Software Release 10.5

Release Notes and User Guide Supplement

PMP 100 and PTP 100 (FSK)
PMP 400 and PTP 200 (OFDM)

FCC Draft

November 2010

Notices

See important regulatory and legal notices in Section 10 on Page 31.

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http://motorola.wirelessbroadbandsupport.com

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1 Introduction

1.1 RELEASE 10.5 OVERVIEW

Release 10.5 is a general release for all Canopy FSK and OFDM radios, including PMP 100, PMP 400/430, PTP 100, and PTP 200 Series modules. This document contains release note information (resolved issues and known open issues) as well as information that supplements the *Motorola PMP Solutions Users Guide* (descriptions, procedures, and reference information).

For the US, Release 10.5 and this document supports

- avoiding interfering with Terminal Doppler Weather Radar (TDWR) (used near major airports) when using the 5.4-GHz band, especially within 35 km (21.75 mi) of the TDWR
- certification and shipment of US 5.4-GHz PMP 430 (OFDM) APs and SMs
- certification and shipment of US Series P11 5.4-GHz PMP 100 (FSK) APs and SMs and PTP 100 (FSK) BHs

For details on these and other Release 10.5 features, see section 4 on page 11.

For improvements and issues resolved in Release 10.5, see section 5 on page 16.

For release open issues, see section 6 on page 17.

Modules should be running Release 10.4 before upgrading to Release 10.5.

To manage modules running Release 10.5, including managing features new to this release, use either Prizm 3.3 or Wireless Manager 2.2.

1.2 DOCUMENT CHANGE HISTORY

FCC Draft	Draft for FCC approval process

1.3 ABBREVIATIONS

The following abbreviations and acronyms are used in these notes and related documentation:

AES	Advanced Encryption Standard
AP	Access Point
BAM	Bandwidth and Authentication Manager
BH	Backhaul Module
BHM	Backhaul Module – Master
BHS	Backhaul Module – Slave
CAP	Access Point Module
CEPT	Conference of European Post and Telecommunications
CIR	Committed Information Rate
CMM	Cluster Management Module
CNUT	Canopy Network Updater Tool
CSM	Subscriber Module
DES	Data Encryption Standard
DFS	Dynamic Frequency Selection
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EIRP	Equivalent Isotropically Radiated Power
EFTA	European Free Trade Association
ETSI	European Telecommunications Standards Institute
EU	European Union
FAA	US Federal Aviation Administration
FCC	US Federal Communications Commission
FSK	Frequency Shift Keying
FTP	File Transfer Protocol
FTPS	Secure FTP
GPS	Global Positioning System
HPAP	High Performance AP (PMP 430 AP)
IC	Industry Canada
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISM	Industrial, Scientific, Medical
LAN	Local Access Network

MAC	Media Access Controller
MIB	Management Information Base
MIR	Maximum Information Rate
NAT	Network Address Translation
NTIA	National Telecommunications and Information Administration
OFDM	Orthogonal Frequency Division Multiplexing
OID	SNMP Object Identifier
P7/P8/P9/P10/P11	Hardware Series
PMP	Point to Multi-Point
PTP	Point to Point
RADIUS	Remote Authentication Dial In User Service
RF	Radio Frequency
RLAN	Radio Local Area Network
SM	Subscriber Module
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
TCP/IP	Transmission Control Protocol/Internet Protocol
VDC	Volts Direct Current
VID	VLAN ID
VLAN	Virtual LAN
WAN	Wide Area Network
WISPA	Wireless Internet Service Providers Association
WM	One Point Wireless Manager

1.4 FEEDBACK ON DOCUMENTATION

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

1.5 TECHNICAL SUPPORT

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

Here is the escalation path for resolution of a problem:

1. Check documentation:
   - These Release Notes
   - *Motorola PMP Solutions Users Guide*, available at http://motorola.wirelessbroadbandsupport.com/software.
2. Consider checking the Community Forum and Knowledge Base at http://motorola.wirelessbroadbandsupport.com/support/community.
3. Consider checking the Support Home Page at http://motorola.wirelessbroadbandsupport.com/support/technical.php
4. Escalate the problem to your supplier or reseller.
5. Escalate the problem to Technical Support or other designated Tier 3 technical support:

Email: EMS-EICC-RM@motorola.com

Phone:

U.S. and Canada	1-866-961-9288

Europe, Middle East, and Africa

Denmark	043682114
France	0157323434
Germany	06950070204
Italy	0291483230
Lithuania	880 030 828
Netherlands	0202061404
Norway	24159815
Portugal	0217616160
Spain	0912754787
Russia	810 800 228 41044
Saudi Arabia	800 844 5345
South Africa	0800981900
United Kingdom	0203 0277499
All other countries	+420 533 336 946

Latin and Central America

Argentina	0800-666-2789
Brazil	0800-891-4360
Columbia	01-800-912-0557
Mexico	001-800-942-7721
Peru	0800-70-086
All other countries	+420 533 336 946

Asia and Pacific

Australia	1 800 457 439
Northern China	10 800 713 0885
Southern China	10 800 130 0867
China, local DID	+86 21 6108 6109
Hong Kong	30 027 861
India	000 800 100 3098
Japan	221626765
Japan, PSTN	(81) 335 708 643
South Korea	080 681 0880
Malaysia	1 800 812 384
New Zealand	0 800 448 472
Philippines	63 29 003 057
Singapore	64 155 110
Taiwan	00 801 14 8690
Thailand	001 800 441 0950
Indonesia	001 803 015 20 20530
All other countries	+420 533 336 946

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

2 Applicability

Release 10.5 is a general release recommended for all the products shown in Figure 1.

Modulation and Module Type	**PMP Radio Series** (Point-to-MultiPoint)	**PTP Radio Series** (Point-To-Point)
FSK AP/SM/BH	PMP 100 Series 	PTP 100 Series 
	Frequencies: 900MHz, 2.4, 5.1, 5.2, 5.4, 5.7, 5.9, 6.050-GHz	Frequencies: 2.4, 5.2, 5.4, 5.7-GHz
	Note: P7 and P8 APs cannot be upgraded **Note**: AES P7 and P8 SMs cannot be upgraded (All DES SMs can be)	**Note**: P7 and P8 BHs cannot be upgraded
OFDM AP/SM	PMP 430 Series 	N/A
	Frequencies: 5.4-GHz PMP 54430 5.8-GHz PMP 58430	N/A
OFDM AP/SM/BH	PMP 400 Series 	PTP 200 Series 
	Frequencies: 4.9-GHz PMP 49400 5.4-GHz PMP 54400	Frequencies: 4.9-GHz PTP 49200 5.4-GHz PTP 54200

Figure 1: Applicable products

Not all products are available in all markets. Please check with your local reseller for availability.

3 Upgrading to Release 10.5

Use version 3.20.13 of the Network Updater Tool (CNUT) to upgrade to Release 10.5.

CNUT and its release notes can be downloaded from the Motorola wireless broadband support web site: http://motorola.wirelessbroadbandsupport.com/software/

Modules in operating sectors should be on Release 10.4 before upgrading to avoid upgrade issues.

3.1 OBTAINING CNUT UPGRADE PACKAGES

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

1. Go to http://motorola.wirelessbroadbandsupport.com/software.
2. Follow the directions on that page to access the software download page.
3. On the software download page, select the appropriate package or packages. Options include [for betas, use packages provided by technical support]
    - CANOPY105BUILDOFFICIAL_DES.pkg3
    - CANOPY105BUILDOFFICIAL_AES.pkg3
    - CANOPY105BUILDOFFICIAL_OFDM_DES.pkg3
    - CANOPY105BUILDOFFICIAL_OFDM_AES.pkg3
4. Click **Accept User Agreement and Request Download Links**.
   RESULT: You will receive an email with a link or links to the software.
5. In the email sent to you, click on the desired link or links.
   RESULT: The appropriate `.pkg3` package or packages will download to your computer.

For additional information on using CNUT, see the CNUT help file or click on the Help menu in the CNUT application.

