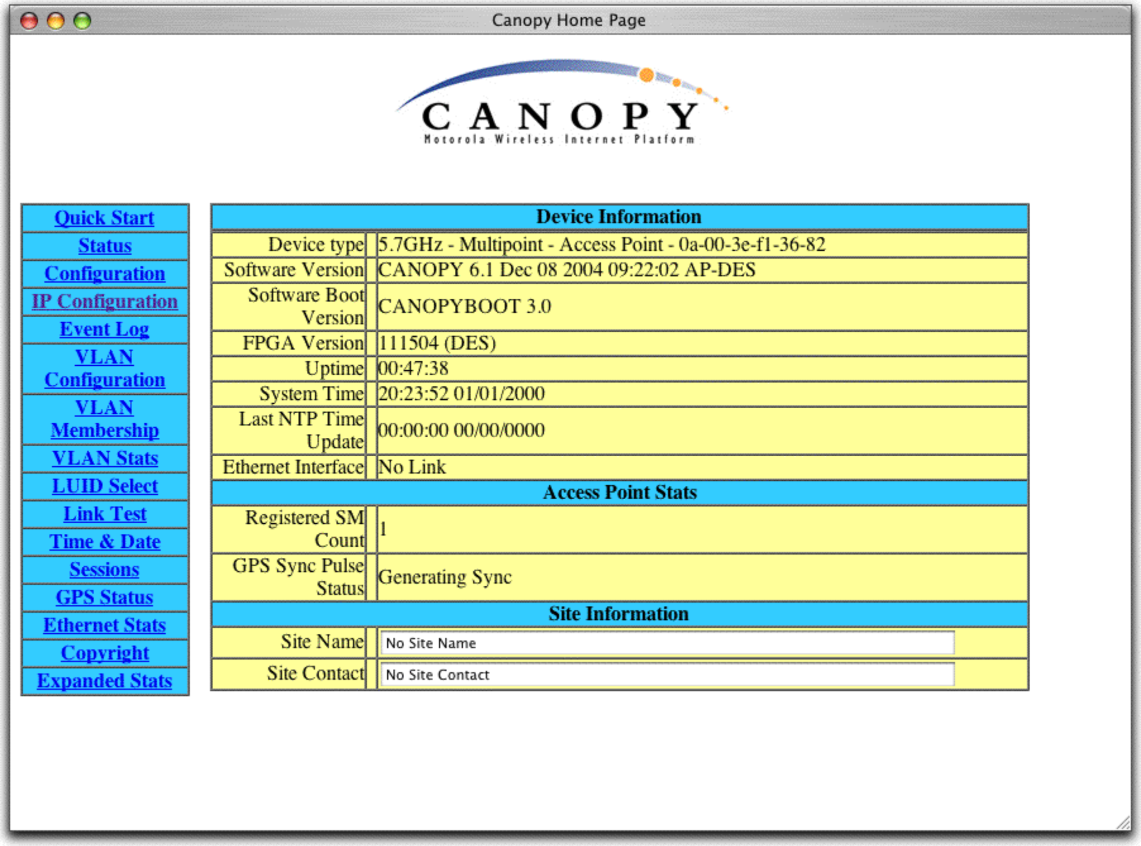
1. Verify that the **Session Status** field of the SM Status page indicates **REGISTERED**.
   NOTE: This indication confirms that the SM is properly functional.
2. While your browser is set to this SM Status page, note (or print) the values of the following fields:
   - **Device type**
   - **Software Version**
   - **Software Boot Version**
   - **FPGA Version**
3. Systematically ensure that you can retrieve this data (from a database, for example) when you later prepare to deploy the SM to subscriber premises.
4. Return your browser to the Sessions page of the AP.
5. Note the LUID of the next SM that you wish to test.

6. Return your browser to the LUID Select page of the SM.
7. Repeat the test procedure from that point. When you have tested all of the SMs that you intend to test, return your browser to the Status page of the AP.

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

16.3.8 Status Page of the AP

An example of an AP Status screen is displayed in Figure 65.



Device Information	
Device type	5.7GHz - Multipoint - Access Point - 0a-00-3e-f1-36-82
Software Version	CANOPY 6.1 Dec 08 2004 09:22:02 AP-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	111504 (DES)
Uptime	00:47:38
System Time	20:23:52 01/01/2000
Last NTP Time Update	00:00:00 00/00/0000
Ethernet Interface	No Link
Access Point Stats	
Registered SM Count	1
GPS Sync Pulse Status	Generating Sync
Site Information	
Site Name	No Site Name
Site Contact	No Site Contact

Figure 65: Status screen, AP

The Status page provides information on the operation of the module. This is the default web page for the module. The Status page provides the following fields.

Device Type

This field indicates the type of the Canopy module. Values include the frequency band of the module, the protocol that is used, and the MAC address of the module.

Software Version

This field indicates the software release that is operated on the module, the release date of the software, the time, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

Software Boot Version

This field indicates the CANOPYBOOT version number.

FPGA Version

This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.

Uptime

This field indicates how long the module has operated since power was applied.

System Time

This field provides the current time. If the AP is connected to a CMM, then this field provides GMT (Greenwich Mean Time). Any SM that registers to the AP inherits the system time.

Ethernet Interface

This field indicates the configuration of the Ethernet interface on the module.

Registered SM Count

This field indicates how many SMs are registered to the AP.

GPS Sync Pulse Status

This field indicates the status of synchronization that the AP is receiving as follows:

- **Generating sync** indicates that the module is set to *generate* the sync pulse.
- **Receiving Sync** indicates that the module is set to *receive* a sync pulse from an outside source and is receiving the pulse.
- **ERROR: No Sync Pulse** indicates that the module is set to *receive* a sync pulse from an outside source and is not receiving the pulse.

NOTE:
When this message is displayed, the AP transmitter is turned off to avoid self-interference within the Canopy system.

Site Name

This field indicates the name of the physical module. You can assign or change this name on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Site Contact

This field indicates contact information for the physical module. You can provide or change this information on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

16.3.9 Concluding the Test of Point-to-Multipoint Links

To conclude the test, perform the following steps.

Procedure 12: Verifying and recording information from the AP

1. Confirm that the **GPS Sync Pulse Status** field indicates **Generating Sync**.
   NOTE: This indication confirms that the AP is properly functional.
2. While your browser is set to this AP Status page, note (or print) the values of the following fields:
   - **Device type**
   - **Software Version**
   - **Software Boot Version**
   - **FPGA Version**
3. Systematically ensure that you can retrieve this data when you prepare to deploy the AP.

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

16.4 CONFIGURING A POINT-TO-POINT LINK FOR TEST

NOTE:
This section supports the Canopy 10- and 20-Mbps Backhaul Modules. To find setup and configuration guides that support the OFDM Series Backhaul Modules, refer to Products Not Covered by This User Guide on Page 34.

Perform the following steps to begin the test setup.

Procedure 13: Setting up the BH for Quick Start

1. In one hand, securely hold the top (larger shell) of the BH that you intend to deploy as a timing master. With the other hand, depress the lever in the back of the base cover (smaller shell). Remove the base cover.
2. Plug one end of a CAT 5 Ethernet cable into the timing master.
3. Plug the other end of the Ethernet cable into the jack in the pig tail that hangs from the power supply.
4. Plug the other connector of the pig tail into the Ethernet jack of the computing device.

WARNING!
From this point until you remove power from the BH, stay at least as far from the BH as the minimum separation distance specified under Preventing Overexposure to RF on Page 168.

5. Plug the power supply into an electrical outlet.
6. Power up the computing device.
7. Start the browser in the computing device.
8. Access the Configuration page of the BH.
9. In the **Timing Mode** parameter, select **Timing Master**.

   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.)

10. Click **Save Changes**.
11. Click **Reboot**.

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

The Canopy BH interface provides a series of web pages to configure and monitor the unit. These screens are subject to change by subsequent software releases.

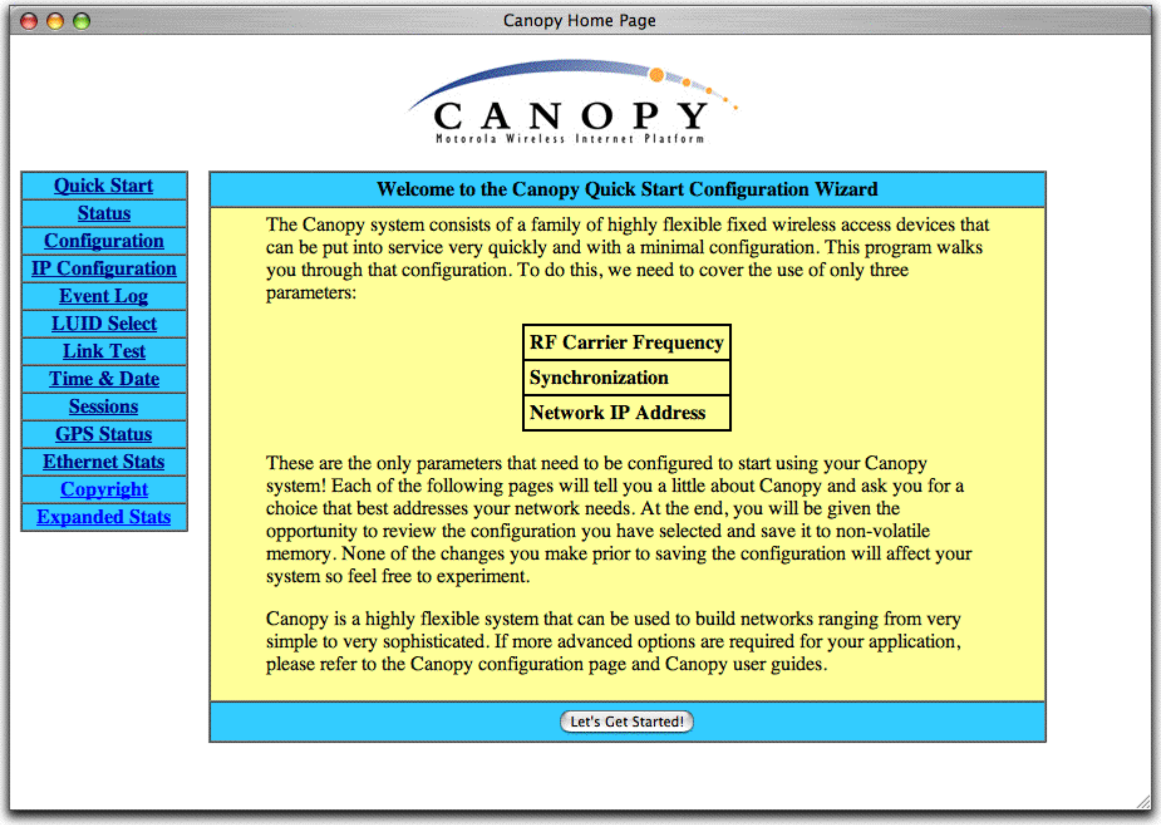
You can access the web-based interface through only a computing device that is either directly connected or connected through a network to the BH. If the computing device is not connected to a network when you are configuring the module in your test environment, and if the computer has used a proxy server address and port to configure a Canopy module, then you may need to first disable the proxy setting in the computer.

To toggle the computer to *not* use the proxy setting, perform Procedure 6 on Page 183.

In the address bar of your browser, enter the IP address of the BHM (default is 169.254.1.1). The BHM responds by opening the Status page.

16.4.1 Quick Start Page of the BHM

To proceed with the test setup, click the **Quick Start** button on the left side of the Status page. The BHM responds by opening the Quick Start page. The standard Quick Start screen is displayed in Figure 66.



Welcome to the Canopy Quick Start Configuration Wizard

The Canopy system consists of a family of highly flexible fixed wireless access devices that can be put into service very quickly and with a minimal configuration. This program walks you through that configuration. To do this, we need to cover the use of only three parameters:

RF Carrier Frequency
Synchronization
Network IP Address

These are the only parameters that need to be configured to start using your Canopy system! Each of the following pages will tell you a little about Canopy and ask you for a choice that best addresses your network needs. At the end, you will be given the opportunity to review the configuration you have selected and save it to non-volatile memory. None of the changes you make prior to saving the configuration will affect your system so feel free to experiment.

Canopy is a highly flexible system that can be used to build networks ranging from very simple to very sophisticated. If more advanced options are required for your application, please refer to the Canopy configuration page and Canopy user guides.

Figure 66: Quick Start screen, BHM

Quick Start is a wizard that helps you to perform a basic configuration that places a BHM into service. Only the following parameters must be configured:

- **RF Carrier Frequency**
- **Synchronization**
- **Network IP Address**

In each page under Quick Start, you can

- specify the settings to satisfy the requirements of the network.
- review the configuration selected.
- save the configuration to non-volatile memory.

Proceed with the test setup as follows.

Procedure 14: Using Quick Start to configure the BH for test

1. At the bottom of the Quick Start page, click the **Let’s Get Started!** button.
   RESULT: The BHM responds by opening the RF Carrier Frequency page.
2. From the pull-down menu in the lower left corner of this page, select a frequency for the test.

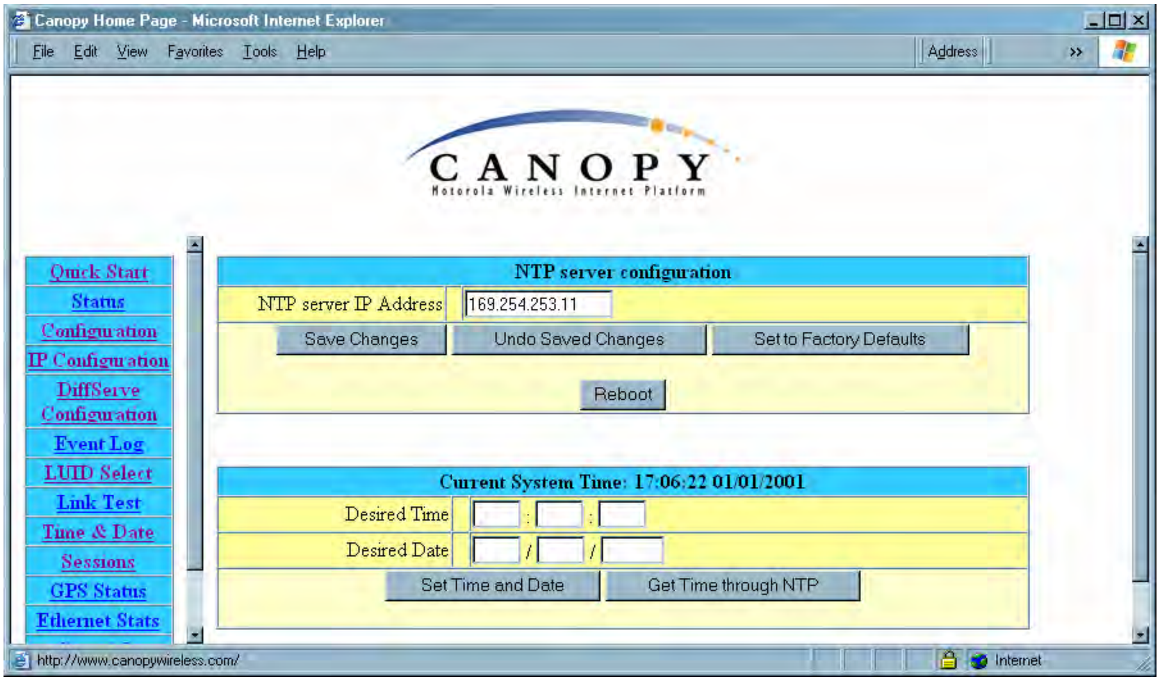
3. Click the **Go To Next Page =>** button.
   RESULT: The BHM responds by opening the Synchronization page.
4. At the bottom of this page, select **Generate Sync Signal**.
5. Click the **Go To Next Page =>** button.
   RESULT: The BHM responds by opening the Lan IP Address page.
6. At the bottom of this page, specify
   a. a **Lan IP Address**.
   b. a **Lan Subnet Mask**.
   c. a **Default Gateway**.
7. Click the **Go To Next Page =>** button.
   RESULT: The BHM responds by opening the Review and Save Configuration page.
8. Ensure that the initial parameters for the BHM are set as you intended.
9. Click the **Save Changes** button.
10. On the left side of the Status page, click the **Configuration** button.
    RESULT: The BHM responds by opening the Configuration page.
11. In the **Timing Mode** parameter, select **Timing Master**.
    RESULT: This BH is now forced to provide sync for the link and the distinct set of web interface pages and parameters for the role of BHM.
    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.)
12. Click the **Save Changes** button.
13. Click the **Reboot** button.
    RESULT: The BHM responds with the message **Reboot Has Been Initiated…**
14. Wait until the indicator LEDs are not red.
15. Trigger your browser to refresh the page until the BHM redisplays the Status page.

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

We encourage you to experiment with the interface. Unless you save a configuration and reboot the BHM after you save the configuration, none of the changes are effected.

16.4.2 Time & Date Page of the BHM

To proceed with the test setup, click the **Time & Date** button on the left side of the Quick Start page. The BHM responds by opening the Time & Date page. An example of the BHM Time & Date web page is displayed in Figure 67.



NTP server configuration

NTP server IP Address	169.254.253.11

Current System Time: 17:06:22 01/01/2001

Desired Time	: :
Desired Date	/ /

Figure 67: Time & Date screen, BHM

To have each log in the BHM correlated to a meaningful time and date, either a reliable network element must pass time and date to the BHM or you must set the time and date whenever a power cycle of the BHM has occurred. A network element passes time and date in any of the following scenarios:

- A connected CMM2 passes time and date (GPS time and date, if received).
- A connected CMMmicro passes the time and date (GPS time and date, if received), but only if both
  - the CMMmicro is operating on CMMmicro Release 2.1 or later release. (These releases include an NTP server functionality.)
  - the BHM is operating on Canopy System Release 4.2 or later release. (These releases include an NTP client functionality.)
- A separate NTP server is addressable from the BHM, and the BHM is operating on Canopy System Release 4.2 or later release.

If the BHM should derive time and date from either a CMMmicro or a separate NTP server, enter the IP address of the CMMmicro or NTP server on this web page. To force the BHM to derive time and date before the first (or next) 15-minute interval query of the NTP server, click **Get Time through NTP**.

If you must set the time and date, the format for entry is

Desired Time		*hh*	:	*mm*	:	*ss*	
Desired Date		*MM*	/	*dd*	/	*yyyy*	

where

hh represents the two-digit hour in the range 00 to 24
mm represents the two-digit minute
ss represents the two-digit second
MM represents the two-digit month
dd represents the two-digit day
yyyy represents the four-digit year

Proceed with the test setup as follows.

Procedure 15: Setting up the BHS for test

1. Enter the appropriate information in the format shown above.
2. Click the **Set Time and Date** button.
   NOTE: The time displayed at the top of this page is static unless your browser is set to automatically refresh.
3. In one hand, securely hold the top (larger shell) of the BH that you intend to deploy as a timing slave. With the other hand, depress the lever in the back of the base cover (smaller shell). Remove the base cover.
4. Plug one end of a CAT 5 Ethernet cable into the BHS.
5. Plug the other end of the Ethernet cable into the jack in the pig tail that hangs from the power supply.
6. Roughly aim the BHS toward the BHM.

> ***WARNING!***
> From this point until you remove power from the BHS, stay at least as far from the BHS as the minimum separation distance specified under Preventing Overexposure to RF on Page 168.

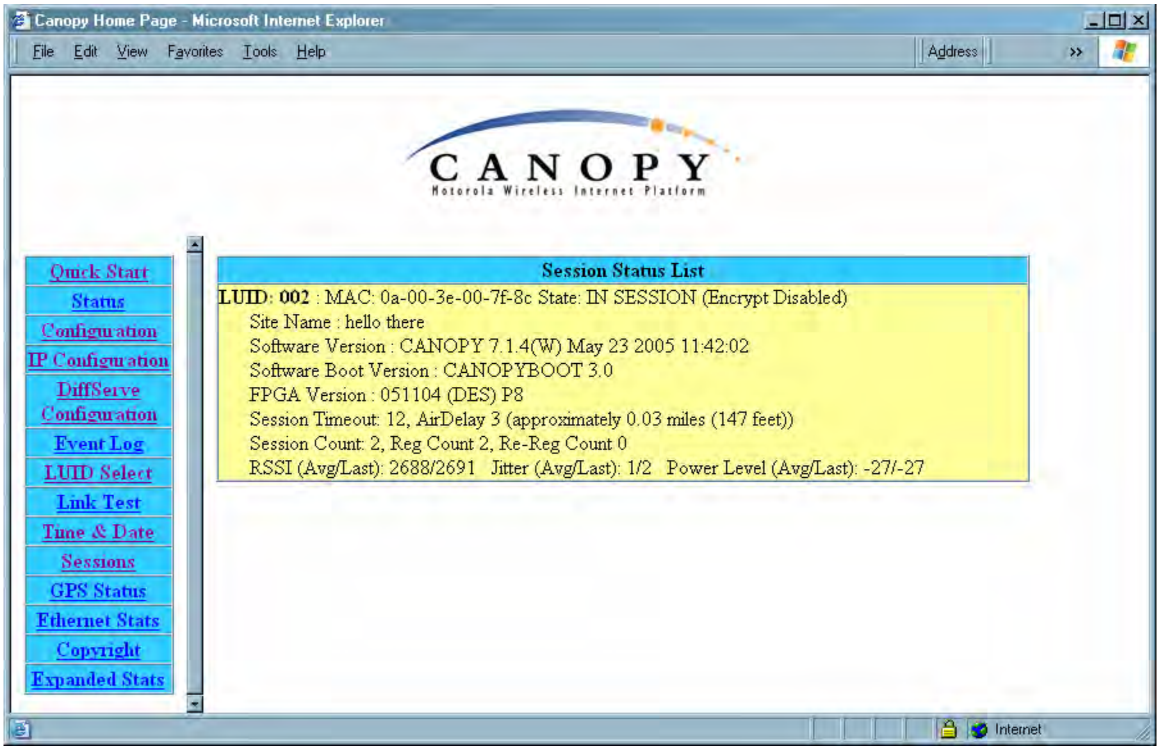
7. Plug the power supply into an electrical outlet.
8. Back at the computing device, on the left side of the BHM Time & Date page, click the **Sessions** button.
   RESULT: The BHM responds by opening the Sessions page.

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

16.4.3 Sessions Page of the BHM

An example of the BHM Sessions page is displayed in Figure 68.

> ***NOTE:***
> In Release 7.3.6 and later, the BHM interface no longer includes a Sessions page.



Session Status List

```
LUID: 002 : MAC: 0a-00-3e-00-7f-8c State: IN SESSION (Encrypt Disabled)
    Site Name : hello there
    Software Version : CANOPY 7.1.4(W) May 23 2005 11:42:02
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 051104 (DES) P8
    Session Timeout: 12, AirDelay 3 (approximately 0.03 miles (147 feet))
    Session Count: 2, Reg Count 2, Re-Reg Count 0
    RSSI (Avg/Last): 2688/2691   Jitter (Avg/Last): 1/2   Power Level (Avg/Last): -27/-27
```

Figure 68: Sessions page data, BHM

If the BHS is not registered to this BHM, then the Sessions page displays the simple message **No sessions**. In this case, try the following steps.

Procedure 16: Retrying to establish a point-to-point link

1. More finely aim the BHS toward the BHM.
2. Recheck the Sessions page of the BHM for the presence of the BHS LUID.
3. If the LUID is still not reported on the Sessions page, click the **Configuration** button on the left side of the page.
   RESULT: The BHM responds by opening the BHM Configuration page.
4. Scroll down to the **Color Code** parameter and note the setting.

5. In the same sequence as you did for the BHM directly under Configuring a Point-to-Point Link for Test on Page 199, connect the BHS to a computing device and to power.
   RESULT: The BHS powers up in the Operational mode, opens the SM Status page, scans, and attempts to register.
6. On the left side of the BHS Status page, click the **Configuration** button. The Configuration page of the BHS opens.
7. In the **Timing Mode** parameter, select **Timing Slave**.
   RESULT: This BH is now forced to receive sync and to provide the distinct set of web interface pages and parameters for the role of BHS.
   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.)
8. Click the **Save Changes** button.
9. Click the **Reboot** button.
   RESULT: The BHS responds with the message **Reboot Has Been Initiated…**
10. Trigger your browser to refresh the page until the BHS redisplays the Status page.
11. If the transmit frequency of the BHM is not selected in the **Custom RF Frequency Scan Selection List** parameter, select the frequency that matches.
12. If the **Color Code** parameter on this page is not identical to the **Color Code** parameter you noted from the BHM, change one of them so that they match.
13. At the bottom of the BHS Configuration page, click **Save Changes**.
14. Click **Reboot**.
15. Allow several minutes for the BHS to reboot and register to the BHM.
16. Return to the computing device that is connected to the BHM.
17. Recheck the Sessions page of the BHM for the presence of the BHS LUID.

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

The Sessions web page provides information about the BHS that has registered to the BHM. This information is useful for managing and troubleshooting a Canopy system. In Release 4.2 and later, all information that you have entered in the **Site Name** field of the BHS displays in the Sessions page of the linked BHM.

The Sessions page provides the following fields.

LUID

This field displays the LUID (logical unit ID) of the BHS. As the BHS registers to the BHM, the BHM assigns an LUID of 2 to the BHS. If the BHS loses registration with the BHM and then regains registration, the BHS will retain the same LUID.

> *NOTE:*
> The LUID association is lost when a power cycle of the BHM occurs.

MAC

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

State

This field displays the current status of the BHS as either

- **IN SESSION** to indicate that the BHS is currently registered to the BHM.
- **IDLE** to indicate that the BHS was registered to the BHM at one time, but now is not.

Software Version

This field displays the software release that operates on the BHS, the release date of the software, the time, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

An unpopulated **Software Version** parameter indicates a version earlier than Version 3.1.

Software Boot Version

This field indicates the CANOPYBOOT version number.

FPGA Version

This field displays the version of field programmable gate array (FPGA) that runs on the BHS. An unpopulated **FPGA Version** parameter indicates a version earlier than Version 082002.

Session Timeout

This field indicates the maximum interval in hours that the BHS may sustain a single session with this BHM.

AirDelay

This field displays the distance of the BHS from the BHM. To derive the distance in meters, the multiply the displayed number by 0.3048. To derive the distance in feet, multiply the displayed number by 49. However, at close distances, the value in this field is unreliable. For example, at a distance of 12 feet, the **AirDelay** field may display a value of 7 (343 feet).

Session Count

This field displays how many sessions the BHS has had with the BHM. If the number of sessions is abnormally high, then this BHS may have an installation problem.

Reg Count

This field displays how many registration request messages the BHM has received from the BHS. If the number of these messages is abnormally high, then this BHS may have an installation problem.

Re-Reg Count

This field displays how many registration request messages the BHM has received from the BHS that is already in session. If the number of these messages is abnormally high, then this BHS may have an installation problem.

RSSI (Avg/Last)

This field displays the average and the latest RSSI (received signal strength indicator) value for the BHS.

Jitter (Avg/Last)

This field displays the average and the latest jitter value for the BHS.

Power Level (Avg/Last)

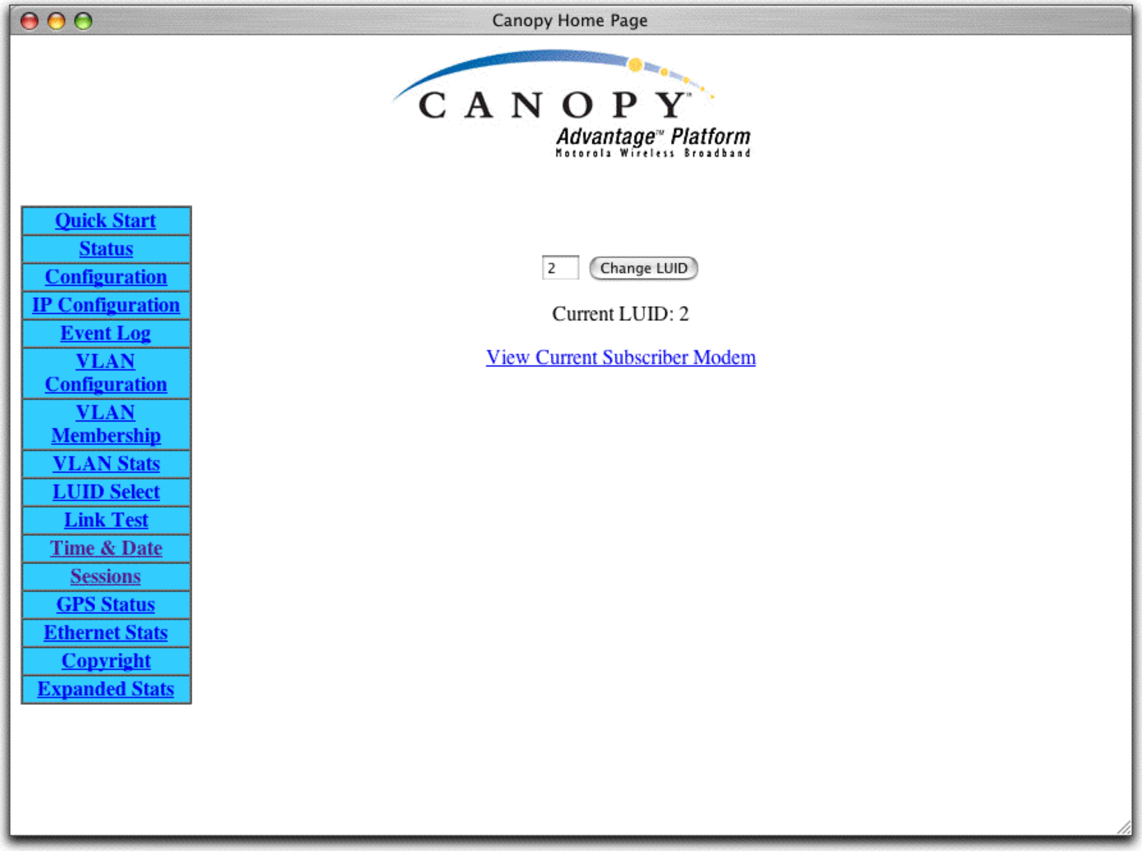
This field displays the average and the latest power level set for the BHS.

16.4.4 Beginning the Test of Point-to-Point Links

To begin the test of links, perform the following steps.

Procedure 17: Viewing BHS pages through the BHM

1. Note the LUID associated with the MAC address of the BHS.
2. On the left side of the Sessions page, click the **LUID Select** button.
   RESULT: The BHM responds by opening the LUID Select page. This web page allows you to view the web pages of a registered BHS over the RF link. An example of a BHM LUID Select screen is displayed in Figure 69.



2

Current LUID: 2

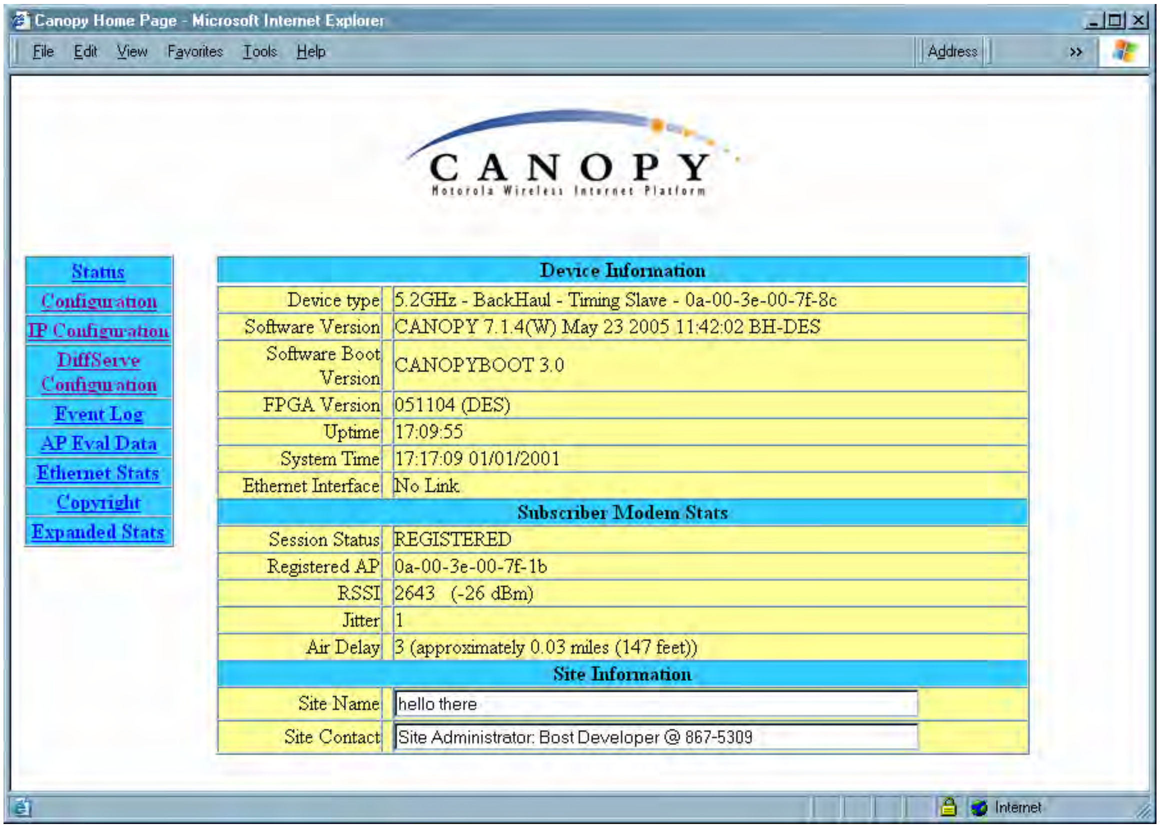
Figure 69: LUID Select screen, BHM

3. Click **View Current Subscriber Modem**.
   RESULT: The Status page of the BHS is displayed.

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

16.4.5 Status Page of the BHS

An example of the BHS Status screen is displayed in Figure 70.



Device Information	
Device type	5.2GHz - BackHaul - Timing Slave - 0a-00-3e-00-7f-8c
Software Version	CANOPY 7.1.4(W) May 23 2005 11:42:02 BH-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	051104 (DES)
Uptime	17:09:55
System Time	17:17:09 01/01/2001
Ethernet Interface	No Link
Subscriber Modem Stats	
Session Status	REGISTERED
Registered AP	0a-00-3e-00-7f-1b
RSSI	2643 (-26 dBm)
Jitter	1
Air Delay	3 (approximately 0.03 miles (147 feet))
Site Information	
Site Name	hello there
Site Contact	Site Administrator: Bost Developer @ 867-5309

Figure 70: Status screen, 5.2-GHz BHS

The Status page provides information on the operation of this BHS. This is the default web page for the BHS. The Status page provides the following parameters.

Device Type

This field indicates the type of the Canopy module. Values include the frequency band of the module, the protocol that is used, and the MAC address of the module.

Canopy Boot Version

This field indicates the version of the software that is operated on the module, the date and time of boot, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

FPGA Version

This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.

Uptime

This field indicates how long the module has operated since power was applied.

System Time

This field provides the current time. The BHS that registers to the BHM inherits the system time, which is displayed in this field as GMT (Greenwich Mean Time).

Ethernet Interface

This field indicates the configuration of the Ethernet interface on the module.

Session Status

This field displays the following information about the current session:

- **Scanning** indicates that this BHS currently cycles through the RF frequencies that are selected in the Configuration page. (See Custom RF Frequency Scan Selection List on Page 257.
- **Syncing** indicates that this BHS currently attempts to receive sync.
- **Registering** indicates that this BHS has sent a registration request message to the BHM and has not yet received a response.
- **Registered** indicates that this BHS is both
  - registered to a BHM.
  - ready to transmit and receive data packets.
- **Alignment** indicates that this BHS is in an aiming mode. See Table 47 on Page 177.

Registered AP

This field displays the IP address of the BHM to which this BHS is registered.

RSSI

This field displays the current RSSI (Radio Signal Strength Indicator)

- for the signal from the BHM if the BHS is registered.
- from any beacon if the SM is scanning.

An acceptable link has an RSSI of greater than 700. However, to achieve the best link possible, the alignment of the module should balance good RSSI values against good jitter values.

> *NOTE:*
> Unless the page is set to auto-refresh, the value displayed is the RSSI value at the instant the Status page was called. To keep a current view of the RSSI, refresh the browser screen or set to auto-refresh.

Jitter

This field displays the current overall quality of reception

- for the signal from the BHM if the BHS is registered.
- from any beacon if the BHS is scanning.

An acceptable link has a jitter value between 0 and 4 in Release 4.0 and later or between 5 and 9 in any earlier release. However, to achieve the best link possible, the alignment of the module should balance good jitter values against good RSSI values.

> *NOTE:*
> Unless the page is set to auto-refresh, the value displayed is the jitter value at the instant the Status page was called. To keep a current view of the jitter, refresh the browser screen or set to auto-refresh.

Air Delay

This field displays the distance in feet between this BHS and the BHM. To derive the distance in meters, the multiply the value of this parameter by 0.3048. Distances reported as less than 200 feet (61 meters) are unreliable.

Site Name

This field indicates the name of the physical module. You can assign or change this name on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Site Contact

This field indicates contact information for the physical module. You can provide or change this information on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

16.4.6 Continuing the Test of Point-to-Point Links

To resume the test, perform the following steps.

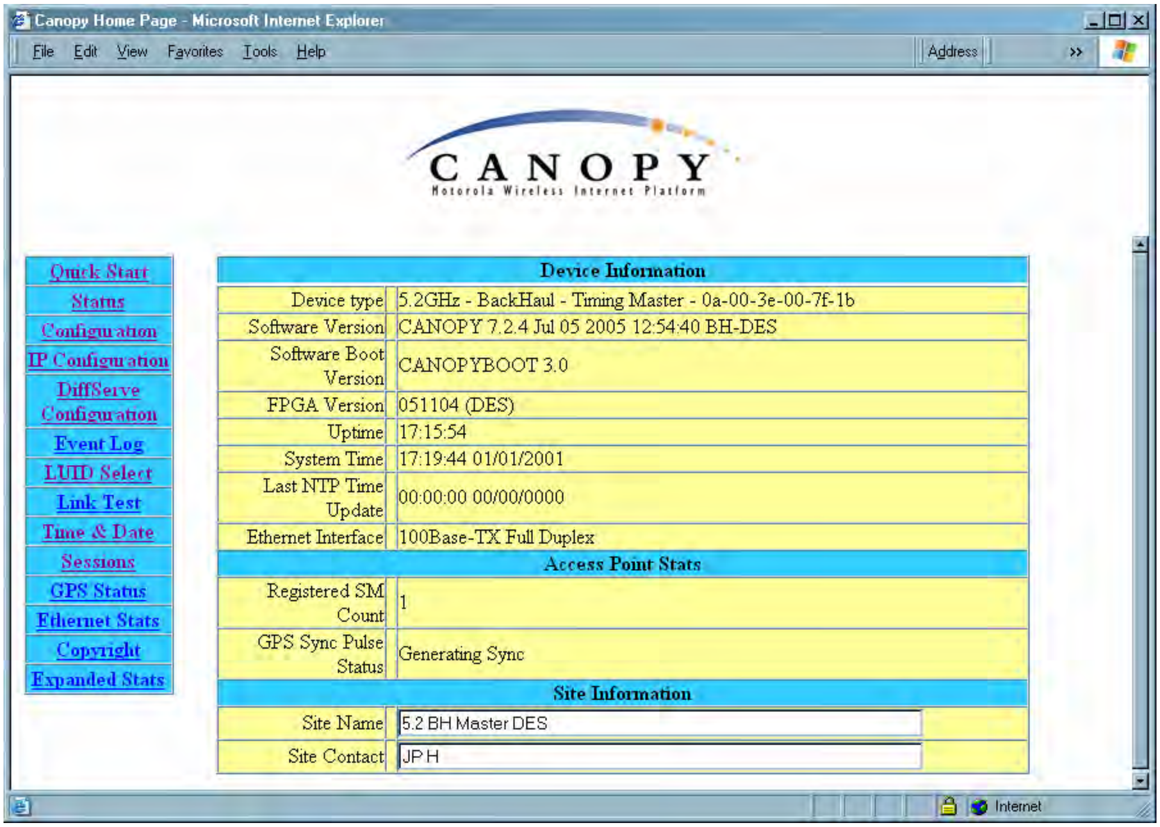
Procedure 18: Verifying and recording information from the BHS

1. Verify that the **Session Status** field of the BHS Status page indicates **REGISTERED**.
   NOTE: This indication confirms that the BHS is properly functional.
2. While your browser is set to this BHS Status page, note (or print) the values of the following fields:
   - **Device type**
   - **Software Version**
   - **Software Boot Version**
   - **FPGA Version**
3. Systematically ensure that you can retrieve this data when you prepare to deploy the BHS.
4. Return your browser to the Status page of the BHM.

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

16.4.7 Status Page of the BHM

An example of an BHM Status screen is displayed in Figure 71.



Device Information	
Device type	5.2GHz - BackHaul - Timing Master - 0a-00-3e-00-7f-1b
Software Version	CANOPY 7.2.4 Jul 05 2005 12:54:40 BH-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	051104 (DES)
Uptime	17:15:54
System Time	17:19:44 01/01/2001
Last NTP Time Update	00:00:00 00/00/0000
Ethernet Interface	100Base-TX Full Duplex
Access Point Stats	
Registered SM Count	1
GPS Sync Pulse Status	Generating Sync
Site Information	
Site Name	5.2 BH Master DES
Site Contact	JP H

Figure 71: Status screen, BHM

The Status page provides information on the operation of the module. This is the default web page for the module. The Status page provides the following fields.

Device Type

This field indicates the type of the Canopy module. Values include the frequency band of the module, the protocol that is used, and the MAC address of the module.

Software Version

This field indicates the software release that is operated on the module, the release date of the software, the time, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When you request technical support, provide the information from this field.

Software Boot Version

This field indicates the CANOPYBOOT version number.

FPGA Version

This field indicates the version of the field-programmable gate array (FPGA) on the module. When you request technical support, provide the information from this field.

Uptime

This field indicates how long the module has operated since power was applied.

System Time

This field provides the current time. If the BHM is connected to a CMM, then this field provides GMT (Greenwich Mean Time). The BHS that registers to the BHM inherits the system time.

Last NTP Time Update

If the Time & Date page of the module specifies that time should be received from an NTP server, then this field indicates when the time was last updated by a Network Time Protocol (NTP) server.

Ethernet Interface

This field indicates the configuration of the Ethernet interface on the module.

Registered SM Count

This field indicates how many BHSs are registered to the BHM.

GPS Sync Pulse Status

This field indicates the status of synchronization that the BHM is receiving as follows:

- **Generating sync** indicates that the module is set to *generate* the sync pulse.
- **Receiving Sync** indicates that the module is set to *receive* a sync pulse from an outside source and is receiving the pulse.
- **ERROR: No Sync Pulse** indicates that the module is set to *receive* a sync pulse from an outside source and is not receiving the pulse.

> *NOTE:*
> When this message is displayed, the BHM transmitter is turned off to avoid self-interference within the Canopy system.

Site Name

This field indicates the name of the physical module. You can assign or change this name on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

Site Contact

This field indicates contact information for the physical module. You can provide or change this information on the Configuration web page. This information is also set into the *sysName* SNMP MIB-II object and can be polled by an SNMP management server.

16.4.8 Concluding the Test of Point-to-Point Links

To conclude the test, perform the following steps.

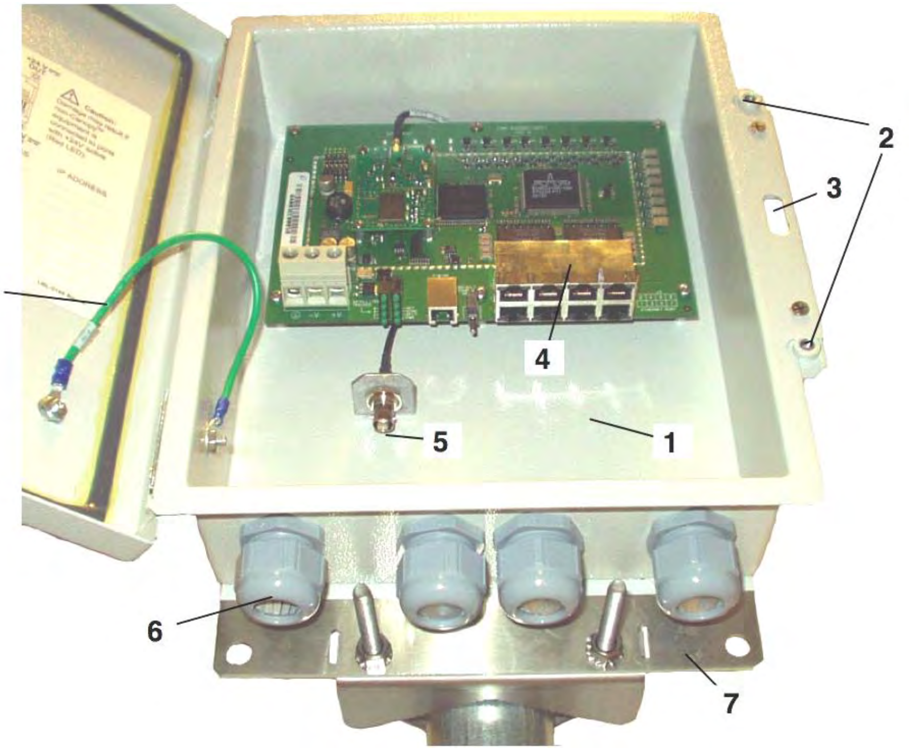
Procedure 19: Verifying and recording information from the BHM

1. Confirm that the **GPS Sync Pulse Status** field indicates **Generating Sync**.
   NOTE: This indication confirms that the BHM is properly functional.
2. While your browser is set to this BHM Status page, note (or print) the values of the following fields:
   ◦ **Device type**
   ◦ **Software Version**
   ◦ **Software Boot Version**
   ◦ **FPGA Version**
3. Systematically ensure that you can retrieve this data when you prepare to deploy the BHM.

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

16.4.9 Configuring a CMMmicro for Test

The layout of the CMMmicro is as shown in Figure 72.



1 Weatherized enclosure
2 Thumb-screw/slot-screwdriver door fasteners
3 Punch-out for padlock
4 Ethernet switch and power module
5 Female BNC connector
6 Water-tight bulkhead connectors
7 Flange for attachment (stainless steel so it grounds to tower or building) using U bolts (provided) or other hardware such as screws or lag bolts or attachment straps (not provided).
8 Ground strap to ground door to enclosure

Figure 72: CMMmicro layout

Perform the following procedure to configure the CMMmicro for testing.

IMPORTANT!
Start with the 24-V DC power converter *unconnected* to AC.

Procedure 20: Configuring a CMMmicro

1. Connect the converter lead whose insulation has a white stripe to +V on the CMMmicro terminal block.
2. Connect the converter lead whose insulation is solid black to -V on the CMMmicro terminal block.
3. Connect the power converter to an AC receptacle using the AC power cord.
4. Wait until the green LED labeled RDY flashes.
   NOTE: This should occur in less than one minute and will indicate that the CMMmicro has transitioned from booting to normal operation.
5. Observe which, if any, Ethernet ports are powered, as indicated by a lit red LED to the right of the Ethernet port.
   NOTE: The position of this +24-V OUT LED is shown in Figure 73 on Page 217.

CAUTION!
Never connect any devices other than Canopy APs and BHs to a powered port. Powered ports are indicated by a red LED to the right of the port. (See Item 7 in Figure 74 on Page 218.) A powered port has 24-V DC on Pins 7 and 8 and 24-V return on Pins 4 and 5. This can damage other networking equipment, such as a computer or a router.

6. On the 8-port Ethernet block of the CMMmicro, use either a straight-through or crossover Ethernet cable to connect any *unpowered* port (*without* the red LED lit) to a browser-equipped computer.
   NOTE: The CMMmicro auto-senses the cable type.
7. Verify these CMMmicro connections against Figure 75 on Page 219.
8. Configure the computer to use DHCP, with no proxy in your network settings.
9. Open the browser.
10. In the address bar, enter 169.254.1.1 (the default IP address of the CMMmicro).
    RESULT: The browser displays the CMMmicro Status page.

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

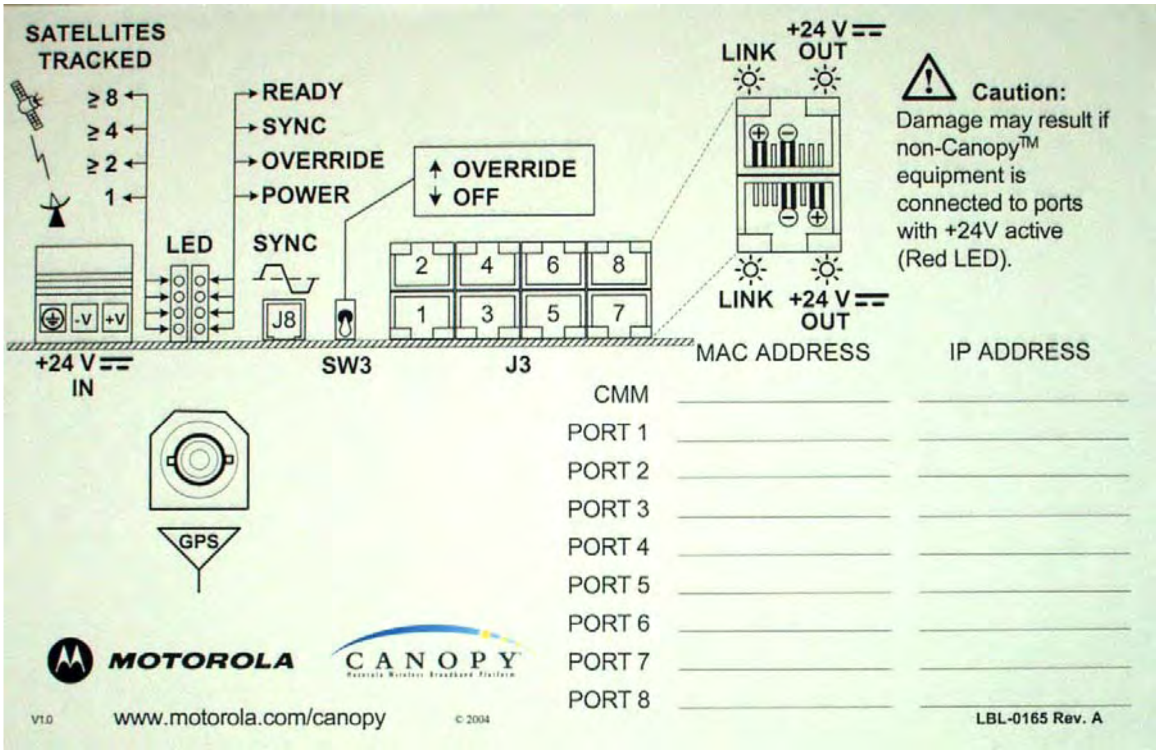
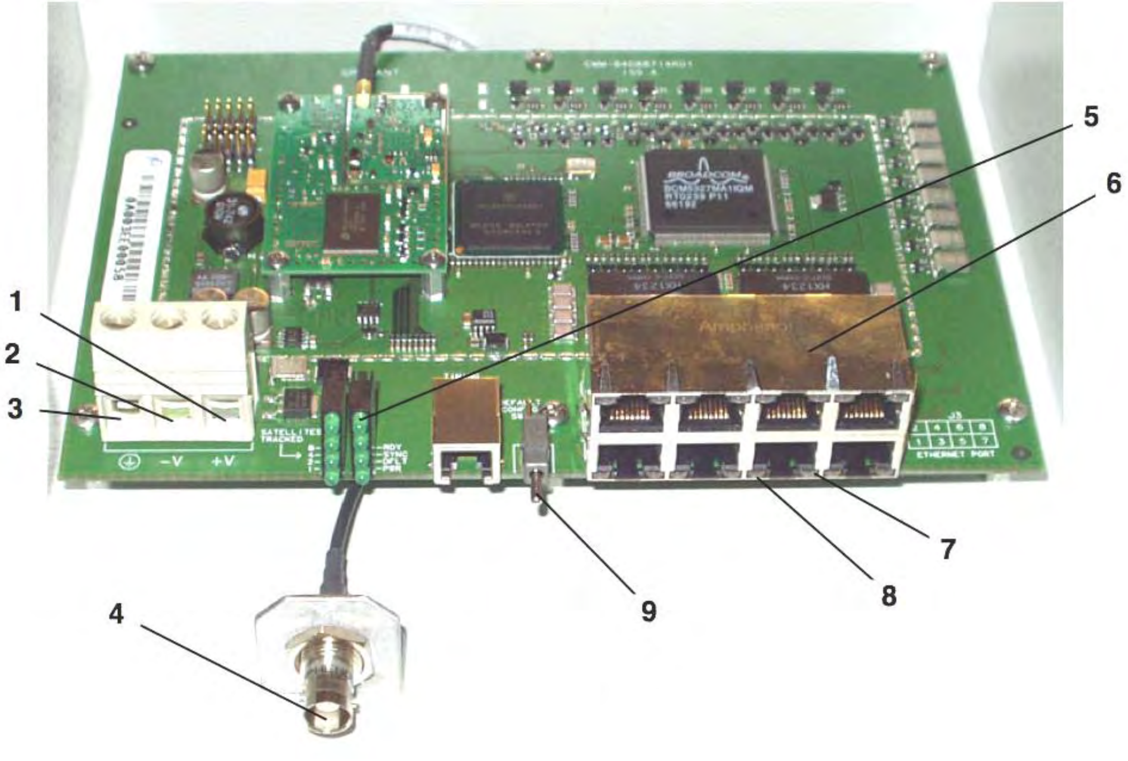


Figure 73: CMMmicro door label



1 24 V DC power connection on terminal block (+V).
2 24 V DC ground connection on terminal block (-V).
3 Ground bonding point for CMMmicro. Ground connection on terminal block, for grounding to Protective Earth (PE) ⏚.
4 Female BNC connector for connecting to coax cable from GPS antenna.
5 Status display of eight green LEDs. The left LEDs show the number of satellites visible to the CMMmicro (1, 2, ≥ 4, and ≥ 8), and the right LEDs show status:
   - RDY (Ready) – Flashing LED indicates CMMmicro software has booted and is operational. LED continues to flash during normal operation.
   - SYNC – Constant LED indicates CMMmicro is receiving signal from the GPS antenna and is able to derive sync.
   - DFLT (default) – Constant LED indicates CMMmicro has booted with Override Switch in down/override position, and therefore with default IP address (169.254.1.1) and no password.
   - PWR (power) – Constant LED indicates CMMmicro has power.

6 8-port Ethernet connection block with 2 LEDs per port indicating port status.
7 Constant red LED to the right of each port indicates the port is powered with 24 V DC (controlled by the CMMmicro Configuration page).
8 Constant green LED to the left of each port indicates the port is detecting Ethernet connectivity.
9 Override toggle switch, for overriding a lost or unknown IP address or password. Down is normal position, while rebooting in the up position brings the CMMmicro up with the default IP address (169.254.1.1) and no password required.

Figure 74: CMMmicro circuit board

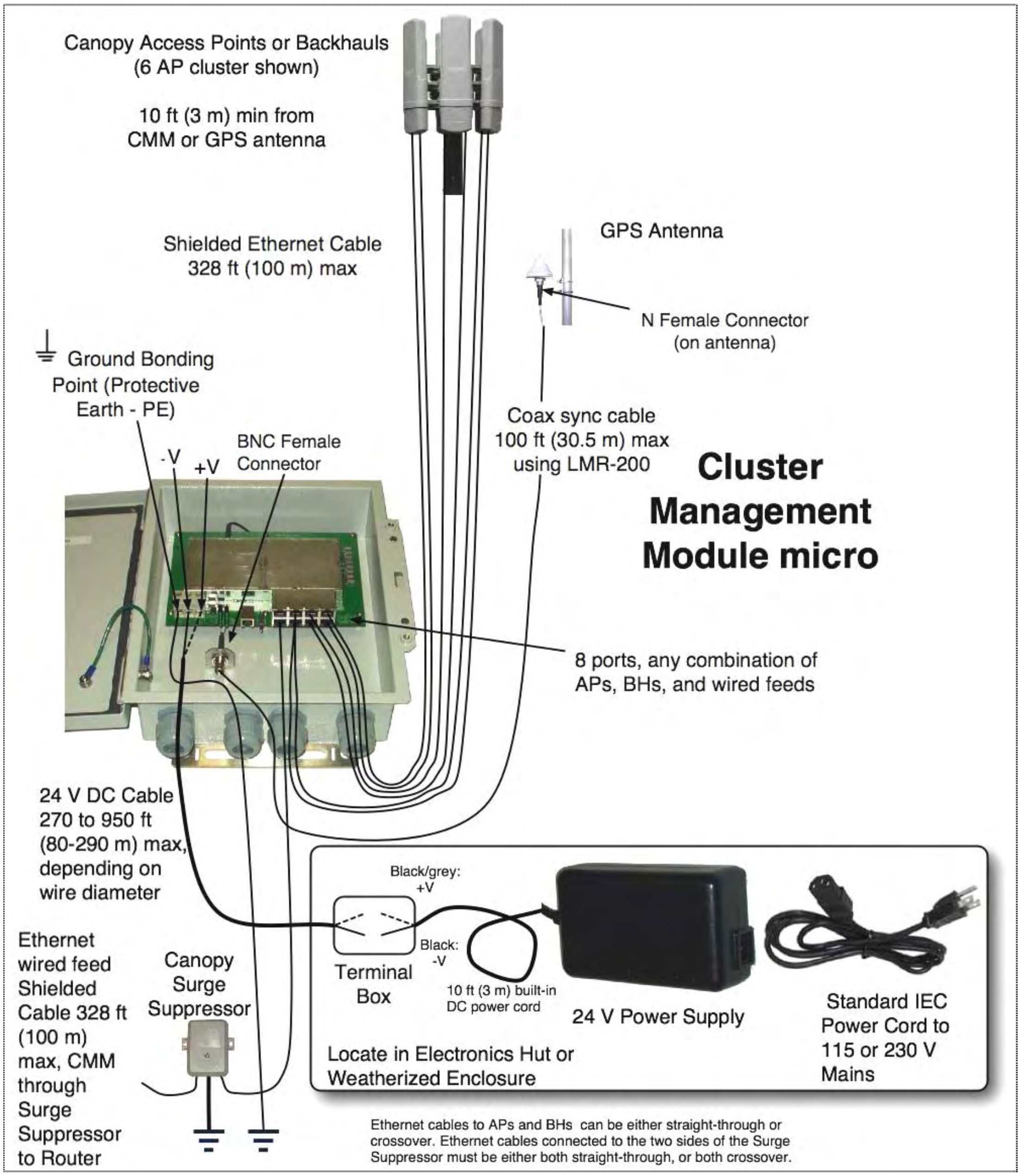
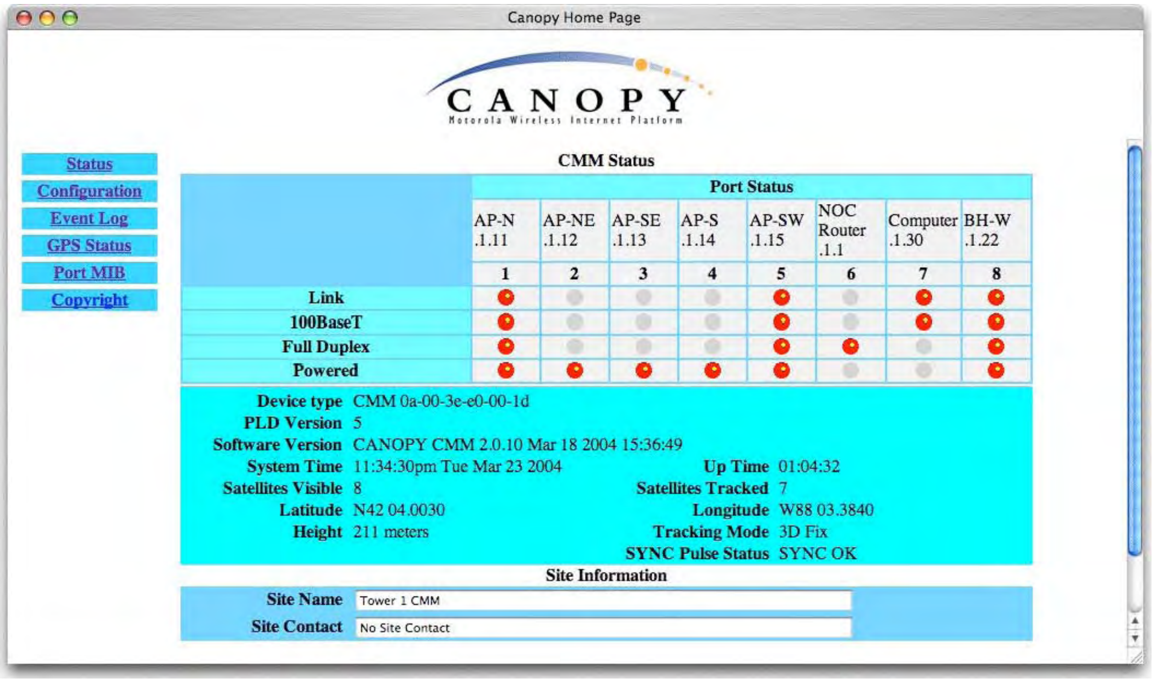


Figure 75: CMMmicro connections

16.4.10 Status Page of the CMMmicro

An example of a CMMmicro Status page is displayed in Figure 76.



CMM Status

	Port Status							
	AP-N .1.11	AP-NE .1.12	AP-SE .1.13	AP-S .1.14	AP-SW .1.15	NOC Router .1.1	Computer .1.30	BH-W .1.22
	1	2	3	4	5	6	7	8
Link	●	○	○	○	●	○	●	●
100BaseT	●	○	○	○	●	○	●	●
Full Duplex	●	○	○	○	●	●	○	●
Powered	●	●	●	●	●	○	○	●

Device type	CMM 0a-00-3e-e0-00-1d		
PLD Version	5		
Software Version	CANOPY CMM 2.0.10 Mar 18 2004 15:36:49		
System Time	11:34:30pm Tue Mar 23 2004	Up Time	01:04:32
Satellites Visible	8	Satellites Tracked	7
Latitude	N42 04.0030	Longitude	W88 03.3840
Height	211 meters	Tracking Mode	3D Fix
		SYNC Pulse Status	SYNC OK

Site Information

Site Name	Tower 1 CMM
Site Contact	No Site Contact

Figure 76: Status screen, CMMmicro

The Status page provides information on the operation of this CMMmicro. This is the default web page for the CMMmicro. The Status page provides the following fields.

Link

A red dot indicates that the port is active and detects Ethernet traffic. A grey dot indicates that the port is not active and no traffic is detected.

100BaseT

A red dot indicates that the port has auto-negotiated to a 100Base-T connection. A grey dot indicates that the port has auto-negotiated to a 10Base-T connection. (This convention is also used on many routers and network interface cards.) If the far end (an AP, a BH, a router) has been set to auto-negotiate, then the CMMmicro links at 100Base-T.

Full Duplex

A red dot indicates that the port has auto-negotiated to a Full Duplex connection. A grey dot indicates that the port has auto-negotiated to a Half Duplex connection. (This convention is also used on many routers and network interface cards.)

Powered

A red dot indicates that the port is powered with 24 V DC to provide power to an AP or BH. A grey dot indicates that the port is not powered. Port power is turned on and off in the **Port Power Control** parameter of the Configuration page. A CMMmicro comes from the factory with no Ethernet ports powered.

> *CAUTION!*
> Never connect any devices other than Canopy APs and BHs to a powered port. Powered ports are indicated by a red LED to the right of the port. (See Item 7 in Figure 74 on Page 218.) A powered port has 24-V DC on Pins 7 and 8 and 24-V return on Pins 4 and 5. This can damage other networking equipment, such as a computer or a router.

Device Type

This field displays the MAC address of the CMMmicro.

PLD Version

This field displays the version of the PLD (Programmable Logic Device) that is installed in the module. Before you request technical support, note this information.

Software Version

This field displays the version of the software that is installed in the module. Before you request technical support, note this information.

System Time

This field displays the current time. If the CMMmicro receives the signal from a GPS antenna, then this field expresses the time in Greenwich Mean Time (GMT).

Satellites Visible

This field displays how many satellites the GPS antenna sees.

> *NOTE:*
> This differs from the **Satellites Tracked** field (described below).

Latitude

If the CMMmicro receives the signal from a GPS antenna, then this field displays the latitude of the site.

Height

If the CMMmicro receives the signal from a GPS antenna, then this field displays the elevation (above sea level) of the GPS antenna.

Uptime

This field displays how much time has elapsed since the last boot of the CMMmicro.

Satellites Tracked

This field displays how many satellites the CMMmicro is tracking.

Longitude

If the CMMmicro receives the signal from a GPS antenna, then this field displays the longitude of the site.

Tracking Mode

If the CMMmicro receives the signal from a GPS antenna, then this field describes how the CMMmicro is tracking satellites.

Sync Pulse Status

This field indicates the status of sync pulse that the CMMmicro is currently able to provide to connected modules.

Site Name

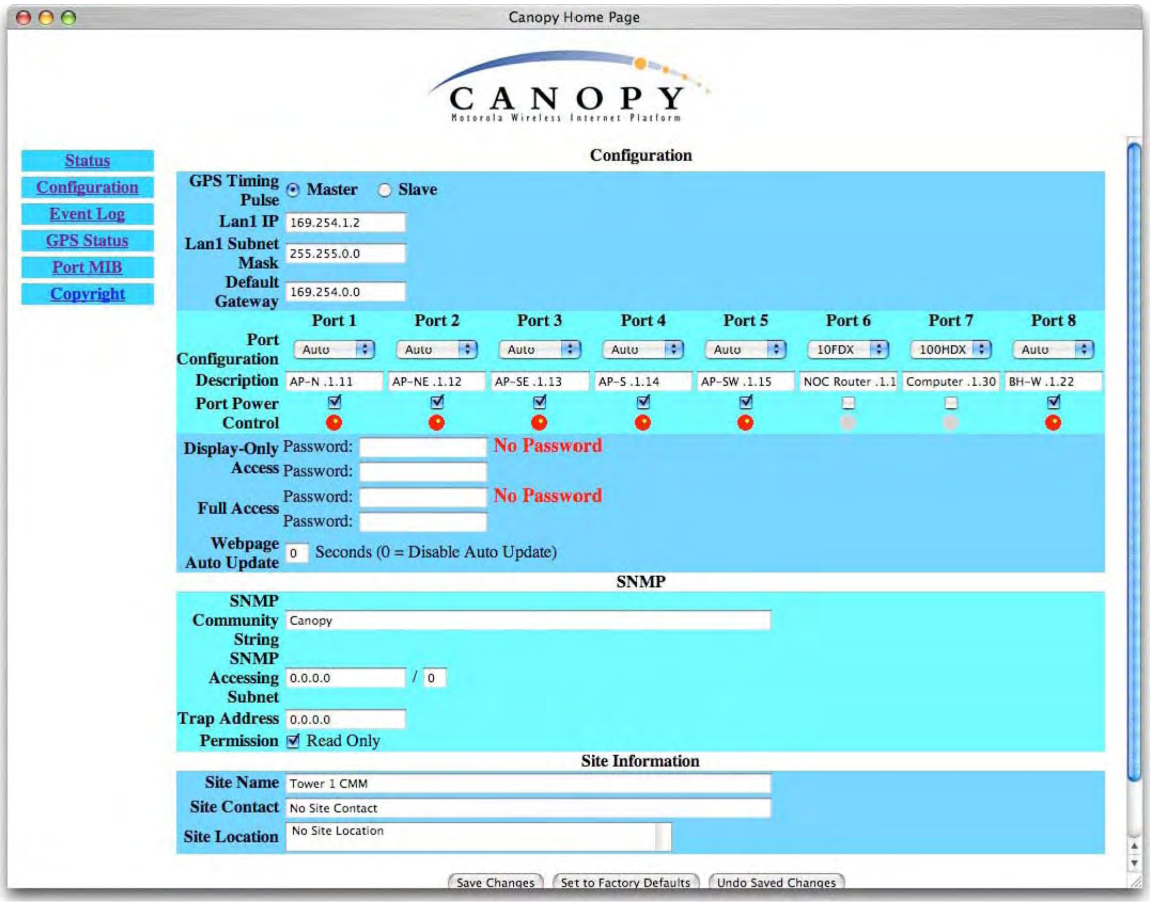
This field displays administrative information that has been entered on the Configuration page of the CMMmicro.

Site Contact

This field displays administrative information that has been entered on the Configuration page of the CMMmicro.

16.4.11 Configuration Page of the CMMmicro

An example of the CMMmicro Configuration page is displayed in Figure 77.



Configuration

GPS Timing Pulse: ● Master ○ Slave
Lan1 IP: 169.254.1.2
Lan1 Subnet Mask: 255.255.0.0
Default Gateway: 169.254.0.0

	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Port Configuration	Auto	Auto	Auto	Auto	Auto	10FDX	100HDX	Auto
Description	AP-N .1.11	AP-NE .1.12	AP-SE .1.13	AP-S .1.14	AP-SW .1.15	NOC Router .1.1	Computer .1.30	BH-W .1.22
Port Power Control	☑ ●	☑ ●	☑ ●	☑ ●	☑ ●	□	□	☑ ●

Display-Only Access Password: No Password
Password:
Full Access Password: No Password
Password:
Webpage Auto Update: 0 Seconds (0 = Disable Auto Update)

SNMP

SNMP Community String: Canopy
SNMP Accessing Subnet: 0.0.0.0 / 0
Trap Address: 0.0.0.0
Permission: ☑ Read Only

Site Information

Site Name: Tower 1 CMM
Site Contact: No Site Contact
Site Location: No Site Location

Figure 77: Configuration screen, CMMmicro

The Configuration web page contains all of the configurable parameters that define how the CMMmicro operates. The first line of information on the Configuration screen echoes the **Device Type** from the Status web page.

