



Canopy™ 900 MHz Access Point (AP) and Subscriber Module (SM)

User Guide

900-UG-en

Issue 1, Draft 1

June 2004

NOTICES

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.

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification

This device complies with part 15 of the U. S. FCC Rules and Regulations and with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the U.S. FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

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

FCC IDs and Industry Canada Certification Numbers are listed in the following table:

NOTE: FCC and Industry Canada Testing is in Progress. The following table is provisional until certification.

Module Types	Operating Frequency Range	Maximum Transmitter Power	Reflector or Antenna	FCC ID	Industry Canada Certification Number
SM AP	ISM 902 to 928 MHz	1W	Maxrad Model # Z1681, flat panel with 10 dBi gain Mars Model # MA-IS91-T2, flat panel with 10 dBi gain MTI Model #MT-2630003/N, flat panel with 10 dBi gain	ABZ89FC5809	109W-9000ISM

Exposure Note

The antenna of a Canopy 900 MHz module must be installed to provide a separation distance of at least 80 cm (approx 32 in) from all persons. When so installed, the module's RF field is within Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website <http://www.hc-sc.gc.ca/rpb>.

The maximum RMS power does not exceed 1W.

The applicable power density exposure limit is 10 Watt/m², according to the FCC OET Bulletin 65, the ICNIRP guidelines, and the Health Canada Safety Code 6. The corresponding compliance distances referenced above have been determined by assuming worst-case scenarios. The peak power density (S) in the far-field of a radio-frequency source with rms transmit power P and antenna gain G at a distance d is

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

In the case of a 900 MHz Canopy SM or AP with an antenna gain of 10 dBi (a factor of 10) and correctly entered in the user interface as a 10 dBi gain antenna, the peak power density equals the exposure limit at a distance of 18 cm. A power compliance margin of over 20 is artificially introduced by setting the distance to 80 cm.

Consider next the case of a 900 MHz Canopy SM or AP with a 12 dBi antenna (a factor of 15.85) set in error in the user interface as an 8 dBi gain antenna. In this case, the peak power density equals the exposure limit at a distance of 36 cm, still giving a power compliance margin of over 5.

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

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1 Introduction

This guide is designed for operators already familiar with the Canopy system who only want the “delta” or “difference” information for the Canopy 900 MHz Access Point and Subscriber Module. The information in this guide will be included in appropriate sections of the Canopy documentation set.

- If you are familiar with the Canopy system, want to know what is new with the 900 MHz modules, and don’t want to search through the general Canopy manuals, this guide is for you.
- If you are new to the Canopy system or need information across all the products and frequency bands in the Canopy family, you should use the general Canopy manuals, not this “differences” user guide.

To ensure you have the latest user information, check the manuals section of the Canopy web site at http://motorola.canopywireless.com/support_library.php#manual-en.

The following abbreviations are used throughout 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

1.1 Document Change History

Issue 1 Draft 1	• Succeeds Beta Issue 4 • Deleted information on integrated antenna. Information will be included in a future issue (Issue 2 or beyond) after FCC approval of the integrated antenna • Added exposure information and recommended distance • Emphasized requirement that external antennas be professionally installed
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1.2 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.

1.3 Technical Support

If problems arise, the Canopy support team is here to help. Here is the escalation path for resolution of a problem:

1. Check this document.
2. Escalate the problem to your Canopy supplier.
3. Escalate the problem to Canopy Technical Support or other designated Tier 3 technical support:

Canopy Technical Support

email: technical-support@canopywireless.com

1 888 605 2552

or

+1 217 824 9742

Hours of Operation:

Mon - Sun, 7am-11pm US Eastern Standard Time

When you send e-mail or call, please include the following information:

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

2 Feature Description and Operation

Each of the following sections describes features that are new or different or important with the introduction of Canopy 900 MHz APs and SMs.

2.1 3.3 Mbps Signaling Rate

Description

Canopy 900 MHz AP and SM modules operate at 3.3 Mbps (compared to 10 Mbps for other Canopy frequency bands). With Downlink Data set to 75%, the AP supports high aggregate throughput to an SM. As in other Canopy frequency bands, an AP has more bandwidth than an individual SM – it takes at least 2 SMs to fully load an AP.

Operation

Uplink and Downlink rates can be checked using the Link Test page on the AP. On an AP, select Expanded Stats, then Link Test.

