

Cambium PMP 450

Migration Techniques

PMP-0355_001v000



Cambium Networks

Introduction

PMP 450 Background and Alternatives to FSK Interoperability

Cambium Networks is excited about the interest and response on the PMP 450 platform. In order to meet the strong customer needs for PMP 430 interoperability and expand the PMP 450 into 2.4 GHz and other bands, Cambium Networks has suspended development on FSK interoperability on the PMP 450. Many customers are managing frequencies to enable their PMP 450 deployments, and as a consequence they are advocating prioritization of PMP 430 interoperability and 5 MHz channel bandwidth on the PMP 450.

With this change, PMP 430 interoperability will be available in an upcoming software release. When this capability is launched, Cambium Networks will implement PMP 430 interoperability without requiring a license fee – a \$400 MSRP savings for our customers. In addition, this change enables us to provide the option to use 5 MHz channels on the PMP 450. This will help many network operators use as much spectrum as possible to meet their customers' demand for bandwidth.

We understand that for some customers who are bandwidth constrained with large FSK networks, there is a need to develop a migration path that satisfies customer needs. Cambium Networks' technical team will work with them to develop frequency planning solutions or network planning to provide service that will satisfy customers and position them for growth.

Cambium Networks is committed to enabling broadband connectivity and providing solutions that exceed network operator and end customer expectations for quality and reliability. As demand for bandwidth continues to grow exponentially, we aim to provide forward looking solutions that enable video, voice and data connectivity.

Techniques for PMP 450 Migration

Re-evaluate Frequency / Sector Configurations

A careful re-evaluation of spectrum utilization may result in additional frequency availability. Co-located PMP 100 Series APs may operate with no guard band between channel edges. Co-located PMP 100 and/or PMP 430 Series AP modules may operate with just 5MHz between adjacent channel edges, reducing the cluster's overall spectrum usage. By reducing the cluster's RF footprint, additional spectrum may become available for migration usage.

Utilize PMP 450 5MHz Channel Bandwidth

In addition to 10MHz and 20MHz channel bandwidth operation, in a future release PMP 450 devices will also support 5MHz channel bandwidth operation allowing for tighter spectral efficiency in frequency-constrained radio environments. In many cases, a 5MHz channel bandwidth PMP 450 AP may be introduced into the network to begin freeing spectrum and migrating subscribers.

Plan for PMP 430 Interoperability

We have listened to your key business requirements for interoperability between PMP 450 Access Points and legacy PMP 430 Subscriber Modules. Cambium has accelerated development of this feature which will allow operators to replace PMP 430 Subscriber Modules with PMP 450 Subscriber modules to meet network capacity needs.

Maximize PMP 450 Frequency Band Options

With the suspension of the FSK Interoperability PMP 450 product, Cambium is able to accelerate development of additional frequency band offerings for the PMP 450 product. Additional frequency offerings provide a valuable migration tool for frequency-constrained operators.

Deploy a FSK/PMP 450 Mounting Adapter

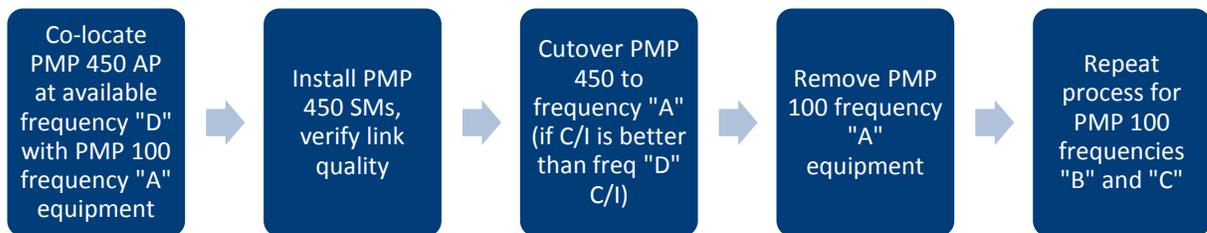
In conjunction with migration techniques above, you can now mount an FSK radio alongside the newly installed PMP 450, potentially saving tower costs while executing your migration strategy over time.



