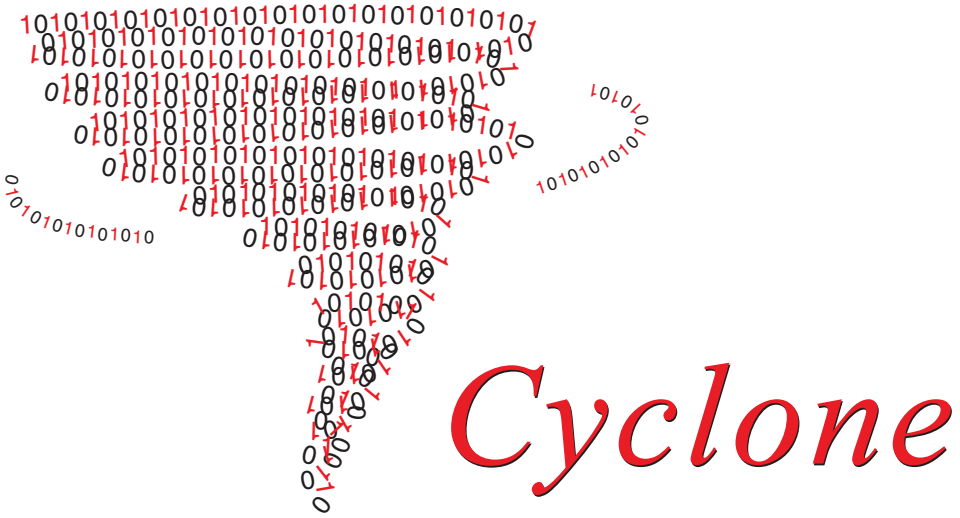

Cyclone 5700-360.OFDM & 5700-VS.OFDM User Manual

1.0 ABBREVIATIONS

The following abbreviations may be used in these notes:

1X	1X operation, with typical max aggregate (up and down) throughput of 7 Mbps
2X	2X operation, with typical max aggregate (up and down) throughput of 14 Mbps
3X	3X operation, with typical max aggregate (up and down) throughput of over 20 Mbps
AP	Access Point Module
BH	Backhaul Module, either timing master or timing slave
BHM	Backhaul Module – timing master
BH	Backhaul Module – timing slave
CAP	Access Point Module
CIR	Committed Information Rate
CMM	Cluster Management Module (CMM4 or CMMicro)
CNUT	Canopy Network Updater Tool
CSM	Subscriber Module
DFS	Dynamic Frequency Selection for radar avoidance
DHCP	Dynamic Host Configuration Protocol
DiffServ	Differentiated Services
EIRP	Equivalent Isotropically Radiated Power
ETSI	European Telecommunications Standards Institute
FSK	Frequency Shift Keying
GPS	Global Positioning System
	Note: CMM uses GPS to synchronize APs & BHs
MIB	Management Information Base for SNMP
NAT	Network Address Translation
OFDM	Orthogonal Frequency Division Multiplexing
PMP	Point-to-Multi-Point (AP to SMs)
PTP	Point-to-Point (Backhauls)
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
SM	Subscriber Module
VLAN	Virtual Local Area Network

2.0 PERFORMANCE

Table 1 shows performance details for Cyclone 5700-360.OFDM series.

Table 1: Performance Details

Product	Channel Width	Parameter	Performance Details		
			1X	2X	3X
Cyclone 5700-360.OFDM	10 MHz	Modulation	QPSK	16 QAM	64 QAM
		Typical Maximum Range	7 mi/ 11.2km	3 mi/ 4.8km	2 mi/3.2 km
		Typical Maximum Aggregate (up+down) Throughput	7.5 Mbps	15 Mbps	22.5 Mbps
		Nominal Receive Sensitivity (including FEC)	-89 dBm	-78 dBm	-70 dBm
		Latency	5-7 msec		

3.0 PLANNING

Cyclone 5700-360.OFDM Series systems use a 10 MHz channel size configurable on 5 MHz centers. This channel size, along with some different characteristics due to the use OFDM carrier technology and QPSK, 16 QAM, or 64 QAM modulations, supports somewhat different channel planning than for standard Canopy. (For reference, PMP 100/200 Series uses 20 MHz channels configurable on 5 MHz centers, single carrier technology, and 2-level and 4-level FSK modulation.)

3.1 TOWER CHANNEL PLANNING

For a single cluster of 4 APs on a tower, 2-channel re-use with channels on 10 MHz channel center spacing gives good performance. In channel design parlance, this can be stated as ABAB channel planning, with no guard band needed between A and B. A typical arrangement might be to use radios configured for 5480 MHz aimed north and south, and radios configured for 5490 MHz aimed east and west.

(For reference, standard Canopy uses 2-channel re-use with clusters of 6 APs on a tower with channel center spacing of either 25 MHz for Advantage APs or 20 MHz for non-Advantage APs. This is ABCABC channel planning, with 5 MHz guard band between the 20 MHz channels for Advantage APs and no guard band needed for non-Advantage.)