3.2 NETWORK MANAGEMENT

Either One Point Wireless Manager or Prizm can be used to manage Motorola PMP and PTP networks. For additional information, see

- One Point Wireless Manager: (http://motorola.wirelessbroadbandsupport.com/support/opws/software/
- Prizm: http://motorola.wirelessbroadbandsupport.com/software/

3.3 PMP 430 – OPTIONS FOR 5, 10, AND 20 MHZ CHANNEL SIZE

PMP 430 APs and SMs ship with a 10-MHz channel size. Using CNUT 3.20.13 this can be changed to 20 MHz or 5 MHz.

Note for US and Canadian Operators: *5.4*-GHz PMP 430 APs and SMs with a US model number (and a locked **Region Code** of **US**) or a **Region Code** of **Canada** *do not* support a 5 MHz channel size, consistent with FCC certification and Industry Canada certification. (*5.7*-GHz PMP 430 APs and SMs *do* include a 5-MHz channel size, consistent with their certifications.)

Changing channel size on an AP requires using CNUT. (CNUT loads the appropriate software components into the AP.)

Changing channel size on deployed SMs can be done on the SM GUI but is usually better done using CNUT, as CNUT changes all the SMs in a sector at once.

Changing channel size on an installing SM should be done on the SM GUI.

The AP and the SM must have the same channel size to connect.

Important: In an operating sector, use CNUT to change the channel size of the SMs *first*, then the AP. If you change the AP's channel size first, SMs won't register to it since the AP and SMs are operating at different channel sizes. You will have to change the AP back before proceeding.

Important for US and Canadian Operators:

Don't change 5.4-GHz APs to 5-MHz channel size. CNUT will change a PMP 430 AP to 5-MHz channel size regardless of the Region Code, but a US or Canada 5.4-GHz PMP 430 AP will boot with transmit disabled, consistent with its certification, and you will have to change the AP back to 10 MHz or 20 MHz channel size using CNUT before proceeding.

Don't set 5.4-GHz SMs to 5-MHz channel size. PMP 430 SMs with a **Region Code** of **US** or **Canada** do not provide the option for a 5-MHz channel. However, if the **Region Code** isn't set or is set to another region, you can set the SM to 5-MHz channel size, but it won't connect to a US or Canada AP, and you will need to change it to the same channel size as the AP to connect.

See the CNUT 3.20.13 release notes for specific procedures for setting PMP 430 channel size.

4 Features

Release 10.5 adds the features listed in Table 1.

Table 1: Release 10.5 Features

Regions Affected	Products Affected	Feature	Description	See for Details
US	All 5.4-GHz 5.4-GHz PMP 100 (FSK) 5.4-GHz PTP 100 (FSK) 5.4-GHz PMP 430 (OFDM) 5.4-GHz PMP 400 (OFDM) 5.4-GHz PTP 200 (OFDM)	Operation to avoid interference with Terminal Doppler Weather Radar (TDWR)	To avoid interference with TDWR (47 locations, near major airports), 5.4-GHz US radios must ◦ be professionally installed ◦ have a transmit frequency set on the AP/BHM at least 30 MHz (center-to-center) from any TDWR within 35 km (21.75 mi) of the AP/BHM or any of its SMs/BHS. http://www.spectrumbridge.com/udia/search.aspx supports the necessary map analysis and includes a database for registering the location of these radios to expedite interference resolution.	Section 4.1
US	US 5.4-GHz PMP 430 (OFDM)	US FCC Certification of new product	US 5.4-GHz PMP 430 APs and SMs are now approved for sale in the US. As certified, the US 5.4-GHz PMP 430 AP is limited to operate at ◦ no higher than 85% **Data Downlink %** ◦ 10-MHz and 20-MHz channel sizes, but not 5-MHz Lens and reflector were not included in the certification.	Section 7.6, Table 10 Section 10.2.1, Table 11
US	US P11 Hardware Series 5.4-GHz PMP 100 (FSK) US P11 Hardware Series 5.4-GHz PTP 100 (FSK)	US FCC Certfication of new hardware series	US P11 5.4-GHz PMP 100 APs and SMs and PTP 100 BHs are now approved for sale in the US. As certified, the US P11 PMP 100 AP and PTP 100 BHM is limited to operate at ◦ no higher than 75% **Data Downlink %** (Older hardware series are not limited by Release 10.5.)	Section 7.5, Table 8, Table 9 Section 10.2.1, Table 11
Canada	5.4-GHz PMP 430 (OFDM)	IC Certification of new product	5.4-GHz PMP 430 APs and SMs are now approved for sale in Canada. As certified, the AP is limited to ◦ 10-MHz and 20-MHz channel sizes, but not 5-MHz For compliant operation, the **Region Code** must be set to **Canada** by the professional installer.	Section 10.2.2 and Table 11

Regions Affected	Products Affected	Feature	Description	See for Details
Canada	P11 Hardware Series 5.4-GHz PMP 100 (FSK) P11 Hardware Series 5.4-GHz PTP 100 (FSK)	IC Certfication of new hardware series	P11 Hardware Series 5.4-GHz PMP 100 APs and SMs and PTP 100 BHs are now approved for sale in Canada. For compliant operation, the **Region Code** must be set to **Canada** by the professional installer.	Section 10.2.2 and Table 11

4.1 US - OPERATION TO AVOID INTERFERENCE WITH TDWR

The US FCC, NTIA, FAA, and industry are working to resolve interference to Terminal Doppler Weather Radar (TDWR) systems used near airports that has occurred from some outdoor wireless systems operating in the 5470 MHz – 5725 MHz band. These wireless devices are subject to Section 15.407. When operating as a master device they are required to implement radar detection and DFS functions and radios must not transmit on channels which overlap the 5600-5650 MHz band used by TDWR.

Additional information is available from

- the FCC's Knowledge Database (KDB) Publication 443999 "Interim Plans to Approve UNII Devices Operating in the 5470-5725 MHz Band with Radar Detection and DFS Capabilities" available at https://fjallfoss.fcc.gov/kdb/GetAttachment.html?id=33781
- the Wireless Internet Service Providers Association (WISPA) in coordination with Spectrum Bridge: http://www.spectrumbridge.com/udia/home.aspx.

5.4-GHz radios must be professionally installed. The professional installer must have the following expertise:

- Understanding of the configurations outlined in Table 11: US FCC IDs and Industry Canada Certification Numbers and covered configurations, especially those applicable to the 5470-5725 MHz U-NII band.
- Understanding of the master/slave operation of the AP/BHM and SM/BHS – that the AP or BHM determines the transmission frequency for both master and slave.
- Understanding of the SM/BHS frequency scan selection settings and how they can be set to prevent scanning and therefore transmission on any specific frequencies.
- Understanding of the option to set primary and two alternate frequencies on the AP or BHM.
- Ability to use the GUI to set the primary and alternate transmit frequencies on an AP or BHM, scanned frequencies on an SM or BHS, and Transmit Output Power of a radio.
- Ability to use the spectrum analyzer feature of the radio to observe the local RF environment.
- Ability to determine if a radio is within 35 km (21.75 mi) of any Terminal Doppler Weather Radar (TDWR) using the Search function available at http://www.spectrumbridge.com/udia/search.aspx, or using various mapping programs and the data from in Table 2: TDWR Location Information.
- Ability to set the AP/BHM's transmit frequency (frequencies, if using alternate frequencies) and SM/BHS's scanned frequencies at least 30 MHz (center-to-center) from any TDWR operating frequency or frequencies within 35 km of the radio.

To gain this expertise the following training is required:

- Study of the documentation
- Familiarization in a lab or test environment
- Hands-on training with an experienced installer.

Procedure 1 provides the specific instructions to avoid interfering with TDWR when using 5.4-GHz APs, SMs, and BHs.

Procedure 1: Avoiding interference with Terminal Doppler Weather Radar (TDWR)

1. Use standard installation procedures with the additional steps outlined below.
2. Confirm the AP, SM, or BH has a **Region Code** of **US**. If it doesn't, set the **Region Code** to **US.**

   Note, all radios currently shipping to the US and older radios previously set to the US Region Code and upgraded to a recent release are "hardset" to the US Region Code.
3. For each 5.4-GHz AP, BH, or SM, determine if it is within 35 km (21.75 mi) of any Terminal Doppler Weather Radar (TDWR). This can be done using the map search tool at http://www.spectrumbridge.com/udia/search.aspx, or other mapping tools using the data from Table 2.
4. If an AP or BHM is within 35 km (21.75 mi) of any TDWR, set the primary transmit frequency (and alternate frequencies, if used) to a frequency (or frequencies) at least 30 MHz (center-to-center) from the TDWR operation frequency shown on http://www.spectrumbridge.com/udia/search.aspx or in Table 2.
5. If an SM or BHS is within 35 km (21.75) mi of any TDWR
   - Ensure its AP or BHM is using primary and alternate (if used) transmit frequencies that are at least 30 MHz from the TDWR operation frequency
   - Set the SM's or BHS's scanned frequencies to not include frequencies within 30 MHz of the TDWR operation frequency.