IMPORTANT!
Changes that are made to the following parameters become effective when you click the **Save Changes** button:

- **Port Configuration**
- **Description**
- **Power Port Control**
- **Webpage Auto Update**

When these parameters listed above have become effective, if you click the **Undo Saved Changes** button, the previous values *are not* restored.

Changes that are made to all other parameters become effective only after all of the following have occurred:

- you have clicked the **Save Changes** button.
- you click the **Reboot** button.
- the CMMmicro reboots.

Procedure 21: Setting CMMmicro parameters for test

To continue the test setup, configure

1. the **GPS Timing Pulse** parameter.
2. the **Lan1 IP** parameter.
3. the **Lan1 Subnet Mask** parameter.
4. the **Default Gateway** parameter.
5. the **Port Power Control** parameter.

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

GPS Timing Pulse

Select **Master**. (**Slave** is for future use.)

> *IMPORTANT!*
> If the GPS Timing Pulse is set to **Slave**, the CMMmicro GPS receiver is disabled.

Lan1 IP

Enter the IP address to be associated with the Ethernet connection on this CMMmicro. The default address is 169.254.1.1. If you set and then forget this parameter, then you must both

1. physically access the module.
2. use the CMMmicro override toggle switch to electronically access the module configuration parameters at 169.254.1.1. See Overriding Forgotten IP Addresses or Passwords on CMMmicro on Page 366.

> *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.

LAN Subnet Mask

Enter the appropriate subnet mask for the module to communicate on the network. The default value for this parameter is 255.255.0.0.

Default Gateway

Enter the appropriate gateway for the module to communicate on the network. The default for this parameter is 169.254.0.0.

Port Configuration

If you wish to force a port to a speed or duplex state, or to return the module to auto-negotiating speed and duplex state, change the selection for the port. The range of selections are defined in Table 49.

Table 49: Port Configuration selections for CMMmicro

Selection	Result
Auto	The port attempts to auto-negotiate speed and duplex state. (This is the default and recommended setting.)
100FDX	The port is forced to 100 Mbps and full duplex.
100HDX	The port is forced to 100 Mbps and half duplex.
10FDX	The port is forced to 10 Mbps and full duplex.
10HDX	The port is forced to 10 Mbps and half duplex.

If you change this value for a port and then click **Save Changes**, then the change becomes effective immediately and the previous value is lost.

Description

You can enter text in this parameter (for example, text that helps you to associate the port number with the connected device.) If you change this value for a port and then click **Save Changes**, then the change becomes effective immediately and the previous value is lost.

Power Port Control

Ensure that power is off for every port that connects to a router, computer, or other network equipment. Turn on 24-V DC power for ports that connect to Canopy APs or BHs.

⚠ *CAUTION!*

Never connect any devices other than Canopy APs and BHs to a powered port. Powered ports are indicated by a red LED to the right of the port. (See Item 7 in Figure 74 on Page 218.) A powered port has 24-V DC on Pins 7 and 8 and 24-V return on Pins 4 and 5. This can damage other networking equipment, such as a computer or a router.

If you change this value for a port and then click **Save Changes**, then the change becomes effective immediately and the previous value is lost.

Display-Only Access

See Configuring Display-Only and Full Access Passwords on Page 362.

To set this password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Display-Only Access** password, then you must both

1. physically access the module.
2. use the CMMmicro override toggle switch to electronically access the module configuration parameters at 169.254.1.1. See Overriding Forgotten IP Addresses or Passwords on CMMmicro on Page 366.

Full Access

If you set the **Full Access** password, this password will allow

- telnet and FTP access to the module.
- *viewing or changing* the parameters of the module.

To set this password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Full Access** password, then you must both

1. physically access the module.
2. use the CMMmicro override toggle switch to electronically access the module configuration parameters at 169.254.1.1. See Overriding Forgotten IP Addresses or Passwords on CMMmicro on Page 366.

NOTE:
You can unset either password (revert the access to no password required). To do so, type a space into the field and reboot the module. You must enter any password twice to allow the system to verify that the password is not mistyped. After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field.

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

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.

If you change this value and then click **Save Changes**, then the change becomes effective immediately and the previous value is lost.

SNMP Community String

Specify a control string that allows an Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string. The default string is **Canopy**.

The **SNMP Community String** value is clear text and is readable by a packet monitor. Additional security derives from the configuration of the **SNMP Accessing Subnet**, **Trap Address**, and **Permission** parameters.

SNMP Accessing Subnet

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

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

The default treatment is to allow all networks access.

Trap Address

Specify the IP address (xxx.xxx.xxx.xxx) of a Network Management Station (NMS) to which trap information should be sent. Trap information informs the monitoring system that something has occurred. For example, trap information is sent

- after a reboot of the module.
- when an NMS attempts to access agent information but either
  - supplied an inappropriate community string or SNMP version number.
  - is associated with a subnet to which access is disallowed.

Permission

Select **Read Only** if you wish to disallow any parameter changes by the 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 CMMmicro Configuration page also provides the following buttons.

Save Changes, Undo Saved Changes, Set to Defaults, Reboot

The effects of clicking these buttons are defined in Table 50.

Table 50: When changes become effective in CMMmicro

For these parameters…	clicking this button…	has this effect.
Port Configuration **Description** **Power Port Control** **Webpage Auto Update**	**Save Changes**	Any change becomes effective immediately and any previous setting is lost.
	Undo Saved Changes	No change is undone, and no previous setting is restored.
	Set to Defaults	The default setting is not restored.
	Reboot	No change that is not already effective becomes effective.
Any other parameter	**Save Changes**	Any change is recorded into flash memory but does not become effective immediately, and any previous setting can be restored.
	Undo Saved Changes	Any change recorded into flash memory is undone, and the previous setting is restored.
	Set to Defaults	The default setting is restored.
	Reboot	Any change recorded in flash memory (and not later undone) becomes effective.

In addition, when you click **Reboot**, the following events occur and are logged:

- The CMMmicro reboots.
- Any AP or BH that receives power from the CMMmicro loses power and thus also reboots.
- Any AP or BH that does not receive power but receives sync from the CMMmicro loses and then regains sync.

16.4.12 Configuring Modules for Connection to CMMmicro

After configuring the CMMmicro, configure the APs and BHs as follows. In each AP or BH that connects to a CMMmicro, you must set the **Sync Input** parameter of the Configuration page of that module to **Sync to Received Signal (Power Port)**.
See

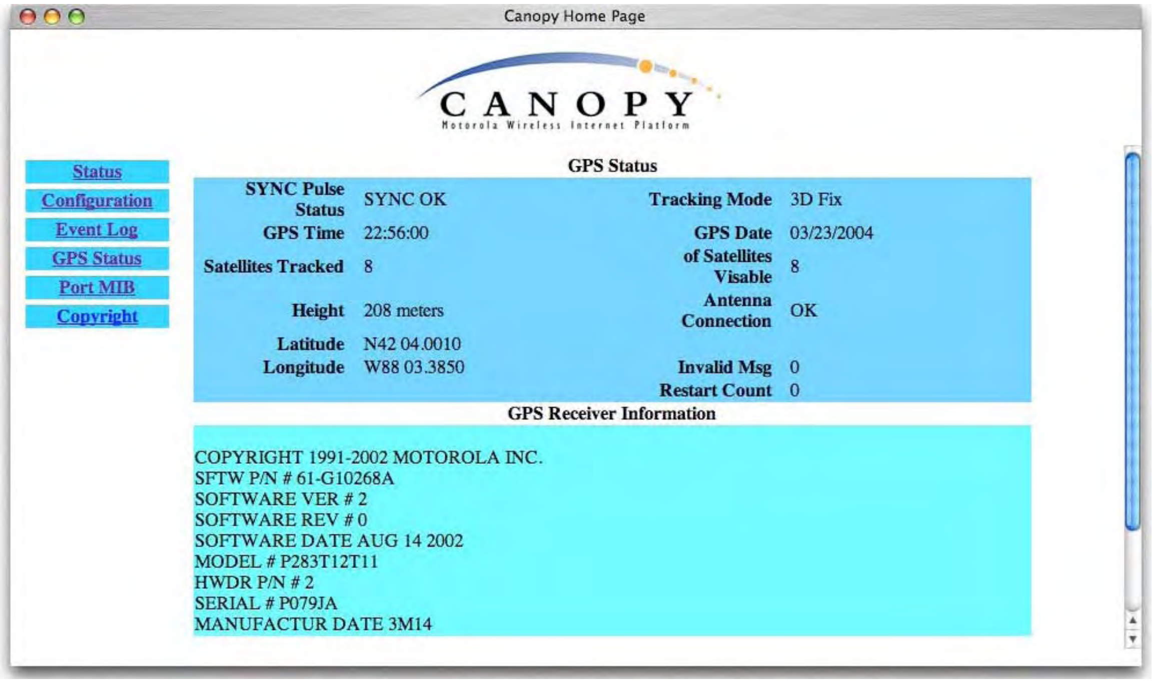
- Sync Input on Page 235.
- Sync Input on Page 294.

16.4.13 Event Log Page of the CMMmicro

This page may contain information that can be useful under the guidance of Canopy technical support. For this reason, the operator should not clear the contents of this page before contacting technical support.

16.4.14 GPS Status Page of the CMMmicro

An example of the CMMmicro GPS Status page is displayed in Figure 78.



GPS Status

SYNC Pulse Status	SYNC OK	Tracking Mode	3D Fix
GPS Time	22:56:00	GPS Date	03/23/2004
Satellites Tracked	8	of Satellites Visable	8
Height	208 meters	Antenna Connection	OK
Latitude	N42 04.0010		
Longitude	W88 03.3850	Invalid Msg	0
		Restart Count	0

GPS Receiver Information

```
COPYRIGHT 1991-2002 MOTOROLA INC.
SFTW P/N # 61-G10268A
SOFTWARE VER # 2
SOFTWARE REV # 0
SOFTWARE DATE AUG 14 2002
MODEL # P283T12T11
HWDR P/N # 2
SERIAL # P079JA
MANUFACTUR DATE 3M14
```

Figure 78: GPS Status screen, CMMmicro

The GPS Status page provides information from the GPS antenna and information about the GPS receiver in the CMMmicro.

Antenna Connection

This field displays the status of the signal from the antenna as follows:

- **OK** indicates that the GPS interface board is detecting an incoming signal on the coaxial cable from the GPS antenna.
- **No Antenna** indicates the GPS interface board is not detecting any incoming signal.

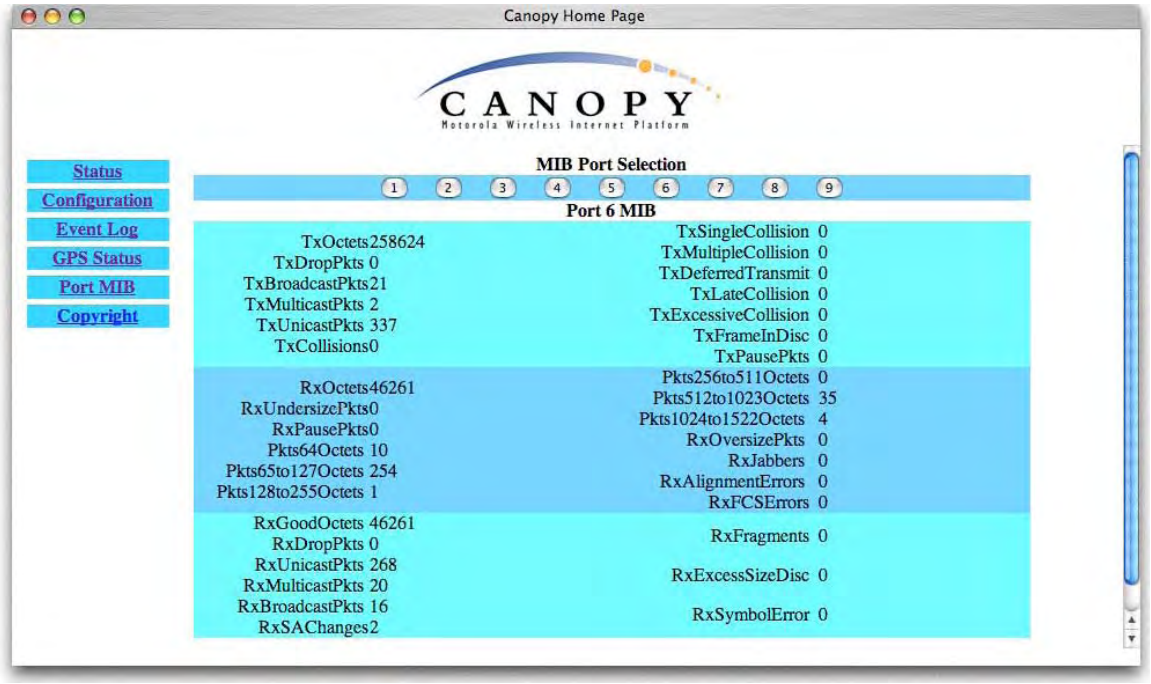
The other GPS Status fields are described under Satellites Visible on Page 221.

GPS Receiver Information

This field displays information about the GPS interface board.

16.4.15 Port MIB Page of the CMMmicro

An example of the Port MIB (Ethernet statistics) web page is displayed in Figure 79.



Port 6 MIB

```
        TxOctets258624                 TxSingleCollision  0
      TxDropPkts 0                   TxMultipleCollision  0
   TxBroadcastPkts21                 TxDeferredTransmit  0
   TxMulticastPkts 2                     TxLateCollision  0
    TxUnicastPkts 337              TxExcessiveCollision  0
      TxCollisions0                      TxFrameInDisc  0
                                           TxPausePkts  0
        RxOctets46261                Pkts256to511Octets  0
   RxUndersizePkts0                 Pkts512to1023Octets  35
      RxPausePkts0                Pkts1024to1522Octets  4
     Pkts64Octets 10                    RxOversizePkts  0
  Pkts65to127Octets 254                     RxJabbers  0
 Pkts128to255Octets 1              RxAlignmentErrors  0
                                          RxFCSErrors  0
    RxGoodOctets 46261
      RxDropPkts 0                         RxFragments  0
    RxUnicastPkts 268
   RxMulticastPkts 20                  RxExcessSizeDisc  0
   RxBroadcastPkts 16
      RxSAChanges2                       RxSymbolError  0
```

Figure 79: Port MIB screen, CMMmicro

The Port MIB page displays Ethernet statistics and traffic information for the ports on the managed switch. To display the port statistics, click on a port number.

Ports 1 through 8 are the regular ports, connected to APs, BHs, or other network elements. Port 9 is the connection between the managed switch and the CMMmicro processor. Thus, updates to interface pages, SNMP activities, and FTP and telnet sessions create traffic on Port 9.

These Ethernet statistics can also be retrieved from the CMMmicro by a Network Management Station using SNMP. During advanced troubleshooting, this information can be useful as you see the activity on a single port or as you compare activity between ports of the CMMmicro.

17 PREPARING COMPONENTS FOR DEPLOYMENT

Your test of the modules not only verified that they are functional, but also yielded data that you have stored about them. Most efficiently preparing modules for deployment involves

- retrieving that data.
- systematically collecting the data into a single repository, while keeping a strong (quick) association between the data and the module.
- immediately merging module access data into this previously stored data.

17.1 CORRELATING COMPONENT-SPECIFIC INFORMATION

You can use the data that you noted or printed from the Status pages of the modules to

- store modules for future deployment.
- know, at a glance, how well-stocked you are for upcoming network expansions.
- efficiently draw modules from stock for deployment.
- plan any software updates that you
  - wish to perform to acquire features.
  - need to perform to have the feature set be consistent among all modules in a network expansion.

You can make these tasks even easier by collecting this data into a sortable database.

17.2 ENSURING CONTINUING ACCESS TO THE MODULES

As you proceed through the steps under Configuring for the Destination on Page 234, you will set values for parameters that specify the sync source, data handling characteristics, security measures, management authorities, and other variables for the modules. While setting these, you will also tighten access to the module, specifically in

- the **Color Code** parameter of Configuration page
- the **Display-Only Access** and **Full Access** password parameters of the Configuration page.
- the addressing parameters of the IP Configuration page.

Before you set these, consider whether and how you may want to set these by a self-devised scheme. A password scheme can help you when you have forgotten or misfiled a password. An IP addressing scheme may be essential to the operation of your network and to future expansions of your network.

As you set these, note the color code and the passwords, and note or print the parameters you set on the IP Configuration page. Immediately associate them with the following previously stored data about the modules:

- device type, which includes the frequency band and MAC address
- software version, which includes the encryption type
- software boot version
- FPGA version, which also includes the encryption type

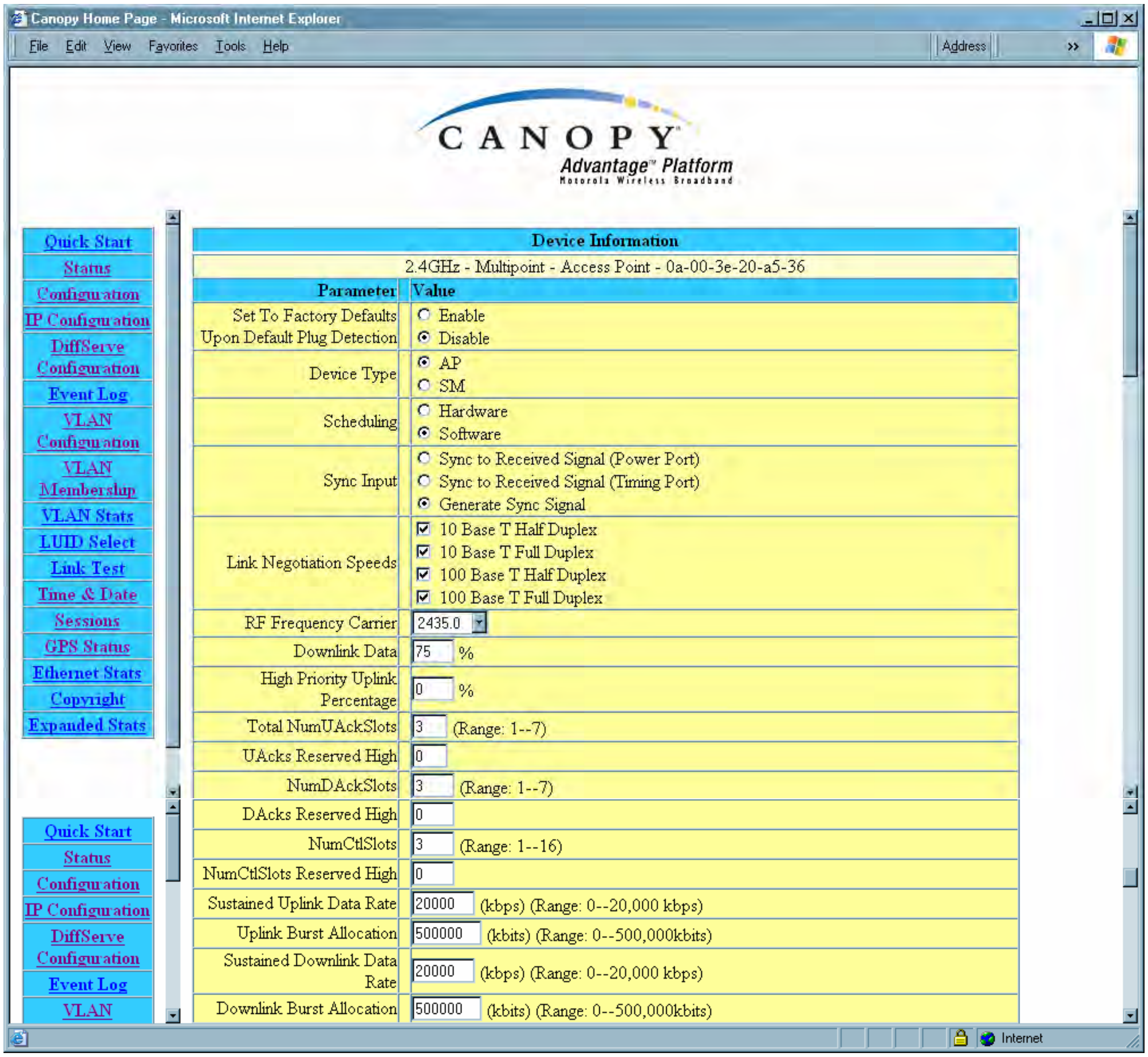
When you have the color code, passwords, and IP addressing readily available in the future, you will be able to access the module pages without physically accessing the module.

18 CONFIGURING FOR THE DESTINATION

18.1 CONFIGURING AN AP FOR THE DESTINATION

18.1.1 Configuration Page of the AP

An example of an AP Configuration screen is displayed in Figure 80.



Device Information

2.4GHz - Multipoint - Access Point - 0a-00-3e-20-a5-36

Parameter	Value
Set To Factory Defaults Upon Default Plug Detection	○ Enable ● Disable
Device Type	● AP ○ SM
Scheduling	○ Hardware ● Software
Sync Input	○ Sync to Received Signal (Power Port) ○ Sync to Received Signal (Timing Port) ● Generate Sync Signal
Link Negotiation Speeds	☑ 10 Base T Half Duplex ☑ 10 Base T Full Duplex ☑ 100 Base T Half Duplex ☑ 100 Base T Full Duplex
RF Frequency Carrier	2435.0
Downlink Data	75 %
High Priority Uplink Percentage	0 %
Total NumUAckSlots	3 (Range: 1--7)
UAcks Reserved High	0
NumDAckSlots	3 (Range: 1--7)
DAcks Reserved High	0
NumCtlSlots	3 (Range: 1--16)
NumCtlSlots Reserved High	0
Sustained Uplink Data Rate	20000 (kbps) (Range: 0--20,000 kbps)
Uplink Burst Allocation	500000 (kbits) (Range: 0--500,000kbits)
Sustained Downlink Data Rate	20000 (kbps) (Range: 0--20,000 kbps)
Downlink Burst Allocation	500000 (kbits) (Range: 0--500,000kbits)

Figure 80: Configuration screen (top), Advantage AP

The Configuration web page contains configurable parameters that define how the module operates. You may set the Configuration page parameters as follows.

Set to Factory Defaults Upon Default Plug Detection

This parameter toggles what occurs when an override plug is detected during a reboot.

- If **Enable** is checked, then all parameters are returned to their factory default values. This parameter is set to **Disable**. You may prefer this setting where a person who has an override plug and access to the module *should not* be able to view what is the current configuration of the module.
- If **Disable** is checked, then the override plug resets the LAN1 IP address to 169.254.1.1 and allows you to access the module through the default configuration *without changing* the configuration. You can then reset the password of the module and view and reset other values. You may prefer this setting where quick recovery from a memory lapse (forgotten IP address or password) is more important than protection against rogue physical access.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 364.

Device Type

In Canopy System Release 6.1 and later, you can temporarily transform an AP into an SM and thereby use the spectrum analyzer functionality. See Using the AP as a Spectrum Analyzer on Page 353. Otherwise, the selection for this parameter is **AP**.

Scheduling

This parameter is present in only Advantage APs. See Software and Hardware Scheduling on Page 91.

6.0 Compatibility

This parameter is present in only 900-MHz APs that have **Scheduling** set to **Hardware**. Typically, you should leave **6.0 Compatibility** set to the default, **Enable**. However, where either the **Max Range** parameter is set to greater than 40 miles or the **Downlink Data** parameter is set to greater than 80%, you should set **6.0 Compatibility** to **Disable**. These recommendations are to minimize framing errors in the communications between the AP and the SMs in its sector.

At the shorter distances and/or smaller downlink percentages, **Enable** avoids framing errors between an AP on Release 6.1 and an SM on Release 6.0. At the longer distances and/or higher downlink percentages, **Disable** avoids framing errors between an AP and an SM that are both on Release 6.1.

APs in other frequency band ranges and APs/SMs in 900-MHz that have **Scheduling** set to **Software** do not experience the framing errors and, consequently, do not provide this parameter.

Sync Input

Specify the type of synchronization for this AP to use:

- Select **Sync to Received Signal (Power Port)** to set this AP to receive sync from a connected CMMmicro.
- Select **Sync to Received Signal (Timing Port)** to set this AP to receive sync from a connected CMM2, an AP in the cluster, an SM, or a BH timing slave.
- Select **Generate Sync Signal** where the AP does not receive sync, and no other AP or BHM is active within the link range.

Link Negotiation 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.

RF Frequency Carrier

Specify the frequency for the module to transmit. The default for this parameter is **None**. (The selection labeled **Factory** requires a special software key file for implementation.) For a list of channels in the band, see Considering Frequency Band Alternatives on Page 137.

Downlink Data

Specify the percentage of the aggregate throughput for the downlink (frames transmitted from the AP to the subscriber). For example, if the aggregate (uplink and downlink total) throughput on the AP is 6 Mb, then 75% specified for this parameter allocates 4.5 Mb for the downlink and 1.5 Mb for the uplink. The default for this parameter is 75%.

> *CAUTION!*
> You must set this parameter exactly the same for all APs in a cluster.

High Priority Uplink Percentage

This parameter is present only when **Scheduling** is set to **Software**. Specify the percentage of the uplink bandwidth to dedicate to low-latency traffic. When set, this percentage of RF link bandwidth is permanently allocated to low-latency traffic, regardless of the amount of low-latency traffic that is present. No corresponding downlink parameter is settable. Scheduling algorithms in the AP allocate the corresponding downlink percentage.

> *IMPORTANT!*
> Carefully consider parameter settings for the high-priority channel. The bandwidth that you allocate to this channel decreases bandwidth on the regular channel, regardless of whether high-priority traffic exists. See High-priority Bandwidth on Page 89.

Wherever you wish to implement the high-priority channel, you must set *all* high-priority parameters (**High Priority Uplink Percentage**, **UAcks Reserved High**, **DAcks Reserved High**, and **NumCtlSlots Reserved High**). If any are not set, then the high-priority channel is not active.

Slot Specifications

The recommended settings for slot specification parameters are provided in Table 51.

Table 51: Slot settings for all APs in cluster with Software Scheduler, based on traffic type

Parameter	Recommended Setting[1]	
	Without High-priority Channel Enabled	*With* High-priority Channel Enabled[2]
Total NumUAckSlots	3	6
UAcks Reserved High	0	3
NumDAckSlots	3	6
DAcks Reserved High	0	3
NumCtlSlots	3[3]	6[4]
NumCtlSlots Reserved High	0	3

NOTES:

1. To avoid self-interference, for each of these six parameters, the value *must be* identical in all APs in a cluster.
2. Presumes that equipment is configured to set the low-latency ToS bit.
3. Where congestion occurs from the control overhead in predominantly small packets, setting this parameter to 4 may be better.
4. Where congestion occurs from the control overhead in predominantly small packets, setting this parameter to 7 may be better.

Total NumUAckSlots

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots to use to acknowledge data that an SM receives. The default value of this parameter is 3. See Slot Specifications above.

UAcks Reserved High

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots to use to acknowledge high-priority data that an SM receives. The default value of this parameter is 0. See Slot Specifications above.

NumDAckSlots

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots are used to acknowledge data that the AP receives. The default value of this parameter is 3. See Slot Specifications above.

DAcks Reserved High

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots to use to acknowledge high-priority data that the AP receives. The default value of this parameter is 0. See Slot Specifications above.

NumCtlSlots

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots to use to send control messages to an AP. The default value of this parameter is 3. See Slot Specifications above. See also Control Slots on Page 84.

NumCtlSlots Reserved High

This parameter is present only when **Scheduling** is set to **Software**. Specify how many slots to use to send control messages to an AP. You should set this parameter only when you implement the high-priority channel. The default value of this parameter is 0. See Slot Specifications above.

Control Slots

This parameter is present only when **Scheduling** is set to **Hardware**. With Hardware Scheduler, the recommended number of control slots is as stated in Table 52.

Table 52: Control slot settings for all APs in cluster with Hardware Scheduler

Number of SMs that Register to the AP	Number of Control Slots Recommended
1 to 10	0
11 to 50	1
51 to 150	2
151 to 200	3

With hardware scheduling, slots reserved for control are used for only SM service requests. (The hardware scheduler does not assign data to the reserved slots.) For data, the hardware scheduler uses unreserved slots first, then any unused slots are available with any reserved slots to the SMs for service requests.

If too few reserved control slots are specified, then latency increases in high traffic periods. If too many are specified, then the maximum capacity is unnecessarily reduced.

Sustained Uplink Data Rate

Specify the rate that each SM registered to this AP is replenished with credits for transmission. This default imposes no restriction on the uplink. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Uplink Burst Allocation

Specify the maximum amount of data to allow each SM to transmit before being recharged at the **Sustained Uplink Data Rate** with credits to transmit more. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Sustained Downlink Data Rate

Specify the rate at which the AP should be replenished with credits (tokens) for transmission to each of the SMs in its sector. This default imposes no restriction on the uplink. See

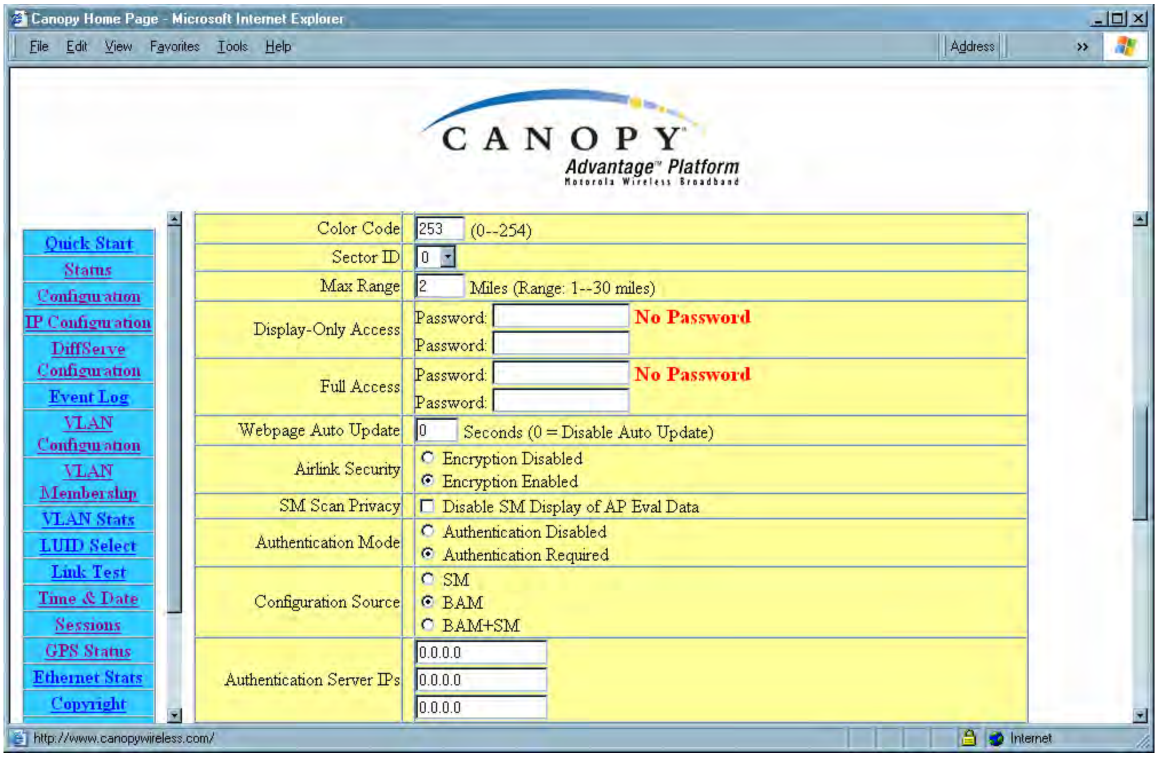
- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Downlink Burst Allocation

Specify the maximum amount of data to allow the AP to transmit to any registered SM before the AP is replenished with transmission credits at the **Sustained Downlink Data Rate**. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

As shown in Figure 81, the Configuration page continues.



Color Code	253 (0--254)
Sector ID	0
Max Range	2 Miles (Range: 1--30 miles)
Display-Only Access	Password: **No Password** Password:
Full Access	Password: **No Password** Password:
Webpage Auto Update	0 Seconds (0 = Disable Auto Update)
Airlink Security	○ Encryption Disabled ● Encryption Enabled
SM Scan Privacy	□ Disable SM Display of AP Eval Data
Authentication Mode	○ Authentication Disabled ● Authentication Required
Configuration Source	○ SM ● BAM ○ BAM+SM
Authentication Server IPs	0.0.0.0 0.0.0.0 0.0.0.0

Figure 81: Configuration screen (middle), Advantage AP

Color Code

Specify a value from 0 to 254. For registration to occur, the color code of the SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.

Color code allows you to force an SM to register to only a specific AP, even where the SM can communicate with multiple APs. On all Canopy 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

Specify a number in the range 1 to 6 to associate with this AP. The Sector ID setting does not affect the operation of the AP. On the AP Eval Data web page of the SM, the **Sector ID** field identifies the AP that the SM sees. The following steps may be useful:

- Assign a unique Sector ID to each sector in an AP cluster.
- Repeat the assignment pattern throughout the entire Canopy system.

Max Range

Enter a number of miles (or kilometers divided by 1.61, then rounded to an integer) for the furthest distance from which an SM is allowed to register to this AP. Do not set the distance to any greater number of miles. A greater distance

- does not increase the power of transmission from the AP.
- can reduce aggregate throughput. See Table 30 on Page 105.

Regardless of this distance, the SM must meet the minimum requirements for an acceptable link. If the AP is in cluster, then you *must* set this parameter on all other APs in the cluster exactly the same, except as described in the NOTE admonition below. The default value of this parameter is 2 miles (3.2 km).

In Release 4.2 and later for 2.4-GHz non-ETSI links, and in Release 7.1.4 and later for APs in the other non 900-MHz frequency band ranges, although the typical maximum range where an SM is deployed with a reflector is unchanged at 15 miles (24 km), you can set this parameter to as far as 30 miles (48 km). Without increasing the power or sensitivity of the AP or SM, the greater value allows you to attempt greater distance where the RF environment and Fresnel zone[6] are especially clear.

[6] See Noting Possible Obstructions in the Fresnel Zone on Page 133.

A value of 15 for this parameter decreases the number of available data slots by 1. With a higher value, the number is further decreased as the AP compensates for the expected additional air delay.

> *NOTE:*
> In a cluster where at least one AP has **Scheduling** set to **Software** and at least one to **Hardware**, you must use the Frame Calculator web page to coordinate the transmit and receive times and you may further need to adjust the value of the **Max Range** parameter for individual APs in the cluster to avoid self interference. See Frame Calculator Page on Page 414.

External Filters Delay

If this parameter is present in an earlier release, leave the value set to 0, regardless of whether optional filters are installed.

Display-Only Access

See Configuring Display-Only and Full Access Passwords on Page 362.

To set this password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Display-Only Access** password, 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 366.

Full Access

If you set the **Full Access** password, this password will allow

- telnet and FTP access to the module.
- *viewing or changing* the parameters of the module.

To set this password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Full Access** password, 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 366.

NOTE:
You can unset either password (revert the access to no password required). To do so, type a space into the field and reboot the module. You must enter any password twice to allow the system to verify that the password is not mistyped. After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field.

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

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.

Airlink Security

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

- **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.

SM Scan Privacy

When the SM Scan Privacy feature is enabled, you can use this field to suppress the display of data about this AP on the AP Eval Data page of all SMs that register.

Authentication Mode

If the AP has authentication capability, then you can use this field to select from among the following authentication modes:

- **Authentication Disabled**—the AP requires no SMs to authenticate.
- **Authentication Required**—the AP requires any SM that attempts registration to be authenticated in BAM or Prizm before registration.
- **Authentication Optional**—the AP requires all SMs that attempt registration to be authenticated before registration, except any SM that is operating on a Canopy system release of earlier than Release 3.0. (These earlier releases *did not* support authentication for SMs.) *This value is not recommended and is removed from Canopy System Release 7.01 and later.*

If the AP *does not* have authentication capability, then this parameter displays **Authentication Not Available**.

Configuration Source

See Setting the Configuration Source on Page 287.

CAUTION!

Do not set this parameter to **BAM** where both

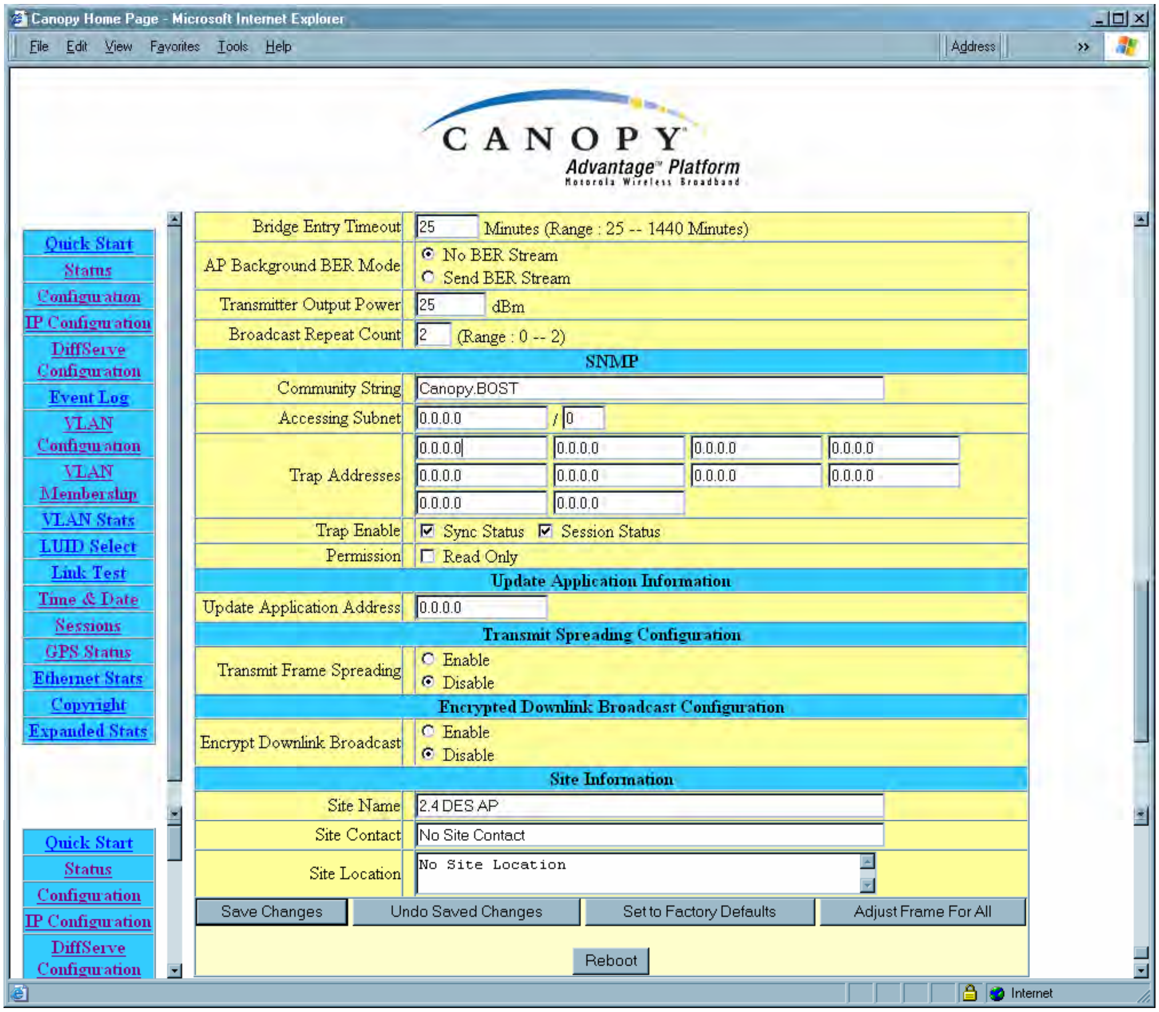
- a BAM release earlier than 2.1 is implemented.
- the **All Local SM Management** parameter (in the VLAN Configuration page of the AP) is set to **Enable**.

This combination causes the SMs to become unmanageable, until you gain direct access with an Override Plug and remove this combination from the AP configuration.

Authentication Server IPs

If either BAM or the BAM subsystem in Prizm is implemented and the AP has authentication capability, enter the IP address of one or more BAM servers that perform authentication for SMs registered to this AP. Enter these in order of primary, secondary, then tertiary.

As shown in Figure 82, the AP Configuration page continues.



Bridge Entry Timeout	25 Minutes (Range : 25 -- 1440 Minutes)
AP Background BER Mode	● No BER Stream ○ Send BER Stream
Transmitter Output Power	25 dBm
Broadcast Repeat Count	2 (Range : 0 -- 2)
SNMP	
Community String	Canopy.BOST
Accessing Subnet	0.0.0.0 / 0

Trap Addresses	0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
	0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
	0.0.0.0 0.0.0.0

Trap Enable	☑ Sync Status ☑ Session Status
Permission	□ Read Only
Update Application Information	
Update Application Address	0.0.0.0
Transmit Spreading Configuration	
Transmit Frame Spreading	○ Enable ● Disable
Encrypted Downlink Broadcast Configuration	
Encrypt Downlink Broadcast	○ Enable ● Disable
Site Information	
Site Name	2.4 DES AP
Site Contact	No Site Contact
Site Location	No Site Location

Figure 82: Configuration screen (bottom), Advantage AP

Bridge Entry Timeout

Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. The Bridge Entry Timeout should be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

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

AP Background BER Mode

Specify whether continuous BER (Bit Error Rate) data collection should be done. When **Send BER Stream** is selected for this parameter, you can read the bit error rate on the subscriber side to assess the quality of a registered link. However, the following caveats apply to this setting:

- This parameter must be identically set for all APs in a cluster.
- When **Send BER Stream** is selected for this parameter, the aggregate available bandwidth decreases by approximately 200 kbps. For this reason, you should limit BER data collection to diagnostic intervals.
- Through Release 7.3.6, BER data collection is not functional where **Scheduling** is set to **Hardware**.

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 9 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 Canopy 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 consistent 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 316.

Power Control

In Release 4.1 and later, select either

- **Low** to set the AP to operate at 18 dB less than full power to reduce the possibility of self-interference with a nearby module.
- **Normal** to allow the AP to operate at full power.

CAUTION!
Selection of **Low** can cause the AP to drop an active RF link to an SM that is too far from the low-power AP. If a link is dropped when Power Control is set to **Low**, the link can be re-established by only Ethernet access.

If you select **Low** and save the changes and reboot the AP, you should *immediately* open the Link Test page and perform a link test.

2X Rate

See 2X Operation on Page 94.

Broadcast Repeat Count

In Release 4.2 and later, this parameter controls how many times, in addition to the original broadcast, the AP repeats each broadcast. Examples of conditions where each setting can be best are provided in the following table.

Value (retries)	Condition
0[1]	Where packet throughput is more important than reliability (such as in downstreaming video).
1[1]	
2[2]	Where the AP *does not* broadcast a significant amount of traffic.
3	Where a high rate of connectionless, unacknowledged packets (such as UDP) are transmitted (for example, where most broadcast traffic is in ARP).

NOTES:

1. If you configure the AP either to not rebroadcast or to rebroadcast only once, monitor transmissions to confirm that acceptable quality is achieved.
2. The previous and current default treatment is two retries.

Hardware Scheduling is not able to repeat broadcasts. Thus, this parameter is available only when Software Scheduling is enabled.

Community String

Specify a control string that allows an Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string. The default string is **Canopy**.

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 AP. The NMS has an address that is among these addresses (this subnet). You must enter both

- The network IP address in the form xxx.xxx.xxx.xxx
- The CIDR (Classless Interdomain Routing) prefix length in the form /xx

For example

- the /16 in 198.32.0.0/16 specifies a subnet mask of 255.255.0.0 (the first 16 bits in the address range are identical among all members of the subnet).
- 192.168.102.0 specifies that any device whose IP address is in the range 192.168.102.0 to 192.168.102.254 can send SNMP requests to the AP, presuming that the device supplies the correct **Community String** value.

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

Trap Addresses

Specify ten or fewer IP addresses (xxx.xxx.xxx.xxx) to which SNMP traps should be sent. Traps inform PrizmEMS or an NMS that something has occurred. For example, trap information is sent

- after a reboot of the module.
- when an NMS attempts to access agent information but either
  - supplied an inappropriate community string or SNMP version number.
  - is associated with a subnet to which access is disallowed.

Trap Enable

Select either **Sync Status**, **Session Status**, or both to allow these types of traps to be reported. If you select neither, then both types are suppressed. For the list of supported Canopy traps, see

- Traps Provided in the Canopy Enterprise MIB on Page 392
- Traps Provided in the Canopy 30/60-Mbps BH Module MIB on Page 392
- Traps Provided in the Canopy 150/300-Mbps BH Module MIB on Page 392

Permission

Select **Read Only** if you wish to disallow any parameter changes through SNMP (for example, from PrizmEMS or an NMS).

Update Application Address

Enter the address of the server to access for software updates on this AP and registered SMs.

Transmit Frame Spreading

If you select **Enable**, then SMs between two APs can register in the assigned AP (do not register in another AP). Where all SMs in which software scheduling is implemented operate on Release 4.0 or later, or where all SMs in which hardware scheduling is enabled operate on Release 7.0 or later

- and multiple AP clusters operate in the same frequency band range and same geographical area, select **Enable**.
- and multiple AP clusters *do not* operate in the same frequency band range and same geographical area, select **Disable**, but observe the following caveat.

IMPORTANT!
SM throughput is 10% greater with this feature disabled. However, if you disable **Transmit Frame Spreading** where this feature was previously enabled, monitor the zone for interference over a period of days to ensure that this action has not made any SMs sensitive to the wrong beacon.

With this selection enabled, the AP does not transmit a beacon in each frame, but rather transmits a beacon in only pseudo-random frames in which the SM expects the beacon. This allows multiple APs to send beacons to multiple SMs in the same range without interference.

Encrypt Downlink Broadcast

In Release 4.2 or later release, when **Encryption Enabled** is selected in the **Airlink Security** parameter (described above) and **Enable** is selected in the **Encrypt Downlink Broadcast** parameter, the AP encrypts downlink broadcast packets as

- DES where the AP is DES capable.
- AES where the AP is AES capable.

CAUTION!
Do not select **Enable** for this parameter until all SMs that will register to this AP are operating on Release 4.2 or later. An SM that operates on an earlier release cannot decrypt encrypted broadcasts and, consequently, drops connectivity (or cannot establish a link) with the AP that is configured to encrypt downlink broadcasts.

For more information about the Encrypt Downlink Broadcast feature, see Encrypting Downlink Broadcasts on Page 369.

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

The Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

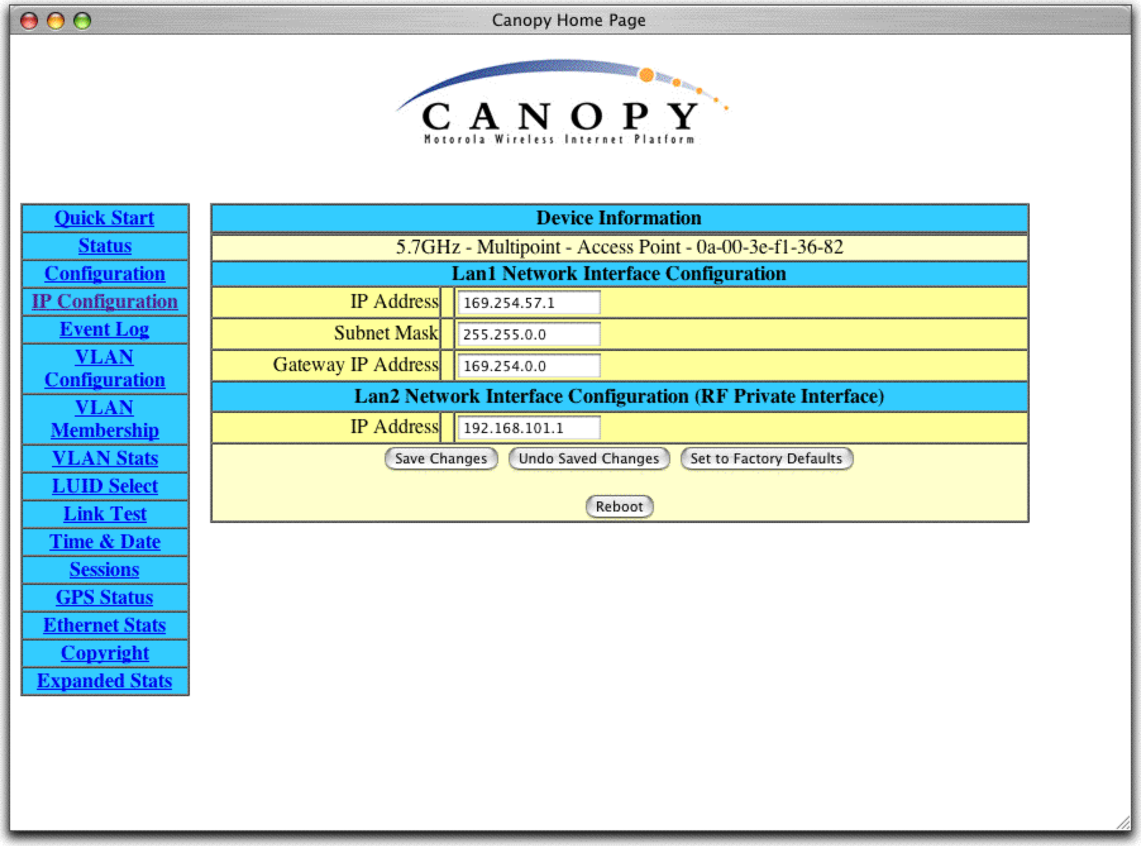
When you click this button

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

Whenever you change a parameter in the Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.1.2 IP Configuration Page of the AP

An example of the AP IP Configuration screen is displayed in Figure 83.



Device Information	
5.7GHz - Multipoint - Access Point - 0a-00-3e-f1-36-82	
Lan1 Network Interface Configuration	
IP Address	169.254.57.1
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0
Lan2 Network Interface Configuration (RF Private Interface)	
IP Address	192.168.101.1

Figure 83: IP Configuration screen, AP

You may set the IP Configuration page parameters as follows.

LAN1 Network Interface Configuration, IP Address

Enter the *non-routable* IP address to associate with the Ethernet connection on this AP. (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 366.

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 AP 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 AP to communicate with the network. The default gateway is 169.254.0.0.

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

You should not change this parameter from the default *AP* private IP address of 192.168.101.1. A /24 CIDR subnet is used to communicate with each of the SMs that are registered. The AP uses a combination of the private IP and the LUID (logical unit ID) of the SM.

For example, if an SM is the first to register in an AP, and another SM registers later, then the AP whose Private IP address is 192.168.101.1 uses the following *SM* Private IP addresses to communicate to each:

SM	LUID	Private IP
First SM registered	2	192.168.101.2
Second SM registered	3	192.168.101.3

NOTE:
Where space is limited for subnet allocation, be advised that an SM *need not* have an operator-assigned IP address. The SM is directly accessible without an LUID if either the SM **Color Code** parameter is set to 0 or the AP has a direct Ethernet connection to the SM.

The IP Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

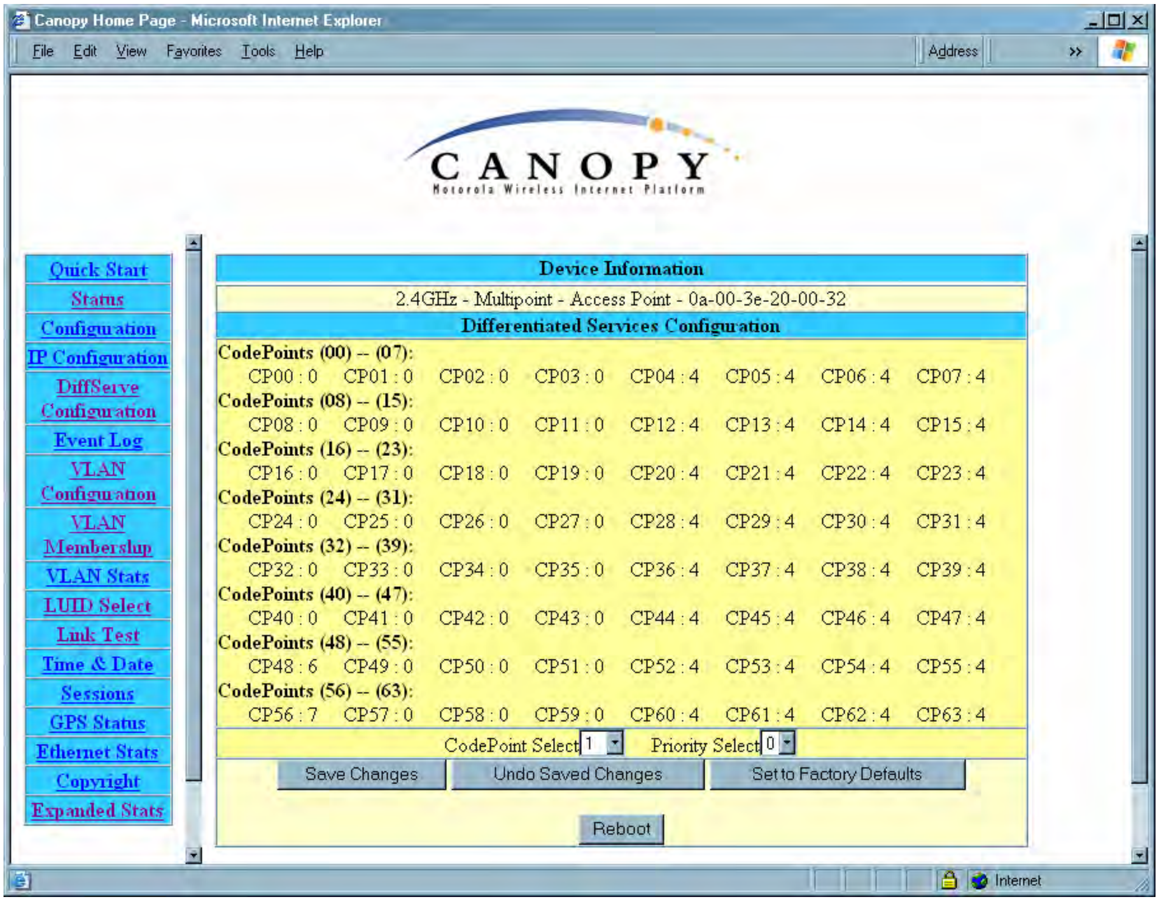
When you click this button

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

Whenever you change a parameter in the IP Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.1.3 Differentiated Services Configuration Page of the AP

An example of the AP Differentiated Services Configuration page is displayed in Figure 84.



Device Information

2.4GHz - Multipoint - Access Point - 0a-00-3e-20-00-32

Differentiated Services Configuration

CodePoints (00) -- (07):
CP00 : 0 CP01 : 0 CP02 : 0 CP03 : 0 CP04 : 4 CP05 : 4 CP06 : 4 CP07 : 4
CodePoints (08) -- (15):
CP08 : 0 CP09 : 0 CP10 : 0 CP11 : 0 CP12 : 4 CP13 : 4 CP14 : 4 CP15 : 4
CodePoints (16) -- (23):
CP16 : 0 CP17 : 0 CP18 : 0 CP19 : 0 CP20 : 4 CP21 : 4 CP22 : 4 CP23 : 4
CodePoints (24) -- (31):
CP24 : 0 CP25 : 0 CP26 : 0 CP27 : 0 CP28 : 4 CP29 : 4 CP30 : 4 CP31 : 4
CodePoints (32) -- (39):
CP32 : 0 CP33 : 0 CP34 : 0 CP35 : 0 CP36 : 4 CP37 : 4 CP38 : 4 CP39 : 4
CodePoints (40) -- (47):
CP40 : 0 CP41 : 0 CP42 : 0 CP43 : 0 CP44 : 4 CP45 : 4 CP46 : 4 CP47 : 4
CodePoints (48) -- (55):
CP48 : 6 CP49 : 0 CP50 : 0 CP51 : 0 CP52 : 4 CP53 : 4 CP54 : 4 CP55 : 4
CodePoints (56) -- (63):
CP56 : 7 CP57 : 0 CP58 : 0 CP59 : 0 CP60 : 4 CP61 : 4 CP62 : 4 CP63 : 4

CodePoint Select 1 Priority Select 0

Figure 84: Differentiated Services Configuration screen, AP

You may set the following Differentiated Services Configuration page parameters.

CodePoint 1 through CodePoint 47

CodePoint 49 through CodePoint 55

CodePoint 57 through CodePoint 63

The default priority value for each settable CodePoint is shown in Figure 109. 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.

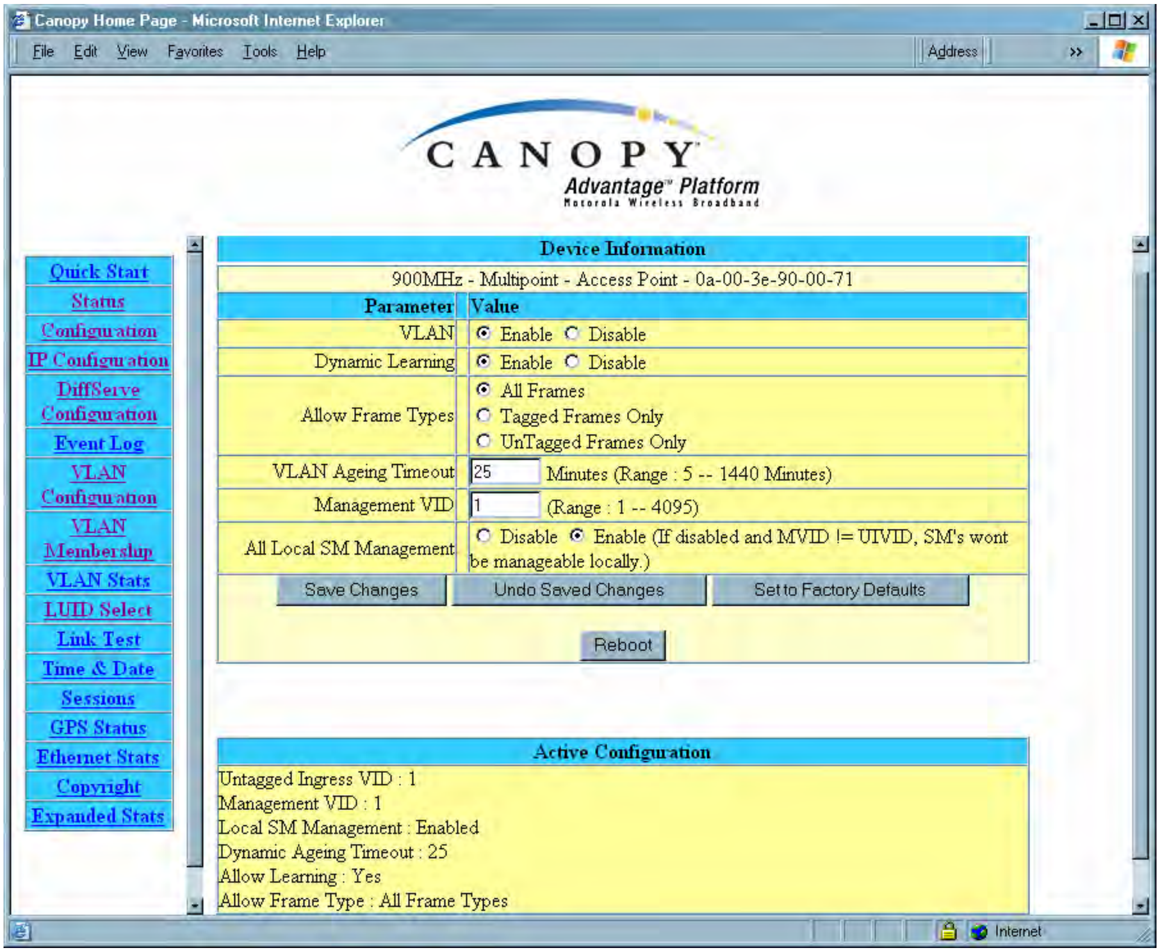
Consistent with RFC 2474

- **CodePoint 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).

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 90.

18.1.4 VLAN Configuration Page of the AP

An example of the AP VLAN Configuration page is displayed in Figure 85.



Device Information

900MHz - Multipoint - Access Point - 0a-00-3e-90-00-71

Parameter	Value
VLAN	● Enable ○ Disable
Dynamic Learning	● Enable ○ Disable
Allow Frame Types	● All Frames ○ Tagged Frames Only ○ UnTagged Frames Only
VLAN Ageing Timeout	25 Minutes (Range : 5 -- 1440 Minutes)
Management VID	1 (Range : 1 -- 4095)
All Local SM Management	○ Disable ● Enable (If disabled and MVID != UIVID, SM's wont be manageable locally.)

Active Configuration

Untagged Ingress VID : 1
Management VID : 1
Local SM Management : Enabled
Dynamic Ageing Timeout : 25
Allow Learning : Yes
Allow Frame Type : All Frame Types

Figure 85: VLAN Configuration screen, Advantage AP

You may set the VLAN Configuration page parameters as follows.

VLAN

Specify whether VLAN functionality for the AP and all linked SMs should (**Enable**) or should not (**Disable**) be allowed. The default value is **Disable**.

Dynamic Learning

Specify whether the AP should (**Enable**) or should not (**Disable**) add the VLAN IDs (VIDs) of upstream frames to the VID table. (The AP passes frames with VIDs that are stored in the table both upstream and downstream.) The default value is **Enable**.

Allow Frame Types

Select the type of arriving frames that the AP should tag, using the VID that is stored in the **Untagged Ingress VID** parameter. The default value is **All Frames**. This parameter is available in Canopy System Release 7.2.9 and later. In earlier releases, the only selectable option among these was for allowing only tagged frames.

VLAN Ageing Timeout

Specify how long the AP should keep dynamically learned VIDs. The range of values is 5 to 1440 (minutes). The default value is **25** (minutes).

NOTE:
VIDs that you enter for the **Management VID** and **VLAN Membership** parameters do not time out.

Management VID

Enter the VID that the operator wishes to use to communicate with the module manager. The range of values is 1 to 4095. The default value is **1**.

All Local SM Management

Specify whether to allow the SM (**Enable**) or the AP (**Disable**) to control the VLAN settings of this SM. The default value is **Enable**. This parameter is available in Canopy System Release 7.2.9 and later.

CAUTION!
Do not set this parameter to **Enable** where both

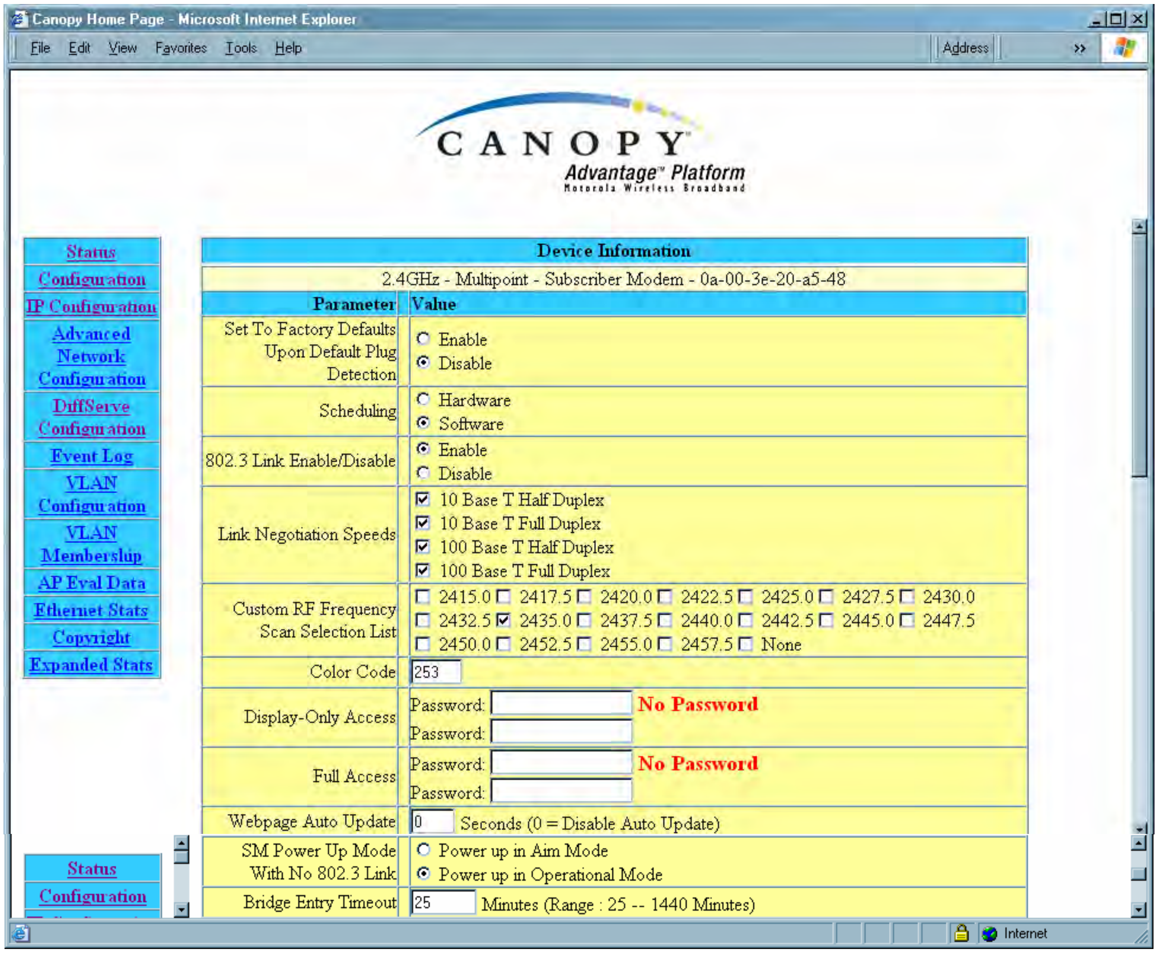
- a BAM release earlier than 2.1 is implemented.
- the **Configuration Source** parameter (in the Configuration page of the AP) is set to **BAM**.

This combination causes the SMs to become unmanageable, until you gain direct access with an Override Plug and remove this combination from the AP configuration.

18.2 CONFIGURING AN SM FOR THE DESTINATION

18.2.1 Configuration Page of the SM

An example of an SM Configuration screen is displayed in Figure 86.



Device Information	
2.4GHz - Multipoint - Subscriber Modem - 0a-00-3e-20-a5-48	
Parameter	Value
Set To Factory Defaults Upon Default Plug Detection	○ Enable ● Disable
Scheduling	○ Hardware ● Software
802.3 Link Enable/Disable	● Enable ○ Disable
Link Negotiation Speeds	☑ 10 Base T Half Duplex ☑ 10 Base T Full Duplex ☑ 100 Base T Half Duplex ☑ 100 Base T Full Duplex
Custom RF Frequency Scan Selection List	□ 2415.0 □ 2417.5 □ 2420.0 □ 2422.5 □ 2425.0 □ 2427.5 □ 2430.0 □ 2432.5 ☑ 2435.0 □ 2437.5 □ 2440.0 □ 2442.5 □ 2445.0 □ 2447.5 □ 2450.0 □ 2452.5 □ 2455.0 □ 2457.5 □ None
Color Code	253
Display-Only Access	Password: No Password Password:
Full Access	Password: No Password Password:
Webpage Auto Update	0 Seconds (0 = Disable Auto Update)
SM Power Up Mode With No 802.3 Link	○ Power up in Aim Mode ● Power up in Operational Mode
Bridge Entry Timeout	25 Minutes (Range : 25 -- 1440 Minutes)

Figure 86: Configuration screen, Advantage SM

The Configuration web page contains all of the configurable parameters that define how the SM operates. The first line of information on the Configuration screen echoes the **Device Type** from the Status web page.

As shown in Figure 86, you may set the Configuration page parameters as follows.

Set to Factory Defaults Upon Default Plug Detection

This parameter toggles what occurs when an override plug is detected during a reboot.

- If **Enable** is checked, then all parameters are returned to their factory default values. This parameter is set to **Disable**. You may prefer this setting where a person who has an override plug and access to the module *should not* be able to view what is the current configuration of the module.

- If **Disable** is checked, then the override plug resets the LAN1 IP address to 169.254.1.1 and allows you to access the module through the default configuration *without changing* the configuration. You can then reset the password of the module and view and reset other values. You may prefer this setting where quick recovery from a memory lapse (forgotten IP address or password) is more important than protection against rogue physical access.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 364.

Scheduling

See

- Software and Hardware Scheduling on Page 91
- Hardware Scheduling Mistakes to Avoid on Page 94.

802.3 Link Enable/Disable

Specify whether to enable or disable Ethernet/802.3 connectivity on the wired port of the SM. This parameter has no effect on the wireless link. When you select **Enable**, this feature allows traffic on the Ethernet/802.3 port. This is the factory default state of the port. When you select **Disable**, this feature prevents traffic on the port. Typical cases of when you may want to select **Disable** include:

- The subscriber is delinquent with payment(s).
- You suspect that the subscriber is sending or flooding undesired broadcast packets into the network, such as when
  - a virus is present in the subscriber's computing device.
  - the subscriber's home router is improperly configured.