Available 5.8 GHz channel center frequencies for each region are shown in Table 2. These vary by region due to different band edge RF specifications (for example, between Canada/US and Europe).

Table 2: 5.8 GHz Channel Center Frequencies, by Region

Region	Range of Center Frequencies Available (MHz)(on 5 MHz centers within this range, inclusive)	Maximum number of non-overlapping channels
US	5730 - 5845	12
Canada	5730 - 5845	12
Europe	5730 - 5870	15

3.2 COLLOCATION OF 5.8 GHZ OFDM WITH STANDARD 5.7 GHZ CANOPY FSK

When locating Cyclone OFDM (5.8 GHz) APs near 5.7 GHz standard Canopy FSK APs (especially on the same tower, but also in the same geographical area), the following practices should be followed to avoid interference between the two systems:

- Plan spacing between OFDM and FSK channels to provide 25 MHz center spacing, which gives a 10 MHz guard band between the 10 MHz OFDM channel and the 20 MHz FSK channel.

- Coordinate Downlink Data %, Range, and Control Slot settings using both the OFDM and the FSK frame calculators. The following paragraphs give more details on these recommended practices.

3.3 CHANNEL SPACING

Center spacing of 25 MHz between collocated FSK and OFDM APs provides a 10 MHz guard band between the 20 MHz and 10 MHz channels, which has proven useful and needed in field testing. Alternatively, in cases where channel planning is severely restricted and the 10 MHz guard band (25 MHz spacing) is not possible, using vertical separation of 5 feet or more between the OFDM and FSK APs may allow collocation with no guard band (15 MHz spacing) in some deployments.

3.4 FRAME CALCULATIONS AND CONFIGURATION SETTINGS

Interference between collocated Canopy systems can be avoided by following two practices:

1. Use a CMM. This synchronizes frame start, so that all collocated APs begin transmitting at the same time each 2.5 millisecond frame.

2. Use the frame calculators in each module, OFDM and FSK (the frame calculators are different, as frame details are different) to select Downlink Data %, Range, and Control Slots for each system that produce “Rec SEQ Start” values that are within 300 bit times. This ensures that all collocated APs end transmission each frame before any collocated AP begins to receive.

When collocating only Canopy OFDM APs together, or collocating only Canopy hardware scheduled FSK APs together, the simple practice of setting the Downlink Data %, Range, and Control Slots the same on all APs ensures they won’t interfere with each other. (These parameters are set on the “Configuration => Radio” page of the AP.) However, due to the different “physical” layer between Canopy OFDM and Canopy FSK, this doesn’t necessarily work when co-locating OFDM and FSK together.

You will need to use frame calculators on both the OFDM and FSK modules, as they are different frame calculators. For the same Downlink Data %, Range, and Control Slots, the frame calculators give different results. Use of the frame calculators is similar to the previous use when co-locating software-scheduled and hardware-scheduled APs.

4 CONFIGURING

Most PMP 430 Series configuration items are identical or very similar to configuration items in standard FSK Canopy modules. This section discusses those that are new or changed and also remarks on some that remain unchanged.

4.1 LINK OPERATION – 1X/2X/3X

Cyclone 5700-360.OFDM Series products offer three levels or speeds of operation – 1X, 2X, and 3X. 3X supports a typical maximum aggregate (sum of up and down) throughput of up to 21 Mbps. If received power is less due to distance between the AP/BHM and the SM/BHS or due to obstructions, or interference affects the RF environment, the Canopy system will automatically and dynamically adjust links to the best operation level. Distance, rates and other information associated with the operation levels are shown in Table 1.

The system chooses its operation rate dynamically, based on Canopy's internal ARQ (Automatic Repeat reQuest) error control method. With ARQ, every data slot of every frame sent over the air (except downlink broadcast) is expected to be acknowledged by the receiver, and if acknowledgement is not received, the data is resent. The sending unit monitors these resends, and adjusts the operation rate accordingly. A normal system may have links that move from 3X to 2X (or 1X) and back as the RF environment changes. Furthermore, the links operate independently; normal operation can have a downlink running at 3X while the uplink RF environment only supports 2X.

The default is for both AP/BHM and SM/BHS to be enabled for 3X operation. An operator may "lock down" a link to 1X/2X operation or to only 1X operation using the Dynamic Rate Adapt parameter on the SM's Configuration => General page as shown in Figure 1. This parameter locks down both uplink and downlink operation. An operator may lock down an entire sector to 2X and 1X operation, or to only 1 X operation, using the Dynamic Rate Adapt parameter on the AP's Configuration => General page. This parameter locks down uplink and downlink of all links in the sector, and overrides any SM 1X/2X/3X settings. For example, if an individual link is set for 3X operation at the SM and the sector is set for 1X operation at the AP, all links in the sector will be locked down to 1X operation.