Link Capacity Test

Duration: Seconds

Current Results Status
Stats for LUID: 2 Test Duration: 10
Downlink RATE: 1485619 bps
Uplink RATE: 346009 bps
Downlink Efficiency: 99 Percent
Max Downlink Index: 98
Actual Downlink Index: 97
Expected Frag Count: 29016
Actual Frag Count: 29773
Uplink Efficiency: 100 Percent
Expected Frag Count: 6758
Actual Frag Count: 6758

Figure 1: Link Capacity Test

2.2 Network Features Identical to 5.2 GHz, 5.7 GHz, and 2.4 GHz

Description

Canopy 900 MHz modules run the same software and provide the same network features as all other Canopy APs and SMs. NAT, color codes, SNMP, authentication, RSSI measurements, jitter measurements, AP connections to a CMM2 or CMMmicro, AES option, and so on all work the same as before.

Operation

Same operation as other frequency bands.

2.3 Available as AP and SM – no Backhaul

Description

AP and SM modules are available for building 900 MHz Point to Multi-point networks. Backhauls are not provided, as the narrower bandwidth available in the allocated 900 MHz frequency band does not lend itself to the capacity usually desired for backhauls.

2.4 Three non-overlapping channels

Description

The Canopy 900 MHz modules provide 3 non-overlapping channels within the allocated 900 MHz spectrum. Channels are 8 MHz wide, and can be set with RF Frequency Carrier (center of the channel) at 906, 907, 911, 915, 919, 923, or 924 MHz. For normal operation, it is recommended that the operator use

- 906 MHz for north and south facing APs
- 915 MHz for northeast and southwest facing APs
- 924 MHz for southeast and northwest facing APs

Note, this takes advantage of the spectrum available to provide 9 MHz between channel centers, 1 MHz greater than the minimum 8 MHz channel size, for additional channel separation.

Operation

On the AP Configuration page, set the RF Frequency Carrier parameter to the desired frequency as shown in Figure 2: Highlights of 900 MHz AP Configuration Page.

On the SM Configuration page, select/check the desired frequencies in the Custom RF Frequency Scan Selection List.

Depending on local practices, this may mean selecting all frequencies to scan (the SM will register to any frequency, but takes longer to scan), only one frequency to scan (forces the SM to only register to an AP on that frequency and minimizes scan time after SM reboot), or the three recommended AP frequencies of 906, 915, and 924 MHz (allows for an SM to “switchover” to an AP on another frequency if the one it is registered to fails or loses signal).

Multi Base 1 Full Duplex		
RF Frequency Carrier	915.0	Set MHz based on direction AP faces • 906 for north and south • 915 for northeast and southwest • 924 for southeast and northwest
Downlink Data	75 %	
High Priority Uplink Percentage	0 %	
Total NumUAckSlots	3 (Range: 1--7)	
UAcks Reserved High	0	Set to distance of furthest planned SM from AP cluster (but don't over-set - it doesn't give more power)
NumDAckSlots	3 (Range: 1--7)	
DAcks Reserved High	0	
NumCtlSlots	3 (Range: 1--16)	
NumCtlSlots Reserved High	0	Leave set to 0 always, regardless whether optional filters are installed
Sustained Uplink Data Rate	10000 (kbps) (Range: 0--10,000 kbps)	
Uplink Burst Allocation	10000 (kbits) (Range: 0--500,000 kbits)	
Sustained Downlink Data Rate	10000 (kbps) (Range: 0--10,000 kb)	
Downlink Burst Allocation	10000 (kbits) (Range: 0--500,000kbits)	Set to • 10 dBi for many external antennas • Check antenna info if not sure
Color Code	9 (0--254)	
Sector ID	0	
Max Range	2 Miles (Range: 1--120 miles)	
External Filters Delay	0 Nanoseconds	
Antenna Gain	15 dBi (Range: 8--32)	
Password	No Passw	

Figure 2: Highlights of 900 MHz AP Configuration Page

2.5 Range of 40 Miles LOS, Significant Foliage Penetration NLOS

Description

The Canopy 900 MHz modules have a Line-of-Sight (LOS) range of 40 miles (over 64 km), and substantial Non-Line-of-Sight (NLOS) range. NLOS range is dependent on foliage, topography, obstructions, and other RF engineering considerations. The physics of longer-wavelength 900 MHz, the power allowed by regulatory authorities, and the low Canopy Carrier-to-Interference (C/I) ratio combine to support service over these increased LOS and NLOS ranges.