   Note, even if the AP or BHM itself is more than 35 km from the TDWR, if any of its SMs or BHS are within 35 km, it must operate at least 30 MHz from the TDWR operation frequency.

   Note, in some instances an AP, BH, or SM may be within 35 km of multiple TDWRs. In this case, the AP, BH, or SM must use a frequency at least 30 MHz from all local TDWR operation frequencies.
6. Register each 5.4-GHz AP, SM, or BH operating within 35 km (21.75 mi) of any TDWR in the voluntary WISPA-sponsored database at http://www.spectrumbridge.com/udia/home.aspx.

   Note, this database may help expedite resolution of any interference to TDWRs.
7. Registration includes, at a minimum, Latitude, Longitude, and External Antenna Model. When registering a device, choose whether to allow General Access or to have the device information viewable only by you and government representatives.

========== **end of procedure** ==========

Table 2: TDWR Location Information

State	City	Longitude	Latitude	Frequency	Terrain Elevation (MSL) (ft)	Antenna Height above Terrain (ft)
AZ	PHOENIX	W 112 09 46	N 33 25 14	5610 MHz	1024	64
CO	DENVER	W 104 31 35	N 39 43 39	5615 MHz	5643	64
FL	FT LAUDERDALE	W 080 20 39	N 26 08 36	5645 MHz	7	113
FL	MIAMI	W 080 29 28	N 25 45 27	5605 MHz	10	113
FL	ORLANDO	W 081 19 33	N 28 20 37	5640 MHz	72	97
FL	TAMPA	W 082 31 04	N 27 51 35	5620 MHz	14	80
FL	WEST PALM BEACH	W 080 16 23	N 26 41 17	5615 MHz	20	113
GA	ATLANTA	W 084 15 44	N 33 38 48	5615 MHz	962	113
IL	MCCOOK	W 087 51 31	N 41 47 50	5615 MHz	646	97
IL	CRESTWOOD	W 087 43 47	N 41 39 05	5645 MHz	663	113
IN	INDIANAPOLIS	W 086 26 08	N 39 38 14	5605 MHz	751	97
KS	WICHITA	W 097 26 13	N 37 30 26	5603 MHz	1270	80
KY	COVINGTON CINCINNATI	W 084 34 48	N 38 53 53	5610 MHz	942	97
KY	LOUISVILLE	W 085 36 38	N 38 02 45	5646 MHz	617	113
LA	NEW ORLEANS	W 090 24 11	N 30 01 18	5645 MHz	2	97
MA	BOSTON	W 070 56 01	N 42 09 30	5610 MHz	151	113
MD	BRANDYWINE	W 076 50 42	N 38 41 43	5635 MHz	233	113
MD	BENFIELD	W 076 37 48	N 39 05 23	5645 MHz	184	113
MD	CLINTON	W 076 57 43	N 38 45 32	5615 MHz	249	97
MI	DETROIT	W 083 30 54	N 42 06 40	5615 MHz	656	113
MN	MINNEAPOLIS	W 092 55 58	N 44 52 17	5610 MHz	1040	80
MO	KANSAS CITY	W 094 44 31	N 39 29 55	5605 MHz	1040	64
MO	SAINT LOUIS	W 090 29 21	N 38 48 20	5610 MHz	551	97
MS	DESOTO COUNTY	W 089 59 33	N 34 53 45	5610 MHz	371	113
NC	CHARLOTTE	W 080 53 06	N 35 20 14	5608 MHz	757	113
NC	RALEIGH DURHAM	W 078 41 50	N 36 00 07	5647 MHz	400	113
NJ	WOODBRIDGE	W 074 16 13	N 40 35 37	5620 MHz	19	113
NJ	PENNSAUKEN	W 075 04 12	N 39 56 57	5610 MHz	39	113
NV	LAS VEGAS	W 115 00 26	N 36 08 37	5645 MHz	1995	64
NY	FLOYD BENNETT FIELD	W 073 52 49	N 40 35 20	5647 MHz	8	97
OH	DAYTON	W 084 07 23	N 40 01 19	5640 MHz	922	97
OH	CLEVELAND	W 082 00 28	N 41 17 23	5645 MHz	817	113
OH	COLUMBUS	W 082 42 55	N 40 00 20	5605 MHz	1037	113
OK	AERO. CTR TDWR #1	W 097 37 31	N 35 24 19	5610 MHz	1285	80
OK	AERO. CTR TDWR #2	W 097 37 43	N 35 23 34	5620 MHz	1293	97
OK	TULSA	W 095 49 34	N 36 04 14	5605 MHz	712	113
OK	OKLAHOMA CITY	W 097 30 36	N 35 16 34	5603 MHz	1195	64
PA	HANOVER	W 080 29 10	N 40 30 05	5615 MHz	1266	113
PR	SAN JUAN	W 066 10 46	N 18 28 26	5610 MHz	59	113
TN	NASHVILLE	W 086 39 42	N 35 58 47	5605 MHz	722	97
TX	HOUSTON INTERCONTL	W 095 34 01	N 30 03 54	5605 MHz	154	97
TX	PEARLAND	W 095 14 30	N 29 30 59	5645 MHz	36	80
TX	DALLAS LOVE FIELD	W 096 58 06	N 32 55 33	5608 MHz	541	80
TX	LEWISVILLE DFW	W 096 55 05	N 33 03 53	5640 MHz	554	31
UT	SALT LAKE CITY	W 111 55 47	N 40 58 02	5610 MHz	4219	80
VA	LEESBURG	W 077 31 46	N 39 05 02	5605 MHz	361	113
WI	MILWAUKEE	W 088 02 47	N 42 49 10	5603 MHz	820	113
Latitude and Longitude are specified in NAD 83 Last updated July 30, 2010						

5 Resolved Issues

Issues resolved in Release 10.5 are listed in Table 3.

Table 3: Issues resolved in Release 10.5

Products Affected	Issue	Discussion
TBD	Stuck VC messages	TBD
TBD	Every 8th ping lost	TBD
TBD	Latency issue	TBD

6 Known Open Issues

Known open issues for Release 10.5 are listed in Table 4.

Table 4: Release 10.5 known open issues

Products affected Release reported	Description	Discussion and Recommendations
TBD	TBD	TBD

7 Notes and Reference

7.1 NOTES

Notes and tips for best operation are listed in Table 5, and Table 6.