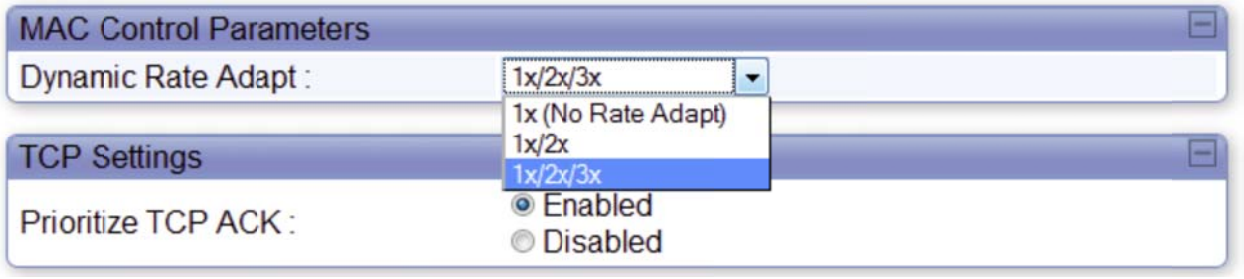

Figure 1: Dynamic Rate Adapt on AP "Configuration => General" page

In most cases an operator is well-served to leave the setting at 1X/2X/3X and let the system automatically and dynamically choose the best rate for each link. Cases when it may be useful to lock down a link to 1X include

- If you are having trouble aiming a link or getting it to register, locking the link down to 2X or 1X may help in some cases.
- If the link is suspected to be oscillating between operation rates to the detriment of throughput, locking the link down may increase throughput. Usually, even if the link is moving rapidly between operation rates, overall link throughput and sector capacity are highest if the link is left at 3X and the link can choose its own rate dynamically.
- General link troubleshooting

Optimal sector utilization involves having as many links as possible running at 3X. This provides as much capacity as possible for the sector. As an example, you want to limit throughput to an individual subscriber to 1X rates. This *does not* mean you should set that link to 1X operation. Use MIR (Maximum Information Rate) settings to cap the SM's bandwidth use, but let the link run at as high an operation rate as the RF environment will allow. This ensures that any transmission uses as little "air time" as possible, leaving more "air time" for other SMs.

4.2 TRANSMITTER OUTPUT POWER (AND NO JITTER)

The AP/BHM's Transmitter Output Power is configured on the AP/BHM's "Configuration => Radio" page.

Radio	Frequency	Transmit Output Power Range	Factory Default Setting
Cyclone OFDM 5.7 GHz	5.8 GHz	-30 dBm to +20 dBm (US) -30 dBm to +21 dBm (Outside US)	**10 dBm**

In most regulatory regions, including the US, Canada, and Europe, Cyclone 5700-360.OFDM Series modules operating in the 5.8 GHz band are limited to 33 dBm with 10MHz channels (Equivalent Isotropic Radiated Power). This is different than the 30 dBm EIRP allowed for Canopy FSK modules operating in the 5.4 GHz band because the regulations are for spectral power density and with half the channel size (10 MHz vs. 20 MHz).

To meet 27 dBm EIRP with the connectorized 18 dBi antenna (with 1 dB of cable loss) that comes with the Cyclone OFDM AP, the maximum setting allowed is 10 dBm (the default) since 27-17=10.

If a connectorized AP has been purchased and the operator has provided the antenna, the Transmitter Output Power must be configured based on that antenna and consistent with local or regional regulations. For example, if a Cyclone 5700-360.OFDM Access Point is being used with a 15 dBi antenna, then the maximum setting allowed to meet 27 dBm EIRP is the full 12 dBm of which the radio is capable.

IMPORTANT!

It is the responsibility of the operator and professional installer to ensure Transmitter Output Power is set within regulatory limits for their country or region. These must be set or confirmed on initial configuration and after a module is reset to factory defaults, and should be confirmed after the software on a module is upgraded.

In most cases the operator will want to set the AP's Transmitter Output Power to the maximum allowed so as to have the greatest overall range and the greatest range for 3X operation. It may be useful to reduce Transmitter Output Power when Canopy systems are located close together, with good coverage given because of their proximity and full power isn't needed, or in cases where an operator is trying to reduce interference from the Canopy system to other systems.

Each SM's Transmitter Output Power is automatically set by the AP. The AP monitors the received power from each SM, and adjusts each SM's Transmitter Output Power so that the received power at the AP from that SM is not greater than -60 dBm.

Cyclone OFDM Series networks use Auto-TPC because OFDM technology is more sensitive to large differences in power levels from SMs operating at various distances from the AP than the single carrier technology used in Canopy FSK. Cyclone OFDM Series modules display the typical Canopy "Receive Power Level" as shown in Figure 2. Due to the different modulation technique no "jitter" is calculated or displayed.

