MOTOROLA

Canopy® Software Release 8.2.1

Software Release Notes

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CANOPY
Motorola Wireless Broadband Platform

Notices

See important regulatory and legal notices in Section 8 on page 40.

Trademarks, Product Names, and Service Names

http://www.motorola.com/canopy

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1 Introduction

These notes cover Canopy Release 8.2.1, including information on Release 8.2.

1.1 NOTES AND HIGHLIGHTS

Highlights of Canopy Release 8.2.1:

- Resolves all known cases of Ethernet lock-ups on P10 series hardware. It is strongly recommended that P10 modules running on any Release 8 version be upgraded to Release 8.2.1.

IMPORTANT!
All P10 modules should be upgraded to Release 8.2.1, as it resolves Ethernet lock-ups seen on P10 modules in earlier releases.

- Supports a High Priority channel on older P7 and P8 series SMs.

Highlights of Canopy Release 8.2:

- Supports DFS for 5.4 GHz modules in the US and Canada, thus opening up this spectrum to Canopy use. Specific guidelines apply for collocating 5.4 GHz modules with 5.2 GHz modules and with 5.7 GHz modules. See Section 7 on page 37.
- Supports DFS for newly sold 5.2 GHz modules in the US, thus allowing the continuing sale of 5.2 GHz modules in this market.
- Simplifies operator configuration by using a “Region Code” to be set by the operator that then sets DFS and other features correctly to region and frequency band requirements.
- Increases the maximum packet-per-second of modules.
- The tested, supported upgrade path is to upgrade from Release 8.1.5.1 (or 8.1.5 or 8.1.5.6 on recently shipped P10 modules) or Release 8.2 to Release 8.2.1.
- Prizm 3.0 will now manage upgrades, in addition to CNUT 2.2. Consider upgrading to Prizm 3.0 before upgrading your network to Canopy Release 8.2.1.

Notes for Release 8 in general:

- Release 8 supports **hardware scheduling ONLY**. Modules must be running hardware scheduling **BEFORE** upgrading.
- Not all modules of all hardware series can be upgraded to Release 8. Specifically, hardware series P7 and P8 APs, BHs, and AES SMs cannot be upgraded. Also, since both ends of a BH link must run the same scheduler (hardware or software), only backhaul links with hardware series P9 BHs on both ends can be upgraded to Release 8. Please see the Release 8.1 Release Notes for more details.
- P10 series hardware runs Release 8 only – P10 hardware will not run on Release 7.3.6 and prior releases.

- P7/8/9 series hardware must be upgraded to Release 7.3.6 and configured for hardware scheduler before upgrading to Release 8.

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 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, look on the Home => General Status page, under “Board Type:”” as shown in Figure 1.

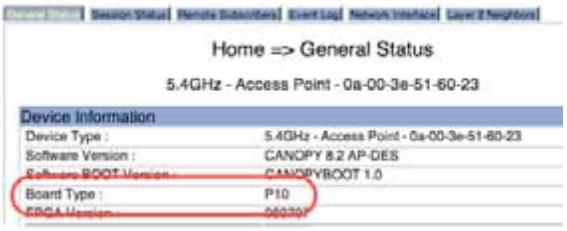


Figure 1: Board Type on Modules running Release 8

- For modules that are running Release 7.3.6, view the Configuration page.
  - If you see an option to choose Scheduling as shown in Figure 2, the module is series P9.

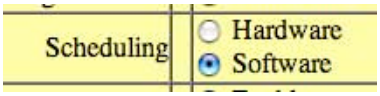


Figure 2: Scheduling option – if viewable, indicates this is a P9 board.

  - If you don’t see the Scheduling option, the module is P7 or P8.

- For modules running any release, telnet into the unit and issue the “version” command. The hardware series is shown under “Hardware Platform:” as 7, 8, 9, or 10.

1.4 DOCUMENT CHANGE HISTORY

Issue 1	First issue

1.5 FEEDBACK ON DOCUMENTATION

We welcome your feedback on Canopy documentation. Comments on structure, content, accuracy, completeness, or any other area are appreciated. Please send your feedback to technical-documentation@canopywireless.com.

1.6 TECHNICAL SUPPORT

Tip! Don’t 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 User’s 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

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

Canopy Technical Support, Europe

email: essc@motorola.com

+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 the following information:

- Information on your network configuration, especially IP addresses and 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.
- Version numbers of the software on the modules with problems.

2 Release 8.2 and Release 8.2.1 Features

Release 8.2.1 adds the new features listed in Table 1.

Release 8.2 added the new features listed in Table 2.

Table 1: Release 8.2.1 Features

Feature Name	Summary	See Section
High Priority channel for P7 and P8 SMs	P7 and P8 SMs running hardware scheduling have not had the option of enabling a High Priority channel. With this release, they now do. The High Priority channel for P7 and P8 SMs is enabled and the CIR configured the same as for P9 and P10 SMs and functions the same. The implementation is different – it does not use a second Virtual Channel - so indications and statistics will only reflect one VC on P7 and P8 SMs even with the High Priority channel enabled. For context, the High Priority channel is often used as part of a Voice over IP implementation.	-
Power Saver Mode on P10 modules	P10 modules now offer a “Power Saver Mode” on the Configuration => Radio page. “Power Saver Mode” uses improved power management to reduce power consumption by about 1 W (10%), depending on module settings and traffic. The recommended setting is “enabled”, which is the default. Note, this feature reduces power consumption, but does not affect transmitter output power, which remains at the value set by the “Transmitter Output Power” parameter on the Configuration => Radio page of a module.	-

Table 2: Release 8.2 Features

Feature Name	Summary	See Section
DFS for US and Canada for 5.4 and 5.2 GHz modules	Opens up the 5.4 GHz spectrum in US, Canada, and Australia by providing compliant DFS. Provides compliant DFS on 5.2 GHz modules, so they can continue to be sold in the US and Canada.	2.1
Updated ETSI DFS	Provides updated DFS (ETSI V1.3.1) for - Europe for 5.4 and 5.7 GHz modules - Brazil for 5.4 GHz modules - other countries that require ETSI DFS	2.1

Feature Name	Summary	See Section
Region Code	Through the use of a new Region Code on every module running R8.2, the operator can set the Region (Other, United States, Canada, Europe, Brazil, Russia, or Australia) and then DFS and other configuration items are correctly set automatically. During upgrade, modules are automatically configured with a Region Code based on their frequency band and previous enabled/disabled DFS setting. New modules loaded with Release 8.2 at the factory or modules "Reset to Factory Defaults" will show a Region Code of "None". APs and BHMs must be set to a Region before they will transmit.	2.1.2
Alternate Frequency Configuration to reduce DFS outage time	The operator can configure up to two alternate frequencies for the AP or BHM to shift to when it detects radar and vacates the current carrier frequency. Note, before selecting the alternate frequencies, complete a spectrum analysis at the site and carefully plan and coordinate channel usage.	2.1.2
"Whitening" option to improve DFS robustness	After a sector's AP and SM are running Release 8.2, "whitening" can be enabled to reduce the possibility of self-interference causing DFS detects.	2.1.2
Higher Packet Processing Rate	Increases the maximum packet processing throughput of a module by over 25%.	2.2
Maximum Information Rate (MIR) cap on broadcast messages over the SM air interface	With this feature, an operator can set uplink broadcast/multicast MIR (Maximum Information Rate) to limit broadcast storms. When the feature is enabled on the SM, the broadcast packets are separated from the uplink stream and use the new MIR settings to be capped. All unicast packets will go under the existing MIR settings for capping. When the feature is disabled, the broadcast and unicast packets are capped under the existing MIR. Setting broadcast MIR to 32 kbps is a typical value for a typical network. Different networks may require different settings to limit broadcast storms without limiting desired broadcast traffic.	-
Management VLAN on Backhauls	PTP 100 Series units (formerly known as 10 Mbps and 20 Mbps Backhauls) can be configured with a Management VLAN ID (MVID). When so configured, the module will only be manageable using packets that are appropriately tagged with the same VLAN ID. Note, this only affects packets addressed to the Management IP of the module. Packets being transported across the backhaul link are not affected and can be either untagged, or tagged with any VLAN ID.	-

