Cambium Networks™

Everything you Need to Know to Take Advantage of 6 GHz for Fixed Wireless

YOU'VE GOT QUESTIONS, WE'VE GOT ANSWERS!

Why 6 GHz?

- 850 MHz of viable spectrum supports wide channels, up to 160 MHz, delivering Gigabit to the edge

- Technology ready for commercial deployment in Q1 2024

- Automated Frequency Coordination (AFC) is simpler than CBRS SAS

- Standard Power propagation is similar to 5 GHz, allowing the reuse of existing tower infrastructure

- Unlicensed spectrum enables entrepreneurial applications and investment

- Compelling economics

> Canada allows an additional 100 MHz (total of 950 MHz) with rules similar to the FCC 🇨🇦

CAMBIUM OFFERS TWO PLATFORMS IN 6 GHz, BOTH SPANNING THE ENTIRE NEW 6 GHz BAND:

- ePMP™ 4600
- PMP 450v

Spectrum not to scale
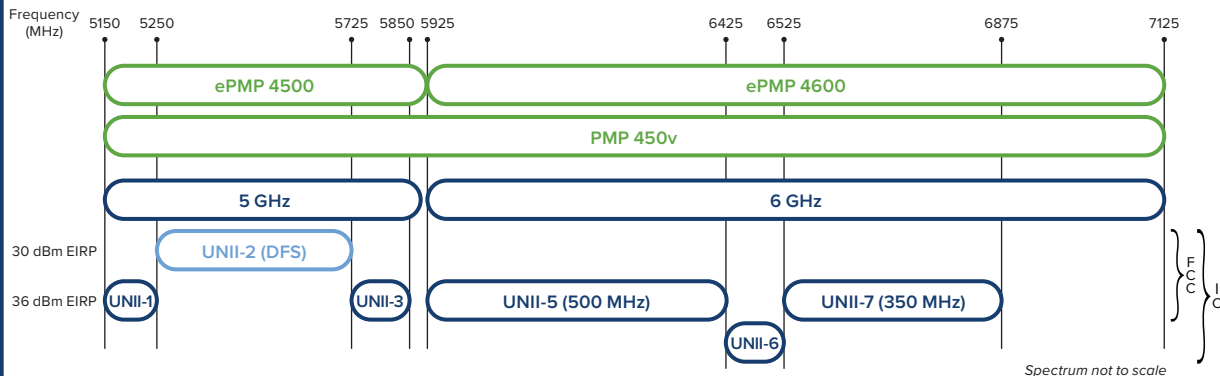
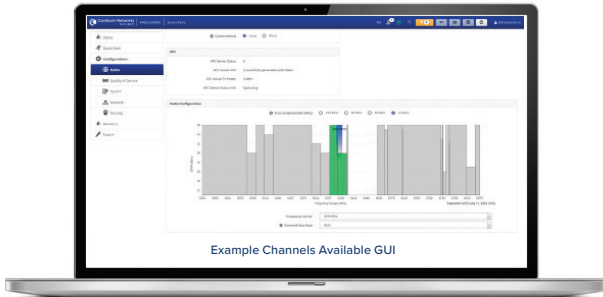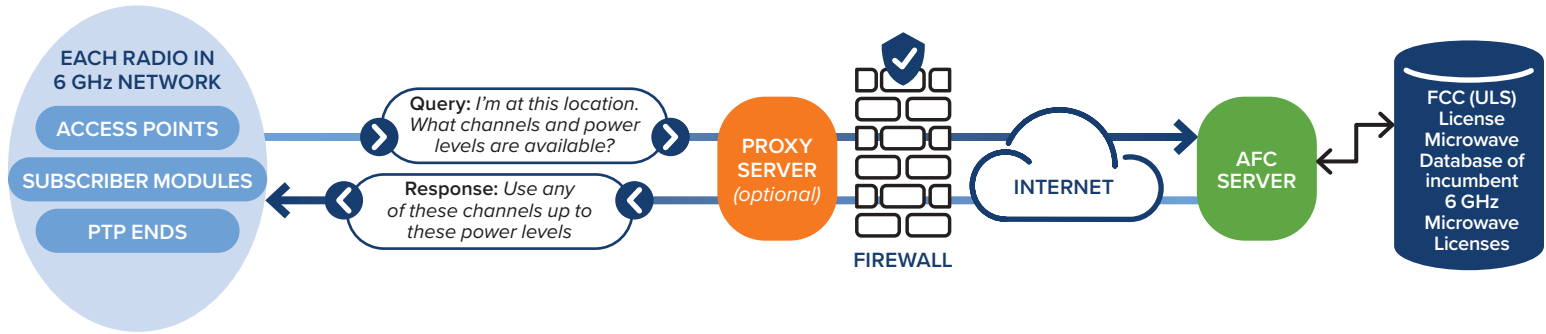## About 6 GHz: Spectrum Landscape

NEW RULES FOR 6 GHz:

- UNII-5 and UNII-7 will be allowed for fixed outdoor use at 36 dBm EIRP in the United States

- Requires the use of AFC

- In addition, Canada allows UNII-6

- All SMs and APs require specific GPS receiver from the manufacturer to indicate location

WHAT IS THE PURPOSE OF THE AFC?