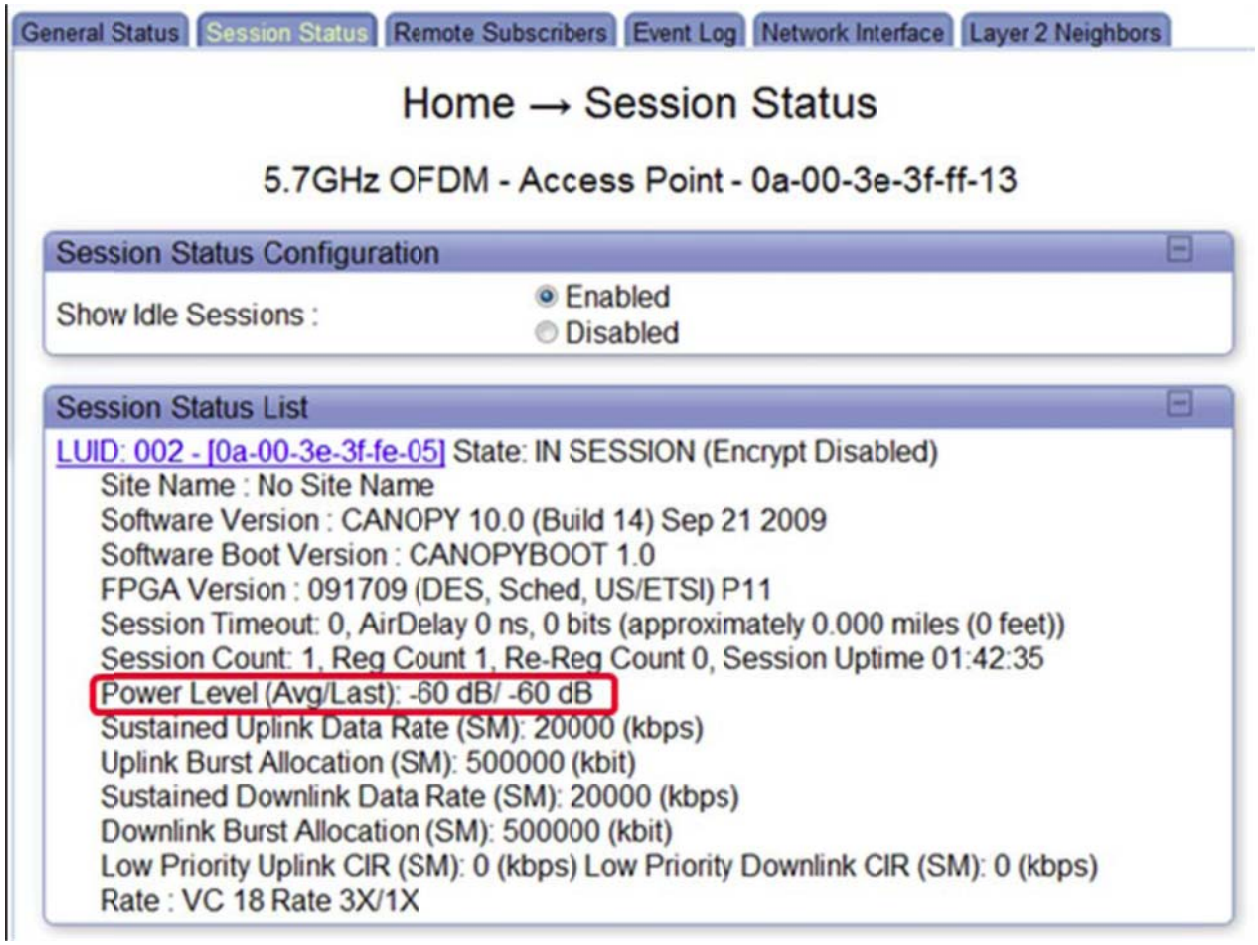

Figure 2: Power Level on AP "Home=>Session Status" page.

4.3 DOWNLINK DATA %, RANGE, AND CONTROL SLOTS

The **Downlink Data** parameter on the AP's and BHM's Configuration => General page can be set in 1% increments between 10% and 90%. The default as shown in Figure 3 is 75%.

The **Range** parameter on the AP's Configuration => General page can be set in 1-mile increments between 1 and 30 miles for Cyclone OFDM APs. The default as shown in Figure 3 is 2 miles. Set the **Range** to the distance of the furthest SM from any AP in the area. The **Range** parameter effectively determines frame structure of the Canopy over-the-air protocol, especially turn-around guard time. Setting **Range** the same across a geographical area give best overall performance.

Range does not change transmit power levels. Do not set a higher **Range** than needed. A higher **Range** gives no higher power and slightly reduces throughput to allow for higher air delay and turn-around time.

