



**Cambium Networks™**

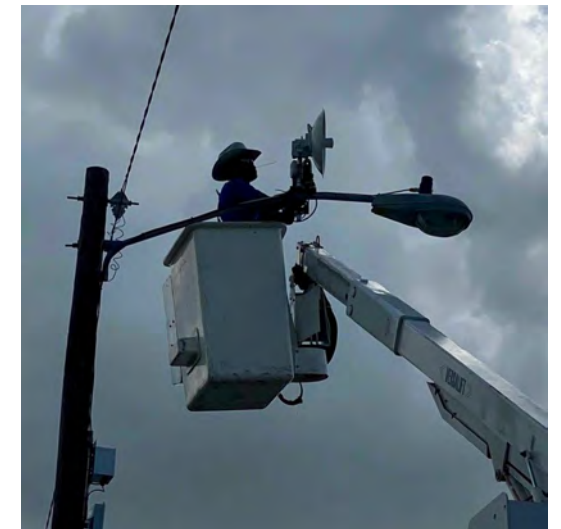
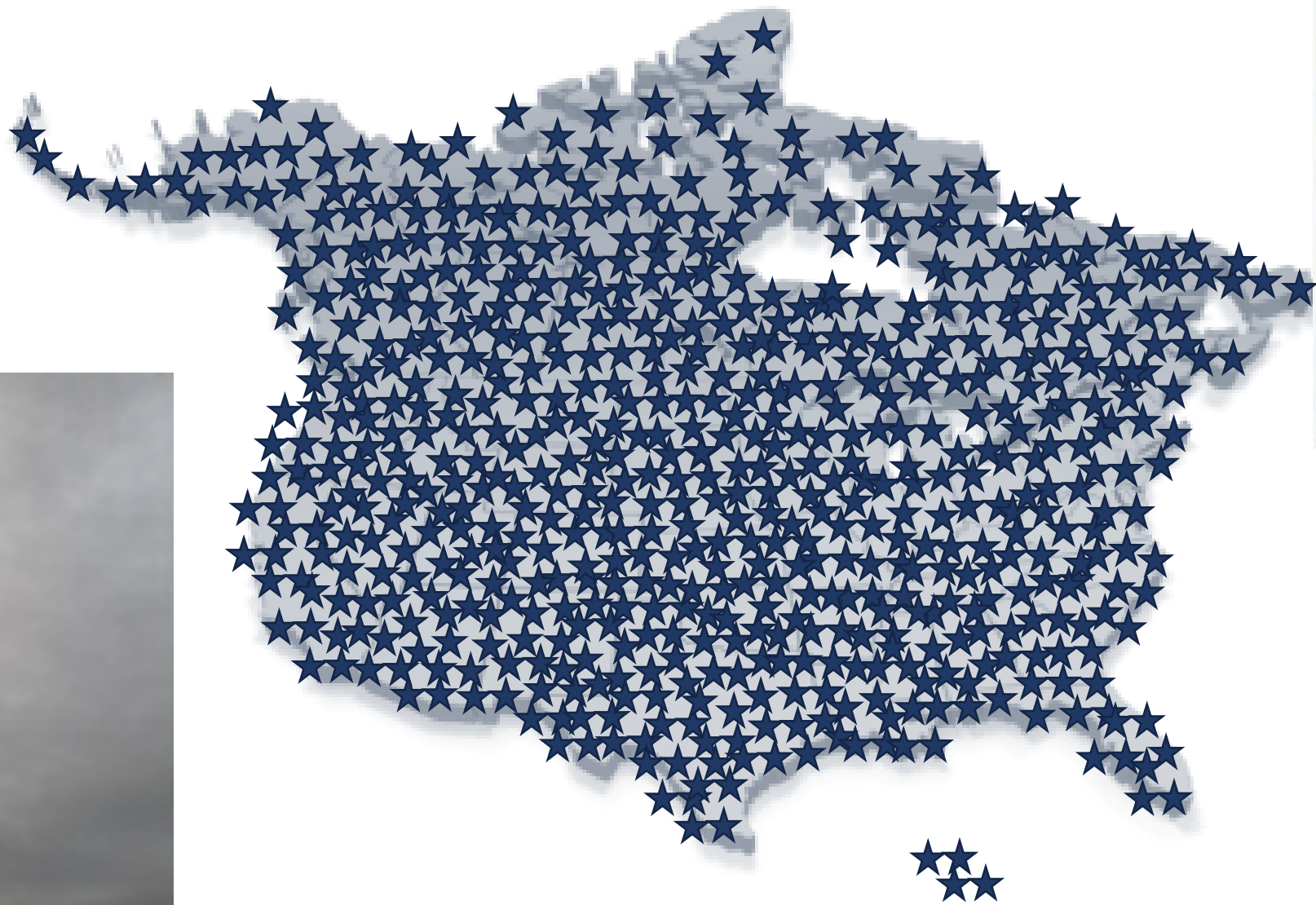
# WISPs Connecting Communities