Feature Name	Summary	See Section
Packet Overload Statistics	The Statistics => Overload page of each module now displays in one place a count of the number of times that each of the 4 module interfaces (Ethernet In, Ethernet Out, RF In, and RF Out) had a discard event, as well as a sum total of the 4. In a discard event, one or more packets (indeterminate) is discarded, so the statistics are not a measure of how many packets were lost, but give a good indication of how often the module interface went into overload.	-
Layer 2 Discovery (LLDP)	Canopy modules will now support LLDP (Link Layer Discovery Protocol) per IEEE standard 802.1AB. SMs, APs, and BHs, transmit information over their wired/Ethernet interface using a multicast address, and also collect this information from neighbors on their wired/Ethernet interface. LLDP is a protocol being supported gradually by more and more network equipment, for use in various features and network scenarios. In the case of Canopy, it will allow Prizm to auto-discover SMs behind a “Remote AP” in a future Prizm release. Some switches, including the switch in the CMMmicro, do not pass the multicast address that LLDP uses. In these cases, the operator must set the Multicast Destination Address on the Configuration => General page to “Broadcast” instead of the default “LLDP Multicast”, if they wish equipment connected to the switch to participate in Layer 2 Discovery. Canopy modules send an LLDP message on their wired/Ethernet interface (multicast or broadcast, depending on how the operator has configured the unit) every 30 seconds. On the Home => Layer 2 Neighbors page, Canopy modules display a list of Canopy modules or other LLDP-active modules they have received LLDP messages from for 2 minutes after the last message is received. Using this scheme, the Home => Layer 2 Neighbors page on a Canopy module lists a neighboring Canopy module about 30 seconds after the neighbor starts up, and will continue to list the neighbor until about 2 minutes after the neighbor shuts down. Neither the 30 second or the 2 minute timer are settable by the operator.	-

Feature Name	Summary	See Section
10 SNMP Accessing Subnets	Some networks require multiple IP addresses for use as SNMP management work stations, so the number of configurable accessing subnets is being increased to 10. Every SNMP access checks whether it is allowed via the SNMP Accessing IP addresses and subnets. By default if there is no accessing subnets defined, then access will be allowed. Otherwise upon an SNMP request, the SNMP accessing subnet list is searched for an address and masked using the CIDR (Classless InterDomain Routing bits). If the IP address after applying the CIDR mask does not match, then the next accessing subnet is tried. If no more exist, then access is denied.	-

2.1 DYNAMIC FREQUENCY SELECTION (DFS)

Dynamic Frequency Selection (DFS) is a requirement in several countries and regions for 5 GHz unlicensed systems to detect radar systems and avoid co-channel operation. With Release 8.2, Canopy modules meet requirements for Dynamic Frequency Selection (DFS) in the US and Canada, as well as in Europe and Brazil as it did previously.

2.1.1 Background and Operation

The modules use region-specific DFS based on a new “Region Code” selected on the module’s Configuration > General page. By directing installers and technicians to set the Region Code correctly, the operator gains confidence the module is operating according to national or regional regulations, without having to deal with the details of each frequency band and each module type for each region.

Available “Region Codes” include Other, United States, Canada, Europe, Brazil, Russia, and Australia. Operators in regions or countries not listed and with no requirements for DFS should use the “Other” Region Code.

New APs and BHMs running Release 8.2 from the factory will show a Region Code of “None”, and will not transmit until the Region Code is set to a value other than “None”. Modules being updated to Release 8.2 in the field will continue to operate as they did before the update, and will display a Region Code consistent with their module type and settings before the update.

For the US, the DFS in Release 8.2 meets FCC Report and Order 03-287. For Canada, the DFS meets Industry Canada requirements. In the US, Canada, and Australia, DFS applies only to APs and BHMs. For countries of the European Union and Brazil, the DFS in Release 8.2 meets ETSI EN 301 893 v1.3.1. In these regions, DFS applies to APs, BHMs, SMs, and BHSs.

Canada and Australia have requirements to avoid certain frequencies used by weather radar. To meet this requirement, modules set to a Region Code of Canada or Australia will not have the center channel frequencies from 5580 MHz to 5670 MHz (inclusive) available on the AP’s or BHM’s Carrier Frequency pop-up or on the SM’s or BHS’s Frequency Scan Selection List.

With DFS support, Canopy 5.4 GHz systems can now be sold in the US, Canada, and Australia. Table 3 shows the number of non-overlapping channels in the Canopy 5.4 GHz frequency band.

Table 3: Number of Channels in 5.4 GHz Band

Region	Number of Non-overlapping channels in Canopy 5.4 GHz frequency band	
	25 MHz channel center spacing (recommended for Advantage APs or 20 Mbps BHs)	20 MHz channel center spacing
United States, Europe, Brazil	9	11
Canada, Australia (with weather notch)	6	7

Table 4 shows the Release 8.2 operation based on Region Code, by frequency band, and module type.

Table 4: Release 8.2 Operation based on Region Code, by 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	FCC/IC DFS[2]	No effect	FCC/IC DFS	No effect	No effect	No effect
Canada	No effect	No effect	NA	FCC/IC DFS[2]	No effect	FCC/IC DFS with Notch[3]	No effect	No effect	No effect
Europe	NA	No effect	NA	NA	NA	ETSI DFS	ETSI DFS	ETSI DFS	ETSI DFS
Brazil	NA	NA	NA	NA	NA	ETSI DFS	ETSI DFS	No effect	No effect
Australia	No effect	No effect	NA	NA	NA	FCC/IC DFS with Notch[3]	No effect	No effect	No effect
Russia	NA	NA	No effect	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. Newly manufactured P10 5.2 GHz modules use DFS. Modules originally shipped without DFS are not required to use DFS. Set the Region Code to the region you are in, and the software will establish compliant operation.
3. Channels with center frequencies from 5580 MHz to 5670 MHz (inclusive) are “notched” out (are not available) to meet requirements to not transmit in weather radar frequencies. Set the Region Code to the region you are in, and the software will establish compliant operation.

When an AP or BHM with DFS boots, it performs a channel availability check on its main carrier frequency for 1 minute, monitoring for the radar signature, without transmitting. If no radar signature is detected during this minute, the module then proceeds to normal beacon transmit mode. If it does detect a radar signature, it marks that carrier frequency out for 30 minutes, and moves to its 1st alternate carrier frequency. It continues this behavior through its 2nd alternate carrier frequency if needed, then will wait until the first frequency has been locked out for 30 minutes. If while in operation, the AP or BHM detects the radar signature, it will lock out its current carrier frequency for 30 minutes, and move to trying the next in-line carrier frequency.

Since an SM or BHS only transmits if it is receiving beacon from an AP or BHM, the SMs in the sector or BHS are also not transmitting when the AP or BHM is not transmitting.

In addition to DFS on APs and BHMs, the ETSI DFS specification requires DFS on SMs and BHSs. In this case, when an SM or BHS boots, it scans to see if an AP or BHM is present (if it can detect a Canopy beacon). If an AP or BHM is found, the SM or BHS performs a channel availability check on that frequency for 1 minute, monitoring for the radar signature, without transmitting.

- For an SM, if no radar pulse is detected during this 1 minute, the SM proceeds through normal steps to register to an AP.
- For a BHS, if no radar pulse is detected during this 1 minute, it registers, and as part of registering and ranging watches for the radar signature for another 1 minute (for a total of 2 minutes of monitoring).

If the SM or BH does detect radar, it locks out that frequency for 30 minutes and continues scanning other frequencies in its scan list.

Note, after an SM or BHS with DFS has seen a radar signature on a frequency and locked out that frequency, it may connect to a different AP or BHM if color codes, AP/BHM transmitting frequencies, and SM/BHS scanned frequencies support that connection.

To simplify operation and ensure compliance, an SM or BHS running Release 8.2 takes on the DFS type of the Release 8.2 AP or BHM it is registering to. For example, when an SM in Europe registers to an AP with the Region Code set to “Europe”, that SM will use ETSI DFS, no matter what its Region Code is set to, even if its Region Code is set to “None”. Note, the operator should still configure the Region Code in the SM correctly, as future releases may use the Region Code for additional region-specific options.

For all modules running DFS, the module displays its DFS state on its Home => General Status page as one of the following:

- `Checking Channel Availability Remaining time n seconds`, where n counts down from 60 to 1.
- `Normal Transmit`
- `Radar Detected Stop Transmitting for n minutes`, where n counts down from 30 to 1.
- `Idle`, only for SM or BHS, indicates module is scanning, but has not detected a beacon from an AP or BHM. Once it detects beacon, the SM or BHS begins a Channel Availability Check on that frequency.

2.1.2 Parameters to set for DFS

Configuration => General => Region Code

All modules running Release 8.2 display a Region Code pop-up on the Configuration => General page, as shown in Figure 3.

On new modules from the factory, or after resetting to factory defaults, the operator should set this Region Code consistent with their country or region. For countries or regions not listed in the Region Code pop-up, set the Region Code consistent with your country's regulatory requirements. (For example, several countries in South America follow the same DFS regulations as Brazil, so in those countries the Region Code should be set to "Brazil".)

IMPORTANT!
Operators under regulatory requirements for DFS must ensure the new Canopy parameter "Region Code" is set correctly. This applies to initial configuration, after a module is reset to factory defaults, or after a module is upgraded.

An AP or BHM will not transmit if the Region Code is configured to "None".

IMPORTANT!
On APs or BHMs received from the factory, with Region Code set to "None", the operator must set the Region Code before the module will transmit. The same is true of APs or BHMs which have been reset to factory defaults.