Table 5: Notes first discussed with Release 10.3.1

Products Affected	Description	Discussion and Recommendations
PMP 430 used with Prizm or BAM	PMP 430 SM MIR configured by Prizm to greater than max sustained MIR data rate (12257)	If the **Configuration Source** on a PMP 430 AP's Configuration > General tab is set to **Authentication Server** or **Authentication Server + SM**, SMs will receive their MIR settings from Prizm (or BAM). The resulting SM MIR may be greater than the keyed throughput of the SM. For context, the PMP 430 SM is available keyed to have a maximum throughput of 4, 10, 20 or 40 Mbps. If the SM receives a MIR setting from Prizm that is greater than the keyed bandwidth, the SM will cap the MIR using this formula: (desired uplink MIR * SM aggregate capped rate) / desired aggregate rate (desired downlink MIR * SM aggregate capped rate) / desired aggregate rate Note: Desired aggregate rate is the sum of the desired uplink rate and desired downlink rate For example, if a PMP 430 4 Mbps SM with a max MIR cap of 4000 receives a MIR setting from Prizm that is greater than 4000 kbps, it will cap the downlink MIR and the uplink MIR to equal a max of 4000 kbps. Below is an example with Prizm settings of 10000 kbps uplink MIR and 7000 downlink MIR sent to a 4 Mbps SM that is capped at 4000 kbps max MIR: Uplink calculation: (10000 * 4000) / (7000 + 10000) = 2352 kbps Downlink calculation: (7000 *4000) / (7000 + 10000) = 1648 kbps Thus the Uplink MIR of 2352 + Downlink MIR of 1648 = 4000 kbps In this example, the PMP 430 AP sessions page will display a SM uplink and downlink MIR SMCAP as shown below. Home → Session Status 5.7GHz OFDM - Access Point - 0a-00-3e-3f-ff-36 Session Status Configuration Show Idle Sessions : Enabled / Disabled Session Status List LUID: 002 - [0a-00-3e-3f-fe-42] State: IN SESSION (Encrypt Disabled) Site Name : No Site Name Software Version : CANOPY 10.0 (Build 28) Software Boot Version : CANOPYBOOT 1.0 FPGA Version : 103009 (DES, Sched, US/ETSI) P11 Session Timeout: 0, AirDelay 25 ns, 0 bits (approximately 0.002 miles (12 feet)) Session Count: 1, Reg Count 1, Re-Reg Count 0, Session Uptime 00:02:19 Power Level (Last): -59 dB Sustained Uplink Data Rate (SMCAP): 2352 (kbps) Uplink Burst Allocation (BAM): 500000 (kbit) Sustained Downlink Data Rate (SMCAP): 1648 (kbps) Downlink Burst Allocation (BAM): 500000 (kbit) Low Priority Uplink CIR (BAM): 10000 (kbps) Low Priority Downlink CIR (BAM): 10000 (kbps) Rate : VC 18 Rate 3X/1X For reference, the max SM MIR in kbps for each SM type is: 4 Mbps SM = 4000 10 Mbps SM = 10000 20 Mbps SM = 20000 40 Mbps SM = 65535 (displays Unlimited in the Home > General Status tab)

Table 6: Notes first discussed with Release 9.5

Products Affected	Description	Discussion and Recommendations
All	SM – DNS below a NATed SM when DNS Server Proxy is enabled	Microsoft Vista and Windows 7 will not route a 169.254/16 subnet used as the default Canopy subnet since these operating systems use 169.254/16 subnet to talk between local machines. This is not an issue if: - the PC is connected directly to the NATed SM. - the NAT/routing CPE underneath the NATed SM provides DNS services. However; if a NAT/routing CPE that is not providing DNS services (e.g. some home routers) is placed between the SM and the user's PC, a Microsoft Vista or Windows 7 machine will not route to the default 169.254/16 SM IP address space to access DNS services. **Workaround:** Reconfigure the SMs NAT LAN address to a private IP address such as 192.168/16, 172.16/12, or 10/8 or leave DNS Server Proxy disabled.
All	Updating Community Strings on the Web GUI (11699)	To flip-flop the read/write and read-only community string names, it is necessary to change one community string to a temp name first before switching community string names.
Remote AP	Remote AP Sync Input (7427)	Remote AP receives sync from SM by setting SYNC Input to Timing Port. However, if this is incorrectly configured as SYNC input to Power port the Remote AP will still correctly receive SYNC.
AP	Disable TCP ACK prioritizing in broadcast video applications (10263)	When optimizing a system for broadcast video, on the AP's Configuration => General page configure **Prioritized TCP ACK** to **Disabled**. In a system being used for internet access or similar applications prioritizing TCP ACKs improves downloading of FTP files and other activities making significant use of TCP ACKs under heavy load. However, in a system being used for broadcast video or video surveillance, prioritizing TCP ACKs can cause sporadic choppy video in the uplink.
AP or SM	Procedures for saving an XML file of a spectrum graph (8484)	When the **SpectrumAnalysis.xml** button is clicked on the SM's Tools > Spectrum Analyzer tab or the AP's Tools > Remote Spectrum Analyzer tab, the spectrum graph is redisplayed using XML and XSL if the browser supports XSL. To save the underlying XML file, right click and select "Save Target As" on a Windows PC, or equivalent action for other operating systems.
SM	SM scan frequencies not "cancelled" by SNMP actions (8172)	If you make frequency changes on the SM GUI, and then back them out using SNMP, the Reboot Required message remains on the GUI. Workaround: If it says Reboot Required, go ahead and reboot, just to clear the message.

Products Affected	Description	Discussion and Recommendations
All	Managing module accounts and passwords (none)	The best security practice is to be aware a factory unit comes with `root` and `admin` accounts, to plan your approach to accounts, and set passwords for all accounts. A module that either is fresh from the factory or has been operator-reset to factory defaults has two user accounts: `root` and `admin`, both with ADMINISTRATOR level permissions. To secure a module, access the Account => Change Users Password tab and add a password to each of these accounts. Adding a password to only one account still leaves the other open. Furthermore, an account without a password will accept any password potentially giving the impression the unit is protected when it isn't. Alternatively, an operator's practices may be to delete the `admin` account or delete the `root` account and replace them with their own account(s). By default, Prizm, One Point Wireless Manager and CNUT use the `root` account to manage the module, so if you delete `root` accounts on modules you will need to make coordinated changes to Prizm, Wireless Manager, and CNUT to access them with your own accounts.
All	Use 16 or fewer alphanumeric characters in user account names, passwords, and Community Strings (7808)	SNMP doesn't do data-entry checking, so more than 16 characters may be entered, but only 16 characters will be saved and displayed.
AP and SM	Timed Spectrum Analyzer settings anomaly (7442)	Values of **Timed Spectrum Analyzer** duration and **Spectrum Analysis on Boot** get saved by clicking any button on the page, not just when clicking **Save Changes** or **Start Time Spectrum Analysis** (which is typical operation for other pages).
AP and SM	Best Practice is to set SM to same **Region Code** as AP (none)	When an SM registers to an AP, it assumes the Region Code and associated parameters of the AP, disregarding any Region code set in the SM by you. However, the best practice is still for you to set a Region Code in the SM so that displayed options are consistent with the region.
All	Details on pinging Canopy modules (4831)	A ping size larger than 1494 bytes to a radio will time out and fail. However, a ping of greater than 1494 bytes to a system that is behind a radio typically succeeds. To gain an accurate view of latency, ping through the radio to a system beyond. Canopy transports ping traffic with the same priority as all transport traffic, but may handle a direct ping with lower priority when running under load.
SM	AP may be listed twice in SM's AP Evaluation tab (5298)	To help during aiming, the SM's Tools > AP Evaluation tab maintains AP entries for 15 minutes. If the frequency of an AP is changed, for 15 minutes the AP is listed twice in the AP Evaluation tab, once with the former frequency, and once with the new one.
AP and SM	When using **Link Test with MIR**, need to set both ends (4844, 2756)	To see the effects of MIR capping, you can run a link test with MIR enabled. To get meaningful results, set **Link Test with MIR** to **Enabled** on the Tools => Link Capacity Test tab *in both* the SM and the AP. When it is enabled on only one end, results are misleading. After you run perform a link test with MIR capping enabled, consider immediately changing **Link Test with MIR** to **Disabled** *in both* the SM and the AP, to avoid mistakenly capping only one end of the link test.

Products Affected	Description	Discussion and Recommendations
AP and SM	Click Spectrum Analyzer **Enable** button twice (5284)	After you click the **Enable** button in the Tools => Spectrum Analyzer tab, the resulting display may omit bars for some frequencies, especially in frequency bands that have a large number of center channels, such as the 5.4-GHz band. If you clicking **Enable** again, the display includes the entire spectrum bar graph. ***TIP:*** In the Configuration => General tab, set the **Webpage Auto Update** parameter to a few seconds, to have the Spectrum Analyzer automatically fully displayed and refreshed. You can later reset the **Webpage Auto Update** time back to 0, to disable refresh.
AP and SM	Blank screen after logging in to SM through AP Session Status tab (4706)	In some instances, depending on network activity and network design, the interface presents a blank screen to a user who logs in to an SM through the Home => Session Status tab in the AP. If you observe this, refresh your browser window.
SM	When connecting to a hub, use only half duplex Ethernet settings (7557)	Ethernet connections set to **10 Base T Full Duplex** or **100 Base T Full Duplex** will not connect to an SM through a hub, due to the way a hub works. Use half duplex settings when using a hub.