Link Negotiation 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.

Custom RF Frequency Scan Selection List

Specify the frequency that the SM scans to find the Access Point. The frequency *band* of the SM affects what channels you should select.

> ***IMPORTANT!***
>
> In the 2.4-GHz frequency band, the SM can register to an AP that transmits on a frequency 2.5 MHz higher than the frequency that the SM 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 SM, 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 138.

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

A list of channels in the band is provided in Considering Frequency Band Alternatives on Page 137.

(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 SM and the AP *must* match. Color code is not a security feature. Instead, color code is a management feature, typically for assigning each sector a different color code.

Color code allows you to force an SM to register to only a specific AP, even where the SM can communicate with multiple APs. On all Canopy 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.

External Filters Delay

If this parameter is present in an earlier release, leave the value set to 0, regardless of whether optional filters are installed.

Display-Only Access

See Configuring Display-Only and Full Access Passwords on Page 362.

To set this password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Display-Only Access** password, 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 366.

Full Access

If you set the **Full Access** password, this password will allow

- telnet and FTP access to the module.
- *viewing or changing* the parameters of the module.

To set this password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Full Access** password, 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 366.

NOTE:
You can unset either password (revert the access to no password required). To do so, type a space into the field and reboot the module. You must enter any password twice to allow the system to verify that the password is not mistyped. After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field.

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

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.

SM Power Up Mode With No 802.3 Link

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

- **Power Up in Aim Mode**—the SM boots in an aiming mode. When the SM senses an Ethernet link, this parameter is automatically reset to Power Up in Operational Mode. When the module senses no Ethernet link within 15 minutes after power up, the SM carrier shuts off. This is the default selection.

- **Power Up in Operational Mode**—the SM boots in Operational mode. The module attempts registration.

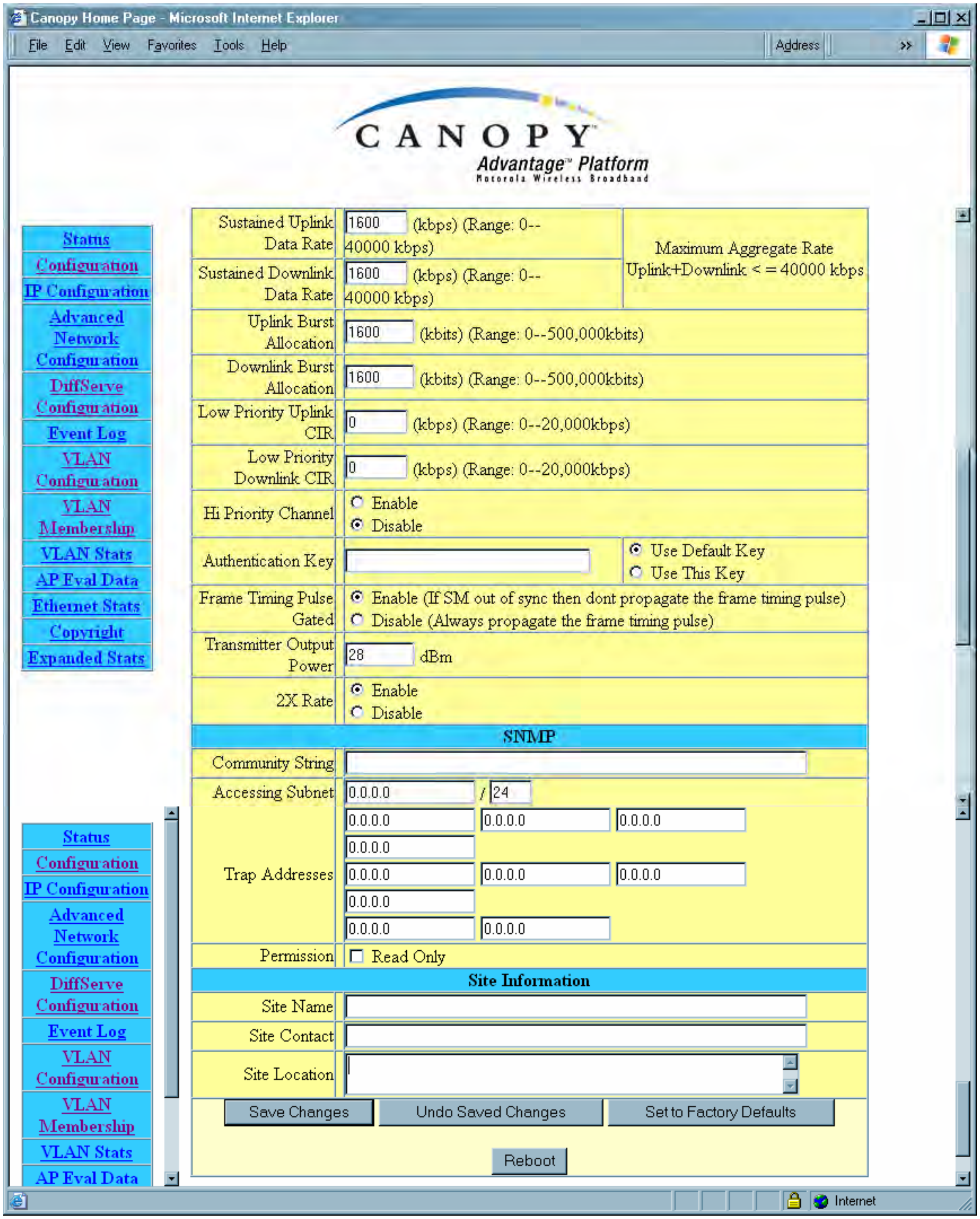
Bridge Entry Timeout

Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. Timeout occurs when the AP encounters no activity with the SM (whose MAC address is the bridge entry) within the interval that this parameter specifies. The Bridge Entry Timeout 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.

As shown in Figure 87, the Configuration page continues.



Sustained Uplink Data Rate	1600 (kbps) (Range: 0--40000 kbps)	Maximum Aggregate Rate Uplink+Downlink < = 40000 kbps
Sustained Downlink Data Rate	1600 (kbps) (Range: 0--40000 kbps)	
Uplink Burst Allocation	1600 (kbits) (Range: 0--500,000kbits)	
Downlink Burst Allocation	1600 (kbits) (Range: 0--500,000kbits)	
Low Priority Uplink CIR	0 (kbps) (Range: 0--20,000kbps)	
Low Priority Downlink CIR	0 (kbps) (Range: 0--20,000kbps)	
Hi Priority Channel	○ Enable ● Disable	
Authentication Key		● Use Default Key ○ Use This Key
Frame Timing Pulse Gated	● Enable (If SM out of sync then dont propagate the frame timing pulse) ○ Disable (Always propagate the frame timing pulse)	
Transmitter Output Power	28 dBm	
2X Rate	● Enable ○ Disable	
SNMP		
Community String		
Accessing Subnet	0.0.0.0 / 24	

Trap Addresses	0.0.0.0 0.0.0.0 0.0.0.0
	0.0.0.0
	0.0.0.0 0.0.0.0 0.0.0.0
	0.0.0.0
	0.0.0.0 0.0.0.0	

Permission	□ Read Only	
Site Information		
Site Name		
Site Contact		
Site Location		

Figure 87: Configuration screen, Advantage SM (continued)

Sustained Uplink Data Rate

Specify the rate that this SM is replenished with credits for transmission. This default imposes no restriction on the uplink. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Sustained Downlink Data Rate

Specify the rate at which the AP should be replenished with credits (tokens) for transmission to this SM. This default imposes no restriction on the uplink. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Uplink Burst Allocation

Specify the maximum amount of data to allow this SM to transmit before being recharged at the **Sustained Uplink Data Rate** with credits to transmit more. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Downlink Burst Allocation

Specify the maximum amount of data to allow the AP to transmit to this SM before the AP is replenished at the **Sustained Downlink Data Rate** with transmission credits. See

- Maximum Information Rate (MIR) Parameters on Page 86
- Interaction of Burst Allocation and Sustained Data Rate Settings on Page 88
- Setting the Configuration Source on Page 287.

Low Priority Uplink CIR

See

- Committed Information Rate on Page 88
- Setting the Configuration Source on Page 287.

Low Priority Downlink CIR

See

- Committed Information Rate on Page 88
- Setting the Configuration Source on Page 287.

Hi Priority Channel

See

- High-priority Bandwidth on Page 89
- Setting the Configuration Source on Page 287.

Authentication Key

Only if the AP to which this SM will register requires authentication, specify the key that the SM should use when authenticating:

- **Use Default Key** specifies the predetermined key for authentication in BAM or Prizm. See Authentication Manager Capability on Page 372.
- **Use This Key** specifies the 32-digit hexadecimal key that is permanently stored on both the SM and the BAM or Prizm database.

> *NOTE:*
> In Release 4.2.2 and earlier releases, if you enter the same key but it has fewer than 32 digits in the SM and the database, the SM cannot authenticate despite the match. In Release 4.2.3 and later, the SM and BAM or Prizm pad the key of any length by the addition of leading zeroes, and if the entered keys match, authentication attempts succeed. However, Canopy recommends that you enter 32 characters to achieve the maximal security from this feature.

Frame Timing Pulse Gated

If this SM extends the sync pulse to a BH master or an AP, select either

- **Enable**—If this SM loses sync from the AP, then *do not* propagate a sync pulse to the BH timing master or other AP. This setting prevents interference in the event that the SM loses sync.
- **Disable**—If this SM loses sync from the AP, then propagate the sync pulse to the BH timing master or other AP.

See Wiring to Extend Network Sync on Page 360.

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 9 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 Canopy 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 consistent 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 316.

Power Control

In Release 4.1 and later, select either

- **Low** to set the SM to operate at 18 dB less than full power to reduce the possibility of self-interference with a nearby module.
- **Normal** to allow the SM to operate at full power.

> ⚠ *CAUTION!*
> Selection of **Low** can cause the SM to drop an active RF link to an AP that is relatively far from the low-power SM. If a link is dropped when Power Control is set to **Low**, the link can be re-established by only Ethernet access.

If you select **Low** and save the changes and reboot the SM, you should *immediately* open the Link Test page and perform a link test.

2X Rate

Disable this parameter to facilitate initial aiming from the destination. Then see 2X Operation on Page 94.

Community String

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

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 SM. 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 SM, 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."

RECOMMENDATION:
The subscriber can access the SM by changing the subscriber device to the accessing subnet. This hazard exists because the **Community String** and **Accessing Subnet** are both visible parameters. To avoid this hazard in Release 4.2 or later, configure the SM to filter (block) SNMP requests. See Filtering Protocols and Ports on Page 367.

Trap Addresses

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

- after a reboot of the module.
- when an NMS attempts to access agent information but either
  - supplied an inappropriate community string or SNMP version number.
  - is associated with a subnet to which access is disallowed.

Permission

Select **Read Only** if you wish to disallow any parameter changes by the 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 Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

When you click this button

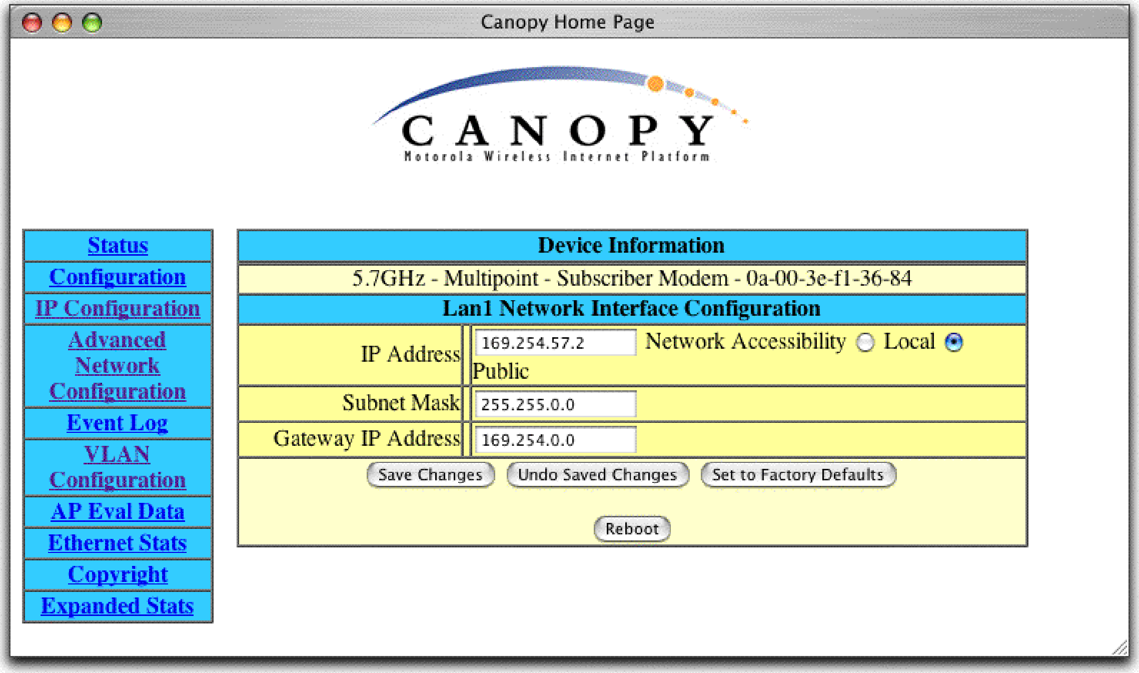
1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

Whenever you change a parameter in the Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.2 IP Configuration Page of the SM with NAT Disabled

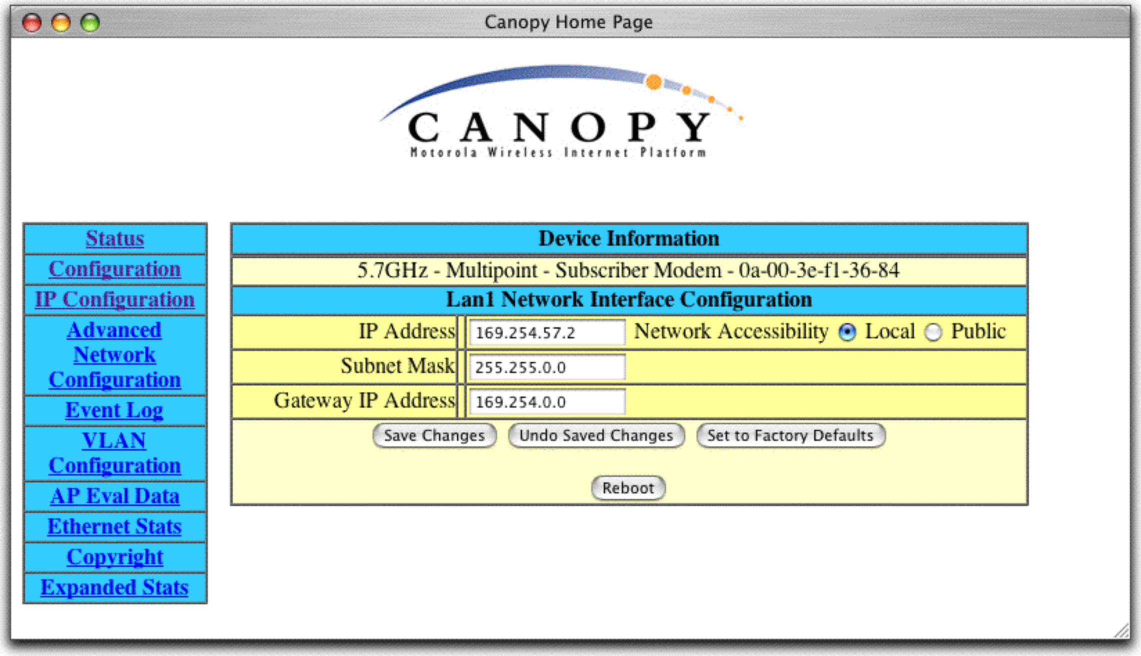
Examples of SM IP Configuration screens are displayed in

- Figure 88 for the NAT Disabled implementation with public accessibility.
- Figure 89 for the NAT Disabled implementation with local accessibility.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Lan1 Network Interface Configuration	
IP Address	169.254.57.2 Network Accessibility ○ Local ● Public
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 88: IP Configuration screen, NAT disabled, public accessibility



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Lan1 Network Interface Configuration	
IP Address	169.254.57.2 Network Accessibility ● Local ○ Public
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 89: IP Configuration screen, NAT disabled, local accessibility

This implementation is illustrated in Figure 48 on Page 157. When NAT (network address translation) is disabled on the NAT Configuration page as shown in Figure 94 on Page 274, then you may set the following IP Configuration page parameters.

LAN1 Network Interface Configuration, IP Address

Enter the *non-routable* IP address to associate with the Ethernet connection on this SM. (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 366.

> *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 SM 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 SM to communicate with the network. The default gateway is 169.254.0.0.

Regardless of whether NAT is enabled, the IP Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

When you click this button

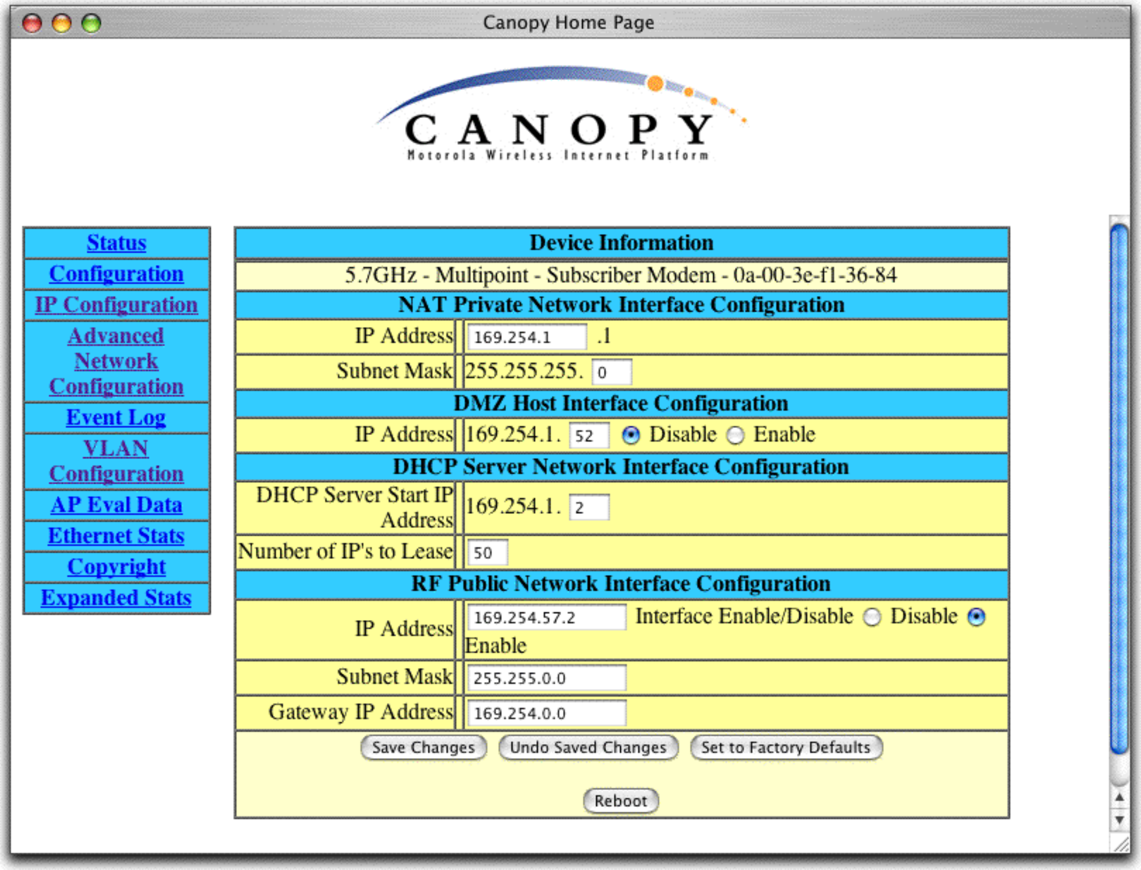
1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

Whenever you change a parameter in the IP Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.3 IP Configuration Page of the SM with NAT Enabled

Further examples of SM IP Configuration screens are displayed in

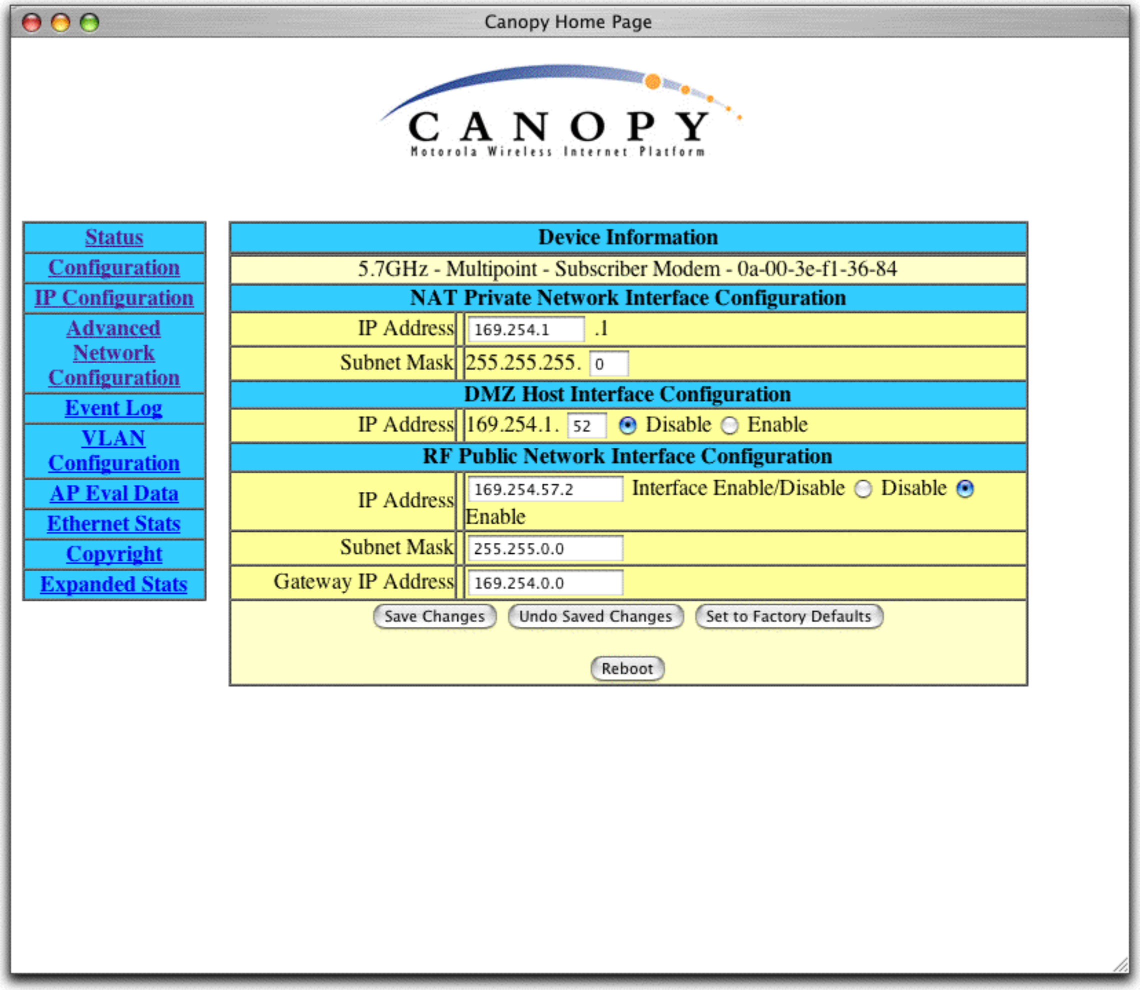
- Figure 90 for the NAT with DHCP Client and DHCP Server implementation.
- Figure 91 for the NAT with DHCP Client implementation.
- Figure 92 for the NAT with DHCP Server implementation.
- Figure 93 for the NAT without DHCP implementation.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
NAT Private Network Interface Configuration	
IP Address	169.254.1 .1
Subnet Mask	255.255.255. 0
DMZ Host Interface Configuration	
IP Address	169.254.1. 52 ● Disable ○ Enable
DHCP Server Network Interface Configuration	
DHCP Server Start IP Address	169.254.1. 2
Number of IP's to Lease	50
RF Public Network Interface Configuration	
IP Address	169.254.57.2 Interface Enable/Disable ○ Disable ● Enable
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 90: IP Configuration screen, NAT with DHCP client and DHCP server

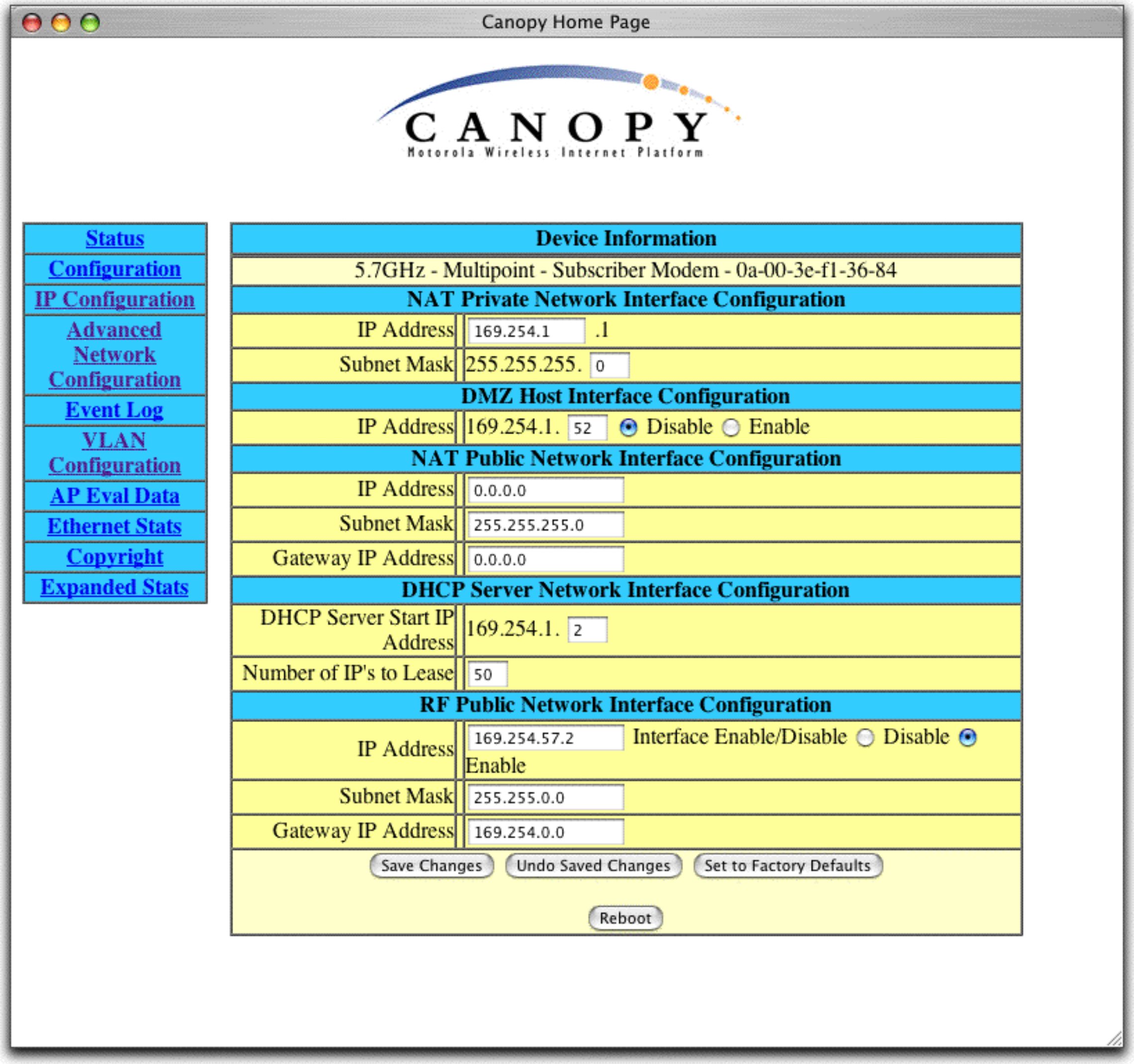
This implementation is illustrated in Figure 49 on Page 158.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
NAT Private Network Interface Configuration	
IP Address	169.254.1 .1
Subnet Mask	255.255.255. 0
DMZ Host Interface Configuration	
IP Address	169.254.1. 52 ● Disable ○ Enable
RF Public Network Interface Configuration	
IP Address	169.254.57.2 Interface Enable/Disable ○ Disable ● Enable
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 91: IP Configuration screen, NAT with DHCP client

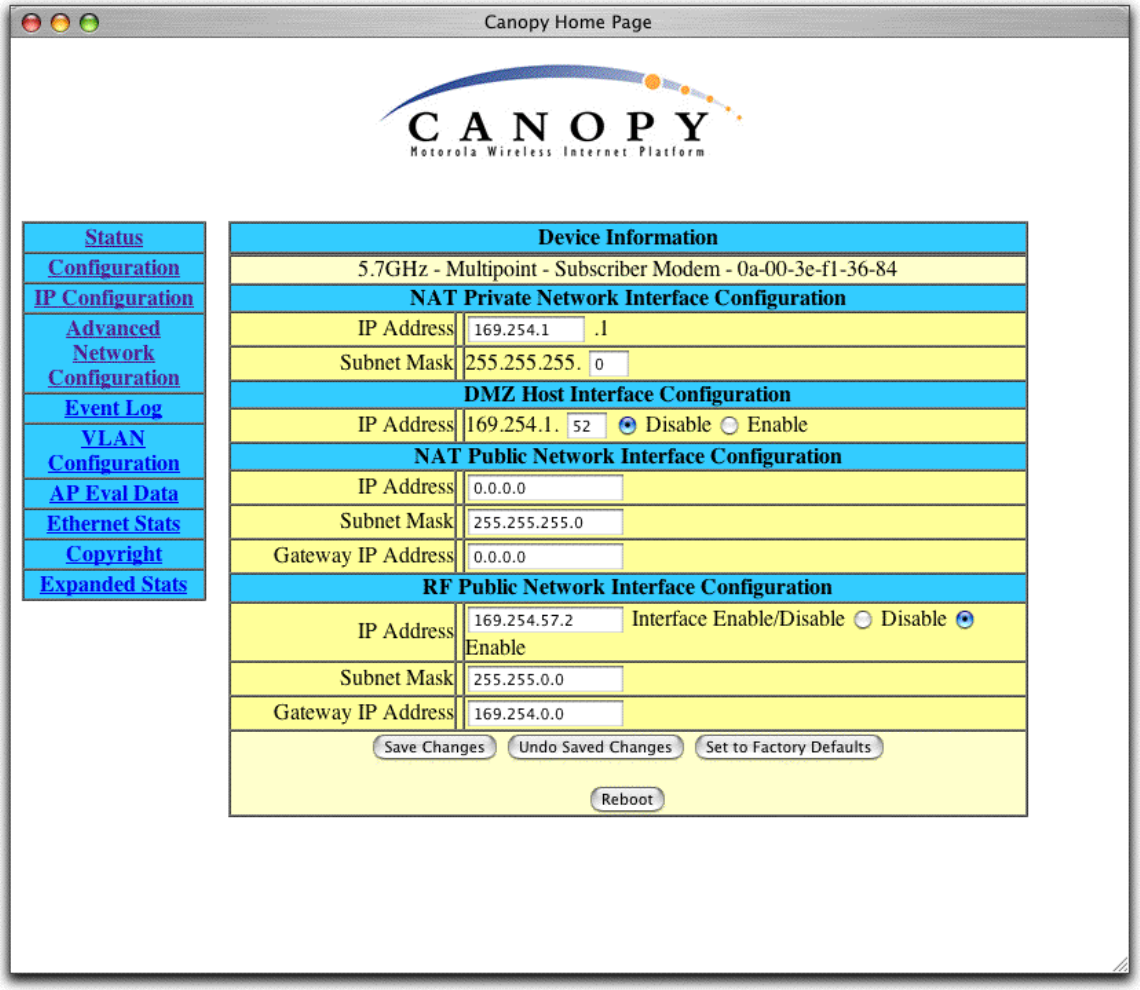
This implementation is illustrated in Figure 50 on Page 159.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
NAT Private Network Interface Configuration	
IP Address	169.254.1 .1
Subnet Mask	255.255.255. 0
DMZ Host Interface Configuration	
IP Address	169.254.1. 52 ● Disable ○ Enable
NAT Public Network Interface Configuration	
IP Address	0.0.0.0
Subnet Mask	255.255.255.0
Gateway IP Address	0.0.0.0
DHCP Server Network Interface Configuration	
DHCP Server Start IP Address	169.254.1. 2
Number of IP's to Lease	50
RF Public Network Interface Configuration	
IP Address	169.254.57.2 Interface Enable/Disable ○ Disable ● Enable
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 92: IP Configuration screen, NAT with DHCP server

This implementation is illustrated in Figure 51 on Page 50.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
NAT Private Network Interface Configuration	
IP Address	169.254.1 .1
Subnet Mask	255.255.255. 0
DMZ Host Interface Configuration	
IP Address	169.254.1. 52 ● Disable ○ Enable
NAT Public Network Interface Configuration	
IP Address	0.0.0.0
Subnet Mask	255.255.255.0
Gateway IP Address	0.0.0.0
RF Public Network Interface Configuration	
IP Address	169.254.57.2 Interface Enable/Disable ○ Disable ● Enable
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 93: IP Configuration screen, NAT without DHCP

This implementation is illustrated in Figure 52 on Page 161. When NAT (network address translation) is enabled, you may set the following IP Configuration page parameters.

NAT Private Network Interface Configuration, IP Address

Assign an IP address for SM management. This address is available from only Ethernet access to the SM. The last characters of this address must be .1. This address becomes the base for the range of DHCP-assigned addresses.

NAT Private Network Interface Configuration, Subnet Mask

Assign a subnet mask of 255.255.255.0 or a more restrictive subnet mask.

DMZ Host Interface Configuration, IP Address

Either enable or disable DMZ for this SM. See DMZ on Page 156.

Also assign the DMZ IP address to use for this SM when DMZ is enabled. The first three octets of this address are automatically set as identical to the first three octets of the address assigned in the **NAT Private Network Interface Configuration, IP Address** field above. Only one such address is allowed.

Behind this SM, the device that should receive network traffic must be assigned this address. The system provides a warning if you enter an address within the range that DHCP can assign.

NAT Public Network Interface Configuration, IP Address

This field displays the IP address of the SM. If DHCP Client is enabled, then the DHCP server automatically assigns this address.

NAT Public Network Interface Configuration, Subnet Mask

This field displays the subnet mask of the SM. If DHCP Client is enabled, then the DHCP server automatically assigns this subnet mask.

NAT Public Network Interface Configuration, Gateway IP Address

This field displays the gateway IP address for the SM. If DHCP Client is enabled, then the DHCP server automatically assigns this gateway IP address.

RF Public Network Interface Configuration, IP Address

Either enable or disable the RF public interface for this SM. Also assign the IP address for over-the-air management of the SM when the RF public interface is enabled.

RF Public Network Interface Configuration, Subnet Mask

Assign the subnet mask for over-the-air management of the SM when the RF public interface is enabled.

RF Public Network Interface Configuration, Gateway IP Address

Assign the gateway IP address for over-the-air management of the SM when the RF public interface is enabled.

> *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.

Regardless of whether NAT is enabled, the IP Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

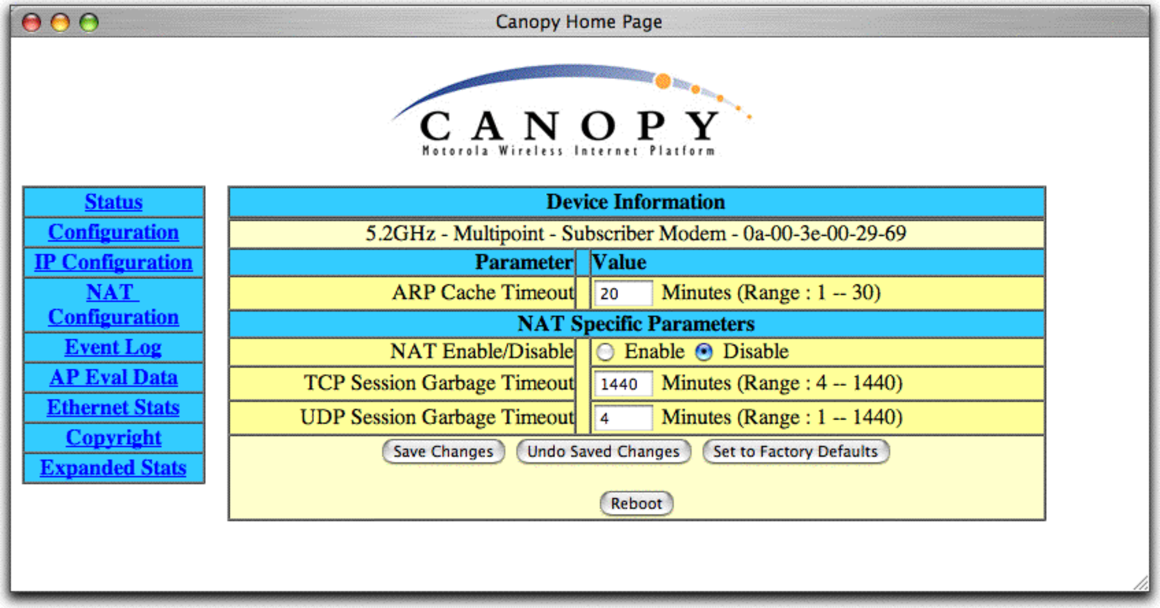
When you click this button

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

Whenever you change a parameter in the IP Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.4 NAT Configuration Page of the SM with NAT Disabled

Some earlier software releases included a NAT Configuration page in the SM. If yours does not, proceed to Advanced Network Configuration Page of the SM with NAT Disabled on Page 276. An example of the SM NAT Configuration page when NAT (network address translation) is disabled is shown in Figure 94. The default state of the SM is with NAT disabled.



Device Information	
5.2GHz - Multipoint - Subscriber Modem - 0a-00-3e-00-29-69	
Parameter	Value
ARP Cache Timeout	20 Minutes (Range : 1 -- 30)
NAT Specific Parameters	
NAT Enable/Disable	○ Enable ● Disable
TCP Session Garbage Timeout	1440 Minutes (Range : 4 -- 1440)
UDP Session Garbage Timeout	4 Minutes (Range : 1 -- 1440)

Figure 94: NAT Configuration screen, NAT disabled

This implementation is illustrated in Figure 48 on Page 157. When NAT (network address translation) is disabled, you may set the following NAT Configuration page parameters.

ARP Cache Timeout

If a router upstream has an ARP cache of longer duration (as some use 30 minutes), enter a value of longer duration than the router ARP cache. The default value of this field is 20 minutes.

NAT Enable/Disable

Either disable NAT, or enable NAT to view additional options.

TCP Session Garbage Timeout

Where a large network exists behind the SM, you can set this parameter to lower than the default value of 1440 minutes (24 hours). This action makes additional resources available for greater traffic than the default value accommodates.

UDP Session Garbage Timeout

You may adjust this parameter in the range of 1 to 1440 minutes, based on network performance. The default value of this parameter is 4 minutes.

Regardless of whether NAT is enabled, the NAT Configuration page also provides the following buttons.

Save Changes

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

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

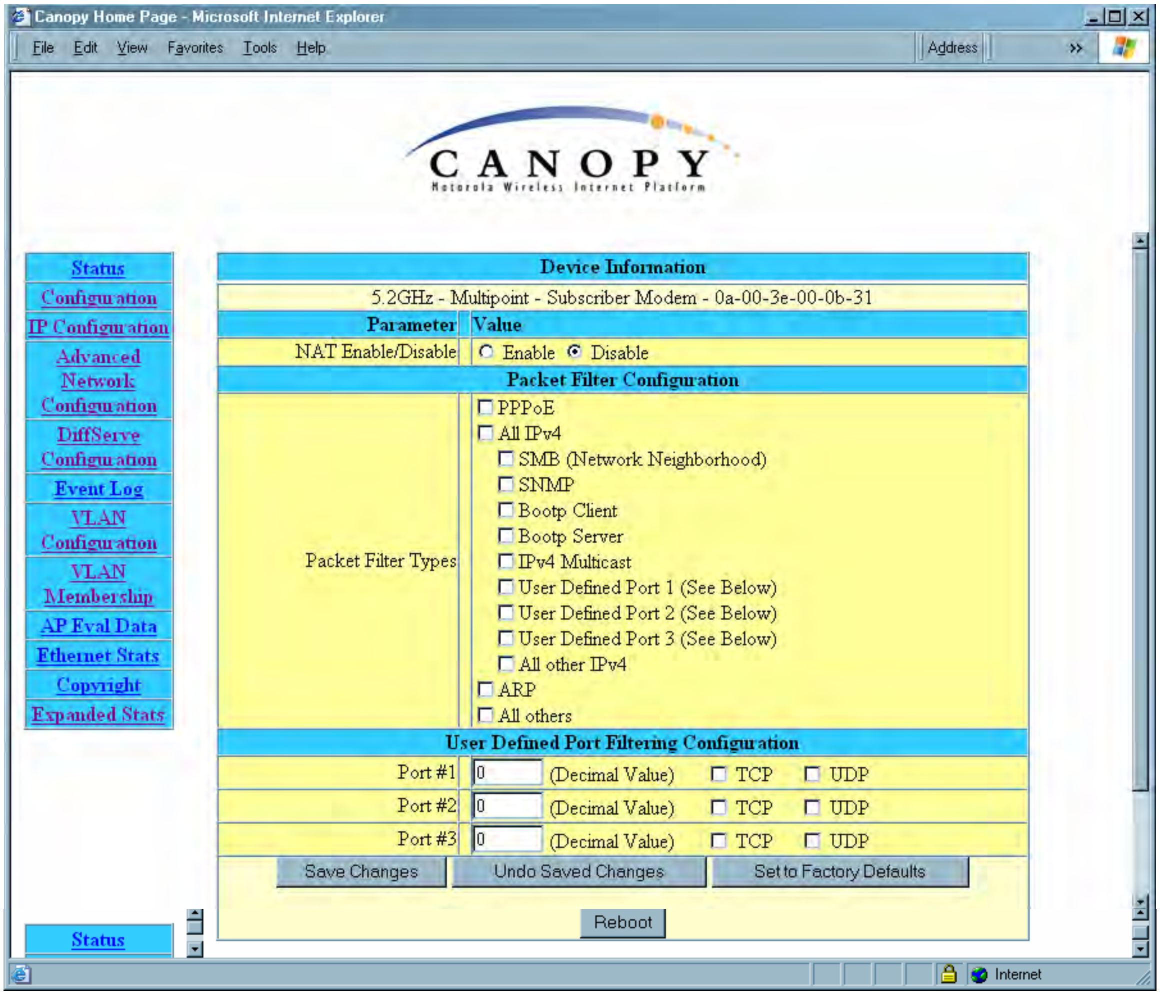
When you click this button

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

Whenever you change a parameter in the NAT Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.5 Advanced Network Configuration Page of the SM with NAT Disabled

An example of the SM Advanced Network Configuration page when NAT (network address translation) is disabled is shown in Figure 95. The default state of this page is with NAT disabled.



Device Information	
5.2GHz - Multipoint - Subscriber Modem - 0a-00-3e-00-0b-31	
Parameter	**Value**
NAT Enable/Disable	○ Enable ● Disable
Packet Filter Configuration	
Packet Filter Types	□ PPPoE □ All IPv4 □ SMB (Network Neighborhood) □ SNMP □ Bootp Client □ Bootp Server □ IPv4 Multicast □ User Defined Port 1 (See Below) □ User Defined Port 2 (See Below) □ User Defined Port 3 (See Below) □ All other IPv4 □ ARP □ All others
User Defined Port Filtering Configuration	
Port #1	0 (Decimal Value) □ TCP □ UDP
Port #2	0 (Decimal Value) □ TCP □ UDP
Port #3	0 (Decimal Value) □ TCP □ UDP

Figure 95: Advanced Network Configuration screen of SM with NAT disabled

This implementation is illustrated in Figure 48 on Page 157. When NAT (network address translation) is disabled, you may set the following Advanced Network Configuration page parameters.

NAT Enable/Disable

Either disable NAT, or enable NAT to view additional options.

Packet Filter Configuration

In Release 4.2 and later, for any box selected, the Protocol and Port Filtering feature blocks the associated protocol type. Examples are provided in Protocol and Port Filtering with NAT Disabled on Page 367.

To filter packets in any of the user-defined ports, you must both

- check the box for **User Defined Port *n* (See Below)** in the **Packet Filter Types** section of this page.
- and, in the User Defined Port Filtering Configuration section of this page, both
  - provide a port number at **Port #*n***.
  - check **TCP**, **UDP**, or both.

User Defined Port Filtering Configuration

In Release 4.2 and later, you can specify ports for which to block subscriber access, regardless of whether NAT is enabled. For more information, see Filtering Protocols and Port on Page 367.

Save Changes

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

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

When you click this button

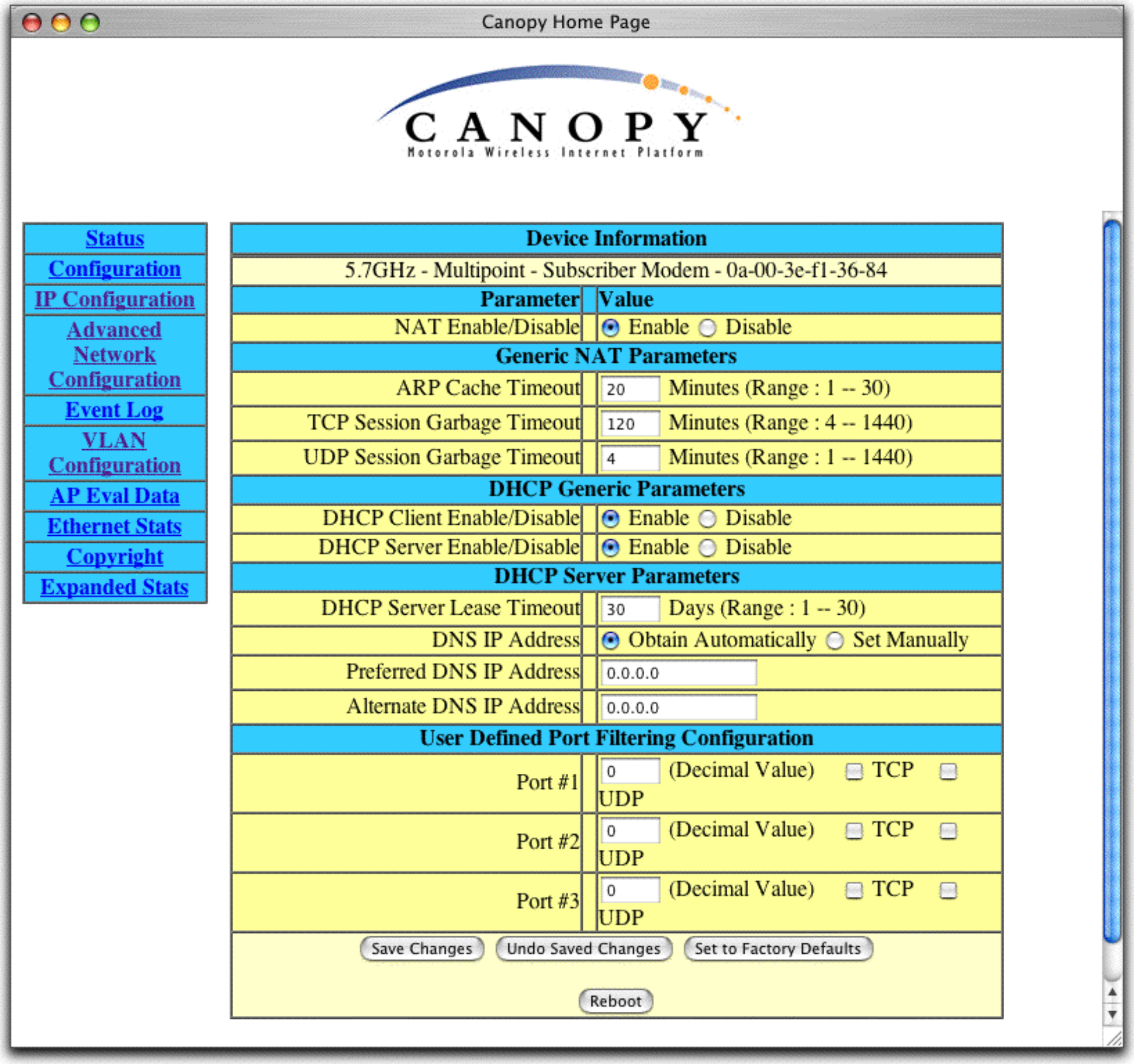
1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

Whenever you change a parameter in the NAT Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.6 NAT/Advanced Network Configuration Page of the SM with NAT Enabled

Examples of SM NAT Configuration screens when NAT is enabled are displayed in

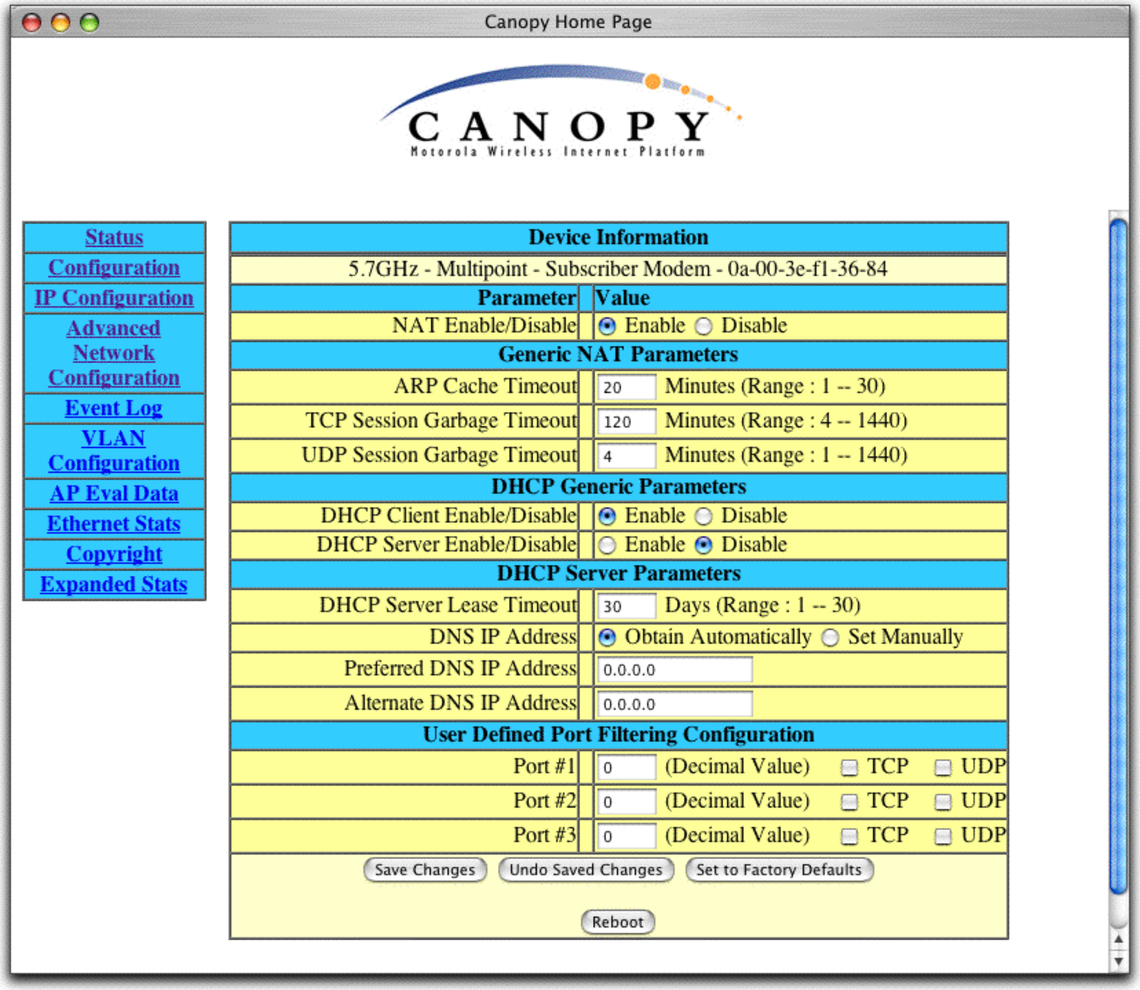
- Figure 96 for the NAT with DHCP Client and DHCP Server implementation.
- Figure 97 for the NAT with DHCP Client implementation.
- Figure 98 for the NAT with DHCP Server implementation.
- Figure 99 for the NAT without DHCP implementation.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Parameter	**Value**
NAT Enable/Disable	● Enable ○ Disable
Generic NAT Parameters	
ARP Cache Timeout	20 Minutes (Range : 1 -- 30)
TCP Session Garbage Timeout	120 Minutes (Range : 4 -- 1440)
UDP Session Garbage Timeout	4 Minutes (Range : 1 -- 1440)
DHCP Generic Parameters	
DHCP Client Enable/Disable	● Enable ○ Disable
DHCP Server Enable/Disable	● Enable ○ Disable
DHCP Server Parameters	
DHCP Server Lease Timeout	30 Days (Range : 1 -- 30)
DNS IP Address	● Obtain Automatically ○ Set Manually
Preferred DNS IP Address	0.0.0.0
Alternate DNS IP Address	0.0.0.0
User Defined Port Filtering Configuration	
Port #1	0 (Decimal Value) □ TCP □ UDP
Port #2	0 (Decimal Value) □ TCP □ UDP
Port #3	0 (Decimal Value) □ TCP □ UDP

Figure 96: Advanced Network Configuration screen, NAT with DHCP client and DHCP server

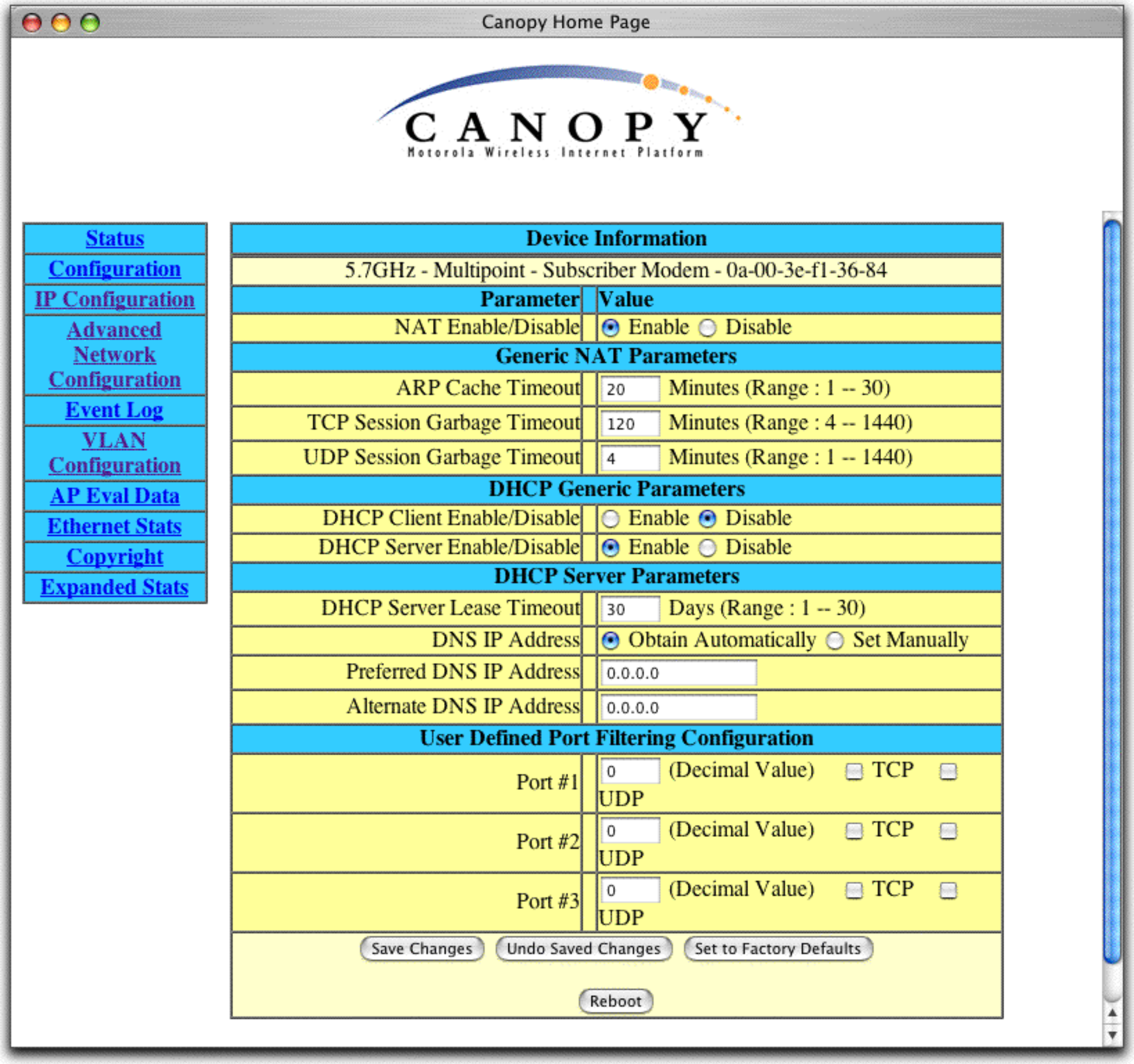
This implementation is illustrated in Figure 49 on Page 158.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Parameter	**Value**
NAT Enable/Disable	● Enable ○ Disable
Generic NAT Parameters	
ARP Cache Timeout	20 Minutes (Range : 1 -- 30)
TCP Session Garbage Timeout	120 Minutes (Range : 4 -- 1440)
UDP Session Garbage Timeout	4 Minutes (Range : 1 -- 1440)
DHCP Generic Parameters	
DHCP Client Enable/Disable	● Enable ○ Disable
DHCP Server Enable/Disable	○ Enable ● Disable
DHCP Server Parameters	
DHCP Server Lease Timeout	30 Days (Range : 1 -- 30)
DNS IP Address	● Obtain Automatically ○ Set Manually
Preferred DNS IP Address	0.0.0.0
Alternate DNS IP Address	0.0.0.0
User Defined Port Filtering Configuration	
Port #1	0 (Decimal Value) □ TCP □ UDP
Port #2	0 (Decimal Value) □ TCP □ UDP
Port #3	0 (Decimal Value) □ TCP □ UDP

Figure 97: NAT Configuration screen, NAT with DHCP client

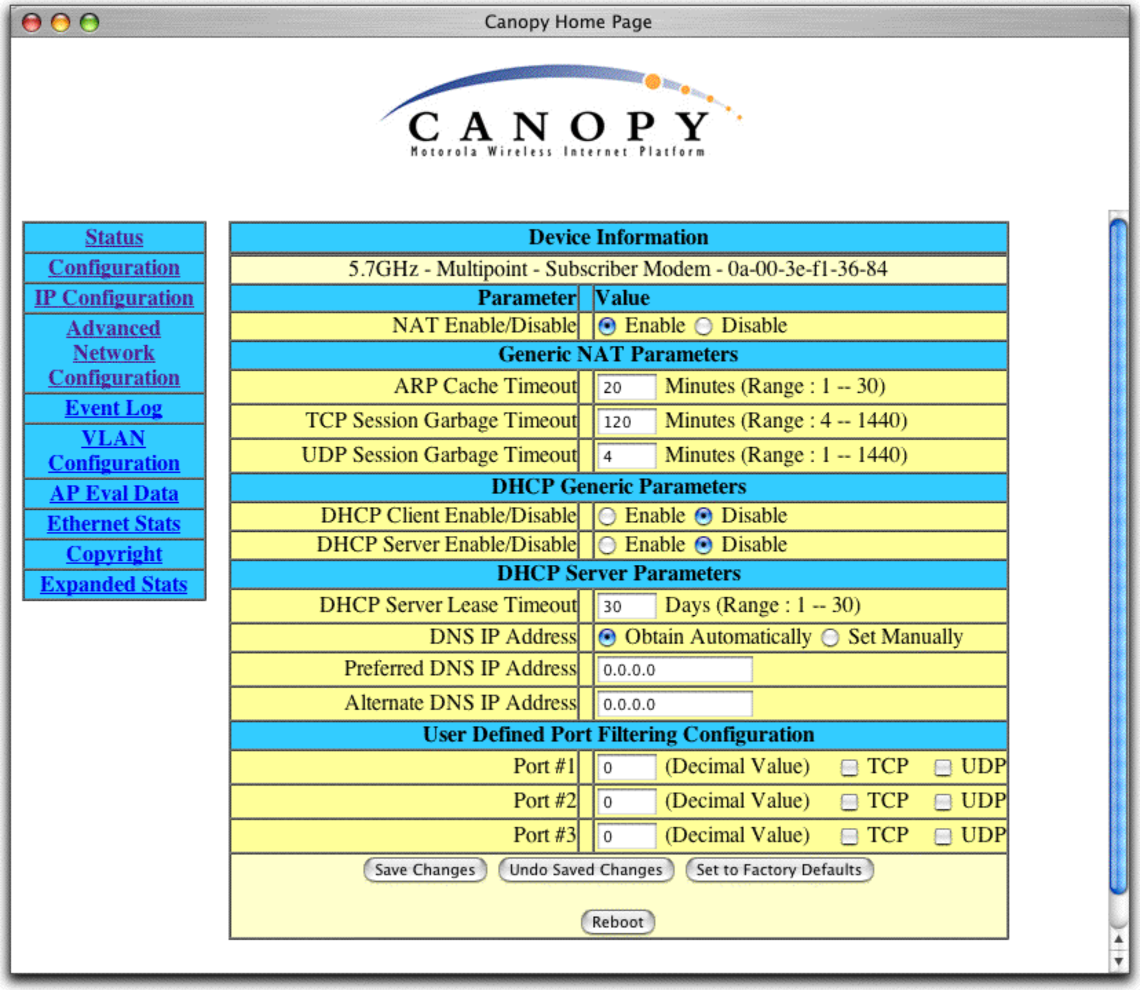
This implementation is illustrated in Figure 50 on Page 159.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Parameter	Value
NAT Enable/Disable	● Enable ○ Disable
Generic NAT Parameters	
ARP Cache Timeout	20 Minutes (Range : 1 -- 30)
TCP Session Garbage Timeout	120 Minutes (Range : 4 -- 1440)
UDP Session Garbage Timeout	4 Minutes (Range : 1 -- 1440)
DHCP Generic Parameters	
DHCP Client Enable/Disable	○ Enable ● Disable
DHCP Server Enable/Disable	● Enable ○ Disable
DHCP Server Parameters	
DHCP Server Lease Timeout	30 Days (Range : 1 -- 30)
DNS IP Address	● Obtain Automatically ○ Set Manually
Preferred DNS IP Address	0.0.0.0
Alternate DNS IP Address	0.0.0.0
User Defined Port Filtering Configuration	
Port #1	0 (Decimal Value) □ TCP □ UDP
Port #2	0 (Decimal Value) □ TCP □ UDP
Port #3	0 (Decimal Value) □ TCP □ UDP

Figure 98: NAT Configuration screen, NAT with DHCP server

This implementation is illustrated in Figure 51 on Page 160.



Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Parameter	**Value**
NAT Enable/Disable	● Enable ○ Disable
Generic NAT Parameters	
ARP Cache Timeout	20 Minutes (Range : 1 -- 30)
TCP Session Garbage Timeout	120 Minutes (Range : 4 -- 1440)
UDP Session Garbage Timeout	4 Minutes (Range : 1 -- 1440)
DHCP Generic Parameters	
DHCP Client Enable/Disable	○ Enable ● Disable
DHCP Server Enable/Disable	○ Enable ● Disable
DHCP Server Parameters	
DHCP Server Lease Timeout	30 Days (Range : 1 -- 30)
DNS IP Address	● Obtain Automatically ○ Set Manually
Preferred DNS IP Address	0.0.0.0
Alternate DNS IP Address	0.0.0.0
User Defined Port Filtering Configuration	
Port #1	0 (Decimal Value) □ TCP □ UDP
Port #2	0 (Decimal Value) □ TCP □ UDP
Port #3	0 (Decimal Value) □ TCP □ UDP

Figure 99: NAT Configuration screen, NAT without DHCP

This implementation is illustrated in Figure 52 on Page 161. When NAT (network address translation) is enabled, you may set the following NAT Configuration page parameters.

ARP Cache Timeout

If a router upstream has an ARP cache of longer duration (as some use 30 minutes), enter a value of longer duration than the router ARP cache. The default value of this field is 20 seconds.

NAT Enable/Disable

Either disable NAT, or enable NAT to view additional options.

TCP Session Garbage Timeout

Where a large network exists behind the SM, you can set this value to lower than the default value of 1440 minutes (24 hours). This action makes additional resources available for greater traffic than the default value accommodates.

UDP Session Garbage Timeout

You may adjust this value in the range of 1 to 1440 minutes, based on network performance. The default value of this parameter is 4 minutes.

DHCP Client Enable/Disable

Select either

- **Enable** to allow the network DHCP server to assign the NAT Public Network Interface Configuration IP address, subnet mask, and gateway IP address for this SM.
- **Disable** to
  - disable DHCP server assignment of this address.
  - enable the operator to assign this address.

DHCP Server Enable/Disable

Select either

- **Enable** to
  - allow this SM to assign IP addresses, subnet masks, and gateway IP addresses to attached devices.
  - assign a start address for the SM.
  - designate how many IP addresses may be leased on the IP Configuration page of this SM.
- **Disable** to disallow the SM to assign addresses to attached devices.

DHCP Server Lease Timeout

You may adjust this parameter in the range of 1 to 30 days, based on network performance. The default value of this parameter is 30 days.

DNS IP Address

Select either

- **Obtain Automatically** to allow the system to set the IP address of the DNS server.
- **Set Manually** to enable yourself to set both a preferred and an alternate DNS IP address.

Preferred DNS IP Address

If the **DNS IP Address** parameter is set to **Set Manually**, set this parameter as the preferred address of the DNS server.

Alternate DNS IP Address

If the **DNS IP Address** parameter is set to **Set Manually**, set this parameter as the alternate address of the DNS server.

User Defined Port Filtering Configuration

This parameter is shown in Figure 96 on Page 278. In Release 4.2 and later, you can specify ports for which to block subscriber access, regardless of whether NAT is enabled. See Filtering Protocols and Port on Page 367.

18.2.7 NAT Configuration Buttons with NAT Enabled

Regardless of whether NAT is enabled, the NAT Configuration page also provides the following buttons.

Save Changes

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

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

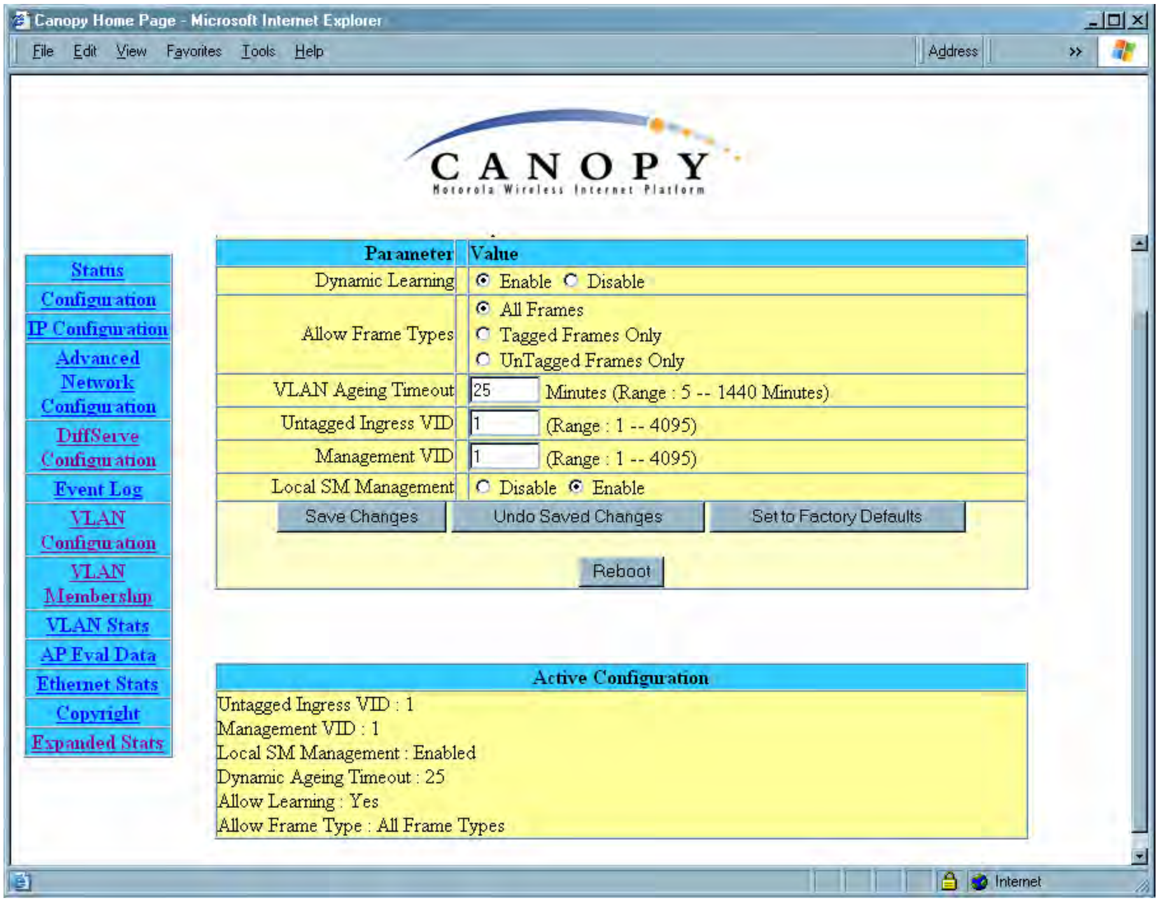
When you click this button

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

Whenever you change a parameter in the NAT Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.2.8 VLAN Configuration Page of the SM

An example screen of the VLAN Configuration page of the SM is displayed in Figure 100.