Modules that are upgraded to Release 8.2 will have the Region Code set automatically during upgrade, based on the model type and previous settings. Operators should confirm the Region Code after the upgrade to ensure correct operation of the module.

IMPORTANT!
Operators in regions outside the US and Europe especially should confirm the Region Code after an upgrade, as it will be set to Europe or US, depending on the frequency band. Although the module will function with the incorrect Region Code, the best practice is to set it correctly after the Release 8.2 upgrade, as features in future releases may use the Region Code.

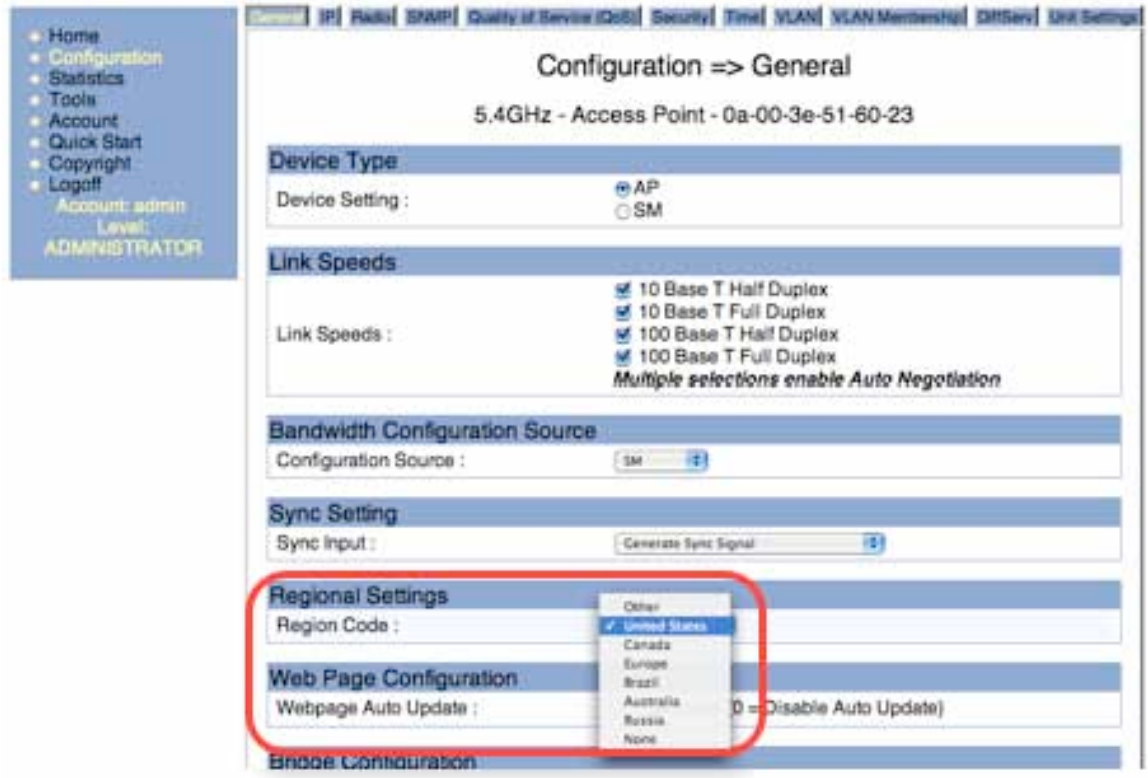


Figure 3: Region Code on AP Configuration => General page

An SM or BHS has both a configurable Region Code and, once it registers to an AP or BHM, an active Region Code. If an SM or BHS registers to an AP or BHM running Release 8.2 or later, it uses the Region of the AP or BHM to determine its DFS behavior and displays the AP's or BHM's Region Code on its Home => General Status page, as shown in Figure 5. If the SM or BHS registers to an AP or BHM running a release prior to Release 8.2, it uses its configured Region Code from its Configuration => General page, as shown in Figure 4. The active Region Code determines the DFS behavior.

The two Region Codes should be the same in normal operation, but will not be the same if, for example, as shown in Figure 4 and Figure 5, an SM configured with a Region Code of "None" has registered to a Release 8.2 AP with a Region Code of Europe.

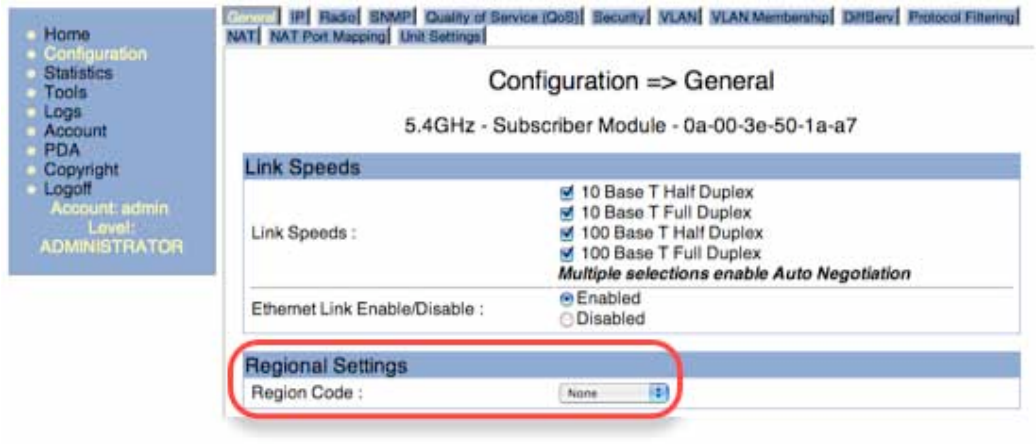


Figure 4: Configured Region Code on SM Configuration => General page

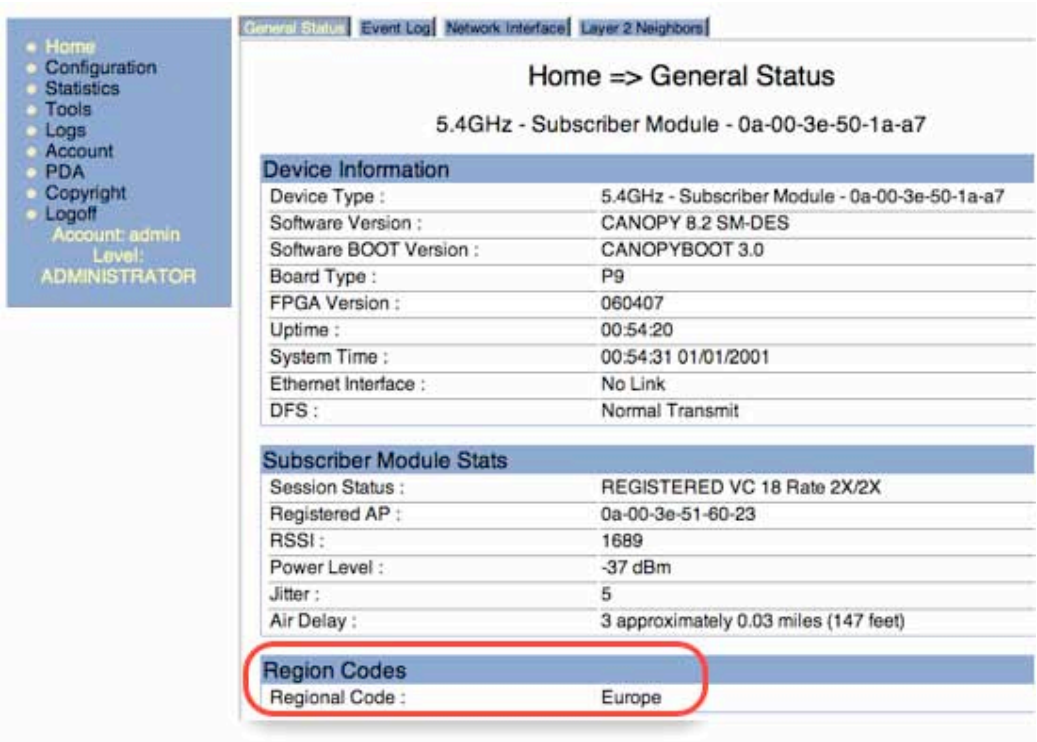


Figure 5: Active Region Code on SM Home => General Status page

IMPORTANT!

An SM or BHS running Release 8.2 with a Region Code of "None" will not register to an AP or BHM running Release 8.1.5.1 or earlier. Configure the SM or BHS with a Region Code, or update the AP or BHM to Release 8.2, or (preferably) do both.

The AP and BHM always operate under their manually configured Region Code (the one on the Configuration => General page), and so do not show a Region Code on their Home => General Status page.