- Goal is to prioritize and protect incumbent 6 GHz licensed microwave networks

- 6 GHz unlicensed networks can only use channels that are not previously assigned to licensed microwave

  - Can use any channel not protected by the AFC

  - There is no prioritization or channel assignment

How does the AFC work?

EACH RADIO IN 6 GHz NETWORK

- ACCESS POINTS
- SUBSCRIBER MODULES
- PTP ENDS

Query: *I'm at this location. What channels and power levels are available?*

Response: *Use any of these channels up to these power levels*

PROXY SERVER *(optional)*

FIREWALL

INTERNET

AFC SERVER

FCC (ULS) License Microwave Database of incumbent 6 GHz Microwave Licenses

Example Channels Available GUI

■ Available channels and power levels

■ Configured channel on the 4600 AP

■ Channels occupied by the 4600 AP

- A GPS receiver is required on all radios (SMs and APs)

- Each radio must separately query the AFC with its precise location and pre-shared encryption key

- An optional proxy server can be configured; all transactions use HTTPS

- Queries happen once at startup and then every 24 hours

- Queries are not latency sensitive and require negligible throughput (message size ~1,000 bytes)

- Radios will not transmit unless in compliance with AFC response

- Cost of AFC access is included by Cambium in the AP and SM purchase price

Why Choose a Cambium 6 GHz Solution?

- More than 100 Cambium customers have 6 GHz experimental licenses using the ePMP 4600 - and the feedback has been outstanding
- Cambium has 5 million+ deployed Point-to-Multipoint radios globally
- Support direct from Cambium and our distribution partners
- 3-year warranty

What Do Other WISPs Say About Cambium?

SKYNET 360

"6 GHz gives us the ability to deploy near to Gigabit service using new spectrum at a competitive price point, which is a true game changer."

— **Jose Camarillo**, CEO and President, SKYNET360

NEXTLINK

"We're excited that the tests bore out exactly what we expected: that we can provide fully-loaded speeds at distance utilizing the new 6 GHz band."

— **Cameron Kilton**, Chief Technology Officer, Nextlink Internet

InfoWest

"With just a SW upgrade, we have seen a 50 Mbps downlink throughput increase on a loaded 3 GHz PMP 450m, with an overall decrease in latency during maximum utilization."

— **Cody Anderson**, Director of Network Operations, InfoWest

NEXTLINK

"We look forward to rolling out Gigabit speed plans in the entirety of our existing fixed wireless service network plus our prospective network expansion. Ultimately, this expansion of Gigabit fixed wireless will cover over four million households and businesses."

— **Bill Baker**, Founder and CEO, Nextlink Internet

WaveLinc

"Our 1,200 subscribers cover one county completely and a quarter of the surrounding counties. There is no way I would have been able to go through and look at all these addresses. cnHeat not only made it possible, it made the time needed minimal."

— **Kurt Fankhauser**, President, Wavelinc Communications

How Do I Get Into 6 GHz?

IF I HAVE PMP 450:

- Replace 450i with 450v
- Replace 450m with 450v
  - Overlay 450v with 450m in same sector, or
  - Move 450m somewhere else
- Overlay with ePMP 4600, relieve strain on 5 GHz network
 - Still have commonality, lower cost SMs

IF I HAVE ePMP:

- Overlay with ePMP 4600, relieve strain on 5 GHz network
  - Consider ePMP 4500 for more capacity at 5 GHz

IF I'M NOT CURRENTLY DEPLOYING CAMBIUM POINT-TO-MULTIPOINT (PTMP) SOLUTIONS:

- Deploy ePMP 4600 at 6 GHz
  - Consider ePMP 4500 for 5 GHz

What Are My Choices for 6 GHz?