7.2 US REGION CODE OPERATION

A 5-GHz PMP 100/400/430 Series AP or a PTP 100/200 Series BH with a **Region Code** set to **United States** is not configurable to another **Region Code** by installers or end users. This is in response to FCC KDB 594280 and ensures that end users and professional installers do not have access to settings which could allow a radio to be configured to operate in a manner other than that which was specified in the FCC equipment authorization grant.

Radios sold in the United States and its territories come with the **Region Code** on the Configuration > General tab pre-configured to United States and not selectable, as shown in Figure 2. Radios sold in regions outside of the United States and its territories are required to be set by the operator to the Region Code of the region in which they are used.

Figure 2: PMP AP and PTP BH Region Code Set to United States

7.3 PMP 430 CENTER CHANNELS

When the PMP 430 AP is using 5-MHz channels, the center channels can be configured every 2.5 MHz. When it is using 10- or 20-MHz channels, the center channels can be configured every 5 MHz. Available center channels as a function of channel size and regioin are shown in Table 7.

Note: PMP430 5.4-GHz for US does not include a 5-MHz channel size.

Table 7: PMP 430 center channels by channel bandwidth and region code

OFDM Radio Model	Channel Size	Region Code(s)	Range of Center Frequencies Available (MHz)	Center Channel Spacing	# of Center Channels
PMP 430 Series AP, 5.4-GHz	5 MHz	Australia	5475 – 5597.5 5652.5 – 5715	2.5 MHz	76
		Europe & Spain	5472.5 – 5597.5 5652.5 – 5717.5	2.5 MHz	78
		Brazil, India, Russia & Other	5475 –5715	2.5 MHz	97
	10 MHz	United States, Canada & Australia	5480 – 5595 5655 – 5710	5 MHz	36
		Europe & Spain	5475 – 5595 5655 – 5715	5 MHz	38
		Brazil, India, Russia & Other	5480 – 5710	5 MHz	47
	20 MHz	United States, Canada & Australia	5480 – 5590 5660 – 5710	5 MHz	34
		Europe & Spain	5475 – 5590 5660 – 5715	5 MHz	36
		Brazil, India, Russia & Other	5480 – 5710	5 MHz	47
PMP 430 Series AP, 5.8-GHz	5 MHz	United States, Canada, Australia, Brazil & Russia	5727.5 –5845	2.5 MHz	48
		Europe & Other	5727.5 –5872.5	2.5 MHz	59
		Spain	5727.5 – 5792.5 5817.5 – 5852.5	2.5 MHz	42
		India	5827.5 –5872.5	2.5 MHz	19
	10 MHz	United States, Canada, Australia, Brazil & Russia	5730 – 5845	5 MHz	24
		Europe & Other	5730 – 5870	5 MHz	29
		Spain	5730 – 5790 5820 – 5850	5 MHz	20
		India	5830 – 5870	5 MHz	9
	20 MHz	United States, Canada, Australia, Brazil & Russia	5735 – 5840	5 MHz	22
		Europe & Other	5735 – 5865	5 MHz	27
		Spain	5735 – 5785 5825 – 5845	5 MHz	16
		India	5835 – 5865	5 MHz	7

7.4 PMP 100 SERIES DFS OPERATION BASED ON REGION CODE

For reference, Table 8 shows operating based on Region Code, by frequency band and module type. Note: 900MHz and 2.4-GHz are not shown as DFS operation does not apply to these frequencies.

Table 8: PMP 100 (FSK) AP/SM DFS operation based on region code

Region Code[1]	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	AP/ SM	AP	SM	AP	SM	AP	SM
United States	NA	≥P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz[2] P11: Limited to 75% Downlink Data	No effect	No effect	No effect
Canada	NA	≥ P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz[2]	No effect	No effect	No effect
Europe & Spain	NA	NA	NA	ETSI EN 301 893 v1.3.1 DFS >July 1, 2008[3]: No 5590-5660 MHz[2]	ETSI EN 301 893 v1.3.1 DFS >July 1, 2008[3]: No 5585-5665 MHz[2]	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS
Brazil	NA	NA	NA	P11: ETSI v1.4.1 DFS ≤ P10: ETSI v1.3.1 DFS	No effect	No effect	No effect
Australia	NA	NA	NA	FCC/IC DFS No 5590-5660 MHz[2]	No effect	No effect	No effect
Russia	Display Com-munity options	No effect	No effect	NA	NA	No effect	No effect
India or Other	No effect	No effect	No effect	No effect	No effect	No effect	No effect

1. Product sold in the US is locked to the US Region Code and has "US" in the model number. In other cases, set the **Region Code** to the region you are in, and the software will determine the correct use of DFS. For countries or regions not listed, use a Region Code that provides DFS functionality and channels consistent with your country's regulatory requirements.
2. Terminal Doppler Weather Radar (TDWR) operates on frequencies 5600 through 5650 MHz. In some countries a "weather notch" is required to avoid impinging on these frequencies.
3. Radios placed on market in Europe after July 1, 2008, can't impinge on weather radar frequencies. To meet this requirement, the software checks the date code of the module and implements the weather notch accordingly. You can tell if a 5.4-GHz module is "newer" or "older" by setting the Region Code to Europe – if the notch frequencies *are not* shown on the Configuration => Radio page, then the module is "newer", if the notch frequencies *are* shown, the module is "older".

7.5 PTP 100 SERIES DFS OPERATION BASED ON REGION CODE

For reference, Table 9 shows operating based on Region Code, by frequency band and module type.

Table 9: PTP 100 (FSK) BHM/BHS operation based on region code

Region Code[1]	2.4 GHz	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	BH	BH	BHM	BHS	BHM	BHS	BHM	BHS
United States	No effect	NA	≥P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz[2] P11: Limited to 75% Downlink Data	No effect	No effect	No effect
Canada	No effect	NA	≥ P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz in FSK[2]	No effect	No effect	No effect
Europe	No effect	NA	NA	NA	ETSI EN 301 893 v1.3.1 DFS >July 1, 08[3]: No 5590-5660 MHz in FSK[2]	ETSI EN 301 893 v1.3.1 DFS >July 1, 08[3]: No 5585-5665 MHz in FSK[2]	ETSI EN 302 502 v1.2.1 DFS	ETSI EN 302 502 v1.2.1 DFS
Brazil	NA	NA	NA	NA	P11: ETSI v1.4.1 DFS ≤ P10: ETSI v1.3.1 DFS	No effect	No effect	No effect
Australia	No effect	NA	NA	NA	FCC/IC DFS No 5590-5660 MHz in FSK[2]	No effect	No effect	No effect
Russia	NA	Display Com-munity options	No effect	No effect	NA	NA	No effect	No effect
India or Other	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

1. Product sold in the US is locked to the US Region Code and has "US" in the model number. In other cases, set the **Region Code** to the region you are in, and the software will determine the correct use of DFS. For countries or regions not listed, use a Region Code that provides DFS functionality and channels consistent with your country's regulatory requirements.
2. Terminal Doppler Weather Radar (TDWR) operates on frequencies 5600 through 5650 MHz. In some countries a "weather notch" is required to avoid impinging on these frequencies.
3. Radios placed on market in Europe after July 1, 2008, can't impinge on weather radar frequencies. To meet this requirement, the software checks the date code of the module and implements the weather notch accordingly. You can tell if a 5.4-GHz module is "newer" or "older" by setting the Region Code to Europe – if the notch frequencies *are not* shown on the Configuration => Radio page, then the module is "newer", if the notch frequencies *are* shown, the module is "older".

7.6 PMP 400/430 AND PTP 200 DFS OPERATION BASED ON REGION CODE

For reference, Table 10 shows operation based on Region Code, by frequency band and radio platform. PMP 400 and PTP 200 are available in the 5.4-GHz frequency band. PMP 430 is available in both the 5.4 and 5.8-GHz frequency bands.

Note: The 4.9-GHz PMP 400 and PTP 200 are not shown as DFS operation does not apply to these frequencies.