While the expected typical range in real-world conditions is 40 miles, the AP can be set for a range up to 120 miles (over 190 km) to accommodate long shots with very clear Fresnel zone (possibly due to high tower or mountain top location) and quiet RF environment.

Setting the range higher tells the software to have a slightly longer switchover time between transmit and receive to accommodate longer air delay. This reduces the slots per frame available for data, which reduces aggregate throughput at the AP. However, the predictability of Canopy point-to-multi-point throughput continues. All SMs served by an AP set to a given range continue to have the same throughput regardless of their distance from the AP.

The 900 MHz modules complement the other frequency bands offered. The 900 MHz modules can be used to cover a larger area, albeit with lower throughput, than the other frequency bands. Depending on specific operator requirements, they can be used to penetrate foliage, have greater range, or add additional subscribers or additional overall throughput to a tower that is maxed out or can't use another frequency band due to interference or tower rights issues.

Operation

Set the Max Range parameter on the AP Configuration page to the distance of the furthest planned SM from the AP cluster, as shown in Figure 2: Highlights of 900 MHz AP Configuration Page.

Important!

- Don't over-set the range. Setting the range higher does not increase the power of the AP.
- Setting the range higher reduces aggregate throughput.
- All 900 MHz APs in a cluster must be set to the same Max Range.

2.6 Modules and Antennas available

NOTE: FCC and IC Testing is in Progress. The text in this section is provisional until certification.

Description

900 MHz AP and SM modules are initially available as connectorized units connecting to connectorized antennas. The following sections describe the module and antenna options.

Connectorized AP or SM

A connectorized 900 MHz AP or SM uses the same housing as a 2.4, 5.2, and 5.7 GHz module and has a 16 inch (approx 40 cm) cable with a male N-type connector for connecting to the antenna. It has a covered Ethernet port and utility port (for alignment headset, sync cable to CMM2, or override plug), the same as 2.4, 5.2, and 5.7 GHz modules.

Connectorized Subscriber Flat Panel Antenna

Motorola offers an external subscriber antenna, as shown in Figure 3: Subscriber 900 MHz Flat Panel Antenna. The attributes of this antenna include:

- 10 dBi gain
- 8.8" x 8.1" x 1.6" (22.4 x 20.6 x 4.06 cm)
- 1.2 lbs (0.54 kg)
- vertical or horizontal polarization
- 12 inch (30.5 cm) cable
- female N-type connector
- 3 dB beam width approximately 60° vertical and 60° horizontal



Figure 3: Subscriber 900 MHz Flat Panel Antenna

Other Connectorized Flat Panel Antennas

Motorola has certified an additional two antennas that are available through Canopy resellers. Third parties may also certify additional antennas for use with the Canopy connectorized 900 MHz module.

The attributes of one of these certified antennas (shown in Figure 4: Additional 900 MHz Flat Panel Antenna) is as follows:

- 10 dBi gain
- 12"x12"x1" (305x305x25 mm)
- 3.3 lbs (1.5 kg)
- vertical or horizontal polarization
- female N-type connector)
- 3 dB beam width 60° vertical and 60° horizontal

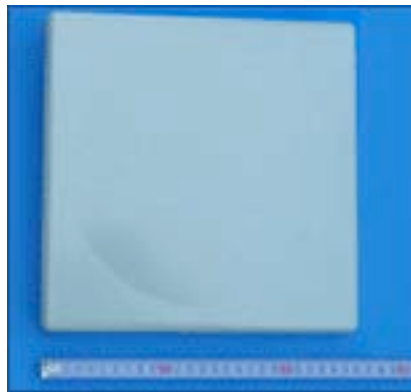


Figure 4: Additional 900 MHz Flat Panel Antenna

Operation

Important! Use of connectorized antennas requires professional installation. The professional installer is responsible for

- Selection of an antenna approved for use with the Canopy 900 MHz AP and SM by the national regulatory agency
- Setting of the gain consistent with the antenna and within regulatory limits
- Use of moisture sealant to increase long-term reliability of the connectorized connection

Enter the dBi gain of your antenna in the Antenna Gain parameter on the AP Configuration page, as shown in Figure 2: Highlights of 900 MHz AP Configuration Page.

