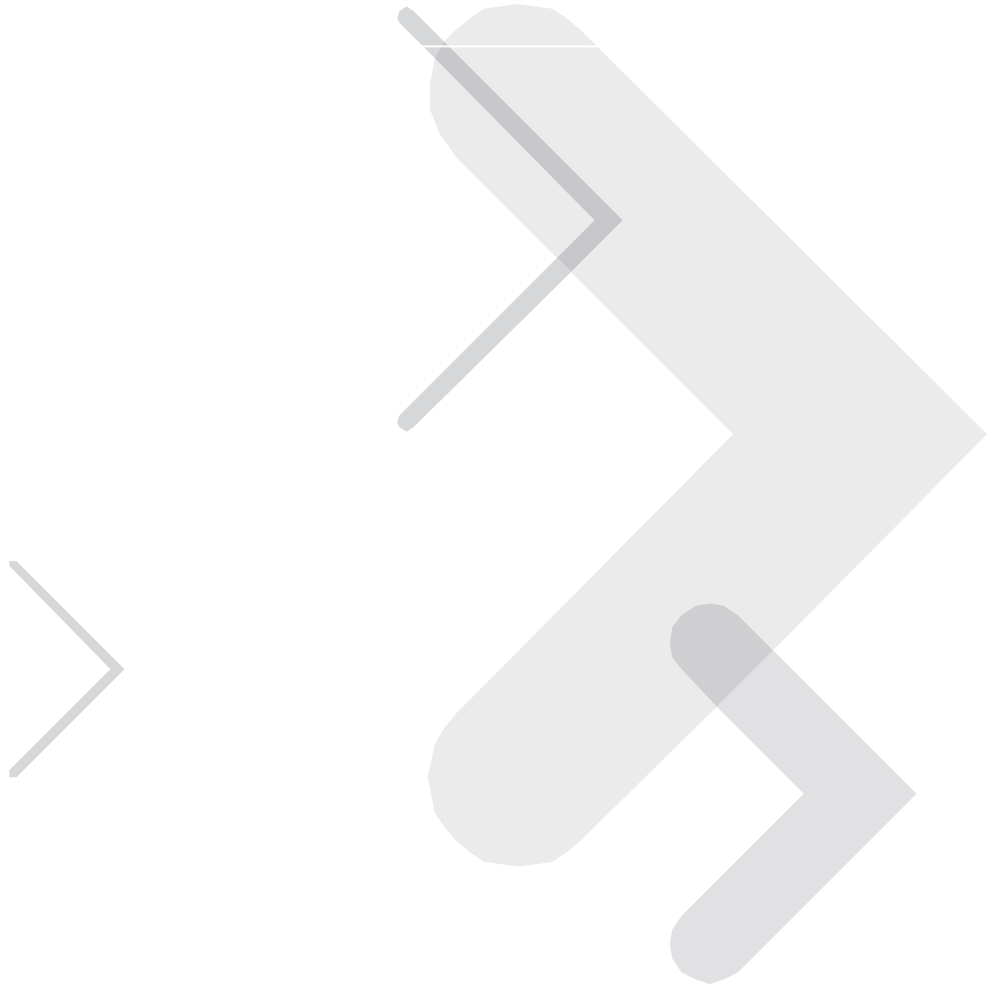
Canopy® Software Release 9.0 Release Notes

Issue 1

October 2008



Notices

See important regulatory and legal notices in Section 9 on Page 49.

Trademarks, Product Names, and Service Names

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http://www.motorola.com/canopy

Table of Contents

List of Tables

List of Figures

1 Introduction

These notes cover Canopy Release 9.0. This release is applicable to Canopyy FSK radios, but not OFDM radios. For details on applicabilty, see section 7.1.1 on page 39, as shown in Table 1.

1.1 NOTES AND HIGHLIGHTS

Highlights of Canopy Release 9.0 include

- Increased performance
- Link Status table ("sector-at-a-glance") on AP
- Alignment Tool page on SMs
- Consistent jitter reporting
- PPPoE (Point-to-Point Protocol over Ethernet) client in SM
- Remote Spectrum Analyzer

For detailed information, see

- Table 2: Release 9.0 enhancements on Page 10
- Table 8: Issues resolved in Release on Page 29
- Table 9: Known open issues on Page 30

Either Prizm 3.1 with Patch 5 or CNUT 3.11 is recommended for upgrading modules to Release 9.0. For details, see Upgrade Tool Options on Page 40.

1.2 ABBREVIATIONS

The following abbreviations are used in these notes:

BH	Backhaul Module, either timing master or timing slave
BHM	Backhaul Module – timing master
BHS	Backhaul Module – timing slave
AP	Access Point Module
SM	Subscriber Module
CNUT	Canopy Network Updater Tool
CMM	Cluster Management Module
DFS	Dynamic Frequency Selection for radar avoidance
MIB	Management Information Base
P7/P8/P9/P10	Shorthand for hardware series levels
ETSI	European Telecommunications Standards Institute

1.3 NAMES

Table 1 shows both the newer PMP/PTP product names and the older product names.

Table 1: Product Names

Product Name	Also Known as	Runs 9.0?
PMP 100 Series	Canopy FSK Classic APs and SMs	Yes

Product Name	Also Known as	Runs 9.0?
PMP 200 Series	Canopy FSK Advantage APs and SMs	Yes
PMP 400 Series	Canopy 5.4 GHz OFDM APs and SMs	No
PTP 100 Series	Canopy FSK BHs, both BH20 (regular) and BH10 (Lite)	Yes
PTP 200 Series	Canopy 5.4 GHz OFDM BHs	No

1.4 IDENTIFYING HARDWARE SERIES (P7, P8, P9, P10)

The following methods can be used to identify the hardware series of a module:

- For modules that are running Release 8 or Release 9, look on the Home => General Status tab, under **Board Type** as shown in Figure 1.

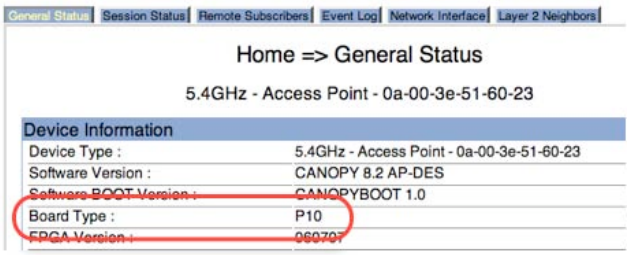


Figure 1: Board Type on modules running Release 8

- For modules that are running Release 7.3.6, view the Configuration web page.
  - If a **Scheduling** option is present, as shown in Figure 2, then the hardware series is P9.

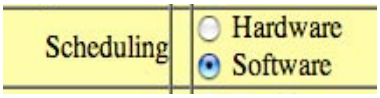


Figure 2: Scheduling option – if viewable, indicates this is a P9 board.

  - If no **Scheduling** option is present, then the series is either P7 or P8.
- For modules running any release, open a **`telnet`** interface to the module and enter **`version`**. The hardware series is shown under `Hardware Platform` (as `7`, `8`, `9`, or `10`).

1.5 DOCUMENT CHANGE HISTORY

Issue 1	First issue

1.6 FEEDBACK ON DOCUMENTATION

Is this document accurate, complete, and clear? How can it be improved? Please send your feedback on Canopy documentation to technical-documentation@canopywireless.com.

1.7 TECHNICAL SUPPORT

Tip! Do not clear the Event Log after you encounter issues. It may be useful to Technical Support, if you need to escalate the issue.

Here is the escalation path for resolution of a problem:

1. Check documentation:
   - this document
   - Canopy System Release 8 Users Guide, available at http://motorola.canopywireless.com/support/library/.
2. Consider checking the Community Forum at http://motorola.canopywireless.com/support/community.
3. Consider checking the Knowledge Base at http://motorola.canopywireless.com/support/knowledge/.
4. Escalate the problem to your Canopy supplier or reseller.
5. Escalate the problem to Canopy Technical Support or other designated Tier 3 technical support:

Worldwide Canopy Technical Support

email: technical-support@canopywireless.com

phone: **1-888-605-2552** or **+1 217 824 9742**

Canopy Technical Support, Europe

email: essc@motorola.com

phone: **+44 (0)1793 564680**

Calls are logged 24 x 7, cases are worked Mon-Fri 09:00 - 17:00 GMT.

When you send e-mail or call, please include, as appropriate, software release on each module, IP addresses, MAC addresses, and features enabled, like NAT, VLAN, high priority channel, or CIR. You may be asked to run the Support Tool on CNUT or Prizm to provide a complete network picture.

2 Features and Enhancements

The following sections list features and enhancements for Release 9.0.

2.1 RELEASE 9.0 ENHANCEMENTS

Release 9.0 adds the enhancements listed in Table 2. For additional information on each enhancement, see the referenced section.

Table 2: Release 9.0 enhancements

Enhancement	Summary	See Section
Increased packets per second (pps) on P10 hardware	Benchmarked pps for P10 hardware increases by over 60%, from 3800 pps to 6200 pps.	2.2
Alignment Tool page on SM	Improved ease of installation with a graphical alignment tool, with near-real-time jitter and received power level information	2.3
Jitter consistent between 1X and 2X on all radios	Displayed jitter value is consistent over time whether the half-link is running in 1X, 2X, or mixed 1X and 2X, making jitter more useful during installation and alignment, and during system monitoring.	2.4
Link Status table on AP	“Sector at a glance” view of bidirectional data for all links	2.5
PPPoE client in SM	Point to Point Protocol over Ethernet supported on SMs for operators using PPPoE in other parts of their network, and for operators wanting to move to PPPoE to gain advantages of per-subscriber authentication, metrics, and usage control.	2.6
DFS Event History log	All radios running DFS now display a DFS Event History log which can be useful in reviewing time-stamped system behavior if the radio does detect a DFS event.	2.7
Remote Spectrum Analysis	Building off the spectrum analyzer in the SM, spectrum analysis can now be performed remotely from the AP, or using a remote link to the SM. Additional features support spectrum analysis on start-up and long-term spectrum analysis.	2.8
Optional revised LED light scheme	An optional new LED light scheme designed to increase subscriber-installs of Indoor 900 SMs can also be enabled on other modules if desired. The legacy LED scheme remains an option also.	2.9
Settable Broadcast Repeat Count on AP	To optimize bandwidth use in some applications, notably video broadcast, the repeat count for downlink broadcast messages is now configurable.	2.10
Downlink Broadcast CIR	CIR (Committed Information Rate) can now be set for downlink broadcasts.	2.11
Option to disable BH 24-hour encryption key refresh	Operators now have a choice to either continue the additional layer of security of 24-hour encryption key refresh on backhauls, or choose not to have a 24-hour service interruption and registration.	2.12
Clearer Ethernet Link Speed selection	A new pop-up menu improves the ease and clarity of choosing Ethernet link speeds.	2.13
BER results clearing	BER results on SMs and BHSs have been improved, and can now be reset to zero to better observe system behavior.	2.14

Enhancement	Summary	See Section
Session uptime times on all radios		2.15
Maximum registered SM counter on AP		2.16
Additional SNMP Community String (Read Only) on all radios		2.17

2.2 INCREASED PACKETS PER SECOND ON P10 HARDWARE

Release 9.0 increases the benchmark for maximum packet processing throughput of a P10 module by over 60%: from 3800 packets per second when running Release 8.2.x to 6200 packets per second when running Release 9.0. Additional results are shown in Table 3.

Table 3: Packet per Second (pps) performance

Packets per Second (pps)	P10 series module	P9 series module
5.x and 2.4 GHz	6200	3500
5.x and 2.4 GHz with VLAN	5200	3200
900 MHz	4600	3600
Note: No significant difference between DES and AES		

The following sections describe the benchmarking process used to measure packets per second and discuss the meaning and limitations of the benchmark.

2.2.1 Definitions

The following terms are used where these release notes discuss packet processing:

Aggregate Throughput Sum of uplink plus downlink traffic.

Offered Load Test equipment generates a specified load to the Ethernet interface of a module (SM or the AP). The specifications of the load include both packet size and packet rate.

Carried Load Test equipment measures the load delivered at the Ethernet interface of a module. The load is calculated from packet size and number of packets. As resources are exhausted at any point in the system, packets may be dropped. The Carried Load equals the Offered Load minus Dropped Packets.

Downlink/Uplink Load Ratio	The ratio of downlink Carried Load to uplink Carried Load. *NOTE: Do not* confuse the Downlink/Uplink Load Ratio with the **Downlink Data** configuration parameter. The Downlink/Uplink Load Ratio is determined from the Carried Loads. The **Downlink Data** is set by the operator and determines the split of downlink and uplink slots in the air frame.

2.2.2 System Performance and System Constraints

In any complex system like Canopy there are multiple performance constraints. Different combinations of system inputs will result in different constraints limiting system performance.

Larger Packets

With larger packets (Canopy handles packets up to 1522 Bytes), the system constraint is *airtime*, which can also be stated as *slots*, or maximum bits per second. This can be calculated as follows:

64 Bytes/fragment x 2 fragments/slot x 34 slots/frame x 400 frames/sec x 8 bits/byte = 14 Mbps

This is an aggregate (uplink plus downlink) limit, as the Canopy system is a Time Division Duplex (TDD) system.

14 Mbps is a typical maximum aggregate throughput for larger packet sizes. Longer range settings can reduce the number of slots in a frame and packet size (breakage on 64-byte boundaries) can affect packing efficiency (the percentage of fragments fully packed with 64 bytes).

