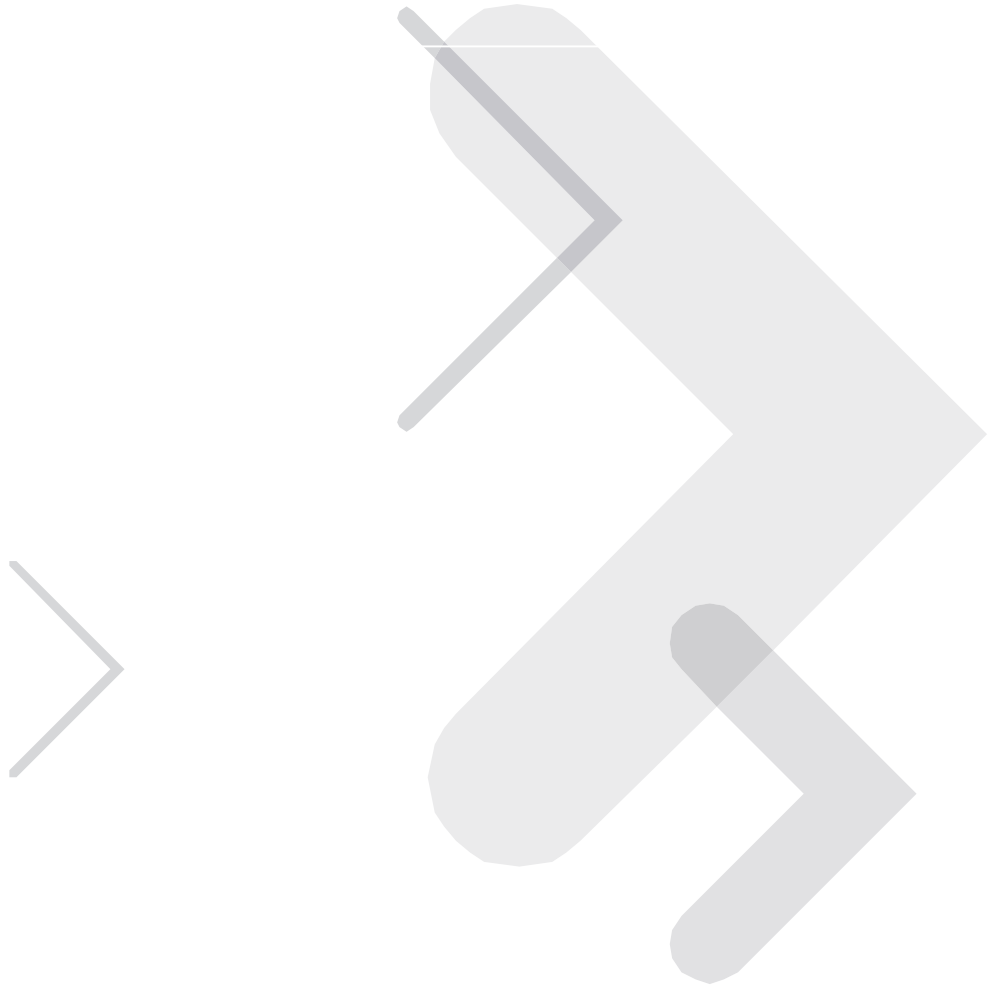
Canopy® Software Release 9.4.2 Release Notes

Issue 1

May 2009



Notices

See important regulatory and legal notices in Section 10 on Page 34.

Trademarks, Product Names, and Service Names

http://www.motorola.com/canopy

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1 Introduction

These notes cover Canopy Release 9.4.2. This release is a general release applicable to

- PMP 100 and PTP 100 (FSK)
- PMP 54400 and PTP 54200 (5.4-GHz OFDM)
- PMP 49400 and PTP 49200 (4.9-GHz OFDM)

Release 9.4.2 is *not* applicable to PMP 35500 (3.5-GHz OFDM)

For details on applicability, see section 7.1.1 and Table 9: Radios Upgradeable to Release 9.4.2 on page 22.

1.1 NOTES AND HIGHLIGHTS

Highlights of Canopy Release 9.4.2 include

- One uniform release for PMP 100 and PTP 100 (FSK), PMP 54400 and PTP 54200 (5.4-GHz OFDM), and PMP 49400 and PTP 49200 (4.9-GHz OFDM). This release brings all these products up to the same level of features and resolved issues.
- PMP 54400 and PTP 54200 (5.4-GHz OFDM) now offer the Release 9 feature set.
- PTP 49200 bridges (4.9-GHz OFDM BHs) are now supported.

Release 9.4.1 was a manufacturing-only release, never released for download. If you receive new radios with Release 9.4.1, upgrade them to Release 9.4.2.

For detailed information, see

- Table 2: Release 9.4.2 enhancements on Page 10
- Table 4: Issues resolved in Release on Page 12
- Table 5: Known open issues on Page 14

Either CNUT 3.12 or Prizm 3.1 with Patch 7 is recommended for upgrading modules to Release 9.4.2. For details, see Upgrade Tool Options on Page 23.