If the **Range** is set to greater than 5 miles, the SM limits the **Downlink Data** to a maximum of 85% to avoid close-in SMs having registration issues. For example, a Range of 6 miles and a **Downlink Data** of 90% is not allowed. Operationally,

- if the Downlink Data % is set to greater than 85% and the user enters a range greater than 5 miles, the module will reset the Downlink Data % to 85%

- if the range is set to greater than 5 miles and the user enters a Downlink Data % of greater than 85%, the module will reset the Downlink Data % to 85%.

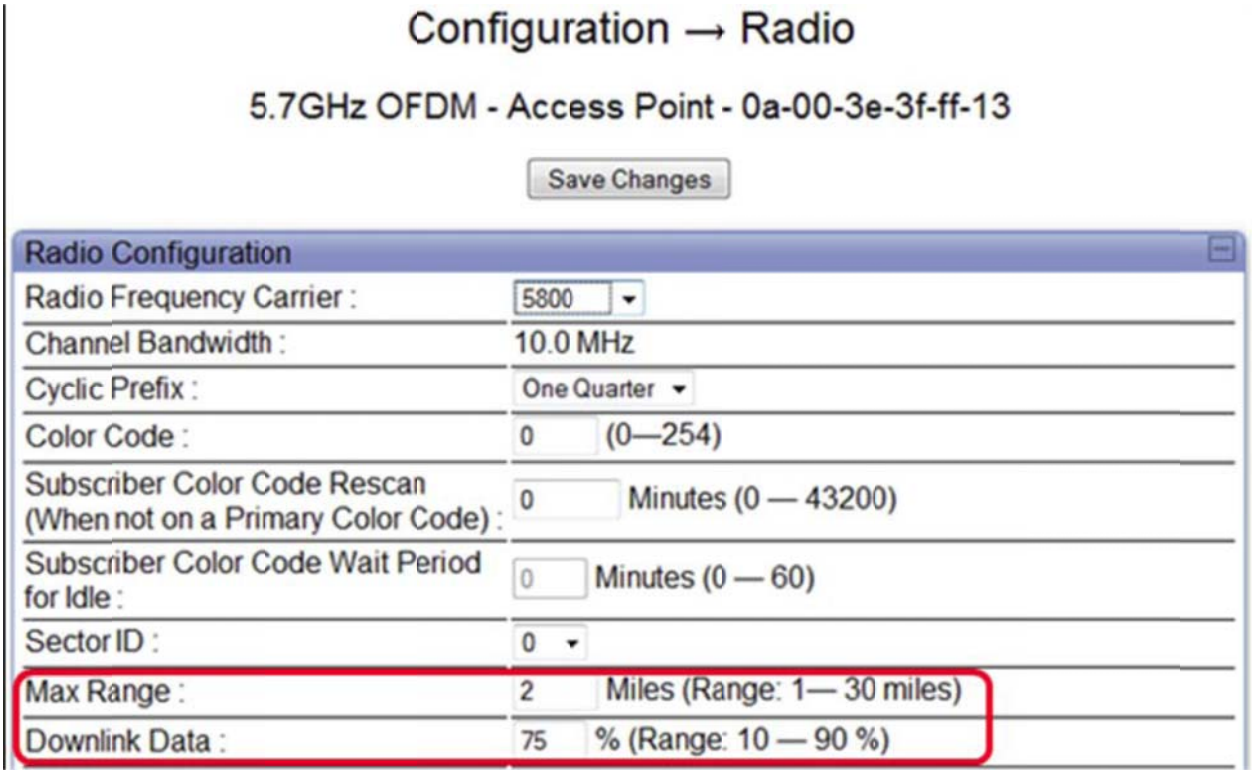

Figure 3: Max Range & Downlink Data on AP "Configuration => Radio" page.

Suggested Control Slot settings as a function of number of SMs in the sector are shown in Table 3. Generally all APs in a cluster should use the same number of control slots so as to keep the frame structures, and thereby the send and receive timing, the same.

Table 3: Cyclone OFDM AP Control Slot Settings

Number of SMs that Register to the AP	Suggested Number of Control Slots
1 to 10	1[1] or 2
11 to 50	4
51 to 150	6
151 to 200	8
Note 1: Any OFDM sector with the Hi Priority Channel enabled on any SM should be configured with at least 1 Control Slot on the AP.	

In some cases operators may find that sectors with high levels of small packet requests, such as might be seen in a sector handling several VoIP streams, benefit overall from slightly higher Control Slot settings. If different sectors require different numbers of Control Slots, the operator should use the Frame Calculator to find a combination of settings that put “Rec SEQ Start” times within 300 bit times.

Control Slots are reserved for SMs' bandwidth requests and never handle data. A higher number of control slots gives higher probability that an SM's bandwidth request will be heard when the system is heavily loaded, but with the tradeoff that sector capacity is reduced by about 100 kbps for each Control Slot configured, so there will be less capacity to handle the request.

Uplink Data Slots are used first for data. If they are the not needed for data in a given frame the data slot can be used by the SMs for bandwidth requests. This allows SMs in sectors with zero control slots configured to still make bandwidth requests using unused data slots.