Parameter	Value
Dynamic Learning	● Enable ○ Disable
Allow Frame Types	● All Frames ○ Tagged Frames Only ○ UnTagged Frames Only
VLAN Ageing Timeout	25 Minutes (Range : 5 -- 1440 Minutes)
Untagged Ingress VID	1 (Range : 1 -- 4095)
Management VID	1 (Range : 1 -- 4095)
Local SM Management	○ Disable ● Enable

Active Configuration

Untagged Ingress VID : 1
Management VID : 1
Local SM Management : Enabled
Dynamic Ageing Timeout : 25
Allow Learning : Yes
Allow Frame Type : All Frame Types

Figure 100: VLAN Configuration screen, SM

You may set the VLAN Configuration page parameters as follows.

Dynamic Learning

Specify whether the SM should (**Enable**) or should not (**Disable**) add the VIDs of upstream frames (that enter the SM through the wired Ethernet interface) to the VID table. The default value is **Enable**.

Allow Frame Types

Select the type of arriving frames that the SM should tag, using the VID that is stored in the **Untagged Ingress VID** parameter. The default value is **All Frames**. This parameter is available in Canopy System Release 7.2.9 and later. In earlier releases, the only selectable option among these was for allowing only tagged frames.

VLAN Ageing Timeout

Specify how long the SM should keep dynamically learned VIDs. The range of values is 5 to 1440 (minutes). The default value is **25** (minutes).

NOTE:
VIDs that you enter for the **Untagged Ingress VID** and **Management VID** parameters do not time out.

Untagged Ingress VID

Enter the VID that the SM(s) should use to tag frames that arrive at the SM(s) untagged. The range of values is 1 to 4095. The default value is **1**.

Management VID

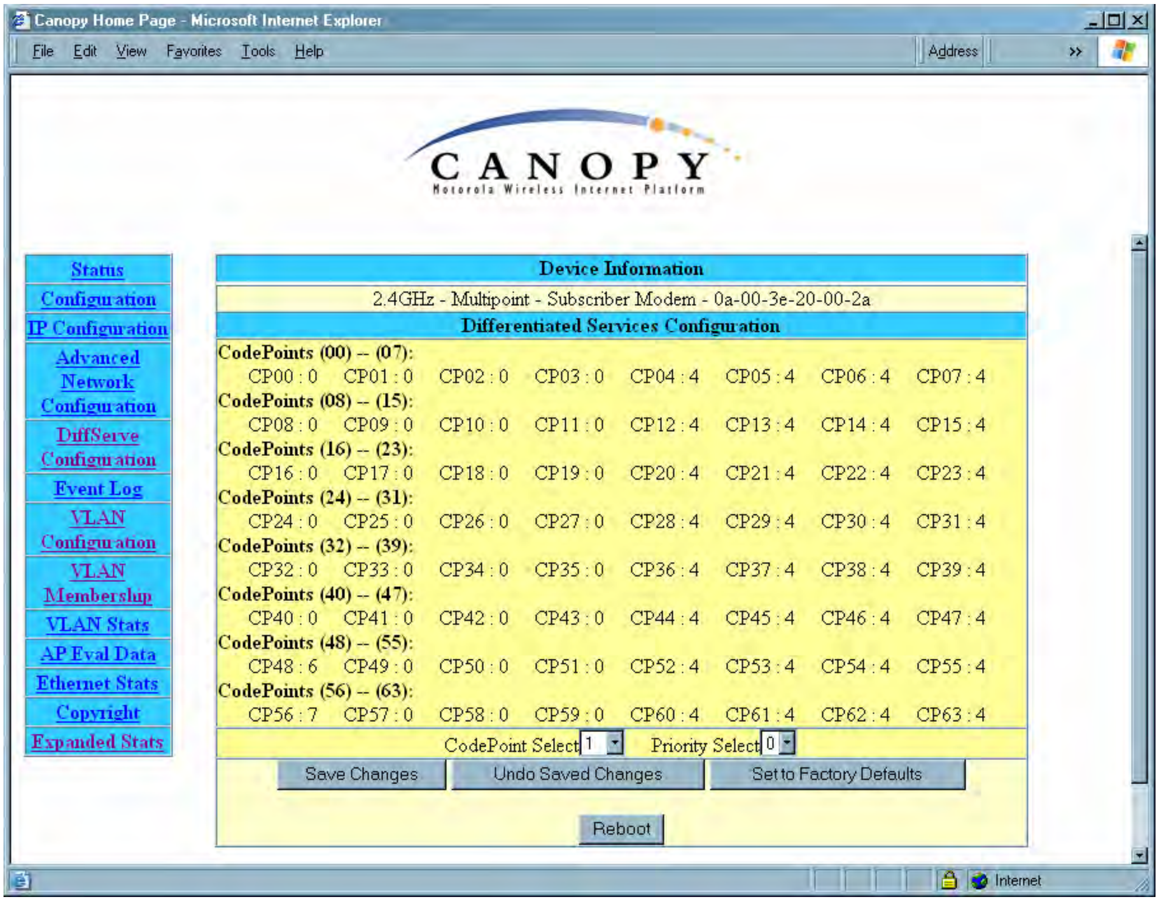
Enter the VID that the SM should share with the AP. The range of values is 1 to 4095. The default value is **1**.

Local SM Management

Specify whether to allow the SM (**Enable**) or the AP (**Disable**) to control the VLAN settings of this SM. The default value is **Enable**. This parameter is available in Canopy System Release 7.2.9 and later.

18.2.9 Differentiated Services Configuration Page of the SM

An example of the SM Differentiated Services Configuration page is displayed in Figure 101.



Device Information

2.4GHz - Multipoint - Subscriber Modem - 0a-00-3e-20-00-2a

Differentiated Services Configuration

CodePoints (00) -- (07):
CP00 : 0 CP01 : 0 CP02 : 0 CP03 : 0 CP04 : 4 CP05 : 4 CP06 : 4 CP07 : 4
CodePoints (08) -- (15):
CP08 : 0 CP09 : 0 CP10 : 0 CP11 : 0 CP12 : 4 CP13 : 4 CP14 : 4 CP15 : 4
CodePoints (16) -- (23):
CP16 : 0 CP17 : 0 CP18 : 0 CP19 : 0 CP20 : 4 CP21 : 4 CP22 : 4 CP23 : 4
CodePoints (24) -- (31):
CP24 : 0 CP25 : 0 CP26 : 0 CP27 : 0 CP28 : 4 CP29 : 4 CP30 : 4 CP31 : 4
CodePoints (32) -- (39):
CP32 : 0 CP33 : 0 CP34 : 0 CP35 : 0 CP36 : 4 CP37 : 4 CP38 : 4 CP39 : 4
CodePoints (40) -- (47):
CP40 : 0 CP41 : 0 CP42 : 0 CP43 : 0 CP44 : 4 CP45 : 4 CP46 : 4 CP47 : 4
CodePoints (48) -- (55):
CP48 : 6 CP49 : 0 CP50 : 0 CP51 : 0 CP52 : 4 CP53 : 4 CP54 : 4 CP55 : 4
CodePoints (56) -- (63):
CP56 : 7 CP57 : 0 CP58 : 0 CP59 : 0 CP60 : 4 CP61 : 4 CP62 : 4 CP63 : 4

CodePoint Select 1 Priority Select 0

Figure 101: Differentiated Services Configuration screen, SM

You may set the following Differentiated Services Configuration page parameters.

CodePoint 1 through CodePoint 47

CodePoint 49 through CodePoint 55

CodePoint 57 through CodePoint 63

The default priority value for each settable CodePoint is shown in Figure 109. 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 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).

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 90.

18.3 SETTING THE CONFIGURATION SOURCE

In Canopy System Release 6.1 and later, the AP includes a **Configuration Source** parameter, which sets where SMs that register to the AP are controlled for MIR, VLAN, the high-priority channel, and CIR as follows.

In a sector where **Software Scheduling** is implemented, the **Configuration Source** parameter affects the source of

- all MIR settings:
  - **Sustained Uplink Data Rate**
  - **Uplink Burst Allocation**
  - **Sustained Downlink Data Rate**
  - **Downlink Burst Allocation**
- all SM VLAN settings:
  - **Dynamic Learning**
  - **Allow Only Tagged Frames**
  - **VLAN Ageing Timeout**
  - **Untagged Ingress VID**
  - **Management VID**
  - **VLAN Membership**

In a sector where **Hardware Scheduling** is implemented, the **Configuration Source** parameter affects the source of

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

> *NOTE:*
> In Canopy System Release 7.0 and later, the **Configuration Source** setting BAM+SM is available.

Most operators whose plans are typical should consult Table 53.

Table 53: Recommended combined settings for typical operations

Most operators who use					
Canopy System Release…	**and BAM Release…**	**should set this parameter…**	**in this web page…**	**of this module…**	**to…**
7.0 or 7.1.4	none	**Authentication Mode**	Configuration	AP	**Authentication Disabled**
		Configuration Source	Configuration	AP	**SM**
	2.0	**Authentication Mode**	Configuration	AP	**Authentication Required**
		Configuration Source	Configuration	AP	**BAM+SM**

Most operators who use					
Canopy System Release…	**and BAM Release…**	**should set this parameter…**	**in this web page…**	**of this module…**	**to…**
7.2 or later	none	**Authentication Mode**	Configuration	AP	**Authentication Disabled**
		Configuration Source	Configuration	AP	**SM**
	2.0	**Authentication Mode**	Configuration	AP	**Authentication Required**
		Configuration Source	Configuration	AP	**BAM+SM**
		All Local SM Management	VLAN Configuration	AP	**Enable**[1]
		Local SM Management	VLAN Configuration	SM	**Enable**
	2.1	**Authentication Mode**	Configuration	AP	**Authentication Required**
		Configuration Source	Configuration	AP	**BAM**[2] **or BAM+SM**[3]
		All Local SM Management	VLAN Configuration	AP	**Disable**[3]
		Local SM Management	VLAN Configuration	SM	**Disable**[2]

NOTES:

1. *Do not* enable **All Local SM Management** at the AP if you set the **Configuration Source** to BAM (rather than **BAM+SM**) with BAM Release 2.0, because this would require a truck roll to each SM to restore the ability to manage them. BAM Release 2.0 does not support setting VLAN parameters from BAM.
2. **Configuration Source** set to BAM with BAM Release 2.1 *does not* allow you to use the Only Untagged filtering option in the Canopy SM. To use this option, set **Configuration Source** to **BAM+SM** or **SM**. The Only Untagged option is described under SM Membership in VLANs on Page 164.
3. Regardless of the **Configuration Source** setting, if you disable **All Local SM Management** at the AP, settings in the SM for VLAN management *will not* be used.

Operators whose plans are atypical should consider the results that are described in Table 54 and Table 55. For any SM whose **Authentication Mode** parameter is set to **Authentication Required**, the listed settings are derived as shown in Table 54.

Table 54: Where feature values are obtained for the SM with authentication required

Configuration Source Setting in the AP	Where These Values are Obtained in a Sector with							
	Software Scheduling				Hardware Scheduling			
	All MIR	All VLAN	HPC	All CIR	All MIR	All VLAN	HPC	All CIR
BAM	BAM	BAM	AP	n/a	BAM	BAM	BAM	BAM
SM	SM	SM	AP	n/a	SM	SM	SM	SM
BAM+SM	BAM	BAM, then SM	AP	n/a	BAM	BAM, then SM	BAM, then SM	BAM, then SM

NOTES:

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

CIR is not available to SMs in a sector where software scheduling is implemented.

BAM+SM is an available **Configuration Source** parameter setting in Canopy System Release 7.0 and later.

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

Where *BAM* is the indication, values in the SM are disregarded.

Where *SM* is the indication, values that BAM sends for the SM are disregarded.

The high-priority channel is unavailable to older SMs that have hardware scheduling enabled.

For any SM whose **Authentication Mode** parameter *is not* set to **Authentication Required**, the listed settings are derived as shown in Table 55.

Table 55: Where feature values are obtained for the SM with authentication disabled

Configuration Source Setting in the AP	Where These Values are Obtained in a Sector with							
	Software Scheduling				Hardware Scheduling			
	All MIR	All VLAN	HPC	All CIR	All MIR	All VLAN	HPC	All CIR
BAM	AP	AP	AP	n/a	AP	AP	AP	AP
SM	SM	SM	AP	n/a	SM	SM	SM	SM
BAM+SM	SM	SM	AP	n/a	SM	SM	SM	SM

BAM Release 2.0 sends only MIR values. BAM Release 2.1 and Prizm Release 2.0 send VLAN and high-priority channel values as well.

For the case where the **Configuration Source** parameter in the AP is set to **BAM**, the SM stores a value for the **Dynamic Learning** VLAN parameter that differs from its factory default. When Prizm does not send VLAN values (because **VLAN Enable** is set to **No** in Prizm), the SM

- uses this stored Disable value for Dynamic Learning.
- shows the following in the VLAN Configuration web page:
    - *either* **Enable** *or* **Disable** as the value of the **Dynamic Learning** parameter.
    - **Allow Learning : No** under **Active Configuration**.

For the case where the **Configuration Source** parameter in the AP is set to **BAM+SM**, and BAM does not send VLAN values, the SM

- uses the configured value in the SM for **Dynamic Learning**. If the SM is set to factory defaults, then this value is **Enable**.
- shows under **Active Configuration** the result of the configured value in the SM. For example, if the SM is set to factory defaults, then the VLAN Configuration page shows **Allow Learning : Yes**.

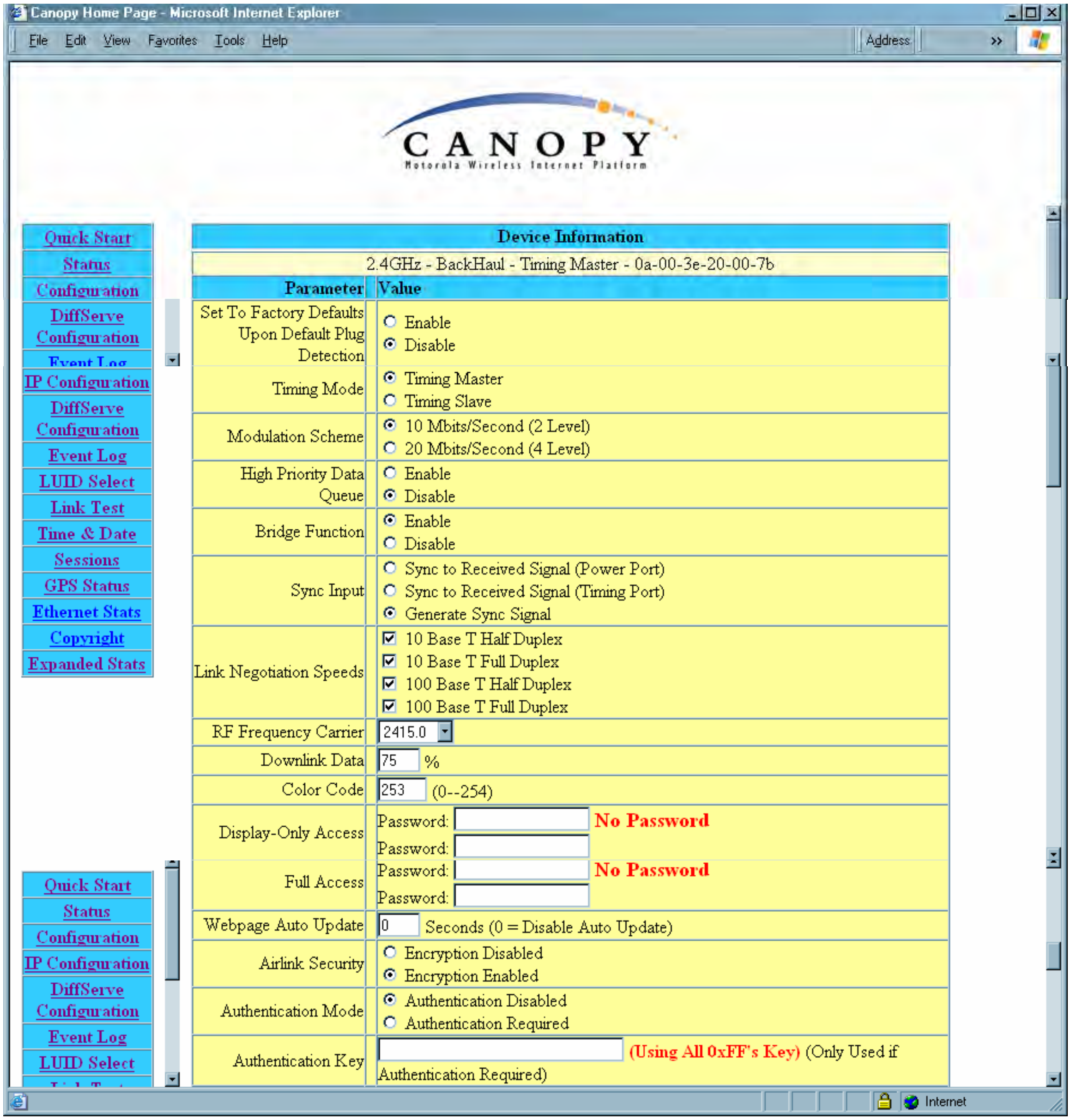
This selection (**BAM+SM**) *is not* recommended where Prizm manages the VLAN feature in SMs.

18.4 CONFIGURING A BH TIMING MASTER FOR THE DESTINATION

NOTE:
The OFDM Series BHs are described in their own dedicated user guides. See Products Not Covered by This User Guide on Page 34.

18.4.1 Configuration Page of the BHM

An example of a BHM Configuration screen is displayed in Figure 102.



Device Information

2.4GHz - BackHaul - Timing Master - 0a-00-3e-20-00-7b

Parameter	Value
Set To Factory Defaults Upon Default Plug Detection	○ Enable ● Disable
Timing Mode	● Timing Master ○ Timing Slave
Modulation Scheme	● 10 Mbits/Second (2 Level) ○ 20 Mbits/Second (4 Level)
High Priority Data Queue	○ Enable ● Disable
Bridge Function	● Enable ○ Disable
Sync Input	○ Sync to Received Signal (Power Port) ○ Sync to Received Signal (Timing Port) ● Generate Sync Signal
Link Negotiation Speeds	☑ 10 Base T Half Duplex ☑ 10 Base T Full Duplex ☑ 100 Base T Half Duplex ☑ 100 Base T Full Duplex
RF Frequency Carrier	2415.0
Downlink Data	75 %
Color Code	253 (0--254)
Display-Only Access	Password: No Password Password:
Full Access	Password: No Password Password:
Webpage Auto Update	0 Seconds (0 = Disable Auto Update)
Airlink Security	○ Encryption Disabled ● Encryption Enabled
Authentication Mode	● Authentication Disabled ○ Authentication Required
Authentication Key	(Using All 0xFF's Key) (Only Used if Authentication Required)

Figure 102: Configuration screen, BHM

The Configuration web page contains all of the configurable parameters that define how the module operates. The first line of information on the Configuration screen echoes the **Device Type** from the Status web page.

You may set the Configuration page parameters as follows.

Device Information

This parameter indicates the frequency band of the module, whether this BH serves as timing master or timing slave, and the MAC address of the module.

Set to Factory Defaults Upon Default Plug Detection

This parameter toggles what occurs when an override plug is detected during a reboot.

- If **Enable** is checked, then all parameters are returned to their factory default values. This parameter is set to **Disable**. You may prefer this setting where a person who has an override plug and access to the module *should not* be able to view what is the current configuration of the module.
- If **Disable** is checked, then the override plug resets the LAN1 IP address to 169.254.1.1 and allows you to access the module through the default configuration *without changing* the configuration. You can then reset the password of the module and view and reset other values. You may prefer this setting where quick recovery from a memory lapse (forgotten IP address or password) is more important than protection against rogue physical access.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 364.

Timing Mode

Select **Timing Master**. This BH will provide sync for the link. Whenever you toggle this parameter to Timing Master from Timing Slave, 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 BHM is made available.

Modulation Scheme

This parameter displays the available modulation rate(s) for the BHM. In a 20-Mbps BHM, either of the available rates is selectable, so that you can specify whether to use the 20-Mbps BH as a 10-Mbps BH. Additionally, with Hardware Scheduling in Hardware Series P9, where the RF environment deteriorates, the 20-Mbps BH pair in Release 7.2.9 or later can automatically adapt its rate to 10 Mbps to preserve the link at a throughput loss of approximately 5%.

The general recommendation for BHs that will remain on Software Scheduling is that they be kept on Release 7.1.4 (not upgraded to 7.2.9 or 7.3.6) because of inherent self interference problems in collocated BHs with Software Scheduling in the later releases.

High Priority Data Queue

Select whether the high-priority channel should be implemented (**Enable**) or not (**Disable**) on this BHM.

Bridge Function

Select whether you want bridge table filtering active (**Enable**) or not (**Disable**) on this BHM. 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.

Sync Input

Specify the type of synchronization for this BH timing master to use.

- Select **Sync to Received Signal (Power Port)** to set this BHM to receive sync from a connected CMMmicro.
- Select **Sync to Received Signal (Timing Port)** to set this BHM to receive sync from a connected CMM2, an AP in the cluster, an SM, or a BH timing slave.
- Select **Generate Sync Signal** where the BHM does not receive sync, and no AP or other BHM is active within the link range.

Link Negotiation 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.

RF 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 137.

Downlink Data

The operator specifies the percentage of the aggregate (uplink and downlink total) throughput that is needed for the downlink. The default percentage depends on the software release.

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 Canopy 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.

Display-Only Access

See Configuring Display-Only and Full Access Passwords on Page 362.

To set this password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Display-Only Access** password, 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 366.

Full Access

If you set the **Full Access** password, this password will allow

- telnet and FTP access to the module.
- *viewing or changing* the parameters of the module.

To set this password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Full Access** password, 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 366.

NOTE:
You can unset either password (revert the access to no password required). To do so, type a space into the field and reboot the module. You must enter any password twice to allow the system to verify that the password is not mistyped. After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field.

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

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.

Airlink Security

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.

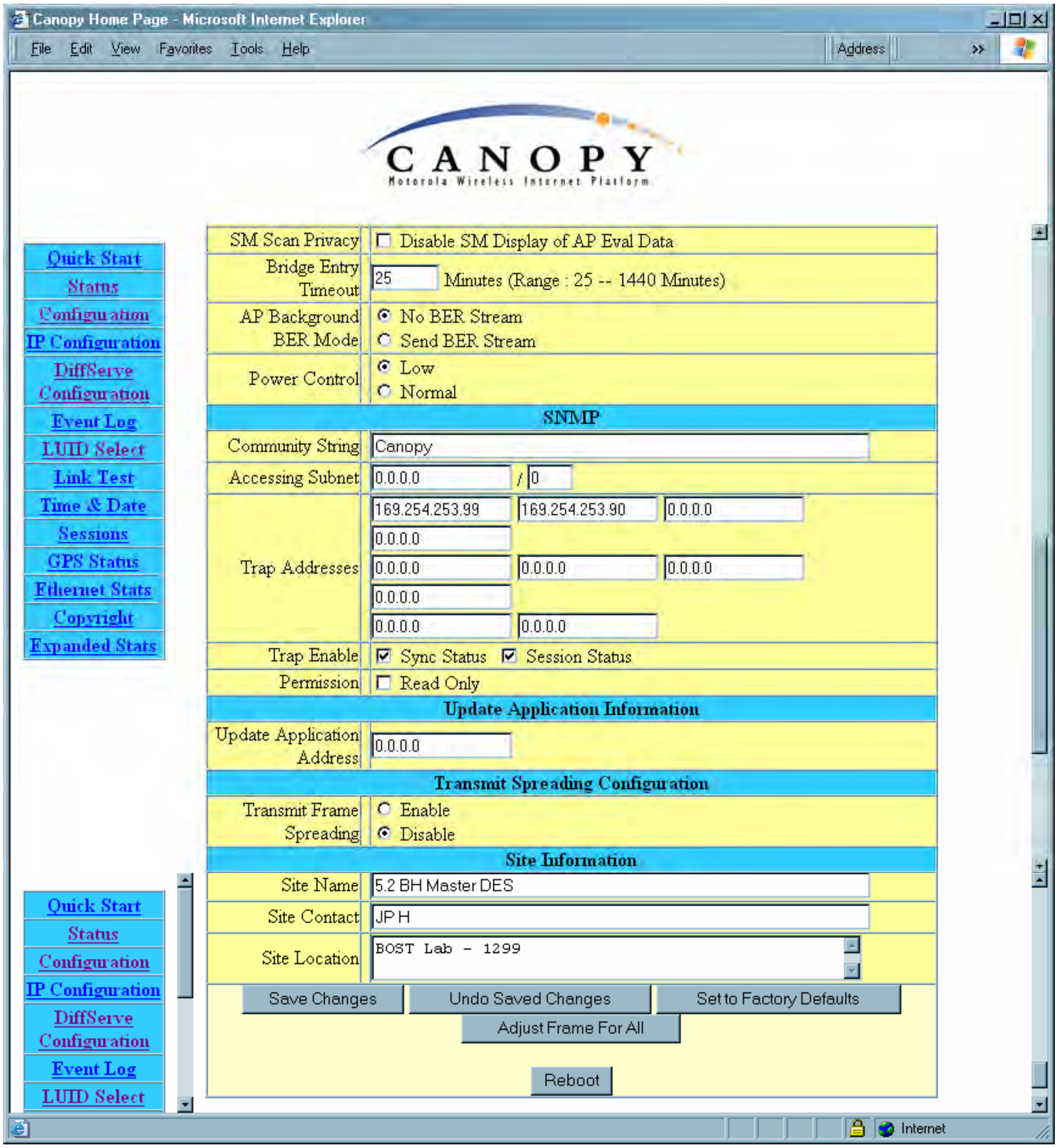
Authentication Mode

This parameter has no effect in the BHM. No BHS is ever required to authenticate in the BHM.

Authentication Key

This parameter has no effect in the BHM. No BHS is ever required to authenticate in the BHM.

As shown in Figure 103, the Configuration page continues with the following parameters.



SM Scan Privacy	□ Disable SM Display of AP Eval Data
Bridge Entry Timeout	25 Minutes (Range : 25 -- 1440 Minutes)
AP Background BER Mode	● No BER Stream ○ Send BER Stream
Power Control	● Low ○ Normal
SNMP	
Community String	Canopy
Accessing Subnet	0.0.0.0 / 0

Trap Addresses	169.254.253.99 169.254.253.90 0.0.0.0
	0.0.0.0
	0.0.0.0 0.0.0.0 0.0.0.0
	0.0.0.0
	0.0.0.0 0.0.0.0

Trap Enable	☑ Sync Status ☑ Session Status
Permission	□ Read Only
Update Application Information	
Update Application Address	0.0.0.0
Transmit Spreading Configuration	
Transmit Frame Spreading	○ Enable ● Disable
Site Information	
Site Name	5.2 BH Master DES
Site Contact	JP H
Site Location	BOST Lab - 1299

Save Changes | Undo Saved Changes | Set to Factory Defaults
Adjust Frame For All
Reboot

Figure 103: Configuration screen, BHM (continued)

SM Scan Privacy

When the SM Scan Privacy feature is enabled, you can use this field to suppress the display of data about this BHM on the AP Eval Data page of the registered BHS.

Bridge Entry Timeout

Specify the appropriate bridge timeout for correct network operation with the existing network infrastructure. The Bridge Entry Timeout should be a longer period than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

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

AP Background BER Mode

Specify whether continuous BER (Bit Error Rate) data collection should be done. When **Send BER Stream** is selected for this parameter, you can read the bit error rate on the BHS side to assess the quality of a registered link. However, when **Send BER Stream** is selected, the aggregate available bandwidth decreases by approximately 200 kbps. For this reason, you should limit BER data collection to diagnostic intervals.

Through Release 7.3.6, BER data collection is not functional where **Scheduling** is set to **Hardware**.

Power Control

In Release 4.1 and later, select either

- **Low** to set the BHM to operate at 18 dB less than full power to reduce the possibility of self-interference with a nearby module.
- **Normal** to allow the BHM to operate at full power.

CAUTION!
Selection of **Low** can cause a link to a distant BHS to drop. If a link drops when Power Control is set to low, the link can be re-established by only Ethernet access.

If you select **Low** and save the changes and reboot the BHM, you should *immediately* open the Link Test page and perform a link test.

Community String

Specify a control string that allows an Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string. The default string is **Canopy**.

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. 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 Addresses

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

- after a reboot of the module.
- when an NMS attempts to access agent information but either
  - supplied an inappropriate community string or SNMP version number.
  - is associated with a subnet to which access is disallowed.

Trap Enable

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

Permission

Select **Read Only** if you wish to disallow any parameter changes by the NMS.

Update Application Address

For capabilities in future software releases, you can enter the address of the server to access for software updates on this BHM.

Transmit Frame Spreading

If you select **Enable**, then a BHS between two BHMs can register in the assigned BHM (not the other BHM). Where the BHS operates on Release 4.0 or later, we strongly recommend 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.

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 Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

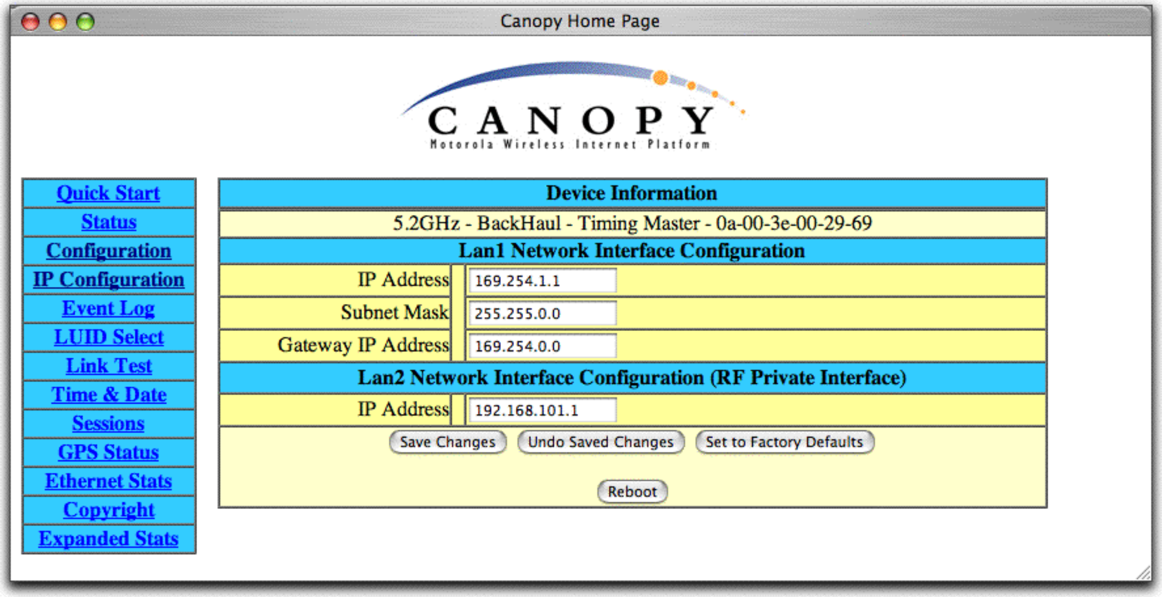
When you click this button

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

Whenever you change a parameter in the Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.4.2 IP Configuration Page of the BHM

An example of a BHM IP Configuration screen is displayed in Figure 104.



Device Information	
5.2GHz - BackHaul - Timing Master - 0a-00-3e-00-29-69	
Lan1 Network Interface Configuration	
IP Address	169.254.1.1
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0
Lan2 Network Interface Configuration (RF Private Interface)	
IP Address	192.168.101.1

Figure 104: IP Configuration screen, BHM

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 366.

> *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.

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 Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

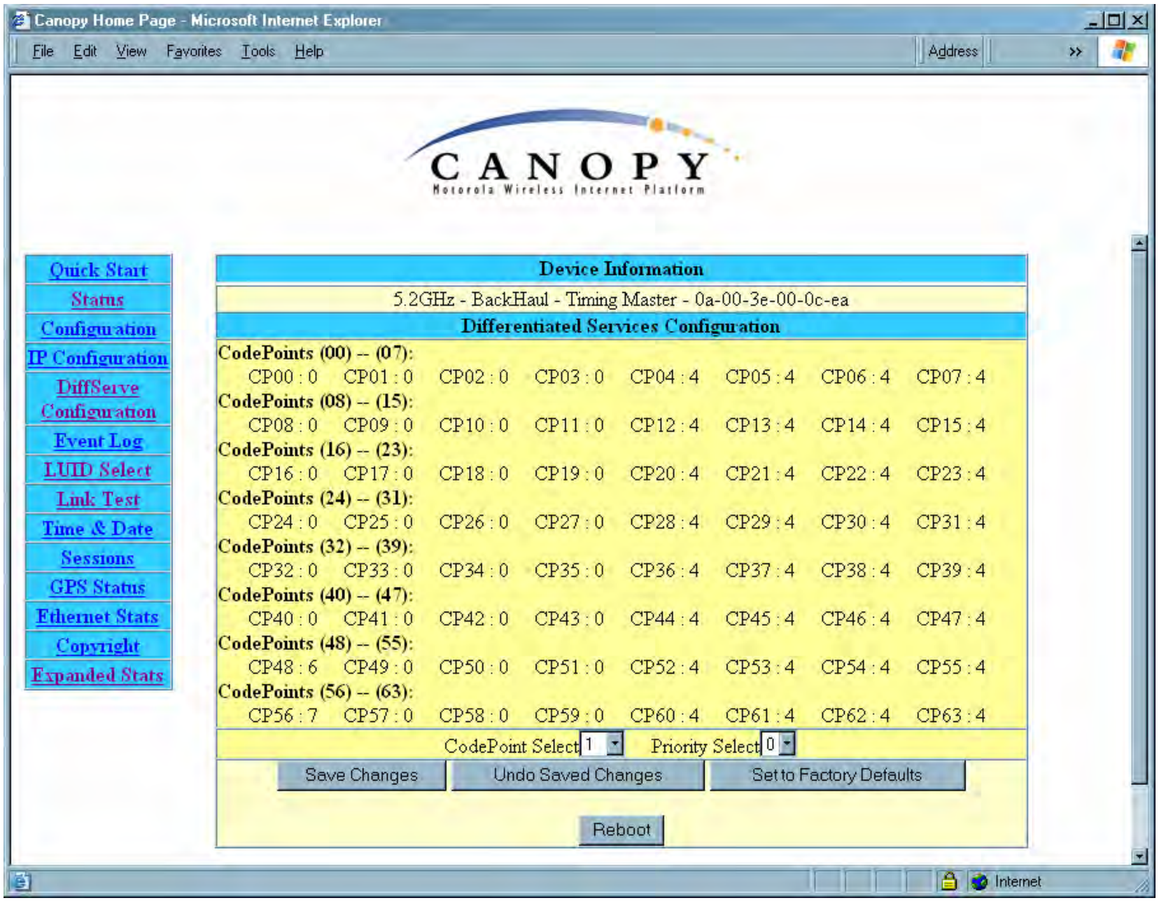
When you click this button

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

Whenever you change a parameter in the IP Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.4.3 Differentiated Services Configuration Page of the BHM

An example of the BHM Differentiated Services Configuration page is displayed in Figure 105.



Device Information

5.2GHz - BackHaul - Timing Master - 0a-00-3e-00-0c-ea

Differentiated Services Configuration

CodePoints (00) -- (07):
CP00 : 0 CP01 : 0 CP02 : 0 CP03 : 0 CP04 : 4 CP05 : 4 CP06 : 4 CP07 : 4

CodePoints (08) -- (15):
CP08 : 0 CP09 : 0 CP10 : 0 CP11 : 0 CP12 : 4 CP13 : 4 CP14 : 4 CP15 : 4

CodePoints (16) -- (23):
CP16 : 0 CP17 : 0 CP18 : 0 CP19 : 0 CP20 : 4 CP21 : 4 CP22 : 4 CP23 : 4

CodePoints (24) -- (31):
CP24 : 0 CP25 : 0 CP26 : 0 CP27 : 0 CP28 : 4 CP29 : 4 CP30 : 4 CP31 : 4

CodePoints (32) -- (39):
CP32 : 0 CP33 : 0 CP34 : 0 CP35 : 0 CP36 : 4 CP37 : 4 CP38 : 4 CP39 : 4

CodePoints (40) -- (47):
CP40 : 0 CP41 : 0 CP42 : 0 CP43 : 0 CP44 : 4 CP45 : 4 CP46 : 4 CP47 : 4

CodePoints (48) -- (55):
CP48 : 6 CP49 : 0 CP50 : 0 CP51 : 0 CP52 : 4 CP53 : 4 CP54 : 4 CP55 : 4

CodePoints (56) -- (63):
CP56 : 7 CP57 : 0 CP58 : 0 CP59 : 0 CP60 : 4 CP61 : 4 CP62 : 4 CP63 : 4

CodePoint Select 1 Priority Select 0

Figure 105: Differentiated Services Configuration screen, BHM

You may set the following Differentiated Services Configuration page parameters.

CodePoint 1 through CodePoint 47

CodePoint 49 through CodePoint 55

CodePoint 57 through CodePoint 63

The default priority value for each settable CodePoint is shown in Figure 109. 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

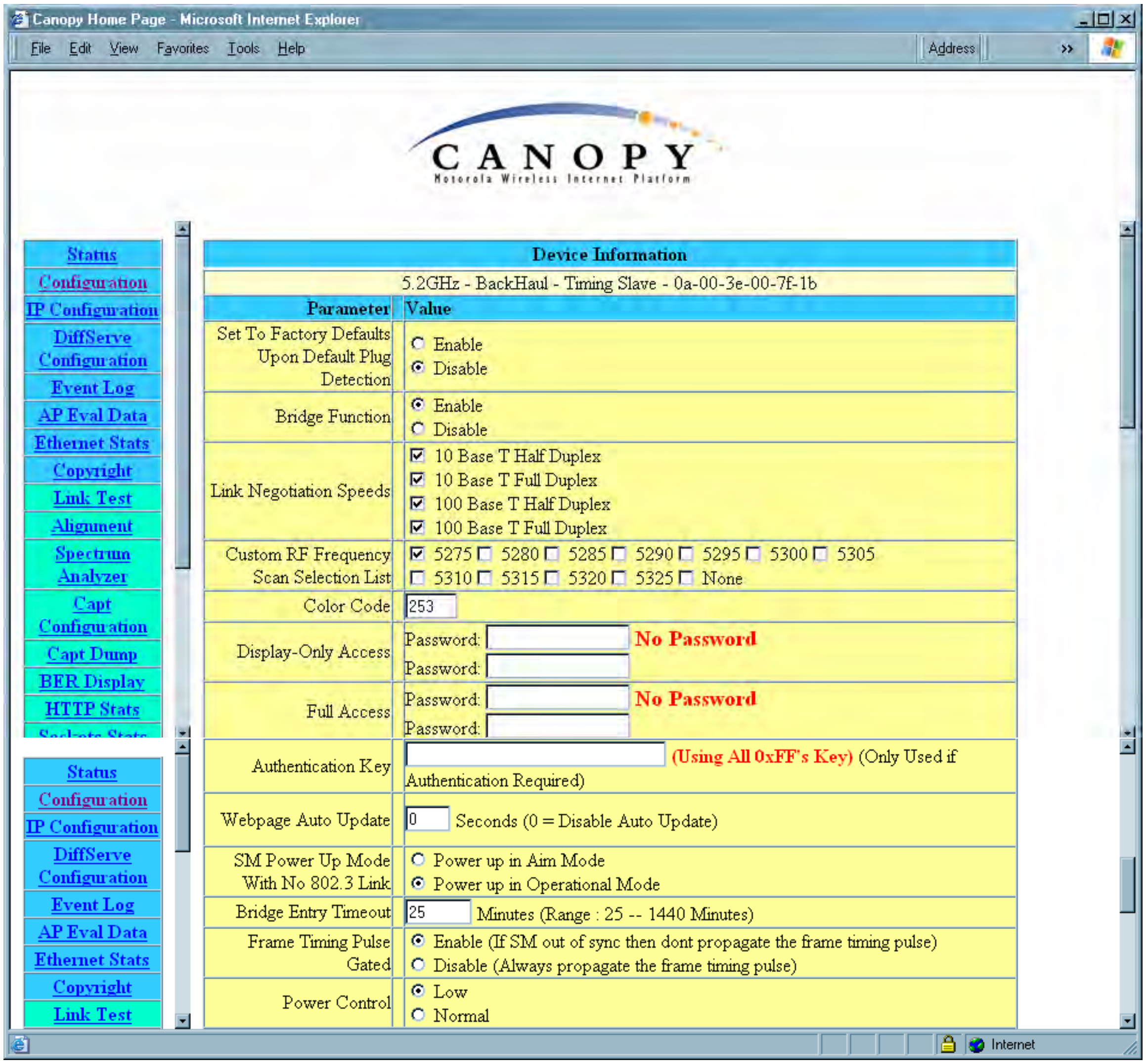
- **CodePoint 0** is predefined to a fixed priority value of **0** (low-priority channel).
- **CodePoint 48** is predefined to a fixed priority value of **6** (high-priority channel).
- **CodePoint 56** is predefined to a fixed priority value of **7** (high-priority channel).

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 90.

18.5 CONFIGURING A BH TIMING SLAVE FOR THE DESTINATION

18.5.1 Configuration Page of the BHS

An example of a BHS Configuration screen is displayed in Figure 106.



Device Information

5.2GHz - BackHaul - Timing Slave - 0a-00-3e-00-7f-1b

Parameter	Value
Set To Factory Defaults Upon Default Plug Detection	○ Enable ● Disable
Bridge Function	● Enable ○ Disable
Link Negotiation Speeds	☑ 10 Base T Half Duplex ☑ 10 Base T Full Duplex ☑ 100 Base T Half Duplex ☑ 100 Base T Full Duplex
Custom RF Frequency Scan Selection List	☑ 5275 □ 5280 □ 5285 □ 5290 □ 5295 □ 5300 □ 5305 □ 5310 □ 5315 □ 5320 □ 5325 □ None
Color Code	253
Display-Only Access	Password: No Password Password:
Full Access	Password: No Password Password:
Authentication Key	(Using All 0xFF's Key) (Only Used if Authentication Required)
Webpage Auto Update	0 Seconds (0 = Disable Auto Update)
SM Power Up Mode With No 802.3 Link	○ Power up in Aim Mode ● Power up in Operational Mode
Bridge Entry Timeout	25 Minutes (Range : 25 -- 1440 Minutes)
Frame Timing Pulse Gated	● Enable (If SM out of sync then dont propagate the frame timing pulse) ○ Disable (Always propagate the frame timing pulse)
Power Control	● Low ○ Normal

Figure 106: Configuration screen, BHS

The Configuration web page contains all of the configurable parameters that define how the module operates. The first line of information on the Configuration screen echoes the **Device Type** from the Status web page.

You may set the following Configuration page parameters.

Set to Factory Defaults Upon Default Plug Detection

This parameter toggles what occurs when an override plug is detected during a reboot.

- If **Enable** is checked, then all parameters are returned to their factory default values. This parameter is set to **Disable**. You may prefer this setting where a person who has an override plug and access to the module *should not* be able to view what is the current configuration of the module.
- If **Disable** is checked, then the override plug resets the LAN1 IP address to 169.254.1.1 and allows you to access the module through the default configuration *without changing* the configuration. You can then reset the password of the module and view and reset other values. You may prefer this setting where quick recovery from a memory lapse (forgotten IP address or password) is more important than protection against rogue physical access.

See Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH on Page 364.

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.)

Modulation Scheme

This parameter sets the available modulation rate(s) for the BHS. In a 20-Mbps BHS, either of the available rates is selectable, so that you can specify whether to use the 20-Mbps BH as a 10-Mbps BH. Additionally, in Hardware Series P9, where the RF environment deteriorates, the 20-Mbps BH pair in Release 7.2.9 or later can automatically adapt its rate to 10 Mbps to preserve the link at a throughput loss of approximately 5%.

The general recommendation for BHs that will remain on Software Scheduling is that they be kept on Release 7.1.4 (not upgraded to 7.2.9 or 7.3.6) because of inherent self interference problems in collocated BHs with Software Scheduling in the later releases.

High Priority Data Queue

Select whether the high-priority channel should be implemented (**Enable**) or not (**Disable**) on this BHS.

Bridge Function

Select whether you want bridge table filtering active (**Enable**) or not (**Disable**) on this BHM. 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.

Link Negotiation 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.

Custom RF 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 138.

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 137.

(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 Canopy 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.

Display-Only Access

See Configuring Display-Only and Full Access Passwords on Page 362.

To set this password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Display-Only Access** password, 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 366.

Full Access

If you set the **Full Access** password, this password will allow

- telnet and FTP access to the module.
- *viewing or changing* the parameters of the module.

To set this password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a telnet or FTP session prompts for this password, you must enter the user name `root` in addition to the password.

If you set and then forget the **Full Access** password, 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 366.

NOTE:
You can unset either password (revert the access to no password required). To do so, type a space into the field and reboot the module. You must enter any password twice to allow the system to verify that the password is not mistyped. After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field.

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

Authentication Key

This parameter has no effect in the BHS. No BHS is ever required to authenticate in the BHM.

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.

SM Power Up Mode With No 802.3 Link

Specify the default mode in which this BHS will power up when the BHS 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. This is the default selection.
- **Power Up in Operational Mode**—the BHS boots in Operational mode and attempts registration.

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.

Frame Timing Pulse Gated

If this BHS extends the sync pulse to a BHM or an AP, 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 SM loses sync.
- **Disable**—If this BHS loses sync, then propagate the sync pulse to the BHM or AP.

See Wiring to Extend Network Sync on Page 360.

Power Control

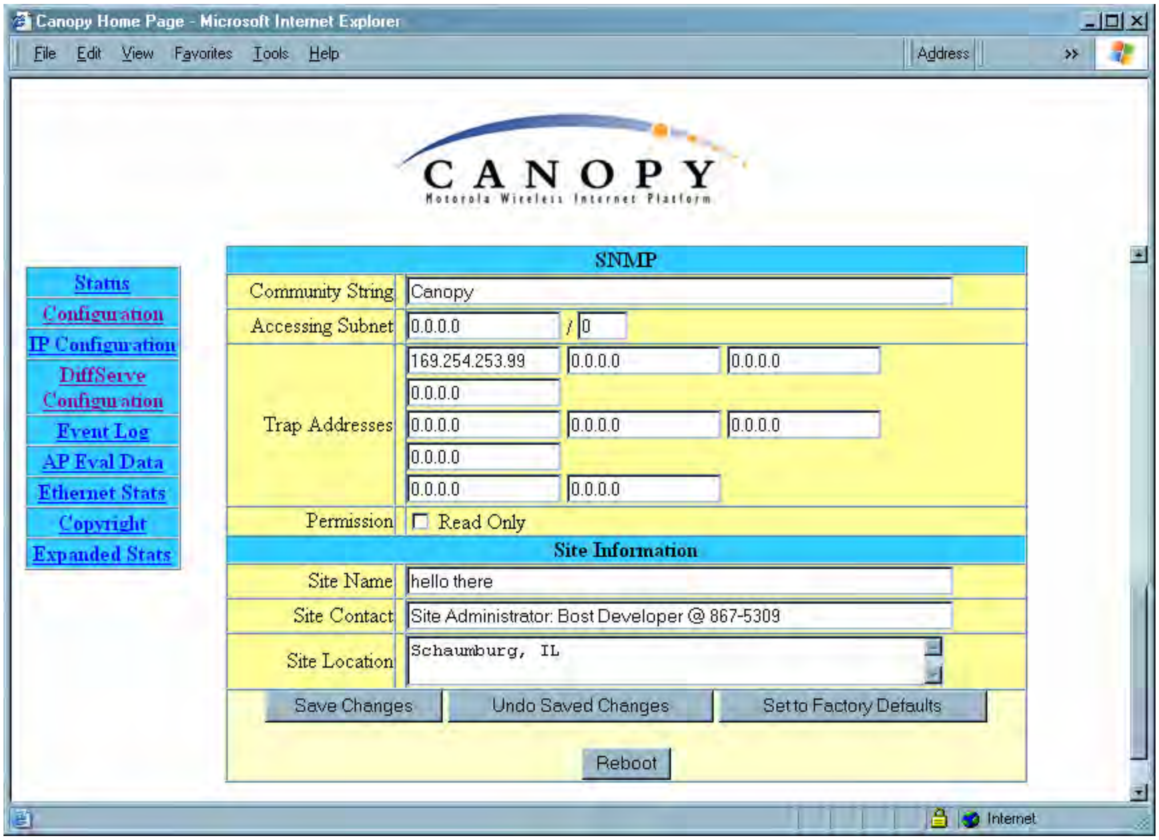
In Release 4.1 and later, select either

- **Low** to set the BHS to operate at 18 dB less than full power (for one-eighth the range) to reduce the possibility of self-interference with a nearby module.
- **Normal** to allow the BHS to operate at full power.

> ***CAUTION!***
> Selection of **Low** can cause a link to a distant BHM to drop. If a link drops when Power Control is set to low, the link can be re-established by only Ethernet access.

If you select **Low** and save the changes and reboot the BHS, you should *immediately* open the Link Test page and perform a link test. In some modules, you can specify the power in dB.

As shown in Figure 107, the Configuration page continues.



SNMP	
Community String	Canopy
Accessing Subnet	0.0.0.0 / 0
Trap Addresses	169.254.253.99 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
Permission	□ Read Only
Site Information	
Site Name	hello there
Site Contact	Site Administrator: Bost Developer @ 867-5309
Site Location	Schaumburg, IL

Figure 107: Configuration screen, BHS (continued)

Community String

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

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. 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.

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

The default treatment is to allow all networks access (set to 0).

Trap Addresses

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

- after a reboot of the module.
- when an NMS attempts to access agent information but either
    - supplied an inappropriate community string or SNMP version number.
    - is associated with a subnet to which access is disallowed.

Permission

Select **Read Only** if you wish to disallow any parameter changes by the 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 Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

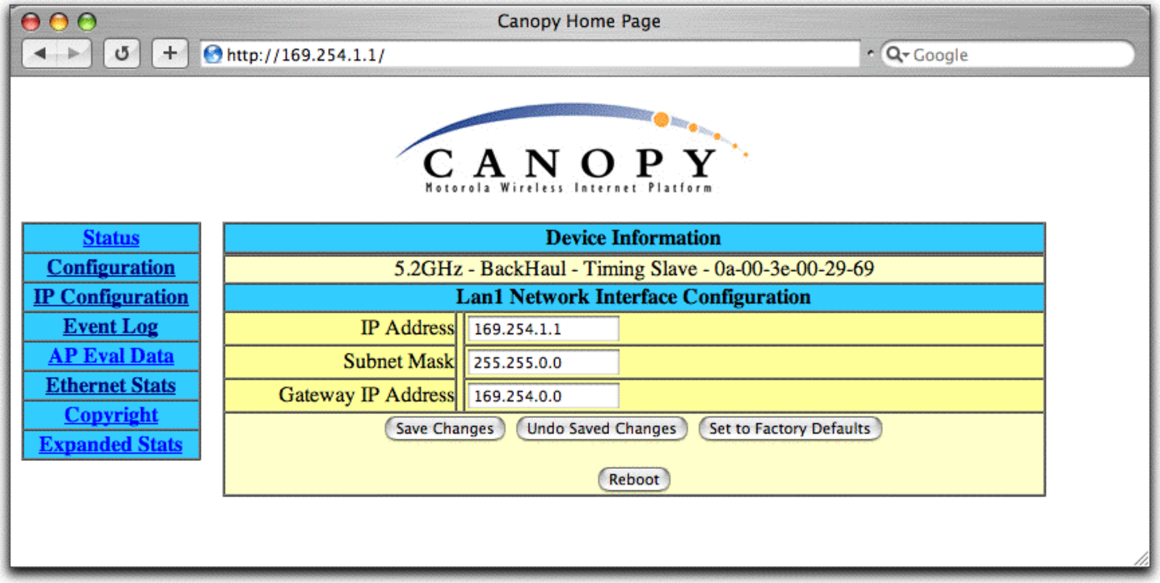
When you click this button

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

Whenever you change a parameter in the Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.5.2 IP Configuration Page of the BHS

An example of the BHS IP Configuration page is displayed in Figure 108.



Device Information	
5.2GHz - BackHaul - Timing Slave - 0a-00-3e-00-29-69	
Lan1 Network Interface Configuration	
IP Address	169.254.1.1
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 108: IP Configuration screen, BHS

You may set the following IP Configuration page 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 366.

> *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.

The IP Configuration page 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.

Undo Saved Changes

When you click this button, any changes that you made but were not committed by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all configurable pages* are reset to the factory settings.

Reboot

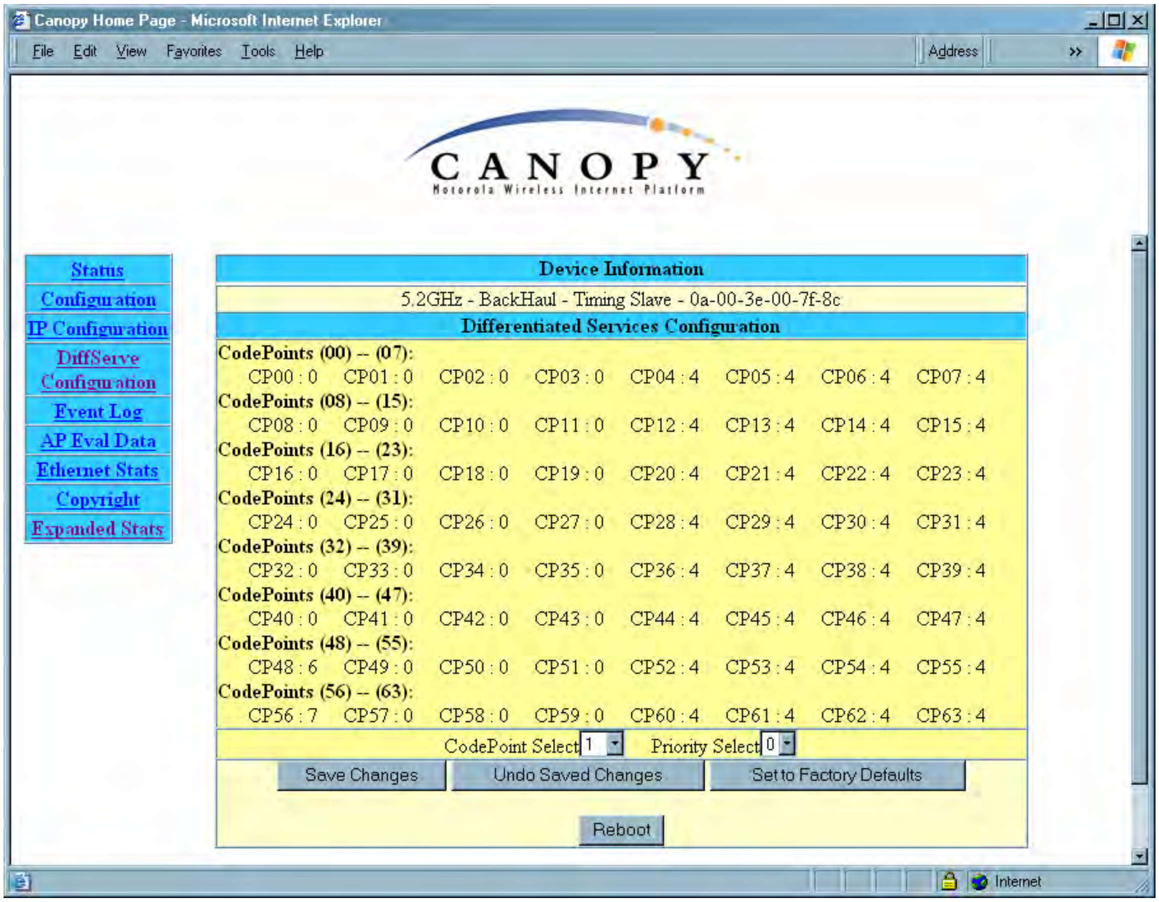
When you click this button

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

Whenever you change a parameter in the IP Configuration page, the system highlights the **Reboot** button as a reminder that a reboot (in addition to a save) is required to implement the changes.

18.5.3 Differentiated Services Configuration Page of the BHS

An example of the BHS Differentiated Services Configuration page is displayed in Figure 109.



Device Information

5.2GHz - BackHaul - Timing Slave - 0a-00-3e-00-7f-8c

Differentiated Services Configuration

CodePoints (00) -- (07):
CP00 : 0 CP01 : 0 CP02 : 0 CP03 : 0 CP04 : 4 CP05 : 4 CP06 : 4 CP07 : 4

CodePoints (08) -- (15):
CP08 : 0 CP09 : 0 CP10 : 0 CP11 : 0 CP12 : 4 CP13 : 4 CP14 : 4 CP15 : 4

CodePoints (16) -- (23):
CP16 : 0 CP17 : 0 CP18 : 0 CP19 : 0 CP20 : 4 CP21 : 4 CP22 : 4 CP23 : 4

CodePoints (24) -- (31):
CP24 : 0 CP25 : 0 CP26 : 0 CP27 : 0 CP28 : 4 CP29 : 4 CP30 : 4 CP31 : 4

CodePoints (32) -- (39):
CP32 : 0 CP33 : 0 CP34 : 0 CP35 : 0 CP36 : 4 CP37 : 4 CP38 : 4 CP39 : 4

CodePoints (40) -- (47):
CP40 : 0 CP41 : 0 CP42 : 0 CP43 : 0 CP44 : 4 CP45 : 4 CP46 : 4 CP47 : 4

CodePoints (48) -- (55):
CP48 : 6 CP49 : 0 CP50 : 0 CP51 : 0 CP52 : 4 CP53 : 4 CP54 : 4 CP55 : 4

CodePoints (56) -- (63):
CP56 : 7 CP57 : 0 CP58 : 0 CP59 : 0 CP60 : 4 CP61 : 4 CP62 : 4 CP63 : 4

CodePoint Select 1 Priority Select 0

Figure 109: Differentiated Services Configuration screen, BHS

You may set the following Differentiated Services Configuration page parameters.

CodePoint 1 through CodePoint 47

CodePoint 49 through CodePoint 55

CodePoint 57 through CodePoint 63

The default priority value for each settable CodePoint is shown in Figure 109. 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 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).

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 90.

18.6 ADJUSTING TRANSMITTER OUTPUT POWER

Authorities may require transmitter output power levels to be adjustable and/or lower than the highest that a module produces. Canopy 2.4-GHz modules with Release 4.2.7 or later and 5.4-GHz modules include a Configuration page parameter to reduce power on an infinite scale to achieve compliance.

The professional installer of Canopy 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 900-MHz and 5.7-GHz Canopy radios is stated in Table 56.

Table 56: Total gain per antenna

Antenna	Antenna Gain	Cable Loss	Net Gain
900-MHz Integrated	12.5 dBi	0.5 dB	12 dBi
900-MHz Connectorized[1]	10 to 10.5 dBi	0.5 dB	10 dBi
5.7-GHz Connectorized	settable	0.5 dB + from any additional cable	See Note 2

NOTES:

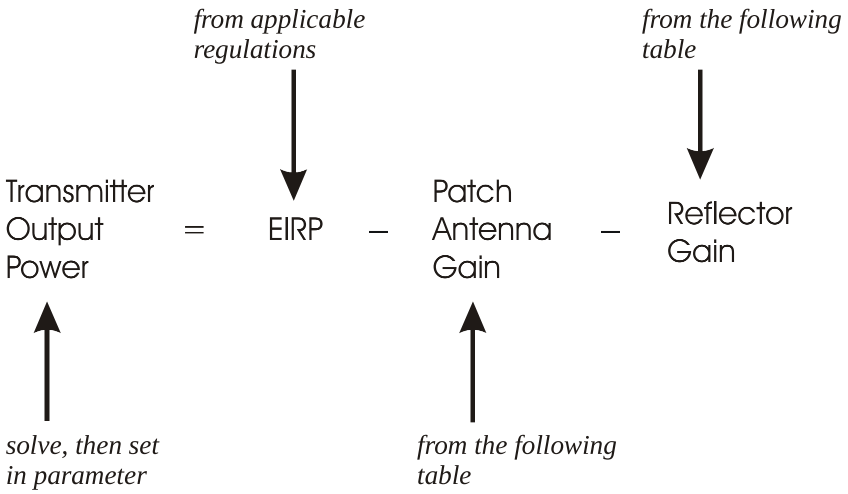
1. With Mars, MTI, or Maxrad antenna.
2. Antenna gain minus cable loss.

Integrated patch antenna and reflector gains are provided in Table 57.

Table 57: Patch antenna and reflector gain

Frequency Band Range	Gain	
	Patch Antenna	Reflector
2.4 GHz	8 dBi	11dBi
5.2, 5.4, or 5.7 GHz	7 dBi	18dBi

The calculation of transmitter output power is as follows:



Transmitter output power is settable as dBm on the Configuration page of the module. Example cases of transmitter output power settings are shown in Table 58.

Table 58: 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	100 mW (20 dBm)	12 dBm	1 dBm
5.4 GHz Integrated	CEPT states	1 W (30 dBm)	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. In Release 7.1.4 and later, this is the default setting, and 28 dBm is the highest settable value. In earlier releases, 28 dBm is the default. The lower default correlates to 36 dBm EIRP where 10-dBi antennas are used. In either case, the default setting for this parameter is applied whenever **Set to Factory Defaults** is selected.

19 INSTALLING COMPONENTS

RECOMMENDATION:
Use *shielded* cable for all Canopy 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 CANOPY MODULES

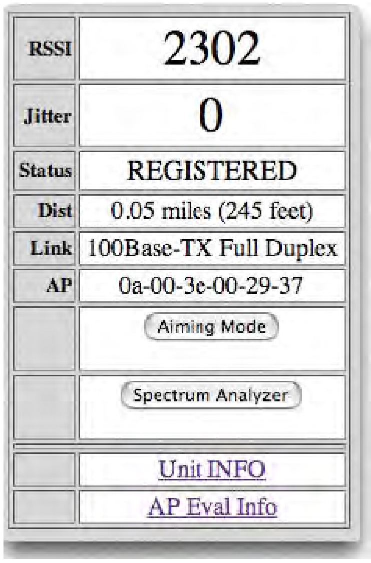
For RF spectrum analysis or module aiming on a roof or tower, a personal digital assistant (PDA) is easier to carry than, and as convenient to use as, a notebook computer. In Release 4.2 and later, the PDA is more convenient to use than in previous releases because no scrolling is required to view

- spectrum analysis results.
- received signal strength indicator (RSSI) and jitter. (See Figure 110.)
- AP evaluation data. (See Figure 111.)
- information that identifies the module, software, and firmware. (See Figure 112.)

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

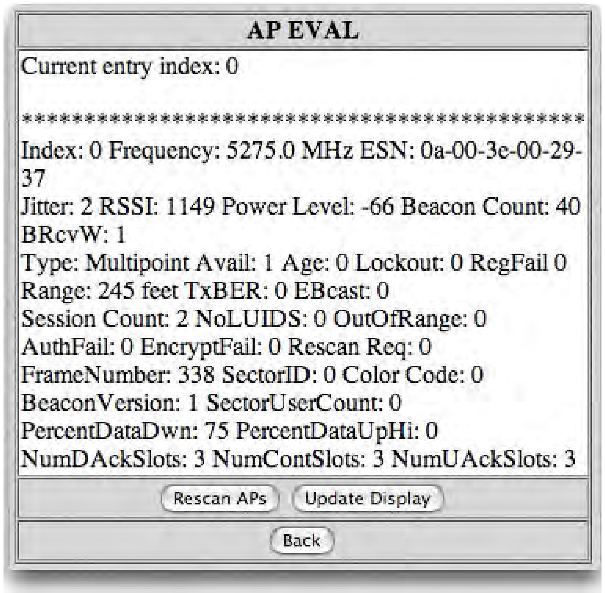
- a Compact Flash card slot.
- any of several Compact Flash wired Ethernet cards.
- a wired Ethernet connection to the module.
- a browser directed to http://*ModuleIPAddress*/pda.html.

The initial page shows signal information as in Figure 110. For additional information about the Spectrum Analyzer feature in an SM or BHS, see Monitoring the RF Environment on Page 350.



RSSI	2302
Jitter	0
Status	REGISTERED
Dist	0.05 miles (245 feet)
Link	100Base-TX Full Duplex
AP	0a-00-3e-00-29-37

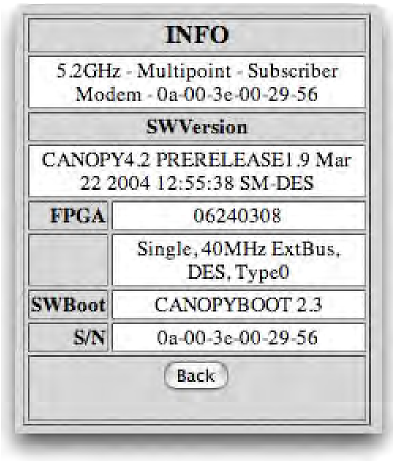
Figure 110: Signal information screen for PDA access, Release 4.2



AP EVAL

```
Current entry index: 0

*********************************************
Index: 0 Frequency: 5275.0 MHz ESN: 0a-00-3e-00-29-
37
Jitter: 2 RSSI: 1149 Power Level: -66 Beacon Count: 40
BRcvW: 1
Type: Multipoint Avail: 1 Age: 0 Lockout: 0 RegFail 0
Range: 245 feet TxBER: 0 EBcast: 0
Session Count: 2 NoLUIDS: 0 OutOfRange: 0
AuthFail: 0 EncryptFail: 0 Rescan Req: 0
FrameNumber: 338 SectorID: 0 Color Code: 0
BeaconVersion: 1 SectorUserCount: 0
PercentDataDwn: 75 PercentDataUpHi: 0
NumDAckSlots: 3 NumContSlots: 3 NumUAckSlots: 3
```

Figure 111: AP Evaluation screen for PDA access, Release 4.2



INFO	
5.2GHz - Multipoint - Subscriber Modem - 0a-00-3e-00-29-56	
SWVersion	
CANOPY4.2 PRERELEASE1.9 Mar 22 2004 12:55:38 SM-DES	
FPGA	06240308
	Single, 40MHz ExtBus, DES, Type0
SWBoot	CANOPYBOOT 2.3
S/N	0a-00-3e-00-29-56

Figure 112: Module information screen for PDA access, Release 4.2

19.2 INSTALLING AN AP

To install the Canopy AP, perform the following steps.

Procedure 22: 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.
   NOTE: Canopy products offer no software utility for alignment of APs or Backhaul timing master modules.
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 Canopy 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 Canopy 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 Canopy 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 Canopy 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 54 on Page 176.)
6. Attach the cables to the AP.
(See Procedure 5 on Page 183.)

NOTE: When power is applied to a Canopy 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 46 on Page 177.

========================== **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 Motorola (Part Number SMMB-1 and consisting of a mounting bracket and L-shaped aluminum tube) holds one Canopy 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 59.

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 Canopy 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.

AP Configuration parameters for the connected antenna are described under

- Max Range on Page 240.
- External Filters Delay on Page 241.

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 23: 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 113.
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** ============================

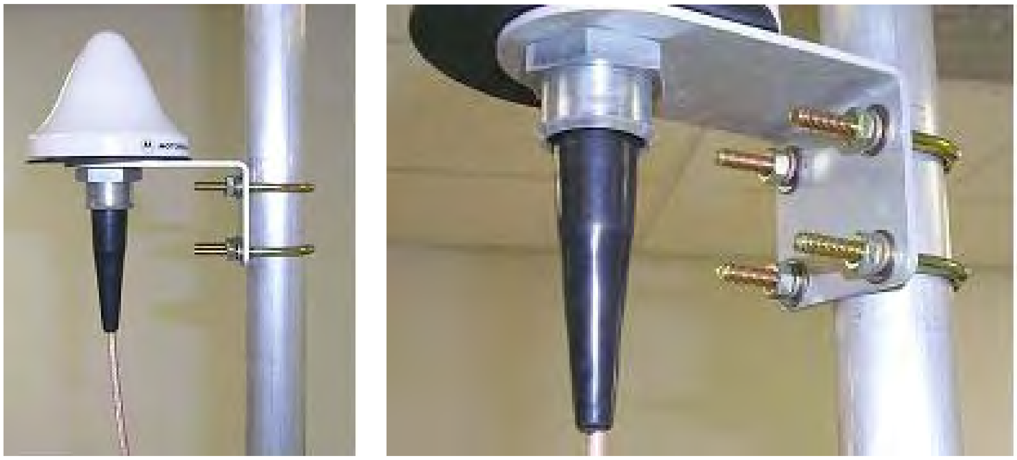


Figure 113: Detail of GPS antenna mounting

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 24: 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 114.
   b. attach the CMM2 flanges to the V-bracket.