Atul Bhatnagar

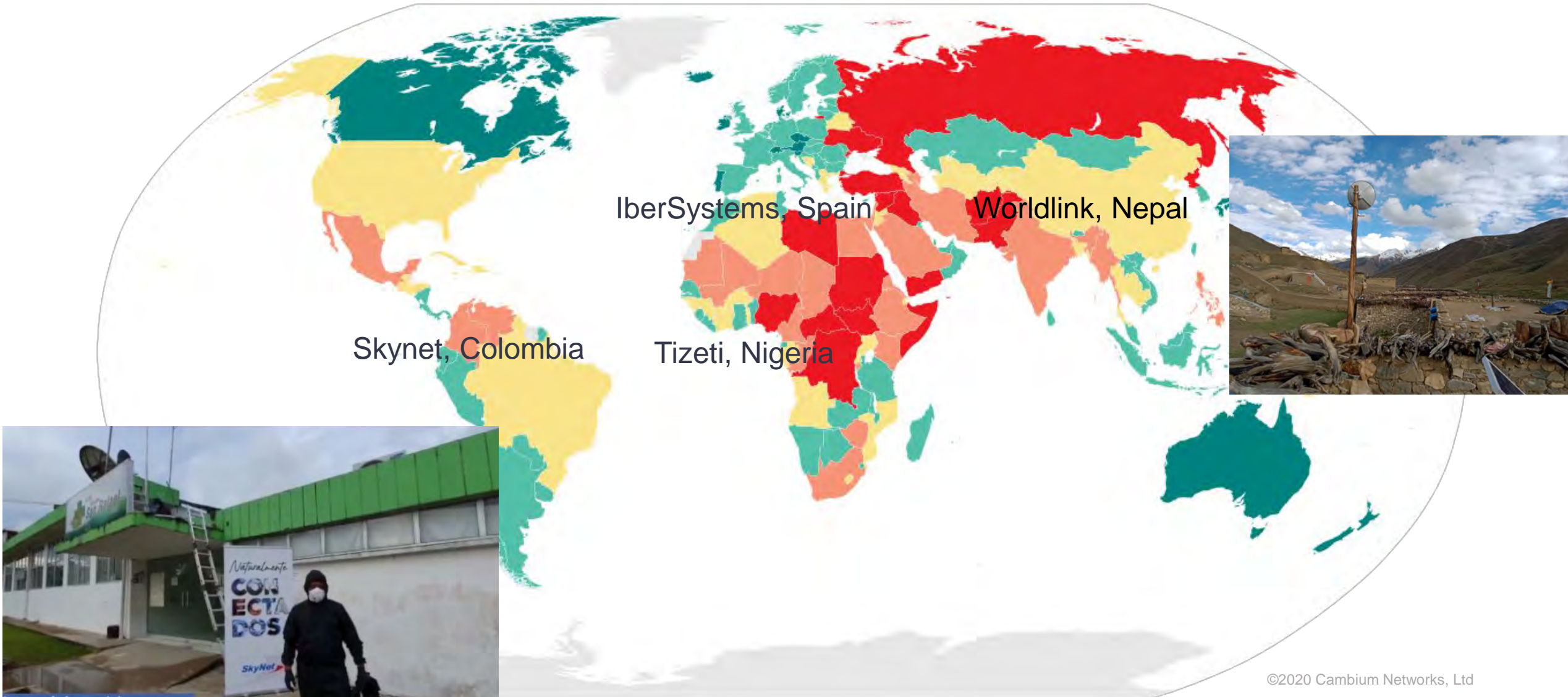
President and CEO, Cambium Networks



# WISPs Connecting Their Communities



# WISPs Connecting Their Communities





## California Fires

Elevate Technologies created links to connect Red Cross field stations



## Hurricane Laura – Louisiana

ITDRC restored communications to local schools



# Core Values: Giving Back to the Community

## Connecting rural schools

- MVTV in Minnesota

## Company-wide food drive

- Cambium employees around the world in one event coming in November

## Bicycle donation







- 60 GHz cnWave™
- Wi-Fi 6
- ePMP™
- PMP 450
- CBRS
- cnRanger™ LTE
- cnHeat

**Support WISP initiatives**

**Investment protection**

**Regulatory advocacy**

**24/7 support**

**Technical field engineering resources**

**Advanced access to technology**







## End user demand is skyrocketing mmWave onset

- Wireless is augmenting fiber
- Now wireless broadband can be Multi-Gigabit

## WAN and LAN become multi-gigabit fabric

- Millimeter wave for broadband
- Single pane of glass
- Cloud-based management and frequency control



- **Coverage and capacity**
- **End-to-end multi-gigabit wireless**
- **Rapidly deployable**
- **Reliable, secure and scalable**
- **Gigabits delivered cost-effectively**

## Multi-Gigabit Wireless Is Here







Cambium Networks™





**Cambium Networks™**

## Product Updates

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# Raffle (for WISPs)

Must be Present to Win!