Migration Scenario 1: PMP 100 Deployed, Additional Spectrum Available

Migration scenario 1 assumes that the existing network is comprised of PMP 100 equipment operating on channels “A”, “B”, and “C”. The migration in this scenario results in a complete replacement of PMP 100 series equipment with PMP 450 equipment by utilizing unused available spectrum (listed in diagram as frequency “D”).

In this scenario there is additional spectrum available and the newly-installed PMP 450 equipment will be co-located (in one sector) with the existing PMP 100 equipment until the cutover to PMP 450 equipment is complete.



Key principles to consider when migrating:

- OFDM equipment requires a higher carrier-to-interference ratio over each modulation state. Based on the measured noise floor levels for channels “A”, “B”, “C”, and “D”, ensure that OFDM equipment is allocated to the “cleanest” frequency available.

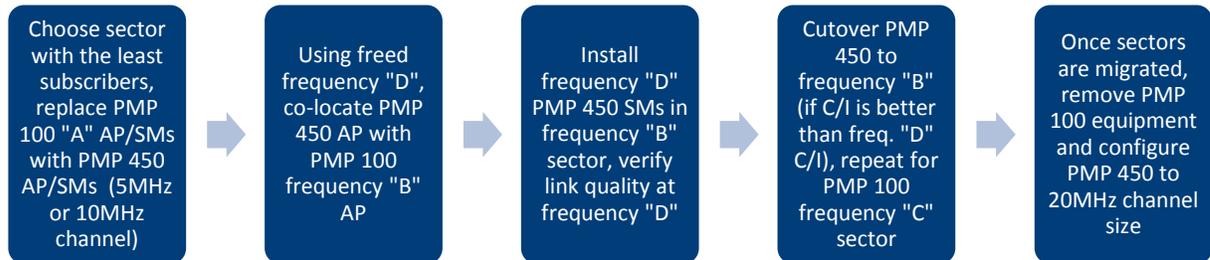
Series / Modulation	Minimum Carrier-to-Interference Ratio	
	Downlink	Uplink
PMP 100 / 1X	3 dB	3 dB
PMP 100 / 2X	10 dB	10 dB
PMP 430 / 1X	7 dB	9 dB
PMP 430 / 2X	15 dB	16 dB
PMP 430 / 3X	23 dB	24 dB
PMP 450 / 2X	10 dB	10 dB
PMP 450 / 4X	18 dB	18 dB
PMP 450 / 6X	25 dB	25 dB

- PMP 450 equipment is available in 5.4GHz and 5.7GHz bands, providing additional spectral options to frequency-constrained operators. Operators may utilize alternate bands to deploy new PMP 450 equipment while maintaining operation of the existing PMP 100 network.
- Ensure that duty cycles between PMP 100 and PMP 450 equipment are the same using the device Frame Calculator (located in the management GUI in tab **Tools**, Frame **Calculator**). To use the Frame Calculator, type into the calculator various configurable parameter values for each proximal AP, then record the resulting **AP Receive Start** value. Next vary the **Downlink Data** percentage in each calculation and iterate until the calculated **AP Receive Start** for all co-located APs are within 300 bit times; if possible, within 150 bit times. In Cambium Point-to-Multipoint systems, 10 bit times = 1 μ s.

Migration Scenario 2: PMP 100 Deployed, Spectrum-Constrained, PMP 5MHz/10MHz Channel Bandwidth Utilized

Migration scenario 2 assumes that the existing network is comprised of PMP 100 equipment operating on channels “A”, “B”, and “C”. The migration in this scenario results in a complete replacement of PMP 100 series equipment with PMP 450 equipment.

For networks operating with PMP 100 (20MHz channel bandwidth), the 5MHz or 10MHz channel PMP 450 equipment may be used to free spectrum during the migration by replacing 20MHz channel sectors with 5MHz/10MHz PMP 450 sectors (to be configured as 20MHz PMP 450 sectors once migration is complete). The following procedure applies this technique to free migration frequency “D”.