ePMP PLATFORM SUMMARY

ePMP 4600   ePMP 4600L   ePMP Force 4625   ePMP Force 4600C with dish
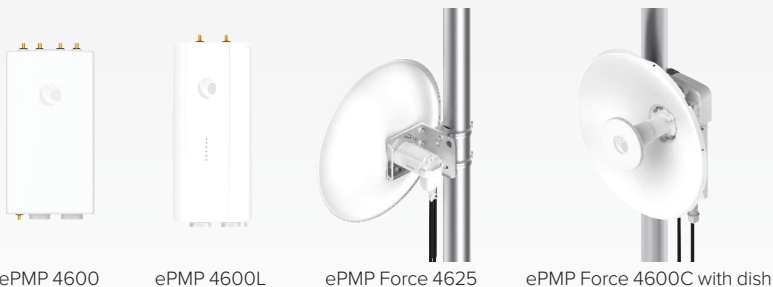
- ePMP 4600 for 6 GHz (ePMP 4500 for 5 GHz)
- PTP solutions up to 2 Gbps with Force 4600C
- Technical features (OFDMA, UL/DL MU-MIMO, TDD SYNC, SmartQoS, 4096QAM, 80/160 MHz channels)

	ePMP	ePMP Part Number
AP Performance	Up to 4 Gbps per sector	ePMP 4600 - C068940A122B ePMP 4600L - C068940A152A
SM Performance	Up to 2 Gbps per SM	Force 4625 - C068940M142A Force 4600C - C068940C122B 25 dBi dish - C060900D021A for 4600C
PTP Performance (total up+down)	Up to 2 Gbps (Force 4600C) Up to 1 Gbps (Force 4625)	

PMP 450v PLATFORM SUMMARY

4x4 450v AP   4x4 450v SM
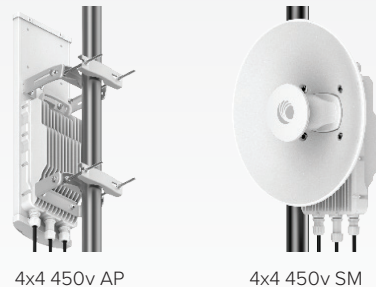
- Spans 5 and 6 GHz
- Interoperates with PMP 450 SMs
- Technical features (4x4 MIMO, cross-band carrier aggregation, up to 2x100 MHz channels)

	PMP 450v	PMP Part Number
1.5 Gbps per sector		4x4 450v AP – C060045A402A
1.5 Gbps per SM		4x4 450v SM – C060045C401A
1.5 Gbps per link		4x4 450v BH - C060045B402A

What's the New Technology in 6 GHz?

Technical Differentiator	Improvement			Impact*
	Capacity	Scalability	Performance	
Wider channels			•	Up to 160 MHz channels for more capacity
UL/DL MU-MIMO	•	•	•	Clients occupy different spatial streams which translates to performance/capacity improvement on both UL and DL. Improves overall performance for video streaming, video calls, entertainment, etc.
ABAB with TDD	•	•		TDD synch reduces self-interference due to an AP receiving when an adjacent AP is transmitting and an SM receiving when another SM in the same sector is transmitting
OFDMA	•	•		OFDMA improves small packet performance partitioning the channel to serve multiple users simultaneously
Higher Modulations			•	With 1024 and 4096 QAM, the number of symbols increases, which means more data bits are transmitted per symbol; more bits means more data

Feature availability varies by platform

Choose your TDD (UL/ DL) ratio, channel BW, AP cell radius, DL & UL MU-MIMO Gain

Choose your SMs (remember to set the gain for connectorized antennas)

Add a mixture of SMs and set distance to each SM

Select Calculate to see how much sector throughput you'll have

Use the ePMP Capacity Planning Tool:

Pick your service plans, distribution, and over-subscription rate to see how many customers (SMs) you can serve per Access Point

How Will My Network Grow with 6 GHz?

| Parameter	Example Selections	Your Scenario	Notes
TDD (UL/DL) Ratio	75/25		
DL & UL MU-MIMO Gain	1.5		
AP Cell Radius	10km		
Frequency	6600		
Channel Bandwidth	160 MHz		
Interference Level	-105 db		
SMs	Pick a mixture of 4625 (integrated) and 4600C (28dBi antenna)		
Service Plans	50% DL/UL = 100/25 30% DL/UL = 250/100 20% DL/UL = 500/100		
Oversubscription	20		
Results			
Sector Capacity	DL Throughput = 1765 UL Throughput = 441		
# of Subscriber Served	86		

What is QoE and What Does It Do for My Network?

QoE is network agnostic software that identifies underperforming hardware and optimizes the bandwidth used across any network to ensure an optimal customer experience.