Downlink Data %, Range, and Control Slots should be set consistent with the results of any collocation planning done using OFDM and FSK frame calculators.

The BHM performs its own ranging and so no range need be set for it.

BHMs do not have settings for control slots, as there is no bandwidth request contention on the one-to-one link.

4.4 BACKGROUND AND OPERATION

The modules use region-specific DFS based on the "Region Code" selected on the module's "Configuration => General" page. By directing installers and technicians to set the Region Code correctly, the operator gains confidence the module is operating according to national or regional regulations without having to deal with the details for each region.

Available "Region Codes" include Other, United States, Canada, Europe, Brazil, Russia, and Australia. Operators in regions or countries not listed and with requirements aligned with one of the listed countries should set the Region Code to that country. Operators in regions or countries with no requirements for DFS should use the "Other" Region Code.

New APs and BHMs from the factory will show a Region Code of "None", and will not transmit until the Region Code is set to a value other than "None".

Canada, United States and Europe have requirements to avoid certain frequencies used by some weather radar. To meet this requirement, modules set to a Region Code of Canada, United States or Europe will display the center channel frequencies on the AP's and BHM's Carrier Frequency pop-up and on the SM's and BHS's Frequency Scan Selection List.

Table 4 shows the details of DFS operation and channels available for each Region Code, including whether DFS is active on the AP/BHM, SM/BHS, which DFS regulation apply, and any channel restrictions..

Table 4: 5.8 GHz OFDM DFS Operation based on Region Code

Region Code[1]	Frequency	AP	SM	Center Channel Frequencies Available[2] (MHZ)
United States	**5.8 GHz**	**No Effect**	**No Effect**	**5730-5845**
Canada	**5.8 GHz**	**No Effect**	**No Effect**	**5730-5845**

1. In all cases set the Region Code to the region you are in and the equipment will provide DFS consistent with that region's regulations. 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.

After an AP or BHM with DFS boots it performs a channel availability check on its main carrier frequency for 1 minute, monitoring for the radar signature without transmitting. If no radar signature is detected during this minute, the module then proceeds to normal beacon transmit mode. If it does detect a radar signature, the frequency is marked for a 30 minute non-occupancy period, and the module moves to its 1st alternate carrier frequency. The AP/BHM continues this behavior through its 2nd alternate frequency if needed and then waits until the first frequency ends the 30 minute non-occupancy period. While operating, if the AP/BHM detects a weather radar signature it marks the current carrier frequency for a 30 minute non-occupancy period and moves to check the next-in-line carrier frequency.

An SM/BHS does not begin transmission until it detects a beacon from an AP/BHM. If APs/BHMs are not transmitting, SMs/BHSs will be silent.

The FCC and IC require DFS only on APs/BHMs. Europe applies the ETSI specification to both APs/BHMs and SMs/BHSs, while Brazil applies it only to AP/BHMs. In the ETSI case, when an SM/BHS boots, it scans to find a Canopy beacon from a AP/BHM. If an AP/BHM is found, the SM/BHS performs a channel availability check on that frequency for 1 minute, monitoring for the radar signature, without transmitting. A DFS decision is made based on the following:

- If no radar pulse is detected during this 1 minute, the SM/BHS proceeds through normal steps to register to an AP/BHM.
- If the SM/BHS does detect radar, it locks out that frequency for 30 minutes and continues scanning other frequencies in its scan list.

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

BHSs would not be expected to connect to a different BHM, as backhaul links should be configured using color codes and authentication to ensure a BHS only connects with its intended BHM.