Smaller Packets

With smaller packets, the system constraint is *processing power* in any module handling the traffic stream. Even though there may be airtime or slots available, the overall throughput is limited by packet handling ability.

2.2.3 Benchmark Definition

In a complex system, any measurement depends on system configuration, traffic mix, various settings, and measurement techniques, and so to have reproducible results a “benchmark” is defined.

As Canopy releases have evolved, we have improved the benchmark to be more representative of field operation in the following ways:

Sample tests show results from the previous benchmark are generally comparable to results from the Release 9.0 benchmark

System configuration

The benchmark system consists of 3 SMs and 1 Advantage AP, as shown in Figure 3 on page 14. Traffic generation and measurement equipment is connected to both SMs and the AP. Traffic is generated such that any one packet attempts to traverse an SM and then the AP, or the AP and then an SM. No SM-to-SM traffic is included in the benchmark. RF conditions are maintained such that all links run in 2X mode.

Traffic mix/Packet size

All generated packets have a size of 64 Bytes. The packet format used is a valid Ethernet/IP packet. The performance of interest is performance near a 50% Downlink/Uplink Load Ratio.

Settings

- Downlink Data: 50%
- Control Slots: 2
- Range: 2 miles
- 2X Rate: Enabled
- Encryption: Enabled (DES modules)
- MIR: 20,000 kbits/sec sustained rate and 500,000 kbits burst allocation (defaults)
- CIR: 0 (default)
- NAT: Disabled (default)
- VLAN: Disabled (default)
- High Priority: Disabled (default)

With Release 9.0 we have evolved the benchmark to be more representative of field operation as shown in Table 4.

Table 4: Benchmark Comparison

Attribute	Old benchmark	New benchmark
System	1 AP, 2 SMs	1 AP, 3 SMs
Packet size	100 Bytes	64 Bytes
Downlink Data %	50%	50%

Sample tests show results from the previous benchmark are generally comparable to results from the Release 9.0 benchmark.

Measurement technique

1. Send a specific number of frames at a specific rate through Canopy uplinks and down links simultaneously (Offered Load) and then count the frames that are received correctly at both sides (Carried Load). Repeat this through the load rates of interest. Review the results, noting where the packet loss (the difference between the Offered Load and Carried Load) is essentially zero (<0.001%).
2. Confirm results by running longer tests at selected load rates.
3. Confirm results by varying Downlink/Uplink Load Ratios to ensure no significant changes around the 50% benchmark.

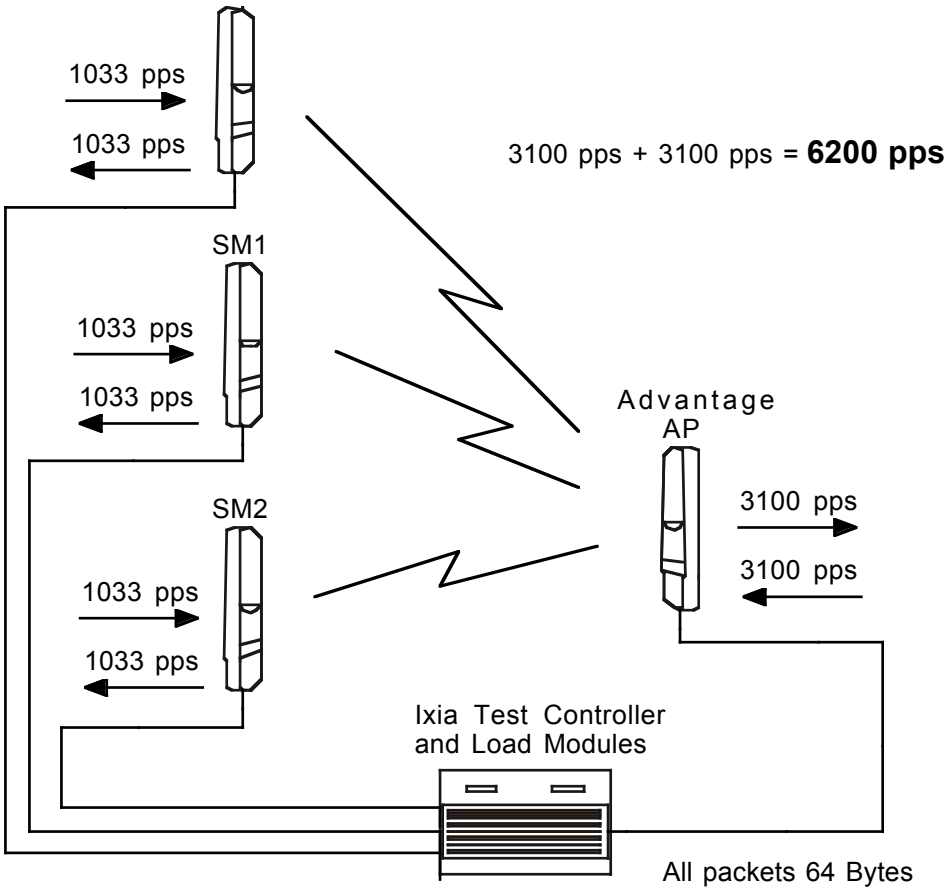


Figure 3: Test setup and results

2.3 ALIGNMENT TOOL PAGE ON SM

To aid installation, a graphical alignment tool page has been added to SMs and BHSs. It is accessed via Tools => Alignment Tool. As shown in Figure 4, jitter and power level are shown graphically using both a bar indicator and color coding (green/yellow/red), as well as a numeric value. Overall link quality is summarized as Good, OK or Bad.

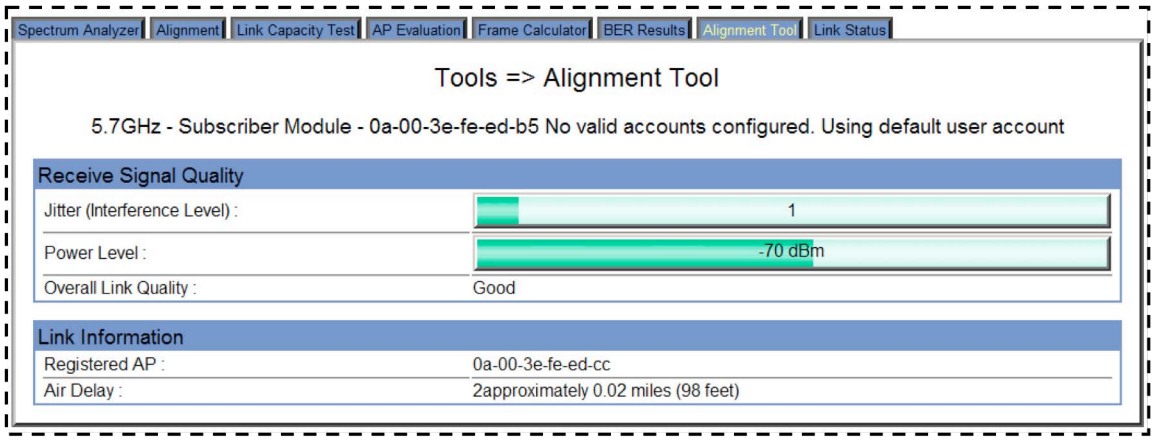


Figure 4: "Good" link

Figure 5 shows a link with low (“Good”) jitter, but only “OK” power level, for an overall link quality of “OK”.

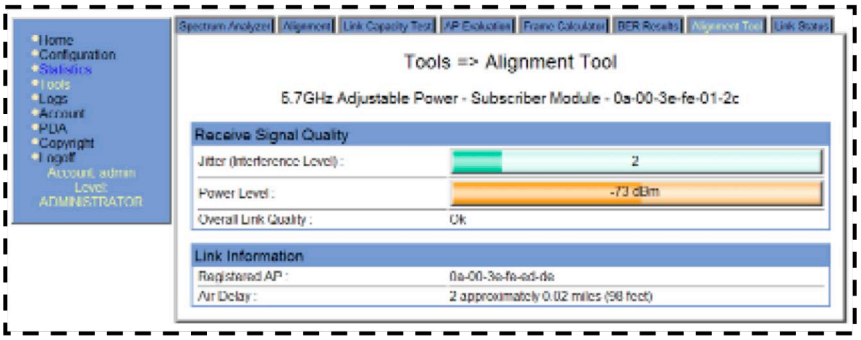


Figure 5: "OK" link

Figure 6 shows a link with “OK” jitter but “Bad” power level, for an overall link quality of “Bad”.

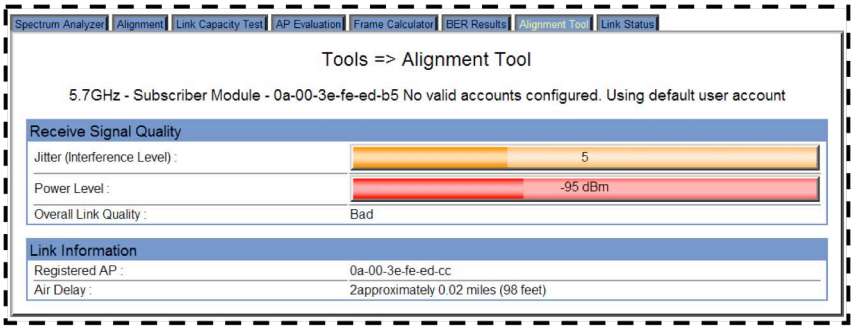


Figure 6: "Bad" link

Table 5 shows the mapping of jitter and power level readings to colors and stated link quality.

Table 5: Mapping of Jitter and Power Level to Colors and Words

Key	Good	OK	Bad
Color	Green	Orange	Red
Jitter	1 to 4	5 to 8	9 to 15
Power Level	> -72 dBm	-72 to -75 dBm	< -75 dBm
Overall Link Quality	Worse of Jitter or Power Level, stated as Good, OK, or Bad		

To support this feature, jitter is now consistent across 1X and 2X operation, and an improved refresh algorithm is used on the web page. Web page refresh frequency continues to be set using the Configuration => General page. To best use the new Alignment Tool, web page refresh frequency should be set to 1 or 2 seconds during alignment.

2.4 JITTER CONSISTENT BETWEEN 1X AND 2X ON ALL RADIOS

To support the new Alignment Tool and generally improve system monitoring, jitter is now consistent, with one scale, across 1X and 2X operation. For jitter, regardless of 1X or 2X operation,

- 1 through 4 is “Good”
- 5 through 8 is “OK”
- 9 through 15 is “Bad”

Min and Max values are now displayed for both Jitter and Power Level, in addition to Actual, as shown in Figure 7.

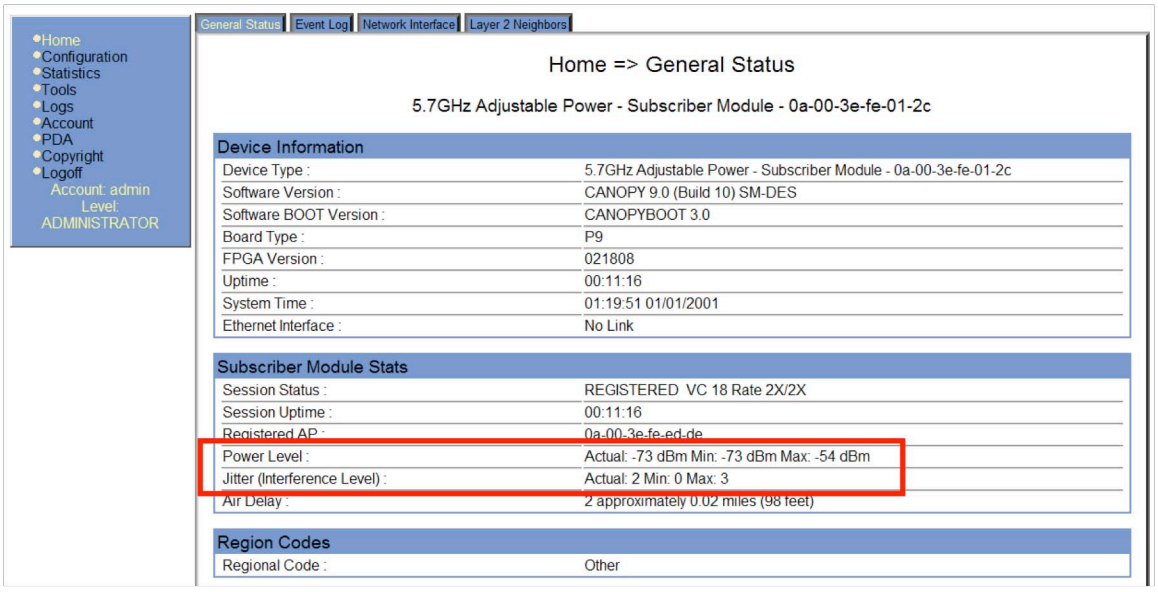
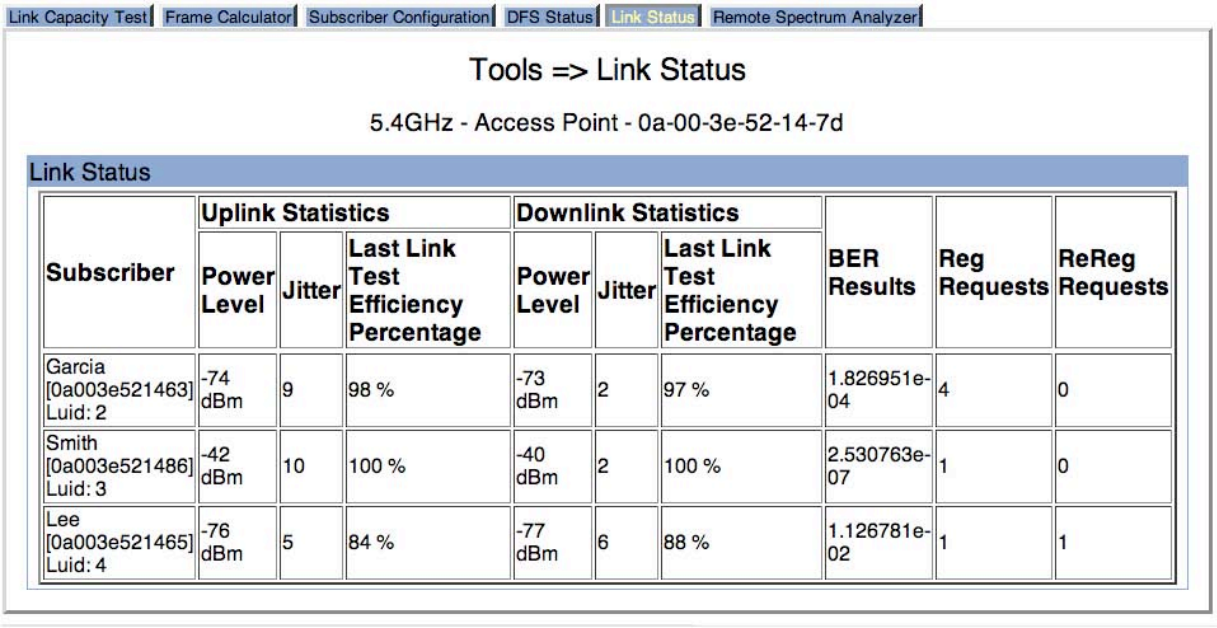