Table 10: PMP 400/430 and PTP 200 (OFDM) DFS operation based on region code

Region Code[1]	Frequency	Radio Platform	AP	SM
United States	5.4-GHz	PMP 400/430 & PTP 200	FCC/IC DFS[3] PMP 430 limited to 85% Downlink Data, no 5-MHz channel size	No effect
	5.8-GHz	PMP 430	No effect	No effect
Canada	5.4-GHz	PMP 400/430 & PTP 200	FCC/IC DFS[3] PMP 430 - no 5-MHz channel size	No effect
	5.8-GHz	PMP 430	No effect	No effect
Europe & Spain	5.4-GHz	PMP 400/430 & PTP 200	ETSI DFS[4]	ETSI DFS[4]
	5.8-GHz	PMP 430	ETSI DFS[5]	ETSI DFS[5]
Brazil	5.4-GHz	PMP 400/430 & PTP 200	ETSI DFS[4]	No effect
	5.8-GHz	PMP 430	No effect	No effect
Australia	5.4-GHz	PMP 400/430 & PTP 200	FCC/IC DFS[3]	No effect
	5.8-GHz	PMP 430	No effect	No effect
Russia	5.4-GHz	PMP 400/430 & PTP 200	No effect	No effect
	5.8-GHz	PMP 430	No effect	No effect
India	5.4-GHz	PMP 400/430 & PTP 200	No effect	No effect
	5.8-GHz	PMP 430	No effect	No effect
Other	5.4-GHz	PMP 400/430 & PTP 200	No effect	No effect
	5.8-GHz	PMP 430	No effect	No effect

1. Product sold in the US is locked to the US Region Code and has “US” in the model number. In other cases, set the **Region Code** to the region you are in, and the software will determine the correct use of DFS. For countries or regions not listed, use a Region Code that provides DFS functionality and channels consistent with your country’s regulatory requirements.
2. In some countries and regions, 5600 MHz to 5650 MHz is “notched” out to meet requirements to not transmit in weather radar frequencies.
3. Complies with FCC Report and Order 03-287 and Industry Canada requirements.
4. Complies with ETSI EN 301 893 v1.3.1.
5. Complies with ETSI EN 302 502 v1.2.1.

8 Canopy MIB

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

Detailed information on the Canopy MIBs is available at http://motorola.wirelessbroadbandsupport.com/support/online_tools.

MIB files are used by Network Management Systems and Element Management Systems, such as the Motorola Prizm and One Point Wireless Manager systems, to support a host of surveillance, monitoring, control, and operational tasks.

Information on the Motorola Prizm element management system is available at http://www.motorola.com/Business/US-EN/Business+Product+and+Services/Wireless+Broadband+Networks/Point-to-Multipoint+Networks/Unlicensed+Point-to-Multipoint+Solutions/Element_Management_PTMP_US-EN

Information on the Motorola One Point Wireless Manager management system is available at http://www.onepointwireless.com/wirelessmanager/

Prizm and One Point Wireless Manager documentation and installers are available for download from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software.

If you are using Prizm: Prizm 3.3.10 includes the MIB information. You do not need to load MIB files.

If you are using One Point Wireless Manager 2.2 or an SNMP network management system (NMS) or element management system (EMS) other than Prizm: Load the MIBs per the instructions for One Point Wireless Manager 2.2 or your NMS or EMS.

Important! When loading the Canopy MIB files

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

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

9 Performance Benchmarking Process

This section describes the performance benchmarking process.

9.1 DEFINITIONS

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

Aggregate Throughput Sum of uplink plus downlink traffic.

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

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

Downlink/Uplink Load Ratio The ratio of downlink Carried Load to uplink Carried Load.

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

9.2 SYSTEM PERFORMANCE AND SYSTEM CONSTRAINTS

Different combinations of system inputs will result in different constraints limiting system performance.

Larger Packets

With larger packets (the system 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:

PMP 100 and PTP 100 Backhauls with 20MHz Channels:

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

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

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

PMP 430 (5.4 and 5.8-GHz OFDM) with 5MHz Channels:

For 1/4 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **15** slots/frame x 400 frames/sec x 8 bits/byte = **9.2** Mbps

For 1/8 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **17** slots/frame x 400 frames/sec x 8 bits/byte = **10.4** Mbps

For 1/16 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **18** slots/frame x 400 frames/sec x 8 bits/byte = **11.0** Mbps

With 5MHz channels, 9.2 Mbps is a typical maximum aggregate (uplink plus downlink) throughput for larger packet sizes in a system configured with 1/4 cyclic prefix. For 1/8 cyclic prefix systems 10.4 Mbps is a typical maximum aggregate throughput and for 1/16 cyclic prefix 11.0 Mbps is a typical maximum aggregate throughput. 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).

PMP 430 (5.4 and 5.8-GHz OFDM) with 10MHz Channels:

For 1/4 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **33** slots/frame x 400 frames/sec x 8 bits/byte = **20.2** Mbps

For 1/8 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **37** slots/frame x 400 frames/sec x 8 bits/byte = **22.7** Mbps

For 1/16 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **42** slots/frame x 400 frames/sec x 8 bits/byte = **25.8** Mbps

With 10MHz channels, 20.2 Mbps is a typical maximum aggregate (uplink plus downlink) throughput for larger packet sizes in a system configured with 1/4 cyclic prefix. For 1/8 cyclic prefix systems 22.7 Mbps is a typical maximum aggregate throughput and for 1/16 cyclic prefix 25.8 Mbps is a typical maximum aggregate throughput. 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).

PMP 430 (5.4 and 5.8-GHz OFDM) with 20MHz Channels:

For 1/4 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **73** slots/frame x 400 frames/sec x 8 bits/byte = **44.8** Mbps

For 1/8 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **81** slots/frame x 400 frames/sec x 8 bits/byte = **49.7** Mbps

For 1/16 Cyclic Prefix the calculation is

64 Bytes/fragment x **3** fragments/slot x **86** slots/frame x 400 frames/sec x 8 bits/byte = **52.8** Mbps

With 20MHz channels, 44.8 Mbps is a typical maximum aggregate (uplink plus downlink) throughput for larger packet sizes in a system configured with 1/4 cyclic prefix. For 1/8 cyclic prefix systems 49.7 Mbps is a typical maximum aggregate throughput and for 1/16 cyclic prefix 52.8 Mbps is a typical maximum aggregate throughput. Longer range settings can reduce the number of slots in a frame and packet size (breakage on 64-byte boundaries) can affect packing efficiency (the percentage of fragments fully packed with 64 bytes).

Smaller Packets

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

9.3 BENCHMARK DEFINITION

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

System configuration

The PMP benchmark system consists of 3 SMs and 1 Advantage AP, as shown in Figure 3 on page 30. Traffic generation and measurement equipment is connected to both SMs and the AP. Traffic is generated such that any one packet attempts to traverse an SM and then the AP, or the AP and then an SM. No SM-to-SM traffic is included in the benchmark. RF conditions are maintained such that all links run at max rate (2X or 3X).

Traffic mix/Packet size

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

PMP Settings

- Downlink Data: 50%
- Control Slots: 2
- Range: 2 miles
- Max rate (2X or 3X) Enabled
- Encryption: Enabled (DES modules)
- MIR: 20,000 kbits/sec sustained rate and 500,000 kbits burst allocation (defaults)
- CIR: 0 (default)
- NAT: Disabled (default)
- VLAN: Disabled (default)
- High Priority: Disabled (default)