Key principles to consider when migrating:

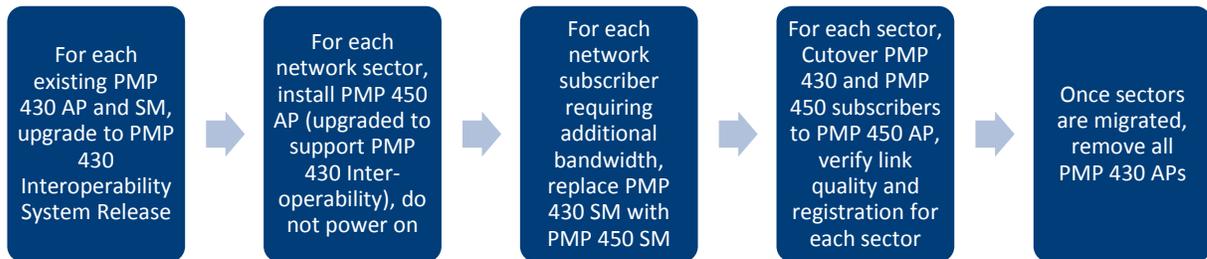
- OFDM equipment (PMP 430 or PMP 450 Series) requires a higher Carrier-to-Interference ratio over each modulation state. Based on the measured noise floor levels for channels “A”, “B”, “C”, and “D”, ensure that OFDM equipment is allocated to the “cleanest” frequency available.

Series / Modulation	Minimum Carrier-to-Interference Ratio	
	Downlink	Uplink
PMP 100 / 1X	3 dB	3 dB
PMP 100 / 2X	10 dB	10 dB
PMP 430 / 1X	7 dB	9 dB
PMP 430 / 2X	15 dB	16 dB
PMP 430 / 3X	23 dB	24 dB
PMP 450 / 2X	10 dB	10 dB
PMP 450 / 4X	18 dB	18 dB
PMP 450 / 6X	25 dB	25 dB

- In regions where regulatory restrictions inhibit usage of 5MHz channel bandwidth for certain frequency bands, consider implementing the techniques in this scenario with a 10MHz channel bandwidth. Also see [Techniques for PMP 450 Migration](#) for guard band recommendations.
- Ensure that duty cycles between PMP 100 and PMP 450 equipment are the same using the device Frame Calculator (located in the management GUI in tab **Tools**, Frame **Calculator**). To use the Frame Calculator, type into the calculator various configurable parameter values for each proximal AP, then record the resulting **AP Receive Start** value. Next vary the **Downlink Data** percentage in each calculation and iterate until the calculated **AP Receive Start** for all co-located APs are within 300 bit times; if possible, within 150 bit times. In Cambium Point-to-Multipoint systems, 10 bit times = 1 μ s.

Migration Scenario 3: PMP 430 Deployed, Spectrum-Constrained, PMP 430 Interoperability Utilized

Migration scenario 3 assumes that the existing network is comprised of PMP 430 equipment operating on channels “A”, “B”, and “C”. With PMP 450 AP / 430 SM Interoperability, PMP 430 SM equipment may be left in place and simply upgraded to register to the newly-installed PMP 450 AP.



Sector capacity reference

The following table exhibits the maximum aggregate sector throughput for several Cambium network deployments. This table may be used as a reference for planning new networks or for planning network upgrades.

Series	Modulation	Maximum Aggregate Sector Throughput (Mbps)		
		5MHz Channel Bandwidth	10MHz Channel Bandwidth	20MHz Channel Bandwidth
PMP 100	1X	N/A	N/A	7
PMP 100	2X	N/A	N/A	14
PMP 430	1X	4	7	15
PMP 430	2X	8	15	32
PMP 430	3X	12	24	50
PMP 450	2X	5	11	25
PMP 450	4X	10	26	60
PMP 450	6X	16	44	98

Note: OFDM Cyclic Prefix is 1/16 for throughput measurements