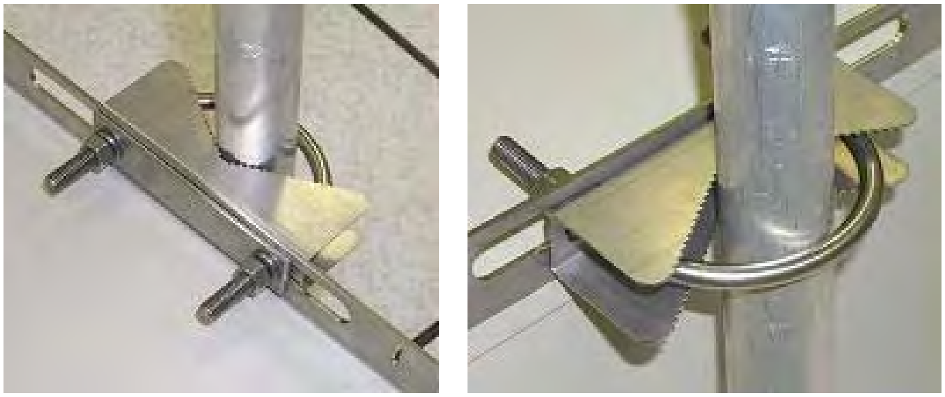


Figure 114: Detail of pole mounting

============================ **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 25: Cabling the CMM2

1. Carefully review the practices recommended in Best Practices for Cabling on Page 180.
2. Remove the base cover from any AP or BH that is to be connected to this CMM2. See Figure 54 on Page 176.
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 115.

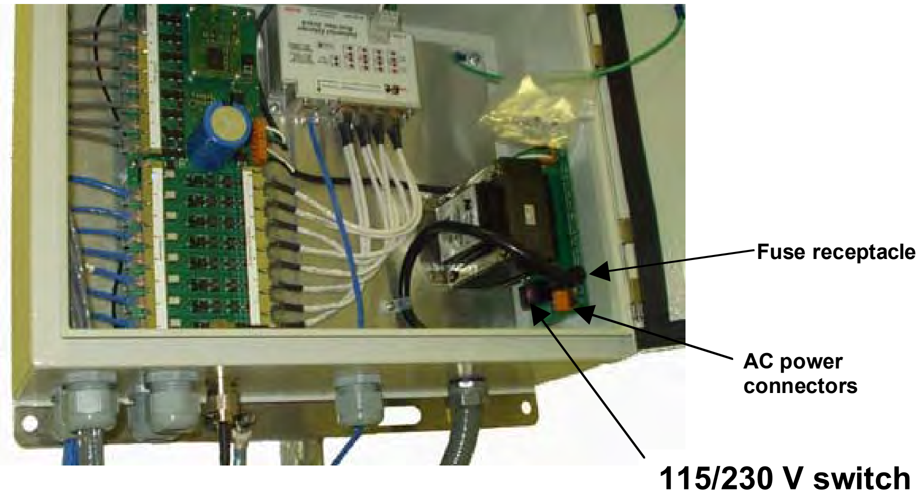


Figure 115: Location of 115-/230-volt switch

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 116.

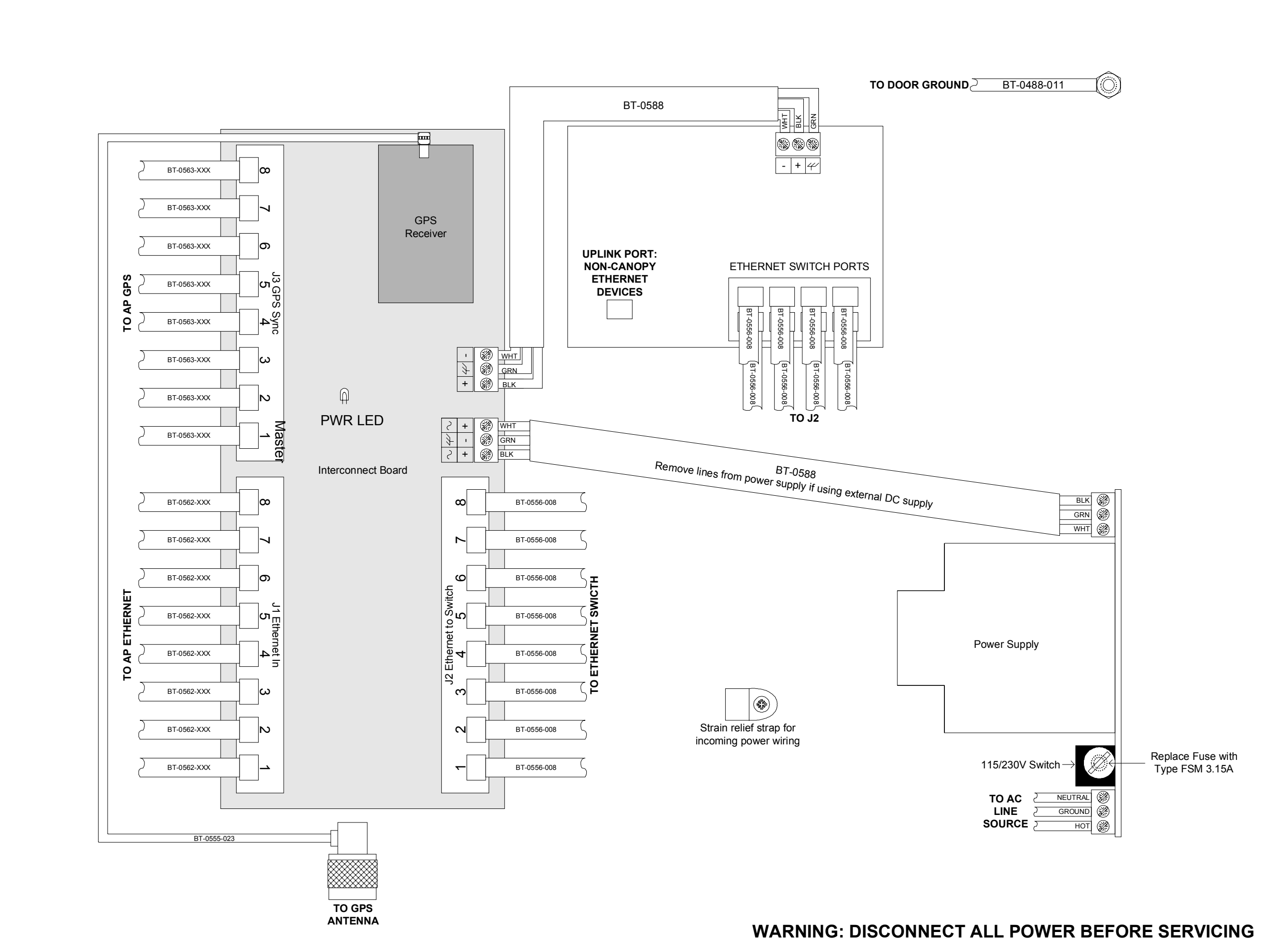


Figure 116: Layout of logical connections in CMM2

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 117 on Page 328 is a photograph of a properly wired CMM2.

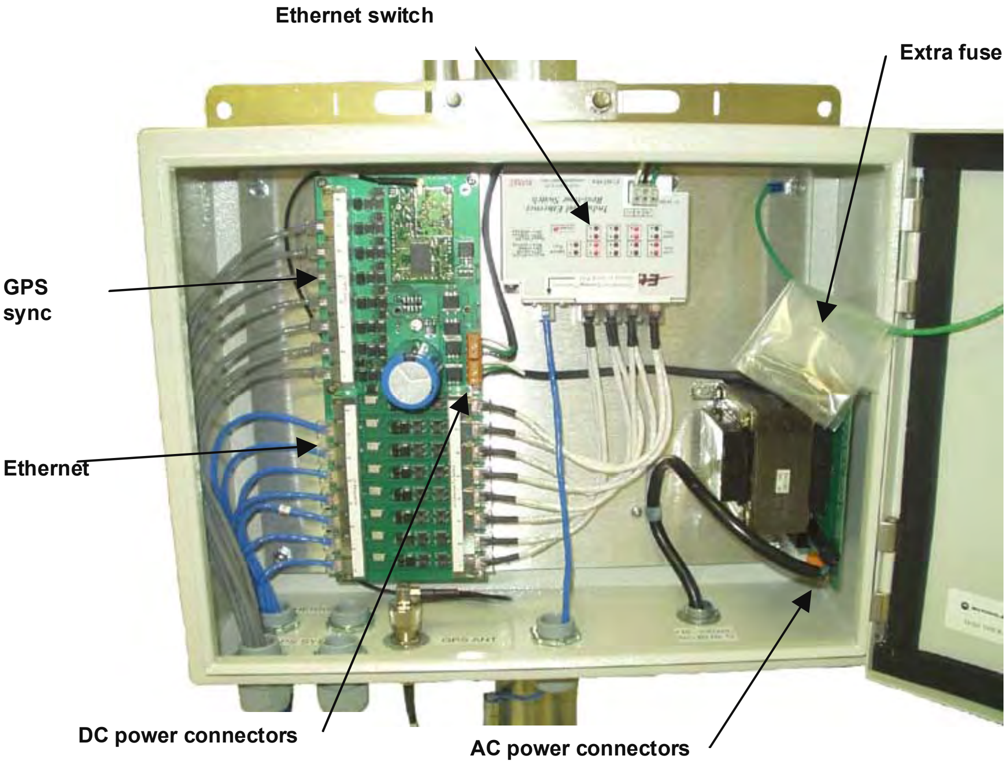


Figure 117: Canopy CMM2, front view

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 117 on Page 328.

    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 Canopy Surge Suppressor provides proper grounding for this situation.

NOTE: Instructions for installing a Canopy Surge Suppressor are provided in Procedure 31: Installing the SM on Page 333.

14. Connect GPS coaxial cable to the N-connector on the outside of the CMM2. See Figure 55 on Page 178.
15. Connect AC or DC power to the CMM2, consistent with Figure 116 on Page 327.
    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 118.

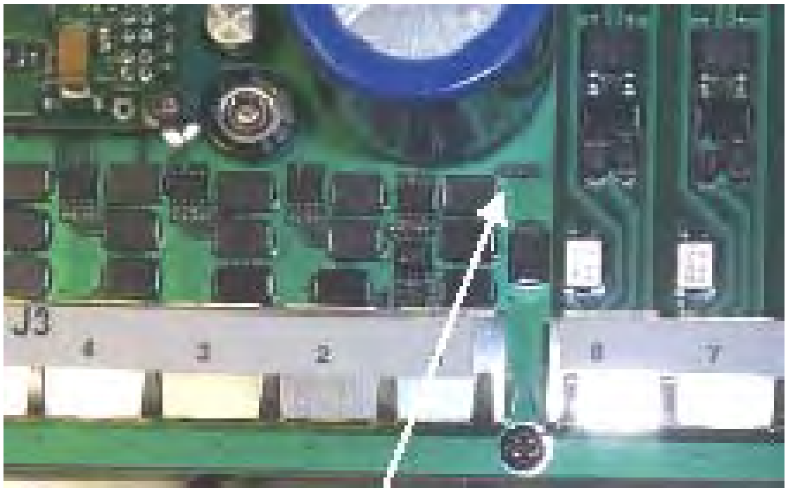


Figure 118: Port indicator LED on Ethernet switch

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 26: Verifying CMM2 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** ============================

19.6 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 Installation 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 27: 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 of the CMMmicro for service.
2. Select a support structure to which the flanges of the CMMmicro 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
   a. attach the V-bracket to the pole as shown in Figure 114 on Page 325.
   b. 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 28: 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 CMMmicro 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 CMMmicro 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 59: Wire size for CMMmicro power runs of longer than 9 feet (2.8 m)

DC Power Cord Length		Proper Wire Size
Where Hardware Scheduling and/or 2X Operation is Enabled	**Where Software Scheduling is Implemented**	
90 ft (~25 m)	270 ft (~80 m)	12 AWG (4 mm^2)
145 ft (~45 m)	450 ft (~140 m)	10 AWG (6 mm^2)
230 ft (~70 m)	675 ft (~205 m)	8 AWG (10 mm^2)
	950 ft (~290 m)	6 AWG (16 mm^2)

3. Refer to Figure 75: CMMmicro connections on Page 219.
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 29: Cabling the CMMmicro

1. Remove the base cover from any AP or BH that is to be connected to this CMMmicro. See Figure 54 on Page 176.
2. Review the schematic drawing inside the CMMmicro and see Figure 75: CMMmicro connections on Page 219.
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 in 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 Canopy 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 Canopy Surge Suppressor provides proper grounding for this situation.
    NOTE: Instructions for installing a Canopy Surge Suppressor are provided as part of Procedure 31: Installing the SM on Page 333.
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 30: 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 31).
- 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 32 on Page 337).

Procedure 31: 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, Motorola offers the SMMB-1 mounting bracket. For mounting 900 MHz SMs, Motorola offers the SMMB-2 mounting bracket.)
3. Remove the base cover of the SM. (See Figure 54 on Page 176.)
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 187.
5. Optionally, attach the SM to the arm of the Canopy Passive Reflector dish assembly as shown in Figure 119.

> *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.

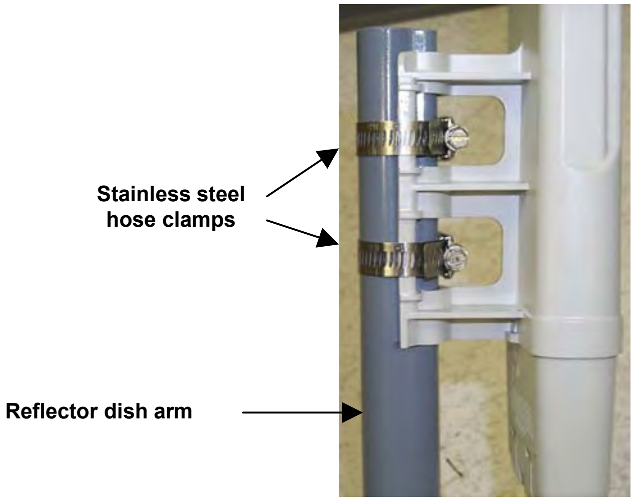


Figure 119: SM attachment to reflector arm

6. Use stainless steel hose clamps or equivalent fasteners to lock the SM into position.
   NOTE: The SM grounding method is shown in Figure 120.

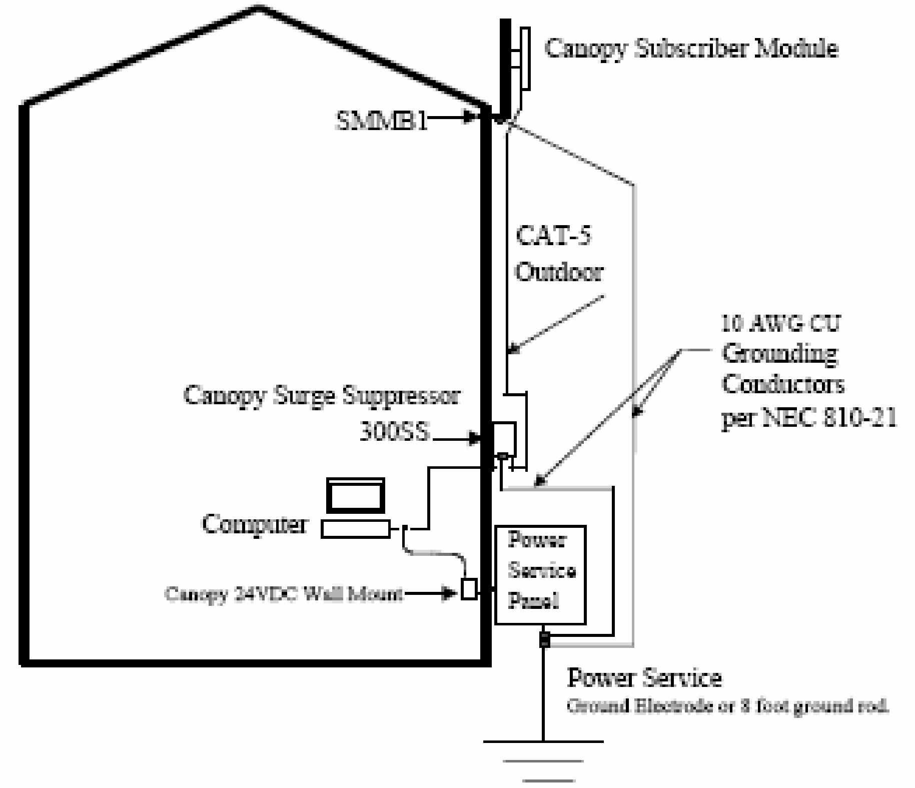
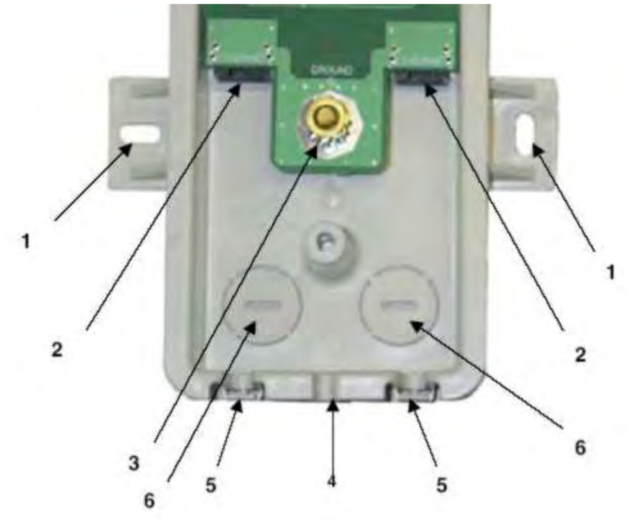


Figure 120: SM grounding per NEC specifications

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 Canopy 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 121: Internal view of Canopy 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 171.
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. Inside the residence or building, connect the Ethernet cable to the Canopy power adaptor, and connect the Canopy power adaptor pig tail to the Ethernet port of a powered-up computer (laptop, desktop, or PDA) to ensure the SM is in Operational Mode. Alternatively, the SM can be pre-configured on the Configuration page to power up in Operational Mode even when no 802.3 link is attached.

> ***NOTE:***
> Connecting the Ethernet cable to a powered-up computer ensures that the SM is in Operational Mode, which is *required for the Alignment Tone* in the next step. Somewhat counterintuitively, a module must be in Operational Mode, not Aim Mode, to use the Alignment Tone. The factory default is to power up in Aim Mode when no 802.3 (Ethernet) link is attached. When the SM senses an Ethernet link or is reconfigured (in its Configuration web page) to power up in Operational Mode, it changes to Operational Mode.

19. For coarse alignment of the SM, use the Audible Alignment Tone feature (Release 4.0 and later) as follows:
    - a. If the Configuration web page of the SM contains a **2X Rate** parameter, set it 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.

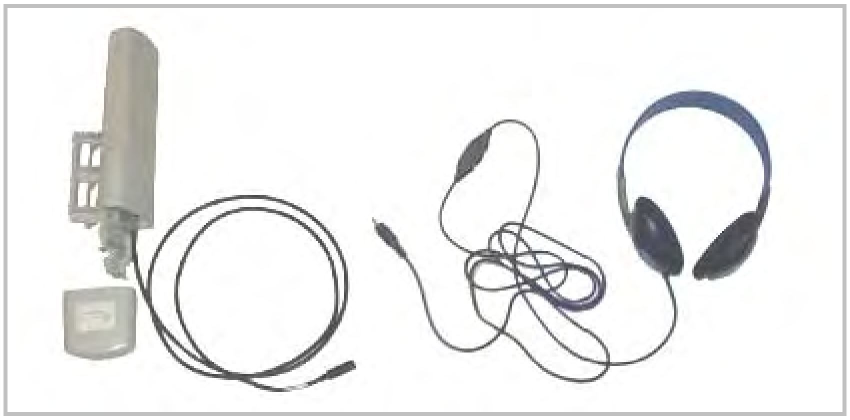


Figure 122: Audible Alignment Tone kit, including headset and connecting cable

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**.

20. 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.

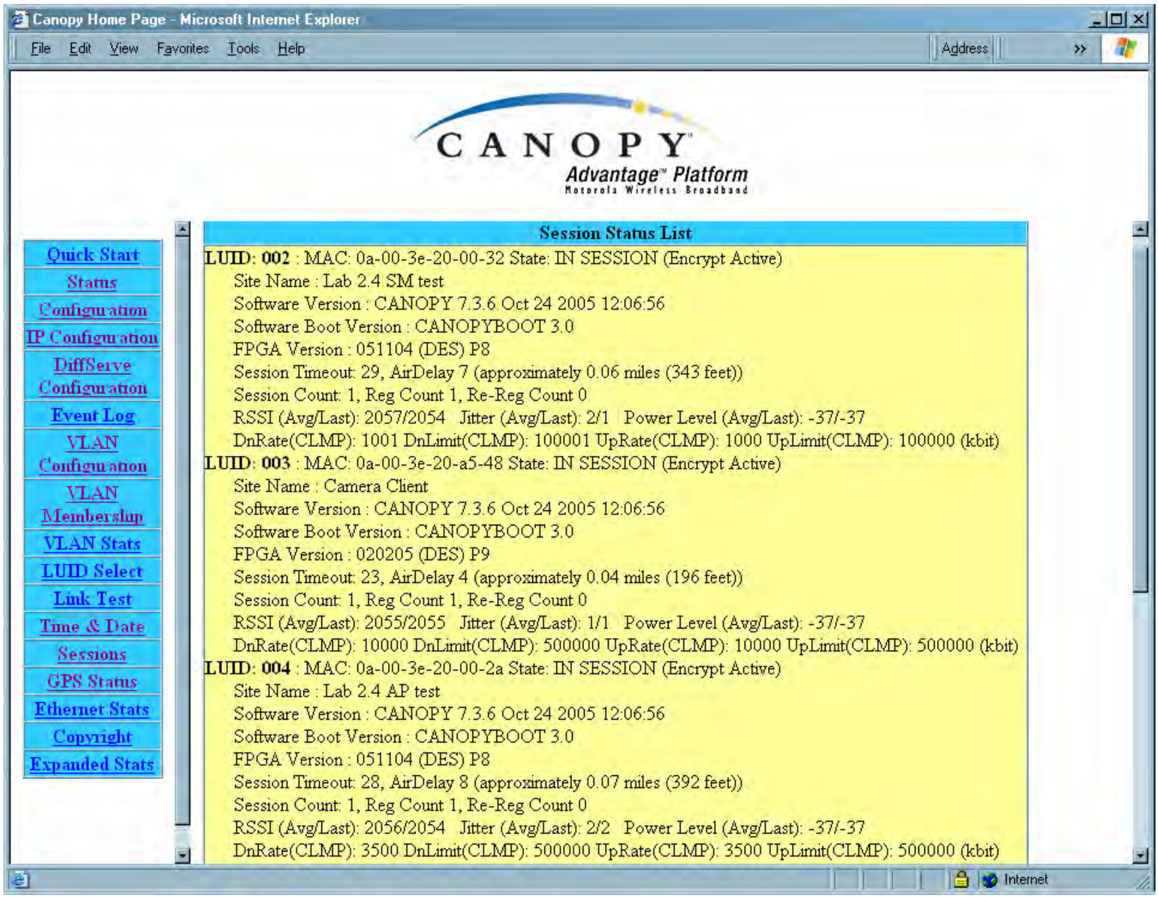
Procedure 32: Verifying performance for an AP-SM link

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 Status web page, look for RSSI and Jitter.
   IMPORTANT: RSSI shows the received power level in dBm and should be maximized. Jitter should be minimized. However, better/lower Jitter should be favored over better/higher dBm. For example, if course alignment gives an SM with a power level of −75 dBm and a jitter of 5, and further refinement of the alignment drops the power level to −78 dBm and a jitter of 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:***
> RSSI is also shown as a unitless measure for historical reasons. The best practice is to use the dBm RSSI and ignore the unitless RSS, which tends to indicate more accuracy and precision than is actually inherent in the measurement.

3. Fine-adjust the SM mounting, if needed, to improve Jitter or RSSI.
4. In the menu on the left side of the Status web page, click **Link Test**.
   NOTE: Use of the Link Test web page is described under Link Test Page (All) on Page 417.
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. Click the **Start Test** button.
   d. Click the **Refresh Display** button (if the web page is not set to automatically refresh).
   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 Sessions page of the AP that the SM is connected to, using the IP address of the AP and its password.
   NOTE: An example of this page is shown in Figure 123.



```
Session Status List
LUID: 002 : MAC: 0a-00-3e-20-00-32 State: IN SESSION (Encrypt Active)
    Site Name : Lab 2.4 SM test
    Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 051104 (DES) P8
    Session Timeout: 29, AirDelay 7 (approximately 0.06 miles (343 feet))
    Session Count: 1, Reg Count 1, Re-Reg Count 0
    RSSI (Avg/Last): 2057/2054   Jitter (Avg/Last): 2/1   Power Level (Avg/Last): -37/-37
    DnRate(CLMP): 1001 DnLimit(CLMP): 100001 UpRate(CLMP): 1000 UpLimit(CLMP): 100000 (kbit)
LUID: 003 : MAC: 0a-00-3e-20-a5-48 State: IN SESSION (Encrypt Active)
    Site Name : Camera Client
    Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 020205 (DES) P9
    Session Timeout: 23, AirDelay 4 (approximately 0.04 miles (196 feet))
    Session Count: 1, Reg Count 1, Re-Reg Count 0
    RSSI (Avg/Last): 2055/2055   Jitter (Avg/Last): 1/1   Power Level (Avg/Last): -37/-37
    DnRate(CLMP): 10000 DnLimit(CLMP): 500000 UpRate(CLMP): 10000 UpLimit(CLMP): 500000 (kbit)
LUID: 004 : MAC: 0a-00-3e-20-00-2a State: IN SESSION (Encrypt Active)
    Site Name : Lab 2.4 AP test
    Software Version : CANOPY 7.3.6 Oct 24 2005 12:06:56
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 051104 (DES) P8
    Session Timeout: 28, AirDelay 8 (approximately 0.07 miles (392 feet))
    Session Count: 1, Reg Count 1, Re-Reg Count 0
    RSSI (Avg/Last): 2056/2054   Jitter (Avg/Last): 2/2   Power Level (Avg/Last): -37/-37
    DnRate(CLMP): 3500 DnLimit(CLMP): 500000 UpRate(CLMP): 3500 UpLimit(CLMP): 500000 (kbit)
```

Figure 123: SM session status indications in the AP Sessions page

8. Find the Session Count line under the LUID that is associated with 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 Sessions in the left pane.
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 31: Installing the SM on Page 333 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 Canopy 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 124. The dish is tipped forward, not vertical, but the focus of the signal is horizontal.

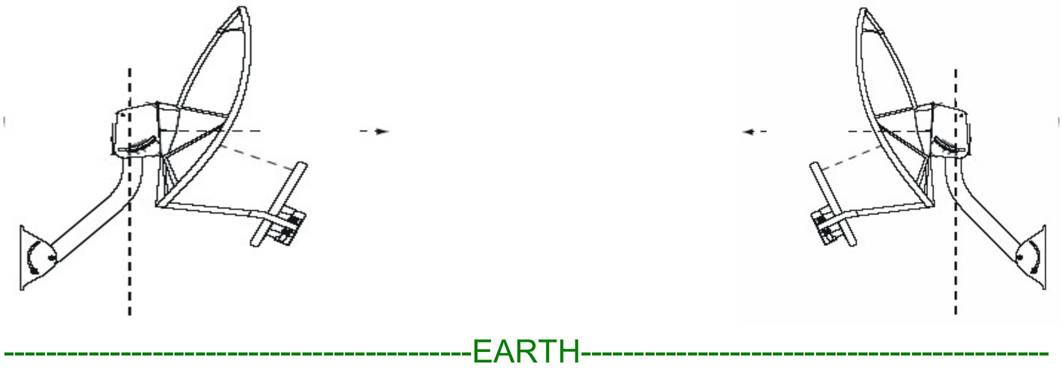


Figure 124: Correct mount with reflector dish

Improper dish, tube, and module positions for this case are illustrated in Figure 125.

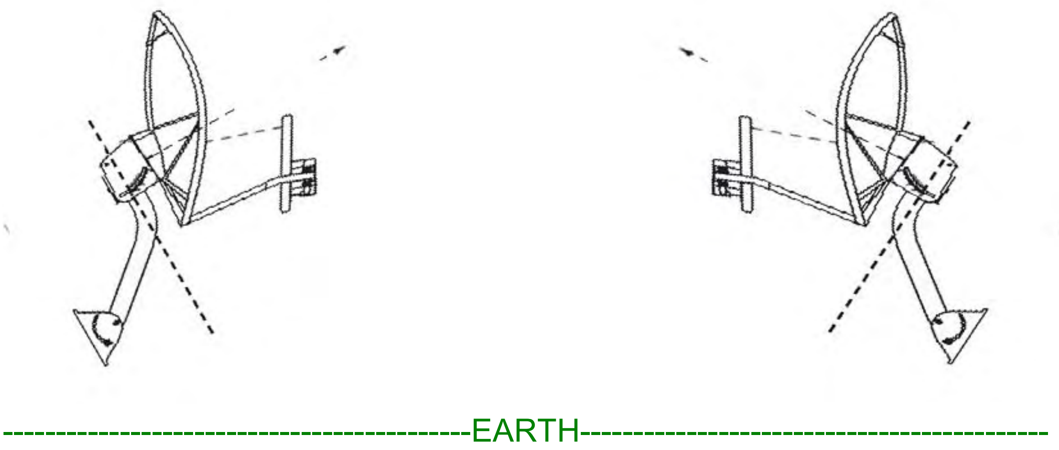


Figure 125: Incorrect mount with reflector dish

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 42 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 126.

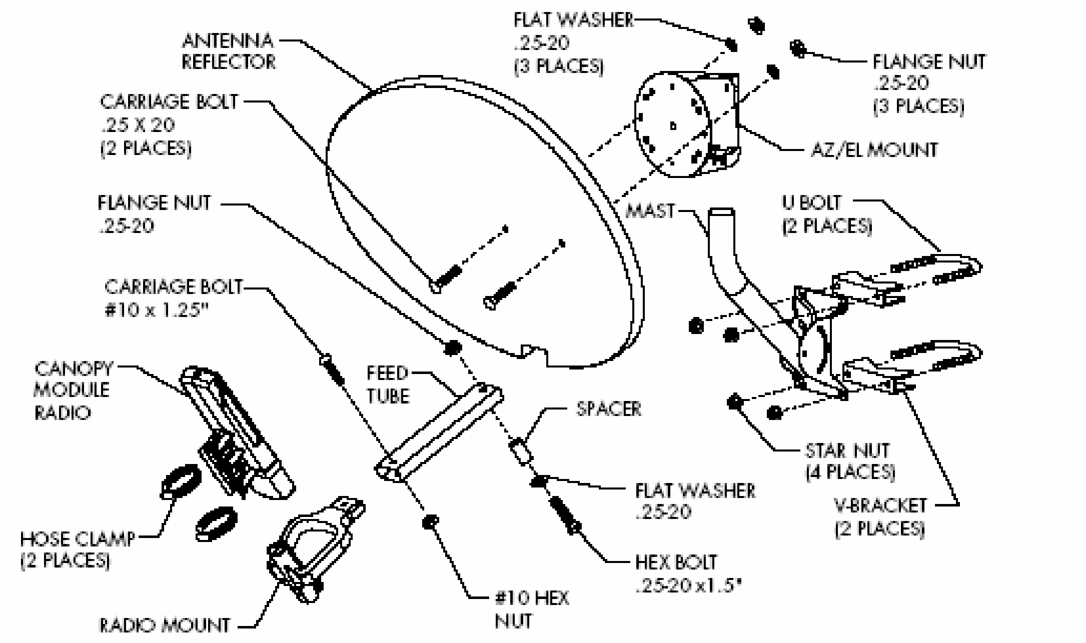


Figure 126: Mounting assembly, exploded view

19.10 INSTALLING A BH TIMING MASTER

To install the Canopy BHM, perform the following steps:

Procedure 33: Installing the BHM

1. If this is a 20-Mbps BH, set the **Modulation Scheme** parameter in the Configuration web page of the BHM to 10 Mbps (for easier course aiming).
2. Remove power from the BHM.
3. Choose the best mounting location for your particular application.

4. Attach the BHM to the arm of the Canopy Passive Reflector dish assembly as shown in Figure 127.

> ***RECOMMENDATION:***
> The arm is molded to receive and properly aim the module relative to the aim of the dish. Stainless steel hose clamps should be used for the attachment.

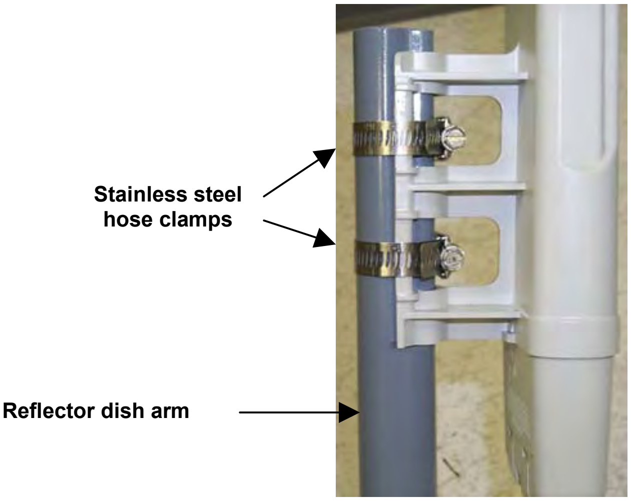


Figure 127: BH attachment to reflector arm

5. 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 Canopy 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 Canopy 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 Canopy 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 Canopy System Calculator page BeamwidthRadiiCalcPage.xls automatically calculates the radii of the beam coverage area.)
6. Using stainless steel hose clamps or equivalent fasteners, lock the BHM into position.
7. Remove the base cover of the BHM. (See Figure 54 on Page 176.)

8. 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.

9. 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 Canopy 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.

10. Access the Configuration page of this module.

11. 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 Canopy BHS consists of two procedures:

◦ Physically installing the BHS and performing coarse alignment using the alignment tone (Procedure 34)

◦ Verifying the BHM-to-BHS link and finalizing alignment using review of power level and jitter, link tests, review of registration and session counts (Procedure 35 on Page 345).

Procedure 34: Installing the BHS

1. If this is a 20-Mbps BH, set the **Modulation Scheme** parameter in the Configuration web page of the BHM to 10 Mbps (for easier course aiming).
2. Remove power from the BHS.
3. Choose the best mounting location for the BHS.
   a. Move the module to where the link will be unobstructed by the radio horizon and no objects penetrate the Fresnel zone. (The Canopy 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 Canopy 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 Canopy System Calculator page DowntiltCalcPage.xls automatically calculates the angle of antenna downward tilt that is required.)
4. Remove the base cover of the BHS. (See Figure 54 on Page 176.)
5. Terminate the UV outside grade Category 5 Ethernet cable with an RJ-45 connector and connect the cable to the BHS.

6. Attach the BHS to the arm of the Canopy Passive Reflector dish assembly as shown in Figure 127.

   NOTE: The arm is molded to receive and properly aim the module relative to the aim of the dish.

7. Using stainless steel hose clamps or equivalent fasteners, lock the BHS into position.
8. Remove the cover of the 300SS Surge Suppressor. (See Figure 121 on Page 335.)
9. With the cable openings facing downward, mount the 300SS *outdoors* at the site, as close as possible to the point where the Ethernet cable penetrates the structure at the site, and as close as possible to the grounding system (Protective Earth).
10. Using diagonal cutters or long nose pliers, remove the knockouts that cover the cable openings to the 300SS.
11. Connect an Ethernet cable from the power adapter located inside the structure, through the building penetration, and to either RJ-45 port of the 300SS.
12. Connect another Ethernet cable from the other RJ-45 port of the 300SS to the Ethernet port of the SM.
13. Review Grounding SMs on Page 171.
14. Wrap an AWG 10 (or 6mm^2) copper wire around the Ground post of the 300SS.
15. Tighten the Ground post locking nut in the 300SS onto the copper wire.
16. Securely connect the copper wire to the grounding system (Protective Earth) according to applicable regulations.
17. Connect a Ground wire to the 300SS.
18. Inside the structure, connect the Ethernet cable to the Canopy power adaptor, and connect the Canopy power adaptor “pig-tail” to the Ethernet port of a powered-up computer (laptop, desktop, PDA) to ensure the BHS is in Operational Mode.

    NOTE: Alternatively, you can configure the BHS on the Configuration page to power up in Operational Mode even when no 802.3 link is attached. Connecting the Ethernet cable to powered-up computer ensures that the BHS is in Operational Mode, which is required for the Alignment Tone to work in the next step. Somewhat counterintuitively, a module must be in Operational Mode, not Aim Mode, to use the Alignment Tone. The factory default is to power up in Aim Mode when no 802.3 (Ethernet) link is attached. When the BHS senses an Ethernet link, it changes to Operational Mode.

19. For coarse alignment of the BHS, use the Audible Alignment Tone feature (Release 4.0 and later) as follows:

    a. At the SM, connect the RJ-11 6-pin connector of the Alignment Tool Headset to the RJ-11 utility port of the BHS.

       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.

b. 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.

c. Adjust the module slightly until you hear the highest pitch and highest volume.

20. 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.

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

19.13 VERIFYING A BH LINK

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

Procedure 35: 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 its configured IP address, if one has been configured.
2. On the Status page, look for RSSI and Jitter. RSSI shows the received power level 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 of 5, and further refinement of the alignment drops the power level to −78 dBm and a jitter of 2-3, the latter is better.
   - At 1X, the Jitter scale is 0-15 with desired Jitter between 0-4.
   - At 2X, the Jitter scale is 0-15 with desired Jitter between 0-9.

   NOTE: RSSI is also shown as a unitless measure for historical reasons. The best practice is to use the dBm and ignore the unitless RSSI, which tends to indicate more accuracy and precision than is actually inherent in the measurement.
3. Fine-adjust the SM mounting if needed to improve Jitter or RSSI.
4. In the menu on the left side of the web page, click **Link Test**.
   NOTE: Use of the Link Test web page is described under Link Test Page (All) on Page 417.

5. Perform several link tests of 10-second duration at 64 to 1522 packets as follows:
    a. Type into the **Duration** field how long (in seconds) the RF link should be tested.
    b. Leave the **Packet Length** field (where present) at the default of 1522 bytes or type into the **Packet Length** field (where present) the packet length at which you want the test conducted.
    c. Click the **Start Test** button.
    d. Click the **Refresh Display** button (if the web page is not set to automatically refresh).
    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% 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 local at 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 Sessions page of the BHM that links to the BHS, using the IP address of the BHS and its password.
8. Find the Session Count line.
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 Sessions in the left pane.
11. If these values are low (for example 1, 1, and 0, respectively, meaning 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 much 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 31: Installing the SM on Page 333 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 36: 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 Web Pages

IMPORTANT!
The following sections describe the use of a Canopy module in scan mode to analyze the RF spectrum. While a module is in the scan mode, no RF connectivity to that module is possible until either you click **Disable** on the Spectrum Analyzer page or 15 minutes elapses since the module entered the scan mode.

For this reason

- *do not* enable the spectrum analyzer from an RF-connected module. (No readings will be displayed when the RF connection is re-established.)
- be advised that, if you enable the spectrum analyzer by Ethernet connection, any current RF connection to that module drops.

You can use any SM or BHS in Release 4.1.n or later, or any AP in Release 6.1 or later, to see at once the frequency and power level of any detectable signal that is within, above, or 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 web page of the module. (For access from a PDA, see PDA Access to Canopy Modules on Page 319.) To enter the scan mode and view readings, click **Enable**. A Canopy SM/BHS displays the Spectrum Analyzer web page as either a graphical or a tabular page. The differences between these page types are shown in Table 60.

Table 60: Differences between graphical and tabular Spectrum Analyzer page

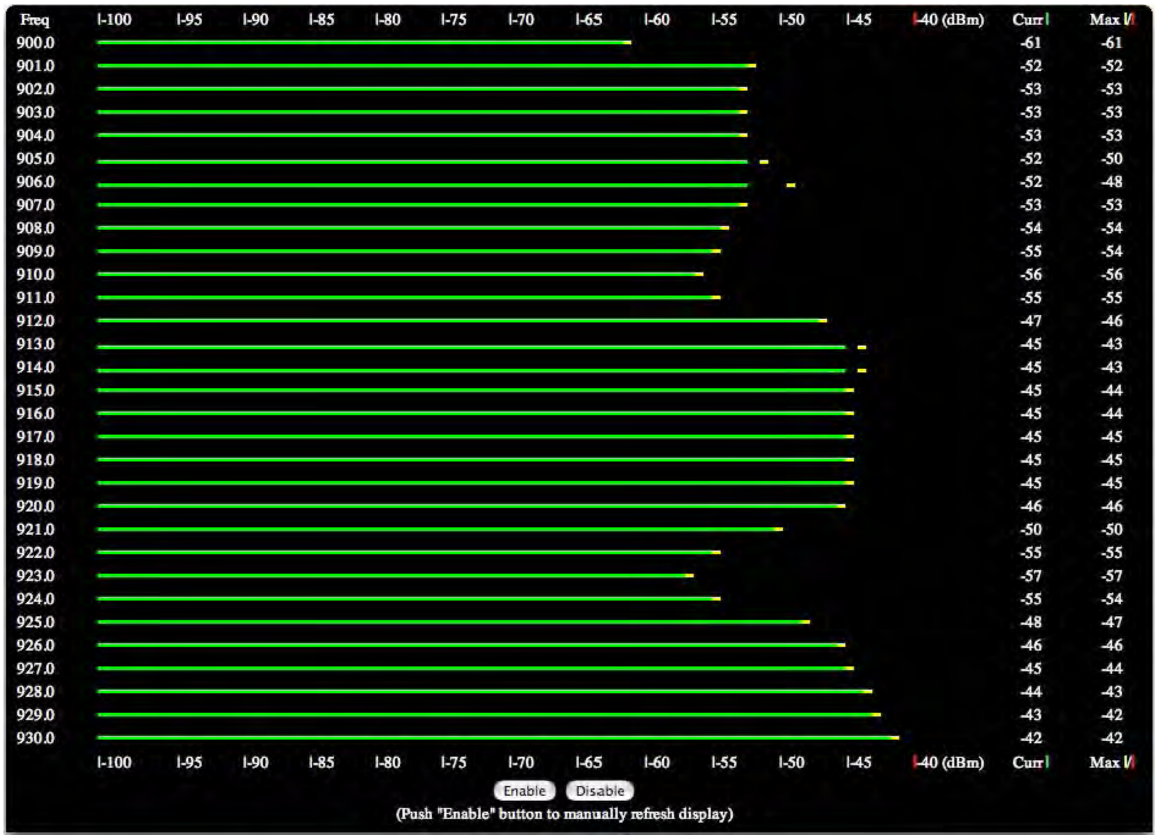
Graphical Spectrum Analyzer Page	Tabular Spectrum Analyzer Page
Green bars display the latest readings.	Table data provide the latest readings.
A yellow tick indicates the highest reading since the SM entered the scan mode.	Only readings from the latest page refresh are provided.
A red tick indicates any −4 dBm reading.	No indication is provided for high readings.

21.1.2 Graphical Spectrum Analyzer Display

An SM/BHS displays the graphical spectrum analyzer only if both

- the module operates on Release 4.2 or later.
- the module is calibrated for received power. This is the case only if the Status page reports received power in units of both RSSI and dBm. More recent modules are calibrated before shipment.

An example of the graphical Spectrum Analyzer web page is shown in Figure 128.



Freq	Curr	Max
900.0	-61	-61
901.0	-52	-52
902.0	-53	-53
903.0	-53	-53
904.0	-53	-53
905.0	-52	-50
906.0	-52	-48
907.0	-53	-53
908.0	-54	-54
909.0	-55	-54
910.0	-56	-56
911.0	-55	-55
912.0	-47	-46
913.0	-45	-43
914.0	-45	-43
915.0	-45	-44
916.0	-45	-44
917.0	-45	-45
918.0	-45	-45
919.0	-45	-45
920.0	-46	-46
921.0	-50	-50
922.0	-55	-55
923.0	-57	-57
924.0	-55	-54
925.0	-48	-47
926.0	-46	-46
927.0	-45	-44
928.0	-44	-43
929.0	-43	-42
930.0	-42	-42

(Push "Enable" button to manually refresh display)

Figure 128: Spectrum Analyzer screen, 900-MHz SM

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.

21.1.3 Tabular Spectrum Analyzer Display

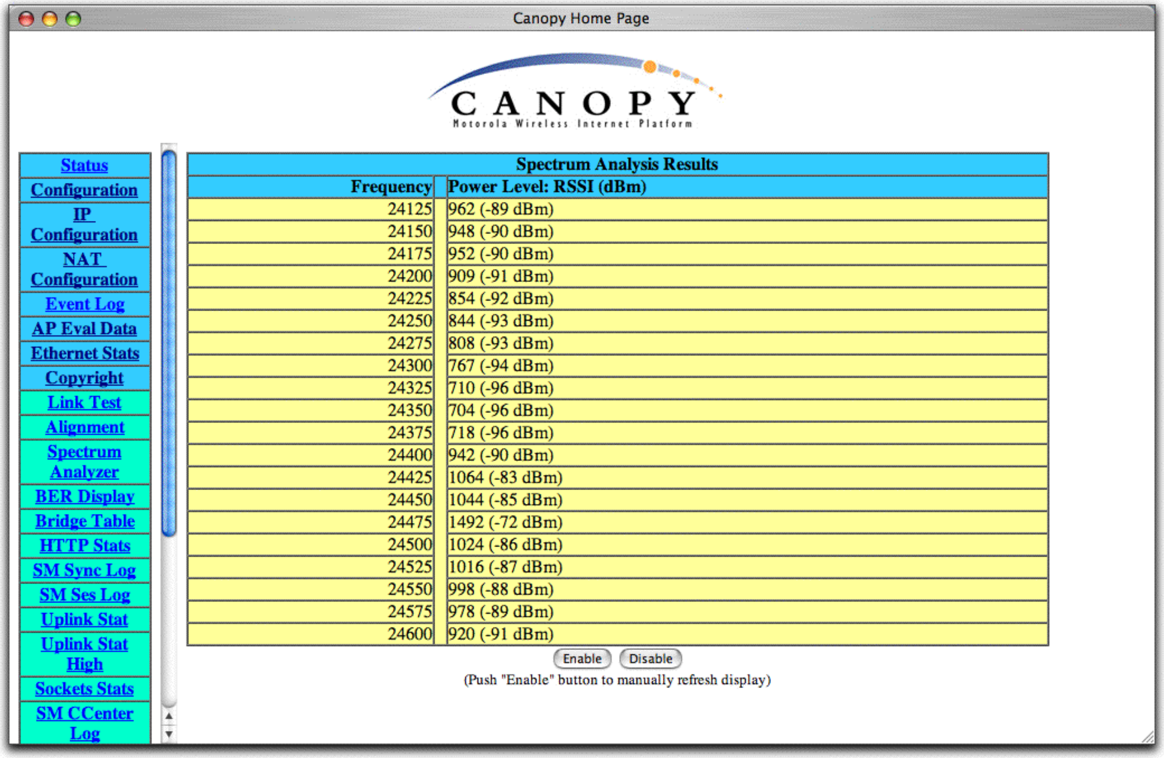
An SM/BHS displays the tabular spectrum analyzer if either

- the module operates on a Canopy system release that is earlier than Release 4.2.
- the module *is not* calibrated for received power. This is the case if the Status page reports received power in units of only RSSI. Earlier modules *were not* calibrated as shipped.

You can calibrate an uncalibrated module. If you wish to do so (in lieu of continuing with the tabular Spectrum Analyzer page), download the required instructions and data from http://www.canopywireless.com/calibrate.php.

> ***NOTE:***
> Although calibration improves the measurement of received power, calibration has no effect on reception, transmission, or other aspects of performance.

An example of the tabular Spectrum Analyzer web page is shown in Figure 129.



Spectrum Analysis Results

Frequency	Power Level: RSSI (dBm)
24125	962 (-89 dBm)
24150	948 (-90 dBm)
24175	952 (-90 dBm)
24200	909 (-91 dBm)
24225	854 (-92 dBm)
24250	844 (-93 dBm)
24275	808 (-93 dBm)
24300	767 (-94 dBm)
24325	710 (-96 dBm)
24350	704 (-96 dBm)
24375	718 (-96 dBm)
24400	942 (-90 dBm)
24425	1064 (-83 dBm)
24450	1044 (-85 dBm)
24475	1492 (-72 dBm)
24500	1024 (-86 dBm)
24525	1016 (-87 dBm)
24550	998 (-88 dBm)
24575	978 (-89 dBm)
24600	920 (-91 dBm)

(Push "Enable" button to manually refresh display)

Figure 129: Spectrum Analyzer screen, 2.4-GHz SM

21.1.4 Updating the Spectrum Analyzer Page Readings

To keep the displayed data current, either set this page to automatically refresh or repeatedly click the **Enable** button. When you are finished analyzing the spectrum, click the **Disable** button to return the module to normal operation.

21.1.5 Using the AP as a Spectrum Analyzer

In Canopy System Release 6.1 and later, you can temporarily transform an AP into an SM and thereby use the spectrum analyzer functionality. This is the only purpose supported for the transformation.

⚠ *CAUTION!*

Although you can toggle the AP **Device Type** parameter to **SM** in the over-the-air interface, you lose connectivity to the AP during spectrum analysis, have no service to any SMs that are connected to it, and can regain connectivity (and toggle it back to AP) through only the wired Ethernet interface to the AP. For this reason, you should perform the transformation to SM in the *Ethernet* interface.

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

Procedure 37: Using the Spectrum Analyzer in AP feature

1. Connect to the wired Ethernet interface of the AP.
2. Access the Configuration page of the AP.
3. Set the **Device Type** parameter to **SM**.
4. Click **Save Changes**.
5. Click **Reboot**.
6. When the module has rebooted as an SM, click the Expanded Stats navigation link.
7. Click the Spectrum Analyzer navigation link.
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. Access the Configuration page of the SM.
11. Set the **Device Type** parameter to **AP**.
12. Click **Save Changes**.
13. Click **Reboot**.
    RESULT: The AP boots with its previous frequency setting.

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

21.2 CONSIDERING SOFTWARE RELEASE COMPATIBILITY

Within the same Canopy network, modules can operate on Releases 4.n.n, and 6.n.n. However, the features that can be enabled are limited to those that the earliest software supports.

21.2.1 Designations for Hardware and Firmware

Canopy documentation refers to both FPGAs and hardware series (for example, Hardware Series P7). P9 provides advanced capabilities. For this reason, the documentation in some instances refers specifically to P9 as being required for a feature. The correlation between hardware series and the MAC addresses of the radio modules is provided in Table 61.

Table 61: 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 62.

Table 62: 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.

   Through Release 7.2.9, hardware scheduling is supported in only Advantage Series P9 APs. These provide higher throughput and lower latency than their Canopy counterparts. In Release 7.3.6 and later, hardware scheduling is supported in Canopy Series P9 APs as well. Although these *do not* provide the higher throughput and lower latency, they do support configuring the high-priority channel per SM.

The correlation between FPGA dates and CANOPYBOOT versions is provided in Table 63.

Table 63: FPGA and CANOPYBOOT versions

Rel	Hardware Series P7 or P8				Hardware Series P9				Boot Version (block.bin)
	SW Scheduler		HW Scheduler		SW Scheduler		HW Scheduler		
	DES	AES	DES	AES	DES	AES	DES	AES	
3.1.5	091102								1.0
4.0	042903	041403							1.1
4.0.1	042903	041403							1.1
4.0.2	062403	041403							1.1
4.0.4	062403	041403							1.1
4.1	062403	041403							1.1
4.1.3	062403	041403							2.3
4.2.1	062403	041403							2.5
4.2.2					051804				3.0
4.2.3	062403	041403			071904	071904			3.0
4.2.7	051104	051104			082504	082504			3.0
6.0					092904		092904		3.0
6.1	051104	051104	110204		111504	111504	111604	111604	3.0

21.2.2 Application, Boot, and FPGA Software Upgrades

Within a module, compatibility is essential between the application, FPGA, and boot software versions. A direct upgrade across more than one progressive software release is possible in some instances. All instances in which a direct upgrade is possible are shown in Table 64.

Table 64: Upgradability from previous software releases

A module can be directly upgraded[1] from System Release …	to System Release …	with tool…
Nahum (SP3)	3.2.5	none
3.n.n	4.2.3	
4.0.n[2]		
4.1.n	6.1	CNUT required
4.2.7		
6.0[3]		
6.0[3]	7.0	CNUT optional
7.0	7.1.4	CNUT required[4]
7.0	7.2.9	
7.1.4	7.2.9	

NOTES:

1. An upgrade to a particular release may require a unique procedural sequence that depends on what release the module is being upgraded from.
2. ***Do not use the SM Auto-update feature (manually or with the Canopy Network Updater Tool [CNUT]) to upgrade from Release 4.0.n to Release 4.2. CNUT and SM Auto-update require Release 4.1 or later.***
3. This system release is dedicated to only the 900-MHz AP and SM.
4. Use CNUT Release 1.1.

21.2.3 System Release 6.1 Compatibility

If you deploy Canopy System Release 6.1, observe the following caveats:

- If you implement VLAN
  - first upgrade the AP and all SMs in the sector to Release 6.1.
  - you do not require VLAN-aware end stations (the SMs are VLAN aware), but you likely require a VLAN switch in your network.
- To implement both VLAN and per-SM MIR, you can
  - select the SM as the source for MIR/CIR/VLAN settings and set the MIR in each SM (BAM Release 2.0 *cannot* do this).
  - select the AP as the source for MIR/CIR/VLAN settings and set the MIR in the AP (for all SMs in the sector, except those in which MIR has been set).
- If you modify any range, downlink percentage, or slot parameter in an AP (or BHM) that operates on Release 6.1, and then experience trouble connecting to an SM (or BHS) that operates on an earlier release, attempt the following remedy in the AP (or BHM):
  1. At the bottom of the Configuration web page, click **Adjust Frame for All**.
  2. If **Reboot Required** appears in red near the Reboot button, click **Reboot**.

- Where you deploy an Advantage AP that is set for Hardware Scheduler, observe the following precautions:
  - Ensure that all SMs that will link to the AP are set for Hardware Scheduler (the AP cannot communicate with any SM that runs the Software Scheduler—the default controller of the interface).
  - Use *only* the Canopy Network Updater Tool (CNUT) to enable Hardware Scheduler on the SMs.
  - Ensure that each SM that will use the high-priority channel is Series P9 or later. (See Table 61 on Page 355.)
- In any 900-MHz AP that meets *either* of the following conditions, select **Disable** for the **6.0 Compatibility** parameter:
  - range set to greater than 40 miles.
  - downlink percentage set to greater than 80%.

21.2.4 BAM Software Compatibility

Bandwidth and Authentication Manager (BAM) software acts independent of the application, FPGA, and boot software version. BAM Release 1.1 and later are sensitive to the configurable parameters of a module regardless of changes in parameter names through evolving system software releases. For example, the **Authorization Key** parameter name has been changed to **Authentication Key**. This change does not affect whether BAM software can read the key.

The compatibility of BAM software, Red Hat Linux operating system, and Canopy system software releases is indicated in Table 65.

Table 65: Compatibility of software releases

BAM	Red Hat Linux OS	Canopy System
1.0	7.3	3.1.n
1.1	9 or Enterprise Version 3 (WS or ES)	3.1.n through 4.2
2.0	Enterprise Version 3 (WS or ES)	4.n through 6.n
2.1	Enterprise Version 3 (WS or ES)	7.1.4 through 7.3.6
in Prizm 2.0	Enterprise Version 4 (WS or ES)	8.0 and later

21.2.5 CMMmicro Software and Hardware Compatibility

The CMMmicro contains both a programmable logic device (PLD) and software. These must be compatible. 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

- be operating on Release 4.0 or later.
- 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 66.

Table 66: 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
5.7 GHz	≤ 0A003EF00F79	≥ 0A003EF00F7A

21.2.6 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 RSSI 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 add the redeployed SM to the ESN data table in the BAM server(s).

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 100. Where a collocated module receives sync over the air, the collocated modules can be wired to pass the sync as follows:

Procedure 38: 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 CANOPY RADIO TRANSMISSIONS

Canopy 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 Canopy 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 Canopy 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

Motorola also offers Canopy 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 Canopy AES feature activation key is one) to ensure that these products are available in only certain regions and by special permit.

The Canopy distributor or reseller can advise service providers about current regional availability. Canopy 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 263.

Feature Availability

Canopy 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.

Canopy 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.

Canopy DES products cannot be upgraded to AES. To have the option of AES encryption, the service provider must purchase AES products.

Interoperability

Canopy 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 PASSWORD ACCESS

22.3.1 Configuring Display-Only and Full Access Passwords

The **Display-Only Access** password protection interacts with the **Full Access** password protection as indicated in Table 67.

Table 67: Types of access per password combination

Passwords Set		GUI Privileges			CNUT telnet/FTP Privileges		
Display-Only Access	**Full Access**	**Level**	**For User**	**With Password**	**Level**	**For User**	**With Password**
		r-w-x	nr	nr	r-w-x	nr	nr
DO		r-w-x	nr	DO	r-w-x	`root`	DO
	FA	r-w-x	nr	FA	r-w-x	`root`	FA
DO	FA	r	nr	DO		`root`	DO
DO	FA	r-w-x	nr	FA	r-w-x	`root`	FA

NOTES:

r indicates *read-only* privileges.

r-w-x indicates *read-write-execute* privileges.

nr indicates *not required*.

Canopy recommends that you do not deploy a module with no passwords set or with only the **Display-Only Access** password set.

Because of these interactions, manage passwords for a module as follows:

- To allow anyone who can interface with a module to view or change module data, set *neither* password.
- To allow only one user to have access to a module, set *either* the Display-Only Access password or the Full Access password.
- To allow one user to have view-only access and another user to have both view and change access, set *both* passwords.

22.3.2 Setting and Changing Passwords

To set the **Display-Only Access** password, enter the same expression in both **Display-Only Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a `telnet` or FTP session prompts for this password, you must enter the user name **`root`** in addition to the password.

To set the **Full Access** password, enter the same expression in both **Full Access** fields for verification. When the web-based interface prompts for this password, no user name is required. However, when a `telnet` or FTP session prompts for this password, you must enter the user name **`root`** in addition to the password.

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

Good business practice is to maintain organized records for all IP addresses and passwords. Overriding these in a tower-mounted module requires both a tower climb and downtime for a portion of your network.

If you set and then forget either or both passwords, 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 366.

After any password is set and a reboot of the module has occurred, a **Password Set** indicator appears to the right of the field. You can unset either password (revert the access to no password required) as follows:

1. Authenticate yourself using the current password.
2. Access the Configuration web page of the module.
3. Type a space into the appropriate (**Display-Only Access** or **Full Access**) field.
4. Type a space into the redundant verification field.
5. Click **Save Changes**.
6. Click **Reboot**.

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

Canopy 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 432 and Reinstating Remote Access Capability on Page 432.)
- You want local access to a module that has had the 802.3 link disabled in the Configuration page.

In releases through 7.2.9, the override plug resets the LAN1 IP address to 169.254.1.1. The plug allows you to access the module through the default configuration *without changing* the configuration. You can then view and reset any non-default values.

In Release 7.3.6 and later, you can configure the module to either

- override the IP address and password as described above.
- reset all configurable parameters to their factory default values.

See Set to Factory Defaults Upon Default Plug Detection on Page 306.

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/motorola.htm. To fabricate an override plug, perform the following steps.

Procedure 39: 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 130.

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

Pin 1 → white / orange	← Pin 1
Pin 2 → white / green	← Pin 2
Pin 3 → white / blue	← Pin 3
Pin 4 → green	← Pin 6
Pin 5 → blue	← Pin 5
Pin 6 → orange	← Pin 4

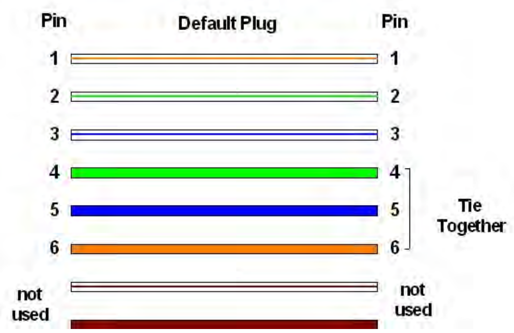


Figure 130: RJ-11 pinout for the override plug

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 40: 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 **Save Changes**.
8. Click **Reboot**.

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

22.3.4 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 41: 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 **Save Changes**.
8. Flip the toggle switch down (away from you).
9. Click **Reboot**.

=========================== **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. The network operator sets this key both in the Configuration page of the SM and in the ESN

database. In the **Authentication Key** parameter of the SM Configuration web page, password access to the page governs whether the network operator or the subscriber can view and set this key.

- random number, generated by Prizm or BAM and used in each attempt by an SM to register and authenticate. Neither the subscriber nor 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. Neither the subscriber nor the network operator can 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 an authentication key in the **Authentication Key** field of the SM Configuration page. See Authentication Key on Page 263.

22.5 FILTERING PROTOCOLS AND PORTS

In Canopy System Release 4.2 and later, you can filter (block) specified protocols and ports from leaving the SM and entering the Canopy 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 131)
- Uplink Broadcast
- ARP (Address Resolution Protocol)
- All others (see Figure 131)

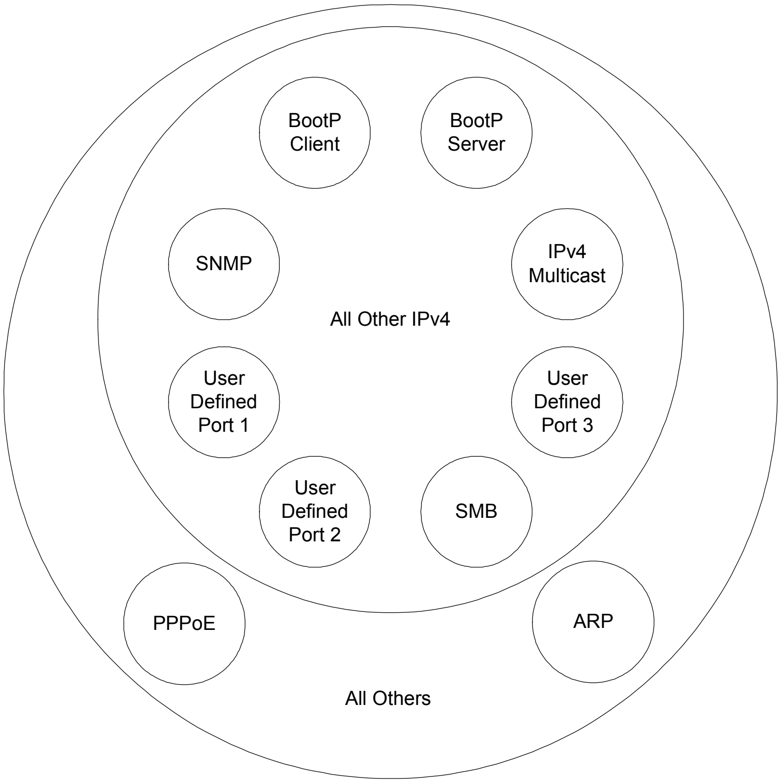


Figure 131: Categorical protocol filtering

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 Packet Filter Configuration block of the Advanced Network Configuration page in the SM are listed in Table 68. Further information is provided under Advanced Network Configuration Page of the SM with NAT Disabled on Page 276.

Table 68: 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

In Canopy System Release 4.2 and later, an AP can be enabled to encrypt downlink broadcast packets such as the following:

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

However, before the Encrypt Downlink Broadcast feature is enabled on the AP

- air link security should be enabled on the AP.
- all SMs that register to the AP *must* operate on Release 4.2 or later release.

> ***CAUTION!***
> An SM that operates on an early release cannot decrypt encrypted broadcasts and, consequently, drops connectivity (or cannot establish a link with) with the AP that is configured to encrypt downlink broadcasts.

The encryption used is DES for a DES module, and AES for an AES module.

23 MANAGING BANDWIDTH AND AUTHENTICATION

This section provides a high-level description of BAM in a Canopy network. For more specific information, see *Canopy Bandwidth and Authentication Manager (BAM) User Guide* or the *Motorola Canopy Prizm User Guide*.

23.1 MANAGING BANDWIDTH WITHOUT BAM OR PRIZM

Unless BAM or Prizm 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 SERVICES AND FEATURES

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

- Change the key that the SM(s) 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 SM(s).
- Set CIR parameters for low-priority and high-priority channel rates.
- Toggle whether to send those CIR parameters to the SM(s).
- Toggle whether to enable the high-priority channel in the SM(s).

23.2.1 Bandwidth Manager Capability

BAM or the BAM subsystem in Prizm allows you to set bandwidth per SM for sustained rates and burst rates. With this capability, the Canopy 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 BAM or Prizm 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 69 and Table 70.

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 69: Example times to download for arbitrary tiers of service with Canopy AP

Equipment	**AP**	**Canopy**		
	SM	**Canopy**		
	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 70: Example times to download for arbitrary tiers of service with Advantage AP

Equipment	AP	Advantage						Advantage
	SM	Canopy						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

BAM or Prizm 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 BAM or Prizm server is operating or when the SM is not listed in the database.

If a BAM or Prizm 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 Canopy 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 THROUGH A NETWORK MANAGEMENT STATION (NMS)

SNMPv2 (Simple Network Management Protocol Version 2) can be used to manage and monitor the Canopy 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 Canopy 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 (Canopy 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 Canopy 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.

24.2 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 Canopy 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 Canopy 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 Canopy 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 71.

Table 71: 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.)
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 Canopy Enterprise MIB

For additional reporting and control, the Canopy Releases 3.2.5 and later provide the Canopy Enterprise MIB, which extends 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 42: Installing the Canopy Enterprise MIB files

1. On the NMS, immediately beneath the `root` directory, create directory *`mibviewer`*.
2. Immediately beneath the *`mibviewer`* directory, create directory *`canopymibs`*.
3. Download the following three standard MIB files from the Internet Engineering Task Force at http://www.simpleweb.org/ietf/mibs into the *`mibviewer/canopymibs`* 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 Canopy software package directory into the *`mibviewer/canopymibs`* directory on the NMS (if necessary, first download the software package from http://www.canopywireless.com):
   - `whisp-tcv2-mib.txt` (Textual Conventions MIB), which defines Canopy 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 393.

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

Canopy modules provide the following Configuration web page parameters that 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.

Canopy modules can also be configured to send traps to a specified IP address, which can be that of the NMS or of any other server. The parameter for this address is named **Trap Address**.

24.4 OBJECTS DEFINED IN THE CANOPY ENTERPRISE MIB

The Canopy Enterprise MIB defines separate sets of objects for

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

> *NOTE:*
> The OFDM Series BHs do not support these objects. The MIBs that they support are listed under Objects Defined in the Canopy OFDM BH Module MIB on Page 390.

24.4.1 AP, SM, and BH Objects

The objects that the Canopy Enterprise MIB defines for all APs, SMs, and BHs are listed in Table 72.

Table 72: Canopy 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
bhModulation	Integer	manage
bhTimingMode	Integer	manage
bridgeEnable	Integer	manage
bridgeEntryTimeout	Integer	manage
clearEventLog	Integer	manage
codePoint*n*[2]	Integer	manage
colorCode	Integer	manage
commString	DisplayString	manage
displayOnlyAccess	DisplayString	manage
dynamicLearning	Integer	manage
eirp[3]	Integer	manage
extFilterDelay	Integer	manage
fecEnable	Integer	manage
fullAccess	DisplayString	manage
linkNegoSpeed	DisplayString	manage
managementVID	Integer	manage
mngtIP	IpAddress	manage
powerControl	Integer	manage
reboot	Integer	manage
removeVlanMember	Integer	manage
scheduling	Integer	manage
setDefaultPlug	Integer	manage
snmpMibPerm	Integer	manage
subnetMask	Integer	manage
taggedFrame[4]	Integer	manage

AP, SM, BH Object Name	Value Syntax	Operation Allowed
transmitterOP	Integer	manage
trapIP*n*[5]	IpAddress	manage
webAutoUpdate	Integer	manage
boxDeviceType	DisplayString	monitor
boxDeviceTypeID	DisplayString	monitor
boxEncryption	DisplayString	monitor
boxFrequency	DisplayString	monitor
etherLinkStatus	DisplayString	monitor
boxTemperature[6]	DisplayString	monitor
pass1Status	DisplayString	monitor
pass2Status	DisplayString	monitor
platformVer	Integer	monitor
whispBoxBoot	DisplayString	monitor
whispBoxEsn	WhispMACAddress	monitor
whispBoxEvntLog	EventString	monitor
whispBoxFPGAVer	DisplayString	monitor
whispBoxSoftwareVer	DisplayString	monitor
whispBridgeAge	Integer	monitor
whispBridgeDesLuid	WhispLUID	monitor
whispBridgeExt	Integer	monitor
whispBridgeHash	Integer	monitor
whispBridgeMacAddr	MacAddress	monitor
whispBridgeTbErr	Integer	monitor
whispBridgeTbFree	Integer	monitor
whispBridgeTbUsed	Integer	monitor
whispVAge	Integer	monitor

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

NOTES:

1. For only 5.7-GHz radios.
2. Where *n* is any number, 0 through 63. In Release 7.3.6 and later, codePoint0, codePoint48, and codePoint56 can be only monitored. In earlier releases, they can be managed.
3. Deprecated in Release 7.2.9 and later.
4. Replaced by frameType in Release 7.2.9 and later.
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 Canopy Enterprise MIB defines for each AP and BH Timing Master are listed in Table 73. The highlighted objects are commonly monitored by the manager. The traps provided in this set of objects are listed under Traps Provided in the Canopy Enterprise MIB on Page 392.