Under normal operations, APs or BHMs operating with DFS (see Table 4) will experience an additional minute after power-up or reboot before they will register any SMs. SMs operating with DFS (see Table 4) will experience an additional minute after they reboot before they will register to an AP. BHSs operating with DFS (see Table 4) will experience an additional two minutes after they reboot before they will register to an BHM.

It takes two reboots to set the parameters described below on a module starting from factory defaults. Set the Region Code as described above, “Save Changes”, and “Reboot”. If the module then invokes DFS (based on the Region Code and frequency band as shown in Table 4), the Radio Frequency Carriers and External Antenna Gain parameters will be displayed. Set them as described below, “Save Changes”, and “Reboot” again.

IMPORTANT!

Set the Region Code, “Save Changes”, and “Reboot” to see the context-sensitive DFS parameters. Unlike with many context-sensitive parameters, these do not appear in the GUI with only a “Save Changes”.

Configuration => Radio => Radio Frequency Carrier

APs running DFS include an option for setting up to two alternate frequencies, as shown in Figure 6, to be used in the event radar is detected and the main frequency is locked out due to DFS detection. If these are left at “None”, no backup frequencies will be used in the case of DFS detection, and the AP will lock itself out from any transmission for 30 minutes.

If radar is detected on the main frequency, either at startup or during operation, A Channel Availability Check will be performed on the 1st alternate frequency before it is then used for transmission. If radar is detected on the 1st alternate frequency, either during Channel Availability Check or during operation, a Channel Availability Check will be performed on the 2nd alternate frequency before it is then used for transmission. If radar is detected on the 2nd alternate frequency, either during Channel Availability Check or during operation, the radio will cease transmission unless or until the primary channel clears its 30 minute lock-out.

Note, use site surveys and RF planning to choose alternate frequencies useful for each sector, and consider testing on the alternate frequencies to ensure compatibility with the sector’s RF environment.

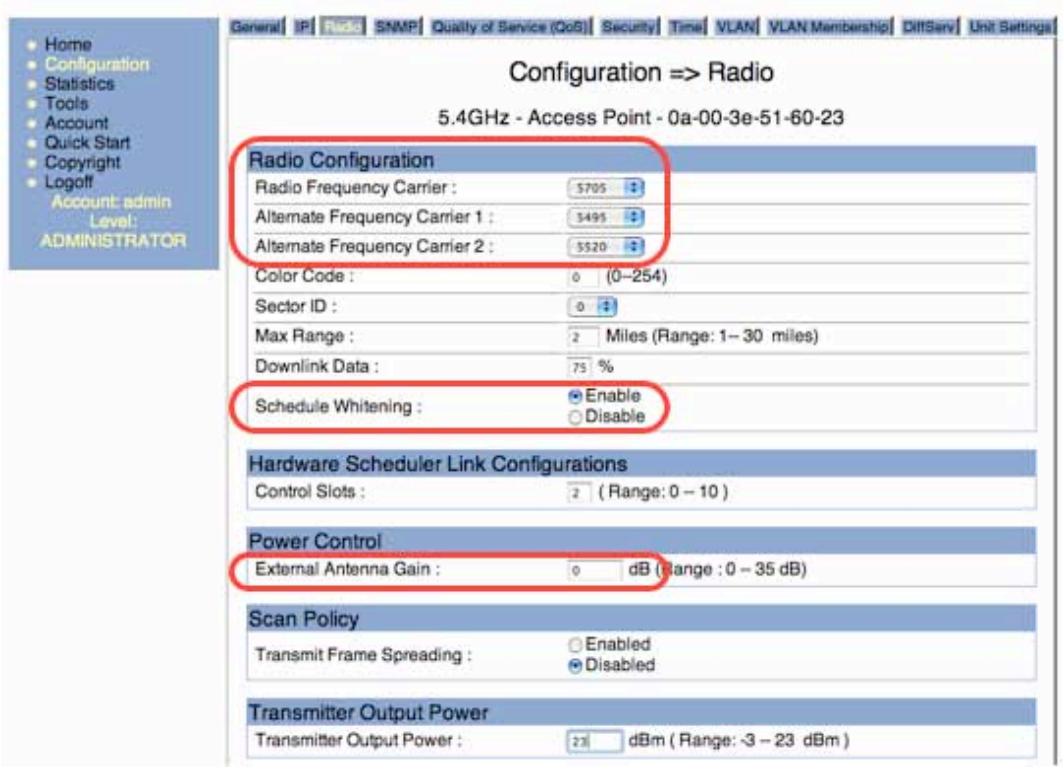


Figure 6: Alternate Frequencies, Whitening, and Antenna Gain on Configuration => Radio page

Configuration => Radio => External Antenna Gain

The GUI on modules running DFS includes an “External Antenna Gain” field, as shown in Figure 6. Enter the gain of any external antenna or reflector in this field, and the module will adjust its DFS sensitivity to radar signals so as to avoid false positives caused by the additional gain. Typical External Antenna Gain values are shown in Table 5.

Table 5: Typical "External Antenna Gain" Values

For this installation	Enter this value in the “External Antenna Gain” field
Canopy module with integrated patch antenna (no external antenna)	0
Canopy module with integrated patch antenna and 9 dB Canopy Lens	9
Canopy module with integrated patch antenna and standard 18 dB reflector	18
Connectorized Canopy module with a 15.5 dBi antenna and 0.5 dB cable loss	15

The value entered in the External Gain field does not affect the transmitter power. The radio transmits at the level entered in the Transmitter Output Power. The module only uses the values

entered in the External Antenna Gain field to adjust DFS sensitivity, not to change transmitter power.

Configuration => Radio => Schedule Whitening

"Whitening" is a transmission technique that changes the energy pattern so as to avoid peaks that could be interpreted as radar and trigger DFS. Whitening is not part of the DFS specification, but rather is a technology used by Canopy to reduce or eliminate false positives from self-interference, and is recommended for all sectors, especially those in frequency bands running DFS in your country or region.

Whitening is enabled on the Configuration => Radio page of an AP or BHM, using the parameter "Schedule Whitening", as shown in Figure 6.

Once Whitening is enabled on an AP or BHM, SMs or BHSs must be running at least Release 8.2 to register to that AP or BHM. SMs or BHSs running previous releases will not register to an AP or BHM that has Whitening enabled.

IMPORTANT!

Ensure all SMs or the BHS in a sector are running at least Release 8.2 before enabling "Schedule Whitening" on the AP or BHM.

Similarly, once an AP is enabled for Whitening, any SMs added to that sector must first be upgraded to at least Release 8.2.

IMPORTANT!

Especially in bands using DFS in your country or region, *do* enable "Schedule Whitening" on the AP after a sector is upgraded to Release 8.2, as it significantly reduces the potential for self-interference causing DFS false positives.

2.2 HIGHER PACKET PROCESSING RATE

Release 8.2 (and Release 8.2.1) increases the benchmark for maximum packet processing throughput of a module by over 25% - from 3000 packets per second when running Release 8.1 to 3800 packets per second when running Release 8.2.1.

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

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.

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).

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. To have a reproducible measurement, the following benchmark is defined:

System configuration

The benchmark system is composed of 2 SMs and 1 Advantage AP, as shown in Figure 7. 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 100 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)

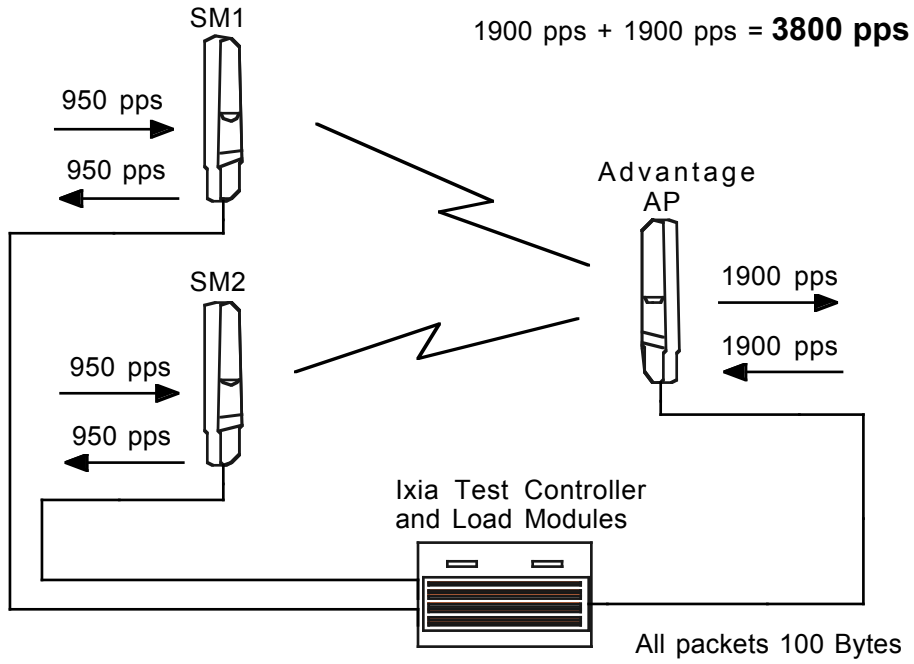
Measurement technique

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%).