1.2 ABBREVIATIONS

The following abbreviations may be 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/P11	Shorthand for hardware series levels
ETSI	European Telecommunications Standards Institute
PMP	Point to Multi-Point
PTP	Point to Point

1.3 NAMES

Table 1 maps product names to previous names, older names, and example model numbers.

Table 1: Product Names

Product Name	Previous Name	Older Name	Model Number (example)
PMP 100 Series	PMP 100 and PMP 200 Series	Canopy FSK point-to-multipoint	—
CAP 120	CAP 100	Classic AP	5700AP
CAP 130	CAP 200	Advantage AP	5750AP
CSM 110	—	Lite SM	5760SM
CSM 120	CSM 100	SM	5700SM
CSM 130	CSM 200	Advantage SM	5750SM
PTP 100 Series	—	Canopy FSK BHs	—
PTP 110	—	4 Mbps BH, 2 Mbps BH	—
PTP 120	PTP 100 Lite	BH10 (7 Mbps BH)	5700BH
PTP 130	PTP 100 Full	BH20 (14 Mbps BH)	5700BH20
PMP 54400 Series	—	Canopy 5.4-GHz OFDM PMP	—
CAP 54400	—	5.4-GHz OFDM AP	5440AP
CSM 54400	—	5.4-GHz OFDM SM	5440SM
PTP 54200 Series	—	Canopy 5.4-GHz OFDM BH	5440BH
PMP 49400 Series	—	Canopy 4.9-GHz OFDM PMP	—
CAP 49400	—	4.9-GHz OFDM AP	4940AP
CSM 49400	—	4.9-GHz OFDM SM	4940SM

Product Name	Previous Name	Older Name	Model Number (example)
PTP 49200 Series	—	Canopy 4.9-GHz OFDM BH	4940BH
PMP 500 Series	—	Canopy 3.5-GHz OFDM PMP	—
CAP 35500	—	3.5-GHz OFDM AP	3540AP
CSM 35500	—	3.5-GHz OFDM SM	3540SM

1.4 IDENTIFYING HARDWARE SERIES (P7, P8, P9, P10, P11)

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.

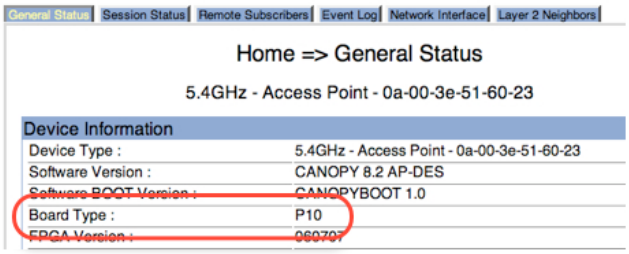

Figure 1: Board Type on modules running Release 8

- 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.

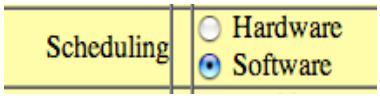

Figure 2: Scheduling option – if viewable, indicates this is a P9 board.

  - 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`, `10`, or `11`.

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.motowi4solutions.com/support/library/.
2. Consider checking the Community Forum and Knowledge Base at http://motorola.motowi4solutions.com/support/community.
3. Escalate the problem to your Canopy supplier or reseller.
4. 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 9.4.2.

2.1 RELEASE 9.4.2 ENHANCEMENTS

Release 9.4.2 adds the enhancements listed in Table 2.

Table 2: Release 9.4.2 enhancements

Product Family	Enhancement	Summary
PMP 100 PTP 100	None	—
PTP 49200	Support for PTP 49200	With Release 9.4.2, 4.9-GHz OFDM radios are now offered as BHs, as well as APs and SMs.
PMP 49400	Change to existing feature: per-SM query replaces Link Status table	On sectors with large numbers of SMs, rapid refresh of the Link Status table on the AP's Tools => Link Status page could potentially cause performance issues on the sector. To avoid this, the table has been replaced with the ability to query each SM for all bidirectional link data, but not display a table.
PMP 54400 PTP 54200	Support for features and enhancements since previous release	5.4-GHz OFDM radios now support the general features and enhancements listed in ◦ Release 9.0 Release Notes ◦ Release 9.3 Release Notes ◦ Release 9.4 Release Notes Please refer to those release notes for details.

2.2 PERFORMANCE – PACKETS PER SECOND

Packet per Second (PPS) performance for Release 9.4.2 is the same as for recent releases. Benchmark values are shown in Table 3.