Table 73: Canopy Enterprise MIB objects for APs and BH timing masters

AP, BHM Object Name	Value Syntax	Operation Allowed
apBeaconInfo	Integer	manage
apTwoXRate	Integer	manage
asIP1	IpAddress	manage
asIP2	IpAddress	manage
asIP3	IpAddress	manage
authKey	DisplayString	manage
authMode	Integer	manage
berMode	Integer	manage
broadcastRetryCount	Integer	manage
configSource	Integer	manage
dAcksReservHigh	Integer	manage
defaultGw	IpAddress	manage

AP, BHM Object Name	Value Syntax	Operation Allowed
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
lanIp	IpAddress	manage
lanMask	IpAddress	manage
linkTestAction	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
txSpreading	Integer	manage
uAcksReservHigh	Integer	manage
updateAppAddress	IpAddress	manage
upLnkDataRate	Integer	manage

AP, BHM Object Name	Value Syntax	Operation Allowed
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
linkInUnknownProtos	Counter32	monitor
linkLastJitter	Integer	monitor
linkLastRSSI	Integer	monitor
linkLUID	Integer	monitor

AP, BHM Object Name	Value Syntax	Operation Allowed
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
testDuration	Integer	monitor
testLUID	Integer	monitor
upLinkEff	Integer	monitor

AP, BHM Object Name	Value Syntax	Operation Allowed
upLinkRate	Integer	monitor
upLnkAckSlot	Integer	monitor
upLnkAckSlotHi	Integer	monitor
whispGPSStats	Integer	monitor

24.4.3 SM and BH Timing Slave Objects

The objects that the Canopy Enterprise MIB defines for each SM and BH Timing Slave are listed in Table 74. The highlighted objects are commonly monitored by the manager.

Table 74: Canopy Enterprise MIB objects for SMs and BH timing slaves

SM, BHS Object Name	Value Syntax	Operation Allowed
allOtherIPFilter	Integer	manage
allOthersFilter	Integer	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
dmzEnable	Integer	manage
dmzIP	IpAddress	manage
dnsAutomatic	Integer	manage
enable8023link	Integer	manage
hiPriorityChannel	Integer	manage
hiPriorityDownlinkCIR	Integer	manage
hiPriorityUplinkCIR	Integer	manage

SM, BHS Object Name	Value Syntax	Operation Allowed
ingressVID	Integer	manage
ip4MultFilter	Integer	manage
lanIp	IpAddress	manage
lanMask	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
port1TCPFilter	Integer	manage
port2TCPFilter	Integer	manage
port3TCPFilter	Integer	manage
port1UDPFilter	Integer	manage
port2UDPFilter	Integer	manage
port3UDPFilter	Integer	manage
powerUpMode	Integer	manage
pppoeFilter	Integer	manage
prefferedDNSIP	IpAddress	manage
radioDbmInt	Integer	manage
rfScanList	DisplayString	manage
smbFilter	Integer	manage
snmpFilter	Integer	manage
tcpGarbageCollectTmout	Integer	manage
timingPulseGated	Integer	manage
twoXRate	Integer	manage
udpGarbageCollectTmout	Integer	manage

SM, BHS Object Name	Value Syntax	Operation Allowed
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
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 Canopy Enterprise MIB defines for each CMMmicro are listed in Table 75.

Table 75: Canopy 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
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

CMMmicro Object Name	Value Syntax	Operation Allowed
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
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

CMMmicro Object Name	Value Syntax	Operation Allowed
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
trackingMode	DisplayString	monitor
txBroadcastPkts	Counter32	monitor
txCollisions	Counter32	monitor
txDeferredTransmit	Counter32	monitor
txDropPkts	Counter32	monitor
txExcessiveCollision	Counter32	monitor
txFrameInDisc	Counter32	monitor
txLateCollision	Counter32	monitor

CMMmicro Object Name	Value Syntax	Operation Allowed
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 CANOPY OFDM BH MODULE MIB

The objects that the Canopy OFDM BH module MIB defines are listed in Table 77.

Table 76: Canopy OFDM BH module 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
receiveChannel	Integer	manage
transmitChannel	Integer	manage
receiveModulationMode	Integer	manage
transmitModulationMode	Integer	manage
receiveSnr[2]	Integer	manage
systemReset	Integer	monitor

Object Name	Value Syntax	Operation Allowed
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 CANOPY 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 Canopy proprietary MIB

24.7 OBJECTS SUPPORTED IN THE CANOPY 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 Canopy 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 CANOPY ENTERPRISE MIB

Canopy 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.
- whispRedarDetected, which signals that the one-minute scan has been completed, radar has been detected, and the radio will shutdown.
- whispRedarEnd, which signals that the one-minute scan has been completed, radar *has not* been detected, and the radio will resume normal operation.

NOTE:
The OFDM Series BHs do not support the traps listed above.

24.10 TRAPS PROVIDED IN THE CANOPY 30/60-Mbps BH MODULE MIB

Canopy 30/60-Mbps BH modules 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 CANOPY 150/300-Mbps BH MODULE MIB

Canopy 150/300-Mbps BH modules 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 Canopy division does not endorse, support, or discourage the use of any these viewers.

To assist end users in this area, Canopy offers a starter guide for one of these viewers—MRTG (Multi Router Traffic Grapher). This starter guide is titled *Canopy Network Management with MRTG: Application Note*, and is available in the Document Library section under Support at http://www.canopywireless.com. 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 MANAGING THROUGH THE CANOPY NETWORK UPDATER TOOL (CNUT)

The Canopy Network Updater Tool manages and automates the software and firmware upgrade process for Canopy 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 Canopy Network Updater Tool

- automatically discovers all Canopy 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.
  - Canopy supplies.

25.2 NETWORK ELEMENT GROUPS

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

- 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 Canopy 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 Canopy 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
- Canopy System Release 4.1 or later

25.6 CNUT DOWNLOAD

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

- a `.zip` file for use without the CNUT application.
- a `.pkg` file (for example, `CANOPY4.2_P1.9_DES.pkg`) that the CNUT application can open.

26 INTERPRETING SYSTEM LOGS

26.1 INTERPRETING MESSAGES IN THE EVENT LOG PAGE

Each line of the Event Log web 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.

26.1.1 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.

26.1.2 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.

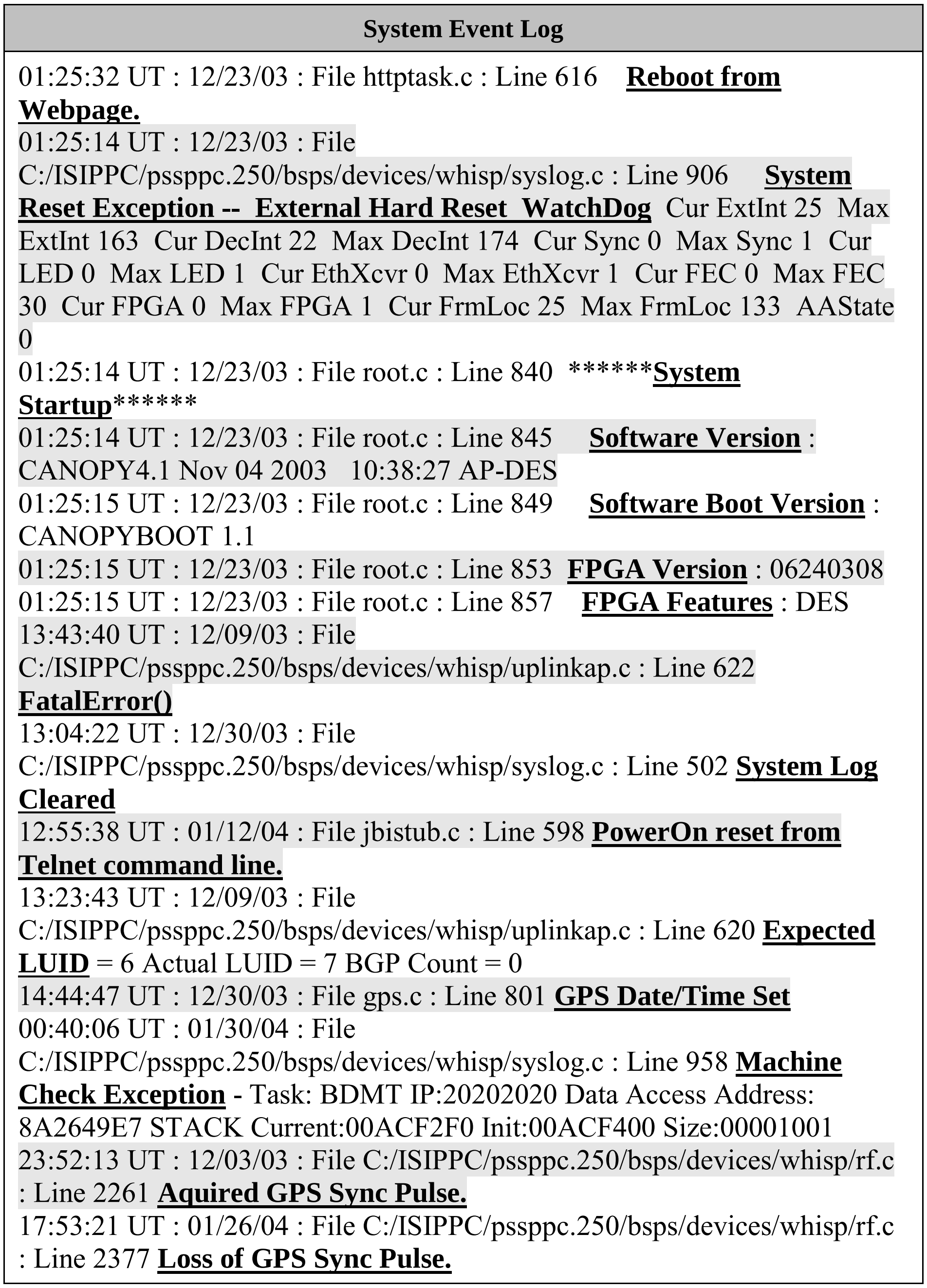
Each line that contains the expression WatchDog flags an event that was both

- 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 132. 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 77 and Table 78.



System Event Log

```
01:25:32 UT : 12/23/03 : File httptask.c : Line 616    Reboot from
Webpage.
01:25:14 UT : 12/23/03 : File
C:/ISIPPC/pssppc.250/bsps/devices/whisp/syslog.c : Line 906    System
Reset Exception --  External Hard Reset  WatchDog  Cur ExtInt 25  Max
ExtInt 163  Cur DecInt 22  Max DecInt 174  Cur Sync 0  Max Sync 1  Cur
LED 0  Max LED 1  Cur EthXcvr 0  Max EthXcvr 1  Cur FEC 0  Max FEC
30  Cur FPGA 0  Max FPGA 1  Cur FrmLoc 25  Max FrmLoc 133  AAState
0
01:25:14 UT : 12/23/03 : File root.c : Line 840  ******System
Startup******
01:25:14 UT : 12/23/03 : File root.c : Line 845    Software Version :
CANOPY4.1 Nov 04 2003   10:38:27 AP-DES
01:25:15 UT : 12/23/03 : File root.c : Line 849    Software Boot Version :
CANOPYBOOT 1.1
01:25:15 UT : 12/23/03 : File root.c : Line 853  FPGA Version : 06240308
01:25:15 UT : 12/23/03 : File root.c : Line 857   FPGA Features : DES
13:43:40 UT : 12/09/03 : File
C:/ISIPPC/pssppc.250/bsps/devices/whisp/uplinkap.c : Line 622
FatalError()
13:04:22 UT : 12/30/03 : File
C:/ISIPPC/pssppc.250/bsps/devices/whisp/syslog.c : Line 502 System Log
Cleared
12:55:38 UT : 01/12/04 : File jbistub.c : Line 598 PowerOn reset from
Telnet command line.
13:23:43 UT : 12/09/03 : File
C:/ISIPPC/pssppc.250/bsps/devices/whisp/uplinkap.c : Line 620 Expected
LUID = 6 Actual LUID = 7 BGP Count = 0
14:44:47 UT : 12/30/03 : File gps.c : Line 801 GPS Date/Time Set
00:40:06 UT : 01/30/04 : File
C:/ISIPPC/pssppc.250/bsps/devices/whisp/syslog.c : Line 958 Machine
Check Exception - Task: BDMT IP:20202020 Data Access Address:
8A2649E7 STACK Current:00ACF2F0 Init:00ACF400 Size:00001001
23:52:13 UT : 12/03/03 : File C:/ISIPPC/pssppc.250/bsps/devices/whisp/rf.c
: Line 2261 Aquired GPS Sync Pulse.
17:53:21 UT : 01/26/04 : File C:/ISIPPC/pssppc.250/bsps/devices/whisp/rf.c
: Line 2377 Loss of GPS Sync Pulse.
```

Figure 132: Event Log page data

26.1.3 Messages that Flag Abnormal Events

The messages listed in Table 77 flag abnormal events and, case by case, may signal the need for corrective action or technical support. See Troubleshooting on Page 444.

Table 77: 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. If your module is operating on an earlier software release, consider upgrading to Release 4.1. 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. If your module is operating on an earlier software release, consider upgrading to Release 4.1. 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.

26.1.4 Messages that Flag Normal Events

The messages listed in Table 78 record normal events and typically *do not* signal a need for any corrective action or technical support.

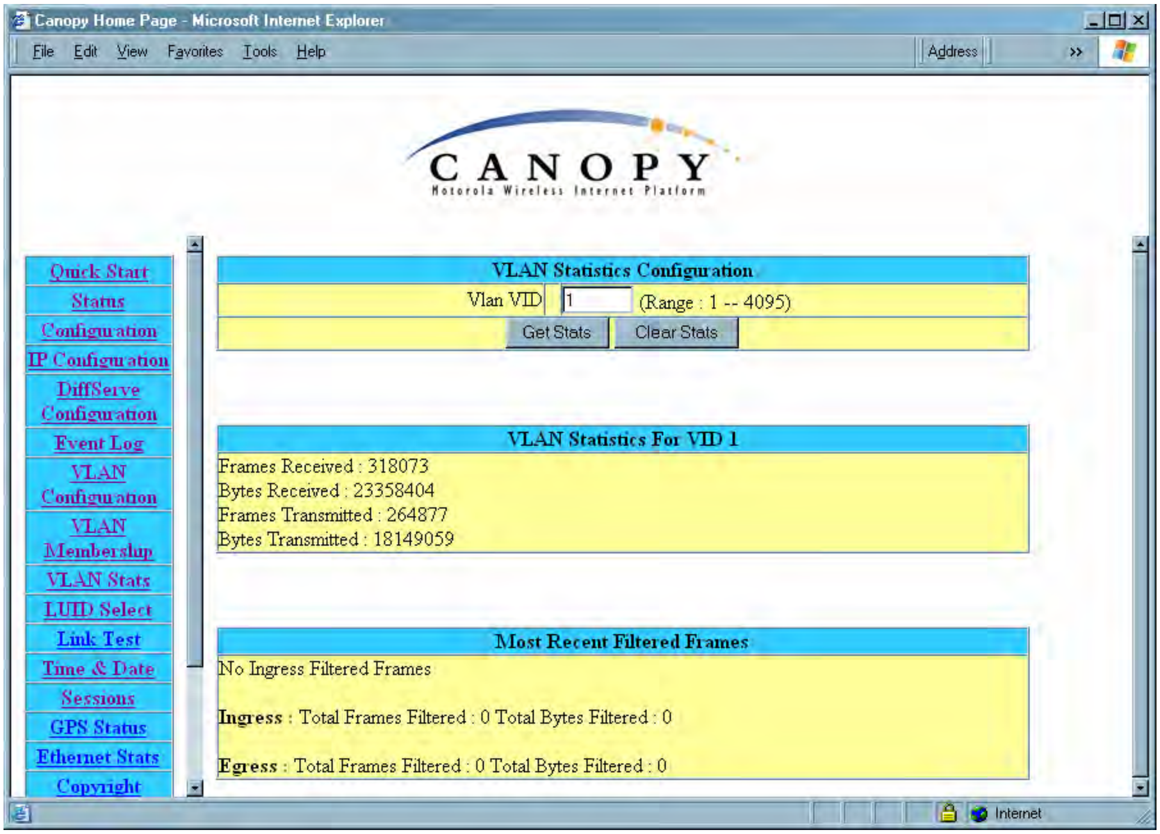
Table 78: Event Log messages for normal events

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.

Event Message	Meaning
Software Version	Canopy release version and authentication method for the unit.
System Log Cleared	Event log was manually cleared.

26.2 INTERPRETING DATA IN THE VLAN STATS PAGE (AP)

The VLAN Stats page provides a list of the most recent packets that were filtered because of VLAN membership violations. An example of the VLAN Stats page is shown in Figure 133.



VLAN Statistics Configuration

Vlan VID 1 (Range : 1 -- 4095)

VLAN Statistics For VID 1

Frames Received : 318073
Bytes Received : 23358404
Frames Transmitted : 264877
Bytes Transmitted : 18149059

Most Recent Filtered Frames

No Ingress Filtered Frames

Ingress : Total Frames Filtered : 0 Total Bytes Filtered : 0

Egress : Total Frames Filtered : 0 Total Bytes Filtered : 0

Figure 133: VLAN Stats screen

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

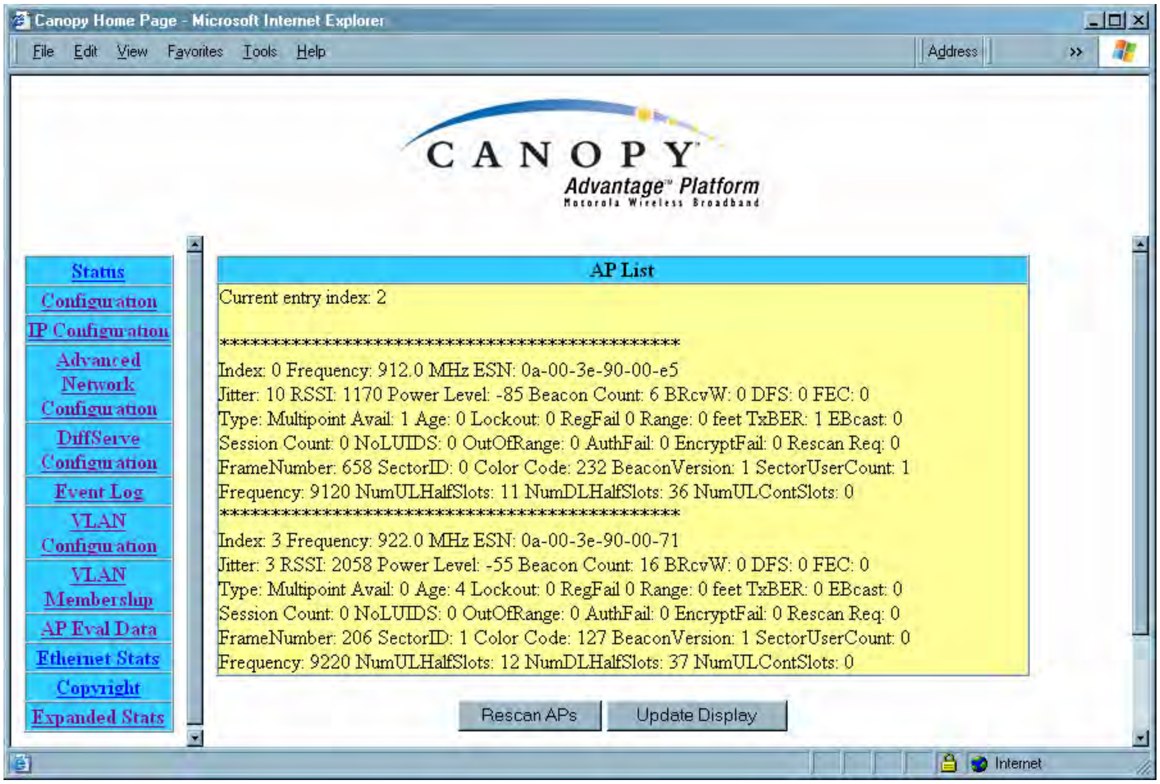
- **Unknown**—This should not occur. Contact Canopy Technical Support.
- **Only Tagged**—The packet was filtered because the configuration is set to accept only packets that have an 802.1Q header, and this packet did not.
- **Ingress**—When the packet entered through the wired Ethernet interface, the 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 Canopy 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.

26.3 INTERPRETING DATA IN THE AP EVAL DATA PAGE (SM, BHS)

The AP Eval Data web page provides information about the AP that the SM sees (or the BHM that the BHS sees). An example of such information is shown in Figure 134.

> *NOTE:*
> In Release 4.0 and later, the data for this page can be suppressed by the **Disable Display of AP Eval Data** selection in the **SM Scan Privacy** field of the Configuration page on the AP.



```
Current entry index: 2

************************************************
Index: 0 Frequency: 912.0 MHz ESN: 0a-00-3e-90-00-e5
Jitter: 10 RSSI: 1170 Power Level: -85 Beacon Count: 6 BRcvW: 0 DFS: 0 FEC: 0
Type: Multipoint Avail: 1 Age: 0 Lockout: 0 RegFail 0 Range: 0 feet TxBER: 1 EBcast: 0
Session Count: 0 NoLUIDS: 0 OutOfRange: 0 AuthFail: 0 EncryptFail: 0 Rescan Req: 0
FrameNumber: 658 SectorID: 0 Color Code: 232 BeaconVersion: 1 SectorUserCount: 1
Frequency: 9120 NumULHalfSlots: 11 NumDLHalfSlots: 36 NumULContSlots: 0
************************************************
Index: 3 Frequency: 922.0 MHz ESN: 0a-00-3e-90-00-71
Jitter: 3 RSSI: 2058 Power Level: -55 Beacon Count: 16 BRcvW: 0 DFS: 0 FEC: 0
Type: Multipoint Avail: 0 Age: 4 Lockout: 0 RegFail 0 Range: 0 feet TxBER: 0 EBcast: 0
Session Count: 0 NoLUIDS: 0 OutOfRange: 0 AuthFail: 0 EncryptFail: 0 Rescan Req: 0
FrameNumber: 206 SectorID: 1 Color Code: 127 BeaconVersion: 1 SectorUserCount: 0
Frequency: 9220 NumULHalfSlots: 12 NumDLHalfSlots: 37 NumULContSlots: 0
```

Figure 134: AP Eval Data screen

26.3.1 AP Eval Data Parameters

The AP Eval Data page provides the following parameters that can be useful to manage and troubleshoot a Canopy system:

Index

This field displays the index value that the Canopy 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

This field displays the last jitter value that was captured between this SM and the AP (or between this BHS and the BHM).

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.

Session Count

This field displays how many times this SM (or BHS) has gone into and out of session with the AP (or BHM). If this number is particularly large, a problem may exist in the link (for example, improper line of sight or interference).

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.

Sector User Count

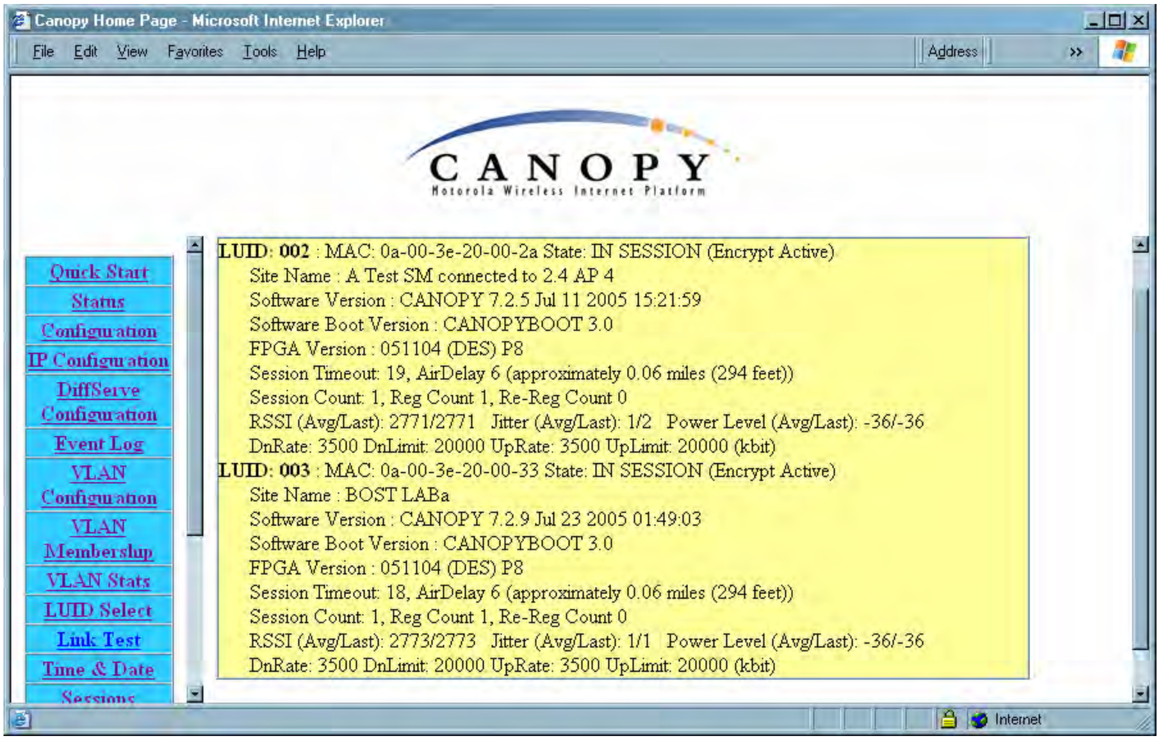
This field displays how many SMs are registered on the AP.

Rescan APs

You can click this button to force the SM or BHS to rescan for the frequencies that are selected in the Configuration page. (See Custom RF Frequency Scan Selection List on Page 257.) This module will then register to the AP or BHM that provides the best results for RSSI, Jitter, and number of registered modules.

26.4 INTERPRETING DATA IN THE SESSIONS PAGE (AP, BHM)

An example of the Sessions page is displayed in Figure 135.



```
LUID: 002 : MAC: 0a-00-3e-20-00-2a State: IN SESSION (Encrypt Active)
    Site Name : A Test SM connected to 2.4 AP 4
    Software Version : CANOPY 7.2.5 Jul 11 2005 15:21:59
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 051104 (DES) P8
    Session Timeout: 19, AirDelay 6 (approximately 0.06 miles (294 feet))
    Session Count: 1, Reg Count 1, Re-Reg Count 0
    RSSI (Avg/Last): 2771/2771   Jitter (Avg/Last): 1/2   Power Level (Avg/Last): -36/-36
    DnRate: 3500 DnLimit: 20000 UpRate: 3500 UpLimit: 20000 (kbit)
LUID: 003 : MAC: 0a-00-3e-20-00-33 State: IN SESSION (Encrypt Active)
    Site Name : BOST LABa
    Software Version : CANOPY 7.2.9 Jul 23 2005 01:49:03
    Software Boot Version : CANOPYBOOT 3.0
    FPGA Version : 051104 (DES) P8
    Session Timeout: 18, AirDelay 6 (approximately 0.06 miles (294 feet))
    Session Count: 1, Reg Count 1, Re-Reg Count 0
    RSSI (Avg/Last): 2773/2773   Jitter (Avg/Last): 1/1   Power Level (Avg/Last): -36/-36
    DnRate: 3500 DnLimit: 20000 UpRate: 3500 UpLimit: 20000 (kbit)
```

Figure 135: Sessions page data

The Sessions web page provides information about each SM that has registered to the AP (or about the BHS that has registered to the BHM). This information is useful for managing and troubleshooting a Canopy system.

26.4.1 Sessions Parameters

The Sessions page provides the following parameters.

LUID

This field displays the LUID (logical unit ID) of the SM or BHS. The first module that registers is assigned an LUID of 2. Each successive module that registers is assigned the next successively higher number. A module that loses registration and then regains registration retains the originally assigned LUID.

> *NOTE:*
> The LUID association is lost when a power cycle of the AP or BHM occurs.

MAC

This field displays the MAC address (or electronic serial number) of the SM or BHS.

State

This field displays the current status of the SM or BHS as either

- **IN SESSION** to indicate that the SM or BHS is currently registered.
- **IDLE** to indicate that the SM or BHS was registered, but now is not.

Software Version

This field displays the software release that operates on the SM or BHS, the release date of the software, the time, and whether the module is secured by DES or AES encryption (see Encrypting Canopy Radio Transmissions on Page 361). When requesting technical support, provide the information from this field.

An unpopulated **Software Version** parameter indicates a version earlier than Version 3.1.

Software Boot Version

This field indicates the CANOPYBOOT version number.

FPGA Version

This field displays the version of FPGA that runs on the SM or BHS. An unpopulated FPGA Version parameter indicates that a version earlier than Version 082002 runs on the SM or BHS.

Session Timeout

This field indicates the maximum interval in hours that the SM or BHS may sustain a single session.

AirDelay

This field displays the distance of the link. To derive the distance in meters, multiply the displayed number by 14.9. To derive the distance in feet, multiply the displayed number by 49.

Session Count

This field displays how many sessions the SM or BHS has had. If the number of sessions is significantly greater than the number that other registered modules have had, then this may indicate a problem in received signal strength.

Reg Count

This field displays how many registration request messages the AP or BHM has received from the module. If the number of these messages is far greater than the number from other registered modules, then this SM or BHS may have an installation problem.

Re-Reg Count

This field displays how many registration request messages the AP or BHM has received from the module that is already in session. If the number of these messages is far greater than the number from other modules that are both registered and in session, then this SM or BHS may have an installation problem.

RSSI (Avg/Last)

This field displays the average and the latest RSSI (received signal strength indicator) value for the SM or BHS.

Jitter (Avg/Last)

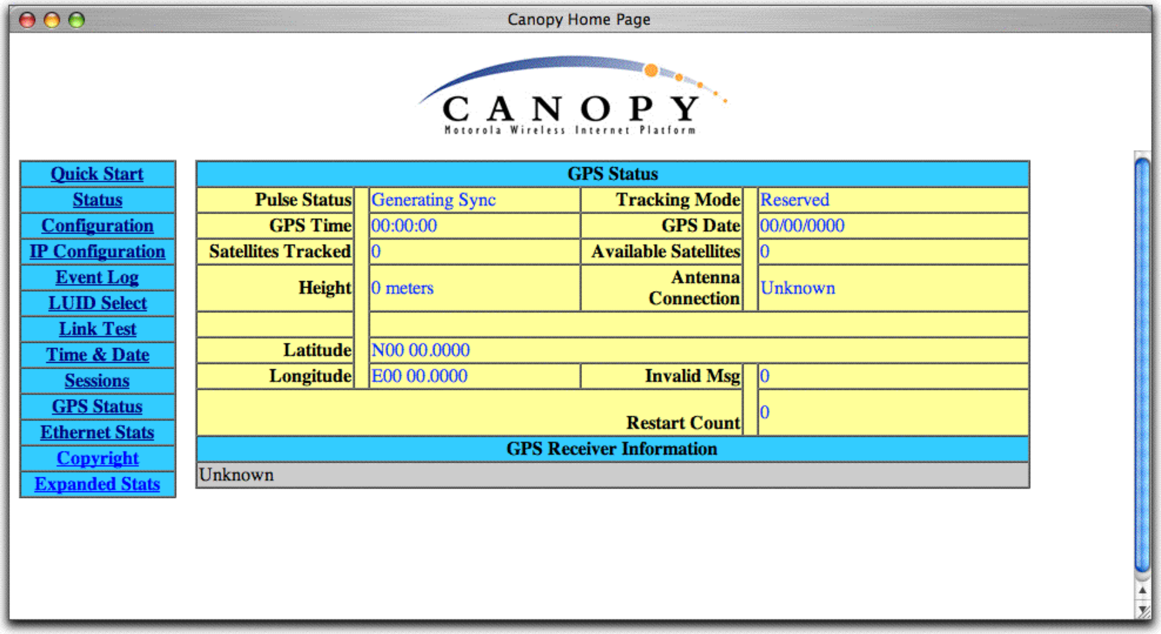
This field displays the average and the latest jitter value for the SM or BHS.

Power Level (Avg/Last)

This field displays the average and the latest power level received for the SM or BHS.

26.5 INTERPRETING DATA IN THE GPS STATUS PAGE (AP, BHM)

An example of the GPS Status screen is displayed in Figure 136.



GPS Status			
Pulse Status	Generating Sync	Tracking Mode	Reserved
GPS Time	00:00:00	GPS Date	00/00/0000
Satellites Tracked	0	Available Satellites	0
Height	0 meters	Antenna Connection	Unknown
Latitude	N00 00.0000		
Longitude	E00 00.0000	Invalid Msg	0
		Restart Count	0

GPS Receiver Information

Unknown

Figure 136: GPS Status screen

If the AP or BHM is configured to **Sync to Received Signal (Power Port)** and is connected to a CMMmicro, or is configured to **Sync to Received Signal (Timing Port)** and is connected to a CMM2, then the GPS Status web page provides information about satellites that the module sees and tracks. See Sync Input on Page 235.

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 (as shown in Figure 136 above) where a later CMM2 or CMMmicro 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.

26.6 INTERPRETING DATA IN THE ETHERNET STATS PAGE (ALL)

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

26.6.1 Ethernet Stats Parameters

The Ethernet Stats page provides the following parameters.

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

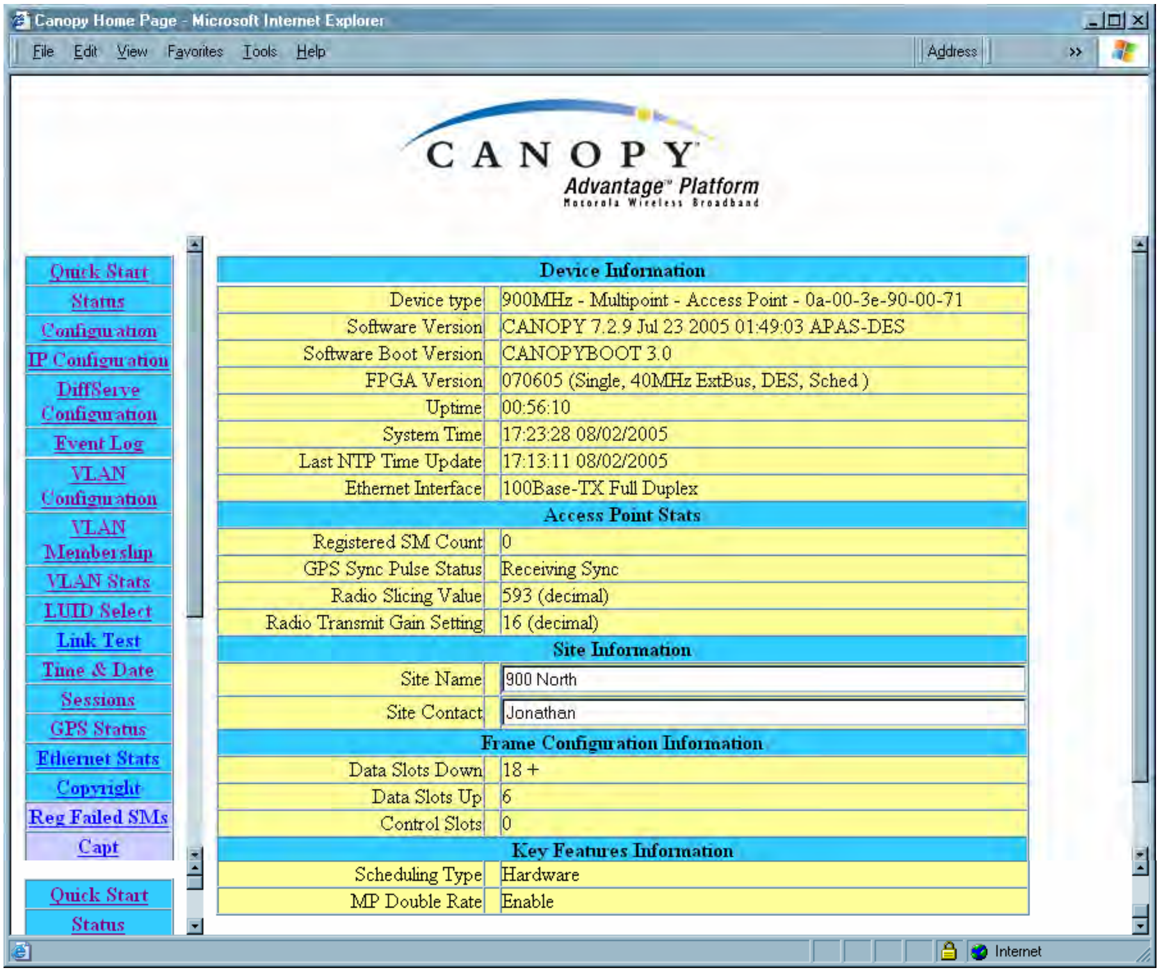
This field displays how many transmission-underrun errors occurred on the Ethernet controller.

CarSenseLost

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

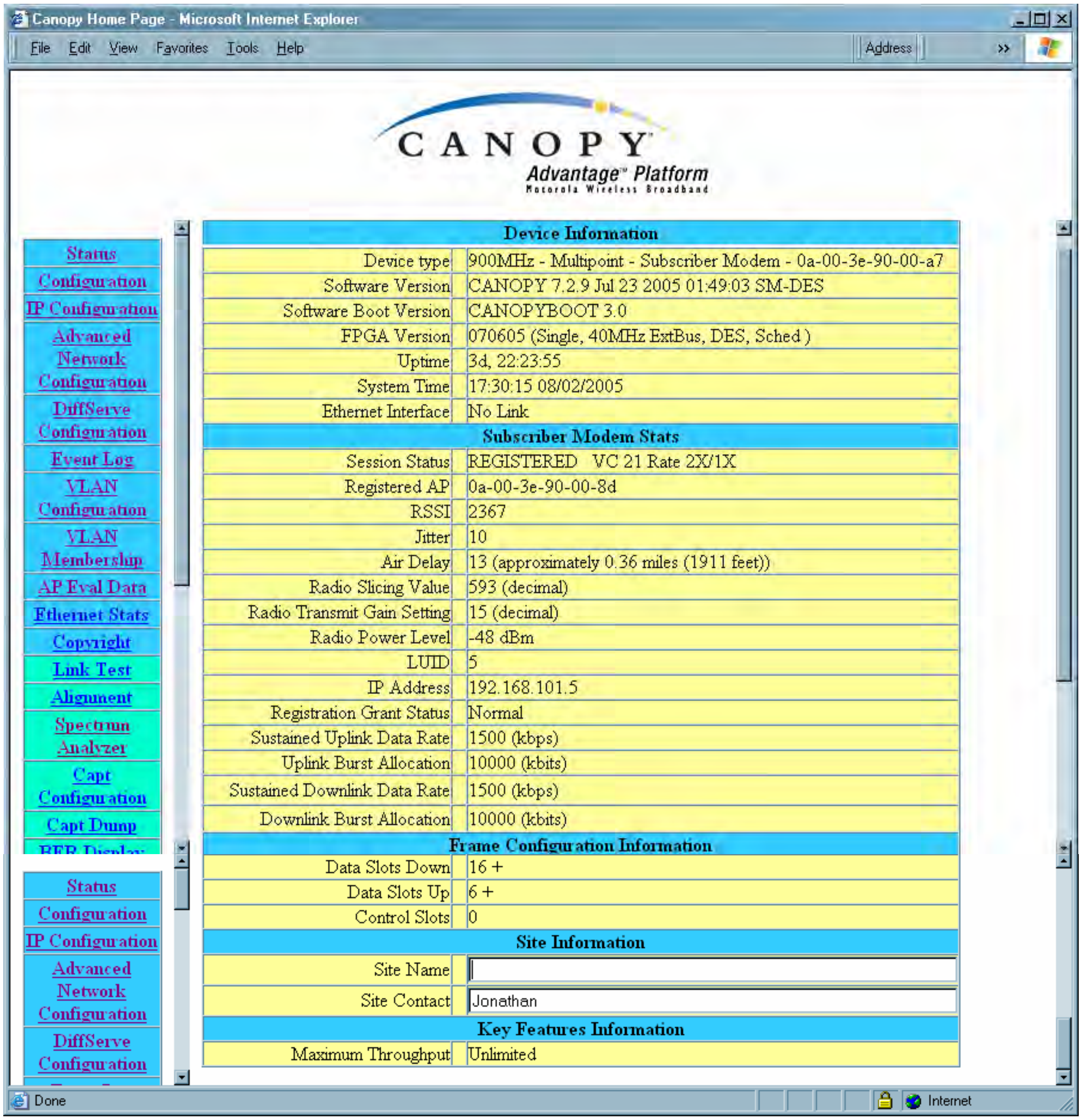
26.7 INTERPRETING DATA FROM EXPANDED STATS

Examples of expanded Status screens are displayed in Figure 137 and Figure 138.



Device Information	
Device type	900MHz - Multipoint - Access Point - 0a-00-3e-90-00-71
Software Version	CANOPY 7.2.9 Jul 23 2005 01:49:03 APAS-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	070605 (Single, 40MHz ExtBus, DES, Sched)
Uptime	00:56:10
System Time	17:23:28 08/02/2005
Last NTP Time Update	17:13:11 08/02/2005
Ethernet Interface	100Base-TX Full Duplex
Access Point Stats	
Registered SM Count	0
GPS Sync Pulse Status	Receiving Sync
Radio Slicing Value	593 (decimal)
Radio Transmit Gain Setting	16 (decimal)
Site Information	
Site Name	900 North
Site Contact	Jonathan
Frame Configuration Information	
Data Slots Down	18 +
Data Slots Up	6
Control Slots	0
Key Features Information	
Scheduling Type	Hardware
MP Double Rate	Enable

Figure 137: Status screen, AP, after Expanded Stats is selected



Device Information	
Device type	900MHz - Multipoint - Subscriber Modem - 0a-00-3e-90-00-a7
Software Version	CANOPY 7.2.9 Jul 23 2005 01:49:03 SM-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	070605 (Single, 40MHz ExtBus, DES, Sched)
Uptime	3d, 22:23:55
System Time	17:30:15 08/02/2005
Ethernet Interface	No Link
Subscriber Modem Stats	
Session Status	REGISTERED VC 21 Rate 2X/1X
Registered AP	0a-00-3e-90-00-8d
RSSI	2367
Jitter	10
Air Delay	13 (approximately 0.36 miles (1911 feet))
Radio Slicing Value	593 (decimal)
Radio Transmit Gain Setting	15 (decimal)
Radio Power Level	-48 dBm
LUID	5
IP Address	192.168.101.5
Registration Grant Status	Normal
Sustained Uplink Data Rate	1500 (kbps)
Uplink Burst Allocation	10000 (kbits)
Sustained Downlink Data Rate	1500 (kbps)
Downlink Burst Allocation	10000 (kbits)
Frame Configuration Information	
Data Slots Down	16 +
Data Slots Up	6 +
Control Slots	0
Site Information	
Site Name	
Site Contact	Jonathan
Key Features Information	
Maximum Throughput	Unlimited

Figure 138: Status Screen, SM, after Expanded Stats is selected

When you click the **Expanded Stats** button on the left side of any earlier-described module web page

- the Status page data in the AP or BHM is expanded to include the following fields:
  - **Radio Slicing Value**
  - **Radio Transmit Gain Setting**
  - **Data Slots Down**
  - **Data Slots Up**
  - **Control Slots**

- **Scheduling Type**
- **MP Double Rate**

◦ the Status page in the SM or BHS is expanded to include the following fields:

- **Radio Slicing Value**
- **Radio Transmit Gain Setting**
- **Radio Power Level**
- **LUID**
- **IP Address**
- **Registration Grant Status**
- **Sustained Uplink Data Rate**
- **Uplink Burst Allocation**
- **Sustained Downlink Data Rate**
- **Downlink Burst Allocation**
- **Data Slots Down**
- **Data Slots Up**
- **Control Slots**
- **Maximum Throughput**

◦ the link menu on the left side of the page is expanded to include links to the following additional web pages:

Alignment Page (SM, BHS)
AP Ses Log Page (AP)
ARP Stats (SM)
BER Display Page (SM, BHS)
Bridge CB Stat Page (All)
Bridge Table Page (All)
Capt Configuration (All)
Capt Dump (All)
DHCP Stats (SM)
DHCP Server IP (SM)
Downlink Log Page (AP)
Downlink Log High Page (AP)
Down Stat Page (AP, BHM)
Down Stat High Page (AP)
Frame Calculator (All)
HTTP Stats Page (All)
Link Test Page (All)
Link Test Log Page (AP)
NAT Table (SM)
NAT Stats (SM)
NI Buf Stat Page (All)
Packet Dump Page (All)
Pkt Filter Stat (SM, BHS)
Reg Failed SMs Page (AP, BHM)
RF Cal Log Page (All)
RF CB Stat Page (All)
RF Session Log Page (AP)
RF Stat Page (All)
RF Sync Log Page (AP)
Sockets Stats Page (All)
Spectrum Analyzer Page (SM, BHS)
Update Sess Log Page (AP)
Uplink Stats Page (SM, BHS, BHM)
Uplink Stat Hi Page (SM, BHS)

NOTE:
The pages italicized in the above list are for viewing under the guidance of Canopy Technical Support. The pages underscored may be absent.

When you have clicked the **Expanded Stats** button, you cannot toggle the interface back (to hide these additional web pages and Status data) by clicking the button again. You can click only the **Back** button of your browser to do so.

26.7.1 Alignment Page (SM, BHS)

Modes

The Alignment web page provides tools to assist in the alignment of an SM to an AP (or BHS to a BHM). Whether and how these tools operate depends on the mode that you invoke. The following modes are available:

- Normal Aiming Mode
- RSSI Only Aiming Mode
- Operating Mode

Regardless of the mode that you select to align the module, you must achieve all of the following indications for an acceptable link between the modules:

- RSSI greater than 700
- jitter value between 0 and 4 in Release 4.0 and later or between 5 and 9 in any earlier release
- uplink efficiency greater than 90%
- downlink efficiency greater than 90%

IMPORTANT!
If any of these values is not achieved, a link can be established but manifest occasional problems. In Release 4.0 and late releases, RSSI measurement is more consistent and jitter control is improved.

In either aiming mode, you must either set the Alignment page to automatically refresh or repeatedly click the **Enable Aiming Mode** button to keep current data displayed as the module is moved. After 15 minutes in an aiming mode, the module is automatically reset into the Operating Mode.

Normal Aiming Mode

In the Normal Aiming Mode

- the screen displays the RSSI level and the jitter value.
- the five left-most LEDs in the module act as a bar graph that indicates the best achieved RSSI level and jitter value when the greatest number of LEDs is lit. (The colors of the LEDs are not an indication in this mode.)

To invoke the Normal Aiming Mode

1. ensure that the **Disabled** button on the **RSSI Only Mode** line is checked.
2. click the **Enable Aiming Mode** button.

RSSI Only Aiming Mode

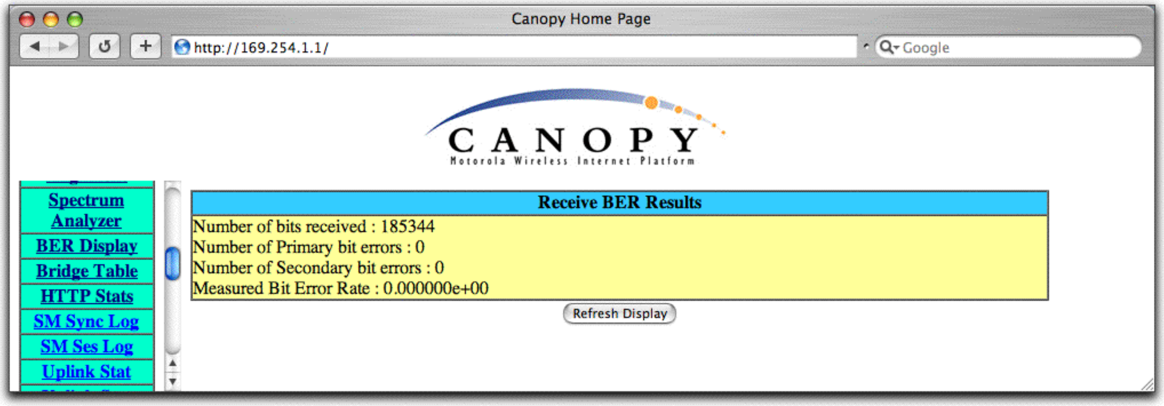
In the RSSI Only Aiming Mode, the screen displays the signal strength based on the amount of energy in the selected frequency, regardless of whether the module has registered. This mode simplifies the aiming process for long links.

To invoke the RSSI Only Aiming Mode

1. select the frequency of the AP in the Configuration Page of the SM. See Custom RF Frequency Scan Selection List on Page 257.
2. click the **Enable** button on the **RSSI Only Mode** line of the Alignment page.
3. click the **Enable Aiming Mode** button.

26.7.2 BER Display Page (SM, BHS)

An example of the BER Results screen is displayed in Figure 139.



Receive BER Results
Number of bits received : 185344
Number of Primary bit errors : 0
Number of Secondary bit errors : 0
Measured Bit Error Rate : 0.000000e+00

Figure 139: BER Results screen

BER Display

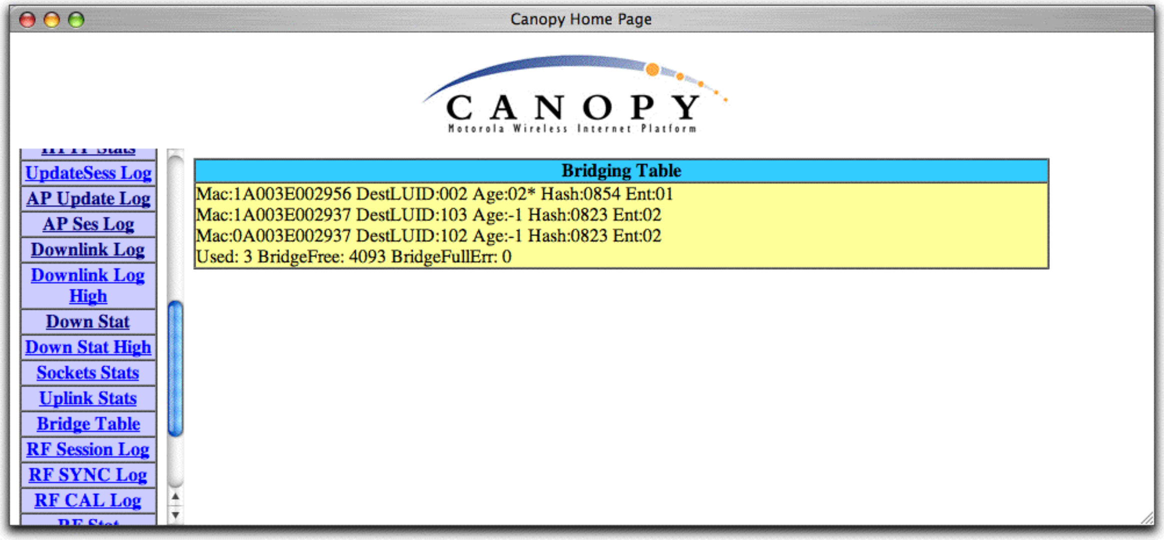
This page displays the current bit error rate in the link, but only if the AP or BHM is configured to send the BER stream. The value in the **Measured Bit Error Rate** field represents the BER at the moment of the last browser refresh. To keep the value of this field current, either repeatedly click the **Refresh Display** button or set the screen to automatically refresh.

BER Results

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.

26.7.3 Bridge Table Page (All)

An example of the Bridge Table screen is displayed in Figure 140.



```
Bridging Table
Mac:1A003E002956 DestLUID:002 Age:02* Hash:0854 Ent:01
Mac:1A003E002937 DestLUID:103 Age:-1 Hash:0823 Ent:02
Mac:0A003E002937 DestLUID:102 Age:-1 Hash:0823 Ent:02
Used: 3 BridgeFree: 4093 BridgeFullErr: 0
```

Figure 140: Bridge Table screen

If NAT (network address translation) is not active on the SM, then the Bridge Table web page provides the MAC address of all devices that are attached to registered SMs (identified by LUIDs). The bridge 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 bridge 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 bridge table entry of the source MAC address on the other end of the *Ethernet* interface.

26.7.4 Frame Calculator Page

Canopy 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. In releases earlier than 6.1, Canopy ensured that APs in a cluster had the same transmit/receive ratio by requiring that all these parameters be set the same. Release 6.1, introduces a new frame structure for hardware scheduler than for software scheduler, but the rule remains: to have all collocated APs have the same transmit/receive ratio. Additional engineering is needed for setting the parameters in a mixed cluster – one running APs on both hardware and software schedulers.

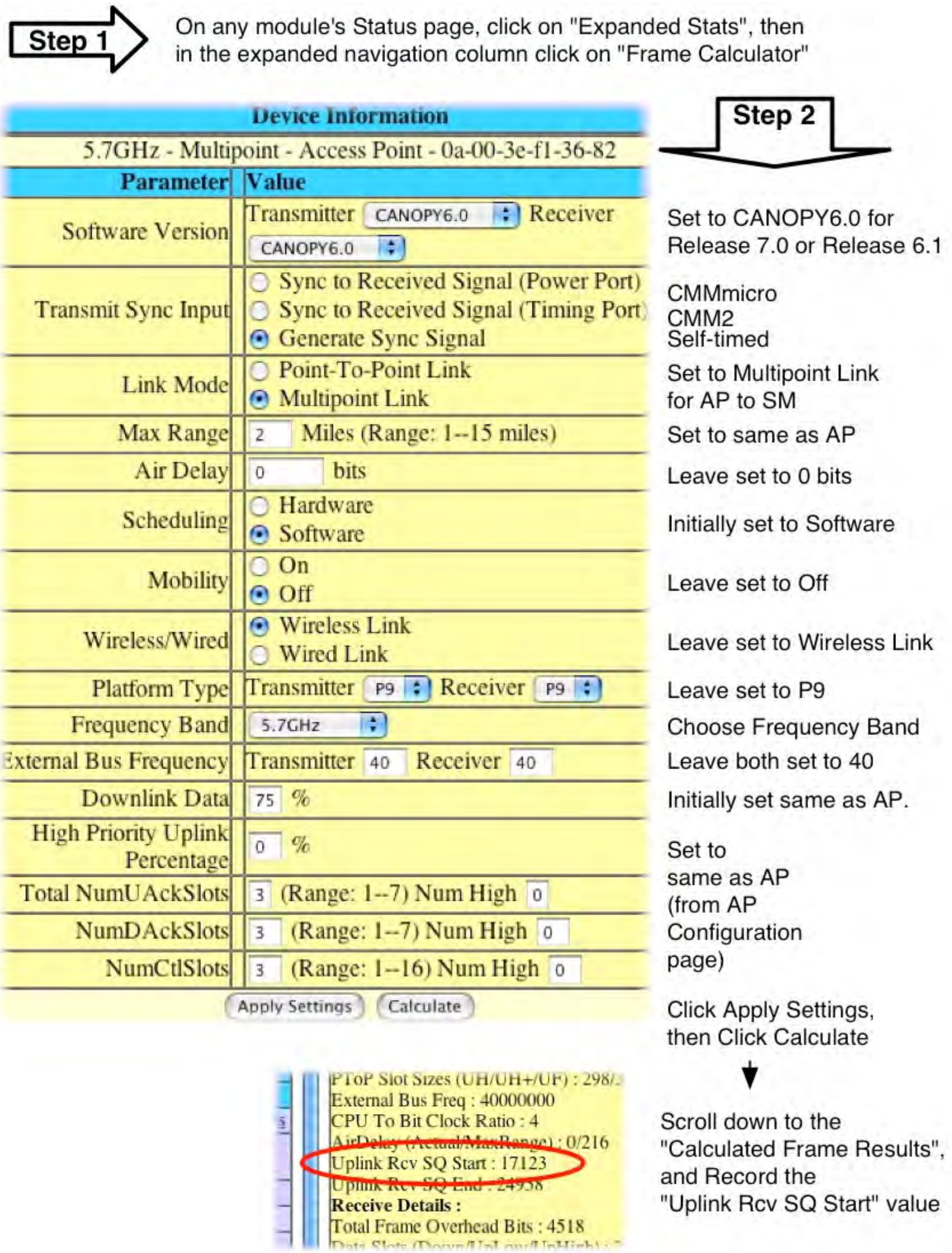
Release 6.1 and later includes a frame calculator to help do this. The operator inputs various AP settings into the calculator, and the calculator outputs many details on the frame including the **Uplink Rec SQ Start**. This calculation should be done for each AP that has different settings. Then the operator varies the **Downlink Data** percentage in each calculation until the calculated **Uplink Rec SQ Start** for all collocated APs is within 300 time bits. The frame calculator is available on any module running Release 6.1 or later 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 running Release 6.1 or later to do the calculations for any AP. Running the calculator on the AP in question is not necessary.

Figure 141 and Figure 142 show how to use the calculator to discover values of **Downlink Data** percentage that will put all the **Uplink Rcv SQ Start** values within the required 300 time bits.

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 wasn’t tuned for collocation may work fine at low traffic levels, but have issues 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.



On any module's Status page, click on "Expanded Stats", then in the expanded navigation column click on "Frame Calculator"

Device Information

5.7GHz - Multipoint - Access Point - 0a-00-3e-f1-36-82

Parameter	Value
Software Version	Transmitter CANOPY6.0 Receiver CANOPY6.0
Transmit Sync Input	○ Sync to Received Signal (Power Port) ○ Sync to Received Signal (Timing Port) ● Generate Sync Signal
Link Mode	○ Point-To-Point Link ● Multipoint Link
Max Range	2 Miles (Range: 1--15 miles)
Air Delay	0 bits
Scheduling	○ Hardware ● Software
Mobility	○ On ● Off
Wireless/Wired	● Wireless Link ○ Wired Link
Platform Type	Transmitter P9 Receiver P9
Frequency Band	5.7GHz
External Bus Frequency	Transmitter 40 Receiver 40
Downlink Data	75 %
High Priority Uplink Percentage	0 %
Total NumUAckSlots	3 (Range: 1--7) Num High 0
NumDAckSlots	3 (Range: 1--7) Num High 0
NumCtlSlots	3 (Range: 1--16) Num High 0

Set to CANOPY6.0 for Release 7.0 or Release 6.1

CMMmicro
CMM2
Self-timed

Set to Multipoint Link for AP to SM

Set to same as AP

Leave set to 0 bits

Initially set to Software

Leave set to Off

Leave set to Wireless Link

Leave set to P9

Choose Frequency Band

Leave both set to 40

Initially set same as AP.

Set to same as AP (from AP Configuration page)

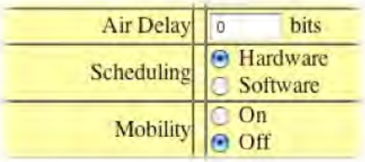
Click Apply Settings, then Click Calculate

Scroll down to the "Calculated Frame Results", and Record the "Uplink Rcv SQ Start" value

```
PToP Slot Sizes (UH/UH+/UF) : 298/
External Bus Freq : 40000000
CPU To Bit Clock Ratio : 4
AirDelay (Actual/MaxRange) : 0/216
Uplink Rcv SQ Start : 17123
Uplink Rcv SQ End : 24938
Receive Details :
Total Frame Overhead Bits : 4518
Data Slots (Down/UpLow/UpHigh) :
```

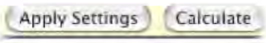
Figure 141: Discovering downlink data percentages for collocation

Step 3

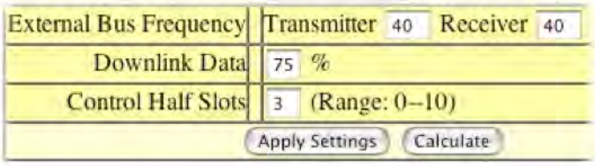


Air Delay	0 bits
Scheduling	● Hardware ○ Software
Mobility	○ On ● Off

Set the Scheduling parameter to Hardware



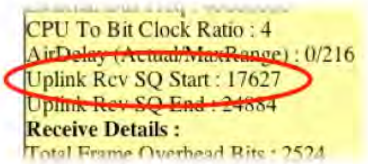
Click Apply Settings



External Bus Frequency	Transmitter 40 Receiver 40
Downlink Data	75 %
Control Half Slots	3 (Range: 0--10)

The parameters at the bottom of the screen page change to those available for hardware scheduler. Enter the number of Control Slots needed.
Caution: what is called Control Half Slots here is the same as what is called Control Slots on the hardware scheduler AP Configuration page.

Click Apply Settings,
then Click Calculate



```
CPU To Bit Clock Ratio : 4
AirDelay (Actual/MaxRange) : 0/216
Uplink Rcv SQ Start : 17627
Uplink Rcv SQ End : 24884
Receive Details :
Total Frame Overhead Bits : 2524
```

Scroll down to the "Calculated Frame Results", and Record the "Uplink Rcv SQ Start" value

Step 4

All the "Uplink Rcv SQ Start" values of collocated APs must be within a 300 time bit range.

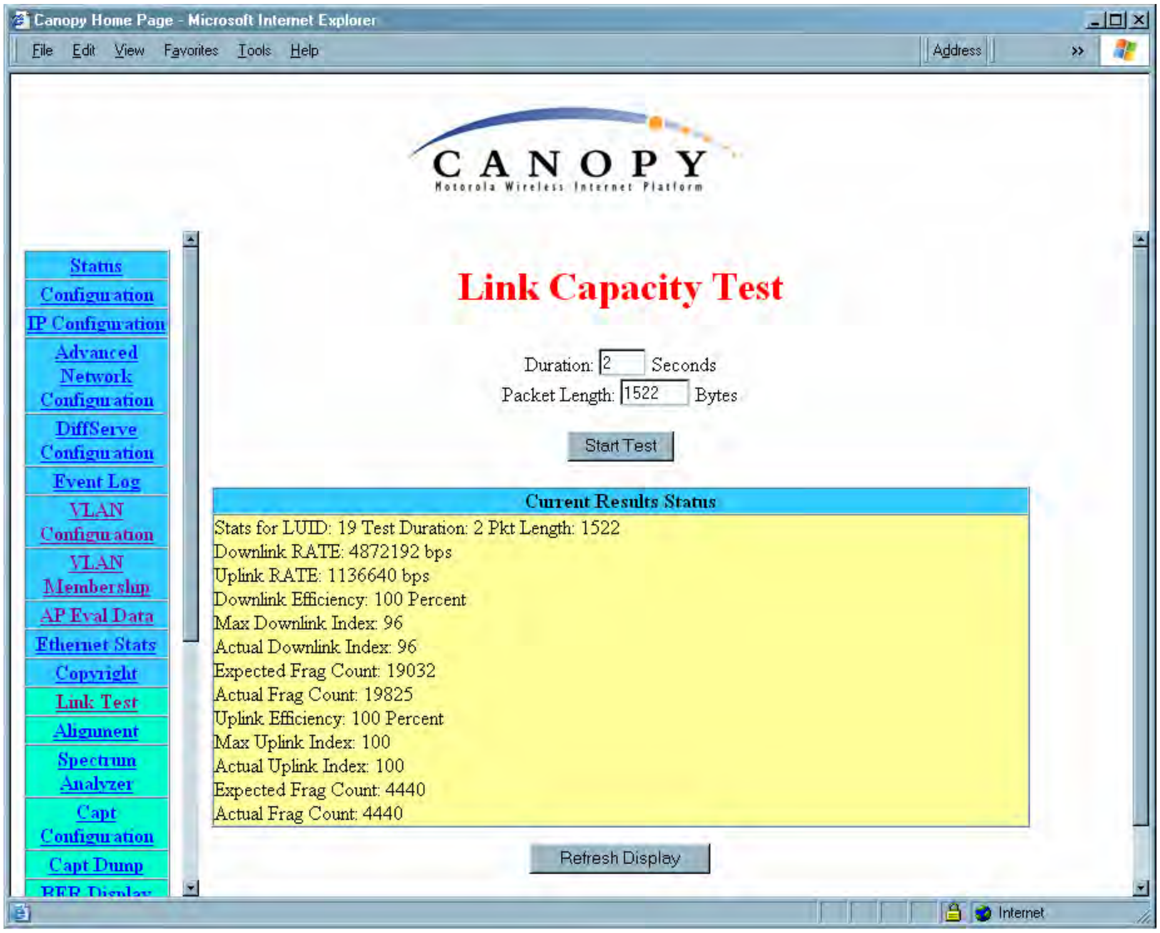
Use the calculator to iterate, changing the "Downlink Data %" to get values for all APs within 300 time bits.

Now leave the Frame Calculator and go to each AP's Configuration page. Use the discovered Downlink Data percentages to set the appropriate AP's Downlink Data % on each AP's Configuration page.

Figure 142: Discovering downlink data percentages for collocation, continued

26.7.5 Link Test Page (All)

An example of the Link Capacity Test screen is displayed in Figure 143.



Link Capacity Test

Duration: 2 Seconds
Packet Length: 1522 Bytes

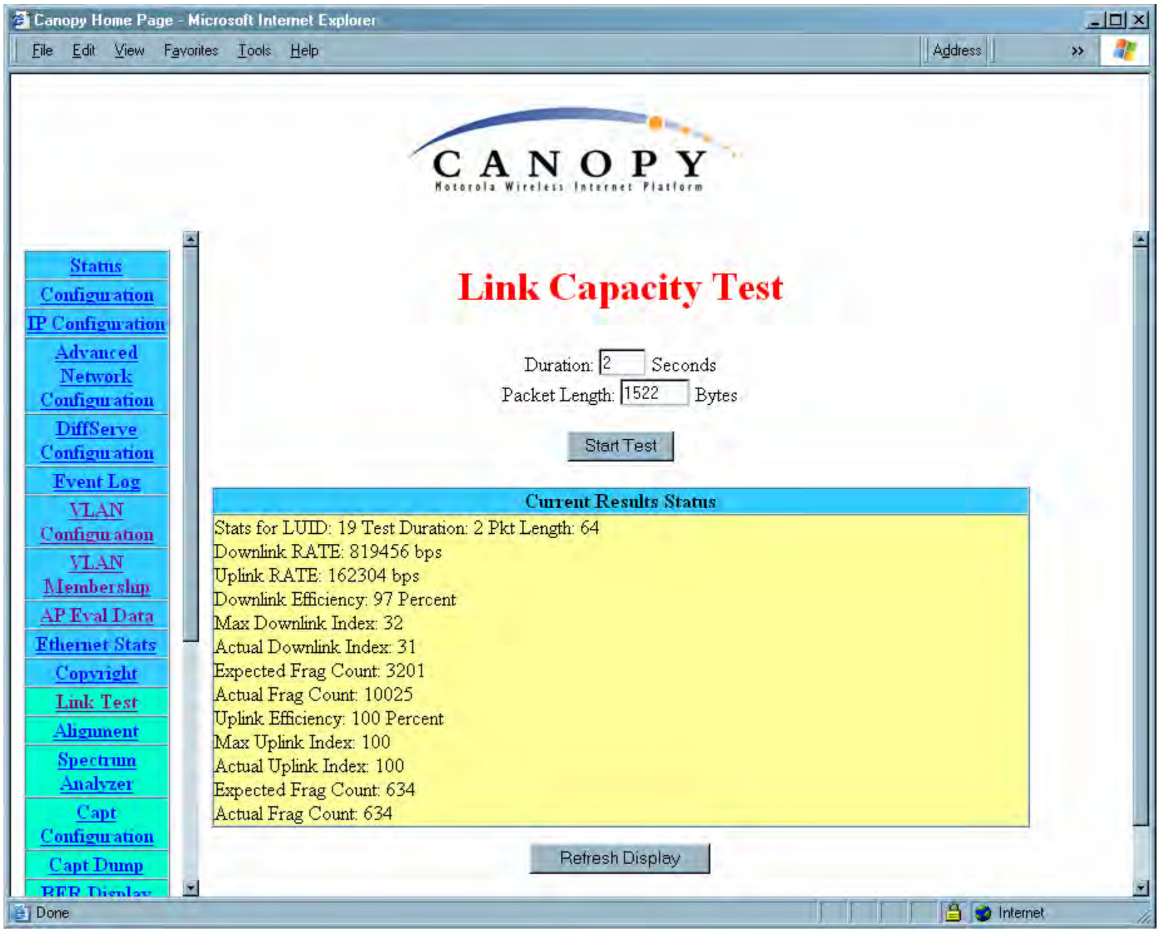
Current Results Status

```
Stats for LUID: 19 Test Duration: 2 Pkt Length: 1522
Downlink RATE: 4872192 bps
Uplink RATE: 1136640 bps
Downlink Efficiency: 100 Percent
Max Downlink Index: 96
Actual Downlink Index: 96
Expected Frag Count: 19032
Actual Frag Count: 19825
Uplink Efficiency: 100 Percent
Max Uplink Index: 100
Actual Uplink Index: 100
Expected Frag Count: 4440
Actual Frag Count: 4440
```

Figure 143: Link Capacity Test screen, 1522-byte packet length

The Link Capacity Test page allows you to measure the throughput and efficiency of the RF link between two Canopy modules. Many factors including packet length affect throughput. In Release 7.1.4 and later, the Link Capacity Test page contains the settable field 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 144.