TCP traffic accelerated 15% on average
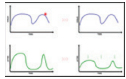
ACM is reducing latency across the network by 20-30% during times of congestion

Multi-criteria traffic shaping is reducing overall peak network load by 30-40%

DPI (Deep Packet Inspection) provides application level statistics used to proactively solve customer issues, identify underperforming hardware, and generate more revenue

More information:

What Do Other WISPs Say About Cambium QoE?

"QoE reduced our customer complaints by 50%"

"QoE eliminated our customer churn"

"QoE improved our fiber network by optimizing the Wi-Fi experience inside the home"

"QoE lowered our capital expenditures on our network saving $200k and months of labor to upgrade our towers"

"QoE Reduced our peak network load by 52%"

How Do I Plan My Network?

LINKPlanner

- Model "what if" scenarios for fixed wireless technologies – based on geography, distance, antenna height, transmit power, and other factors – to optimize system performance before purchase
- Support PTP/PMP configuration with BOM creation and proposal generation tools
- Cloud-based application

More information:

cnHeat

- cnHeat increases pre-qualification accuracy and single truck roll install success rates
- Radio Frequency planning, predictions, and covered buildings analysis for fixed wireless
- Uses LiDAR data to create precise coverage plans

More information:

cnMaestro™

- Manage the network from a single pane of glass

- Network management for fixed wireless, Wi-Fi, switching and device visibility

- Elastic scalability and management to deliver secure, end-to-end network and wireless lifecycle management with zero-touch provisioning, monitoring, and troubleshooting capabilities
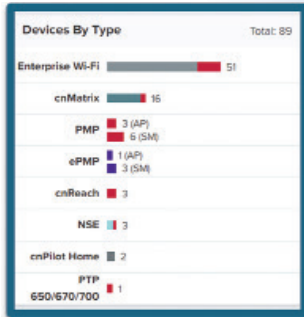
More information:

How Do I Deploy Cambium 6 GHz ePMP Equipment?

We expect the FCC to release official support for 6 GHz in early 2024 - no licenses will be needed going forward. Whether you've previously obtained an experimental license or just starting your first deployment, get started with 6 GHz by following the below steps.

1. Make sure each radio (SM, AP and PTP) has access to the internet for AFC connection

2. Make sure each radio has a GPS signal providing the location which is used by the AFC

   - ePMP 4600 AP and ePMP 4600C include a GPS antenna

   - ePMP 4625 SM requires a USB GPS receiver to be purchased separately

   - Ensure all GPS antennas are connected and have clear visibility to the sky

3. After completing steps 1 and 2, update the radio firmware to the latest version. Find the latest version at cambiumnetworks.com/support

4. No additional configuration is necessary as the ePMP firmware already knows how to access the AFC

CONTACT YOUR CAMBIUM SALES REP WITH QUESTIONS

What Other Questions Do You Have? FAQs

Does Cambium require a separate price or subscription for operation with the AFC?

No. AFC functionality is included with the price of the radio, providing payment to Qualcomm AFC for the first 7 years. After that, there may be a nominal fee. Contact Cambium for questions and support.

Will radios in 6 GHz operate without the AFC?

No. As required by the FCC, each radio must successfully query the AFC prior to transmitting.

How often does the radio have to query the AFC?

Each SM and AP must query the AFC at power-up and again every 24 hours.

What information is shared from the radio to the AFC and returned from the AFC?

The radio sends its latitude and longitude location, MAC address and a pre-shared key to the AFC. The AFC responds with available channels at that location and transmit power allowed on each. The user has the option to use any of those channels up to the maximum power allowed.

What happens to my network operation if the radio can't reach the AFC?

At each boot-up/power cycle, each AP and SM must get a response from the AFC prior to transmitting. On the subsequent 24-hour/daily queries, there is a grace period and the radio will try again every 5 minutes for the next 24 hours before halting transmissions.

How does the AFC indicate which channel and channel size that the radio operates on or cannot operate on?

The AFC provides the frequency ranges and associated transmit powers that are allowed in a specific geography. You can choose any of the available channels up to the allowed EIRP. Maximum EIRP allowed in the band is 36 dBm, but the AFC may return a result that says a lower power is required, which will be displayed graphically on the ePMP channel availability screen in the GUI and in tabular format on the PMP 450v.

Does the AFC provide any protection of my selected channel vs. another network operating unlicensed in 6 GHz?

No. The sole purpose of the AFC is to protect incumbent licensed microwave links from being interfered with by unlicensed 6 GHz operation. There is no prioritization, management, or exclusivity. When using the AFC, all radio operations are considered unlicensed (similar to operation in 5 GHz).

Which radios need to connect to the AFC?

All 6 GHz APs and SMs and PTP links must query the AFC prior to operation. We are exploring a way to provide an HTTPS proxy service so queries can go through a single point of egress, reducing the number of devices needing to reach out to the internet.