Table 3: Packet per Second (pps) performance

Product	Hardware series	
	P11 or P10	P9
PMP 5x100 and PMP 24100	6200	3500
PMP 5x100 and PMP 24100 with VLAN	5200	3200
PMP 09100 (900 MHz)	4600	3600
PTP 5x100 and PTP 24100	6200	3200[1]
PMP 54400	6800	—
PTP 54200	4800	—
PMP 49400	6300	—
PMP 49400 with VLAN	5300	—

Product	Hardware series	
	P11 or P10	P9
Note: No significant difference between DES and AES 1: Links with a P9 module on one end and a P10 or P11 module on the other perform between 3200 and 3500 pps		

Section 9, Performance Benchmarking Process, on page 31 describes the benchmarking process used to measure packets per second and discusses the meaning and limitations of the benchmark.

2.3 SUPPORT FOR P11 HARDWARE

5.2-GHz and 5.4-GHz P11 modules require, at a minimum, Release 9.4 and will initially ship with Release 9.4 or Release 9.4.1 installed. These modules should be upgraded to Release 9.4.2 before being deployed.

5.7-GHz P11 modules require, at a minimum, Release 9.3 and will initially ship with Release 9.3 installed.

P11 modules exhibit performance similar to P10, as shown in Table 3 on page 10.

2.3.1 Mixing Hardware Vintages

P11 APs and SMs can be mixed with other hardware vintages in a sector. P11 BHs can be mixed with P9 and P10 BHs on a link.

2.3.2 Mixing Software Releases

To smooth the transition to P11 hardware, mixing Releases 9.0 and 9.4.2, or Releases 9.0 and 9.3, in a sector is supported. For example, if you purchase an SM and it is P11 hardware running Release 9.3 from the factory, it can be run in a sector with an AP and other SMs running Release 9.0. Or, if you purchase an AP and it is P11 hardware running Release 9.4.2 from the factory, it can be run with a sector of SMs running Release 9.0.

Before deploying P11 hardware into a sector, existing APs and SMs in the sector should first be upgraded to at least Release 9.0.

3 Resolved Issues

Issues resolved in Release 9.4.2 are listed in Table 4.

Table 4: Issues resolved in Release 9.4.2

Product Family	Description	Explanation
All	PPPoE-configured SM stuck in "LCP (Link Control Protocol) Negotiating"	Before, on a link with some re-regs, the SM might get stuck in "LCP Negotiating" mode if a PPPoE session was started, but the LCP and IPCP stages never completed. Connect/disconnect buttons wouldn't have resolved the issue. Release 9.4 partially resolved this issue, and Release 9.4.2 fully resolves it. A new stage of PPPoE session status called Connecting was added. Now if there is a problem setting up the PADI/PADO part of the PPPoE session Connecting will be reported rather than LCP Negotiating.
All	TFTP server option available for upgrades (9958, 10352)	The TFTP server option for distributing files to SMs during upgrading now works. Using a TFTP server can significantly speed up upgrades because ◦ Each sector can have 20 SMs under upgrade at a time (network performance permitting) instead of the 4 SMs maximum when files are served from the AP. ◦ The TFTP server doesn't use a 20-minute inactivity timer between servicing different hardware series (P7/8/9, P10, and P11) as it can serve any hardware series SM on demand. To use a TFTP server for upgrading SMs ◦ The TFTP server must be located on the same machine as the CNUT or Prizm software. ◦ The SMs must be configured with Public Network Accessibility (not Local) and have assigned IP addresses. For additional information on using the TFTP server option see the CNUT Help user guide.
PMP 100	On P9 FSK APs, unable to change Config Source and VLAN Allow Frame types (10357)	On P9 FSK APs, Release 9.4 doesn't allow changing of the Config Source or VLAN Allow Frame types using the GUI. This is resolved in Release 9.4.2
PMP 100	P9 FSK 900-MHz radios may show erratic Received Power (10380)	A Release 9.4 improvement in P10 FSK 900-MHz radios' displayed Received Power caused an issue with displayed Received Power on P9 FSK 900-MHz radios in some cases. The underlying performance of the radio was not affected. Release 9.4.2 resolves this display issue for P9 900-MHz radios and retains the improvements in P10 900-MHz Received Power reporting accuracy.

Product Family	Description	Explanation
PMP 54400 PMP 49400	Downlink broadcast traffic can exhibit packet loss (9492)	This issue affected all systems (OFDM/PMP 400 and FSK/PMP 100). It is resolved for OFDM in Release 9.4.2, but can still affect FSK systems. For OFDM (PMP 400) systems, set the **Broadcast Repeat Count** to 0 or 1 on an AP handling broadcast video and to the default of 2 on other APs. For FSK (PMP 100) systems, to reduce the potential for packet loss, the **Broadcast Repeat Count** on the AP's Configuration => Radio page should not be set to 0. Use either 1 or 2 repeats.
PMP 54400 PTP 54200	Same default for both read/write and read-only community strings for 5.4-GHz OFDM radios (10264)	5.4-GHz OFDM modules running Release 8.4.3 used "canopy" as the default for both the read/write and read-only community strings. With Release 9.4.2, these radios now default to "canopy" for the read/write community string and "canopyro" for the read-only community string, the same as other radios.
PMP 54400 PTP 54200	Resolves general issues since Release 8.4.3 (the previous 5.4-GHz OFDM release)	For 5.4-GHz radios, Release 9.4.2 resolves general issues listed in ◦ Release 9.0 Release Notes ◦ Release 9.3 Release Notes ◦ Release 9.4 Release Notes Please refer to those release notes for details.
PMP 49400 PTP 49200	Resolves general issues since Release 9.3.1 (the previous 4.9-GHz OFDM release)	For 4.9-GHz radios, Release 9.4.2 resolves general issues listed in the following Release Notes: ◦ Release 9.4 Release Notes Please refer to those release notes for details.

