



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

User Guide

900-UG-en

Issue 2

August 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.

This device has been certified with Industry Canada to operate with an antenna having a maximum gain of 10 dBi. Using an antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms. To reduce potential radio interference to other users, Industry Canada requires the antenna type and its gain be chosen so that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

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

Module Types	Operating Frequency Range	RMS Power	Reflector or Antenna	FCC ID	Industry Canada Certification Number
SM AP	ISM 902 to 928 MHz	Up to 0.4 W (26 dBm)	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 60 cm (approx 24 inches) 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>. Per Health Canada Safety Code 6, the installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population.

Currently certified 900 MHz antennas have an antenna gain of 10 dBi, which means they are limited to a maximum RMS power of 0.4 W (26 dBm) to remain within the regulatory limit of 4 W (36 dBm) for the 900 MHz frequency band.

The applicable power density exposure limit for radios operating in the 900 MHz frequency band is 6 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 antenna, the peak power density equals the exposure limit at a distance of 23 cm. A power compliance margin of nearly 7 times is artificially introduced by setting the distance to 60 cm.

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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Table of Contents

1	<i>Introduction</i>	6
1.1	Document Change History	6
1.2	Feedback on Documentation	6
1.3	Technical Support	6
2	<i>Feature Description and Operation</i>	8
2.1	3.3 Mbps Signaling Rate	8
2.2	Network Features Identical to 5.2 GHz, 5.7 GHz, and 2.4 GHz	8
2.3	Available as AP and SM – no Backhaul	8
2.4	Three non-overlapping channels	8
2.5	Range of 40 Miles LOS, Increased Foliage Penetration NLOS	9
2.6	Modules and Antennas available	10
2.7	Spectrum Analyzer	13
2.8	Remote AP without Tower	14
2.9	900 MHz Modules Use Release 4.2.2	14
3	<i>900 MHz AP and SM Specifications</i>	15

List of Figures

<i>Figure 1: Highlights of 900 MHz AP Configuration Page</i>	9
<i>Figure 2: Connectorized 900 MHz Canopy module and Flat Panel Antenna</i>	11
<i>Figure 3: Additional Connectorized 900 MHz module and Flat Panel Antenna</i>	12
<i>Figure 4: 900 MHz SM Spectrum Analyzer</i>	14

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:

AP	Access Point Module
SM	Subscriber Module

1.1 Document Change History

Issue 2	<ul style="list-style-type: none"> • Updated exposure distance calculation details (in Notices section) - exposure separation distance remains unchanged at 60 cm (approx 24 in).
Issue 1	<ul style="list-style-type: none"> • First Issue

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

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% on the AP Configuration page, the AP supports high throughput to an SM. As in other Canopy frequency bands, an AP has more bandwidth than an individual SM.

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.

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 1: 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
Downlink Data	75 %
High Priority Uplink Percentage	0 %
Total NumUAckSlots	3 (Range: 1--7)
UAcks Reserved High	0
NumDAckSlots	3 (Range: 1--7)
DAcks Reserved High	0
NumCtlSlots	3 (Range: 1--16)
NumCtlSlots Reserved High	0
Sustained Uplink Data Rate	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)
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

Set MHz based on direction AP faces

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

Set to distance of furthest planned SM from AP cluster (but don't over-set - it doesn't give more power)

Leave set to 0 always, regardless whether optional filters are installed

Set to

- 10 dBi for many external antennas
- Check antenna info if not sure

Figure 1: Highlights of 900 MHz AP Configuration Page

2.5 Range of 40 Miles LOS, Increased Foliage Penetration NLOS

Description

The Canopy 900 MHz modules have a Line-of-Sight (LOS) range of 40 miles (over 64 km), and increased 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 slightly 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 1: 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 can reduce aggregate throughput.
- All 900 MHz APs in a cluster must be set to the same Max Range.

2.6 Modules and Antennas available

Description

900 MHz AP and SM modules are initially available as connectorized units connecting to connectorized antennas. The following sections describe the module and three regulatory agency certified 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. Figure 2: Connectorized 900 MHz Canopy module and Flat Panel Antenna shows a connectorized module connected to a flat panel antenna.

Connectorized Flat Panel Antenna

Motorola offers an external antenna, as shown in Figure 2: Connectorized 900 MHz Canopy module and 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 2: Connectorized 900 MHz Canopy module and 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 3: Additional Connectorized 900 MHz module and Flat Panel Antenna) is as follows:

- 10 dBi gain
- 12"x12"x1" (30.5 x 30.5 x 2.5 cm)
- 3.3 lbs (1.5 kg)
- vertical or horizontal polarization
- female N-type connector)
- 3 dB beam width 60° vertical and 60° horizontal



Figure 3: Additional Connectorized 900 MHz module and Flat Panel Antenna

Operation

To install an antenna to a mast or structure, follow the antenna manufacturer's instructions. The module and antenna should be installed in a safe and secure manner using industry practices.

Important! The Universal Mounting Bracket available from Motorola (part number SMMB-1 and consisting of a mounting bracket and L-shaped aluminum tube) is designed for holding one Canopy module. It is not designed for holding both the module and a connectorized antenna.

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 sealing tape or wrap 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 1: Highlights of 900 MHz AP Configuration Page.