Confirm results by running longer tests at selected load rates.

Confirm results by varying Downlink/Uplink Load Ratios to ensure no significant changes around the 50% benchmark.

Figure 7: Test Setup and Results



2.2.4 Results

When running Release 8.2.1, the benchmark gives a result of roughly 3800 packets per second. In comparison, P9 series modules running Release 8.1 benchmark at roughly 3000 packets per second.

3 Issues Resolved in Release 8.2 and Release 8.2.1

Release 8.2.1 resolves the issues listed in Table 6

Release 8.2 resolved the issues listed in Table 7.

Table 6: Issues Resolved in Release 8.2.1

Description	Discussion and Recommendations
P10 series hardware Ethernet lock-up (ID 5512)	Release 8.2.1 resolves all known cases of Ethernet lock-ups on P10 series hardware. Under some traffic conditions, the Ethernet port on P10 series modules running previous releases would lock up. Although more often seen in the field on P10 APs, the lock-up could also happen on P10 SMs or BHs, depending on traffic. Recovery has been through power cycling or rebooting (the module was still accessible from the RF side). **It is strongly recommended that all P10 modules be upgraded to Release 8.2.1.** In addition, either ◦ set Auto Negotiation on both ends of an Ethernet link and ensure both ends share at least one option in common (among 10 Base T Half Duplex, 10 Base T Full Duplex, 100 Base T Half Duplex, and 100 Base T Full Duplex) ◦ or manually set both ends of an Ethernet link to the same configuration (10 Base T Half Duplex, 10 Base T Full Duplex, 100 Base T Half Duplex, or 100 Base T Full Duplex) Auto Negotiation is not “Auto-sense” – best practice is for either both ends to be using the Auto Negotiation procedure, or neither end. For example, setting an SM to 10 Base T Full Duplex and a connected PC to Auto Negotiation will result in data collisions. The Ethernet port does not lock up in this case, but a downlink FTP session will be dropped. In this example, the FTP session drops can be avoided by either setting the PC to 10 Base T Full Duplex, or setting the SM to Auto Negotiation by checking at least 2 of the 4 link speeds: 10 Base T Half Duplex, 10 Base T Full Duplex, 100 Base T Half Duplex, and 100 Base T Full Duplex.
Issue with DHCP server on NATted SMs on Release 8.2 (ID 5827)	SMs running Release 8.2 and enabled for NAT did not provide reliable DHCP server functionality. This is now fixed.
Improved resistance to noise on sync over power over Ethernet (ID 5449)	Gives additional margin for operation, which may help in some cases where an AP or BHM is taking re-registrations due to sync issues.

Description	Discussion and Recommendations
Ethernet CRC errors on P10 modules (ID 5764)	Under traffic, P10 boards reported a low number of Ethernet CRC errors. This is now fixed.
Erroneous “out errors” counts (ID 5764)	“Out errors” statistic counts on P10 boards incremented erroneously. This is now fixed.
Reduced throughput on NATted AES SMs (ID 5058)	AES SMs enabled for NAT were exhibiting reduced throughput. This is now resolved.
Auto reset on NATted P10 SMs (ID 5935)	With very low occurrence, a P10 SM with NAT enabled would incur a stack dump, and the module would reboot. This is now fixed.
Disable Transmit Frame Spreading on 900 MHz APs (ID 5750)	Transmit Frame Spreading is now automatically disabled on 900 MHz APs as it does not support the frame size used with 900 MHz systems. Release 8.2 removed Transmit Frame Spreading as a configuration option on 900 MHz APs. Release 8.2.1 ensures it is disabled, even if enabled before the upgrade to Release 8.2.1.
Nonapplicable “External Antenna Gain” field on 900 MHz (ID 5846)	900 MHz modules were showing the “External Antenna Gain” field. This field is only applicable to modules using DFS, and should not be displayed for 900 MHz. The field is removed for 900 MHz in R8.2.1. (Its contents were ignored previously.)
Inaccurate indication on 5.4 GHz P10 Lite SMs (ID 5926)	Some 5.4 GHz P10 Lite SMs were displaying an antenna type of "External (Connectorized)", even though no Lites are connectorized. This is now fixed.
SNMP omission for connectorized P9 5.7 GHz modules (ID 5888)	On connectorized P9 5.7 GHz APs and BHMs, carrier frequency (including DFS Alternate Frequency Carriers) could not be set using SNMP. This is now fixed.
Inaccurate response to BH SNMP query (ID 5839)	BHMs and BHSs with Software Release 8.2 show up as SMs when doing a SNMP query. This is now fixed.
SNMP MIB formatting errors (ID 5767)	Fixed some MIB syntax that was causing some MIB parsers to report errors.

Table 7: Issues Resolved in Release 8.2

Description	Discussion and Recommendations
P10 series hardware Ethernet lock-up (ID 5642)	Release 8.2 resolved many cases of Ethernet lock-ups. Under some traffic conditions, the Ethernet port on P10 series modules running previous releases would lock up. Although more often seen in the field on P10 APs, the lock-up could also happen on P10 SMs or BHs, depending on traffic. Recovery has been through power cycling or rebooting (the module was still accessible from the RF side).
Actual CIR values double when operating at 2X. (ID 986)	Entries of 100 kbps in an SM's Configuration => Quality of Service (QoS) page would result in a CIR (Committed Information Rate) of 100 kbps up and down during 1X operation, and 200 kbps up and down during 2X operation. This is now fixed so the configured CIR is delivered regardless of 1X or 2X operation.
Under some conditions, the High Priority channel does not function correctly. (ID 4600)	When an SM with High Priority enabled (P9 or P10) would lose connectivity and re-register before the AP had timed out the session, the uplink high priority channel was not reestablished. This is now fixed. Some additional notes: Upon initial registration, the High Priority channel was bidirectional. It was only after a re-reg that it became unidirectional. The High Priority channel is often used in VoIP applications. Release 8.2 and prior Release 8 versions only support a High Priority channel on P9 and P10 series hardware, not P7 and P8.
Auto reset associated with NAT and Public DHCP Client (ID 4782)	This issue occurred occasionally and was associated with using NAT and DHCP Client and having the Radio Public RF IP address on a different subnet than the SM Public NAT IP address. Along with the auto reset, the Event Log also contained a stack dump when the issue occurred.
Transmit Frame Spreading should not be an option on 900 MHz APs (ID 5586)	Transmit Frame Spreading does not support the frame size used with 900 MHz systems, and should not be an option. Do not use Transmit Frame Spreading on 900 MHz systems.
PDA Aim Page does not auto update (ID 4759)	The PDA Aim page (PDA => AIM on the SM GUI) did not auto update. Other pages refresh at the interval set in the Webpage Auto Update field on the Configuration => General page, and now the PDA Aim Page does also.
On P10 hardware, Carrier Sense Lost and No Carrier statistic counts are erroneous (ID 3814, 4484)	On newer, P10 series hardware, Ethernet packets transmitted over the wired interface were causing CarSenseLost and No Carrier statistics to increment erroneously. Functionality was not affected, but the statistic would report erroneously high. CarSenseLost (Carrier Sense Lost) and NoCarrier is shown on each module on the Statistics > Ethernet page. This is now fixed.
A connectorized radio always displays "Vertical" antenna polarity (5327)	The parameter name has changed to "Antenna" and will display values of "Horizontal", "Vertical", or "External (Connectorized)" as appropriate.

Description	Discussion and Recommendations
Connection error when using NAT, DHCP, and a hub or switch (ID 4711)	This issue happened when • using NAT on an SM, and • more than 1 device was bridged to the Ethernet port of the SM, usually through a switch or hub. After an SM rebooted, the NAT DCHP tried to assign the first IP address in the pool to the first device (computer, router) to make a DHCP request, even if that IP address was previously assigned to a device already on the subnet. This is now fixed.
With no users configured, you can log in with any user name (5088)	The top of the page will now indicate there are no configured accounts, to avoid the possibility of mistakenly believing the module is protected with a log in and password, just because one was used to access the module.
When adding a new user “Confirm Password” is irrelevant (ID 4708)	When adding a new user through the GUI, even if the “Confirm Password” was different from the “New Password”, the operation would still be successful. This is now fixed.
Session Status page takes too long to load, may cause AP reset (ID 5423)	On an AP with a large number of SMs, the Session Status page could take many seconds to load, and in some cases cause an AP reset. This is now fixed – the page should take less than a second to load.
IP address not clear when NAT and DHCP is enabled (ID 4765)	Changed to match the Network Interface page on the radio, and added additional LAN information for SM with NAT and public RF on.
Special VLANs: 0 and 4095 (ID 4706) Also, VLAN 1 reserved for system use.	VLAN 0 and VLAN 4095 are special cases per the IEEE specs. VLAN 0 packets should carry an 802.1p priority but otherwise should be handled as if they were untagged packets. VLAN 4095 is reserved for internal use. With R8.2, Canopy now handles these VLANs per the specs. Because of this, VLAN 0 should not be used as a management VLANs, and VLAN 4095 cannot be used at all. Also note, VLAN 1 is not available for operator use. VLAN 1 is used internally to identify traffic that was untagged when entering the SM and should be untagged when it leaves the system. This is hard-coded (not configurable) at the AP. As such, VLAN 1 cannot be used for system VLAN traffic.
No ARP stats page (ID 4774)	The ARP table is useful when troubleshooting DHCP behavior on a network. The table is restored.
CNUT Customer Support Tool can lock-up HTTP to radio (ID 4781)	The use of the CNUT Customer Support Tool, used to gather information on a module, could result in locking up HTTP access to the module. The lock-up might or might not also block Telnet access. This is now resolved.