Figure 7: Consistent Jitter Indication

2.5 LINK STATUS TABLE ON AP

APs now provide a Link Status table available at Tools => Link Status. As shown in Figure 8, the Link Status table shows the latest value of Power Level, Jitter, and Link Test for both uplink and

downlink directions, cumulative downlink BER results, and Registration and Re-registration counts, for all SMs in the sector.



Subscriber	Uplink Statistics			Downlink Statistics			BER Results	Reg Requests	ReReg Requests
	Power Level	Jitter	Last Link Test Efficiency Percentage	Power Level	Jitter	Last Link Test Efficiency Percentage			
Garcia [0a003e521463] Luid: 2	-74 dBm	9	98 %	-73 dBm	2	97 %	1.826951e-04	4	0
Smith [0a003e521486] Luid: 3	-42 dBm	10	100 %	-40 dBm	2	100 %	2.530763e-07	1	0
Lee [0a003e521465] Luid: 4	-76 dBm	5	84 %	-77 dBm	6	88 %	1.126781e-02	1	1

Figure 8: Link Status table

Power Level and **Jitter** are reported near-instantaneously if web refresh rate is set to 1 or 2 seconds and are the same values displayed on the AP's Sessions page and the SM's Home page.

Last Link Test Efficiency shows results of the last link test initiated from the SM. Due to system data reporting constraints, link tests initiated from the AP are not shown. Running a link test from the AP will not populate this field – the link test has to be run from the SM for the data to flow into this field. As a reminder, a link test exercises both uplink and downlink, and efficiencies for both are reported, whether you run the link test from the SM or AP. The "best practice" to get full benefit of this table is to run link tests from the SM rather than the AP, so the results flow into the Link Status table.

BER Results (Bit Error Rates) are shown for each downlink. The BER shown is "over-the-air" BER, not transport BER. Canopy's ARQ (Automatic Resend reQuest) ensures that the transport BER, the BER seen end-to-end through a Canopy network, is essentially zero. Acceptable "over-the-air" BER will vary based on operating requirements, but a reasonable value for a "good" link is a BER of 1e-4 (1×10^{-4}) or better, which calculates roughly into a packet resend rate of 5%. BER is generated using unused bits in the downlink. During periods of peak load, BER data is not updated as often, as the system puts priority on transport, not on BER calculation. A related feature is the ability to reset ("zero out") BER without rebooting the SM – see section 2.14 on page 27.

Registration Requests and Re-registration Requests are shown for each SM since the time of the last AP reboot. As a reminder. Registration Requests are a count of the number of times the SM registered after the AP knew the link had been taken down, whereas Re-registration

Requests are a count of the number of times the SM registered when the AP thought the link was still up.

2.6 PPPOE CLIENT IN SM

Point-to-Point Protocol (PPP) over Ethernet (PPPoE) is a protocol that encapsulates PPP frames inside Ethernet frames. PPP has its roots in dial-up access and with PPPoE an operator gets the benefits of PPP at Ethernet speeds

- Access control
- Service monitoring
- Customer statistics
- Re-use of infrastructure and operational practices (for operators who already have PPP for other networks)

A new Configuration => PPPoE page supports configuring PPPoE in the SM, as shown in Figure 9. A new Statistics => PPPoE page support PPPoE statistics, as shown in Figure 10.

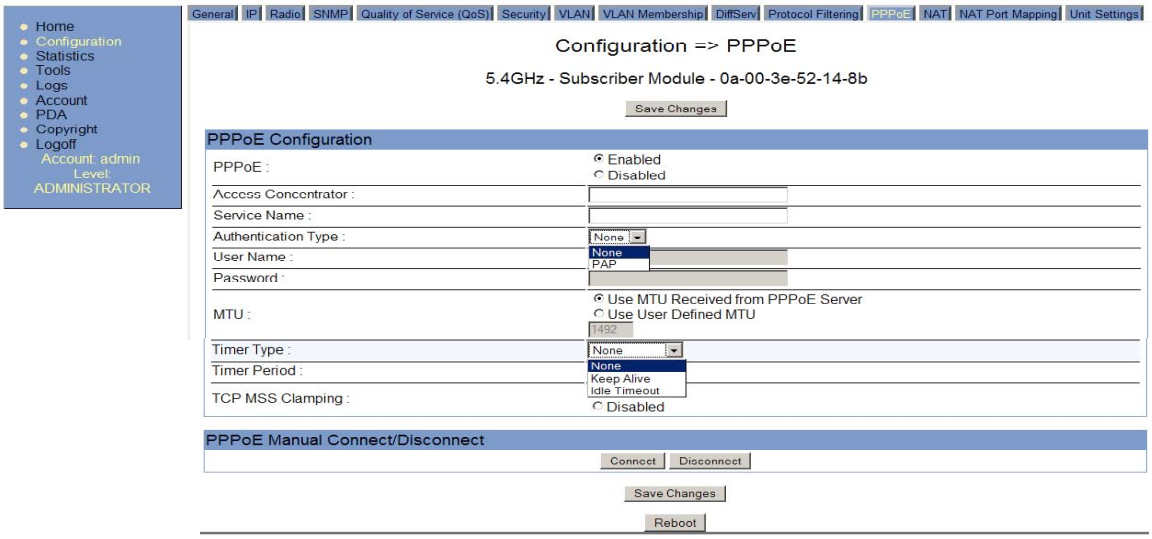


Figure 9: PPPoE Configuration page

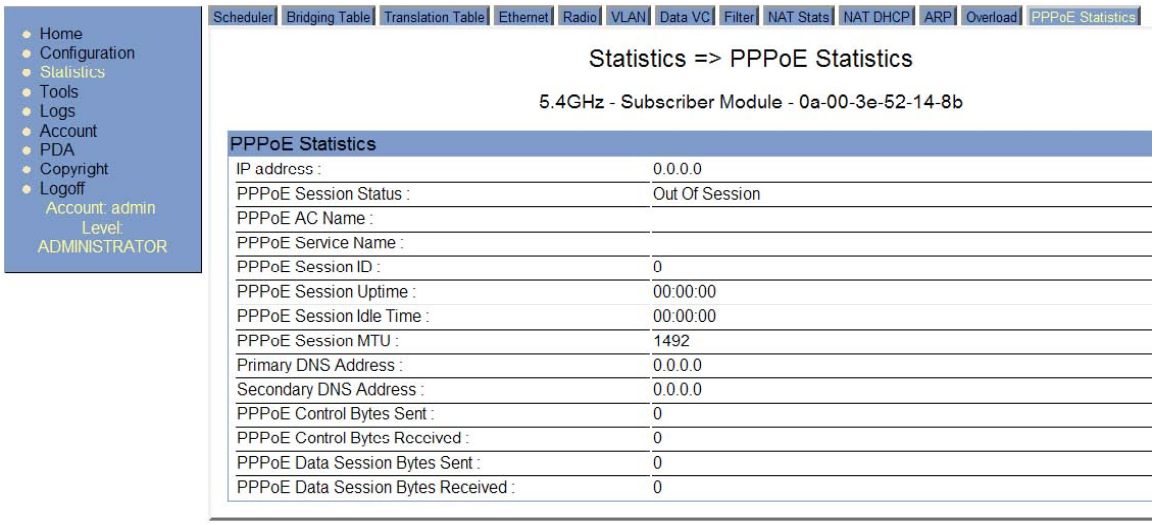


Figure 10: PPPoE Statistics page

Canopy configuration requirements for PPPoE include

- NAT on the SM enabled (the interface enforces this)
- Translation Bridging on the AP disabled (the default) for PPPoE to work.
- NAT Public IP DHCP Client disabled

With PPPoE enabled, the SM first registers to the AP, then immediately attempts to connect to the PPPoE server.

Implementing PPPoE on a network includes planning for the PPPoE server and operations to support and take advantage of PPPoE, as well as configuring the Canopy SM consistent with your PPPoE implementation.

2.7 DFS EVENT HISTORY LOG

A DFS Event History log has been added to the Home => DFS Status page, which appears on any module running DFS (as determined by the Region code). The log is useful for seeing when DFS events happened, including the response of any **Alternate RF Carriers** assigned.

Figure 11 shows an example of the new page on an AP. In this example, at 1:03 (mm:ss) the AP started transmitting on 5580 MHz, the Primary RF Carrier Frequency after a 60 second Channel Availability Check (CAC), then took a DFS hit at 6:58:58 (hh:mm:ss), switched to the Alternate RF Carrier Frequency 1 of 5590 MHz, and about 60 seconds later after a CAC started transmitting on 5590 MHz.

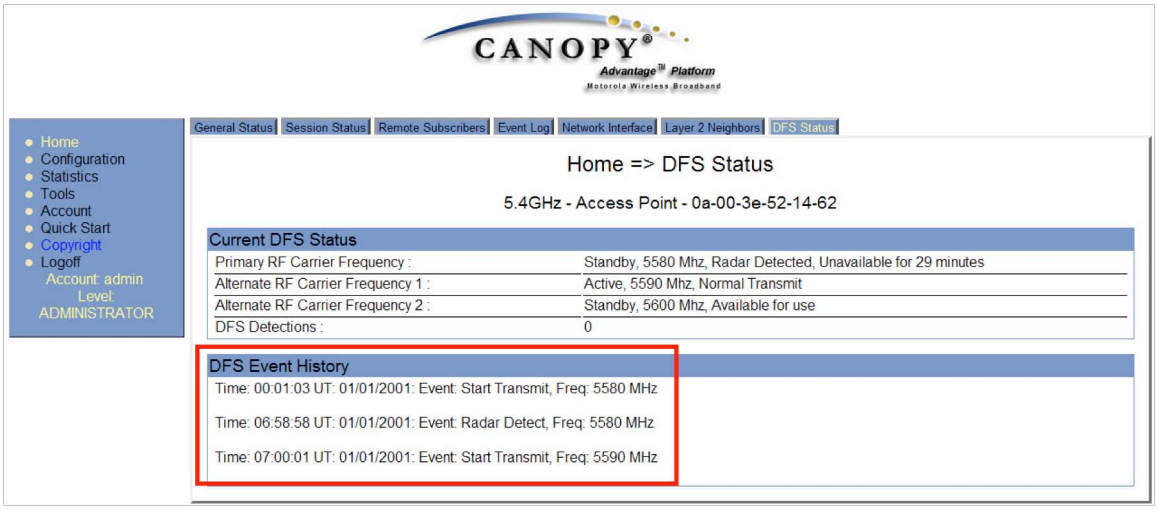


Figure 11: DFS Event History log

Figure 12 shows an example of the new page on an SM.

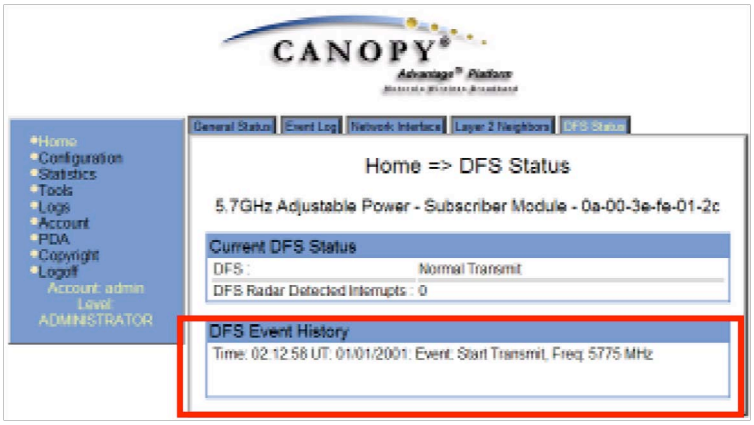


Figure 12: SM DFS Event History log

2.8 REMOTE SPECTRUM ANALYSIS

Several new spectrum analysis features give additional flexibility to the use of the SM's built-in spectrum analyzer.