Link Capacity Test

Duration: 2 Seconds
Packet Length: 1522 Bytes

Current Results Status

```
Stats for LUID: 19 Test Duration: 2 Pkt Length: 64
Downlink RATE: 819456 bps
Uplink RATE: 162304 bps
Downlink Efficiency: 97 Percent
Max Downlink Index: 32
Actual Downlink Index: 31
Expected Frag Count: 3201
Actual Frag Count: 10025
Uplink Efficiency: 100 Percent
Max Uplink Index: 100
Actual Uplink Index: 100
Expected Frag Count: 634
Actual Frag Count: 634
```

Figure 144: Link Capacity Test screen, 64-byte packet length

As shown in Figure 144, the **Refresh Display** operation displays the results of the 64-byte packet length test, but resets the **Packet Length** value to 1522. So if you want to repeat the 64-byte test, for example, you must first overwrite that value with 64.

To test a link using this page, perform the following steps:

1. Type into the **Duration** field how long (in seconds) the RF link should be tested.
2. Type into the **Packet Length** field (where present) the packet length at which you want the test conducted.
3. Click the **Start Test** button.
4. Click the **Refresh Display** button (if the web page is not set to automatically refresh).
5. View the results of the test.
6. Optionally
    a. change the packet length.
    b. repeat Steps 3 through 5.
    c. compare this throughput levels to that of the other test(s).

Key Link Capacity Test Fields

The key fields in the test results are

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

Capacity Criteria for the Link

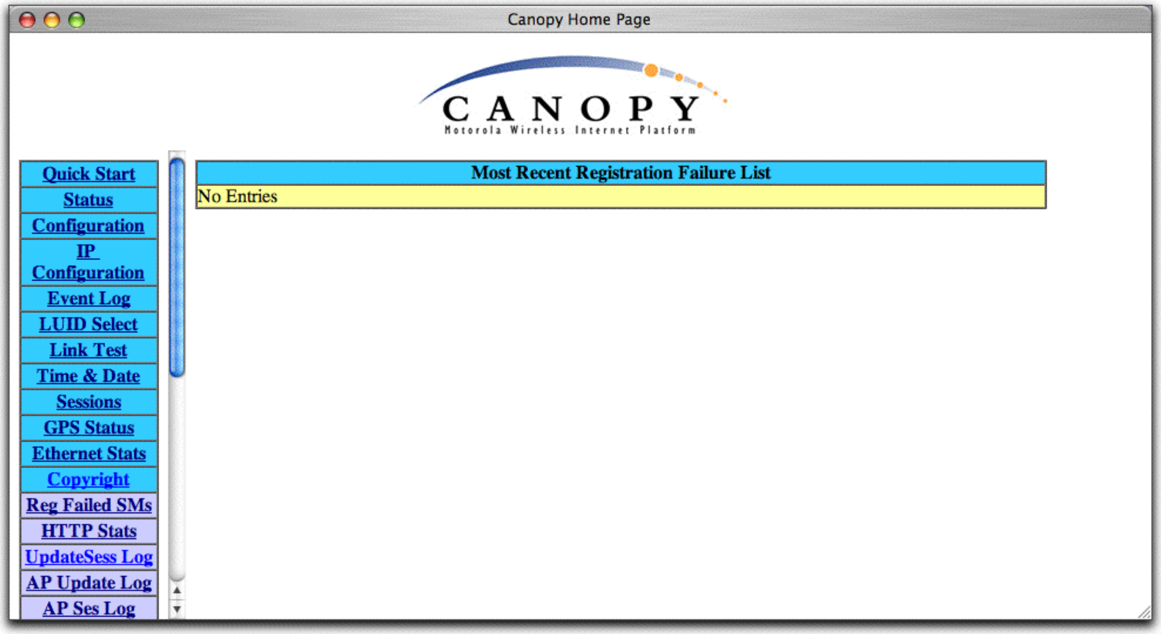
A Canopy system link is acceptable only if the efficiencies of the link test are greater than 90% in both the uplink and downlink direction, except during 2X operation. See Using Link Efficiency to Check Received Signal Quality on Page 135. Whenever you install a new link, execute a link test to ensure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

Factors That Affect Throughput

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.

26.7.6 Reg Failed SMs Page (AP, BHM)

An example of the Reg Failed SMs screen is displayed in Figure 145.



Most Recent Registration Failure List
No Entries

Figure 145: Reg Failed SMs screen

The Reg Failed SMs web page identifies SMs (or BHSs) that have recently attempted and failed to register to this AP (or BHM).

26.7.7 Spectrum Analyzer Page (SM, BHS)

See Monitoring the RF Environment on Page 350.

27 MAINTAINING YOUR CANOPY SOFTWARE

Canopy provides release compatibility information and caveats about each release.

27.1 HISTORY OF SYSTEM SOFTWARE UPGRADES

Canopy currently supports System Releases 3.2, 4.0, 4.1, and 4.2.

27.1.1 System Release 3.1.5 Features

Canopy System Release 3.1.5 introduced the following features:

- 5.7-GHz Module Support
- Enhanced Alignment Mode
- BHM Bridge Changes
- Bridge Table from 256 to 4096 Entries
- Configurable Bridge Table Timeout
- Data Encryption Standard (DES) Encryption
- Default Downlink Percentages: AP 75%, BH 50%
- Public IP Access for SM
- Public IP Access for BHS
- Customer Logo on Web-based Interface
- BH Configurable for Master or Slave
- Passwords on FTP and Telnet Sessions
- Default Router Change for BHS
- Default Router Change for SM
- GPS Sync Protection

27.1.2 System Release 3.2 Features and Fixes

Canopy System Release 3.2 introduced the following features:

- Disable SM Ethernet Interface
- Canopy Enterprise MIB

Canopy Software Release 3.2 also introduced the following fixes:

- Oversized (Up to 1532 Bytes) Ethernet Frame Fix
- BH Hash Table Fix

27.1.3 System Release 4.0 Features

Canopy System Release 4.0 introduced the following features:

- 5.7-GHz Module ISM Frequencies Support
- Advanced Encryption Standard (AES) Encryption
- Audible Alignment Tone
- BH Authentication

- Transmit Frame Spreading
- GPS Antenna Connection Status
- Improved Jitter Control
- Updated Canopy Enterprise MIB
- 20-Mbps BH to 10-Mbps BH Modulation
- Power Level Measurement
- Display Registered AP
- Registration Failed SM List
- No Remote Access
- Improved Received Signal Strength Indicator (RSSI)
- SM Scan Privacy
- Extended Network with Sync

27.1.4 System Release 4.0.1 Fixes

Canopy System Release 4.0.1 introduced the following fixes:

- Bus Bandwidth Limitation Causing 20-Mbps BH Errors Fix
- 20-Mbps BH Jitter Measurement Fix

27.1.5 System Release 4.0.2 Fixes

Canopy System Release 4.0.2 introduced the following fixes:

- Audible Alignment Tone on Only SMs and BHSs Fix
- ISM State Preserved through Reset to Factory Defaults Fix

27.1.6 System Release 4.0.4 Fix

Canopy System Release 4.0.4 introduced the following fix:

- Telnet Corrupting GPS Information Fix

27.1.7 System Release 4.1 Features

Canopy System Release 4.1 introduced the following features:

- SM Auto Update
- DHCP Server and Client in SM
- Demilitarized Zone (DMZ) in SM
- Updated Canopy Enterprise MIB
- Network Address Translation (NAT) in SM
- Low Power Mode (18-dB Reduction)
- Spectrum Analyzer in SM and BHS

27.1.8 System Release 4.2.1 Features and Fixes

Canopy System Release 4.2.1 introduced the following features:

- Software Limit Increase on 2.4-GHz Module (from 15 to 30 Miles)
- Settable AP Broadcast Repeat Count
- Encrypted Downlink Broadcast
- Protocol and Port Filtering
- Configurable Hyperlinked Logo
- Updated Canopy Enterprise MIB
- NAT Support for VPNs—L2TP Over IPSec
- SM and BHS Site Names in AP or BHM Sessions Page
- Graphical Spectrum Analyzer in SM and BHS
- PDA Info and Spectrum Analyzer Pages
- Telnet Commands Defined
- Web Pages Remain Scrolled
- Time & Date for APs or BHMs Connected to CMMmicro

Canopy System Release 4.2.1 also introduced the following fixes:

- BH 64-byte Packet Asynchronicity Fix
- Wrongly Reported DMZ IP Conflict with DHCP Server IP Range Fix
- SNMP Manager and SM Subnet Address Fix

27.1.9 System Release 4.2.2 Feature

Canopy System Release 4.2.2 introduced the following feature:

- 900-MHz Module (all P9) Support

27.1.10 System Release 4.2.3 Features and Fixes

Canopy System Release 4.2.3 introduced the following features:

- 5.7-GHz Module P9 Support
- New Alignment Tone for P9 Boards
- Floating Licenses for APs with Authentication
- Shorter than 32 Hex Authentication Keys Accepted
- CANOPYBOOT Version 3.0 Fix (Replaces Version 2.5)
- Dynamic Frequency Selection (DFS) for 5.7-GHz Module
- Improved Protocol and Port Filtering
- Consistent Display of FPGA as 6 digits
- Updated Canopy Enterprise MIB

Canopy System Release 4.2.3 also introduced the following fixes:

- DHCP Client Sends Lease Renewals as Unicast Fix
- DMZ Host as FTP Client Fix

27.1.11 System Release 4.2.7 Features and Fix

Canopy System Release 4.2.7 introduced the following features:

- 2.4-GHz Module P9 Support
- 5.2-GHz Module P9 Support
- 5.4-GHz Module P9 Support
- 5.4-GHz Module Dynamic Frequency Selection (DFS) for Radar
- 5.4-GHz Module Adjustable Power
- 2.4-GHz Module Adjustable Power

Canopy System Release 4.2.7 also introduced the following fix:

- Alignment Tone Fix

27.1.12 System Release 6.0 Features

Canopy System Release 6.0 introduced the following features:

- 900-MHz Module Dynamic per-SM High-priority Channel with Hardware Scheduler
- 900-MHz Module Hardware Scheduler Reduced Latency
- 900-MHz Module Spectrum Analyzer in AP
- 900-MHz Module Hardware Scheduler Increased Throughput

27.1.13 System Release 6.1 Features and Fix

Canopy System Release 6.1 introduced the following features:

- Release 6.0 Compatibility Mode for 900-MHz Module
- Committed Information Rate (CIR) with Hardware Scheduler
- Configuration Source Parameter at AP for VLAN, MIR, and CIR
- Frame Calculator for Tuning Mixed Clusters
- All Frames Adjusted for Cross-release Communications
- Dynamic per-SM High-priority Channel with Hardware Scheduler
- Reduced Latency with Hardware Scheduler
- Maximum Information Rate (MIR) Settable at SM
- 5.7-GHz Module Adjustable Power with Connectorized Antenna
- Spectrum Analyzer in AP
- Increased Throughput with Hardware Scheduler
- VLAN (802.1Q)

Canopy System Release 6.1 also introduced the following fix:

- Alignment Tone Fix

27.1.14 System Release 7.0 Features

Canopy System Release 7.0 introduced the following features:

- 2X Operation
- BAM+SM Configuration Source
- Priority on VLANs (802.1P)
- Improved Dynamic Frequency Selection (DFS)
- 900-MHz Module Adjustable Power
- Transmit Frame Spreading with Hardware Scheduling

27.1.15 System Release 7.1.4 Features and Fixes

Canopy System Release 7.1.4 introduced the following features:

- AP Max Range Parameter Accepts Greater Distances
- Antenna Gain Parameter for Input to DFS Sensitivity
- Per-sector Disabling of 2X Operation
- Reduced Transmitter Output Power Default in 900-MHz AP/SM
- Packet Length Settable for Link Test

Canopy System Release 7.1.4 also introduced the following fixes:

- Ethernet Port Lockup Fix
- AP Reboot No Longer Caused by SM Reboot
- AP Reboot No Longer Caused by >100 SMs Registering
- Canopy SMs Display 1X or 2X Operation Status
- Immediate 2X Operation for SMs That Register with 2X Disabled
- VLAN Membership Page for SM Not Registered to VLAN-enabled AP
- AP Eval Data Page with Correct Sector User Count
- Out-of-range Low Transmitter Output Power Value Sets Lowest Supported Power
- Correct Per-LUID Records in AP Sessions Page

Not fixed in Release 7.1.4 are the following problems:

- When hardware scheduling is enabled
  - a high incidence of re-registrations occurs for 900-MHz SMs.
  - the alignment tone is not available in SMs of Hardware Series P7 or P8.
  - the **AP Broadcast Repeat Count** parameter is not settable.

  - double the set Committed Information Rate (CIR) is applied to SMs of Hardware Series P9 in 2X operation. (Set CIR in these SMs to half the desired level.)
  - *do not* enable the high-priority channel.

27.1.16 System Release 7.2.9 Features and Fixes

Canopy System Release 7.2.9 introduced the following features:

- Differentiated Services
- VLAN Filtering Enhancement in SMs
- Disable Bridge Table Filtering in BHs
- Automatic Rate Adaption for 20-Mbps BH
- 10 SNMP Trap Destinations
- Only Contiguous Subnet Masks Allowed
- Configuration Source on AP Sessions Page

Canopy System Release 7.2.9 also introduced the following fixes:

- High Incidence of Re-registrations Fixed for 900-MHz Module
- High-priority Channel with Hardware Scheduler
- Alignment Tone with Hardware Scheduler (Series P8 or P9)
- Power Level Settable via SNMP for 900-MHz Modules
- AP Max Range Parameter Accepts Greater Distances via SNMP
- Packet Length Settable via SNMP for Link Test

27.1.17 System Release 7.3.6 Features and Fixes

Canopy System Release 7.3.6 introduced the following features:

- Hardware Scheduler on Canopy (non-Advantage) Series P9 AP
- Expanded Information on AP Sessions page
- Use of Override Plug for Resetting to Factory Defaults

Canopy System Release 7.3.6 also introduced the following fixes:

- Prevention of Low-priority Traffic from Sporadically Blocking High-priority Traffic
- Accurate linkOutOctets MIB Object Value in AP with Hardware Scheduler

27.2 HISTORY OF CMMmicro SOFTWARE UPGRADES

Canopy currently supports CMMmicro Releases 1.0, 2.1, and 2.1.1. Release 2.1 introduced the NTP Server in CMMmicro feature. Release 2.1.1 introduced the following features:

- Telnet Support in CMMmicro for All Clients
- Telnet through Radio to CMMmicro

27.3 TYPICAL CONTENTS OF RELEASE NOTES

Canopy supports each release with software release notes. This documentation includes

- description of features that are introduced in the new release.
- problems that the new release resolves.
- known problems inherent in the new release.
- installation procedures for the new release.
- troubleshooting information for the upgrade.

27.4 TYPICAL UPGRADE PROCESS

In a typical upgrade process, proceed as follows:

1. Visit the software page of the Canopy web site.
2. Read the compatibility information and any caveats that Canopy associates with the release.
3. Read the software release notes from the web site.
4. On the basis of these, decide whether the release is appropriate for your network.
5. Download the software release and associated files.
6. Use CNUT to manage the upgrade across your network.

27.4.1 Downloading Software and Release Notes

All supported software releases, the associated software release notes document, and updated MIB files are available for download at any time from http://motorola.canopywireless.com/support/software/. This web site also typically provides a summary of the backward compatibility and any advantages or disadvantages of implementing the release.

When you click on the release that you wish to download, you are prompted for information that identifies yourself and your organization (such as name, address, and e-mail address). When you complete and submit the form that prompts for this information, the download is made available to you.

28 REBRANDING MODULE INTERFACE SCREENS

Distinctive fonts indicate

`literal user input.`
`variable user input.`
`literal system responses.`
`variable system responses.`

The interface screens on each module display the Canopy or Canopy Advantage logo. These logos can be replaced with other logos using Procedure 43.

The logo is a hyperlink and clicking on it takes the user to the Canopy web site. A different site (perhaps the operator's support site) can be made the destination using Procedure 44.

To return a module to regular logos and hyperlinks, use Procedure 45.

The logo at the top of each page is a key indicator to the user whether a module is Canopy or Canopy Advantage. If you choose to replace the Canopy logos, use two noticeably different logos so that users can continue to easily distinguish between a Canopy module and a Canopy Advantage module.

To replace logos and hyperlinks efficiently throughout your network, read the following procedures, write a script, and execute your script through the Canopy Network Updater Tool (CNUT).[7] To replace them individually, use one of the following two procedures.

Procedure 43: Replacing the Canopy logo on the GUI with another logo

1. If the current logo is the Canopy logo, name your custom logo file on your computer `canopy.jpg` and put it in your home directory.

   If the current logo is the Canopy Advantage logo, name your custom logo file on your computer `advantaged.jpg` and put it in your home directory.

2. Use an FTP (File Transfer Protocol) session to transfer this file to the module, as in the example session shown in Figure 146.

[7] See Managing through the Canopy Network Updater Tool (CNUT) on Page 394.

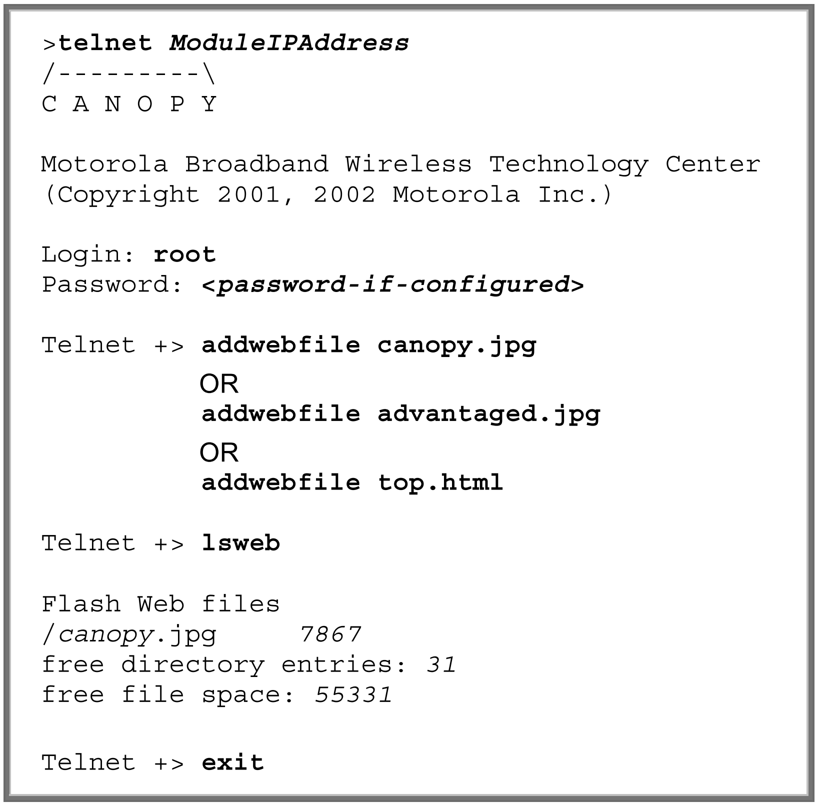
```
> ftp ModuleIPAddress
Connected to ModuleIPAddress
220 FTP server ready
Name (ModuleIPAddress:none): root
331 Guest login ok
Password: <password-if-configured>
230 Guest login ok, access restrictions apply.

ftp> binary
200 Type set to I
ftp> put canopy.jpg
     OR
     put advantaged.jpg
     OR
     put top.html
ftp> quit
221 Goodbye
```

Figure 146: Example ftp session to transfer custom logo file

3. Use a telnet session and the **`addwebfile`** command to add the new file to the file system, as in the example session shown in Figure 147.

NOTE:
Supported telnet commands execute the following results:

- **`addwebfile`** adds a custom logo file to the file system.
- **`clearwebfile`** clears the logo file from the file system.
- **`lsweb`** lists the custom logo file and display the storage space available on the file system.



```
>telnet ModuleIPAddress
/---------\
C A N O P Y

Motorola Broadband Wireless Technology Center
(Copyright 2001, 2002 Motorola Inc.)

Login: root
Password: <password-if-configured>

Telnet +> addwebfile canopy.jpg
          OR
          addwebfile advantaged.jpg
          OR
          addwebfile top.html

Telnet +> lsweb

Flash Web files
/canopy.jpg     7867
free directory entries: 31
free file space: 55331

Telnet +> exit
```

Figure 147: Example telnet session to activate custom logo file

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

Procedure 44: Changing the URL of the logo hyperlink

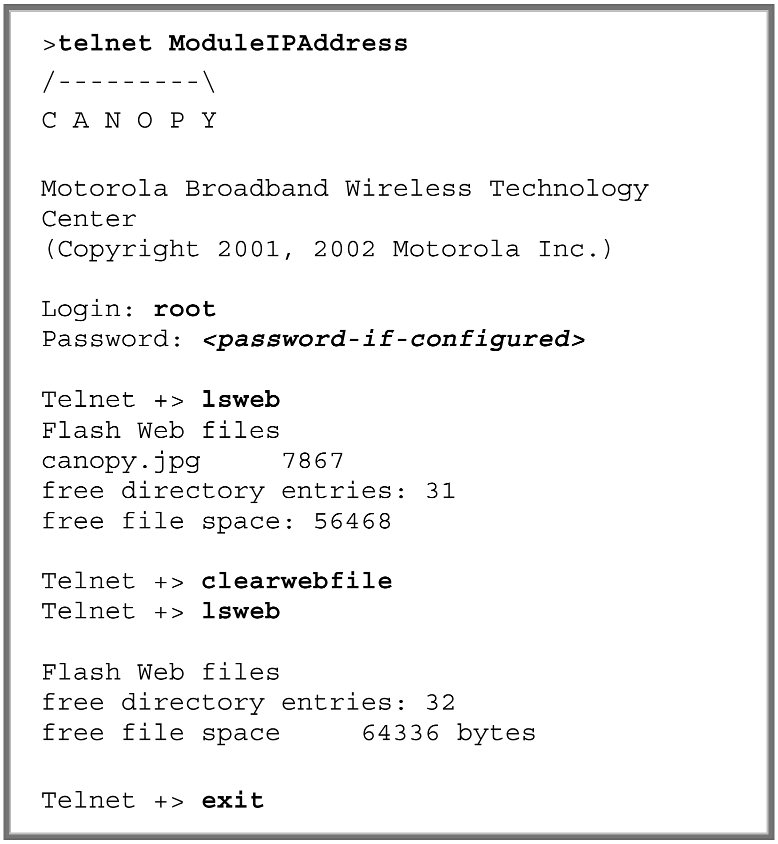
1. Browse to http://*ModuleIPAddress*/top.html.
2. Save the page as an html file named `top.html`.
3. In the editor of your choice, open the file `top.html`.
4. Find the expression `http://www.canopywireless.com`.
5. Change `http://www.canopywireless.com` to the URL to which you want the browser directed when the user clicks the logo.
6. Save and close the file as `top.html`.
7. Use an FTP (File Transfer Protocol) session to transfer this file to the module, as in the example session shown in Figure 146 on Page 429.
8. Use a telnet session and the addwebfile command to add the new file (top.html) to the file system, as in the example session shown in Figure 147.

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

If you ever want to restore the original logo and hyperlink in a module, perform the following steps.

Procedure 45: Returning a module to its original logo and hyperlink

1. Use a telnet session and the clearwebfile command to clear all custom files from the file system of the module, as in the example session shown in Figure 148 below.



```
>telnet ModuleIPAddress
/---------\
C A N O P Y

Motorola Broadband Wireless Technology
Center
(Copyright 2001, 2002 Motorola Inc.)

Login: root
Password: <password-if-configured>

Telnet +> lsweb
Flash Web files
canopy.jpg     7867
free directory entries: 31
free file space: 56468

Telnet +> clearwebfile
Telnet +> lsweb

Flash Web files
free directory entries: 32
free file space     64336 bytes

Telnet +> exit
```

Figure 148: Example telnet session to clear custom files

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

29 TOGGLING REMOTE ACCESS CAPABILITY

In Release 4.0 and later, based on your priorities for additional security and ease of network administration, you can deny or permit remote access individually to any AP, SM, or BH.

29.1 DENYING ALL REMOTE ACCESS

Wherever the No Remote Access feature is enabled (by the following procedure), physical access to the module is required for

- any change in the configuration of the module.
- any software upgrade in the module.

Where additional security is more important that ease of network administration, you can disable all remote access to a module as follows:

Procedure 46: Denying all remote access

1. Insert the override plug into the RJ-11 GPS utility port of the module.
2. Power up or power cycle the module.
3. Access the web page http://169.254.1.1/lockconfig.html.
4. Click the check box.
5. Save the changes.
6. Reboot the module.
7. Remove the override plug.
   RESULT: No access to this module is possible through HTTP, SNMP, FTP, telnet, or over an RF link.

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

29.2 REINSTATING REMOTE ACCESS CAPABILITY

Where ease of network administration is more important than the additional security that the No Remote Access feature provides, this feature can be disabled as follows:

Procedure 47: Reinstating remote access capability

1. Insert the override plug into the RJ-11 GPS utility port of the module.
2. Power up or power cycle the module.
3. Access the web page http://169.254.1.1/lockconfig.html.
4. Click the check box to uncheck the field.
5. Save the changes.
6. Reboot the module.
7. Remove the override plug.
   RESULT: Access to this module is possible through HTTP, SNMP, FTP, telnet, or over an RF link.

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

30 SETTING UP A PROTOCOL ANALYZER ON YOUR CANOPY NETWORK

Selection of protocol analyzer software and location for a protocol analyzer depend on both the network topology and the type of traffic to capture. However, the examples in this section are based on free-of-charge Ethereal software, which is available at http://ethereal.com/

The equipment required to set up a protocol analyzer includes:

- 1 hub
- 1 laptop computer with protocol analyzer software installed
- 2 straight-through Ethernet cables
- 1 Canopy power converter (ACPS110)

30.1 ANALYZING TRAFFIC AT AN SM

The IP address of the protocol analyzer laptop computer must match the IP addressing scheme of the SM. If the SM has DHCP enabled, then configure the laptop computer to automatically obtain an address. If DHCP is not enabled, then ensure that the laptop computer is configured with a static IP address in the same subnet as the SM.

The configuration for analyzing traffic at an SM is shown in Figure 149.

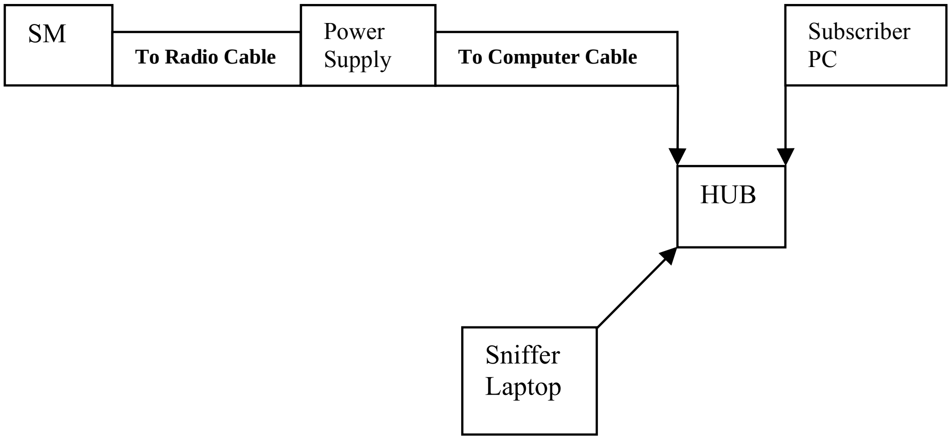


Figure 149: Protocol analysis at SM

30.2 ANALYZING TRAFFIC AT AN AP OR BH WITH NO CMM

The IP address of the protocol analyzer laptop computer must match the IP addressing scheme of the AP/BH. If the router is configured to be a DHCP server, then configure the laptop computer to automatically obtain an address. If DHCP is not enabled, then ensure that the laptop computer is configured with a static IP address in the same subnet as the AP/BH.

The configuration for analyzing traffic at an AP or BH that *is not* connected to a CMM is shown in Figure 150.

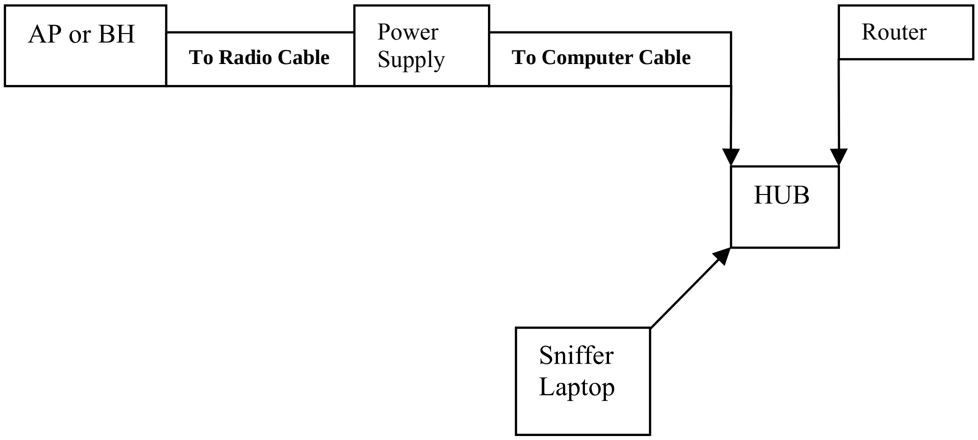


Figure 150: Protocol analysis at AP or BH not connected to a CMM

30.3 ANALYZING TRAFFIC AT AN AP OR BH WITH A CMM

The IP address of the protocol analyzer laptop computer must match the IP addressing scheme of the AP/BH. If the router is configured to be a DHCP server, then configure the laptop computer to automatically obtain an address. If DHCP is not enabled, ensure that the laptop computer is configured with a static IP address in the same subnet as the AP/BH.

Connect the hub to the J2 Ethernet to Switch of the port that is associated with the AP/BH. This example is of capturing traffic from AP/BH 111, which is connected to Port 1. The configuration for analyzing traffic at an AP or BH that is connected to a CMM is shown in Figure 151.

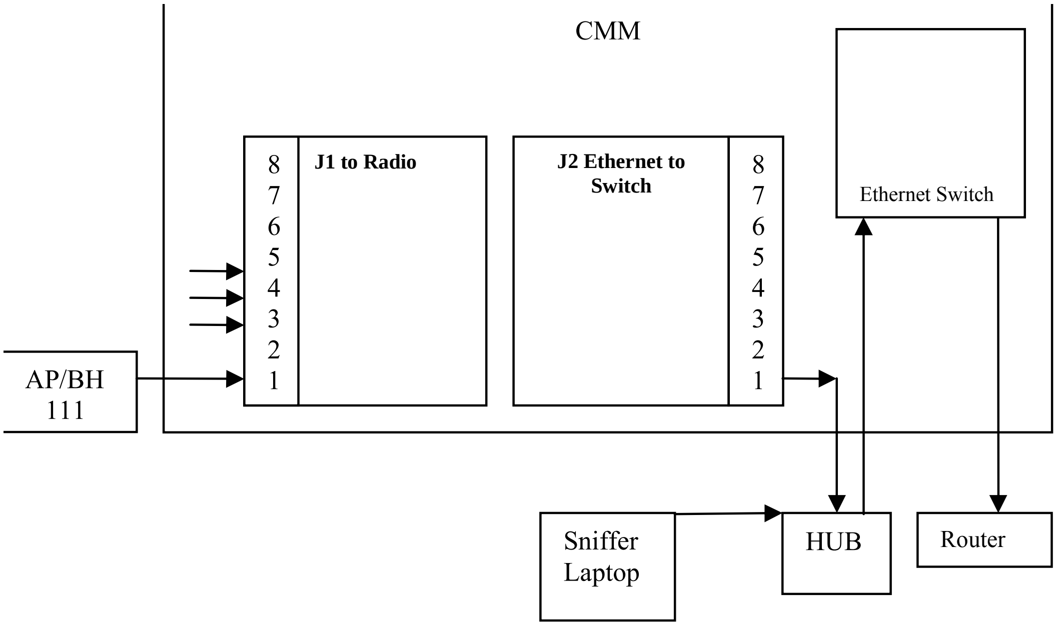


Figure 151: Protocol analysis at AP or BH connected to a CMM

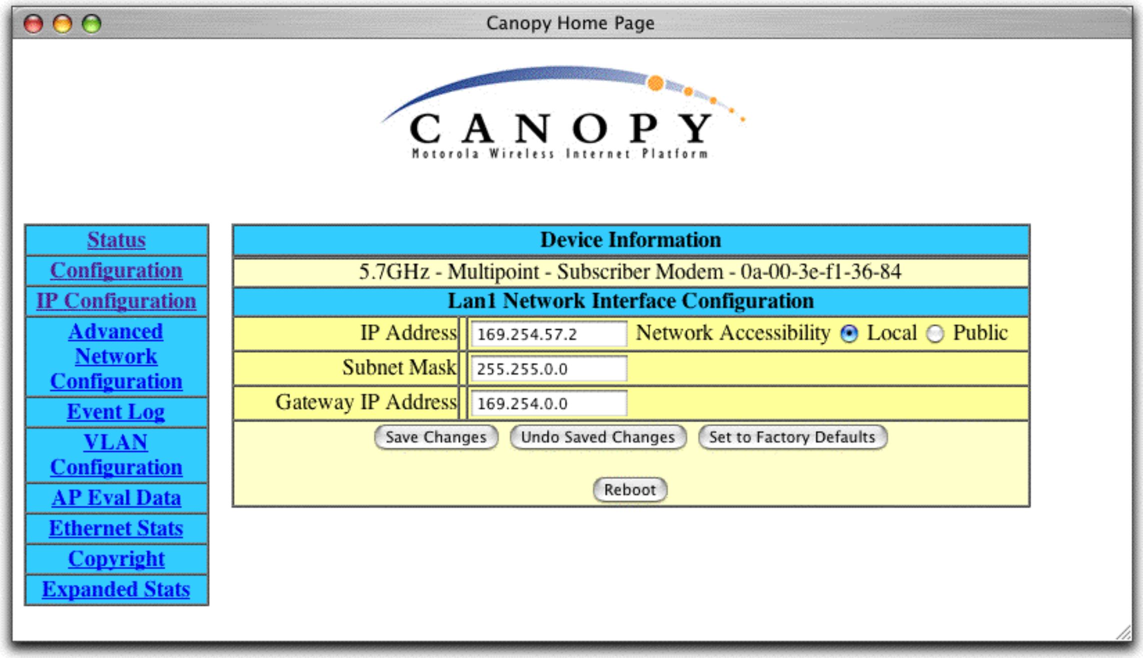
30.4 EXAMPLE OF A PROTOCOL ANALYZER SETUP FOR AN SM

The following is an example of a protocol analyzer setup using Ethereal software to capture traffic at the SM level. This example is based on the following assumptions:

- All required physical cabling has been completed.
- The hub, protocol analyzer laptop computer, subscriber PC are successfully connected.
- The SM is connected
  - as shown in Figure 150 on Page 434.
  - to the subscriber PC and the AP.
- Ethereal software is operational on the laptop computer.

Although these procedures involve the SM, the only difference in the procedure for analyzing traffic on an AP or BH is the hub insertion point.

An IP Configuration screen of the example SM is shown in Figure 152.

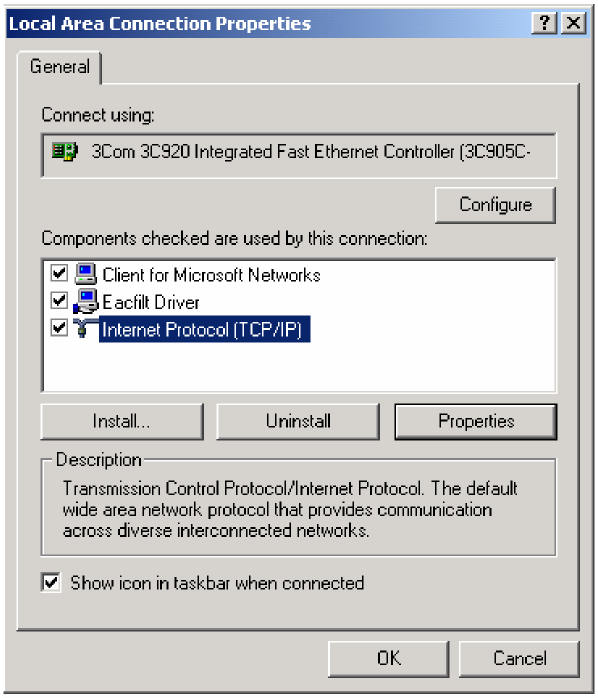


Device Information	
5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84	
Lan1 Network Interface Configuration	
IP Address	169.254.57.2 Network Accessibility ● Local ○ Public
Subnet Mask	255.255.0.0
Gateway IP Address	169.254.0.0

Figure 152: IP Configuration screen for SM

Procedure 48: Setting up a protocol analyzer

1. Note the IP Configuration of the SM.
2. Browse to **Start→My Network Places→Network and Dialup Connections**.
3. For **Local Area Connection**, select **Properties**.
   RESULT: The Local Area Connections Properties window opens, as shown in Figure 153.



Connect using:

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-

Components checked are used by this connection:

☑ Client for Microsoft Networks
☑ Eacfilt Driver
☑ Internet Protocol (TCP/IP)

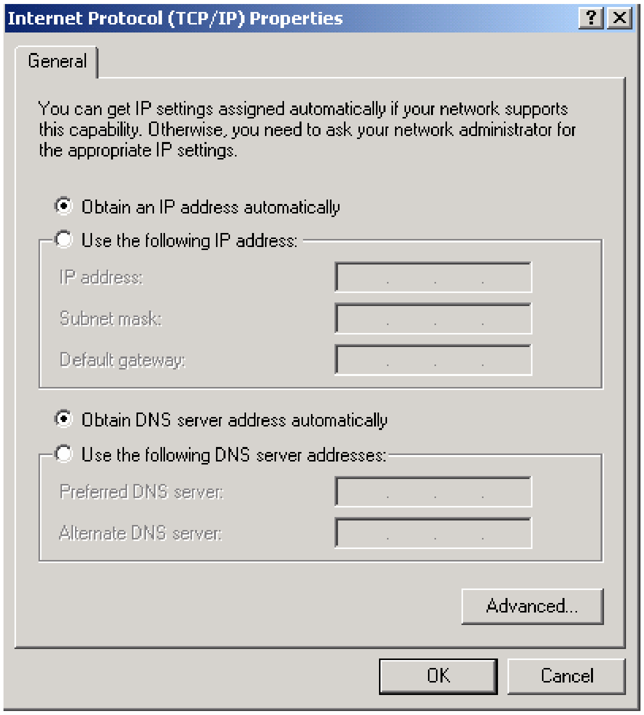
Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

☑ Show icon in taskbar when connected

Figure 153: Local Area Connection Properties window

4. Select **Internet Protocol (TCP/IP)**.
5. Click the **Properties** button.
   RESULT: The Internet Protocol (TCP/IP) Properties window opens, as shown in Figure 154.



Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

● Obtain DNS server address automatically

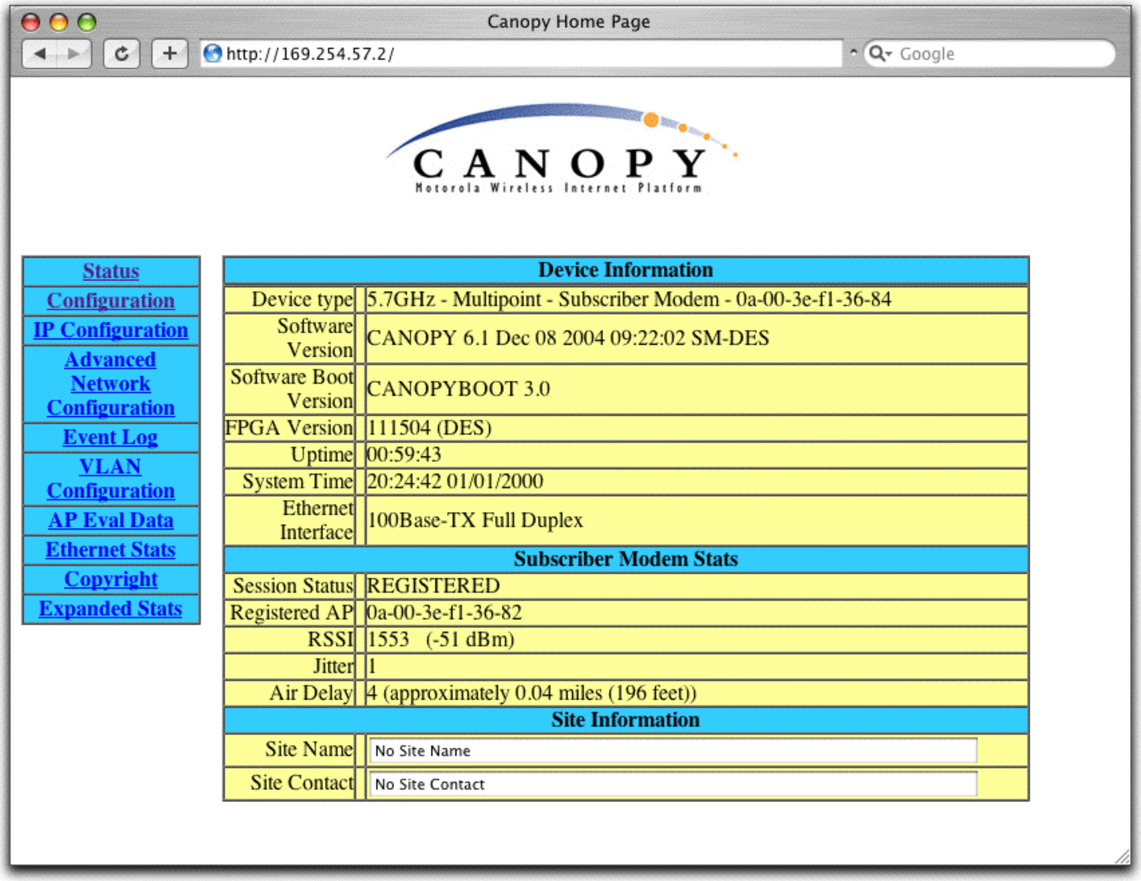
○ Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

Figure 154: Internet Protocol (TCP/IP) Properties window

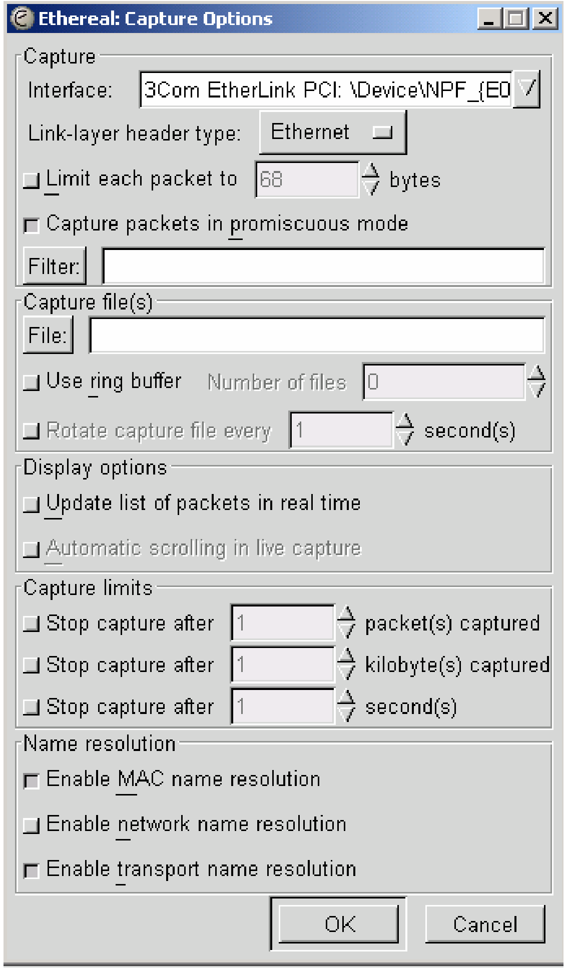
6. Unless you have a static IP address configured on the SM, select **Obtain an IP address automatically** for the protocol analyzer laptop computer, as shown in Figure 154.
7. If you have configured a static IP address on the SM, then
   a. select **Use the following IP address**.
   b. enter an IP address that is in the same subnet as the SM.
8. Click **OK**.
9. Open your Web browser.
10. Enter the IP address of the SM.
    RESULT: The Status page of the SM opens, as shown in Figure 155.



Device Information	
Device type	5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-36-84
Software Version	CANOPY 6.1 Dec 08 2004 09:22:02 SM-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	111504 (DES)
Uptime	00:59:43
System Time	20:24:42 01/01/2000
Ethernet Interface	100Base-TX Full Duplex
Subscriber Modem Stats	
Session Status	REGISTERED
Registered AP	0a-00-3e-f1-36-82
RSSI	1553 (-51 dBm)
Jitter	1
Air Delay	4 (approximately 0.04 miles (196 feet))
Site Information	
Site Name	No Site Name
Site Contact	No Site Contact

Figure 155: Status screen for SM

11. If the Status page did not open, reconfigure how the laptop computer obtains an IP address.
12. Verified that you have connectivity from the laptop computer to the SM with the hub inserted.
13. Launch the protocol analyzer software on the laptop computer.
14. In the **Capture** menu, select **Start**.
    RESULT: The Ethereal Capture Options window opens, as shown in Figure 156.



Capture

Interface: 3Com EtherLink PCI: \Device\NPF_{E0

Link-layer header type: Ethernet

□ Limit each packet to 68 bytes

☑ Capture packets in promiscuous mode

Filter:

Capture file(s)

File:

□ Use ring buffer Number of files 0

□ Rotate capture file every 1 second(s)

Display options

□ Update list of packets in real time

□ Automatic scrolling in live capture

Capture limits

□ Stop capture after 1 packet(s) captured

□ Stop capture after 1 kilobyte(s) captured

□ Stop capture after 1 second(s)

Name resolution

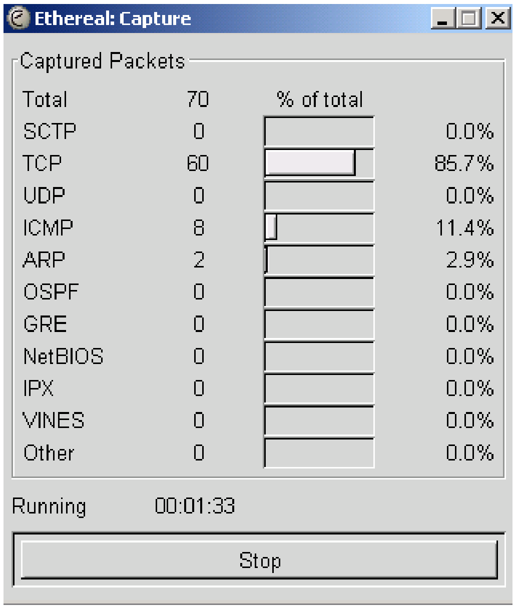
☑ Enable MAC name resolution

□ Enable network name resolution

☑ Enable transport name resolution

Figure 156: Ethereal Capture Options window

15. Ensure that the **Interface** field reflects the network interface card (NIC) that is used on the protocol analyzer laptop computer.
    NOTE: Although you can select filters based on specific types of traffic, all values are defaults in this example.
16. If you wish to select filters, select them now.
17. Click **OK**.
    RESULT: The Ethereal Capture window opens, as shown in Figure 157.



Captured Packets

Total	70	% of total
SCTP	0	0.0%
TCP	60	85.7%
UDP	0	0.0%
ICMP	8	11.4%
ARP	2	2.9%
OSPF	0	0.0%
GRE	0	0.0%
NetBIOS	0	0.0%
IPX	0	0.0%
VINES	0	0.0%
Other	0	0.0%

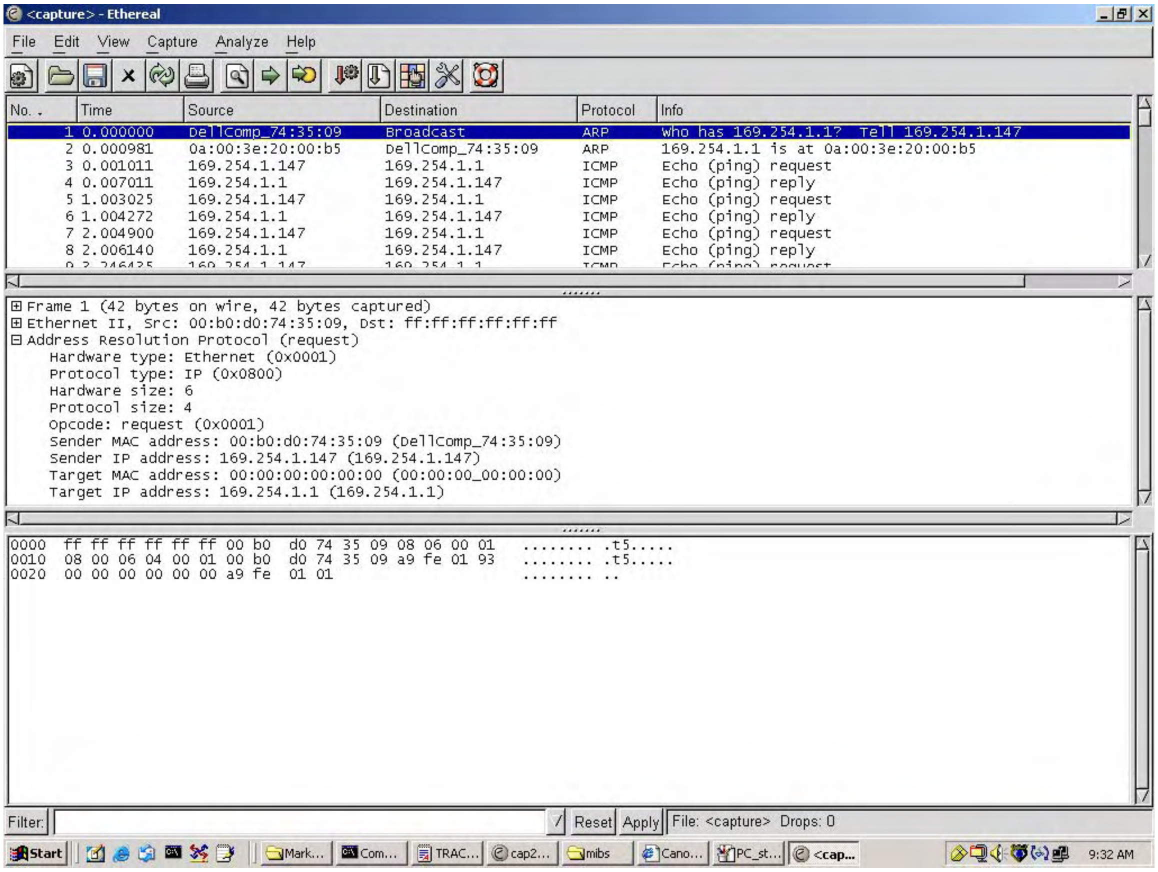
Running 00:01:33

Figure 157: Ethereal Capture window

NOTE: This window graphically displays the types of packets (by percentage) that are being captured.

18. If all packet types are displayed with 0%, either
    - launch your Web browser on the subscriber PC for the IP address of the SM
    - ping the SM from the home PC.
19. If still all packet types are displayed with 0% (meaning that no traffic is being captured), reconfigure IP addressing until you can successfully see traffic captured on the laptop computer.
20. Whenever the desired number of packets have been captured, click **Stop**.
    RESULT: When you stop the packet capture, the <capture> - Ethereal window opens, as shown in Figure 158.

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



No.	Time	Source	Destination	Protocol	Info
1	0.000000	DellComp_74:35:09	Broadcast	ARP	Who has 169.254.1.1? Tell 169.254.1.147
2	0.000981	0a:00:3e:20:00:b5	DellComp_74:35:09	ARP	169.254.1.1 is at 0a:00:3e:20:00:b5
3	0.001011	169.254.1.147	169.254.1.1	ICMP	Echo (ping) request
4	0.007011	169.254.1.1	169.254.1.147	ICMP	Echo (ping) reply
5	1.003025	169.254.1.147	169.254.1.1	ICMP	Echo (ping) request
6	1.004272	169.254.1.1	169.254.1.147	ICMP	Echo (ping) reply
7	2.004900	169.254.1.147	169.254.1.1	ICMP	Echo (ping) request
8	2.006140	169.254.1.1	169.254.1.147	ICMP	Echo (ping) reply
9	2.246425	169.254.1.147	169.254.1.1	ICMP	Echo (ping) request

```
⊞ Frame 1 (42 bytes on wire, 42 bytes captured)
⊞ Ethernet II, Src: 00:b0:d0:74:35:09, Dst: ff:ff:ff:ff:ff:ff
⊟ Address Resolution Protocol (request)
    Hardware type: Ethernet (0x0001)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (0x0001)
    Sender MAC address: 00:b0:d0:74:35:09 (DellComp_74:35:09)
    Sender IP address: 169.254.1.147 (169.254.1.147)
    Target MAC address: 00:00:00:00:00:00 (00:00:00_00:00:00)
    Target IP address: 169.254.1.1 (169.254.1.1)
```

```
0000  ff ff ff ff ff ff 00 b0  d0 74 35 09 08 06 00 01   ........ .t5.....
0010  08 00 06 04 00 01 00 b0  d0 74 35 09 a9 fe 01 93   ........ .t5.....
0020  00 00 00 00 00 00 a9 fe  01 01                     ........ ..
```

File: <capture> Drops: 0

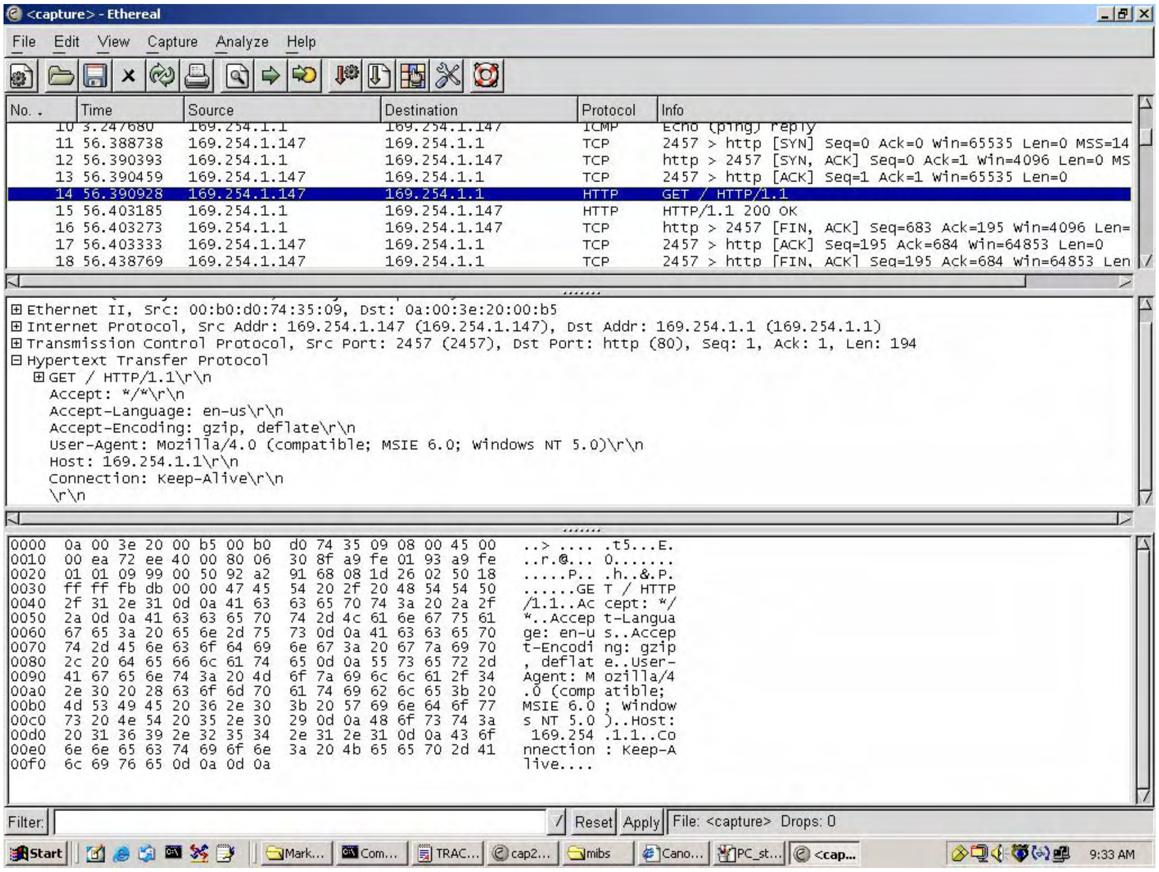
Figure 158: <capture> - Ethereal window, Packet 1 selected

This window has three panes:

- The top pane provides a sequenced summary of the packets captured and includes SRC/DEST address and type of protocol. What you select in this pane determines the additional information that is displayed in the lower two panes.
- The lower two panes facilitate drill-down into the packet that you selected in the top pane.

In this example, Packet 1 (a broadcast ARP request) was selected in the top pane. The lower two panes provide further details about Packet 1.

Another example is shown in Figure 159.



```
No. .  Time       Source          Destination     Protocol  Info
   10 3.247680   169.254.1.1     169.254.1.147   ICMP      Echo (ping) reply
   11 56.388738  169.254.1.147   169.254.1.1     TCP       2457 > http [SYN] Seq=0 Ack=0 Win=65535 Len=0 MSS=14
   12 56.390393  169.254.1.1     169.254.1.147   TCP       http > 2457 [SYN, ACK] Seq=0 Ack=1 Win=4096 Len=0 MS
   13 56.390459  169.254.1.147   169.254.1.1     TCP       2457 > http [ACK] Seq=1 Ack=1 Win=65535 Len=0
   14 56.390928  169.254.1.147   169.254.1.1     HTTP      GET / HTTP/1.1
   15 56.403185  169.254.1.1     169.254.1.147   HTTP      HTTP/1.1 200 OK
   16 56.403273  169.254.1.1     169.254.1.147   TCP       http > 2457 [FIN, ACK] Seq=683 Ack=195 Win=4096 Len=
   17 56.403333  169.254.1.147   169.254.1.1     TCP       2457 > http [ACK] Seq=195 Ack=684 Win=64853 Len=0
   18 56.438769  169.254.1.147   169.254.1.1     TCP       2457 > http [FIN, ACK] Seq=195 Ack=684 Win=64853 Len
```

```
⊞ Ethernet II, Src: 00:b0:d0:74:35:09, Dst: 0a:00:3e:20:00:b5
⊞ Internet Protocol, Src Addr: 169.254.1.147 (169.254.1.147), Dst Addr: 169.254.1.1 (169.254.1.1)
⊞ Transmission Control Protocol, Src Port: 2457 (2457), Dst Port: http (80), Seq: 1, Ack: 1, Len: 194
⊟ Hypertext Transfer Protocol
   ⊞ GET / HTTP/1.1\r\n
     Accept: */*\r\n
     Accept-Language: en-us\r\n
     Accept-Encoding: gzip, deflate\r\n
     User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0)\r\n
     Host: 169.254.1.1\r\n
     Connection: Keep-Alive\r\n
     \r\n
```

```
0000  0a 00 3e 20 00 b5 00 b0  d0 74 35 09 08 00 45 00   ..> .... .t5...E.
0010  00 ea 72 ee 40 00 80 06  30 8f a9 fe 01 93 a9 fe   ..r.@... 0.......
0020  01 01 09 99 00 50 92 a2  91 68 08 1d 26 02 50 18   .....P.. .h..&.P.
0030  ff ff fb db 00 00 47 45  54 20 2f 20 48 54 54 50   ......GE T / HTTP
0040  2f 31 2e 31 0d 0a 41 63  63 65 70 74 3a 20 2a 2f   /1.1..Ac cept: */
0050  2a 0d 0a 41 63 63 65 70  74 2d 4c 61 6e 67 75 61   *..Accep t-Langua
0060  67 65 3a 20 65 6e 2d 75  73 0d 0a 41 63 63 65 70   ge: en-u s..Accep
0070  74 2d 45 6e 63 6f 64 69  6e 67 3a 20 67 7a 69 70   t-Encodi ng: gzip
0080  2c 20 64 65 66 6c 61 74  65 0d 0a 55 73 65 72 2d   , deflat e..User-
0090  41 67 65 6e 74 3a 20 4d  6f 7a 69 6c 6c 61 2f 34   Agent: M ozilla/4
00a0  2e 30 20 28 63 6f 6d 70  61 74 69 62 6c 65 3b 20   .0 (comp atible;
00b0  4d 53 49 45 20 36 2e 30  3b 20 57 69 6e 64 6f 77   MSIE 6.0 ; Window
00c0  73 20 4e 54 20 35 2e 30  29 0d 0a 48 6f 73 74 3a   s NT 5.0 )..Host:
00d0  20 31 36 39 2e 32 35 34  2e 31 2e 31 0d 0a 43 6f    169.254 .1.1..Co
00e0  6e 6e 65 63 74 69 6f 6e  3a 20 4b 65 65 70 2d 41   nnection : Keep-A
00f0  6c 69 76 65 0d 0a 0d 0a                            live....
```

Figure 159: <capture> - Ethereal window, Packet 14 selected

In this second example, Packet 14 (protocol type HTTP) is selected in the top pane. The two lower panes provide further details about Packet 14.

31 TROUBLESHOOTING

31.1 GENERAL PLANNING FOR TROUBLESHOOTING

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

1. Identify troubleshooting tools that are available at your site (such as a protocol analyzer).
2. Identify commands and other sources that can capture baseline data for the site. These may include
   - **`ping`**
   - **`tracert`** or **`traceroute`**
   - Link Test results
   - throughput data
   - Configuration screen captures
   - Status page captures
   - session logs
3. Start a log for the site.
4. Include the following information in the log:
   - operating procedures
   - site-specific configuration records
   - network topology
   - software releases, boot versions, and FPGA firmware versions
   - types of hardware deployed
   - site-specific troubleshooting processes
   - escalation procedures
5. Capture baseline data into the log from the sources listed in Step 2.

31.2 GENERAL FAULT ISOLATION PROCESS

Effective troubleshooting also requires an effective fault isolation methodology that includes

- attempting to isolate the problem to the level of a system, subsystem, or link, such as
  - AP to SM
  - AP to CMM
  - AP to GPS
  - CMM to GPS
  - BHM to BHS
  - BHM to CMM
  - power

- researching Event Logs of the involved equipment. (See Interpreting Messages in the Event Log Page on Page 397.)
- answering the questions listed in the following section.
- reversing the last previous corrective attempt before proceeding to the next.
- performing only one corrective attempt at a time.

31.3 QUESTIONS TO HELP ISOLATE THE PROBLEM

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

1. What is the history of the problem?
   - Have we changed something recently?
   - Have we seen other symptoms before this?
2. How wide-spread is the symptom?
   - Is the problem on only a single SM? (If so, focus on that SM.)
   - Is the problem on multiple SMs? If so
     - is the problem on one AP in the cluster? (If so, focus on that AP)
     - is the problem on multiple, but not all, APs in the cluster? (If so, focus on those APs)
     - is the problem on all APs in the cluster? (If so, focus on the CMM and the GPS signal.)
3. Based on data in the Event Log (described in Interpreting Messages in the Event Log Page on Page 397)
   - does the problem correlate to External Hard Resets with no WatchDog timers? (If so, this indicates a loss of power. Correct your power problem.)
   - is intermittent connectivity indicated? (If so, verify your configuration, RSSI, jitter, cables and connections, and the speed duplex of both ends of the link).
   - does the problem correlate to loss-of-sync events?
4. Are connections made via *shielded* cables?
5. Does the GPS antenna have an *unobstructed* view of the entire horizon?

31.4 SECONDARY STEPS

After preliminary fault isolation through the above steps

1. check the Canopy knowledge base (http://motorola.canopywireless.com/support/knowledge) to find whether other network operators have encountered a similar problem.
2. proceed to any appropriate set of diagnostic steps. These are organized as follows:
   - Module Has Lost or Does Not Establish Connectivity
   - NAT/DHCP-configured SM Has Lost or Does Not Establish Connectivity on Page 447
   - SM Does Not Register to an AP on Page 448
   - BHS Does Not Register to a BHM on Page 449
   - Module Has Lost or Does Not Gain Sync on Page 449

- Module Does Not Establish Ethernet Connectivity on Page 450
- Module Does Not Power Up on Page 450
- Power Supply Does Not Produce Power on Page 451
- CMM2 Does Not Power Up on Page 452
- CMM2 Does Not Pass Proper GPS Sync to Connected Modules on Page 452

31.5 PROCEDURES FOR TROUBLESHOOTING

31.5.1 Module Has Lost or Does Not Establish Connectivity

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

Procedure 49: Troubleshooting loss of connectivity

1. Isolate the end user/SM from peripheral equipment and variables such as routers, switches, and firewalls.
2. Set up the minimal amount of equipment.
3. On each end of the link
   a. check the cables and connections.
   b. verify that the cable/connection scheme—straight-through or crossover—is correct.
   c. verify that the LED labeled LNK is green.
   d. access the Status page of the module
   e. verify that the SM is registered.
   f. verify that RSSI is 700 or higher.
   g. verify that jitter is reported as 9 or lower.
   h. access the IP Configuration page of the module.
   i. verify that IP addresses match and are in the same subnet.
4. On the SM end of the link
   a. verify that the PC that is connected to the SM is correctly configured to obtain an IP address through DHCP.
   b. execute `ipconfig`.
   c. verify that the PC has an assigned IP address.
5. On each end of the link
   a. access the Configuration page of the module.
   b. verify that the settings for link negotiation, frequency, and color code match those of the other module.
   c. access the browser LAN settings (for example, at **Tools→Internet Options→Connections→LAN Settings** in Internet Explorer).
   d. verify that none of the settings are selected.
   e. access the Link Test page of the module.
   f. perform a link test.

g. verify that the link test results show efficiency greater than 90% in both the uplink and downlink.

h. execute `ping`.

i. verify that no packet loss was experienced.

j. verify that response times are not significantly greater than

   - 2.5 ms from BH to BH
   - 4 ms from AP to SM
   - 15 ms from SM to AP

k. replace any cables that you suspect may be causing the problem.

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

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

31.5.2 NAT/DHCP-configured SM Has Lost or Does Not Establish Connectivity

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

- NAT with DHCP Client and DHCP Server
- NAT with DHCP Client
- NAT with DHCP Server
- NAT without DHCP

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

Procedure 50: Troubleshooting loss of connectivity for NAT/DHCP-configured SM

1. Isolate the end user/SM from peripheral equipment and variables such as routers, switches, and firewalls.
2. Set up the minimal amount of equipment.
3. On each end of the link
   a. check the cables and connections.
   b. verify that the cable/connection scheme—straight-through or crossover—is correct.
   c. verify that the LED labeled LNK is green.
4. At the SM
   a. select Expanded Stats.
   b. access the NAT Table page.
   c. verify that the correct NAT translations are listed.
   RESULT: NAT is eliminated as a possible cause if these translations are correct.
5. If this SM is configured for NAT with DHCP, then at the SM
   a. execute **ipconfig**.
   b. verify that the PC has an assigned IP address.

c. if the PC *does not* have an assigned IP address, then
   - enter **`ipconfig /release`** ***`"Adapter Name"`***.
   - enter **`ipconfig /renew`** ***`"Adapter Name"`***.
   - reboot the PC.
   - retreat to Step 5a.

d. if the PC has an assigned IP address, then
   - access the DHCP pages of the SM.
   - verify that DHCP is operating as configured.

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

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

31.5.3 SM Does Not Register to an AP

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

Procedure 51: Troubleshooting SM failing to register to an AP

1. Access the Configuration page of the SM.
2. Note the **Color Code** of the SM.
3. Access the Configuration page of the AP.
4. Verify that the **Color Code** of the AP matches that of the SM.
5. Note the **RF Frequency Carrier** of the AP.
6. Verify that the value of the **RF Frequency Carrier** of the AP is selected in the **Custom RF Frequency Scan Selection List** parameter on the Configuration page of the SM.
7. On the Configuration page of the AP, verify that the **Max Range** parameter is set to a distance slightly greater than the distance between the AP and the furthest SM that must register to this AP.
8. Verify that a clear line of sight exists between the AP and the SM, and that no obstruction significantly penetrates the Fresnel zone of the attempted link.
   If these conditions are not established, then verify that the AP and SM are 900-MHz modules in close proximity to each other.
9. Verify that both the AP and SM are of the same frequency band range and encryption (for example, 5200AP and 5200SM).
10. Remove the bottom cover of the SM to expose the LEDs.
11. Power cycle the SM.
    RESULT: Approximately 25 seconds after the power cycle, the green LED labeled LNK should light to indicate that the link has been established. If the orange LED labeled SYN is lit instead, then the SM is in Alignment mode because the SM failed to establish the link.
12. In this latter case, and if the SM has encountered no customer-inflicted damage, then request an RMA for the SM.