PTP Settings

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

Measurement technique

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

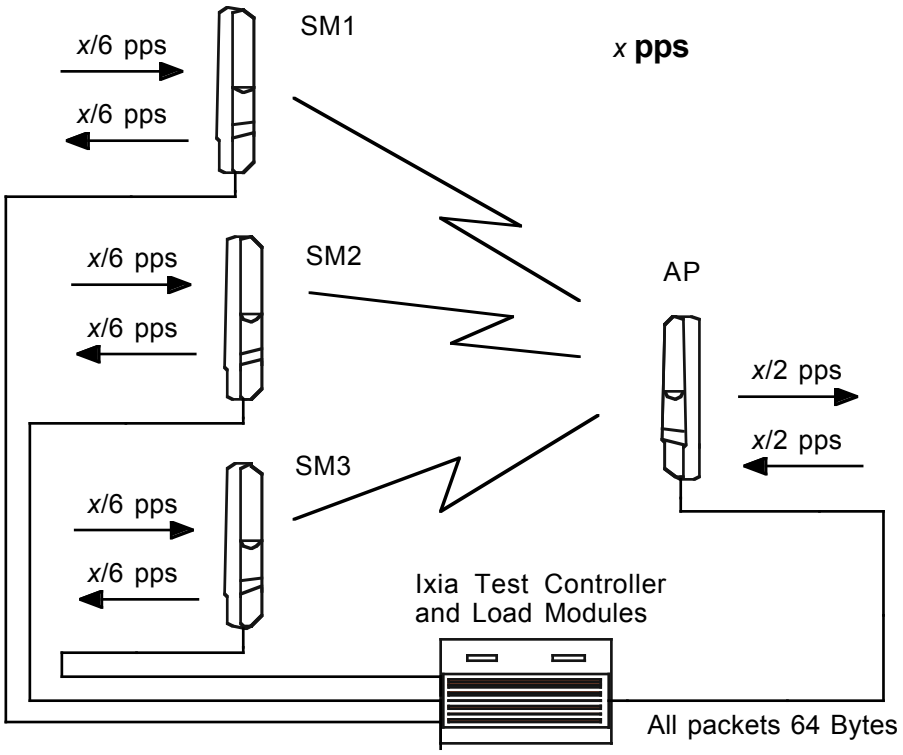

Figure 3: PPS Benchmark Test Setup

10 Regulatory and Legal Notices

10.1 IMPORTANT NOTE ON MODIFICATIONS

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

10.2 NATIONAL AND REGIONAL REGULATORY NOTICES

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

For 900MHz, 2.4, 5.2, 5.4, 5.7 and 5.8-GHz devices:

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

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

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

FCC IDs and the specific configurations covered are listed in Table 11.

Specific instructions to avoid interfering with Terminal Doppler Weather Radar (TDWR) are included below Table 11.

For 4.9-GHz devices:

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

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

FCC ID	Industry Canada Cert Number	Frequencies and Channels	Module Families	Antenna	Maximum Tx Output Power
ABZ89FC5809	109W-9000	8 MHz channels, centered on 906-924 MHz in 1 MHz increments (within the 902-928 MHz ISM band)	9000 SM, AP (PMP 100)	12 dBi integrated antenna	24 dBm (250 mW)
				17 dBi Last Mile Gear Cyclone 900-17H Yagi	18 dBm (63 mW)
				10 dBi Maxrad Model # Z1681 (MP9027XFPT or Motorola AN900A) flat panel	26 dBm (390 mW)
				10 dBi Mars Model # MA-IS91-T2, flat panel	26 dBm (390 mW)
				10 dBi MTI Model # MT-2630003/N (MT-263003/N) flat panel	26 dBm (390 mW)
ABZ89FC5808	109W-2400	20 MHz channels, centered on 2415-2457.5 MHz in 2.5 MHz increments (within the 2400-2483.5 MHz ISM band)	2400 BH, SM, AP	8 dBi internal	25 dBm (340 mW)
			2400 BH, SM	8 dBi internal + 11 dB reflector	25 dBm (340 mW)
ABZ89FC3789	109W-5200	20 MHz channels, centered on 5275-5325 MHz in 5 MHz increments (within the 5250-5350 MHz U-NII band)	5200 BH, SM, AP (PMP 100, PTP 100)	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FT7623	109W-5400	20 MHz channels, centered on 5495-5585 and 5665-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5400 BH, SM, AP (PMP 100, PTP 100)	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5804	109W-5700	20 MHz channels, centered on 5735-5840 MHz in 5 MHz increments (within the 5725-5850 MHz ISM band)	5700 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
			5700 BH, SM (PMP 100, PTP 100)	7 dBi internal + 18 dB reflector	23 dBm (200 mW)
				7 dBi internal + 10 dB lens	23 dBm (200 mW)
			5700 AP (PMP 100)	7 dBi internal + 10 dB lens	19 dBm (80 mW)

FCC ID	Industry Canada Cert Number	Frequencies and Channels	Module Families	Antenna	Maximum Tx Output Power
ABZ89FT7634	109W-5780	5 MHz channels, centered on 5727.5-5845 in 5 MHz increments (within the 5725-5850 MHz ISM band)	5780 APC (PMP 430)	17 dBi connectorized PCTEL Model 8514724E01 antenna (60° x 5° -3 dB beam width) with 1 dB connector cable loss	19 dBm
		10 MHz channels, centered on 5730-5845 in 5 MHz increments (within the 5725-5850 MHz ISM band)			19 dBm
		20 MHz channels, centered on 5735-5840 in 5 MHz increments (within the 5725-5850 MHz ISM band)			19 dBm
ABZ89FT7635	109W-5790	5 MHz channels, centered on 5727.5-5845 in 5 MHz increments (within the 5725-5850 MHz ISM band)	5790 SM (PMP 430)	10 dBi (55° x 55° -3 dB beam width)	19 dBm
		10 MHz channels, centered on 5730-5845 in 5 MHz increments (within the 5725-5850 MHz ISM band)			19 dBm
		20 MHz channels, centered on 5735-5840 in 5 MHz increments (within the 5725-5850 MHz ISM band)			19 dBm
ABZ89FT7637	109W-5480	10 MHz channels, centered on 5480-5595 and 5655-5710 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5480 APC (PMP 430)	18 dBi connectorized PCTEL Model 8514724E01 antenna (60° x 5° -3 dB beam width) with 1 dB connector cable loss	10 dBm
		20 MHz channels, centered on 5485-5590 and 5660-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)			13 dBm
ABZ89FT7638	109W-5490	10 MHz channels, centered on 5480-5595 and 5655-5710 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5490 SM (PMP 430)	10 dBi (55° x 55° -3 dB beam width)	17 dBm
		20 MHz channels, centered on 5485-5590 and 5660-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)			19 dBm

FCC ID	Industry Canada Cert Number	Frequencies and Channels	Module Families	Antenna	Maximum Tx Output Power
ABZ89FT7629	109W-5440	10 MHz channels, centered on 5480-5595 and 5655-5710 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5440 AP (PMP 400)	18 dBi connectorized PCTEL Model 8514724E01 antenna (60° x 5° -3 dB beam width) with 1 dB connector cable loss	10 dBm
			5440 SM (PMP 400) 5440 BH (PTP 200)	17 dBi integrated antenna (15° x 15° -3 dB beam width)	10 dBm
ABZ89FT7631	109W-4940	10 MHz channels, centered on 4945-4985 in 5 MHz increments (within the 4940-4990 MHz public safety licensed band)	4940 AP (PMP 400)	18 dBi connectorized PCTEL Model AP 85010066001 antenna (60° x 5° -3 dB beam width) with 1 dB cable loss	18 dBm
			4940 SM (PMP 400) 4940 BH (PTP 200)	17 dBi integrated antenna (15.5° x 17.5° (el x az) -3 dB beam width)	18 dBm
To ensure regulatory compliance, including DFS compliance, the professional installer is responsible for: ◦ setting the Transmitter Output Power on the Confiiguration => Radio page no higher than listed for a given configuration ◦ setting the External Gain on the Configuration => Radio page, if displayed, to the gain of any external device (such as a reflector or lens) ◦ following instructions to avoid interfering with Terminal Doppler Weather Radar (TDWR) in the 5470-5725 MHz U-NII band.					

10.2.2 Industry Canada (IC) Notification

For 900MHz, 2.4-GHz, 5.2-GHz. 5.4-GHz, 5.7-GHz and 5.8-GHz devices:

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

Users should be cautioned to take note that in Canada high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

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

- Increase the separation between the affected equipment and the unit;

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

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

Industry Canada Certification Numbers and the specific configurations covered are listed in Table 11.

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

For 4.9-GHz devices:

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

10.2.3 Regulatory Requirement for CEPT Member States (www.cept.org)

When operated in accordance with the instructions for use, Motorola Canopy Wireless equipment operating in the 2.4 and 5.4 GHz bands is compliant with CEPT Recommendation 70-03 Annex 3 for Wideband Data Transmission and HIPERLANs. For compliant operation in the 2.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 100mW (20dBm). For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 1 W (30 dBm).