For this antenna:	Enter this Antenna Gain:
900 MHz Flat Panel antenna available through Motorola	10 dBi
Additional Flat Panel antennas certified with regulatory agency by Motorola	10 dBi
Antenna certified by third party	Consult antenna documentation

Leave the External Filters Delay parameter on the AP Configuration page (see Figure 2: Highlights of 900 MHz AP Configuration Page at the factory default of 0 Nanoseconds, regardless of whether you have filters installed. (The External Filter Delay was included in the user interface in case it was needed, but turns out to never be needed – leave it set to 0.)

Important! To remain within the legal regulatory limits for antenna output power, you must not set the Antenna Gain parameter **lower** than the actual gain of your antenna. If you have a 10 dBi antenna, **do not** enter an Antenna Gain of 8 or 9. This parameter must be set equal to or higher than the actual gain of your antenna to remain within the legal regulatory limits for antenna output power.

The parameter has a range from 8 dBi to 32 dBi. When set to 8 dBi, the radio will have a power-out of 28 dBm to generate the legal maximum EIRP of 36 dBm (4 W). When set to 32 dBi, the radio will have a power-out of 4 dBm to again generate the legal maximum EIRP of 36 dBm (4 W).

Note! In some circumstances, it may be advantageous to set the parameter **higher** than the actual gain of your antenna. This reduces the power (and range) of the link, and may be useful to control RF emissions and reduce multi-pathing and jitter in some situations.

Important! When using connectorized antennas, the connector can be a point of failure over time due to water egress. Accepted industry practices should be used to apply sealant and wrap the connector to prevent water egress.

The male and female N-type connectors form a gas tight seal with each other, but the point where the cable enters each connector can be a point for water egress, with eventual corrosion and failure of the connection. Sealing and wrapping is critical to long-term reliability of the connection.

2.7 Spectrum Analyzer

Description

The Canopy 900 MHz SM provides a spectrum analyzer much like 2.4, 5.2, and 5.7 GHz SMs, as shown in Figure 5: 900 MHz SM Spectrum Analyzer. Due to the heavy general use of the 900 MHz spectrum, it is advisable to use the SM's built-in spectrum analyzer or other equipment to confirm the RF environment both at AP and at SM locations during site surveys.

Operation

On the SM, click on Expanded Stats, then on Spectrum Analyzer. Click Enable several times to scan and collect data, then click Disable to return the SM to normal mode.