4 Known Open Issues

Known open issues for Release 9.4.2 are listed in Table 5.

Table 5: Known open issues

Product Family	Description	Discussion and Recommendations
All	PPPoE In Session message not syncing to AP (10385)	Under some conditions, occasionally an SM establishes a PPPoE session successfully and correctly displays **PPPoE In Session** on the SM's Home => General Status page, but the AP does not show the SM in a PPPoE session on the AP's Home => Session Status page. **Workaround**: If in doubt about the status of a PPPoE session to an SM, check the SM's Home => General Status page.
All	Anomalous Event Log messages associated with NTP server (10402)	Starting with Release 9.4, some Event Log messages were added to aid debug of NTP server issues. If you have configured an NTP server IP Address on the AP's Configuration => Time page, you may get "zero delay no update necessary" messages in the Event Log. The message can mean either the NTP server did not respond (in which case the message wording should be different), or the NTP server did respond but there was no time difference from the previous NTP message and no display update was needed (in which case it is an extraneous error message that can be ignored). Currently there is no way to tell from the message which case is indicated. **Workaround**: Ignore the "zero delay no update necessary" message and continue to use previous methods for debugging NTP server issues.
All	ARP table shows 00-00-00-00-00-00 for the NAT WAN interface (9711)	The SM's Statistics => ARP page shows a physical address of 00-00-00-00-00-00 in the NAT WAN ARP Table in error. The correct physical address for the IP address is shown in the Public RF NAT Table further down on the page.
All	No SNMP support for Translation Table (10053)	OIDs do not exist for the data on the SM's Statistics => Translation Table page and therefore the data is not retrievable using SNMP. (For background, the Translation Table is associated with Translation Bridging and only displays data when Translation Bridging is enabled at the AP.)
All	No SNMP support for counters on Scheduler page (10595)	OIDs do not exist for the data on the Statistics => Scheduler page and therefore the data is not retrievable using SNMP. (The Scheduler page appears on every module type - AP, SM, and BH.)
All	Prizm 3.1 cannot change LED Panel Mode. (9764)	Prizm 3.1 cannot set the LED Panel Mode to Revised Mode. LEDs are in Legacy Mode by default. **Workaround**: Set LED Panel Mode using the GUI.
PMP 100	Downlink broadcast traffic on FSK radios can exhibit packet loss (9492)	**Broadcast Repeat Count** on the AP's Configuration => Radio page should not be set to 0. Use either 1 or 2 repeats. **Workaround:** When using applications such as broadcast video that make significant use of downlink broadcast packets, set the parameter to 1. Otherwise, in most cases, leave the parameter set to the default of 2. This issue has been resolved for OFDM radios, but can still affect FSK radios running Release 9.4.2.

Product Family	Description	Discussion and Recommendations
PMP 49400 PMP 54400	Ranging issues at maximum settings (9798)	**Workaround**: Due to occasional ranging issues at higher settings, a sector configured for a **Max Range** of 11 miles or greater should have its **Downlink Data** set no higher than 80%. **Max Range** and **Data Downlink** are set on the AP's Configuration => Radio page. Sectors configured for a **Max Range** of 10 miles or less are not affected by this limitation.

5 Notes and Reference

5.1 NOTES

Table 6 lists notes new for this release.

Table 7 lists continuing notes first mentioned in previous Release Notes.

Table 6: New Notes for Release 9.4.2

Product Family	Description	Discussion and Recommendations
All	A derived temperature is now shown on a module's web page (10379)	The temperature is board (not ambient air) temperature. Different hardware vintages use different methods for deriving temperature. Newer hardware vintages will see a temperature indication that tracks more closely with temperature changes and is more consistent from radio to radio, whereas older hardware vintages may see significant differences between radios and from the same radio over time.
All	Disable TCP ACK prioritizing in broadcast video applications (10263)	When optimizing a system for broadcast video, on the AP's Configuration => General page configure **Prioritized TCP ACK** to **Disabled**. In a system being used for internet access or similar applications prioritizing TCP ACKs improves downloading of FTP files and other activities making significant use of TCP ACKs under heavy load. However, in a system being used for broadcast video or video surveillance, prioritizing TCP ACKs can cause sporadic choppy video in the uplink.
PTP 54200	5.4-GHz OFDM BHs may see a 600 kbps reduction in uplink or downlink throughput (9574)	Guard times in the OFDM PTP scheduler were increased slightly, changing the ranges at which time slots are lost to air delay. Depending on the distance between BHs and the configured Downlink Data %, this may or may not affect a given installation. For example, at 0 miles and 50% Downlink Data the uplink/downlink slots change from 33/33 in Release 8.4.3 to 33/32 with Release 9.4.2, resulting in 600 Mbps less downlink throughput. However, at 3 miles the slots are 32/32 for both Release 8.4.3 and Release 9.4.2 resulting in no change in throughput between the releases.