Description	Discussion and Recommendations
RCV SEQ START removed from Frame calculator (5155)	The RCV SEQ START value has been returned to the Frame Calculator. This value is needed by operators when the Frame Calculator is used to engineer collocation.
SNMP – ColdStart trap not being sent (ID 3273, 5106)	ColdStart traps were not being sent properly, affecting monitoring by Prizm or other SNMP systems.
SNMP – Accessing Subnet parameter has restricted subnets (ID 4763)	Release 8.1 required SNMP Accessing Subnet masks of /8, /16, /24 , or /32. With Release 8.2, all /x subnet masks work. The Accessing Subnet field is configured on the Configuration => SNMP page of a module.
SNMP – Same OIDs for two objects (ID 4766)	There were two objects with the same OID 1.3.6.1.4.1.161.19.3.2.2.20: enterprises.mot.whispRoot.whispProducts.whispSm.whispSmStatus.dhcpServerTable enterprises.mot.whispRoot.whispProducts.whispSm.whispSmStatus.adaptRate
SNMP – “SNMP IP Accessing Subnet” changes take place immediately, without a reboot (ID 4625)	Changes to the SNMP Accessing Subnet field on a module’s Configuration => SNMP page now require a reboot. (Changes that can affect transport or management connectivity are designed to require a Save Changes and a Reboot, which gives more opportunity to recover before committing to the change.)
SNMP – No OID for retrieving uplink link test result (ID 4663)	Fixed. There were two OIDs for Downlink Index (.1.3.6.1.4.1.161.19.3.1.2.2.8, .1.3.6.1.4.1.161.19.3.1.2.2.9) but no OID for Uplink Index.
SNMP – Inconsistent naming in WHISP-SM MIB file (ID 4595)	Inconsistent naming previously for rate adapt object in WHISP-SM-MIB.txt file – line 1068 is: “twoXRate,”, while line 658 is: “smRateAdapt OBJECT-TYPE”. Now both are smRateAdapt..
SNMP – Inconsistency adding users modules (ID 4707)	When using OIDs username, userPassword, and userAccessLevel (.1.3.6.1.4.1.161.19.3.3.2.45-47) to add a “user” (administrator or installer) to a module, the SNMP set appeared to be successful, but the new user was not created on the module. Now the new user is created successfully.

4 Known Open Issues and Notes for Release 8.2.1

Table 8 lists known issues and special notes for Release 8.2.1.

Table 8: Open Issues and Notes for Release 8.2.1

ID	Description	Severity or Note	Discussion and Recommendations
5939	Auto-resets on AP with over 135 SMs and authentication enabled	major	An AP with a large number of SMs (over 135) and with authentication enabled (and therefore using Prizm or BAM) can take periodic, repeated auto-resets. This issue is not specific to Release 8.2.1. If you see this behavior, please call technical support for support with a work-around.
4706	Blank screen after logging into SM through AP Sessions Status page	minor	In some instances, depending on network activity and network design, the user gets a blank screen after logging into an SM through the AP's Sessions Status page. Workaround: Refresh your browser window
5570	After setting the Region Code, must reboot to see related options	note	For most settings, a "Save Changes" displays context-appropriate options. However, after setting Region Code, "Save Changes" and "Reboot" is needed to see related options.
4767	Bootp Client filter blocks SM's DHCP of its IP address	note	Don't configure an SM to request its IP address via DHCP by enabling the DHCP State (on the module's Configuration => IP page), and then block that request by enabling the Bootp Client Packet Filtering (on the Configuration => Protocol Filtering page). Since filters are applied to all packets leaving the RF side of the SM, including packets generated by the SM, and since DHCP uses bootp, this configuration blocks itself. If it is desired to enable DHCP on the SM and avoid ill effects from errant DHCP requests from subscribers, enable the Bootp Server Packet Filtering on all SMs in the sector (so responses are filtered/discarded), instead of the Bootp Client filter.
3463	VLANs below a NATted SM are not supported	note	When NAT is enabled at the SM, VLANs are not supported on the wired side of that SM. (Note, this does not preclude using NAT on SMs on a sector which has VLAN enabled, but may constrain some VLAN network designs.)

ID	Description	Severity or Note	Discussion and Recommendations
4831	Details on “pinging” Canopy modules	note	"Pinging" Canopy modules using ping sizes larger than 1494 bytes will not succeed and will time out. This does not preclude pinging systems beyond the Canopy module with larger packets. Canopy modules can transport larger packets, but the protocol stack used for packets addressed to Canopy modules does not support ICMP messages ("ping" uses ICMP) larger than the maximum Ethernet packet size of 1518 bytes (1494 IP + 16 Ethernet header + 4 VLAN + 4 CRC = 1518 bytes). “Pinging” a module under load will not give a good indication of system latency time because the Canopy protocol stack does not put priority on responding to pings. Pinging a system (router, PC, etc.) beyond the Canopy system will give a better indication, as those pings are transported through the Canopy system with the priority given to all transport traffic.
5298	AP Listed twice in the AP Evaluation List	note	The AP Evaluation list contains old entries for up to 15 minutes to aid in aiming. So if an AP has its frequency changed, for 15 minutes it will show up in the AP Evaluation list twice, once under the old frequency, and once under the new.
None	When adding passwords to a module, ensure both “root” and “admin” accounts get passwords	note	Beginning with Release 8.1.4, a module fresh from the factory (or after being reset to factory defaults by the operator) has two user accounts: “root” and “admin”, both with ADMINISTRATOR level permissions. To secure the modules, add passwords to both accounts, using the Account > Change Users Password web page. (Adding a password to only one account still leaves the other open.) Alternatively, delete the “admin” account. Do not delete the “root” account as it is used by CNUT and Prizm to manage the module.
4789	Lowest settable Transmit Power varies	note	The low end of the Transmit Power can vary from radio to radio due to manufacturing tolerances. If you set this parameter to lower than the range capable on a given radio, the value is automatically reset to the lowest value that radio is capable of. Note, the high end of the range of settable Transmit Power does not vary from radio to radio.

ID	Description	Severity or Note	Discussion and Recommendations
4844, 2756	When using Link Test with MIR, need to set both ends	note	Link Tests (Tools => Link Capacity Test) can be run with MIR enabled to see the effects of MIR capping. To get meaningful results, “Link Test with MIR” (on the Tools => Link Capacity Test page) must be “Enabled” on both the SM and the AP. If “Link Test with MIR” is only enabled on one end, the results will be misleading. After running a link test with MIR capping enabled, consider immediately changing “Link Test with MIR” to “Disabled” on both the SM and the AP, so you don’t leave capping on one end of the link test by mistake.
5284	Click Spectrum Analyzer “enable” button twice	note	After clicking the “enable” button on the Spectrum Analyzer page, the first “painting” may not display bars for all frequencies, especially on frequency bands with a large number of center channels, like the 5.4 GHz band. Clicking “enable” again will display the entire spectrum bar graph. Tip: Set the “Web Refresh” time on the Configuration => General page to a few seconds to have the Spectrum Analyzer automatically fully displayed and refreshed. (Setting the “Web Refresh” time back to 0 will disable refresh.)
5407	5580 through 5670 may interfere with weather radar, not allowed in Canada and Australia	note	Canopy center channel frequencies of 5580 MHz through 5670 MHz may interfere with, or be interfered by, weather radar in the US, Canada, and Australia. In Canada and Australia, to be in regulatory compliance, operators must not transmit on these frequencies. Setting the Region Code to Canada or Australia notches out these frequencies and ensures compliance. In the US, while performing a site survey operators 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.

5 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 8.2.1.

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 the Prizm System: Skip this section on MIBs. Prizm software includes the MIB information. The operator does not need to load MIB files when using the Prizm system.

If you are not using an SNMP Network Management System: Skip this section on MIBs.