PMP 450 MicroPoP Omni



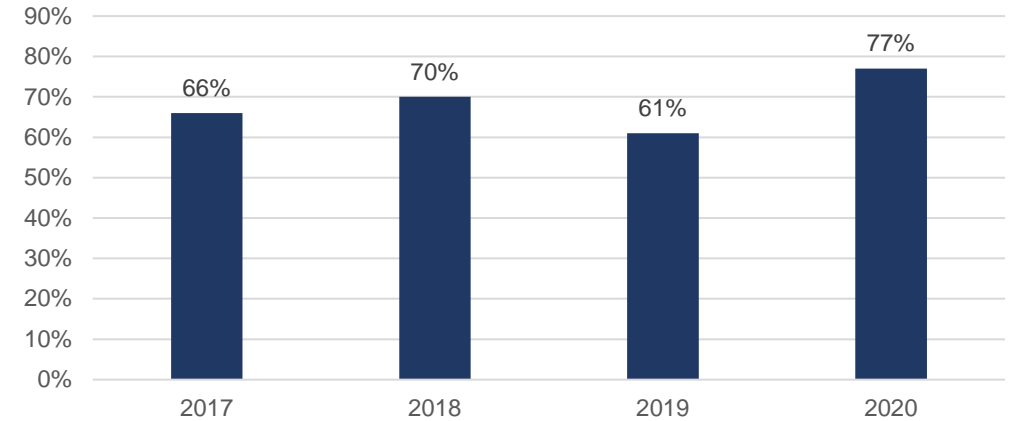
PMP 450b Retro



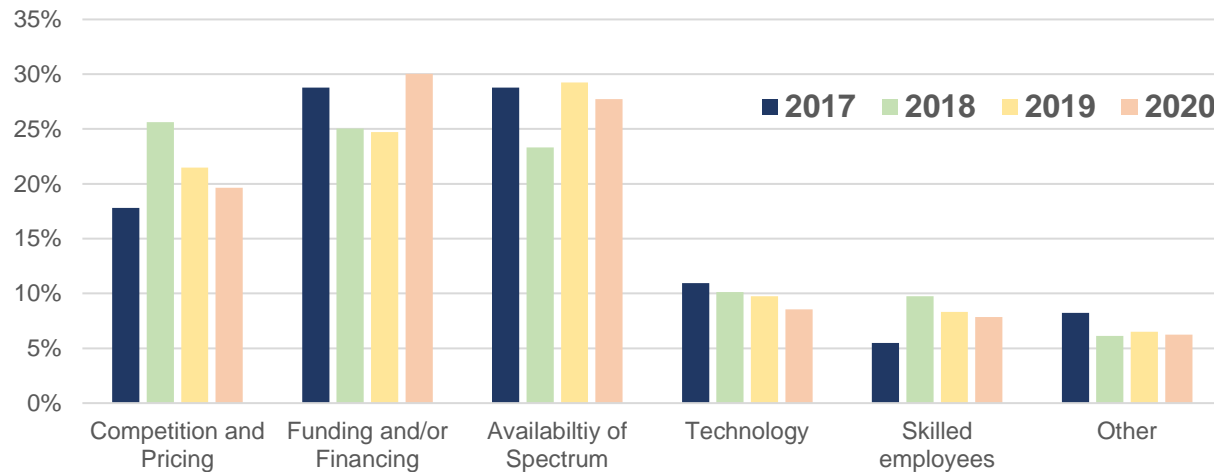


- Fourth Consecutive Year
- Participants: 433 WISPs in 58 countries
- Conducted July and August 2020
- Optimism at record high
- Financing and spectrum availability are key constraints
- 25% are offering Managed Wi-Fi services
- 56% of new customers are from references

