# Cambium Networks™

# *e*PMP™

# Optimization Guide

Purpose of this guide is to help guide the operator to improve and/or debug existing ePMP network's performance from an RF/wireless perspective. The ePMP AP and SM come with default settings for all parameters. To optimize performance under different conditions, it is important to tune the default values to what will be suitable for that specific deployment. This guide lists some important parameters which are sometimes challenging for the operator to understand and determine the right values for a particular deployment.
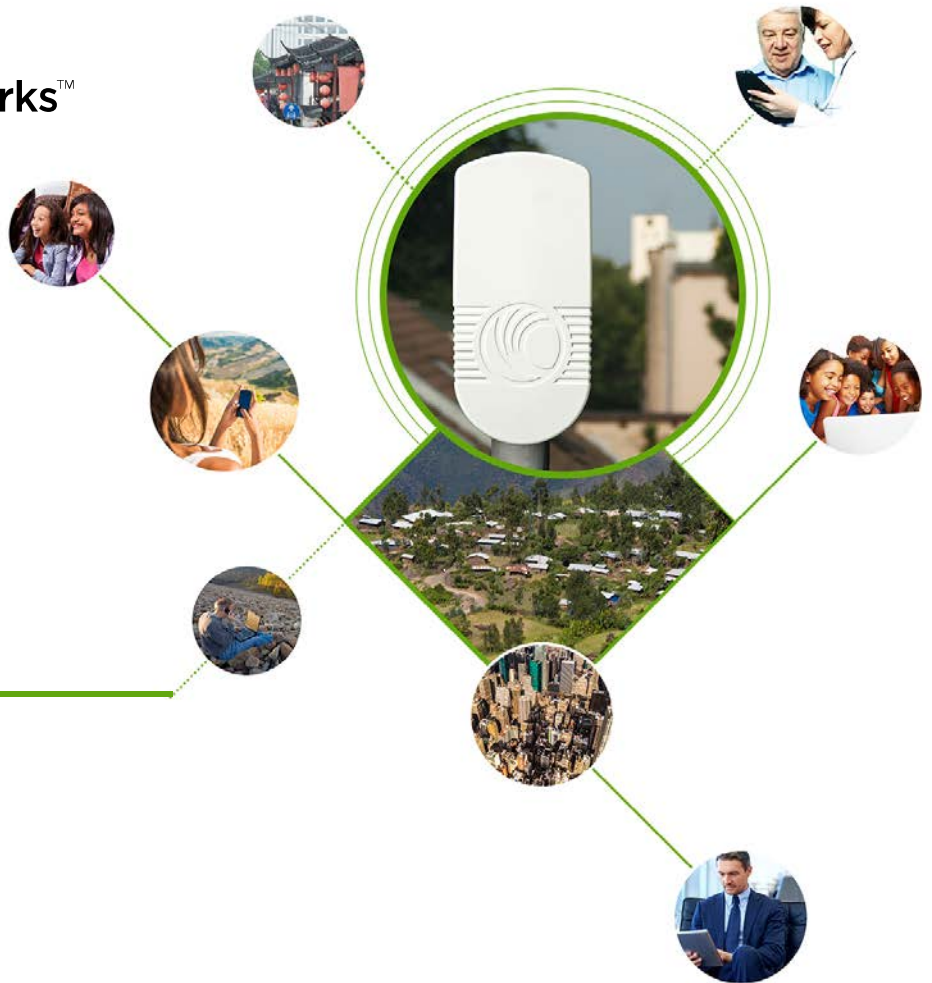
## Fixed Mode Vs. Flexible Mode of Operation:

➢ User can select fixed or flexible mode of operation on AP under Configuration >> Radio tab.



➢ **For Fixed mode of operation**, select either 75/25, 50/50 or 30/70. These three modes will allow the radio to operate in a fixed Downlink and Uplink ratio with or without GPS sync (Depends if GPS sync is enabled or not). In other words, this ratio represents the duration of transmit and receive cycle within the TDD frame.

➢ **In Flexible mode of operation**, the radio dynamically selects Downlink and Uplink resources every frame based on traffic demands. Flexible mode allows for more throughput and lower latency. However the radio operates in an unsynchronized mode as explained later in the document (NO GPS Sync)

➢ If the AP is in a sector or in range of another AP, it is recommended to use GPS sync (i.e. the user selects one of the three Downlink/Uplink Ratios and all of the AP's in a cluster and nearby AP's are configured the same to avoid overlapping RF transmissions resulting in system interference.)

## Synchronized vs. Unsynchronized mode of operation:

➢ This feature is supported on GPS synchronized units only. GPS sync can be enabled by navigating to Configuration >> Radio tab.