If you are using an SNMP Network Management System or Element Management System other a Prizm system: Load the MIBs per the instructions for your NMS or EMS.

Important! When loading the Canopy MIB files,

- First load the three standard MIB files,
- 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 will avoid any issues with loading sequence.

6 Upgrading to Release 8.2.1

6.1 BEFORE YOU BEGIN

6.1.1 Applicability

Release 8.2.1 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 8.2.1 is **not** applicable to

- Series P7 and P8 APs and BHs (Release 8.2.1 only supports hardware scheduling, and Series P7 and P8 APs and BHs do not run hardware scheduling)
- Series P7 and P8 AES modules of any type (AES encryption is not supported on P7 or P8 modules running hardware scheduling)
- PTP 400 Series (formerly 30/60 Mbps) Backhaul modules
- PTP 600 Series (formerly 150/300 Mbps) Backhaul modules
- CMMs (Cluster Management Modules)
- Powerline MU Gateway and Modem
- Canopy T1/E1 Multiplexer

6.1.2 Upgrade only modules running Releases 8.1.5, 8.1.5.1, 8.1.5.6, or 8.2

The tested, supported upgrade path is from Release 8.1.5, 8.1.5.1, 8.1.5.6, or 8.2 to Release 8.2.1.

Releases 8.1.5.1 and 8.2 are previous field releases. Modules and sectors running Releases 8.1.5.1 or 8.2 are upgradeable directly to Release 8.2.1. Modules and sectors running Releases prior to Release 8.1.5.1 should first be upgraded to Release 8.1.5.1, following the upgrade path shown in Figure 8. For details on upgrading to Release 8.1.5.1, please see the Release 8.1.5.1 Release Notes available on the Canopy web site at http://motorola.canopywireless.com/support/software under Canopy System Software.

P10 series modules have been shipped pre-loaded with Releases 8.1.5, 8.1.5.6, and 8.2. These modules are upgradeable directly to Release 8.2.1.

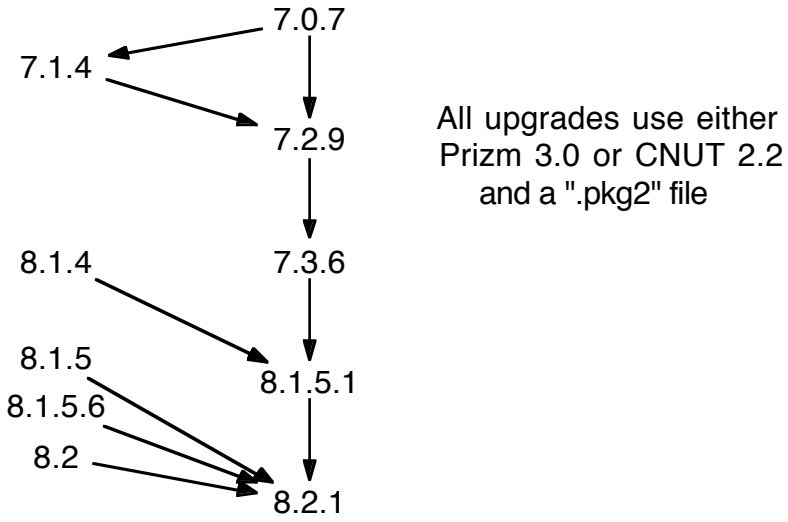


Figure 8: Supported Upgrades

6.1.3 Upgrade using Prizm 3.0 or CNUT 2.2 (Canopy Network Updater Tool)

Either Prizm 3.0 or CNUT 2.2 may be used to upgrade modules to Release 8.2.1.

Prizm is an Element Management System offered by Motorola that provides a host of monitoring and management functions. With Prizm 3.0, module upgrade has been integrated into Prizm. In addition, a Prizm 3.0 update provides “device templates” to support new features in Release 8.2, including the ability to set Region Code across multiple modules and set Alternate Frequencies and Whitening across multiple APs.

Prizm 3.0 does not include the Hardware Scheduler Update tool, so sectors running software scheduling must first be switched to hardware scheduling using CNUT 2.2 before using Prizm 3.0 to manage upgrades. For details on switching to hardware scheduling, see previous Release Notes, especially Release Notes for Release 7.3.6.

Operators running Prizm releases previous to Release 3.0 should consider upgrading to Prizm 3.0 first, then using Prizm 3.0 to upgrade their Canopy modules to Release 8.2.1.

For more information and details on installing Prizm 3.0 on a PC or Linux machine, see http://motorola.canopywireless.com/products/prizm.

CNUT (Canopy Network Updater Tool) is a free tool for upgrading Canopy modules.

For more 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 to CNUT 2.2.

CNUT 2.2 and Prizm 3.0 use packages ending with “.pkg2”. Earlier packages ending with “.pkg” cannot be used with CNUT 2.2 and Prizm 3.0.

6.1.4 Upgrade using the latest .pkg2 packages

Download Canopy System Software Release 8.2.1 from the “Canopy System Software” section of http://motorola.canopywireless.com/support/software/. This will download a zip file named

Canopy_8.2.1_DES.zip (or Canopy_8.2.1_AES.zip for AES modules). The zip file contains CANOPY821_DES.pkg2 (or CANOPY821_AES.pkg2 for AES modules) which Prizm 3.0 or CNUT 2.2 can use to upgrade BHs, APs, or SMs to Release 8.2.1, as well as the lastest release notes and MIB files.

6.2 PROCEDURES TO UPGRADE TO RELEASE 8.2.1

The following steps should be used for upgrading to Release 8.2.1. 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.

6.2.1 Prepare CNUT or Prizm for the Upgrade

1. Plan your upgrade. Many operators perform an upgrade on a lab system or a friendly 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. Obtain the following from the Canopy web site at http://motorola.canopywireless.com/support/software/
   - Canopy System Software for Release 8.2.1
   - Canopy Network Updater Tool (CNUT) 2.2 for Windows or Linux and CNUT 2.2 Release Notes. Note, CNUT 2.2 is a big download (~50 MB) that contains the correct release of Java in order to simplify installation and use of CNUT. Separate installation of Perl is no longer required with CNUT 2.2.

   OR

   - Use previously installed Prizm 3.0
3. Install CNUT on a PC or a Linux machine using the CNUT 2.2 Release Notes.

   OR

   Use previously installed Prizm 3.0

4. If you don't have a previously stored network 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 you establish in the outline view. This should be the connectivity as viewed from the point you connect to the network, *not* necessarily your network hierarchy (depending on where you connect to your network to do the update). When CNUT or Prizm "discovers" the network, it will update any elements that are misnamed, but CNUT or Prizm relies on the connectivity information you enter in the outline view to manage the network update and step through the infrastructure elements during update.

6.2.2 Perform the Upgrade using CNUT or Prizm

1. Enter the password(s) for the root login accounts of all modules you are upgrading into CNUT or Prizm.
2. Refresh/Discover Entire Network to find information on your network elements, and auto-detect all your SMs.
3. Add the Canopy 8.2.1 .pkg2 to CNUT or Prizm: CANOPY821_DES.pkg2 (or CANOPY821_AES.pkg2 for AES modules).

4. Just before doing any updates, use Refresh/Discover to confirm all SMs are active before upgrading.
5. Choose the elements you wish to update at this time – a selection of elements, a network branch, or the entire network. As mentioned before, most operators will plan to gain experience by upgrading a portion of their network at a time, depending on network size and their own operations procedures.
6. Update, and monitor the update's progress.
7. After the update is complete, Refresh/Discover to confirm all elements have updated.
8. To update SMs that do not have Publicly Accessible IP addresses, turn on SM Auto-update on the APs that those SMs are registered to.
9. Confirm the upgrade is complete by verifying that the Software Version is shown as CANOPY 8.2.1.

   Occasionally an SM will complete the software loading and fail to reboot, or in reality reboot but CNUT or Prizm will display a messages such as "Reboot failed" or "Failed to find Element in update. Cannot open new telnet connection to device." In these cases, where it appears the sector in general has upgraded successfully and is stable on Release 8.2.1, first try a Refresh/Discover. If that doesn't result in CNUT or Prizm showing the SM successfully on the new release, consider rebooting a recalcitrant SM to see if that will bring it up on Release 8.2.1.
10. Disable SM Auto-update on CNUT or Prizm, per CNUT or Prizm instructions.

6.2.3 Set Region Code

After a sector or link or standalone module has been upgraded to Release 8.2.1, confirm the Region Code on each module is set to the local region. If needed, set the Region Code correctly on each module, Save Changes, and Reboot. See Section 2.1.2 on page 15 for details.

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.

6.2.4 Set DFS Parameters

Confirm the Region Code is set correctly. If not, set it correctly, Save Changes, and Reboot. Now check to see if the following parameters are displayed on the Configuration => Radio page. ("Alternate Radio Frequency Carrier" and "External Antenna Gain" parameters will only appear on 5.2, 5.4, and 5.7 GHz modules in certain regions, and indicate DFS is active on the module.)