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

31.5.4 BHS Does Not Register to a BHM

To troubleshoot an BHS failing to register to a BHM, perform the following steps.

Procedure 52: Troubleshooting BHS failing to register to a BHM

1. Access the Configuration page of the BHS.
2. Note the **Color Code** of the BHS.
3. Access the Configuration page of the BHM.
4. Verify that the **Color Code** of the BHM matches that of the BHS.
5. Note the **RF Frequency Carrier** of the BHM.
6. Verify that the value of the **RF Frequency Carrier** of the BHM is selected in the **Custom RF Frequency Scan Selection List** parameter on the Configuration page of the BHS.
7. Verify that a clear line of sight exists between the BHM and BHS, and that no obstruction significantly penetrates the Fresnel zone of the attempted link.
8. Verify that both the BHM and BHS are of the same frequency band range and encryption (for example, 5200BH and 5200BH).
9. Verify that both the BHM and BHS are of the same modulation rate from the factory (BH10 or BH 20).
10. Remove the bottom cover of the BHS to expose the LEDs.
11. Power cycle the BHS.
    RESULT: Approximately 25 seconds after the power cycle, the green LED labeled LNK should light to indicate that the link has been established. If the orange LED labeled SYN is lit instead, then the BHS is in Alignment mode because the BHS failed to establish the link. In this latter case, and if the BHS has encountered no customer-inflicted damage, then request an RMA for the BHS.

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

31.5.5 Module Has Lost or Does Not Gain Sync

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

Procedure 53: Troubleshooting loss of sync

1. Access the Event Log page of the SM.
2. Check for messages with the following format:
   `RcvFrmNum =`
   `ExpFrmNum =`
   (See Table 77: Event Log messages for abnormal events on Page 399.)
3. If these messages are present, check the Event Log page of another SM that is registered to the same AP for messages of the same type.
4. If the Event Log of this second SM *does not* contain these messages, then the fault is isolated to the first SM.
5. If the Event Log page of this second SM contains these messages, access the GPS Status page of the AP.

6. If the **Satellites Tracked** field in the GPS Status page of the AP indicates fewer than 4 or the **Pulse Status** field does not indicate Generating Sync, check the GPS Status page of another AP in the same AP cluster for these indicators.
7. If these indicators are present in the second AP
   a. verify that the GPS antenna still has an unobstructed view of the entire horizon.
   b. visually inspect the cable and connections between the GPS antenna and the CMM.
   c. if this cable is not shielded, replace the cable with shielded cable.
8. If these indicators *are not* present in the second AP
   a. visually inspect the cable and connections between the CMM and the AP antenna.
   b. if this cable is not shielded, replace the cable with shielded cable.

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

31.5.6 Module Does Not Establish Ethernet Connectivity

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

Procedure 54: Troubleshooting loss of Ethernet connectivity

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

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

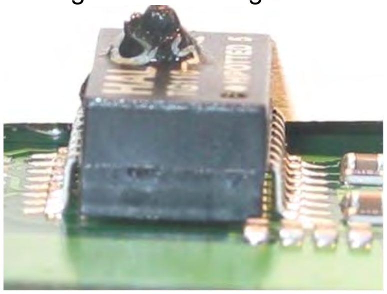
31.5.7 Module Does Not Power Up

To troubleshoot the failure of a module to power up, perform the following steps.

Procedure 55: Troubleshooting failure to power up

1. Verify that the connector crimps on the Ethernet cable are not loose.
2. Verify that the Ethernet cable is not damaged.

3. Verify that the cable is wired and pinned out according to the specifications provided under Wiring Connectors on Page 181.
4. Remove the cover of the module to expose the components on the printed wiring board.
5. Find the Ethernet transformer, which is labeled with either the name Halo or the name Pulse.
6. Verify that the Ethernet transformer does not show damage that would have been caused by improper cabling. (You can recognize damage as the top of the transformer being no longer smooth. The transformer in the following picture is damaged and is ineligible for an RMA.)



7. Connect the power supply to a known good Canopy module via a known good Ethernet cable.
8. Attempt to power up the known good module and
   - if the known good module fails to power up, request an RMA for the power supply.
   - if the known good module powers up, return to the module that does not power up.
9. Reconnect the power supply to the failing module.
10. Connect the power supply to a power source.
11. Verify that the red LED labeled PWR lights.
12. If this LED *does not* light, and the module has not been powered up since the last previous FPGA firmware upgrade was performed on the module, then request an RMA for the module.

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

31.5.8 Power Supply Does Not Produce Power

To troubleshoot the failure of a power supply to produce power, perform the following steps.

Procedure 56: Troubleshooting failure of power supply to produce power

1. Verify that the connector crimps on the Ethernet cable are not loose.
2. Verify that the Ethernet cable is not damaged.
3. Verify that the cable is wired and pinned out according to the specifications provided under Wiring Connectors on Page 181.
4. Connect the power supply to a known good Canopy module via a known good Ethernet cable.

5. Attempt to power up the known good module.
6. If the known good module fails to power up, request an RMA for the power supply.

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

31.5.9 CMM2 Does Not Power Up

To troubleshoot a malfunctioning CMM2, perform the following steps.

Procedure 57: Troubleshooting CMM2 that malfunctions

1. Verify that the 115-/230-V switch (in the lower right-hand corner of the CMM2) is in the correct position for the power source. (See Figure 115 on Page 326.) Applying power when this switch is in the wrong position can damage the CMM2 and will render it ineligible for an RMA.
2. Verify that the electrical source to the CMM2 meets Canopy specifications. See Table 20 on Page 75.
3. Verify that the electrical source is connected to the CMM2 at the proper connection point. (See Figure 117 on Page 328.)
4. Verify that the fuse is operational.
5. Verify that the fuse is properly seated in the receptacle.
6. Attempt to power up the CMM2.
7. If the power indicator on the interconnect board of the CMM2 fails to light when power is applied to the CMM2, request an RMA for the CMM2.

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

31.5.10 CMM2 Does Not Pass Proper GPS Sync to Connected Modules

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

Procedure 58: Troubleshooting CMM2 not passing sync

1. Verify that the GPS antenna has an unobstructed view of the entire horizon.
2. Verify that the GPS coaxial cable meets specifications.
3. Verify that the GPS sync cable meets specifications for wiring and length.
4. If the web pages of connected modules indicate any of the following, then find and eliminate the source of noise that is being coupled into the GPS sync cable:
   - In the GPS Status page
     - anomalous number of **Satellites Tracked** (greater than 12, for example)
     - incorrect reported **Latitude** and/or **Longitude** of the antenna
   - In the Event Log page
     - garbled GPS messages
     - large number of `Acquired GPS Sync Pulse` messages
5. If these efforts fail to resolve the problem, then request an RMA for the CMM2.

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

31.5.11 Module Software Cannot be Upgraded

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

Procedure 59: Troubleshooting an unsuccessful software upgrade

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

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

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

31.5.12 Module Functions Properly, Except Web Interface Became Inaccessible

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

Procedure 60: Restoring the web interface to a module

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

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

32 OBTAINING TECHNICAL SUPPORT

NOTE:
The contact information for Canopy Technical Support staff is included at the end of this section (on Page 458). However, in most cases, you should follow the procedure of this section before you contact them.

To get information or assistance as soon as possible for problems that you encounter, use the following sequence of actions:

1. Search this document, the user guides of products that are supported by dedicated documents, and the software release notes of supported releases
   a. in the Table of Contents for the topic.
   b. in the Adobe Reader® search capability for keywords that apply.[8]
2. Visit http://motorola.canopywireless.com/support/knowledge to view the Canopy Knowledge Base.
3. Ask your Canopy products supplier to help.
4. View and analyze event logs, error messages, and debug messages to help isolate the problem.
5. Check release notes and verify that all of your Canopy equipment is on the correct software release.
6. Verify that the Canopy configuration files match the last known good (baseline) Canopy configuration files captured in the site log book.
7. Verify connectivity (physical cabling).
8. At the SM level, minimize your network configuration (remove home network devices to help isolate problem).
9. Perform the site verification checklist.
10. Use Table 79 (two pages) as a job aid to collect basic site information for technical support to use.

[8] Reader is a registered trademark of Adobe Systems, Incorporated.

Table 79: Basic site information for technical support

Call Log Number:	Company:	Location:
Problem Type:	Site Contact:	Site Phone:
Call Severity (Select One): 1- Urgent-Customer Svc Down 2- Serious- Customer Svc Impacted 3- Non-Critical/General Inquiry	Open Date:	Close Date:
Product Types Involved: (ID the product type) 2400 SM/AP/BHM/BHS 5200 ER /BHM/BHS 5200 SM/AP/BHM/BHS 5700 SM/AP/BHM/BHS 1008CK 300SS ACPS110	MAC Addresses:	IP Addresses:
Software Releases:	Boot Versions:	FPGA Versions:
Authentication ?: Yes/No Type:	Is the customer using shielded cables? Yes/No	Remote Access Method: IP Address:

Network Scenario for this issue: (ID those that apply) SM to Subscriber PC Yes/No SM to AP (Point to Multipoint) Yes/No BHM to BHS (Point to Point) Yes/No 20Meg or 10Meg backhaul Yes/No	Link Distance: dBm= Jitter=	Reflectors in use: Yes/No
NAT/DHCP Scenario: NAT Disabled Yes/No NAT with DHCP Client and DHCP Server Yes/No NAT with DHCP Client Yes/No NAT with DHCP Server Yes/No NAT with no DHCP Yes/No	Problem Description: New Install: Yes/No	NAT/DHCP Scenario: NAT Disabled Yes/No NAT with DHCP Client and DHCP Server Yes/No NAT with DHCP Client Yes/No NAT with DHCP Server Yes/No NAT with no DHCP Yes/No

11. Save your basic site information as file `Site_Info`.
12. From among Figure 36 on Page 109, Figure 37 on Page 110, and Figure 38 on Page 110, select the basic network topology diagram that most closely matches your network configuration.
13. If you selected Figure 36.
    a. Indicate how many APs are in each cluster.
    b. Indicate how many AP clusters are deployed (and what types).
    c. Include the IP addresses.
    d. Indicate the frequency for each sector.
    e. Indicate the type of synchronization.
    f. Indicate how much separation exists between clusters.
    g. For each AP collect the following additional information:
       - Sector number:
       - SW release:

        - Frequency:
        - Color code:
        - IP address:
        - Downlink/uplink ratio:
        - Max range:
        - Bridge entry timeout:
        - Number of subscribers:
        - Method of synchronization:

14. If you selected Figure 37
    a. Indicate how many APs are in each cluster.
    b. Indicate how many AP clusters are deployed (and what types).
    c. Indicate how many BH links are configured.
    d. Include the IP addresses.
    e. Indicate the frequency for each sector.
    f. Indicate the type of synchronization.
    g. Indicate how much separation exists between clusters and BHs.
    h. Indicate the types of BH links (10-Mbps or 20-Mbps).
    i. Distances of links.
    j. Frequency used by each BH.
    k. For each AP and BHM, collect the following additional information:
        - Sector number:
        - SW release:
        - Frequency:
        - Color code:
        - IP address:
        - Downlink/uplink ratio:
        - Max range:
        - Bridge entry timeout:
        - Number of subscribers:
        - Method of synchronization:
15. If you selected Figure 38, collect the following additional information:
    - Sector number:
    - SW release:
    - Frequency:
    - Color code:
    - IP address:
    - Downlink/uplink ratio:
    - Max range:
    - Bridge entry timeout:
    - Number of subscribers:

- Method of synchronization:

16. Add any details that are not present in the generic diagram that you selected.
17. Save your diagram as file `Net_Diagram`.
18. Capture screens from the following web pages of affected modules:
    - Status as file `SM/AP/BHM/BHS_Status.gif`
    - Configuration as file `SM/AP/BHM/BHS_Config.gif`
    - IP Configuration as file `SM/AP/BHM/BHS_IPconfig.gif`
    - Sessions as file `SM/AP/BHM/BHS_Sessions.gif`
    - Event Log as file `SM/AP/BHM/BHS_Events.gif`
    - Link Test (with link test results) as file `SM/AP/BHM/BHS_LinkTST.gif`
    - RF Stat as file `SM/AP/BHM/BHS_RFstats.gif`
19. For any affected SM or BHS, capture screens from the following additional web pages:
    - AP Eval Data as file `SM/BHS_APEval.gif`
    - SM Sync Log as file `SM/BHS_SMSync.gif`
    - SM Session Log as file `SM/BHS_SMSess.gif`
    - SM CCenter Log as file `SM/BHS_SMCcent.gif`
20. For any affected SM that has NAT/DHCP enabled, capture screens from the following additional web pages:
    - NAT Configuration as file `SM _Natconfig.gif`
    - NAT Table as file `SM _NatTable.gif`
    - NAT Stats as file `SM _NatStats.gif`
    - ARP Stats as file `SM _ArpStats.gif`
    - DHCP Stats as file `SM _DhcpStats.gif`
    - DHCP Client Log as file `SM _DhcpClient.gif`
    - DHCP Info Log as file `SM _DhcpInfo.gif`
    - DHCP Server Log as file `SM _DhcpServer.gif`

    Also capture the Windows 2000 IP Configuration screen as file `SM _WindowsIP.gif`.
21. Escalate the problem to Canopy systems Technical Support (or another technical support organization that has been designated for you) as follows:

    a. Start e-mail to technical-support@canopywireless.com. In this email
    - Describe the problem.
    - Describe the history of the problem.
    - List your attempts to solve the problem.
    - Attach the above files.
    - List the files that you are attaching.

    b. Send the email.

    c. Call 1 888 605 2552 (or +1 217 824 9742).

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

33 GETTING WARRANTY ASSISTANCE

For warranty assistance, contact your reseller or distributor for the process.

REFERENCE INFORMATION

34 ADMINISTERING MODULES THROUGH TELNET INTERFACE

In the telnet administrative interface to a module that operates on Canopy System Release 4.2 or later release, the Canopy platform supports the commands defined in Table 80. Many of these are not needed with CNUT.

Table 80: Supported telnet commands for module administration

Command	System help Definition	Notes
addwebfile	Add a custom web file	Syntax: **addwebfile *filename***. Copies the custom web file *filename* to non-volatile memory.
burnfile	Burn flash from file	Syntax: **burnfile *filename***. Updates the CPU firmware with a new image. User the image contained in *filename* if *filename* is provided. If provided, *filename* must match the module type (for example, SMboot.bin for a Subscriber Module or APboot.bin for an Access Point Module).
cat	Concatenate and display.	Syntax: **cat *filename***. Displays the contents of *filename*.
clearsyslog	Clear the system event log	Syntax: **clearsyslog**. Clears the system event log.
clearwebfile	Clear all custom web files	Syntax: **clearwebfile**. Deletes all *custom* web files.
exit	Exit from telnet session	Syntax: **exit**. Terminates the telnet interface session.
fpga_conf	Update FPGA program	Syntax: **fpga_conf**. Forces a module to perform a hard (FPGA and CPU) reset. (See reset.)
ftp	File transfer application	Syntax: **ftp**. Launches the ftp client application on the module.
help	Display command line function help	Syntax: **help**. Displays a list of available telnet commands and a brief description of each.
jbi	Update FPGA program	Syntax: **jbi -aprogram *file.jbc***. Updates the FPGA firmware with the new image contained in *file.jbc*.

Command	System help Definition	Notes
ls	List the contents of a directory	Syntax: **ls**. Lists the file names of all files in the directory. Syntax: **ls -l**. Displays additional information, such as the sizes and dates of the files.
lsweb	List Flash Web files	Syntax: **lsweb**. Lists the file names of the saved custom web files.
ping	Send ICMP ECHO_REQUEST packets to network hosts	Syntax: **ping *IPaddress***. Sends an ICMP ECHO_REQUEST to *IPaddress* and waits for a response. If a response is received, the system returns *IPaddress* is alive. If no response is received, the system returns no answer from *IPaddress*.
reset	Reboot the unit	Syntax: **reset**. Forces the module to perform a hard (FPGA and CPU) module reset. (See **fpga_conf**.)
rm	Remove (unlink) files	Syntax: **rm *filename***. Remove *filename*.
syslog	Display system event log: syslog <optional filename>	Syntax: **syslog**. Displays the contents of the system log. Syntax: **syslog *filename***. Saves the contents of the system log to *filename*. Caution: overwrites *filename* if it already exists.
telnet	Telnet application	Syntax: **telnet *hostIPaddress***. Launches the telnet client application on the Canopy module.
tftp	tftp application	Syntax: **tftp *hostIPaddress***. Launches the tftp client application on the Canopy module.
update	Enable automatic SM code updating	Syntax: **update *actionlist.txt***. Enables the automated update procedure that *actionlist.txt* specifies. (Supported for only the Access Point Module.)
updateoff	Disable automatic SM code updating	Syntax: **updateoff**. Disables the automated update procedure.
version	Display the software version string	Syntax: **version**. Displays the module version string, which contains the software/firmware/hardware versions, the module type, and the operating frequency.

35 MANAGING THROUGH A BAM COMMAND-LINE INTERFACE

The following sections list and describe SSE commands to interface with the MySQL or PostgreSQL database. For further information about

- BAM, see Canopy Bandwidth and Authentication Manager (BAM) User Guide at http://www.canopywireless.com.
- PostgreSQL databases, see the index of PostgreSQL documentation at http://www.postgresql.org/docs.
- MySQL databases, see *MySQL® Reference Manual* at http://www.mysql.com/documentation/index.html.

35.1 CAVEATS

To avoid commonly experienced errors, observe the following caveats about command-line entries:

- `telnet` commands are used to configure SM data and configure or administer users and passwords for `telnet` access to the SSE interface.
- ESNs are entered without dashes in these commands.
- The Canopy system maintains telnet ports in `/etc/services`.
- The SSE port, Port 9080, is aliased as `sse`.

BAM Release 2.1 is superseded by Prizm Release 2.0, which provides no command-line interface. In Prizm, all BAM subsystem operations are performed in the GUI.

35.2 SSE DATABASE COMMANDS

This section provides the database commands for use with the SSE interface, and defines the allowed usage for each command. At any time, you can enter **`help`** at the `sse` prompt to view these lists.

Distinctive fonts indicate

`literal user input.`
`variable user input.`
`literal system responses.`

`cmd show version`
Display the version of SSE software that is installed.

`cmd show esn`
Display all ESNs with related information. This information includes the cap value and the last `suldr` and `sdldr` values applied to the SM.

`cmd show esn` ***`esn`***
Display the specified ESN (in hexadecimal format without dashes) with related information. ***`esn`*** must be expressed in hexadecimal format.

EXAMPLE: **`cmd show esn 1f2a3f4e3d22`**

`cmd show vlanmembers vlanid` ***`vlanid`***
List all of the ESNs that are associated with ***`vlanid`***.

RULES:

`vlanid`	VLAN ID in the range `1` to `4095`

`cmd show config`
Display all configuration values that the database uses. This command calls the `show variables` SQL command.

NOTE: This command is deprecated in BAM Release 2.0 and later.

`cmd show all`
Display all configuration values and statistics that are in the database. This command calls the `cmd show config` SSE command.

NOTE: This command is deprecated in BAM Release 2.0 and later.

`cmd clear esn counter` ***`esn`***
Reset the counter to zero for the specified ESN (in hexadecimal format without dashes).

EXAMPLE: **`cmd clear esn counter 1f2a3f4e3d22`**

`config save database` ***`/path/filename.txt`***
Save the ESN data from the database to the specified path and file.

NOTE: This syntax (`database`) is for execution in only Releases 2.0. The format of SSE database in Releases 1.0 and 1.1 is incompatible with Release 2.0. However, the BAM GUI can be used to import the Release 1.0 or 1.1 format for use with Release 2.0. Using BAM to export the database in Release 2.1 and later is not supported.

`config upload database` ***`/path/filename.txt`***
Upload a properly formatted ESN data file from the specified path to the database.

NOTE: This syntax (`database`) is for execution in only Releases 2.0 and later.

`config add esn` ***`esn skey suldr sdldr ulba dlba`***
Add the specified ESN with the specified data rates and burst allocations.

RULES:

`esn`	hexadecimal without dashes. For example, `1f2a3f4e3d22`.
`skey`	either `0` for the default key or a unique 32-character hexadecimal number for a non-default key.
`suldr`	**Sustained Uplink Data Rate** in the range `0` to `10000` kbps.
`sdldr`	**Sustained Downlink Data Rate** in the range `0` to `10000` kbps.
`ulba`	**Uplink Bandwidth Allocation** in the range `0` to `500000` kbits.
`dlba`	**Downllink Bandwidth Allocation** in the range `0` to `500000` kbits.

```
config modify esn esn [skey|suldr|sdldr|ulba|dlba][allowhg] value
```

Reset the specified ESN to the specified data rate or burst allocation.

NOTE: This command is for execution in only Releases 2.0 and later. Rules are as defined above.

RULES: All options as above, but also

allowhg request from the license management server a floating Cap 2 (uncapping) license for the SM when the SM registers with **suldr** and **sdldr** values that sum to greater than 7000 kbps, unless the SM already has Cap 2. Value must be either `1` (enable) or `0` (disable).

IMPORTANT!

The following commands suspend or reinstate subscriber access. When you suspend (or reinstate) access by using the BAM SSE command line interface, access is immediately suspended (or reinstated) for the subscriber—a current session is dropped (or registration is now allowed). By contrast, when you suspend (or reinstate) access by selecting **Suspend** (or **Active**) in the BAM GUI, access is not suspended (or reinstated) until the next registration attempt from the subscriber.

```
config delete esn esn
```

Remove the specified ESN from the database.

```
config disable esn esn
```

Immediately disable the specified ESN in the database. (See *IMPORTANT* above.)

NOTE: This command is for execution in only Releases 2.0 and later.

```
config enable esn esn
```

Immediately enable the specified ESN in the database. (See *IMPORTANT* above.)

NOTE: This command is for execution in only Releases 2.0 and later.

```
config enable esn esn featurename
```

Immediately enable the feature ***featurename*** for the specified ESN.

RULES:

featurename **cir**, **CIR**, **vlan**, or **VLAN**.

```
config disable esn esn featurename
```

Immediately disable the feature ***featurename*** for the specified ESN. Rules are as defined above.

```
config modify esn esn cir [lpruldr|lprdldr|hpruldr|hprdldr|enablehpr] value
```

Set or reset the specified CIR parameter for the ESN to the specified value.

RULES:

lpruldr **Low Priority Uplink CIR** in the range 0 to 20000 kbps.

lprdldr **Low Priority Downlink CIR** in the range 0 to 20000 kbps.

hpruldr **High Priority Uplink CIR** in the range 0 to 20000 kbps.

hprdldr **High Priority Downlink CIR** in the range 0 to 20000 kbps.

enablehpr **Hi Priority Channel** parameter as 1 (enable) or 0 (disable).

```
config modify esn esn vlan [alllearn|allframe|timeout|ingvid|managevid] value
```

Set or reset the specified VLAN parameter for the ESN to the specified value.

RULES:

alllearn **Dynamic Learning** parameter as 1 (enable) or 0 (disable).

allframe **Allow Only Tagged Frames** parameter as 1 (enable) or 0 (disable).

timeout **VLAN Aging Timeout** parameter in the range 5 to 1440 minutes.

ingvid **Untagged Ingress VID** parameter in the range 1 to 4095.

managevid **Management VID** parameter in the range 1 to 4095.

```
config add vlanmember esn esn vlanid vlanid
```

Associate ***esn*** with the VLAN ***vlanid***.

RULES:

vlanid 1 to 4095

```
config delete vlanmember esn esn vlanid vlanid
```

Dissociate ***esn*** from the VLAN ***vlanid***. Rules are as defined above.

⚠ *CAUTION!*
The following command erases all data in the remote database before the copy execution.

```
config copy to database ip user password
```

Copy configuration data from port on the network element that is identified by ***ip*** into the database. To do so, identify the ***user*** and ***password*** that the database has stored.

NOTE: This command is deprecated in BAM Release 2.0 and later.

35.3 SSE TELNET COMMANDS

This section provides the `telnet` commands for use with the SSE interface, and defines the allowed usage for each command. At any time, the operator can enter **`help`** at the `sse` prompt to view these lists.

> Distinctive fonts indicate
>
> **literal user input.**
> ***variable user input.***

telnet ***localhost*** **sse**
Initiate a telnet session in the SSE interface. The default user name is **root**. The default password is **root**.

config add user ***user password password***
Insert a new SSE `telnet` user into the user list. The second instance of ***password*** is a required confirmation. By default, a new user is given both read and write access. To restrict access to read-only, use the **config modify level** ***user level*** command as documented below.

config delete user ***user***
Remove the specified ***user*** from the user list. The user name is required as an argument.

config store user
Save changes to the SSE `telnet` user list.

NOTE: (This command is deprecated in BAM Release 2.0 and later.)

config change pass ***user password password***
Change the password for the specified ***user*** in the SSE `telnet` user list. The first instance of ***password*** is the new password. The second instance of ***password*** is a required confirmation of the new password.

config modify level ***user level***
Change the level of the ***user*** from either the default Level 2 or a level previously set by this command. Level 1 allows only read access. Level 2 allows both read and write access. Level 3 allows administrator privileges.

EXAMPLE:

```
config modify level patquinn 1
```

help
Display the full list of supported SSE commands.

exit
Conclude and leave the SSE telnet session, but allow the server to continue to operate on software.

36 LEGAL AND REGULATORY NOTICES

36.1 IMPORTANT NOTE ON MODIFICATIONS

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

36.2 NATIONAL AND REGIONAL REGULATORY NOTICES

36.2.1 U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification

This device complies with part 15 of the US FCC Rules and Regulations and with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

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

FCC IDs and Industry Canada Certification Numbers are listed in Table 81:

Table 81: US FCC IDs and Industry Canada certification numbers

Module Types	Operating Frequency Range	Maximum Transmitter Output Power	Reflector or Antenna	FCC ID	Industry Canada Certification Number
SM AP	ISM 902 to 928 MHz	250 mW (24 dBm)	Canopy integrated antenna with 12 dBi gain	ABZ89FC5809	109W-9000ISM
		400 mW (26 dBm)	Maxrad Model # Z1681, flat panel with 10 dBi gain		
		400 mW (26 dBm)	Mars Model # MA-IS91-T2, flat panel with10 dBi gain		
		400 mW (26 dBm)	MTI Model #MT-2630003/N, flat panel with 10 dBi gain		
SM AP BH	ISM 2400-2483.5 MHz	340 mW	Allowed on SM and BH	ABZ89FC5808	109W-2400
SM AP BH	U-NII 5250-5350 MHz	200 mW	Not Allowed	ABZ89FC3789	109W-5200
BH	U-NII 5250-5350 MHz	3.2 mW	Recommended	ABZ89FC5807	109W-5210
SM AP BH	ISM 5725-5850 MHz	200 mW	Allowed on SM and BH	ABZ89FC5804	109W-5700

36.2.2 Regulatory Requirements for CEPT Member States (http://www.cept.org)

When operated in accordance with the instructions for use, Motorola Canopy Wireless equipment operating in the 2.4 and 5.4 GHz bands is compliant with CEPT Recommendation 70-03 Annex 3 for Wideband Data Transmission and HIPERLANs. For compliant operation in the 2.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 100mW (20dBm). For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 1 W (30 dBm).

The following countries have completely implemented CEPT Recommendation 70-03 Annex 3A (2.4 GHz band):

- EU & EFTA countries: Austria, Belgium, Denmark, Spain, Finland, Germany, Greece, Iceland, Italy, Ireland, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Switzerland, Sweden, UK
- New EU member states: Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: Bulgaria, Bosnia and Herzegovina, Turkey

The following countries have a limited implementation of CEPT Recommendation 70-03 Annex 3A:

- France **-** Outdoor operation at 100mW is only permitted in the frequency band 2400 to 2454 MHz;
    - Any outdoor operation in the band 2454 to 2483.5MHz shall not exceed 10mW (10dBm);
    - Indoor operation at 100mW (20dBm) is permitted across the band 2400 to 2483.5 MHz
- French Overseas Territories:
    - Guadeloupe, Martinique, St Pierre et Miquelon, Mayotte – 100mW indoor & outdoor is allowed
    - Réunion and Guyana – 100mW indoor, no operation outdoor in the band 2400 to 2420MHz
- Italy - If used outside own premises, general authorization required
- Luxembourg **-** General authorization required for public service
- Romania - Individual license required. T/R 22-06 not implemented

Motorola Canopy Radios operating in the 2400 to 2483.5MHz band and 5470 to 5725 MHz band are categorized as “Class 2” devices within the EU and are marked with the class identifier symbol ⓘ, denoting that national restrictions apply (for example, France). The French restriction in the 2.4 GHz band will be removed in 2011. Users are advised to contact their national administrations for the current status on the implementation of ECC DEC(04)08 for the 5.4GHz band.

This equipment is “CE” marked CEⓘ to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://www.canopywireless.com/doc.php.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. However, for CEPT member states, 2.4 GHz Wideband Data Transmission equipment has been designated exempt from individual licensing under decision ERC/DEC(01)07. For EU member states, RLAN equipment in both the 2.4 & 5.4GHz bands is exempt from individual licensing under Commission Recommendation 2003/203/EC. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see http://www.ero.dk for further information.

36.2.3 European Union Notification

The 5.7 GHz connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

This equipment is marked CE ⓘ 0977 to show compliance with the European R&TTE directive 1999/5/EC.

The relevant Declaration of Conformity can be found at http://www.canopywireless.com/doc.php.

The relevant Declaration of Conformity can be found at http://www.canopywireless.com/doc.php.

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

For further details, see
http://europa.eu.int/information_society/policy/radio_spectrum/ref_documents/index_en.htm.

36.2.4 UK Notification

The 5.7 GHz connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK Interface Requirement IR2007 specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

36.2.5 Belgium Notification

Belgium national restrictions in the 2.4 GHz band include

- EIRP must be lower than 100 mW
- For crossing the public domain over a distance > 300m the user must have the authorization of the BIPT.
- No duplex working

36.2.6 Luxembourg Notification

For the 2.4 GHz band, point-to-point or point-to-multipoint operation is only allowed on campus areas. 5.4GHz products can only be used for mobile services.

36.2.7 Czech Republic Notification

2.4 GHz products can be operated in accordance with the Czech General License No. GL-12/R/2000.

5.4 GHz products can be operated in accordance with the Czech General License No. GL-30/R/2000.

36.2.8 Norway Notification

Use of the frequency bands 5725-5795 / 5815-5850 MHz are authorized with maximum radiated power of 4 W EIRP and maximum spectral power density of 200 mW/MHz. The radio equipment shall implement Dynamic Frequency Selection (DFS) as defined in Annex 1 of ITU-R Recommendation M.1652 / EN 301 893. Directional antennae with a gain up to 23 dBi may be used for fixed point-to-point links. The power flux density at the border between Norway and neighbouring states shall not exceed - 122.5 dBW/m^2 measured with a reference bandwidth of 1 MHz.

Canopy 5.7 GHz connectorized products have been notified for use in Norway and are compliant when configured to meet the above National requirements. Users shall ensure that DFS functionality is enabled, maximum EIRP respected for a 20 MHz channel, and that channel spacings comply with the allocated frequency band to protect Road Transport and Traffic Telematics services (for example, 5735, 5755, 5775 or 5835 MHz are suitable carrier frequencies). Note that for directional fixed links, TPC is not required, conducted transmit power shall not exceed

30 dBm, and antenna gain is restricted to 23 dBi (maximum of 40W from the Canopy 5.7 GHz connectorized products).

36.2.9 Greece Notification

The outdoor use of 5470-5725MHz is under license of EETT but is being harmonized according to the CEPT Decision ECC/DEC/(04) 08, of 9th July. End users are advised to contact the EETT to determine the latest position and obtain any appropriate licenses.

36.2.10 Brazil Notification

Local regulations do not allow the use of 900 MHz, 2.4 GHz, or 5.2 GHz Canopy modules in Brazil, nor do they allow the use of passive reflectors on 5.4 or 5.7 GHz Canopy Access Points.

For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 1 W (30 dBm). When using the passive reflector along with a 5.4 GHz Canopy radio, the transmitter output power of the radio must be configured no higher than 5 dBm. When not using the passive reflector, the transmitter output power of the radio must be configured no higher than 23 dBm.

The operator is responsible for enabling the DFS feature on any Canopy 5.4 GHz radio, and re-enabling it if the module is reset to factory defaults.

Important Note

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

36.2.11 Australia Notification

900 MHz modules must be set to transmit and receive only on 922 or 923 MHz so as to stay within the ACMA approved band of 915 MHz to 928 MHz for the class license and not interfere with other approved users.

After taking into account antenna gain (in dBi), 900 MHz modules transmitter output power (in dBm) must be set to stay within the legal regulatory limit of 30 dBm (1 W) EIRP for this 900 MHz frequency band.

36.3 EXPOSURE

See Preventing Overexposure to RF on Page 168.

36.4 EQUIPMENT DISPOSAL

Waste (Disposal) of your Electronic and Electric Equipment

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

36.5 LEGAL NOTICES

36.5.1 Software License Terms and Conditions

ONLY OPEN THE PACKAGE, OR USE THE SOFTWARE AND RELATED PRODUCT IF YOU ACCEPT THE TERMS OF THIS LICENSE. BY BREAKING THE SEAL ON THIS DISK KIT / CDROM, OR IF YOU USE THE SOFTWARE OR RELATED PRODUCT, YOU ACCEPT THE TERMS OF THIS LICENSE AGREEMENT. IF YOU DO NOT AGREE TO THESE TERMS, DO NOT USE THE SOFTWARE OR RELATED PRODUCT; INSTEAD, RETURN THE SOFTWARE TO PLACE OF PURCHASE FOR A FULL REFUND. THE FOLLOWING AGREEMENT IS A LEGAL AGREEMENT BETWEEN YOU (EITHER AN INDIVIDUAL OR ENTITY), AND MOTOROLA, INC. (FOR ITSELF AND ITS LICENSORS). THE RIGHT TO USE THIS PRODUCT IS LICENSED ONLY ON THE CONDITION THAT YOU AGREE TO THE FOLLOWING TERMS.

Now, therefore, in consideration of the promises and mutual obligations contained herein, and for other good and valuable consideration, the receipt and sufficiency of which are hereby mutually acknowledged, you and Motorola agree as follows:

Grant of License. Subject to the following terms and conditions, Motorola, Inc., grants to you a personal, revocable, non-assignable, non-transferable, non-exclusive and limited license to use on a single piece of equipment only one copy of the software contained on this disk (which may have been pre-loaded on the equipment)(Software). You may make two copies of the Software, but only for backup, archival, or disaster recovery purposes. On any copy you make of the Software, you must reproduce and include the copyright and other proprietary rights notice contained on the copy we have furnished you of the Software.

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37 ADDITIONAL RESOURCES

Canopy provides two additional resources where you can raise questions and find answers:

- Canopy Community Forums at http://motorola.canopywireless.com/support/community/.
  This resource facilitates communication with other users and with authorized Canopy experts. Available forums include General Discussion, Network Monitoring Tools, and Suggestions.
- Canopy Knowledge Base at http://motorola.canopywireless.com/support/knowledge.
  This resource facilitates exploration and searches, provides recommendations, and describes tools. Available categories include
  - General (Answers to general questions provide an overview of the Canopy system.)
  - Product Alerts
  - Helpful Hints
  - FAQs (frequently asked questions)
  - Hardware Support
  - Software Support
  - Tools

38 HISTORY OF DOCUMENTATION

Issue 1 of this *Canopy System User Guide* integrated content from and supersedes

- Issue 5 of the following user manuals:
  - *Canopy Access Point Module (AP) User Manual*
  - *Canopy Backhaul Module (BH) User Manual*
  - *Canopy Subscriber Module (SM) User Manual*
  - *Canopy Cluster Management Module 2 (CMM2) User Manual*
- Issue 3 of the *Canopy Cluster Management Module micro (CMMmicro) User Guide*
- Issue 1 of the *Canopy 900-MHz Access Point (AP) and Subscriber Module (SM) User Guide*
- Issue 2 of the *Canopy Surge Suppressor User Manual*
- Issue 1 of the *Canopy System and Wireless Broadband Terminology Glossary*.

Issue 2 of this user guide supports Canopy System Releases 7.0, 7.1.4, 7.2.9, and 7.3.6, and the Canopy products that were introduced before these releases.

GLOSSARY

~.
The command that terminates an SSH Secure Shell session to another server. Used on the Bandwidth and Authentication Manager (BAM) master server in the database replication setup.

10Base-T
Technology in Ethernet communications that can deliver 10 Mb of data across 328 feet (100 meters) of CAT 5 cable.

100Base-TX
Technology in Ethernet communications that can deliver 100 Mb of data across 328 feet (100 meters) of CAT 5 cable.

169.254.0.0
Gateway IP address default in Canopy modules.

169.254.1.1
IP address default in Canopy modules.

169.254.x.x
IP address default in Microsoft and Apple operating systems without a DHCP (Dynamic Host Configuration Protocol) server.

255.255.0.0
Subnet mask default in Canopy modules and in Microsoft and Apple operating systems.

802.3
An IEEE standard that defines the contents of frames that are transferred through Ethernet connections. Each of these frames contains a preamble, the address to which the frame is sent, the address that sends the frame, the length of the data to expect, the data, and a checksum to validate that no contents were lost.

802.11
The IEEE standard for wireless local area networks.

802.15
The IEEE standard for wireless personal area networks.

Access Point Cluster
Two to six Access Point Modules that together distribute network or Internet services to a community of 1,200 or fewer subscribers. Each Access Point Module covers a 60° sector. This cluster covers as much as 360°. Also known as AP cluster.

Access Point Module
Also known as AP. One module that distributes network or Internet services in a 60° sector to 200 subscribers or fewer.

ACT/4
Second-from-left LED in the module. In the operating mode, this LED is lit when data activity is present on the Ethernet link. In the aiming mode for a Subscriber Module or a Backhaul timing slave, this LED is part of a bar graph that indicates the quality of the RF link.

Activate
To provide feature capability to a module, but not to *enable* (turn on) the feature in the module. See also Enable.

Address Resolution Protocol
Protocol defined in RFC 826 to allow a network element to correlate a host IP address to the Ethernet address of the host. See http://www.faqs.org/rfcs/rfc826.html.

Advanced Encryption Standard
Over-the-air link option that provides extremely secure wireless connections. Advanced Encryption Standard (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.

AES
See Advanced Encryption Standard.

Aggregate Throughput
The sum of the throughputs in the uplink and the downlink.

AP
Access Point Module. One module that distributes network or Internet services in a 60° sector to 200 subscribers or fewer.

APA
Access Point module address.

Apache
A trademark of Apache Software Foundation, used with permission.

APAS
Status page indication that confirms that authentication is *active* for the AP. However, this indication does not confirm that authentication is *enabled* (turned on) for the AP. See also Activate and Enable.

API
Application programming interface for web services that supports Prizm integration with an operations support systems (OSS) such as a customer relationship management (CRM), billing, or provisioning system.

APs MIB
Management Information Base file that defines objects that are specific to the Access Point Module or Backhaul timing master. See also Management Information Base.

ARP
Address Resolution Protocol. A protocol defined in RFC 826 to allow a network element to correlate a host IP address to the Ethernet address of the host. See http://www.faqs.org/rfcs/rfc826.html.

ASN.1
Abstract Syntax Notation One language. The format of the text files that compose the Management Information Base.

Attenuation
Reduction of signal strength caused by the travel from the transmitter to the receiver, and caused by any object between. In the absence of objects between, a signal that has a short wavelength experiences a high degree of attenuation nevertheless.

Authentication Key
Software key that correlates to the random number that the Bandwidth and Authentication Manager (BAM) server generates and sends in a challenge through the AP to the SM. The network operator can create and, at some security risk, send this key over the air to the SM. The SQL database in the BAM server correlates this key to QoS information about the SM. The format of this key is 32 hexadecimal characters of 0 to 9 and a to f, padded with leading zeroes in Release 4.2.3 and later. This key must be unique to the individual SM.

Authorization Key Field
Name of the parameter that identifies the *authentication* key in the SM Configuration web page. See Authentication Key or skey.

Backhaul Module Also known as BH. A module that provides point-to-point connectivity as either a standalone link or a link to an Access Point cluster through a selected Access Point Module. See also Backhaul Timing Master and Backhaul Timing Slave.

Backhaul Timing Master Backhaul Module that sends network timing (synchronization) to another Backhaul Module, which serves as the Backhaul timing slave.

Backhaul Timing Slave Backhaul Module that receives network timing (synchronization) from another Backhaul Module, which serves as the Backhaul timing master.

BAM Bandwidth and Authentication Manager. A Canopy software product that operates on a Linux server to manage bandwidth, high-priority channel, and VLAN settings individually for each registered Subscriber Module. This software also provides secure Subscriber Module authentication and user-specified encryption keys. The upgrade path for this product is to Prizm Release 2.0 or later.

BER Bit Error Rate. The ratio of incorrect data received to correct data received.

BH Backhaul Module. A module that provides point-to-point connectivity as either a standalone link or a link to an Access Point cluster through a selected Access Point Module.

Bit Error Rate Ratio of incorrect data received to correct data received.

Box MIB Management Information Base file that defines module-level objects. See also Management Information Base.

BRAID Stream cipher that the TIA (Telecommunications Industry Association) has standardized. The secret keys in both modules communicate with each other to establish the Data Encryption Standard key. See Data Encryption Standard.

Bridge Network element that uses the physical address (not the logical address) of another to pass data. The bridge passes the data to either the destination address, if found in the simple routing table, or to all network segments other than the one that transmitted the data. Canopy modules are Layer 2 bridges except that, where NAT is enabled for an SM, the SM is a Layer 3 switch. Compare to Switch and Router, and see also NAT.

Bridge Entry Timeout Field Value that the operator sets as the maximum interval for no activity with another module, whose MAC address is the Bridge Entry. This interval should be longer than the ARP (Address Resolution Protocol) cache timeout of the router that feeds the network.

Buckets Theoretical data repositories that can be filled at preset rates or emptied when preset conditions are experienced, such as when data is transferred.

Burst Preset amount limit of data that may be continuously transferred.

C/I Ratio Ratio of intended signal (carrier) to unintended signal (interference).

Canopy A trademark of Motorola, Inc.

canopy.xml File that stores specifications for the Bandwidth and Authentication Manager (BAM) GUI.

Carrier-to-interference Ratio Ratio of intended reception to unintended reception.

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

CAT 5 Cable Cable that delivers Ethernet communications from module to module. Later modules auto-sense whether this cable is wired in a straight-through or crossover scheme.

cdf Canopy Data Formatter tool that creates an initial ESN Data Table. Inputs for this tool include a list of SM ESNs and default values of sustained data rates and burst allocations for each listed ESN.

chkconfig A command that the Linux® operating system accepts to enable MySQL® and Apache™ Server software for various run levels of the mysqld and httpd utilities.

CIR See Committed Information Rate.

Cluster Management Module Module that provides power, GPS timing, and networking connections for an AP cluster. Also known as CMM. If this CMM is connected to a Backhaul Module, then this CMM is the central point of connectivity for the entire site.

CMM Cluster Management Module. A module that provides power, GPS timing, and networking connections for an Access Point cluster. If this CMM is connected to a Backhaul Module (BH), then this CMM is the central point of connectivity for the entire site.

CodePoint See DiffServ.

Color Code Field Module parameter that identifies the other modules with which communication is allowed. The range of values is 0 to 255. When set at 0, the Color Code does not restrict communications with any other module.

Committed Information Rate For an SM or specified group of SMs, a level of bandwidth that can be guaranteed to never fall below a specified minimum. In the Canopy implementation, this is controlled by the Low Priority Uplink CIR, Low Priority Downlink CIR, High Priority Uplink CIR, and High Priority Downlink CIR parameters.

Community String Field
Control string that allows a network management station to access MIB information about the module.

CPE
Customer premises equipment.

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

CRM
Customer relationship management system.

Data Encryption Standard
Over-the-air link option that uses secret 56-bit keys and 8 parity bits. Data Encryption Standard (DES) performs a series of bit permutations, substitutions, and recombination operations on blocks of data.

Date of Last Transaction
A field in the data that the `cmd show esn` command generates from data in the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field identifies the date of the most recent authentication attempt by the SM. Expressed in the database output as DLT.

Dell
A trademark of Dell, Inc.

Demilitarized Zone
Internet Protocol area outside of a firewall. Defined in RFC 2647. See http://www.faqs.org/rfcs/rfc2647.html.

DES
Data Encryption Standard. An over-the-air link option that uses secret 56-bit keys and 8 parity bits. DES performs a series of bit permutations, substitutions, and recombination operations on blocks of data.

Desensed
Received an undesired signal that was strong enough to make the module insensitive to the desired signal.

DHCP
Dynamic Host Configuration Protocol, defined in RFC 2131. Protocol that enables a device to be assigned a new IP address and TCP/IP parameters, including a default gateway, whenever the device reboots. Thus DHCP reduces configuration time, conserves IP addresses, and allows modules to be moved to a different network within the Canopy system. See http://www.faqs.org/rfcs/rfc2131.html. See also Static IP Address Assignment.

Diffraction
Partial obstruction of a signal. Typically diffraction attenuates a signal so much that the link is unacceptable. However, in some instances where the obstruction is very close to the receiver, the link may be acceptable.

DiffServ

Differentiated Services, consistent with RFC 2474. A byte in the type of service (TOS) field of packets whose values correlates to the channel on which the packet should be sent. The value is a numeric code point. Canopy maps each of 64 code points to values of 0 through 7. Three of these code points have fixed values, and the remaining 61 are settable. Values of 0 through 3 map to the low-priority channel; 4 through 7 to the high-priority channel. The mappings are the same as 802.1p VLAN priorities. Among the settable parameters, the values are set in the AP for all downlinks within the sector and in the SM for each uplink.

Disable

To turn off a feature in the module after both the feature activation file has *activated* the module to use the feature and the operator has *enabled* the feature in the module. See also Activate and Enable.

DLT

Date of last transaction. A field in the data that the `cmd show esn` command generates from data in the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field identifies the date of the most recent authentication attempt by the SM.

DMZ

Demilitarized Zone as defined in RFC 2647. An Internet Protocol area outside of a firewall. See http://www.faqs.org/rfcs/rfc2647.html.

Dynamic Host Configuration Protocol

Protocol defined in RFC 2131 that enables a device to be assigned a new IP address and TCP/IP parameters, including a default gateway, whenever the device reboots. Thus Dynamic Host Configuration Protocol reduces configuration time, conserves IP addresses, and allows modules to be moved to a different network within the Canopy system. See http://www.faqs.org/rfcs/rfc2131.html. See also Static IP Address Assignment.

Electronic Serial Number

Hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number. Same as MAC Address.

Element Pack

A license for Prizm management of a multi-point sector and covers the AP and up to 200 SMs, a backhaul link, or an Powerline LV link.

Enable

To turn on a feature in the module after the feature activation file has *activated* the module to use the feature. See also Activate.

Engine

Bandwidth and Authentication Manager (BAM) interface to the AP and SMs. Unique sets of commands are available on this interface to manage parameters and user access. Distinguished from SSE. See also SSE.

ESN

Electronic Serial Number. The hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number. Same as MAC Address.

ESN Data Table

Table in which each row identifies data about a single SM. In tab-separated fields, each row stores the ESN, authentication key, and QoS information that apply to the SM. The operator can create and modify this table. This table is both an input to and an output from the Bandwidth and Authentication Manager (BAM) SQL database, and should be identically input to redundant BAM servers.

/etc/services

File that stores telnet ports on the Bandwidth and Authentication Manager (BAM) server.

EthBusErr Field

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

Ethernet Protocol

Any of several IEEE standards that define the contents of frames that are transferred from one network element to another through Ethernet connections.

Fade Margin

The difference between strength of the received signal and the strength that the receiver requires for maintaining a reliable link. A higher fade margin is characteristic of a more reliable link. Standard operating margin.

FCC

Federal Communications Commission of the U.S.A.

Feature Activation Key

Software key file whose file name includes the ESN of the target Canopy module. When installed on the module, this file *activates* the module to have the feature *enabled* or disabled in a separate operator action.

Field-programmable Gate Array

Array of logic, relational data, and wiring data that is factory programmed and can be reprogrammed.

File Transfer Protocol

Utility that transfers of files through TCP (Transport Control Protocol) between computing devices that do not operate on the same platform. Defined in RFC 959. See http://www.faqs.org/rfcs/rfc959.html.

FPGA

Field-programmable Gate Array. An array of logic, relational data, and wiring data that is factory programmed and can be reprogrammed.

Frame Spreading

Transmission of a beacon in only frames where the receiver expects a beacon (rather than in every frame). This avoids interference from transmissions that are not intended for the receiver.

Frame Timing Pulse Gated Field

Toggle parameter that prevents or allows the module to continue to propagate GPS sync timing when the module no longer receives the timing.

Free Space Path Loss

Signal attenuation that is naturally caused by atmospheric conditions and by the distance between the antenna and the receiver.

Fresnel Zone

Space in which no object should exist that can attenuate, diffract, or reflect a transmitted signal before the signal reaches the target receiver.

FSK

Frequency Shift Keying, a variation of frequency modulation to transmit data, in which two or more frequencies are used.

FTP

File Transfer Protocol, defined in RFC 959. Utility that transfers of files through TCP (Transport Control Protocol) between computing devices that do not operate on the same platform. See http://www.faqs.org/rfcs/rfc959.html.

Global Positioning System

Network of satellites that provides absolute time to networks on earth, which use the time signal to synchronize transmission and reception cycles (to avoid interference) and to provide reference for troubleshooting activities.

GPS

Global Positioning System. A network of satellites that provides absolute time to networks on earth, which use the time signal to synchronize transmission and reception cycles (to avoid interference) and to provide reference for troubleshooting activities.

GPS/3

Third-from-left LED in the module. In the operating mode for an Access Point Module or Backhaul timing master, this LED is continuously lit as the module receives sync pulse. In the operating mode for a Subscriber Module or a Backhaul timing slave, this LED flashes on and off to indicate that the module is not registered. In the aiming mode for a Subscriber Module or a Backhaul timing slave, this LED is part of a bar graph that indicates the quality of the RF link.

GUI

Graphical user interface.

High-priority Channel

Channel that supports low-latency traffic (such as Voice over IP) over low-latency traffic (such as standard web traffic and file downloads). To recognize the latency tolerance of traffic, this channel reads the IPv4 Type of Service Low Latency bit.

HTTP

Hypertext Transfer Protocol, used to make the Internet resources available on the World Wide Web. Defined in RFC 2068. See http://www.faqs.org/rfcs/rfc2068.html.

ICMP

Internet Control Message Protocols defined in RFC 792, used to identify Internet Protocol (IP)-level problems and to allow IP links to be tested. See http://www.faqs.org/rfcs/rfc792.html.

indiscards count Field

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 Field

How many inbound packets contained errors that prevented their delivery to a higher-layer protocol.

innucastpkts count Field

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

inoctets count Field

How many octets were received on the interface, including those that deliver framing information.

Intel

A registered trademark of Intel Corporation.

inucastpkts count Field

How many inbound subnetwork-unicast packets were delivered to a higher-layer protocol.

inunknownprotos count Field

How many inbound packets were discarded because of an unknown or unsupported protocol.

IP

Internet Protocol defined in RFC 791. The Network Layer in the TCP/IP protocol stack. This protocol is applied to addressing, routing, and delivering, and re-assembling data packets into the Data Link layer of the protocol stack. See http://www.faqs.org/rfcs/rfc791.html.

IP Address

32-bit binary number that identifies a network element by both network and host. See also Subnet Mask.

IPv4

Traditional version of Internet Protocol, which defines 32-bit fields for data transmission.

ISM

Industrial, Scientific, and Medical Equipment radio frequency band, in the 900-MHz, 2.4-GHz, and 5.8-GHz ranges.

Jitter

Timing-based measure of the reception quality of a link. An acceptable link displays a jitter value between 0 and 4 for a 10-Mbps Backhaul timing slave in Release 4.0 and later, between 0 and 9 for a 20-Mbps Backhaul timing slave, or between 5 and 9 for any Subscriber Module or for a Backhaul timing slave in any earlier release.

L2TP over IPSec

Level 2 Tunneling Protocol over IP Security. One of several virtual private network (VPN) implementation schemes. Regardless of whether Subscriber Modules have the Network Address Translation feature (NAT) enabled, they support VPNs that are based on this protocol.

Late Collision Field

This field displays how many late collisions occurred on the Ethernet controller. A normal collision occurs during the first 512 bits of the frame transmission. A collision that occurs after the first 512 bits is considered a late collision. A late collision is a serious network problem because the frame being transmitted is discarded. A late collision is most commonly caused by a mismatch between duplex configurations at the ends of a link segment.

Latency Tolerance

Acceptable tolerance for delay in the transfer of data to and from a module.

Line of Sight
Wireless path (not simply visual path) direct from module to module. The path that results provides both ideal aim and an ideal Fresnel zone.

Linux
A registered trademark of Linus Torvalds.

LNK/5
Furthest left LED in the module. In the operating mode, this LED is continuously lit when the Ethernet link is present. In the aiming mode for a Subscriber Module or a Backhaul timing slave, this LED is part of a bar graph that indicates the quality of the RF link.

Logical Unit ID
Final octet of the 4-octet IP address of the module.

LOS
Line of sight. The wireless path (not simply visual path) direct from module to module. The path that results provides both ideal aim and an ideal Fresnel zone.

LUID
Logical Unit ID. The final octet of the 4-octet IP address of the module.

MAC Address
Media Access Control address. The hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number.

Management Information Base
Space that allows a program (agent) in the network to relay information to a network monitor about the status of defined variables (objects).

Master
Designation that defines the role of a component relative to the role of another. This designation both applies to a Backhaul module that provides synchronization over the air to another Backhaul module (a Backhaul timing slave) and applies to a Bandwidth and Authentication Manager (BAM) server whose SQL database is automatically copied onto a redundant BAM server (BAM slave). In each case, the master is not a product. Rather, the master is the role that results from deliberate configuration steps.

Maximum Information Rate
The cap applied to the bandwidth of an SM or specified group of SMs. In the Canopy implementation this is controlled by the Sustained Uplink Data Rate, Uplink Burst Allocation, Sustained Downlink Data Rate, and Downlink Burst Allocation parameters.

Media Access Control Address
Hardware address that the factory assigns to the module for identification in the Data Link layer interface of the Open Systems Interconnection system. This address serves as an electronic serial number.

MIB
Management Information Base. Space that allows a program (agent) in the network to relay information to a network monitor about the status of defined variables (objects).

MIR
See Maximum Information Rate.

MySQL
A registered trademark of MySQL AB Company in the United States, the European Union, and other countries.

mysqladmin
A command to set the administrator and associated password on the Bandwidth and Authentication Manager (BAM) server.

mysql-server
Package group that enables the SQL Database Server application in the Red Hat® Linux® 9 operating system to provide SQL data for Bandwidth and Authentication Manager (BAM) operations.

NAT
Network Address Translation defined in RFC 1631. A scheme that isolates Subscriber Modules from the Internet. See http://www.faqs.org/rfcs/rfc1631.html.

NBI
See Northbound Interface.

NEC
National Electrical Code. The set of national wiring standards that are enforced in the U.S.A.

NetBIOS
Protocol defined in RFC 1001 and RFC 1002 to support an applications programming interface in TCP/IP. This interface allows a computer to transmit and receive data with another host computer on the network. RFC 1001 defines the concepts and methods. RFC 1002 defines the detailed specifications. See http://www.faqs.org/rfcs/rfc1001.html and http://www.faqs.org/rfcs/rfc1002.html.

Network Address Translation
Scheme that defines the Access Point Module as a proxy server to isolate registered Subscriber Modules from the Internet. Defined in RFC 1631. See http://www.faqs.org/rfcs/rfc1631.html.

Network Management Station
Monitor device that uses Simple Network Management Protocol (SNMP) to control, gather, and report information about predefined network variables (objects).

NMS
Network Management Station. A monitor device that uses Simple Network Management Protocol (SNMP) to control, gather, and report information about predefined network variables (objects).

Northbound Interface
The interface within Prizm to higher-level systems. This interface consists of a Simple Network Management Protocol (SNMP) agent for integration with a network management system (NMS); a Simple Object Access Protocol (SOAP) XML-based application programming interface (API) for web services that supports integration with an operations support systems (OSS) such as a customer relationship management (CRM), billing, or provisioning system; and console automation that allows such higher-level systems to launch and appropriately display the PrizmEMS management console in a custom-developed GUI.

Object
Network variable that is defined in the Management Information Base.

OptiPlex
A trademark of Dell, Inc.

OSS

Operations support system, such as a customer relationship management (CRM), billing, or provisioning system. The application programming interface (API) for Prizm supports integrating Prizm with an OSS.

outdiscards count Field

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 Field

How many outbound packets contained errors that prevented their transmission.

outnucastpkts count Field

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.

outoctets count Field

How many octets were transmitted out of the interface, including those that deliver framing information.

outucastpkts count Field

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.

Override Plug

Device that enables the operator to regain control of a module that has been locked by the No Remote Access feature, the 802.3 Link Disable feature, or a password or IP address that cannot be recalled. This device can be either fabricated on site or ordered.

Pentium

A registered trademark of Intel Corporation.

php-mysql

Package group that enables the Web Server application in the Red Hat® Linux® 9 operating system to provide data from the SQL Database Server application as PHP in the Bandwidth and Authentication Manager (BAM) GUI.

Point-to-Point Protocol

Standards that RFC 1661 defines for data transmittal on the Internet. Also known as PPP or PTP. See http://www.faqs.org/rfcs/rfc1661.html.

Power Control

Feature in Release 4.1 and later that allows the module to operate at less than 18 dB less than full power to reduce self-interference.

PPTP

Point to Point Tunneling Protocol. One of several virtual private network implementations. With the Network Address Translation (NAT) feature enabled, Subscriber Modules *do not* support VPNs that are based on this protocol. With NAT disabled, they do support VPNs that are based on this protocol.

Prizm

The Canopy software product that allows users to partition their entire Canopy networks into criteria-based subsets and independently monitor and manage those subsets. Prizm Release 1.0 and later includes a Northbound Interface to higher-level systems. Prizm Release 2.0 and later integrates Canopy Bandwidth and Authentication Manager (BAM) functionality and supports simple migration of a pre-existing authentication, bandwidth, and VLAN settings into the Prizm database.

Protective Earth

Connection to earth (which has a charge of 0 volts). Also known as ground.

Proxy Server

Network computer that isolates another from the Internet. The proxy server communicates for the other computer, and sends replies to only the appropriate computer, which has an IP address that is not unique or not registered.

PTMP

Point-to-Multipoint Protocol defined in RFC 2178, which specifies that data that originates from a central network element can be received by all other network elements, but data that originates from a non-central network element can be received by only the central network element. See http://www.faqs.org/rfcs/rfc2178.html.

PTP

Point-to-Point Protocol. The standards that RFC 1661 defines for data transmittal on the Internet. See http://www.faqs.org/rfcs/rfc1661.html.

QoS

Quality of Service. A frame field that Bandwidth and Authentication Manager (BAM) provides to the AP and SM the sustained data rates and burst data limits of the SM. The format of this field is 64 hexadecimal characters of 0 to 9 and a to f. The BAM SQL database expresses this field as five contiguous subfields.

Quality of Service

A frame bit that Bandwidth and Authentication Manager (BAM) provides to the AP and SM the sustained data rates and burst data limits of the SM. The format of this field is 64 hexadecimal characters of 0 to 9 and a to f. The BAM SQL database expresses this field as five contiguous subfields. Also known as QoS.

Quick Start

Interface page that requires minimal configuration for initial module operation.

Radio Signal Strength Indicator

Relative measure of the strength of a received signal. An acceptable link displays an Radio Signal Strength Indicator (RSSI) value of greater than 700.

Random Number

Number that the Bandwidth and Authentication Manager (BAM) generates, invisible to both the SM and the network operator, to send to the SM as a challenge against an authentication attempt.

Reader

A registered trademark of Adobe Systems, Incorporated.

Recharging Resumed accumulation of data in available data space (buckets). See Buckets.

Red Hat A registered trademark of Red Hat, Inc.

Reflection Change of direction and reduction of amplitude of a signal that encounters an object larger than the wavelength. Reflection may cause an additional copy of the wavelength to arrive at after the original, unobstructed wavelength arrives. This causes partial cancellation of the signal and may render the link unacceptable. However, in some instances where the direct signal cannot be received, the reflected copy may be received and render an otherwise unacceptable link acceptable.

Registrations MIB Management Information Base file that defines registrations for global items such as product identities and product components. See also Management Information Base.

repl-m A command that sets up the database replication process on a Bandwidth and Authentication Manager (BAM) master server, uses SFTP to copy both the database and the `repl-s` script to a BAM slave server, and remotely executes the `repl-s` script on the BAM slave server. See Master, Slave, `repl-s`, Secure Shell, and SFTP.

repl-s A command that sets up the database replication process on a Bandwidth and Authentication Manager (BAM) slave server. See Master, Slave, and `repl-m`.

RES Result. A field in the data that the `cmd show esn` command generates from the SQL database in the Bandwidth and Authentication Manager (BAM) server.

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

RF Radio frequency. How many times each second a cycle in the antenna occurs, from positive to negative and back to positive amplitude.

RJ-11 Standard cable that is typically used for telephone line or modem connection.

RJ-45 Standard cable that is typically used for Ethernet connection. This cable may be wired as straight-through or as crossover. Later Canopy modules auto-sense whether the cable is straight-through or crossover.

Router Network element that uses the logical (IP) address of another to pass data to only the intended recipient. Compare to Switch and Bridge.

RPM Red Hat® Package Manager.

rpm

A command that the Linux® operating system accepts to identify the version of Linux® software that operates on the Bandwidth and Authentication Manager (BAM) server.

RSSI

Radio Signal Strength Indicator. A relative measure of the strength of a received signal. An acceptable link displays an RSSI value of greater than 700.

RxBabErr Field

This field displays how many receiver babble errors occurred.

RxOverrun Field

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

SDK

PrizmEMS™ Software Development Kit (SDK)—the document that provides server administrator tasks, GUI developer information for console automation that allows higher-level systems to launch and appropriately display the Prizm management console. The SDK also describes the how to define new element types and customize the Details views.

Secure Shell

A trademark of SSH Communications Security.

Self-interference

Interference with a module from another module in the same network.

SES/2

Third-from-right LED in the module. In the Access Point Module and Backhaul timing master, this LED is unused. In the operating mode for a Subscriber Module or a Backhaul timing slave, this LED flashes on and off to indicate that the module is not registered. In the aiming mode for a Subscriber Module or a Backhaul timing slave, this LED is part of a bar graph that indicates the quality of the RF link.

Session Key

Software key that the SM and Bandwidth and Authentication Manager (BAM) separately calculate based on that both the authentication key (or the factory-set default key) and the random number. BAM sends the session key to the AP. Neither the subscriber nor the network operator can view this key. See also Random Number.

SFTP

Secure File Transfer Protocol.

Simple Network Management Protocol

Standard that is used for communications between a program (agent) in the network and a network management station (monitor). Defined in RFC 1157. See http://www.faqs.org/rfcs/rfc1157.html.

skey

Software key that correlates to the random number that the Bandwidth and Authentication Manager (BAM) server generates and sends in a challenge through the AP to the SM. The network operator can create and, at some security risk, send this key over the air to the SM. The SQL database in the BAM server correlates this key to QoS information about the SM. The format of this key is 32 hexadecimal characters of 0 to 9 and a to f. This key must be unique to the individual SM. Also known as authentication key.

Slave

Designation that defines the role of a component relative to the role of another. This designation both applies to a Backhaul slave that receives synchronization over the air from another Backhaul module (a Backhaul timing master) and applies to a redundant Bandwidth and Authentication Manager (BAM) server whose SQL database is automatically overwritten by a copy from the primary BAM server (BAM master). In each case, the slave is not a product. Rather, the slave is the role that results from deliberate configuration steps.

SM

Customer premises equipment (CPE) device that extends network or Internet services by communication with an Access Point Module or an Access Point cluster.

SM MIB

Management Information Base file that defines objects that are specific to the Subscriber Module or Backhaul timing slave. See also Management Information Base.

SNMP

Simple Network Management Protocol, defined in RFC 1157. A standard that is used for communications between a program (agent) in the network and a network management station (monitor). See http://www.faqs.org/rfcs/rfc1157.html.

SNMP Trap

Capture of information that informs the network monitor through Simple Network Management Protocol of a monitored occurrence in the module.

SOAP

Simple Object Access Protocol (SOAP). The protocol that the Northbound Interface in Prizm uses to support integration of Prizm with an operations support systems (OSS) such as a customer relationship management (CRM), billing, or provisioning system

SSE

Bandwidth and Authentication Manager (BAM) interface to the SQL server. Unique sets of commands are available on this interface to manage the BAM SQL database and user access. Distinguished from Engine. See also Engine.

Standard Operating Margin

See Fade Margin.

Static IP Address Assignment

Assignment of Internet Protocol address that can be changed only manually. Thus static IP address assignment requires more configuration time and consumes more of the available IP addresses than DHCP address assignment does. RFC 2050 provides guidelines for the static allocation of IP addresses. See http://www.faqs.org/rfcs/rfc2050.html. See also DHCP.

su -

A command that opens a Linux$^{®}$ operating system session for the user `root`.

Subnet Mask

32-bit binary number that filters an IP address to reveal what part identifies the network and what part identifies the host. The number of subnet mask bits that are set to 1 indicates how many leading bits of the IP address identify the network. The number of subnet mask bits that are set 0 indicate how many trailing bits of the IP address identify the host.

Subscriber Module

Customer premises equipment (CPE) device that extends network or Internet services by communication with an Access Point Module or an Access Point cluster.

Sustained Data Rate

Preset rate limit of data transfer.

Switch

Network element that uses the port that is associated with the physical address of another to pass data to only the intended recipient. Compare to Bridge and Router.

SYN/1

Second-from-right LED in the module. In the Access Point Module or Backhaul timing master, as in a registered Subscriber Module or Backhaul timing slave, this LED is continuously lit to indicate the presence of sync. In the operating mode for a Subscriber Module or Backhaul timing slave, this LED flashes on and to indicate that the module is not registered. In the aiming mode for a Subscriber Module or a Backhaul timing slave, this LED is part of a bar graph that indicates the quality of the RF link.

Sync

GPS (Global Positioning System) absolute time, which is passed from one module to another. Sync enables timing that prevents modules from transmitting or receiving interference. Sync also provides correlative time stamps for troubleshooting efforts.

TCP

Alternatively known as Transmission Control Protocol or Transport Control Protocol. The Transport Layer in the TCP/IP protocol stack. This protocol is applied to assure that data packets arrive at the target network element and to control the flow of data through the Internet. Defined in RFC 793. See http://www.faqs.org/rfcs/rfc793.html.

tcp

Transport Control type of port. The Canopy system uses Port 3306:tcp for MySQL® database communications, Port 9080:tcp for SSE `telnet` communications, and Port 9090:tcp for Engine `telnet` communications.

TDD

Time Division Duplexing.

TDMA

Time Division Multiple Access.

telnet

Utility that allows a client computer to update a server. A firewall can prevent the use of the `telnet` utility to breach the security of the server. See http://www.faqs.org/rfcs/rfc818.html, http://www.faqs.org/rfcs/rfc854.html and http://www.faqs.org/rfcs/rfc855.html.

Textual Conventions MIB

Management Information Base file that defines Canopy system-specific textual conventions. See also Management Information Base.

Time of Last Transaction

A field in the data that the `cmd show esn` command generates from data in the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field identifies the time of day of the most recent authentication attempt by the SM. Expressed in the database output as TLT.

TLT

Time of last transaction. A field in the data that the `cmd show esn` command generates from data in the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field identifies the time of day of the most recent authentication attempt by the SM.

TNAF

Total number of authentication requests failed. A field in the data that the `cmd show esn` command generates from the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field indicates how many times the SM (identified by ESN in the related data) attempted to authenticate but was denied by BAM.

TNAR

Total number of authentication requests. A field in the data that the `cmd show esn` command generates from the SQL database in the Bandwidth and Authentication Manager (BAM) server. This field indicates how many times the SM (identified by ESN in the related data) attempted to authenticate, regardless of whether the attempt succeeded.

Tokens

Theoretical amounts of data. See also Buckets.

TOS

8-bit field in that prioritizes data in a IP transmission. See http://www.faqs.org/rfcs/rfc1349.html.

TxUnderrun Field

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

UDP

User Datagram Protocol. A set of Network, Transport, and Session Layer protocols that RFC 768 defines. These protocols include checksum and address information but does not retransmit data or process any errors. See http://www.faqs.org/rfcs/rfc768.html.

udp

User-defined type of port.

U-NII

Unlicensed National Information Infrastructure radio frequency band, in the 5.1-GHz through 5.8-GHz ranges.

VID

VLAN identifier. See VLAN.

VLAN

Virtual local area network. An association of devices through software that contains broadcast traffic, as routers would, but in the switch-level protocol.

VPN Virtual private network for communication over a public network. One typical use is to connect remote employees, who are at home or in a different city, to their corporate network over the Internet. Any of several VPN implementation schemes is possible. With the Network Address Translation feature (NAT) enabled, SMs on Canopy System Release 4.2 or later support L2TP over IPSec (Level 2 Tunneling Protocol over IP Security) VPNs, but *do not* support PPTP (Point to Point Tunneling Protocol) VPNs. With NAT disabled, SMs support all types of VPNs.