Table 7: Previous Notes

ID	Description	Discussion and Recommendations
-	Changes to boxTemperature OIDs	Starting with Release 9.4 the boxTemperature (1.3.6.1.4.1.161.19.3.3.1.5) OID (which returned an octet string value) is no longer valid. Two new OIDS which return integer values are added: boxTemperatureC Object ID: 1.3.6.1.4.1.161.19.3.3.1.35 Syntax: INTEGER Access: read-only Status: current Radio temperature in Celsius. boxTemperatureF Object ID: 1.3.6.1.4.1.161.19.3.3.1.36 Syntax: INTEGER Access: read-only Status: current Radio temperature in Fahrenheit.
-	More accurate Received Power readings for P10 900-MHz radios	For P10 900-MHz radios, Release 9.4 included improvements in the accuracy of the displayed Received Power based on improvements in temperature measurement. The displayed Received Power may be lower or higher than for the same radio running a previous release. The actual performance of the radio has not changed. With this accuracy improvement, P10 900-MHz radios should see less variation of displayed Received Power over time (as temperature changes) and from radio to radio.
8484	Procedures for saving an XML file of a spectrum graph	When the **SpectrumAnalysis.xml** button is clicked on the SM's Tools => Spectrum Analyzer page or the AP's Tools => Remote Spectrum Analyzer page, the spectrum graph is redisplayed using XML and XSL if the browser supports XSL. To save the underlying XML file, right click and select "Save Target As" on a Windows PC, or equivalent action for other operating systems.
8172	SM scan frequencies not "cancelled" by SNMP actions	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.
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.

ID	Description	Discussion and Recommendations
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.
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.
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.

ID	Description	Discussion and Recommendations
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.

5.2 OPERATION BASED ON REGION CODE AND FREQUENCY BAND

There are no changes to Region Code operation in Release 9.4.2. For reference, Table 8 shows operation based on Region Code, by frequency band and module type.

Table 8: Release 9.4.2 operation based on Region Code and frequency band

Region Code[1]	900 MHz	2.4 GHz	4.9 GHz	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	AP/SM	AP/SM /BH	AP/SM /BH	AP/SM/ BH	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS
United States	No effect	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	No effect	NA	≥ P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS 5590-5660 MHz not available[2]	No effect	No effect	No effect
Europe	NA	No effect	No effect	NA	NA	NA	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS >July 1, 08: 5590-5660 MHz not available[2,4]	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS >July 1, 08: 5590-5660 MHz not available[2,4]	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS
Brazil	NA	NA	No effect	NA	NA	NA	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS	No effect	No effect	No effect
Australia	No effect	No effect	No effect	NA	NA	NA	FCC/IC DFS 5590-5660 MHz not available[2]	No effect	No effect	No effect
Russia	NA	NA	No effect	Display Com-munity 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	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. 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 MIB

The Canopy Enterprise MIB (Management Information Base), consisting of 5 MIB definition files, supports SNMP access to Canopy modules. The MIB files are available for download from the Canopy tab of http://motorola.motowi4solutions.com/software/.

Detailed information on the Canopy MIBs is available at http://motorola.motowi4solutions.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.

Information on the Motorola Prizm element management system is available at http://motorola.motowi4solutions.com/products/prizm/.

Prizm documentation and installers are available for download from the Canopy tab of http://motorola.motowi4solutions.com/software/.

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 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 9.4.2

7.1 BEFORE YOU UPGRADE

7.1.1 Applicability

Table 9 shows the product series, hardware series, and radio types that are upgradeable to Release 9.4.2.

Table 9: Radios Upgradeable to Release 9.4.2

Product Family	Radio Type	Product Encryption Type			
		DES Product		AES Product	
		Hardware Vintage			
		P7, P8	P9, P10, P11	P7, P8	P9, P10, P11
PMP 100 (Canopy FSK)	SM	Yes	Yes	No	Yes
	AP	No	Yes	No	Yes
PTP 100 (Canopy FSK)	BH	No	Yes	No	Yes
		All vintages		All vintages	
PMP 54400 (5.4-GHz OFDM)	SM, AP	Yes		Yes	
PTP 54200 (5.4-GHz OFDM)	BH	Yes		Yes	
PMP 49400 (4.9-GHz OFDM)	SM, AP	Yes		Yes	
PTP 49200 (4.9-GHz OFDM)	BH	Yes		Yes	

Release 9.4.2 is *not* applicable to

- PMP 500 Series modules (Canopy 3.5 GHz OFDM APs and SMs)
- 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

Upgrade paths for operating sectors are shown in Figure 3.