The following countries have completely implemented CEPT Recommendation 70-03 Annex 3A (2.4 GHz band):

- EU & EFTA countries: Austria, Belgium, Denmark, Spain, Finland, Germany, Greece, Iceland, Italy, Ireland, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Switzerland, Sweden, UK
- New EU member states: Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: Bosnia and Herzegovina, Turkey

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

- France – Outdoor operation at 100mW is only permitted in the frequency band 2400 to 2454 MHz;

– Any outdoor operation in the band 2454 to 2483.5MHz shall not exceed 10mW (10dBm);

– Indoor operation at 100mW (20dBm) is permitted across the band 2400 to 2483.5 MHz

- French Overseas Territories:

– Guadeloupe, Martinique, St Pierre et Miquelon, Mayotte – 100mW indoor & outdoor is allowed

– Réunion and Guyana – 100mW indoor, no operation outdoor in the band 2400 to 2420MHz

- Italy – If used outside own premises, general authorization required
- Luxembourg - General authorization required for public service
- Romania – Individual license required. T/R 22-06 not implemented

Motorola Canopy Radios operating in the 2400 to 2483.5MHz band are categorized as “Class 2” devices within the EU and are marked with the class identifier symbol  , denoting that national restrictions apply (for example, France). The French restriction in the 2.4 GHz band will be removed in 2011.

This 2.4 GHz equipment is “CE” marked  to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://motorola.wirelessbroadbandsupport.com/doc.php.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. However, for CEPT member states, 2.4 GHz Wideband Data Transmission equipment has been designated exempt from individual licensing under decision ERC/DEC(01)07. For EU member states, RLAN equipment in both the 2.4 & 5.4GHz bands is exempt from individual licensing under Commission Recommendation 2003/203/EC. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see www.ero.dk for further information.

Motorola Canopy Radio equipment operating in the 5470 to 5725 MHz band are categorized as "Class 1" devices within the EU in accordance with ECC DEC(04)08 and are "CE" marked CE to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://motorola.wirelessbroadbandsupport.com/doc.php.

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

10.2.4 European Union Notification for 5.7 and 5.8 GHz Product

The 5.7 and 5.8 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 to show compliance with the European R&TTE directive 1999/5/EC.

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

10.2.5 Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment

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

10.2.6 EU Declaration of Conformity for RoHS Compliance

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

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

10.2.7 UK Notification

The 5.7 and 5.8 GHz connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation

profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK licensing specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

10.2.8 Belgium Notification

Belgium national restrictions in the 2.4 GHz band include

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

10.2.9 Luxembourg Notification

For the 2.4 GHz band, point-to-point or point-to-multipoint operation is only allowed on campus areas. 5.4GHz products can only be used for mobile services.

10.2.10 Czech Republic Notification

2.4 GHz products can be operated in accordance with the Czech General License No. GL-12/R/2000.
5.4 GHz products can be operated in accordance with the Czech General License No. GL-30/R/2000.

10.2.11 Norway Notification

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

Canopy 5.7 and 5.8 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 and 5.8 GHz connectorized products).

10.2.12 Brazil Notification

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

For compliant operation of an AP in the 5.8 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 36 dBm (4 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 11 dBm. When using the LENS (10 dB at 5.8 GHz), transmitter output power must be configured no higher than 19 dBm.

For compliant operation in the 5.4 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 30 dBm (1 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 5 dBm. When using the LENS (9 dB at 5.4 GHz), transmitter output power must be configured no higher than 14 dBm. When not using the passive reflector or the LENS, the transmitter output power of the radio must be configured no higher than 23 dBm.

The operator is responsible for enabling the DFS feature on any Canopy 5.4 GHz radio by setting the Region Code to “Brazil”, including after the module is reset to factory defaults.

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

10.2.13 Australia Notification

900 MHz modules must be set to transmit and receive only on center channels of 920, 922, or 923 MHz so as to stay within the ACMA approved band of 915 MHz to 928 MHz for the class license and not interfere with other approved users.

After taking into account antenna gain (in dBi), 900 MHz modules' transmitter output power (in dBm) must be set to stay within the legal regulatory limit of 30 dBm (1 W) EIRP for this 900 MHz frequency band.

10.2.14 Labeling and Disclosure Table for China

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

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

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

Logo 1  Logo 2 

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

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

Table 12: China disclosure table

部件名称	有毒有害物质或元素					
	铅 (**Pb**)	汞 (**Hg**)	镉 (**Cd**)	六价铬 (Cr^{6+})	多溴联苯 (**PBB**)	多溴二苯醚 (**PBDE**)
金属部件	×	○	×	×	○	○
电路模块	×	○	×	×	○	○
电缆及电缆组件	×	○	×	×	○	○

塑料和聚合物部件	○	○	○	○	○	×
○： 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。						
×： 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。						

10.3 RF EXPOSURE SEPARATION DISTANCES

To protect from overexposure to RF energy, install Canopy radios so as to provide and maintain the minimum separation distances from all persons shown in Table 13.

Table 13: Exposure separation distances

Module Type	Separation Distance from Persons
Canopy Module (FSK or OFDM)	At least 20 cm (approx 8 in)
Canopy Module with Reflector Dish	At least 1.5 m (approx 5 ft)
Canopy Module with LENS	At least 50 cm (approx 20 in)
900 MHz, integrated or connectorized antenna	At least 80 cm (32 in)
Indoor 900 MHz SM	At least 10 cm (4 in)

The following section and its Table 14 provide details and discussion of the associated calculations.

10.3.1 Details of Exposure Separation Distances Calculations and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/rpb and Safety Code 6.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields*.

The applicable power density exposure limits from the documents referenced above are

- 10 W/m^2 for RF energy in the 5.7/5.8-GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

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

where
S = power density in W/m^2
P = RMS transmit power capability of the radio, in W
G = total Tx gain as a factor, converted from dB
d = distance from point source, in m

Rearranging terms to solve for distance yields $$d = \sqrt{\frac{P \cdot G}{4 \pi S}}$$

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

Table 14: Calculated exposure distances and power compliance margins

Band	Antenna	Variable			d (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	G	S			
900 MHz FSK	integrated	0.25 W (24 dBm)	15.8 (12 dB)	6 W/m^2	23 cm	80 cm (32 in)	12
	external Yagi	0.063 W (18 dBm)	50.1 (17 dB)	6 W/m^2	20 cm	80 cm (32 in)	15
	external flat panel	0.39 W (26 dBm)	10.0 (10 dB)	6 W/m^2	23 cm	80 cm (32 in)	12
	indoor, integrated	Simulation model used to estimate Specific Absorption Rate (SAR) levels				10 cm (4 in)	2
2.4 GHz FSK	integrated	0.34 W (25 dBm)	6.3 (8 dB)	10 W/m^2	13 cm	20 cm (8 in)	2.3
	integrated plus reflector	0.34 W (25 dBm)	79.4 (19 dB)	10 W/m^2	46 cm	1.5 m (5 ft)	10
5.2 GHz FSK	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 FSK	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 FSK	Integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.2 W (23 dBm)	316 (25 dB)	10 W/m^2	71 cm	1.5 m (5 ft)	4.5
	integrated plus LENS	0.2 W (23 dBm)	50 (17 dB)	1 W/m^2	28 cm	50 cm (20 in)	3.13
5.4 GHz OFDM	integrated SM, PMP 400, PTP 200	0.01 W (10 dBm)	50 (17 dB)	10 W/m^2	6 cm	20 cm (8 in)	10
	Integrated SM, PMP 430	0.079 W (19 dBm)	10 (10 dB)	10 W/m^2	8 cm	20 cm (8 in)	6.4
	connectorized AP, 18 dBi	0.02 W (13 dBm)	50 (17 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
5.8 GHz OFDM	integrated SM	0.079 W (19 dBm)	10 (10 dB)	10 W/m^2	8 cm	20 cm (8 in)	6.4
	connectorized AP, 17 dBi	0.079 W (19 dBm)	40 (16 dB)	10 W/m^2	16 cm	80 cm (32 in)	25.6
4.9 GHz OFDM	Integrated, 17 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m^2	14 cm	20 cm (8 in)	2
	connectorized, 18 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m^2	14 cm	20 cm (8 in)	2

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

These are conservative distances:

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

10.4 LEGAL NOTICES

10.4.1 Software License Terms and Conditions

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10.4.2 Hardware Warranty in US

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

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