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

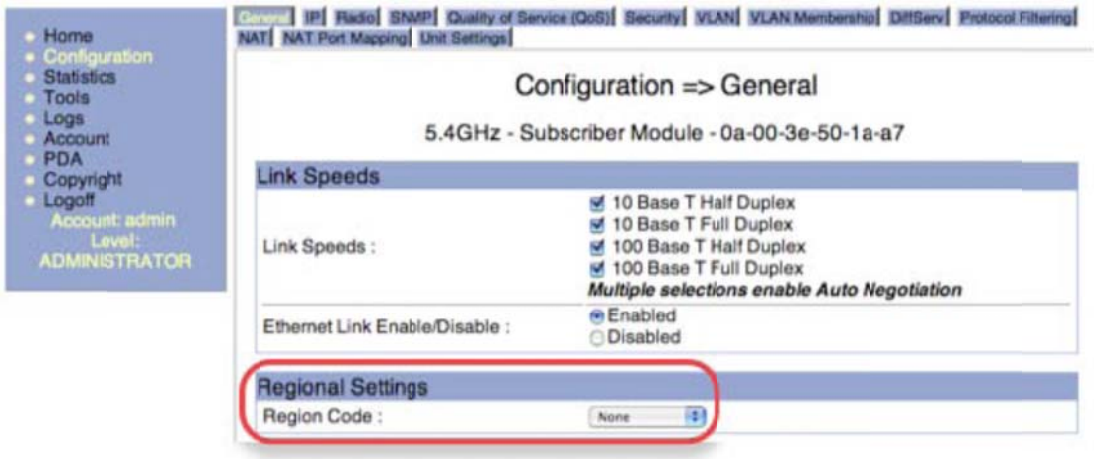

Figure 27: Configured Region Code on SM Configuration => General page

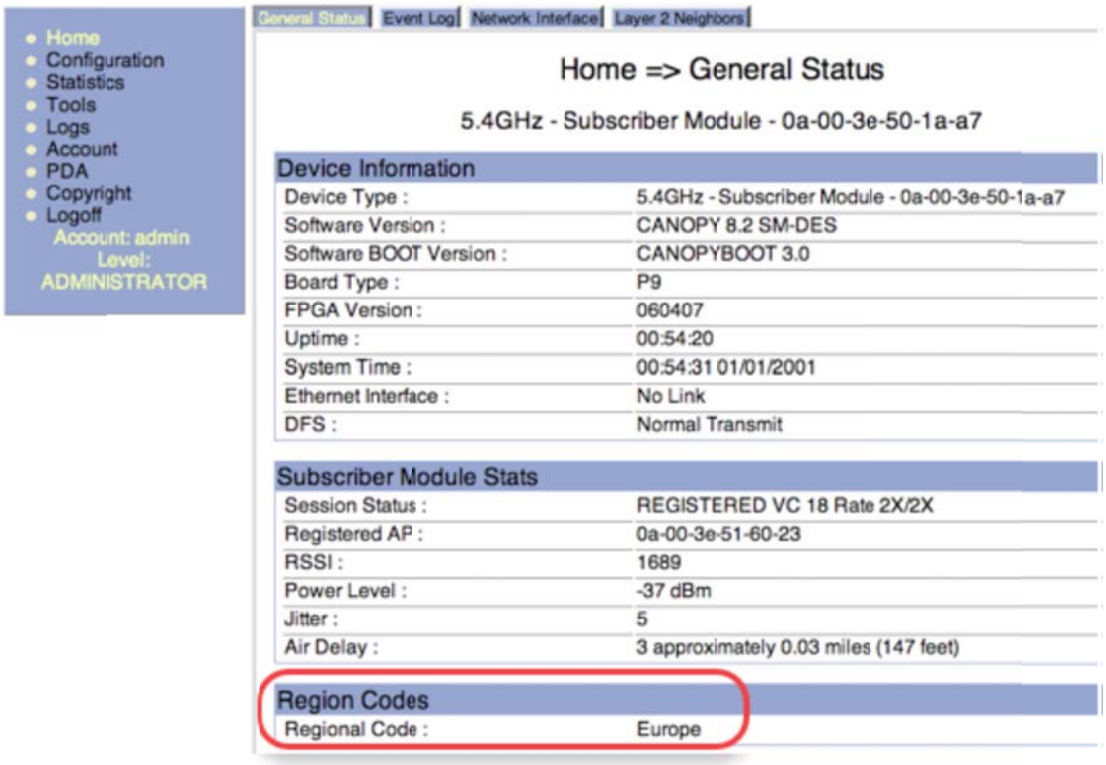

Figure 28: Active Region Code on SM Home => General Status page

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

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

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

IMPORTANT!

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

Setting Radio Frequencies

APs and BHMs running DFS include an option for setting up to two alternate frequencies on the "Configuration => Radio" page, in addition to the primary frequency. These alternate frequencies are used in the unlikely event radar is detected and the main frequency is locked out due to DFS detection. If these are left at "None", no backup frequencies will be used in the case of DFS detection, and the AP or BHM will lock itself out from any transmission for 30 minutes.

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

The alternate frequencies configured in the AP/BHM must be included in the SM/BHS's Frequency Scan List, or the SMs/BHS can't follow their AP/BHM if it switches to a new channel. Additional frequencies may checked in the Frequency Scan List depending on local practices, for example an operator may want to configure an SM to only register on certain frequencies to drive a known SM to AP mapping. Another example would be an operator who configures an SM to register on many frequencies so that it may find another AP to register to if its usual AP isn't available.

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

4.5 EXTERNAL GAIN FIELD

An AP, SM, or BH needs to know the gain of its antenna to perform DFS and Auto-TPC (Automatic Transmit Power Control) (SM only) consistent with regional or national regulations. The GUI includes a **External Gain** field to support this.

Key points about the **External Gain** field include:

- External Gain is defined as the gain of the antenna minus the loss in the coaxial cable and connectors.
- The External Gain is set on the Configuration => Radio page of each module (AP, SM, BHM, or BHS)
- The default on a 5.8-GHz SM or a unit reset to factory default is 0 dB
- The range is 0 to 35 dB.
- Any radio using DFS will use the External Gain to appropriately adjust sensitivity to radar signals. The use of DFS is determined by the Region Code setting on the Configuration => Home page.
- The Auto-TPC used by the Cyclone OFDM Series system takes into account the External Gain so as not to exceed national or regional EIRP limits.