Do I need a GPS receiver to automate the collection of location for each SM?

Yes. FCC rules require all APs and SMs to have a GPS receiver specifically certified by the manufacturer and active at all times. ePMP 4600 and 4600L APs, Force 4600C SMs, and all versions of 450v have the GPS receiver built in. For ePMP Force 4625, a separate receiver (N000940L001A) must be purchased and deployed with each SM to operate with the AFC.

What network connectivity is required from the radios to the AFC and what is the bandwidth and latency requirement?
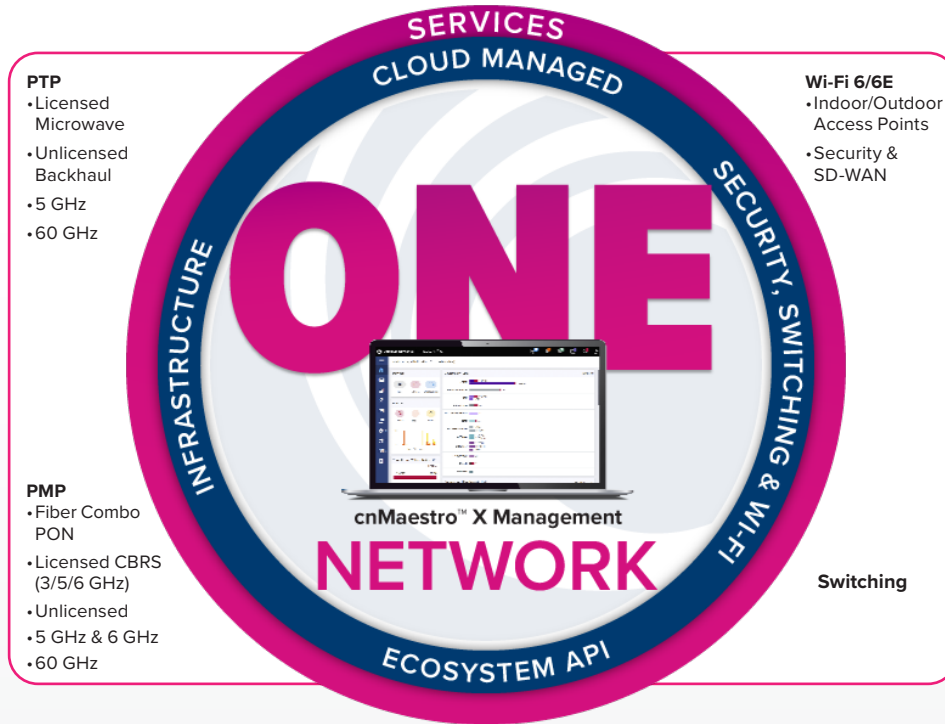
All 6 GHz radios (AP, SM or PTP) must be able to reach a specific URL on the internet using the protocol HTTPS port 443 for security. The bandwidth consumption is less than a few thousand bytes per query and the protocol is not latency sensitive. For PMP 450v, cnMaestro is required to register and onboard the devices into the AFC.

How is the EIRP limit different in 6 GHz vs. traditional 5 GHz?

The EIRP limit in 6 GHz is up to 36 dBm for both uplink and downlink. 5.8 GHz allows higher EIRP in uplink.

What happens to my AP if it is configured to operate on a specific AFC-allowed channel that later becomes unavailable due to a newly registered licensed microwave link?

Because each AP can be configured with an alternate channel, an alert is generated by the AP and the AP automatically moves to the backup channel.

PTP
- Licensed Microwave
- Unlicensed Backhaul
- 5 GHz
- 60 GHz

PMP
- Fiber Combo PON
- Licensed CBRS (3/5/6 GHz)
- Unlicensed
- 5 GHz & 6 GHz
- 60 GHz

Wi-Fi 6/6E
- Indoor/Outdoor Access Points
- Security & SD-WAN

Switching

SERVICES
CLOUD MANAGED
SECURITY, SWITCHING & WI-FI
INFRASTRUCTURE
ECOSYSTEM API

ONE NETWORK

cnMaestro™ X Management

ONE NETWORK
Wi-Fi, switching, security & backhaul in one solution

SUPERIOR PERFORMANCE
- Application optimized
- High, density, long range

SIMPLE TO OPERATE
- Cloud managed
- Integrated automation

ECONOMICAL
- Less equipment
- Lower TCO

S H O P

Cambium 6GHz

Please call us at **855-947-7776** or
email us at **SALES@ISPSUPPLIES.COM** for more information.