On a new page on the AP – Tools => Remote Spectrum Analyzer – you can set a timed duration of 10 to 1000 seconds and select an SM from a pop-up menu and **Start Remote Spectrum Analysis** at that SM, as shown in Figure 13. The AP de-registers the target SM, the SM scans for the set duration to collect data for the bar graph, then re-registers to the AP and the AP displays the bar graph.

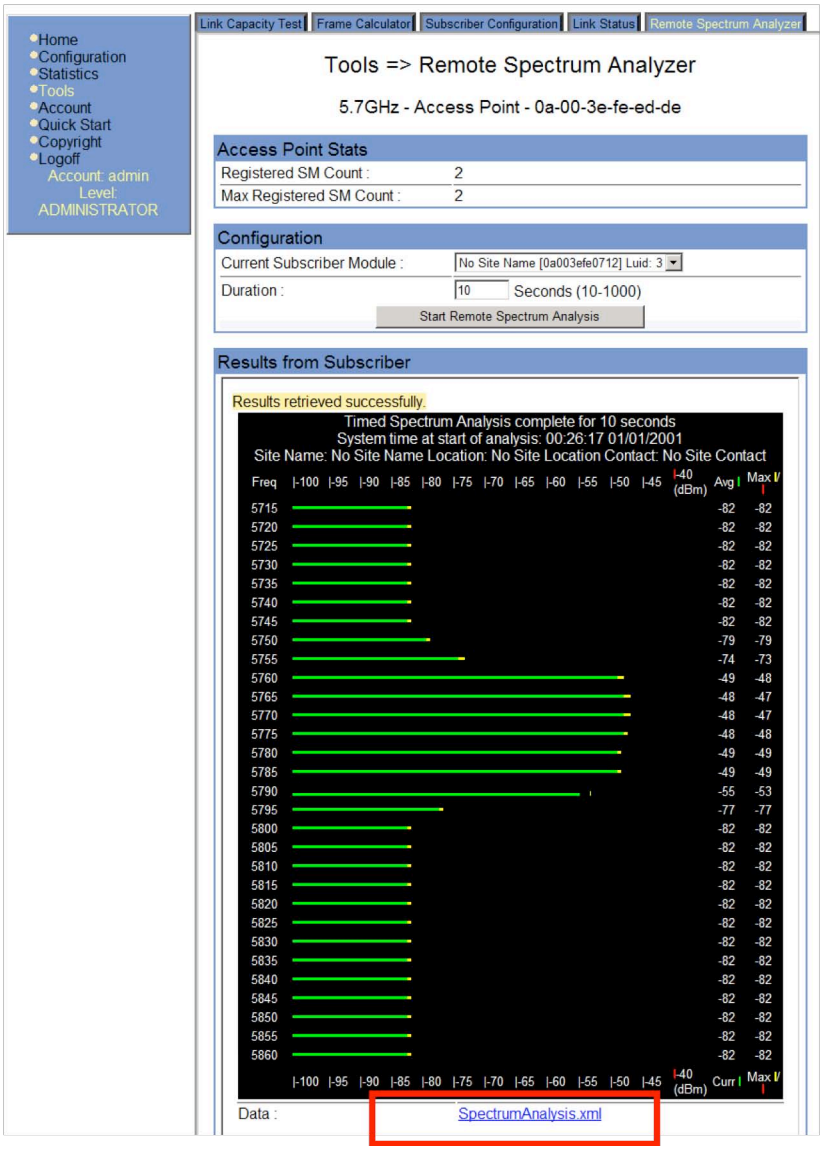


Figure 13: AP Remote Spectrum Analyzer

On the SM's Tools => Spectrum Analysis page you can set a timed duration of 10 to 1000 seconds and Start Timed Spectrum Analysis as shown in Figure 14. The SM de-registers from its AP if it was registered, scans for the set duration to collect data for the bar graph, then displays the bar graph and re-registers. If you were connected to the SM over the air, you can connect again after it re-registers, and view the bar graph.

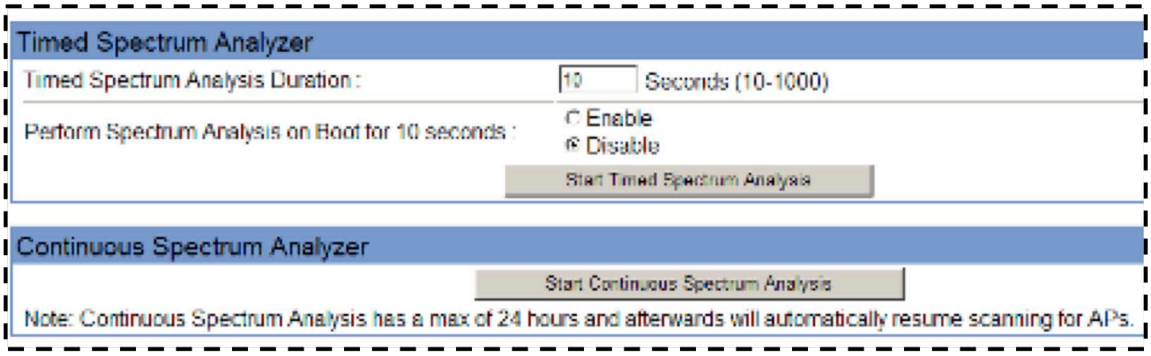


Figure 14: SM Spectrum Analyzer

On the SM's Tools => Spectrum Analyzer page you can enable the SM to perform spectrum analysis for 10 seconds every time it boots, and hold the bar graph for your future viewing.

On the SM's Tools => Spectrum Analyzer page you can **Start Continuous Spectrum Analysis**. The SM will gather data and update its spectrum bar chart until you stop it or up to a maximum of 24 hours. If allowed to, it will run for 24 hours, then stop spectrum analysis and resume scanning for an AP.

On either the SM or AP, after the bar graph is displayed, click the **SpectrumAnalysis.xml** link to redraw the bar chart using XML, then right click on the chart and "Save Target As" to save the XML file. As an XML file, it is smaller and can be more easily stored and compared to other spectrum analysis outputs.

2.9 OPTIONAL REVISED LED LIGHT SCHEME

An optional light scheme supports end customers/subscribers self-installing the 900 MHz Indoor SM (aka Wireless Modem). The scheme uses the same LEDs as currently and is based on the signal light analogy: green is good, yellow is okay, and red is bad. The **Revised Mode** can be selected on any SM in any frequency band on the Configuration => Unit Settings page as shown in Figure 15 and may be useful in some settings and workflows for outdoor SMs.

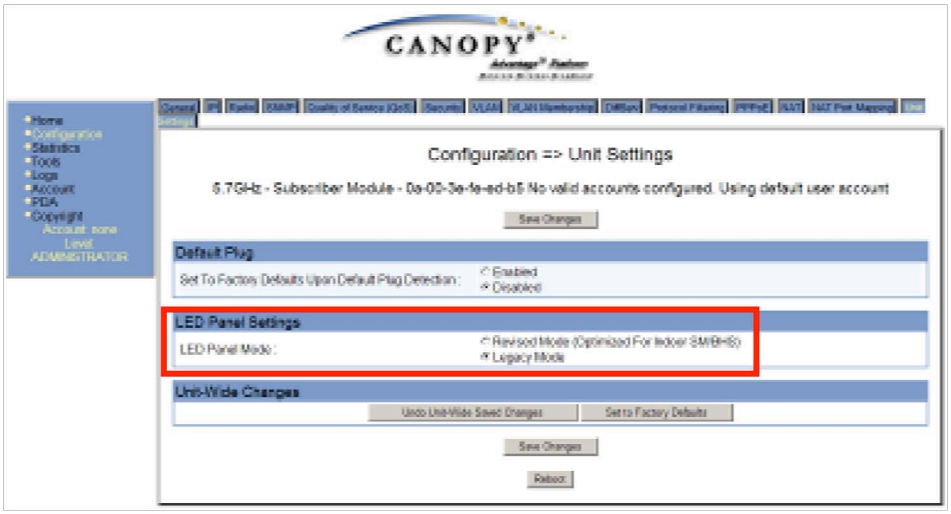


Figure 15: LED Settings - Revised or Legacy Mode

The mental model of the **Revised Mode** is to get rid of the red, try for green, and accept yellow. The functions of the LEDs have been changed as shown in Figure 16 and Table 6.

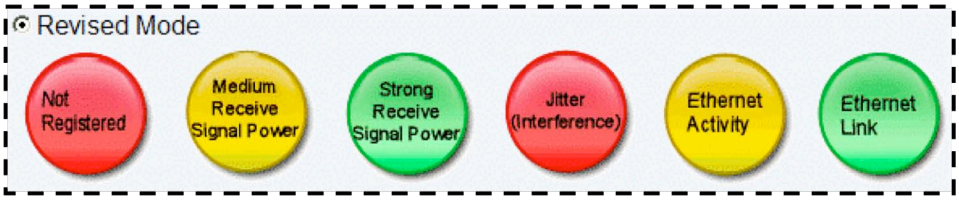


Figure 16: Revised Mode LEDs

Table 6: LED Light Scheme - Revised Mode vs Legacy Mode

Color	Revised Mode	Both Modes	Legacy Mode
Red	*Not Registered* Off when registered to AP On when not registered to AP		*Power*
Yellow	*Medium Receive Signal Power* Blinking from slow to full-on to indicate medium power, getting stronger	*Scanning* Blink in sequence before registering	*Sync*
Green	*Strong Receive Signal Power* Blinking from slow to full-on to indicate strong power, getting stronger		*Session*
Red	*Interference (Jitter)* On - high interference Blinking - medium interference Off - low interference		NA
Yellow	*Activity*		*Activity*
Green	*Link*		*Link*

2.10 SETTABLE BROADCAST REPEAT COUNT ON AP

The downlink broadcast repeat count is now a settable parameter, set on the Configuration => Radio page of the AP, as shown in Figure 17. The default is 2 repeats (in addition to the original broadcast packet, for a total of 3 packets sent for every one needed), and is settable to 1 or 0 repeats (2 or 1 packets for every broadcast).

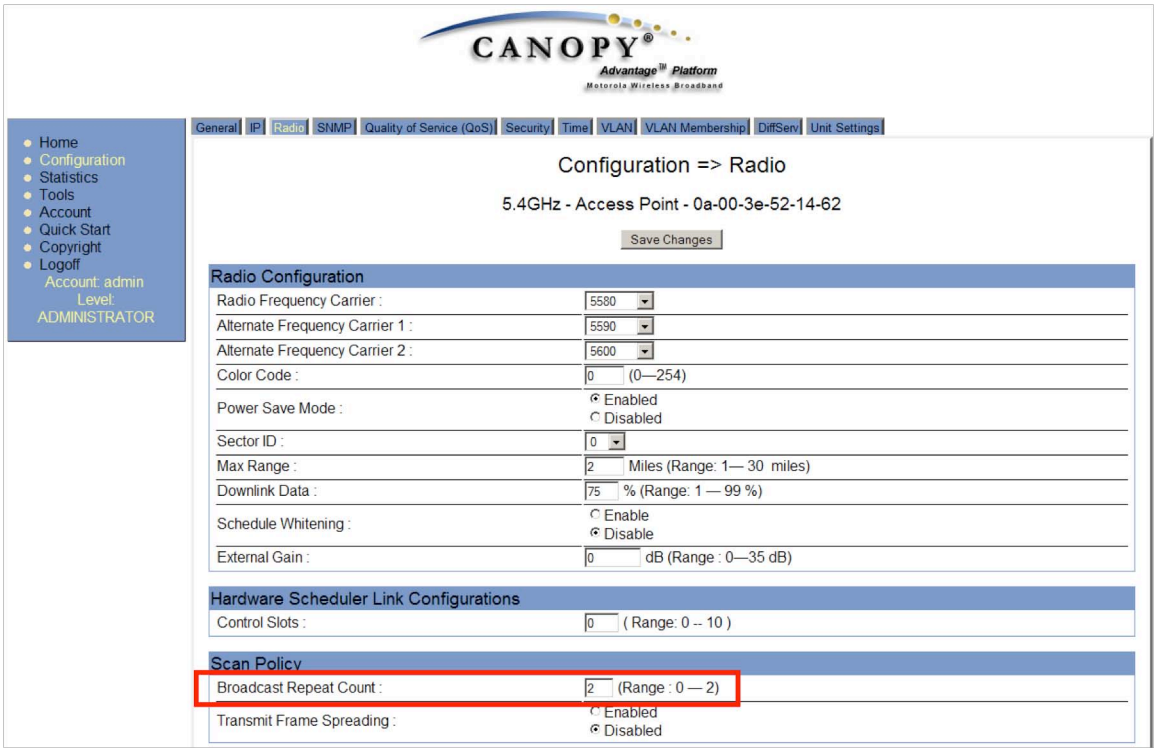


Figure 17: Broadcast Repeat Count

Canopy does not have ARQ (Automatic Repeat reQuest) on downlink broadcast packets, as that would lead to unwarranted uplink traffic from every SM for each broadcast packet. To help ensure successful transport without ARQ, Canopy repeats downlink broadcast packets. The SMs filter out all repeated broadcast packets before transporting further – the repeats are only within the Canopy system and not seen end-to-end.

The default of 2 repeats is optimum for typical uses of Canopy as an internet access system. When Canopy is used in applications with heavy download broadcast such as video distribution, overall throughput is significantly improved by setting the repeat count to 1 or 0 and avoiding flooding the downlink with repeat broadcast packets.