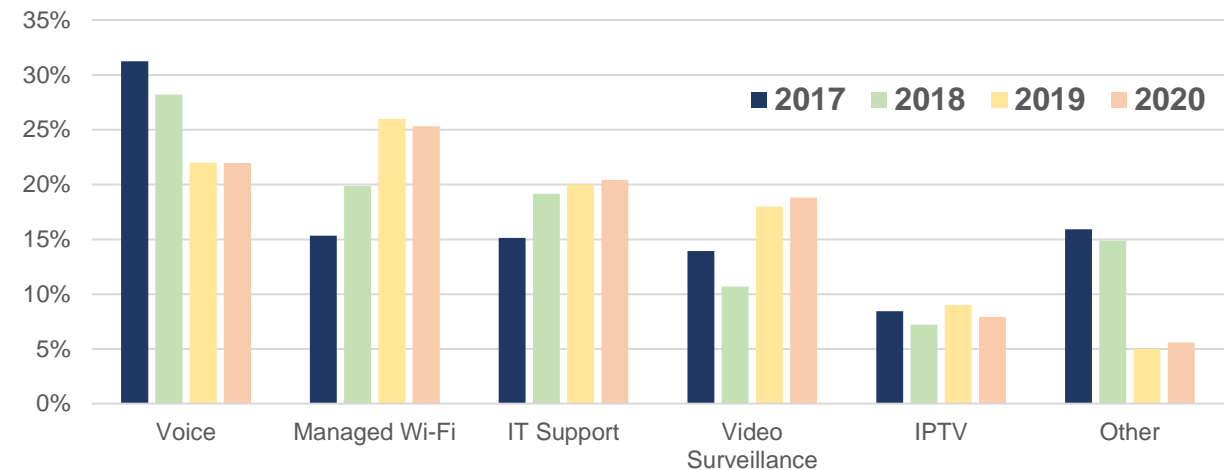
### WISP Overall Optimism



### Constraints to Growth



### Services Offered in Addition to Broadband







# Service Plan Poll



# CBRS

## The Time has Arrived



- **October 17<sup>th</sup> – Critical Transition Date**
- PMP 450 platform is ready, is Software Upgradeable, and works with YOUR CHOICE of SAS Providers