➢ When the AP is deployed in a cluster or in vicinity of another ePMP AP it is a good practice to use GPS sync to avoid self-interference. To enable GPS sync select either GPS or CMM as a sync source as per availability. GPS synchronization is supported in fixed mode of operation (fixed TDD ratio) as explained above.

➢ In Flexible mode of operation GPS synchronization is not supported and the AP will switch to internal mode (i.e. no GPS sync.)

➢ When doing RF Planning for the deployment of collocated APs with channel reuse, it is recommended to use a channel reuse pattern as recommended in the **ePMP ABAB frequency reuse deployment** document (https://support.cambiumnetworks.com/files/epmp/).

## PTP mode of operation:

➢ User can select PTP only mode from the AP radio page (under Configuration >> Radio) as shown in the screenshot below. For PTP links it is recommended to select this mode. For many countries regulations are different for PTP and PMP mode (E.g. Transmit power, EIRP).

> For PTP mode, it is recommended not to re-use frequencies that are being used on the nearby PMP clusters.
> If there are no other ePMP sectors in nearby area, it is recommended to use flexible mode. (Flexible mode provides low latency and more throughput).

## Subscriber Module Target Received Level: (TRL)

> Each SM's transmitter output power is automatically set by the AP. The AP monitors received power from each SM and adjusts each SM's transmitter output power so that received power at the AP from the SM is not greater than what is configured in **SM Target Received Power Level**. These automatic power adjustments ensure that the SM is not transmitting excessive energy (raising system noise level) and that the SM is able to achieve an optimal modulation state (and maximum achievable throughput).
> Nominally, target receive levels must be set lesser than -60 dBm in order to prevent interference from co-located co-channel sectors.

This parameter is located on access point under **Configuration >> Radio tab**.



> **In Fixed TDD ratio mode**, since GPS synchronization is supported, minimizing self-interference is important. In this scenario this parameter should be set to the lowest value possible so as to keep the SM Transmit power to a minimum to lower the noise floor/self-interference but at the same time allow the SMs to transmit at the highest possible MCS. For Co-located AP's reusing the same channels this is an important parameter and should be set the same on all AP's. The recommended and default value in such scenarios is -60dBm. (Low enough to prevent self-interference but high enough to allow SM that can reach such target RSSI to operate at MCS15).
> **In flexible mode**, self-interference is still a challenge as the ePMP radio is not using GPS synchronization. However, it is still good practice to keep the self-generated noise to a minimum noise floor so as not to cause interference with other sectors on the same tower or nearby towers. This value should be approximately -50dBm.
> Sensitivity for MCS15 is around -64dBm for 20MHz. The default value of TRL is -60dBm. This value may not be adequate in noisy/interference environments. Set this value to -50dBm in case of lower throughput than what is expected at MCS15 OR if the wireless link is not operating at MCS15. Please note if lowering TRL value does not help, set this back in range from -50dBm to -60dBm. Do not set this value to -40dBm it will cause all SM's to transmit at higher power to meet this value increasing noise floor for all nearby sectors.

## Max Range

> Max Range parameter can be configured from Configuration >> Radio tab

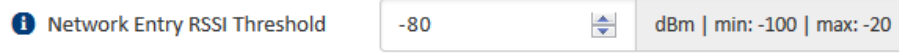| | |
|---|---|
| ℹ Max Range | 3   ⇕   miles \| min: 1 \| max: 40 |

➢ Enter a number of miles or kilometers for the furthest distance from which an SM is allowed to register to this AP. Do not set the distance farther than what is required. A greater distance:

- Does not increase the power of transmission from the AP.
- Can reduce aggregate throughput.

➢ Regardless of this distance, the SM must meet the minimum requirements for an acceptable link. The AP will reject any SM network entry attempts from outside the configured maximum range. The default value is 3 miles.

➢ This parameter is set based on the farthest SM being deployed. Calculate the distance of farthest subscriber module using Link Planner or any other suitable tools. Set this value 1 to 2 miles higher than the calculated number. Do not set this parameter to the max value as it will waste time allocated for data transmission when it is not needed.

➢ If the AP is in a cluster or is in the range of another AP, then you must set this parameter exactly the same on all other AP's.  Otherwise, overlapping RF transmissions will introduce system interference.

➢ Users can refer to the Cambium Link Planner software available online to calculate accurate link budget. (http://www.cambiumnetworks.com/products/planning-tools/link-planner).

## Network Entry RSSI Threshold:

➢ This parameter is located on the Subscriber Module under **Configuration >> Radio tab**

| | |
|---|---|
| ℹ Network Entry RSSI Threshold | -80   ⇕   dBm \| min: -100 \| max: -20 |

➢ This parameter represents the minimum Received Signal Strength Indicator (RSSI) required at the SM for the SM to attempt registration with AP. Main purpose of this parameter is to prevent SM with poor link quality from registering to an AP.