2.11 DOWNLINK BROADCAST CIR

Downlink Broadcast CIR (Committed Information Rate) can now be set on the AP's Configuration => Quality of Service (QoS) page. The option of having CIR (a floor or minimum) on downlink broadcasts supports some system designs where downlink broadcast is desired to have higher priority than other traffic.

For many system designs, especially typical internet access networks, leave the Downlink Broadcast CIR at the default.

Downlink Broadcast CIR is closely tied to **Broadcast Repeat Count.** When **Broadcast Repeat Count** is changed it changes the total bandwidth available since packets are being sent one, two or three times, depending on settings. Table 7 shows how the maximum **Downlink Broadcast CIR** changes as **Broadcast Repeat Count** is changed.

Table 7: Broadcast Repeat Count vs Max Downlink Broadcast CIR

Broadcast Repeat Count	Number of times each packet is sent	Maximum Downlink Broadcast CIR
0	1	7000 kbps
1	2	3500 kbps
2	3	2333 kbps

2.12 OPTION TO DISABLE BH 24-HOUR ENCRYPTION KEY REFRESH

BHMs enabled for encryption have forced re-registration every 24 hours to refresh the encryption key. Now the **24 Hour Encryption Key Refresh** can be enabled or disabled on the Configuration => Security page of the BHM as shown in Figure 18.

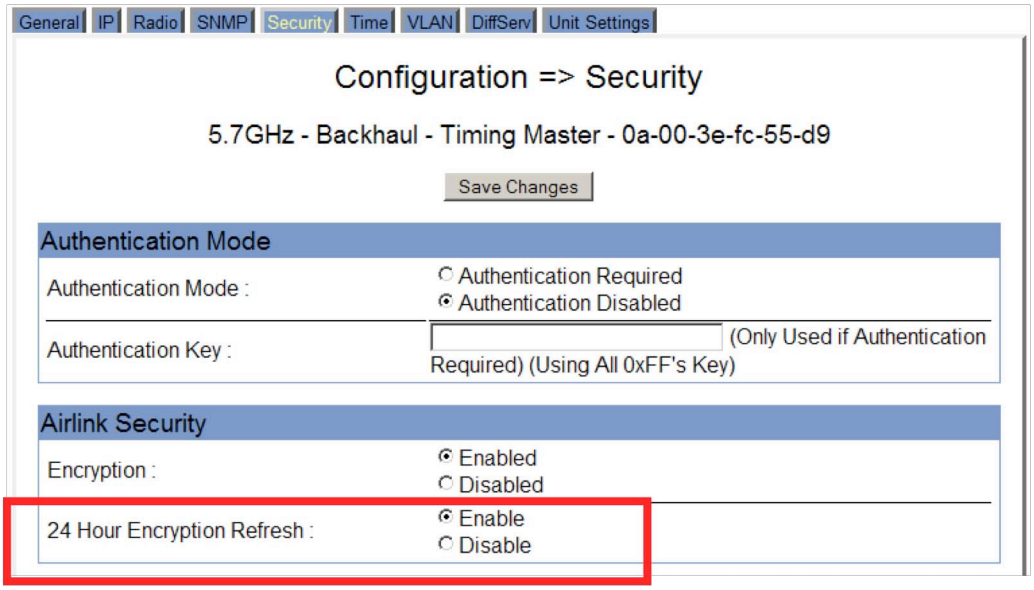


Figure 18: 24 Hour Encryption Refresh on Backhauls

The 24-hour encryption key refresh provides an additional level of security, but at the trade-off of a short downtime every 24 hours. The key refresh happens at 24 hour increments after the link is established, so the only good way to set the time-of-day (for example, 2:00 AM) of the key refresh is by rebooting the BHM or BHS.

The Advanced Encryption Standard (AES) algorithm used in AES radios has been certified by the National Institute of Standards and Technology (NIST) to meet government Federal Information Processing Standard-197 (FIPS-197) for ensuring secure data communication. The 24-hour encryption key refresh is not needed for AES radios to meet FIPS 197, but provides an additional level of security.

2.13 CLEARER ETHERNET LINK SPEED SELECTION

Ethernet link speeds are now selected from a pop-up menu as shown in Figure 19. Previously the operator set Ethernet link speeds by selecting 1, 2, 3, or 4 of 4 choices: 10 Mbps, 100 Mbps, Half Duplex, and Full Duplex. Choosing two or more triggered the use of the Ethernet link speed auto-negotiation protocol. Now with the pop-up, only non-troublesome combinations are offered, and it

is clearer if the link is being forced to one option or told to auto-negotiate the link speed. As a reminder, Ethernet links work best when either both ends are set to forced speeds, or both ends are set to auto-negotiate and have at least one common speed.

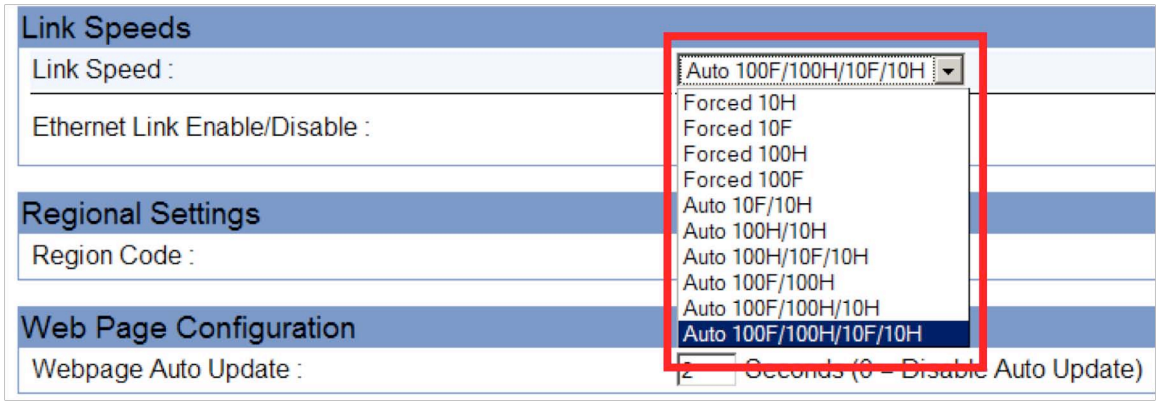


Figure 19: Ethernet Link Speed Selection

2.14 BER RESULTS CLEARING

BER (Bit Error Rate) can now be cleared (reset to zero) as shown in Figure 20, without rebooting the SM.

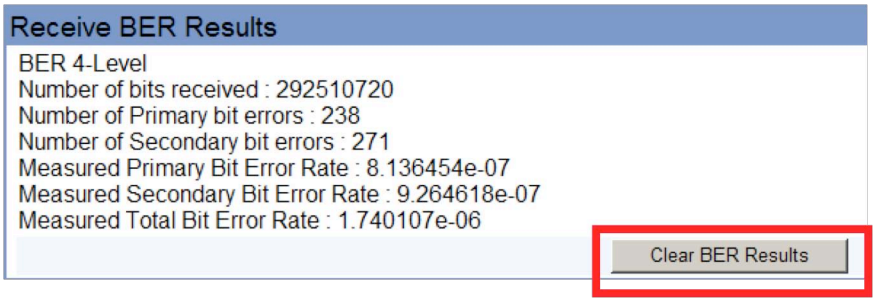


Figure 20: BER Results Clearing

In addition to calculating a total bit error rate, if the AP is enabled for 2X operation both Primary (1X) and Secondary (2X) fields are shown, and if the link operates at least some of the time in 2X, the Secondary fields will be populated in addition to the Primary fields.

For additional discussion on BER, see the BER paragraph in section 2.5 on page 16.

2.15 SESSION UPTIME TIMES ON ALL RADIOS

The Module's Stats for SMs and BHSs now displays Session Uptime as shown in Figure 21.

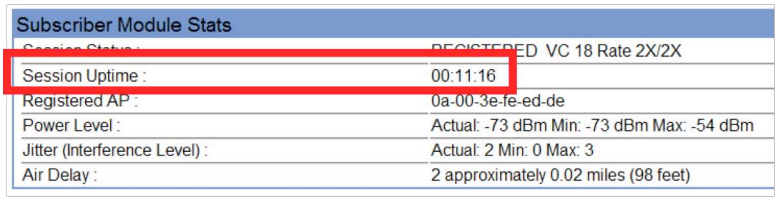


Figure 21: Session Uptime

2.16 MAXIMUM REGISTERED SM COUNTER ON AP

The AP now displays **Max Registered SM Count**, as well as current **Registered SM Count**, as shown in. **Max Registered SM Count** is the maximum number of SMs that have been registered to the AP at any one time since it was last rebooted. The count gives an operator additional insight into sector history, and allows easy comparisons between current and max SM counts.

2.17 ADDITIONAL SNMP COMMUNITY STRING (READ ONLY) ON ALL RADIOS

Radios now offer two SNMP Community Strings, as shown in Figure 22. **Community String 1** can be selected for **Read Only** or **Read/Write**. **Community String 2** is always **Read Only**.

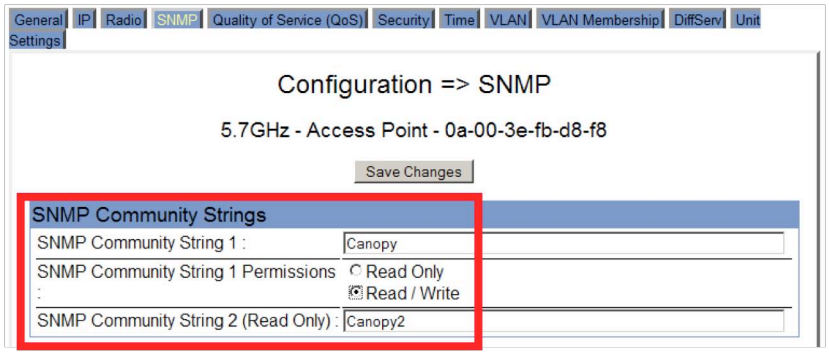


Figure 22: Additional SNMP Community String, Read Only

3 Issues Resolved

Issues resolved in Release 9.0 are listed in Table 8.

Table 8: Issues resolved in Release 9.0

Description	Explanation
SM and NAT and 2 DHCP servers (6161)	In some cases, if there were two DHCP servers on the subnet, the radio would not obtain NAT public IP via DHCP. This is now resolved.
Lost Telnet session between CNUT and AP during update process (ID 6248, 7281)	Resolved in Release 8.2.7, so the issue won't occur when upgrading from Release 8.2.7 to Release 9.0, or from Release 9.0 to a future release. However, the issue may still occur when upgrading from Release 8.2.4 to Release 9.0.
During upgrade, an SM is not upgrading, and a calloc 1 failed message appears in the SM Event log (ID 7060)	Resolved in Release 8.2.7, so the issue won't occur when upgrading from Release 8.2.7 to Release 9.0, or from Release 9.0 to a future release. However, the issue may still occur when upgrading from Release 8.2.4 to Release 9.0.
Misleading "Factory" frequency on Europe 5.4 GHz APs or BHMs after upgrade	Resolved in Release 8.2.7, so the issue won't occur when upgrading from Release 8.2.7 to Release 9.0, or from Release 9.0 to a future release. However, the issue may still occur when upgrading from Release 8.2.4 to Release 9.0. The issue is that an AP or BHM set to a **Region Code** of **Europe** and using a **Radio Frequency Carrier**, **Alternate Frequency Carrier 1,** or **Alternate Frequency Carrier 2** in the "weather notch" (5590 to 5660 MHz, inclusive) running on Release 8.2.4 or earlier will display "Factory" in the frequency pop-up after upgrading to Release 9.0. The AP or BHM is still transmitting and will function on the previous frequency.
Misleading scan selection list on Europe 5.4 GHz SMs or BHSs after upgrade	Resolved in Release 8.2.7, so the issue won't occur when upgrading from Release 8.2.7 to Release 9.0, or from Release 9.0 to a future release. However, the issue may still occur when upgrading from Release 8.2.4 to Release 9.0. The issue is that an SM or BHS set to a **Region Code** of **Europe** and set to scan frequencies in the "weather notch" (5590 to 5660 MHz, inclusive) running on Release 8.2.4 or earlier will continue to scan and register to those frequencies after upgrading to Release 8.2.7 or later. The frequencies are not shown on the Configuration => Radio page of the SM or BHS, but are available for use.
Errors occur in BER statistics (ID 7500)	BER statistics now functions correctly.
SNMP issue (7403)	GUI would show up to 20 Layer 2 Neighbor elements, SNMP would only show 10. This is now resolved so both show 20.
SNMP Community String issue (7498)	Non-empty Community Strings are now not allowed. Before, you could enter a blank/empty Community String in the GUI and then SNMP didn't work.

4 Known Open Issues

Known open issues for Release 9.0 are listed in Table 9.

Table 9: Known open issues

Description	Discussion and Recommendations
On NATted SM, DHCP server should NAK duplicate IP address (8276)	SM does not “Negative Acknowledge” (NAK) a second device doing a DHCP Request that has the same IP address of one already assigned, thus resulting in the second device keeping its previous IP which in some cases results in a duplicate IP scenario. Workaround: If you get a duplicate IP address warning on your computer, it may be from this issue, or may be from other network addressing issues. To recover, consider renewing the lease or disable and enable the Ethernet interface or NIC card.
SM scan frequencies not “cancelled” by SNMP actions (8172)	If you make frequency changes on the SM GUI, and then back them out using SNMP, the Reboot Required message remains on the GUI. Workaround: If it says Reboot Required, go ahead and reboot, just to clear the message.