Procedure for setting the External Gain

1. If using a BH or SM with an integrated antenna or a connectorized AP with the connectorized antenna sold with it, leave the **External Gain** on the Configuration => Radio page set to the factory default of **17** dB. If using another antenna, set the **External Gain** to the gain of the antenna minus the loss in coaxial cable and connectors.

IMPORTANT!

Ensure the **External Gain** is set correctly. Setting it low or high can lead to either a system overly sensitive to DFS events or a system not transmitting at its full legal power.

4.6 NETWORK CONTROL PARAMETERS

Parameters for High Priority/DiffServ, NAT, DHCP, VLAN, MIR, and CIR are configured the same as they are in standard Canopy. The operator may (or may not) want to take advantage of the higher possible MIR to provide greater bandwidth to a given SM.

4.7 FORWARD ERROR CORRECTION

Cyclone 5700-360.OFDM Series radios use FEC (Forward Error Correction) to extend the range of the modules. They use Reed-Solomon error correction optimized at 3/4 coding. The coding rate is not settable by the operator.

4.8 CYCLIC PREFIX (CONFIGURABLE ONLY ON CYCLONE OFDM AP/SM)

OFDM technology uses a cyclic prefix, where a portion of the end of a symbol (slot) is repeated at the beginning of the symbol (slot) to allow multi-pathing to settle before receiving the desired data. A 1/4 cyclic prefix means that for every 4 bits of throughput data transmitted, an additional bit is used, A 1/8 cyclic prefix means that for every 8 bit of throughput data transmitted, an additional bit is used.

Cyclone OFDM Series networks use a default cyclic prefix of 1/4 that is configurable by the operator to 1/8. The Cyclic Prefix is set on the Configuration => Radio page on the AP. Changing the default from ¼ to 1/8 can increase throughput by ~2 Mbps (assuming 75% duty cycle) in installations with low multipath conditions. It is recommended to test 1/8 cyclic prefix to determine actual performance based on RF conditions.

Procedure for setting the Cyclic Prefix

Set the **Cyclic Prefix** on the Configuration => Radio page of both the BHM and the BHS to **1/8** before deployment

During installation use Link Tests to confirm link quality per standard installation and alignment procedures.

If a Link Test shows low throughput or efficiency, consider changing the Cyclic Prefix to **1/4** on *both* the BHM and the BHS along with other standard installation troubleshooting procedures such as re-aiming, off-axis aiming, changing location, raising or lowering the height of the radio, adjusting **Transmission Power** up or down, or identifying and mitigating sources of interference.

5 INSTALLATION

WARNING!

Installing a unit usually involves height, electricity, and exposure to RF (Radio Frequency) energy. To avoid personal injury, follow applicable national and local safety regulations along with industry best practices. Also follow the specific guidelines in this document, including Exposure Separation Distances in section 6 on page 14.

5.1 INSTALLING AN AP WITH CONNECTORIZED ANTENNA

This section addresses installation aspects specific to the Cyclone 5700-360.OFDM Series AP. General communications equipment, infrastructure, and facilities site design should be performed in line with Motorola's "Standards and Guidelines for Communications Sites" (also known as the R56 manual - document #68P81089E50-A)

These procedures are specific to the case of as AP purchased as a kit consisting of a connectorized antenna and a connectorized radio. They are also generally applicable to connectorized APs, SMs, or BHs when the antenna is purchased separately by the operator.

A short coaxial cable from the radio terminates in a male N connector. The antenna has a chassis-mounted female N connector. The antenna includes tower mount brackets with adjustable down-tilt.

Installing an AP typically consists of four phases:

1. Configuring the AP at an operator's facility or at the installation site using the information and settings defined previously in Planning (Section 3) and Configuring (Section 4).

2. Assembling the AP (radio and antenna and brackets) and physically installing it using on the mounting structure.

3. Cabling the AP to the CMMmicro or CMM4 (for Cyclone OFDM APs), and grounding it to Protective Earth – PE using Procedure 4. This phase can also include cabling to backhauls, or running terrestrial feeds.

4. Confirming operation, using SMs in the field.

Local practices and choices of installation options will dictate the actual processes. For example, variations on these generalized procedures can be used to install on a building or install multiple APs on a pipe mount before hoisting up a tower for final attachment.

6 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 6.

Table 5: Exposure Separation Distances

Module Type	Separation Distance from Persons
Cyclone 5700-360.OFDM	At least 24 cm (approx. 9.5 in)
Cyclone 5700-VS.OFDM	At least 24 cm (approx. 9.5 in)
Canopy Module (for comparison)	At least 20 cm (approx. 8 in)