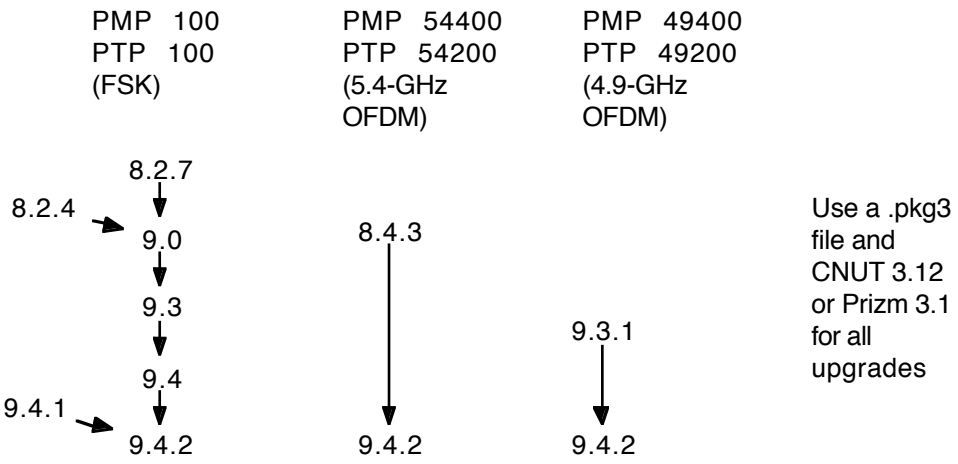

Figure 3: Upgrade path for operating sectors

Each release has new feature content and may have changes to message structures and protocols used between the AP and the SMs. These changes may affect operation of APs and SMs operating on untested mixed releases during the upgrade period, resulting in features or indicators not working properly, or in the worst case SMs being stranded by the use of untested combinations. Following the tested upgrade path is strongly recommended for operating sectors.

Standalone modules such as spares can be upgraded from any Release 8.x (or any *hardware scheduling* release) to Release 9.4.2. For details on upgrading modules running *software scheduling* see previous release notes, especially the Release 7.3.6 Release Notes.

7.1.3 Upgrade Tool Options

Use either CNUT or Prizm for the upgrade.

CNUT

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 the Canopy tab of http://motorola.motowi4solutions.com/software/. If you need to upgrade from a previous CNUT release, ensure you back up your network file before upgrading CNUT.

CNUT 3.12 supports upgrades of P11 modules, including 2 Mbps and 4 Mbps BHs, and should be used for upgrading modules to Release 9.4.2. See the CNUT 3.12 release notes for additional details.

Prizm

Motorola offers Prizm as an EMS that provides monitoring and management functions, including module upgrade. Prizm 3.1 with Patch 7 supports upgrading modules to Release 9.4.2.

Prizm 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 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 9.4.2.

Information on the Motorola Prizm element management system is available at http://motorola.motowi4solutions.com/products/prizm/.

Prizm documentation and installers are available for download from the Canopy tab of http://motorola.motowi4solutions.com/software/.

.pkg3 Packages

Upgrades use package files whose name extensions are `.pkg3`. Earlier packages (`.pkg` or `.pkg2` files) *cannot* be used with CNUT Release 3.12 and Prizm Release 3.1. A key aspect of `.pkg3` packages and the tools that use them is that they support upgrading modules using module accounts other than `root` and therefore do not require a module to have an account named `root`.

7.1.4 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. 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 OBTAINING AND PREPARING CNUT OR PRIZM

Use either CNUT Release 3.12 or later or Prizm Release 3.1 with Patch 7 or later for the upgrade.

7.2.1 Obtaining and Preparing CNUT

1. From the Canopy tab of http://motorola.motowi4solutions.com/software/, download
   - Network Updater Tool Release 3.12 for Windows

     or
   - Network Updater Tool Release 3.12 for Linux
   - Network Updater Tool Release 3.12 Release Notes
2. Install CNUT Release 3.12 on Windows or Linux using the CNUT release notes.
3. If you do not have a previously stored network archive file within CNUT, 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 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 Obtaining and Preparing Prizm

1. Download Prizm 3.1 Patch 7 and Prizm 3.1 Patch 7 Release Notes. If upgrading PMP 49400 or using PTP 49200 modules, also download Prizm 3.1 Patch 4.9 OFDM.
2. From the Canopy tab of http://motorola.motowi4solutions.com/software/, download
    - Prizm 3.1 Patch 7
    - Prizm 3.1 Patch 7 Release Notes.
    - If upgrading PMP 49400 or using PTP 49200 modules, also download Prizm 3.1 Patch 4.9 OFDM.
3. Install Patch 7 using the Patch 7 Release Notes.
4. If upgrading PMP 49400 or using PTP 49200 modules, install Patch 4.9 OFDM.
5. If you do not have a previously stored network archive file within 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.