5 Notes

Table 10 lists new notes of interest to operators. Table 11 lists continuing notes first mentioned in previous Release Notes.

Table 10: New Notes

ID	Description	Discussion and Recommendations
None	RSSI is no longer displayed	RSSI appears to give high resolution (over a thousand steps) compared to received **Power Level** in dBm (tens of steps), but due to the way raw RSSI was calculated the resolution was neither accurate nor precise, either for absolute or relative measures. Best practice is to use the received **Power Level** readings along with jitter to optimize aiming, and then confirm by running Link Tests.
7522	**Air Time Delay** may be different from previously	With Release 9.0, the air time delay calculation is less granular (smaller internal steps) and more accurate. Due to this, the displayed air time delay for an SM may be slightly different than it was in previous releases, even though neither the AP nor SM has moved.
8241	Avoid power cycling modules during upgrading	Power cycling a module while it is upgrading can cause anomalous events, such as rebooting every time you try to access the GUI. Recovery: Attempt to upgrade again. If CNUT reports the module as upgraded and refuses to upgrade again, downgrade the module and then upgrade it again.
None	Managing module accounts and passwords	The best security practice is to be aware the unit starts with `root` and `admin` accounts, to plan your approach to accounts, and set passwords for all accounts. A module that either is fresh from the factory or has been operator-reset to factory defaults has two user accounts: `root` and `admin`, both with ADMINISTRATOR level permissions. To secure a module, access the Account => Change Users Password tab and add a password to each of these accounts. Adding a password to only one account still leaves the other open. Furthermore, an account without a password will accept any password potentially giving the impression the unit is protected when it isn't. Alternatively, an operator's practices may be to delete the `admin` account or delete the `root` account and replace them with their own account(s). By default Prism and CNUT use the `root` account to manage the module, so if you delete `root` accounts on modules you will need to make coordinated changes to Prizm and CNUT to access them with your own accounts.
7808	Use up to 16 alphanumeric characters in user account names, passwords, and Community Strings	SNMP doesn't do data-entry checking, so more than 16 characters may be entered, but only 16 characters will be saved and displayed. You can set Community Strings that include characters like ~`!@#$%^&*()_+[]{}|;:,./<>? from the GUI, but SNMP only accepts alphanumeric characters and SNMP get or set commands will return errors.

ID	Description	Discussion and Recommendations
7442	Timed Spectrum Analyzer settings anomaly	Values of **Timed Spectrum Analyzer** duration and **Spectrum Analysis on Boot** get saved by clicking any button on the page, not just when clicking **Save Changes** or **Start Time Spectrum Analysis** (which is typical operation for other pages).
None	Best Practice is to set SM to same **Region Code** as AP	When an SM registers to an AP, it assumes the Region Code and associated parameters of the AP, disregarding any Region code set in the SM by you. However, the best practice is still for you to set a Region Code in the SM so that displayed options are consistent with the region.

Table 11: Previous Notes

ID	Description	Discussion and Recommendations
None	The received **Power Level** is a relative, not absolute, value	The received Power Level displayed in the SMs Session Status page and the AP's Sessions page is not designed to be highly accurate. The reading is useful during aiming, where relative values over a short period of time are of interest. However, the reading varies from module to module and varies with board-level temperature. If you use it to monitor a link over time, to compare a reading to calculated values, or to compare links or SMs, be aware of its limited accuracy.
None	Spectrum analyzer is best used for relative, not absolute values	The built-in spectrum analyzer is useful for ascertaining the relative power levels across the spectrum at a given moment, but does not replace the accuracy and repeatability of stand-alone spectrum analysis equipment.
None	Enabling NAT can reduce throughput of an SM.	NAT uses processing power and therefore can reduce the throughput of an SM. The throughput reduction is usually 5-0% and varies with packet size, traffic characteristics, mix of uplink and downlink traffic, and board series.

ID	Description	Discussion and Recommendations
None	Using the spectrum analyzer on a VLAN-enabled AP requires special procedures	When an AP on a Management VLAN is rebooted with a **Device Setting** of **SM**, to use the SM Spectrum Analyzer feature, the module is no longer on a Management VLAN. The method of connectivity to the module has to change to adapt to this. To use the Spectrum Analyzer feature on a VLAN-enabled AP that has **Management VID** configured, perform the following steps: 1. Access the AP through its Management VLAN ***NOTE:*** The specific configuration to do this is network/site/operator dependent. 2. In its Configuration => General tab, configure the **Device Setting** to **SM**. 3. Reboot the module. ***RESULT:*** You have now lost connectivity to the module. 4. Access the module *without* using a Management VLAN. ***NOTE:*** The module is not on a management VLAN at this point. Details of this step vary with network design. In many networks, this step requires connecting to a different (non-tagging) port of the VLAN switch in your Network Operations Center. 5. Perform the desired spectrum analysis in the usual way. 6. When you are ready to return the module to normal operation as an AP, reset **Device Setting** to **AP** in the Configuration => General tab. 7. Reboot the module. ***RESULT:*** You have now lost connectivity to the module. 8. Access the module using its Management VLAN. ***NOTE:*** Details of this step vary with network design. In many networks, this step requires connecting to an appropriately tagged port of the VLAN switch in your Network Operations Center. Often during spectrum analysis, it is advisable to first configure all six APs at a site to be SMs, perform spectrum analysis one sector at a time without using a Management VLAN, then reconfigure them all as APs, and return to using a Management VLAN for access.
5570	After setting the **Region Code**, must reboot to see related options	After you set the **Region Code** parameter, you must **Save Changes** and **Reboot** before the interface shows related options. This differs from most parameter change operations, where **Save Changes** alone causes the interface to show context-appropriate options. For example, after you set **Region Code** to **Canada** then click **Save Changes,** you must **Reboot** to see **Alternate Frequency Carriers** are configurable, and to have “weather notch” frequencies not displayed.
4767	**Bootp Client** filter blocks DHCP of the SM IP address	If the **DHCP state** parameter is set to **Enabled** in the Configuration => IP tab of the SM, *do not* check the **Bootp Client** option for **Packet Filter Types** in its Protocol Filtering tab, because doing so would block the DHCP request. (Filters apply to all packets that leave the SM via its RF interface, including those that the SM itself generates.) If you want to keep DHCP enabled and avoid the blocking scenario, select the **Bootp Server** option instead. This will result in responses being appropriately filtered and discarded.
3463	VLANs below a NAT-enabled SM are not supported	When NAT is enabled in the SM, VLANs are not supported on the wired side of that SM. This does not preclude using NAT on SMs in a sector that has VLAN enabled, but may constrain some VLAN network designs.

ID	Description	Discussion and Recommendations
4831	Details on pinging Canopy modules	A ping size larger than 1494 Bytes to a Canopy module times out and fails. However, a ping of this size or larger to a system that is behind a Canopy module typically succeeds. It is generally advisable to ping such a system, since Canopy handles that ping with the same priority as is given all other transport traffic. The results are unaffected by ping size and by the load on the Canopy module that brokers this traffic.
5298	AP may be listed twice in AP Evaluation tab	To help during aiming, the Tools => AP Evaluation tab maintains AP entries for 15 minutes. If the frequency of an AP is changed, for 15 minutes the AP is listed twice in the AP Evaluation tab, once with the former frequency, and once with the new.
4789	Lowest settable **Transmitter Output Power** varies	The low end of the **Transmitter Output Power** can vary from radio to radio due to manufacturing tolerances. If you set this parameter to lower than the range capable on a radio, the value is automatically reset to the lowest capable. ***NOTE:*** The high end of the range of settable **Transmitter Output Power** does not vary from radio to radio.
4844, 2756	When using **Link Test with MIR**, need to set both ends	To see the effects of MIR capping, you can run a link test with MIR enabled. To get meaningful results, set **Link Test with MIR** to **Enabled** on the Tools => Link Capacity Test tab *in both* the SM and the AP. When it is enabled on only one end, results are misleading. After you run perform a link test with MIR capping enabled, consider immediately changing **Link Test with MIR** to **Disabled** *in both* the SM and the AP, to avoid mistakenly capping only one end of the link test.
5284	Click Spectrum Analyzer **Enable** button twice	After you click the **Enable** button in the Tools => Spectrum Analyzer tab, the resulting display may omit bars for some frequencies, especially in frequency bands that have a large number of center channels, such as the 5.4-GHz band. If you clicking **Enable** again, the display includes the entire spectrum bar graph. ***TIP:*** In the Configuration => General tab, set the **Webpage Auto Update** parameter to a few seconds, to have the Spectrum Analyzer automatically fully displayed and refreshed. You can later reset the **Webpage Auto Update** time back to `0`, to disable refresh.
4706	Blank screen after logging in to SM through AP Session Status tab	In some instances, depending on network activity and network design, the interface presents a blank screen to a user who logs in to an SM through the Home => Session Status tab in the AP. If you observe this, refresh your browser window.
5407	5590 through 5660 may interfere with weather radar, not allowed in Europe, Canada, and Australia	Canopy center channel frequencies of 5590 MHz through 5660 MHz may interfere with, or be interfered by, weather radar in several Regions, including Europe, the US, Canada, and Australia. In Europe, Canada, and Australia, to be in regulatory compliance, operators *must not* transmit on these frequencies. Setting the **Region Code** to **Europe**, **Canada** or **Australia** notches out these frequencies and ensures compliance. Operators who perform a site survey in the United States should use the built-in Spectrum Analyzer or a stand-alone spectrum analyzer to check for activity on these channels and select other channels as appropriate.
7557	When connecting to a hub, use only half duplex Ethernet settings	Ethernet connections set to **10 Base T Full Duplex** or **100 Base T Full Duplex** will not connect to an SM through a hub, due to the way a hub works. Use half duplex settings when using a hub.

For reference, Table 12 shows Release 9.0 operation based on Region Code, by frequency band and module type.

Table 12: Release 9.0 operation based on Region Code and frequency band

Region Code[1]	900 MHz	2.4 GHz	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	AP/SM	AP/SM/ BH	AP/SM/ BH	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS
United States	No effect	No effect	NA	> P10: FCC/IC DFS < P9: no DFS	No effect	FCC/IC DFS	No effect	No effect	No effect
Canada	No effect	No effect	NA	> P10: FCC/IC DFS < P9: no DFS	No effect	FCC/IC DFS 5590 through 5660 MHz not available[2,3]	No effect	No effect	No effect
Europe	NA	No effect	NA	NA	NA	ETSI 1.3.1 DFS Newer radios: 5590 through 5660 MHz not available[2,3,4]	ETSI 1.3.1 DFS Newer radios: 5590 through 5660 MHz not available[2,3,4]	ETSI 1.3.1 DFS	ETSI 1.3.1 DFS
Brazil	NA	NA	NA	NA	NA	ETSI 1.3.1 DFS	No effect	No effect	No effect
Australia	No effect	No effect	NA	NA	NA	FCC/IC DFS 5590 through 5660 MHz not available[2,3]	No effect	No effect	No effect
Russia	NA	NA	Display Community options	No effect	No effect	NA	NA	No effect	No effect
Other	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

1. In all cases, set the **Region Code** to the region you are in, and the software will determine the correct use of DFS.
2. Weather radar operates on frequencies from 5600 through 5650 MHz. In some countries a “weather notch” is required to avoid impinging on these frequencies.
3. Changed from Release 8.2.7, which had 5580 through 5670 MHz not available. After additional analysis and testing, more frequencies are available while still meeting “weather notch” requirements.
4. Radios placed on market in Europe after July 1, 2008, can’t impinge on weather radar frequencies. To meet this requirement, the software checks the date code of the module and implements the weather notch accordingly. You can tell if a 5.4 GHz module is “newer” or “older” by setting the Region Code to Europe – if the notch frequencies *are not* shown on the Configuration => Radio page, then the module is “newer”, if the notch frequencies *are* shown, the module is “older”.

6 Canopy Management Information Base (MIB)

The Canopy Enterprise MIB, consisting of 5 MIB definition files, has been updated to support SNMP access to the new and changed features in Release 9.0. The MIB files are included in the downloaded Canopy Software Installation Package. Detailed information on the Canopy MIB files, Object Identifiers (OIDs), variable names, and object types is available at http://motorola.canopywireless.com/support/online_tools.

MIB files are used by Network Management Systems and Element Management Systems, such as the Motorola Prizm system, to support a host of surveillance, monitoring, control, and operational tasks. More information on the Motorola Prizm element management system is available at http://motorola.canopywireless.com/products/prizm.

If you are using Prizm: Prizm software includes the MIB information. You do not need to load MIB files.

If you are using an SNMP network management system (NMS) or element management system (EMS) other than Prizm: Load the MIBs per the instructions for your NMS or EMS.

Important! When loading the Canopy MIB files

1. First load the three standard MIB files.
2. Then load the Canopy MIB files.

Some NMSs are not sensitive to order, but some require a specific loading order to build a MIB tree. Loading in the recommended order avoids any problems arising from loading sequence.