➢ If all Subscriber Modules are expected to have good link budget of -60 to -70dBm and hence a good link quality, leave this value to default.

➢ If SM's are being deployed at distances farther from the AP where the link budget is between -75dBm to -80dBm, Network Entry RSSI Threshold should be set to a lower value. E.g. -85dBm.

➢ However, it is recommended not to deploy SM's with low link quality (RSSI) as it may result in an unstable link. Customers should explore options of adding another AP to improve coverage of such Subscriber Modules.

## Network Entry SNR Threshold:

➢ This parameter is located on the Subscriber Module under **Configuration >> Radio tab**

| | |
|---|---|
| ℹ Network Entry SNR Threshold | 0   ⇕   dB \| min: -5 \| max: 60 |

➢ This parameter represents the minimum Signal to Noise Ratio (SNR) required at the SM for the SM to attempt registration with the AP. The purpose of this parameter is to not allow SM's to register that are not in the AP's sector. Main purpose of this parameter is to prevent SM with low SNR from registering to an AP

> ➢ If all Subscriber Modules are expected to have good SNR, leave this value to default.
> ➢ If SM's are being deployed at distances farther from AP where SNR is low, Set Network Entry Threshold to a lower value e.g. 10dB.
> ➢ However, it is recommended not to deploy SM's with such a low SNR as it may result in an unstable link. Customers should explore options of adding another AP to improve coverage of such Subscriber Modules.

## Management Packet Rate:

> ➢ This parameter can be configured from **Configuration >> Radio tab**



> ➢ The ePMP AP allows users to set MCS (modulation) of management packets. The default is MCS1.
> ➢ User can set this value to MCS0 if deployment is in really noisy environment.
> ➢ If the event log is shows GPF's lost messages, the user can switch MCS of management packets from default value to MCS0. MCS0 will be more tolerant to noisy environments than MCS1 and can prevent SM's from losing session in noisy environments.

## Transmit power and antenna gain:

> ➢ This parameter can be configured from **Configuration >> Radio tab**



> ➢ Antenna gain value should be set based on the antenna being used.
> ➢ Please note setting antenna gain to a value higher than the actual antenna gain does not mean increase in total output power. It may decrease the radio's actual transmit power to meet EIRP requirements for regulatory purposes.
> ➢ Ideally sectors antennas in used with co-located APs should be identical (same specifications).
> ➢ Set transmit power to max value allowed for country code.
> ➢ If user has difficulty getting integrated SM (i.e. No external antenna) register to AP or SM is registered at lower RSSI, it might be a good option to add Force110. Force110 will increase signal strength by 12dB.
> ➢ **Note**: Installer should note that default GUI refresh rate is 5 seconds. When installer is aiming SM's towards AP it is very important to move SM very slowly and wait for GUI to respond or change RSSI value.

## Automatic Channel Selection (ACS):

> ➢ User can Enable/Disable ACS feature on AP from **Configuration >> Radio tab**

Access Point Configuration

| AP SSID | Cambium-AP |
| Max Registrations Allowed | 120 | stations | min: 1 | max: 120 |
| ℹ Max Range | 3 | miles | min: 1 | max: 40 |
| ℹ Automatic Channel Selection | ◉ Disabled  ◯ Enabled |

➢ Automatic channel selection feature is recommended to use when user cannot find any specific channel with low noise/interference from spectrum scan.

➢ When ACS is enabled, the radio will scan the entire band and look for the channel with lowest interference level. ACS feature is very useful when all channels have high energy OR the user does not want to run a manual spectrum analysis to select the channel manually.

➢ ACS is not recommended for co-located, synchronized AP's (i.e. when AP is in a cluster with perfectly planned RF network).

➢ It is considered a good practice to turn off ACS feature once user finds a clean channel. This will prevent any scenarios where all AP's in a sector lost power, came back up and started using same channel.

## Security:

➢ User can configure security options form Configuration >> Security



Configuration ➤ Security

Security Options

Wireless Security  ◯ Open  ◉ WPA2  ◯ RADIUS

Configuration ➤ Security

Security Options

Wireless Security  ✔ RADIUS  ✔ WPA2  ☐ Open

➢ User must select security options (i.e. Open, WPA2 and RADIUS) same on AP and SM. Mismatched configuration will cause AP to reject SM's registration request.

## Subscriber Module Scan List:

➢ User can configure Subscriber Scan list from Configuration >>Radio page on the SM.

➢ It is recommended to only select frequencies and bandwidth that user is planning to use on Subscriber Module. Leaving all frequencies unchecked will force SM to scan entire band which will increase registration times. Selecting specific frequencies will also avoid SM from registering to some random AP's from someone else's network.