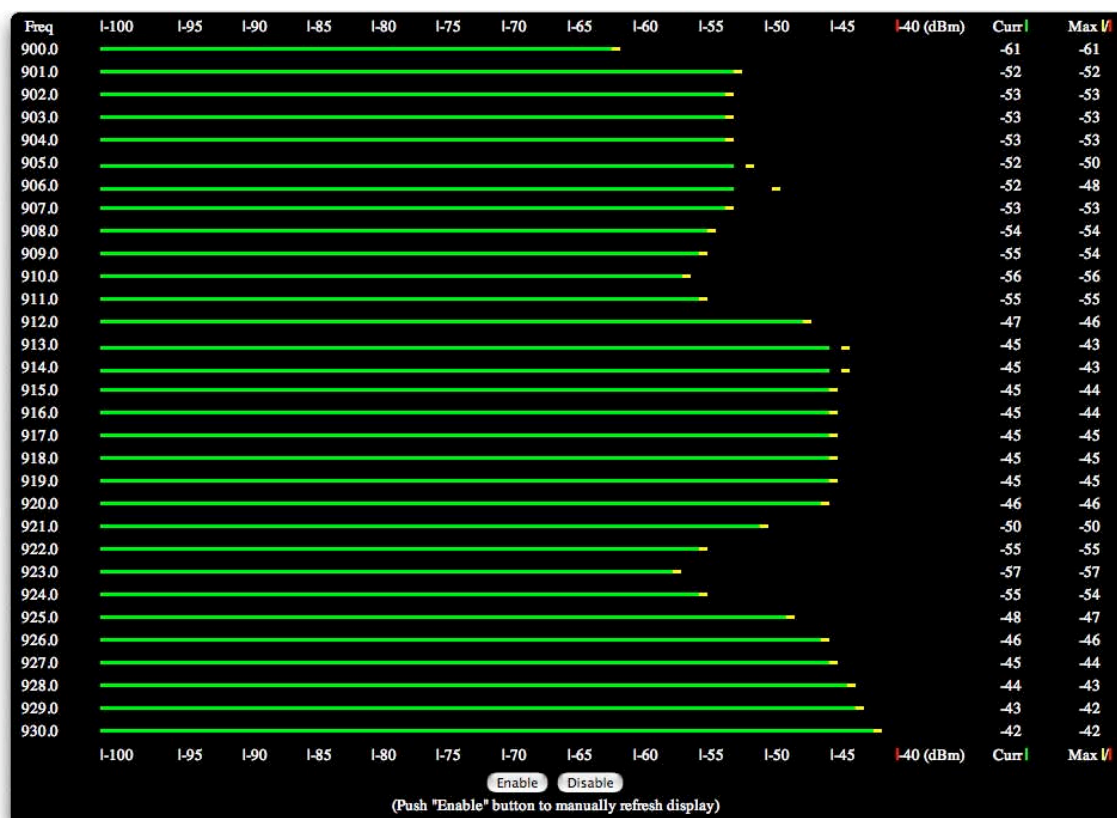


Figure 5: 900 MHz SM Spectrum Analyzer

2.8 Remote AP without Tower

Description

A 900 MHz AP can be collocated with a 2.4, 5.2, or 5.7 GHz SM to provide a “remote AP” solution and provide coverage to a cluster of further distant subscribers, or subscribers with foliage, with no tower location or backhaul needed at the remote AP site. The 2.4, 5.2, or 5.7 GHz SM has to have clear LOS to its AP, but it can be located near the ground and collocated with a 900 MHz AP that then communicates with NLOS 900 MHz SMs. NLOS range is dependent on foliage, topography, obstructions, and other RF engineering considerations.

2.9 900 MHz Modules Use Release 4.2.2

Description

Canopy 900 MHz APs and SMs require Canopy Software Release 4.2.2 or later, FPGA Version 051804 or later (for DES modules), and Canopy Boot 3.0 or later. Release 4.2.2 will not be released for use with 2.4, 5.2, and 5.7 GHz modules. 900 MHz modules running on Release 4.2.2 are fully compatible with mixed networks containing other frequency band modules running on older releases.

3 900 MHz AP and SM Specifications

Specification	Canopy System Range
Frequency Band Ranges	902 to 928 MHz (ISM)
Access Method	TDD/TDMA
Signaling Rate	3.3 Mbps
Modulation Type	High-index 2-level FSK (Frequency Shift Keying) (Optimized for interference rejection)
Carrier to Interference (C/I)	Less than 3 dB nominal
Receiver Sensitivity	-90 dBm at 10^{-4} BER
Operating Range	Up to 40 miles (64 km) Line-of Sight Significant foliage penetration Non Line-of-Sight
Transmitter Power	Up to 1 W (30 dBm)
Subscriber Flat Panel Antenna	10 dBi gain. Vertically or horizontally polarized (changed by physical position), approximately 60° horizontal x 60° vertical 3 dB beam width.
DC Power (measured at DC converter)	For both AP and SM: Typically 0.3 A @ 24 VDC (7.2 watts) For AP: May reach 0.35 A @ 24 VDC (8.4 watts) under heavy load (high transmit ratio (set by downlink percentage), high packet throughput)
Ethernet, GPS sync, and GPS coax cables	The use of cables that are rated for the operation temperature of the product and that conform to UV light protection specifications is mandatory. The use of shielded cables is strongly recommended, especially on infrastructure (APs).
Interface	10/100BaseT, half/full duplex. Rate auto-negotiated (802.3 compliant).
Protocols Used	IPv4, UDP, TCP, ICMP, Telnet, HTTP, FTP, SNMP, DES. Optionally, AES.
Protocols Supported	Switched Layer 2 Transport with support for all common Ethernet protocols, such as IPv6, NetBIOS, DHCP, IPX.
Software Upgrade Path	Remotely downloaded into flash memory
Network Management	HTTP, telnet, FTP, SNMP
Wind	118 miles/hour (190 km/hour)
Operation Temperature	-40° F to +131° F (-40° C to +55° C)
Connectorized Module	Weight: 1 lb (0.45 kg) Dimensions: 11.75" H x 3.4" W x 3.4" D (29.9 cm H x 8.6 cm W x 8.6

Specification	Canopy System Range
	cm D)