7 Upgrading to Release 9.0

7.1 BEFORE YOU BEGIN

7.1.1 Applicability

Within

- PMP 100 Series (Canopy FSK Classic)
- PMP 200 Series (Canopy FSK Advantage APs and SMs)
- PTP 100 Series (Canopy FSK BHs, both BH20 (PTP 100) and BH10 (PTP 100 Lite))

Release 9.0 *is* applicable to

- All series of DES SMs
- Series P9 and P10 AES SMs
- Series P9 and P10 APs and BHs (DES and AES)

Release 9.0 is *not* applicable to

- Series P7 and P8 APs and BHs (Release 9.0 supports only hardware scheduling, and these modules do not run hardware scheduling)
- Series P7 and P8 AES modules of any type

Release 9.0 is also *not* applicable to

- PMP 400 Series modules (Canopy 5.4 GHz OFDM APs and SMs)
- PTP 200 Series Bridges (Canopy 5.4 GHz OFDM BHs)
- PTP 300 Series Bridges
- PTP 400 Series Bridges (formerly 30-/60-Mbps backhaul modules)
- PTP 500 Series Bridges
- PTP 600 Series Bridges (formerly 150-/300-Mbps backhaul modules)
- CMMs (Cluster Management Modules)
- Powerline MU Gateway and Modem

7.1.2 Supported Upgrade Path for Operating Sectors

The tested, supported upgrade path for operating sectors is from Release 8.2.4 or 8.2.7, as shown in Figure 23. Directly upgrading a sector to Release 9.0 from Release 8.1.x or earlier risks issues due to changes in features and changes in message structures and protocols between AP and SM. Following the tested upgrade path is strongly recommended for operating sectors.

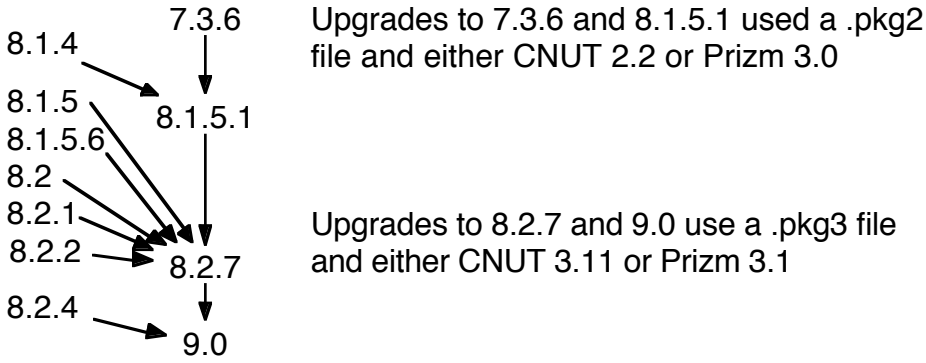


Figure 23: Supported upgrades

7.1.3 Upgrade Tool Options

Either

- Prizm 3.1 with Patch 5, or
- CNUT 3.11

should be used to upgrade modules to Release 9.0.

Motorola offers Prizm as an EMS that provides monitoring and management functions, including module upgrade. Prizm 3.1 with Patch 2 supports upgrading modules to Release 9.0 and includes device templates for the new features in Release 9.0.

Prizm Release 3.1 or later *does not* include the Hardware Scheduler Update tool, so sectors that run software scheduling must first be switched to hardware scheduling using CNUT, before using Prizm Release 3.1 or later to manage upgrades. For details on switching to hardware scheduling, see previous release notes, especially the release notes for Canopy Release 7.3.6.

Operators running Prizm releases earlier than Release 3.1 should upgrade to the current Prizm release, then use Prizm to upgrade their Canopy modules to Release 9.0. For details on installing Prizm on Windows or Linux, see http://motorola.canopywireless.com/products/prizm.

CNUT (Canopy Network Updater Tool) is a free tool for upgrading Canopy modules.
For information and details on installing CNUT on a PC or Linux machine, download the CNUT software and help file from http://motorola.canopywireless.com/support/software. If you need to upgrade from a previous CNUT release, be sure to back up your network file before upgrading CNUT. CNUT 3.11 should be used for upgrading modules to Release 9.0, as it includes important fixes and improvements to support network operation.

Upgrades using CNUT Release 3.11 and Prizm Release 3.1 use files whose name extensions are `.pkg3`. Earlier packages (`.pkg` or `.pkg2` files) *cannot* be used with either of these versions of CNUT or Prizm. A key aspect of `.pkg3` packages and the tools that use them is that they support the use of accounts other than `root` for the modules they are upgrading. In Canopy Release 8.2.7 and later, upgrading modules no longer require `root` accounts.

7.1.4 Using the Latest Upgrade Package

To download the Canopy software, perform the following steps:

1. Go to http://www.motowi4solutions.com/software/.
2. On that page, follow the directions to access the software download pages.
3. On the software download pages, select Canopy System Software v9.0 (DES) or Canopy System Software v9.0 (AES) as appropriate and click **Accept User Agreement and Request Download Links**.
   RESULT: You will receive an email with a link to the software.
4. In the email sent to you, click on the link.
   RESULT: The zip files downloaded will contain the `.pkg3` package, as well as the latest release notes and MIB files.

7.1.5 Special Planning for European Operators using 5.4 GHz Radios

Operators with modules set to a **Region Code** of **Europe** are well-served to ensure they are not using any channels with center frequencies of 5590 to 5660 MHz inclusive (in the weather notch) before upgrading to Release 9.0. A sector currently using 5590 to 5660 MHz inclusive will complete the upgrade successfully and existing SMs will register and function, but since these channels are not available on equipment placed on market in Europe from July 1, 2008, adding SMs, or replacing SMs or APs, becomes problematic.

Operators with modules set to a **Region Code** of **Europe** may need to perform channel planning and coordinated change of the transmitting channel on APs and BHMs *before* the upgrade.

7.2 PROCEDURES TO UPGRADE TO RELEASE 9.0

Use the following steps for upgrading to Release 9.0. For specifics using Prizm, see the Prizm user guide. For specifics using CNUT, see the CNUT help file or click on the Help menu in the CNUT application.

Either CNUT Release 3.11 or later, or Prizm Release 3.1 with Patch 5 or later, should be used for the upgrade.

7.2.1 Preparing CNUT or Prizm for the Upgrade

1. Plan your upgrade. Many operators perform an upgrade on a lab system or a familiar AP sector to gain experience with the upgrade procedures and also gain experience with the new features, then proceed with a full network upgrade. Schedule the upgrade during a *maintenance window*.
2. Download the following from the Canopy web site at http://motorola.canopywireless.com/support/software/:
   - Canopy System Software for Release 9.0
   - If using CNUT, download Canopy Network Updater Tool (CNUT) Release 3.11 or later for Windows or Linux and the corresponding CNUT release notes.
   - If using Prizm, download Patch 5 for Prism 3.1.

3. If using CNUT, install CNUT Release 3.11 on Windows or Linux using the appropriate CNUT release notes.
4. If using Prizm, install Patch 5 using the patch notes README file.
5. If you do not have a previously stored network archive file within CNUT or Prizm, add your Canopy infrastructure elements (APs, BHs, and CMMs) to the network root and Move and Modify the elements until you have captured your network.

IMPORTANT! Pay particular attention to the connectivity that you establish in the network tree. This should be the connectivity as viewed at the point from where you connect to the network to perform the upgrade. If you are connecting at your POP, this will be the same as your network hierarchy. If you are connecting at some point other than your POP, it should reflect connectivity from that point. When CNUT or Prizm discovers the network and when it steps through the infrastructure elements during an upgrade, it relies on the connectivity information you enter in the network tree.

7.2.2 Performing the Upgrade Via CNUT or Prizm

1. Enter the password(s) for the `root` login accounts of all modules you are upgrading into CNUT or Prizm. If taking advantage of the ability to use accounts other than `root`, enter the accounts and passwords.
2. Refresh/Discover Entire Network to auto-detect all of your SMs and to display information about your network elements.
3. Add `CANOPY90_DES.pkg3` (or `CANOPY90_AES.pkg3` for AES modules) to the managed packages.
4. Consider rebooting APs on sectors you plan to update to eliminate any memory fragmentation issues and ensure there is space to hold the new image.
5. Just before doing any updates, use Refresh/Discover to confirm that all SMs are active.
6. Choose the elements that you want to update at this time: a selection of elements, a network branch, or the entire network. Most operators gain experience by upgrading a portion of their network at a time, depending on network size and their own procedures.
7. Use Prizm or CNUT to confirm use of SM Auto-update, as appropriate. With SM Auto-update, the SMs are updated by their AP instead of by CNUT, which significantly reduces the time needed for updating an entire network. In addition, SM Auto-update must be used to update any SMs that have their **Network Accessibility** parameter set to **Local**, as these SMs are not addressable by CNUT or Prizm over the network.
8. Initiate the Update operation.
9. Monitor the update progress through the Network Tree.
10. Allow the update to run, leaving CNUT/Prizm active, until all involved SMs are upgraded.
    NOTE: An AP enabled for Auto-update
    a. updates all registered or registering P7/8/9 SMs that require an upgrade.
    b. waits for 20 minutes of no activity.
    c. updates all registered or registering P10 SMs that require an upgrade.
    d. waits for 20 minutes of inactivity.
    e. continues this alternating cycle until Auto-update is disabled (using CNUT or Prizm) or until the AP is rebooted.

    With this algorithm, any SMs that are not properly upgraded are found by CNUT or Prizm on a subsequent cycle and then successfully upgraded, without operator action. There may be quiet times during a sector upgrade followed by active updating of SMs.

With CNUT 3.11 or Prizm 3.1 with Patch 5, the operator can choose whether to upgrade P7/8/9 SMs first, or upgrade P10 SMs first. Sectors with a majority of P10 SMs may update more quickly by choosing to upgrade P10 SMs first.

When upgrading a P9 radio from Release 8.2.4 or 8.2.7 to Release 9.0 a message such as "Selecting FPGA: SCH_DES_080218_S40A.rbf index: 0" may be reported in the Event Log. Ignore the message – it is an artifact of image restructuring between 8.2.x and 9.x for P9 boards only, and does not indicate an error.

11. After the upgrade appears to have completed, Refresh/Discover.
12. Verify that the Software Version for each module is shown as `CANOPY 9.0`.
13. If any SM completed the software loading and then failed to reboot, or did reboot but CNUT or Prizm displayed a message such as Reboot failed or Failed to find Element in update. Cannot open new telnet connection to device, and if the rest of the sector successfully upgraded and became stable on Release 9.0, perform the following steps:
    a. Refresh/Discover.
    b. Check whether the resulting elements list shows the SM as operating on the new release.
    c. If it does not, reboot the problem SM.
    d. Check whether the SM is shown as operating on Release 9.0.
    e. If it is not, re-initiate the upgrade of the SM using CNUT or Prizm.
14. Disable SM Auto-update on CNUT or Prizm, according to CNUT help file or Prizm documentation.

7.2.3 Setting the Region Code

After a sector or link or standalone module has been upgraded to Release 9.0, confirm that the **Region Code** on each module is set to the local region. If needed, set the **Region Code** and associated parameters correctly on each module, **Save Changes**, and **Reboot**.

On new APs or BHMs, or APs or BHMs that have been reset to factory defaults, the Region Code must be set before the module will transmit.

8 Collocation

8.1 COLLOCATING 5.2-GHz AND 5.4-GHz MODULES

5.4-GHz radios that are set to a center channel frequency of 5595 MHz or lower produce a signal that is 280 MHz below their center channel. This signal can interfere with 5.2-GHz radios in the proximity, as shown In Table 13. Because of this, care needs to be taken in choosing 5.4-GHz channels where collocated 5.2-GHz systems exist.

In most cases, choosing from the 5.4-GHz channels of 5540 MHz and below, or 5600 MHz and above, is the best option to avoid interference. Alternatively, provide 100 ft (30 m) of vertical separation between the 5.2-GHz and the 5.4-GHz radios, or in cases of partial clusters of 5.2-GHz radios, select 5.4-GHz channels that will not interfere.

Table 13: 5.4- and 5.2-GHz interfering frequencies

This 5.4-GHz center channel (in MHz)…	may interfere with these 5.2-GHz channels (in MHz)
5545	5275
5550	5275, 5280
5555	5275, 5280, 5285
5560	5275, 5280, 5285, 5290
5565	5275, 5280, 5285, 5290, 5295
5570	5280, 5285, 5290, 5295, 5300
5575	5285, 5290, 5295, 5300, 5305
5580	5290, 5295, 5300, 5305, 5310
5585	5295, 5300, 5305, 5310, 5315
5590	5300, 5305, 5310, 5315, 5320
5595	5305, 5310, 5315, 5320, 5325

Background

What causes this collocation issue? As part of their radio operation, Canopy radios produce a low level signal outside of their frequency band. By design, this signal is above the band for some center channel frequencies and below the band for other center channel frequencies. This signal is present at all times (both during transmit and receive), and is well within regulatory requirements for out-of-band emissions. However, it is strong enough to interfere with a closely collocated Canopy radio in another band, if that radio is using a channel impinged upon by the out of band signal, as can happen between 5.4- and 5.2-GHz radios.

If a CMM provides sync and ensures compatible receive start times (as advised in Collocating Same-Frequency Band Modules *on Page 46**), aren't collocation issues avoided?* No. Using sync and ensuring compatible receive start times are necessary to avoid *other* collocation issues, but do not help *this* collocation issue, because the interfering signal is present at all times, during transmit and receive.

8.2 COLLOCATING 5.4-GHz AND 5.7-GHz MODULES

For collocation design, the 5.4-GHz and 5.7-GHz frequency bands are essentially one continuous band. When collocating 5.4-GHz and 5.7-GHz modules, use the guidelines for collocating modules within a band listed under Collocating Same-Frequency Band Modules on Page 46.