7.3 OBTAINING UPGRADE PACKAGES

To download the Canopy software to your computer, perform the following steps:

1. Go to http://www.motowi4solutions.com/software/.
2. Follow the directions on that page to access the software download page.
3. On the software download page, select the appropriate package or packages. Options include
    - Release 9.4.2 FSK Software - DES
    - Release 9.4.2 FSK Software - AES
    - Release 9.4.2 OFDM Software - DES
    - Release 9.4.2 OFDM Software - AES

    PMP 100 and PTP 100 series (Canopy FSK radios) use the FSK software.

    PMP 400 and PTP 200 series (Canopy OFDM radios, both 5.4 GHz and 4.9 GHz) use the OFDM software.
4. Click **Accept User Agreement and Request Download Links**.
   RESULT: You will receive an email with a link or links to the software.
5. In the email sent to you, click on the desired link or links.
   RESULT: The appropriate `.pkg3` package or packages will download to your computer.

7.4 PERFORMING THE UPGRADE VIA CNUT OR PRIZM

Upgrade using the following steps. For additional details on using CNUT, see the CNUT help file or click on the Help menu in the CNUT application. For additional details on using Prizm, see the Prizm user guide. The CNUT help file and Prizm user guide are available for download from the Canopy tab of http://motorola.motowi4solutions.com/software/.

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 the appropriate .pkg3 file(s) to the managed packages list. Depending on the package downloaded in section 7.3, Obtaining Upgrade Packages, you will have one or more of the following .pkg3 files:
    - CANOPY94_2BUILDOFFICIAL_DES.pkg3
    - CANOPY94_2BUILDOFFICIAL_AES.pkg3
    - CANOPY94_2BUILDOFFICIAL_OFDM_DES.pkg3
    - CANOPY94_2BUILDOFFICIAL_OFDM_AES.pkg3
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, 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. 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 upgrade or new P7/8/9 registration activity.
    c. updates all registered or registering P10 SMs that require an upgrade.
    d. waits for 20 minutes of no upgrade or new P10 registration activity.
    e. updates all registered or registering P11 SMs that require an upgrade.
    f. waits for 20 minutes of no upgrade or new P11 registration activity.
    g. continues this 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 will be quiet times during a sector upgrade due to the 20-minute inactivity timer, followed by active updating of SMs.

    With CNUT 3.12 or Prizm 3.1 with Patch 7, the operator can choose the update order among P7/P8/P9 SMs, P10 SMs, and P11 SMs by setting the SM Autoupdate Configuration. For example, sectors with no P7/8/9 SMs should be set to upgrade P10 SMs first and not upgrade P7/P8/P9 SMs to avoid a 20 minute wait until upgrade of P10 SMs begins.
11. After the upgrade appears to have completed, Refresh/Discover.
12. Verify that the Software Version for each module is shown as `CANOPY 9.4.2`.
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 9.4.2, 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 9.4.2.
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.

7.4.1 Setting the Region Code

After a sector or link or standalone module has been upgraded to Release 9.4.2, 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 channels as shown In Table 10. Because of this, care needs to be taken in choosing 5.4-GHz channels where 5.4 GHz systems are collocated with 5.2-GHz systems.

Choosing 5.4-GHz channels of 5495 through 5540 MHz or 5600 through 5705 MHz avoids this collocation issue and is often the best option. 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 10: 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 29**), 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 29.

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 Performance Benchmarking Process

9.1.1 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.

9.1.2 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 for an FSK system. 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.

9.1.3 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.

System configuration

The PMP benchmark system consists of 3 SMs and 1 Advantage AP, as shown in Figure 4 on page 33. 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 at max rate (2X or 3X).

The PTP benchmark system consists of 1 BHM and 1 BHS, with traffic generation and measurement equipment connected to both BHs.

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.

PMP Settings

- Downlink Data: 50%
- Control Slots: 2
- Range: 2 miles
- Max rate (2X or 3X) 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)

PTP Settings

- Downlink Data: 50%
- Max rate (2X or 3X) Enabled
- Encryption: Enabled (DES modules)

Measurement technique

1. Send a specific number of frames at a specific rate through SMs and AP (uplinks) and AP and SM (downlink) simultaneously. This is the Offered Load. Count the frames that are received correctly at both sides. This is the 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.