- Alternate Radio Frequency Carriers
- External Antenna Gain
- Schedule Whitening

If so, set them following the procedures in Section 2.1.2 on page 15.

7 Collocation

7.1 COLLOCATING 5.2 GHZ AND 5.4 GHZ MODULES

5.4 GHz radios set to center channel frequencies of 5595 MHz and below produce a signal 280 MHz below their center channel that can interfere with closely collocated 5.2 GHz radios, as shown In Table 9. Because of this, care needs to be taken in choosing 5.4 GHz channels when collocating with 5.2 GHz systems. 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 modules, or in cases of partial clusters of 5.2 GHz select 5.4 GHz channels that won't interfere.

Table 9: 5.4 and 5.2 GHz Interfering Frequencies

This 5.4 GHz 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

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.

But if I use sync from a CMM and ensure compatible receive start times (see Section 7.3), don't I avoid collocation issues? No, using sync and ensuring compatible receive start times are necessary to avoid other collocation issues, but don't help this collocation issue since the interfering signal is present at all times, during transmit and receive.

7.2 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 in Section 7.3.

Alternatively,

- Provide 100 ft (30 m) of vertical separation between the 5.4 GHz and 5.7 GHz modules.
- If 100 ft (30 m) of vertical separation is not possible, provide as much vertical separation as practical, 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.

As an example, when collocating a cluster of 6 5.4-GHz APs with a cluster of 6 5.7-GHz APs, all hardware scheduled, set them all for the same range, downlink data %, and control slots, and use standard frequency re-use within each cluster (ABCABC).

As another example, when collocating a cluster of 6 5.4-GHz APs with a reflectorized 5.7-GHz BH, provide 100 vertical feet of separation. If not possible, choose channels for the APs that are at the bottom of the 5.4-GHz band, choose a channel for the BH that is at the top of the 5.7-GHz band, locate the modules so the reflector on the BH shields the APs from the BH module, ensure the over-illumination around the edges of the reflector is not directed at the APs, and confirm with simultaneous link tests.

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 separate? 5.4 GHz and 5.7 GHz modules 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.

7.3 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. When collocating modules in the same frequency band,

- Within the same band, only collocate one type of module (APs OR BHMs OR BHSs)
- Use a CMM so transmit start times are in sync
- Use identical module type and scheduler type (hardware or software) and set identical range, downlink data %, and slot settings, or use the Frame Calculator (see Section 7.2) 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.

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. Any module’s frame calculator can be used to perform all frame calculations. The operator enters settings into the calculator, and the calculator outputs details on the frame including a value called “Uplink Rcv SQ Start”.

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”.

Alternatively,

- 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 practical, 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.

A system under no load with SMs registered and able to communicate indicates basic connectivity, but does not necessarily ensure the system will function well under heavy load. Design more conservatively, and interference issues won’t be hidden under light loads only to cause issues when the system gets heavily loaded.

8 Regulatory and Legal Notices

8.1 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.

8.2 NATIONAL AND REGIONAL REGULATORY NOTICES

8.2.1 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 10.

Table 10: 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	25 dBm (340 mW)
			2400 BH, SM	8 dBi internal + 11 dBi 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 or SM, only P10 Modules	7 dBi internal + 18 dBi reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dBi lens	14 dBm
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 dBi 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)
			5400 BH, SM	7 dBi internal + 18 dBi reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dBi lens	14 dBm
---	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)
			5400 BH, SM	7 dBi internal + 18 dBi reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dBi lens	14 dBm
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 dBi reflector	23 dBm (200 mW)
				7 dBi internal + 10 dBi lens	23 dBm (200 mW)

8.2.2 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 10.

This device has been designed to operate with the antennas listed in Table 10 and having a maximum gain as shown in Table 10. Antennas not included in Table 10 or having a gain greater than as shown in Table 10 are strictly prohibited from use with this device. Required antenna impedance is 50 ohms.

8.2.3 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**:** Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: Bulgaria, Bosnia and Herzegovina, Turkey

The following countries have a limited implementation of CEPT Recommendation 70-03 Annex 3A:

- France - Outdoor operation at 100mW is only permitted in the frequency band 2400 to 2454 MHz;
    - Any outdoor operation in the band 2454 to 2483.5MHz shall not exceed 10mW (10dBm);
    - Indoor operation at 100mW (20dBm) is permitted across the band 2400 to 2483.5 MHz
- French Overseas Territories:
    - Guadeloupe, Martinique, St Pierre et Miquelon, Mayotte – 100mW indoor & outdoor is allowed
    - Réunion and Guyana – 100mW indoor, no operation outdoor in the band 2400 to 2420MHz
- Italy - If used outside own premises, general authorization required
- Luxembourg - General authorization required for public service
- Romania - Individual license required. T/R 22-06 not implemented

Motorola Canopy Radios operating in the 2400 to 2483.5MHz band 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 CE ⓘ to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC.

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 marked with the “CE” mark to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC.

Relevant Declarations 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.

8.2.4 European Union Notification

The 5.7 GHz connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses

required to operate this product and these must be obtained before using the product in any particular country.

This equipment is marked CE 0977 to show compliance with the European R&TTE directive 1999/5/EC.

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

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

Consequently, these 5.4GHz products are only marked with the CE symbol and may be used in any member state.

For further details, see http://europa.eu.int/information_society/policy/radio_spectrum/ref_documents/index_en.htm

8.2.5 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.

8.2.6 UK Notification

The 5.7 GHz connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK Interface Requirement IR2007 specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

8.2.7 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

8.2.8 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.

8.2.9 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.

8.2.10 Norway Notification

Use of the frequency bands 5725-5795 / 5815-5850 MHz are authorized with maximum radiated power of 4 W EIRP and maximum spectral power density of 200 mW/MHz. The radio equipment shall implement Dynamic Frequency Selection (DFS) as defined in Annex 1 of ITU-R Recommendation M.1652 / EN 301 893. Directional antennae with a gain up to 23 dBi may be used for fixed point-to-point links. The power flux density at the border between Norway and neighbouring states shall not exceed - 122.5 dBW/m^2 measured with a reference bandwidth of 1 MHz.

Canopy 5.7 GHz connectorized products have been notified for use in Norway and are compliant when configured to meet the above National requirements. Users shall ensure that DFS functionality is enabled, maximum EIRP respected for a 20 MHz channel, and that channel spacings comply with the allocated frequency band to protect Road Transport and Traffic Telematics services (for example, 5735, 5755, 5775 or 5835 MHz are suitable carrier frequencies). Note that for directional fixed links, TPC is not required, conducted transmit power shall not exceed 30 dBm, and antenna gain is restricted to 23 dBi (maximum of 40W from the Canopy 5.7 GHz connectorized products).

8.2.11 Greece Notification

The outdoor use of 5470-5725MHz is under license of EETT but is being harmonized according to the CEPT Decision ECC/DEC/(04) 08, of 9th July. End users are advised to contact the EETT to determine the latest position and obtain any appropriate licenses.

8.2.12 Brazil Notification

Local regulations do not allow the use of 900 MHz, 2.4 GHz, or 5.2 GHz Canopy modules in Brazil, nor do they allow the use of passive reflectors on 5.4 or 5.7 GHz Canopy Access Points.

For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 1 W (30 dBm). When using the passive reflector along with a 5.4 GHz Canopy radio, the transmitter output power of the radio must be configured no higher than 5 dBm. When not using the passive reflector, the transmitter output power of the radio must be configured no higher than 23 dBm.

The operator is responsible for enabling the DFS feature on any Canopy 5.4 GHz radio 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.

8.2.13 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.

8.2.14 China Regulatory

THIS TABLE IS INTENDED ONLY TO COMMUNICATE COMPLIANCE WITH CHINA REQUIREMENTS; IT IS NOT INTENDED TO COMMUNICATE COMPLIANCE WITH EU RoHS OR ANY OTHER ENVIRONMENTAL REQUIREMENTS

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。

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8.3 EXPOSURE SEPARATION DISTANCE

The following table shows separation distances that support applicable exposure limits:

Table 11: Exposure Separation Distances

Module Type	Separation Distance from all 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 a Canopy 900 MHz Module	At least 60 cm (approx 24 in)

8.3.1 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 12 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 12: Calculated Exposure Distances and Power Compliance Margins

Frequency Band	Antenna	Variable			d (calculated)	Recommended 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
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

Frequency Band	Antenna	Variable			*d* (calculated)	Recommended Distance	Power Compliance Margin
		P	*G*	S			
	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)	10 W/m^2	28 cm	50 cm (12 in)	3.13

The compliance distance is greatly overestimated in the reflector cases because the far-field equation neglects the physical dimension of the reflector, which is modeled as a point-source.

8.4 LEGAL NOTICES

8.4.1 Software License Terms and Conditions

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