For this antenna:	Enter this Antenna Gain:
Flat Panel antennas certified with regulatory agencies 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 1: Highlights of 900 MHz AP Configuration Page) at the factory default of 0 Nanoseconds, regardless of whether you have cavity filters. (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 at the connector, which along with an 8 dBi antenna will generate the legal maximum EIRP of 36 dBm (4 W). When set to 12 dBi, the radio will have a power-out of 24 dBm at the connector, which along with a 12 dBi antenna will 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 reduce RF power levels, multi-pathing, and jitter in some situations.

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

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 ingress, with eventual corrosion and failure of the connection. Wrapping and sealing is critical to long-term reliability of the connection.

One option for a weather-tight wrap around the N-type connector is Coax-Seal, made by Universal Electronics, <http://www.coaxseal.com>. Sealing material may also be provided with some antennas.

Start the wrap on the cable 0.5 to 2 inches (about 1.5 to 5 cm) from the connection and finish on the cable 0.5 to 2 inches (about 1.5 to 5 cm) above the connection. See the cable in Figure 1: Highlights of 900 MHz AP Configuration Page. Note this cable has been wrapped, but not yet tied or secured against the wind. Once done wrapping, squeeze the wrap with your hand or fingers to compress and remove any trapped air. For abrasion resistance and appearances, premium vinyl electrical tape can be used over the wrap.

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 4: 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.

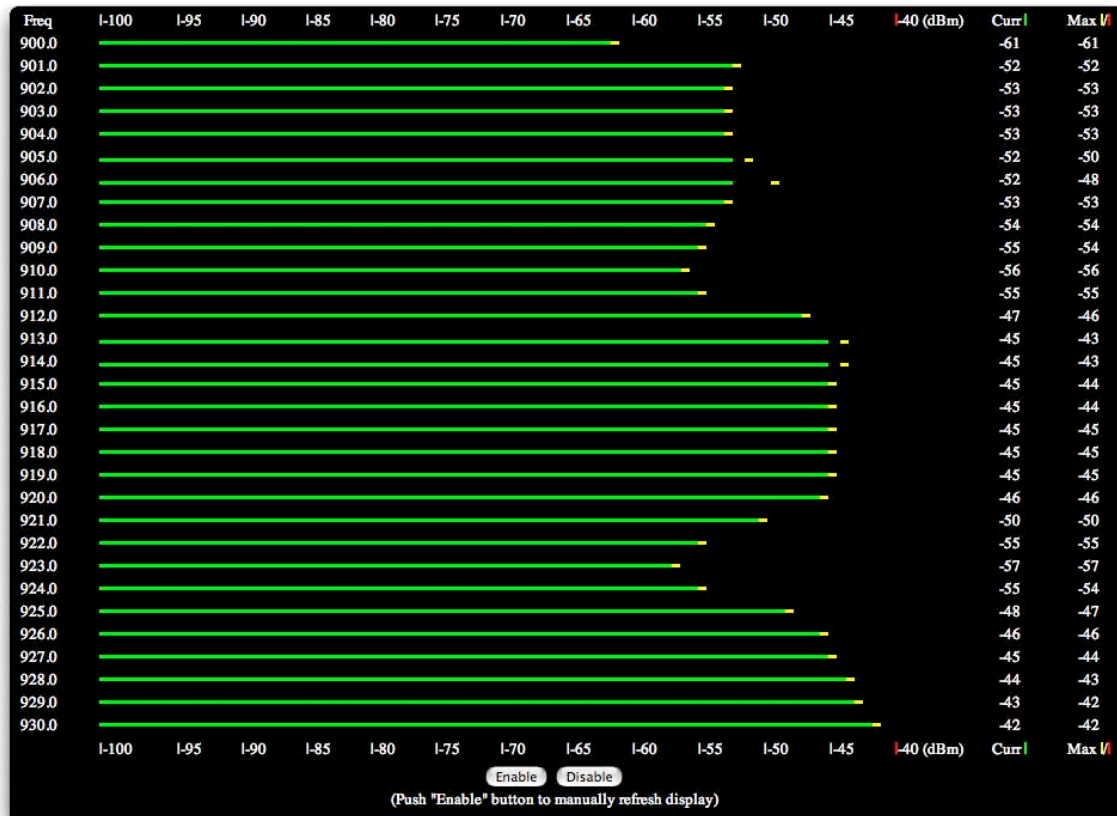


Figure 4: 900 MHz SM Spectrum Analyzer

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 only be available on 900 MHz APs and SMs and will **not** be available for general download off the Canopy website 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 typical
Operating Range	Up to 40 miles (64 km) Line-of Sight Increased foliage penetration Non Line-of-Sight
Transmitter Power	Up to 0.63 W (28 dBm) (when the antenna gain is entered as 8 dBi in the user interface)
Effective Isotropic Radiated Power (EIRP)	Up to 4 W (36 dBm) (when the antenna gain is entered in the user interface consistent with the actual attached antenna, for example, set to 10 dBi for a 10 dBi antenna)
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. Horizontal polarization is recommended, since most cellular and paging systems (which use adjacent frequency bands) use vertically polarized antennas.
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

Specification	Canopy System Range
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 cm D)