Alternatively, either

- provide 100 ft (30 m) of vertical separation between the 5.4-GHz and 5.7-GHz radios.
- if 100 ft (30 m) of vertical separation is not possible, provide as much vertical separation as possible, and choose frequencies far apart within the combined 5.4-GHz and 5.7-GHz bands. The physical and spectral separation and local RF conditions, influenced by tower geometries, layout and position of modules, and use of reflectors on BHs, among other variables, may support good performance, but testing and monitoring will be required to confirm that they do.

For example, when collocating a cluster of six 5.4-GHz APs with a cluster of six 5.7-GHz APs, all hardware scheduled, set them all to the same range, downlink data %, and control slots, and use standard frequency re-use around each cluster (ABCABC).

For another example, when collocating a cluster of six 5.4-GHz APs with a 5.7-GHz BH that is retrofitted with a reflector, provide 100 vertical feet of separation. If this is not possible

1. choose channels for the AP that are at the bottom of the 5.4-GHz band.
2. choose a channel for the BH that is at the top of the 5.7-GHz band.
3. locate the modules so the reflector on the BH shields the APs from the BH module.
4. ensure the over-illumination around the edges of the reflector is not directed at the APs.
5. confirm with simultaneous link tests.

Background

Why are 5.4-GHz and 5.7-GHz bands considered one band for Canopy collocation, whereas other bands (say 5.2-GHz and 5.7-GHz) are considered separate? 5.4-GHz and 5.7-GHz radios use the same radio front end, whereas 5.2-GHz and 5.7-GHz Canopy modules have different radio front ends. For collocation design, the 5.4-GHz and 5.7-GHz bands are essentially one continuous band, albeit one with possibilities for large spectral separation of channels.

8.3 COLLOCATING SAME-FREQUENCY BAND MODULES

Canopy can avoid self-interference if collocated modules in the same frequency band are of the same type, start each frame transmission at the same time, and start each frame reception at the same time. If you collocate radios of the same frequency band, do the following also:

- Within the same band, collocate only one type of module (only APs, only BHMs, or only BHSs).
- Use a CMM, so that transmit start times are in sync.
- Use identical scheduler type (hardware or software)
- Either
  - Set identical range, downlink data %, and slot settings
  - Use the Frame Calculator (see Using the Frame Calculator below) to ensure compatible receive start times.

This ensures that at any one instant the collocated modules are either all receiving or all transmitting. This avoids, for example, the issue of one AP attempting to receive a signal from a distant SM, while a nearby AP is transmitting and overpowering the signal from the distant SM.

8.3.1 Using the Frame Calculator

Parameters that affect receive start times include range, slots, downlink data percentage, and high priority uplink percentage (with software scheduling only). A frame calculator is included in every module as a helper application to help calculate compatible settings. The frame calculator does not itself configure or change any settings on the module.

The frame calculator in a module can be used to perform all frame calculations. The operator enters settings into the calculator, and the calculator outputs details on the frame including an **Uplink Rcv SQ Start** value. This calculation should be done for each AP that has different settings. Then the operator varies the **Downlink Data** % in each calculation until the calculated values of **Uplink Rcv SQ Start** for all collocated APs are within 150 time bits.

For more details on using the frame calculator, refer to the Canopy Release 8 User Guide, available at http://motorola.canopywireless.com/support/library/ under User Guides.

8.3.2 Establishing Vertical Separation

If you do not use the Frame Calculator

- provide 100 ft (30 m) of vertical separation between same-band modules.
- if 100 ft (30 m) of vertical separation is not possible, alternatively provide as much vertical separation as possible, and choose frequencies far apart within the band. The physical and spectral separation and local RF conditions (influenced by tower geometries, layout and position of modules, and use of reflectors on BHs, among other variables) may support good performance, but testing and monitoring will be required to confirm that they do.

A system that is under no load with SMs registered and is able to communicate indicates basic connectivity, but does not indicate that the system will function well under heavy load. The more conservatively you design collocation, the less you will see interference issues, which may be hidden under light loads, but cause problems when the system becomes heavily loaded.

9 Regulatory and Legal Notices

9.1 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.

9.2 NATIONAL AND REGIONAL REGULATORY NOTICES

9.2.1 U.S. Federal Communication Commission (FCC) Notification

This device complies with Part 15 of the US FCC Rules and Regulations. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

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

FCC IDs and the specific configurations covered are listed in Table 14.

Table 14: US FCC IDs and Industry Canada Certification Numbers and covered configurations

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna or Reflector	Maximum Transmitter Output Power
ABZ89FC5809	109W-9000	8 MHz channels, centered on 906-924 MHz in 1 MHz increments (within the 902-928 MHz ISM band)	900 SM, AP	12 dBi Canopy integrated antenna	24 dBm (250 mW)
				10 dBi Maxrad Model # Z1681, flat panel	26 dBm (400 mW)
				10 dBi Mars Model # MA-IS91-T2, flat panel	26 dBm (400 mW)
				10 dBi MTI Model #MT-2630003/N, flat panel	26 dBm (400 mW)

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna or Reflector	Maximum Transmitter Output Power
ABZ89FC5808	109W-2400	20 MHz channels, centered on 2415-2457.5 MHz in 2.5 MHz increments (within the 2400-2483.5 MHz ISM band)	2400 BH, SM, AP	8 dBi internal	28 dBm (630 mW)
			2400 BH, SM	8 dBi internal + 11 dB reflector	25 dBm (340 mW)
ABZ89FC3789	109W-5200	20 MHz channels, centered on 5275-5325 MHz in 5 MHz increments (within the 5250-5350 MHz U-NII band)	5200 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
			5200 BH SM, AP, only P10 Modules	7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5807	109W-5210	20 MHz channels, centered on 5275-5325 MHz in 5 MHz increments (within the 5250-5350 MHz U-NII band)	5210 BH	7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
ABZ89FT7623	---	20 MHz channels, centered on 5495-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band)	5400 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
---	109W-5400	20 MHz channels, centered on 5495-5575 and 5675-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5400 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5804	109W-5700	20 MHz channels, centered on 5735-5840 MHz in 5 MHz increments (within the 5725-5850 MHz ISM band)	5700 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
			5700 BH, SM	7 dBi internal + 18 dB reflector	23 dBm (200 mW)
				7 dBi internal + 10 dB lens	23 dBm (200 mW)
			5700 AP	7 dBi internal + 10 dB lens	23 dBm (200 mW)

9.2.2 Industry Canada (IC) Notification

This device complies 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.

Users should be cautioned to take note that in Canada 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 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.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so its Equivalent Isotropic Radiated Power (EIRP) is not more than that permitted for successful communication.

Industry Canada Certification Numbers and the specific configurations covered are listed in Table 14.

This device has been designed to operate with the antennas listed in Table 14 and having a maximum gain as shown in Table 14. Antennas not included or having a gain greater than as shown in Table 14 are strictly prohibited from use with this device. Required antenna impedance is 50 ohms.

9.2.3 Regulatory Requirements for CEPT Member States (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: Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: 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 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.

This 2.4 GHz equipment is “CE” marked 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://motorola.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 www.ero.dk for further information.

Motorola Canopy Radio equipment operating in the 5470 to 5725 MHz band are categorized as “Class 1” devices within the EU in accordance with ECC DEC(04)08 and are “CE” marked 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://motorola.canopywireless.com/doc.php.

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

9.2.4 European Union Notification for 5.7 GHz Product

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 0977to 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.

9.2.5 Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment

Please do not dispose of Electronic and Electric Equipment or Electronic and Electric Accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment. In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

9.2.6 EU Declaration of Conformity for RoHS Compliance

Motorola hereby, declares that these Motorola products are in compliance with the essential requirements and other relevant provisions of Directive 2002/95/EC, Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment.

The relevant Declaration of Conformity can be found at http://www.canopywireless.com/doc.php.

9.2.7 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 licensing 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.

9.2.8 Belgium Notification

Belgium national restrictions in the 2.4 GHz band include

- EIRP must be lower then 100 mW
- For crossing the public domain over a distance >300m the user must have the authorization of the BIPT.
- No duplex working

9.2.9 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.

9.2.10 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.

9.2.11 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 neighboring 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).

9.2.12 Brazil Notification

Local regulations do not allow the use of 900 MHz, 2.4 GHz, or 5.2 GHz Canopy modules in Brazil.

For compliant operation of an AP in the 5.7 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 36 dBm (4 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 11 dBm.

When using the LENS (10 dB at 5.7 GHz), transmitter output power must be configured no higher than 19 dBm.

For compliant operation in the 5.4 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 30 dBm (1 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 5 dBm. When using the LENS (9 dB at 5.4 GHz), transmitter output power must be configured no higher than 14 dBm. When not using the passive reflector or the LENS, 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 by setting the Region Code to “Brazil”, including after the module is reset to factory defaults.

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

9.2.13 Australia Notification

900 MHz modules must be set to transmit and receive only on center channels of 920, 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.

9.2.14 Labeling and Disclosure Table for China

The People’s Republic of China requires that Motorola’s products comply with China Management Methods (CMM) environmental regulations. (China Management Methods refers to the regulation *Management Methods for Controlling Pollution by Electronic Information Products*.) Two items are used to demonstrate compliance; the label and the disclosure table.

The label is placed in a customer visible position on the product.

- Logo 1 means that the product contains no substances in excess of the maximum concentration value for materials identified in the China Management Methods regulation.
- Logo 2 means that the product may contain substances in excess of the maximum concentration value for materials identified in the China Management Methods regulation, and has an Environmental Friendly Use Period (EFUP) in years, fifty years in the example shown.

Logo 1  Logo 2 

The Environmental Friendly Use Period (EFUP) is the period (in years) during which the Toxic and Hazardous Substances (T&HS) contained in the Electronic Information Product (EIP) will not leak or mutate causing environmental pollution or bodily injury from the use of the EIP. The EFUP indicated by the Logo 2 label applies to a product and all its parts. Certain field-replaceable parts, such as battery modules, can have a different EFUP and are marked separately.

The Disclosure table is intended to communicate compliance with only China requirements; it is not intended to communicate compliance with EU RoHS or any other environmental requirements.

Table 15: Disclosure table

部件名称	有毒有害物质或元素					
	铅 (**Pb**)	汞 (**Hg**)	镉 (**Cd**)	六价铬 (**Cr^{6+}**)	多溴联苯 (**PBB**)	多溴二苯醚 (**PBDE**)

金属部件	×	○	×	×	○	○
电路模块	×	○	×	×	○	○
电缆及电缆组件	×	○	×	×	○	○
塑料和聚合物部件	○	○	○	○	○	×

○： 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。

×： 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。

9.3 RF EXPOSURE SEPARATION DISTANCES

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 16.

Table 16: Exposure separation distances

Module Type	Separation Distance from Persons
Canopy Module	At least 20 cm (approx 8 in)
Canopy Module with Reflector Dish	At least 1.5 m (approx 60 in or 5 ft)
Canopy Module with LENS	At least 0.5 m (approx 20 in)
Antenna of connectorized or integrated 900 MHz module	At least 60 sm (24 in)
Indoor 900 MHz SM	At least 10 cm (4 in)

The following section and its Table 17 provide details and discussion of the associated calculations.

9.3.1 Details of Exposure Separation Distances Calculations 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 $$d = \sqrt{\frac{P \cdot G}{4 \pi S}}$$

Table 17 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 17: Calculated exposure distances and power compliance margins

Band	Antenna	Variable			*d* (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	*G*	S			
900 MHz	external	0.4 W (26 dBm)	10.0 (10 dB)	6 W/m^2	23 cm	60 cm (24 in)	7
	integrated	0.25 W (24 dBm)	15.8 (12 dB)	6 W/m^2	23 cm	60 cm (24 in)	7
	indoor, integrated	Simulation model used to estimate Specific Absorption Rate (SAR) levels				10 cm (4 in)	2
2.4 GHz	integrated	0.34 W (25 dBm)	6.3 (8 dB)	10 W/m^2	13 cm	20 cm (8 in)	2.3
	integrated plus reflector	0.34 W (25 dBm)	79.4 (19 dB)	10 W/m^2	46 cm	1.5 m (5 ft)	10
5.2 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	9 cm	1.5 m (5 ft)	279
	integrated plus LENS	0.025 W (14 dBm)	40 (16 dB)	10 W/m^2	9 cm	50 cm (12 in)	31
5.4 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	9 cm	1.5 m (5 ft)	279

Band	Antenna	Variable			*d* (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	*G*	S			
	integrated plus LENS	0.020 W (13 dBm)	50 (17 dB)	10 W/m^2	9 cm	50 cm (12 in)	31
5.7 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.2 W (23 dBm)	316 (25 dB)	10 W/m^2	71 cm	1.5 m (5 ft)	4.5
	Integrated plus LENS	0.2 W (23 dBm)	50 (17 dB)	1 W/m^2	28 cm	50 cm (12 in)	3.13

The Recommended Separation Distance is chosen to give significant compliance margin in all cases. It is also chosen so that a given item (bare module, reflector, or LENS) always has the same distance, regardless of frequency band, to simplify following exposure distances in the field.

These are conservative distances:

- They are along the beam direction (the direction of greatest energy). Exposure to the sides and back of the module is significantly less.
- They meet sustained exposure limits for the general population (not just short-term occupational exposure limits), with considerable margin.
- In the reflector cases, the calculated compliance distance *d* is greatly overestimated because the far-field equation models the reflector as a point source and neglects the physical dimension of the reflector.

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