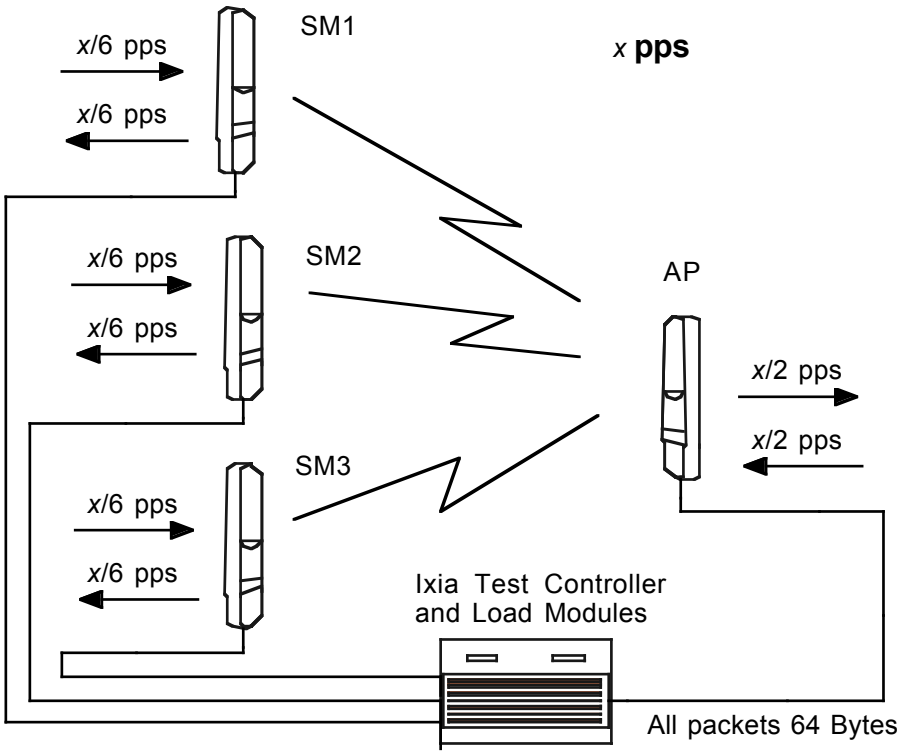

Figure 4: Benchmark test setup

10 Regulatory and Legal Notices

10.1 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.

10.2 NATIONAL AND REGIONAL REGULATORY NOTICES

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

For 900-MHz, 2.4-GHz, 5.2-GHz. 5.4-GHz, and 5.7-GHz devices:

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 11.

For 4.9-GHz devices:

The 4.9-GHz band is a licensed band allocated to public safety services. State and local government entities that provide public safety services are eligible to apply for 4.9 GHz licenses. For additional information, refer to FCC regulations.

Table 11: US FCC IDs and Industry Canada Certification Numbers and covered configurations

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna, Reflector, or Lens[1]	Maximum Transmitter Output Power[1]
ABZ89FC5809	109W-9000	8 MHz channels, centered on 906-924 MHz in 1 MHz increments (within the 902-928 MHz ISM band)	9000 SM, AP	12 dBi 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, Reflector, or Lens[1]	Maximum Transmitter Output Power[1]
				8 dBi integrated antenna (Indoor SM)	26 dBm (400 mW)
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	25 dBm (340 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 P7/8/9	7 dBi internal	23 dBm (200 mW)
			5200 BH SM, AP P10/11	7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5807 for P7/8/9 ABZ89FC3789 for P10/11	109W-5210 for P78/9 109W-5200 for P10/11	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	19 dBm (80 mW)

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna, Reflector, or Lens[1]	Maximum Transmitter Output Power[1]
Note 1: To ensure regulatory compliance, including DFS compliance, the professional installer is responsible for ◦ setting the Transmitter Output Power on the Confiiguration => Radio page no higher than listed for a given configuration ◦ setting the Region Code on the Configuration => General page to the correct region ◦ setting the External Gain on the Configuration => Radio page, if displayed, to the gain of any external device (reflector, lens)					

10.2.2 Industry Canada (IC) Notification

For 900-MHz, 2.4-GHz, 5.2-GHz. 5.4-GHz, and 5.7-GHz devices:

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 11.

This device has been designed to operate with the antennas listed in Table 11 and having a maximum gain as shown in Table 11. Antennas not included or having a gain greater than as shown in Table 11 are strictly prohibited from use with this device. Required antenna impedance is 50 ohms.

For 4.9-GHz devices:

The 4.9-GHz band is a licensed band allocated to public safety services. Government entities that provide public safety services are eligible to apply for 4.9 GHz licenses. For additional information, refer to Industry Canada regulations.

10.2.3 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

10.2.4 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 CE! 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.

10.2.5 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.

10.2.6 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.

10.2.7 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.

10.2.8 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

10.2.9 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.

10.2.10Czech 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.

10.2.11 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).

10.2.12 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.

10.2.13 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.

10.2.14 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 12: 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。						

10.3 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 13.

Table 13: 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 14 provide details and discussion of the associated calculations.

10.3.1 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 14 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 14: Calculated exposure distances and power compliance margins

Band	Antenna	Variable			*d* (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	*G*	S			

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
	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.

10.4 LEGAL NOTICES

10.4.1 Software License Terms and Conditions

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10.4.2 Hardware Warranty in US

Motorola US offers a warranty covering a period of 1 year from the date of purchase by the customer. If a product is found defective during the warranty period, Motorola will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labor.

10.5 LIMIT OF LIABILITY

IN NO EVENT SHALL MOTOROLA BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY, EVEN IF MOTOROLA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.) IN NO CASE SHALL MOTOROLA'S LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.