federated wireless  COMMSCOPE<sup>®</sup>

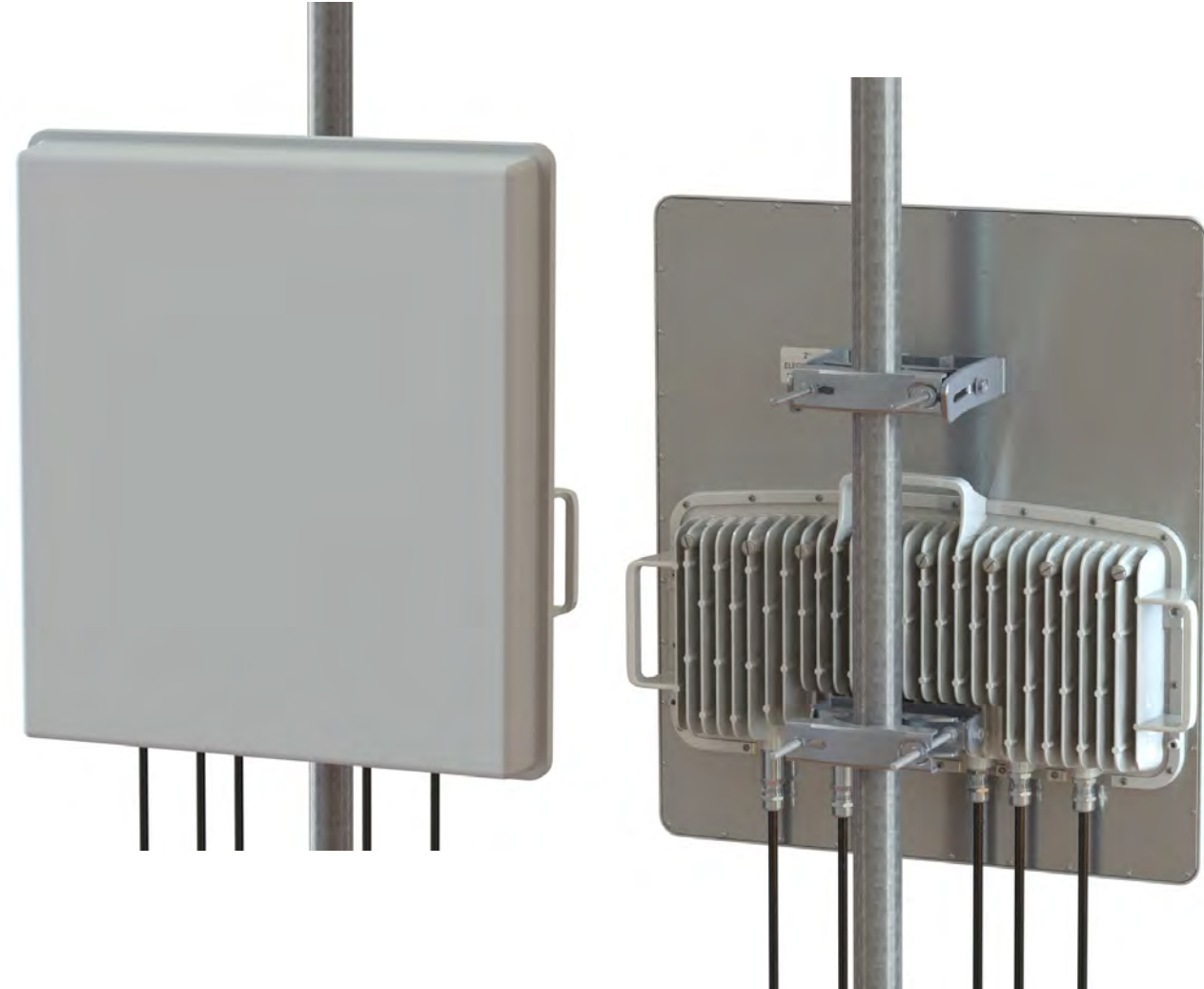
- Commercial operation since April
- **> 50,000** devices in operation now and rapidly expanding



All 3 GHz 450  
platform equipment  
approved for Part 96!  
(as of July 10, 2019)



- **One Simple Device to Install**
- **More than 3x Capacity vs. 450/450i**
  - cnMedusa™ 8x8 MU-MIMO technology allows simultaneous communication to four SMs
- **Supreme Spectral Efficiency**
  - DL and UL MU-MIMO supported
  - Achieve up to 750 Mbps in a 40 MHz channel
- **CBRS Users are reporting increased power levels resulting in:**
  - Enhanced coverage
  - Higher rate plans
  - Connecting additional subscribers



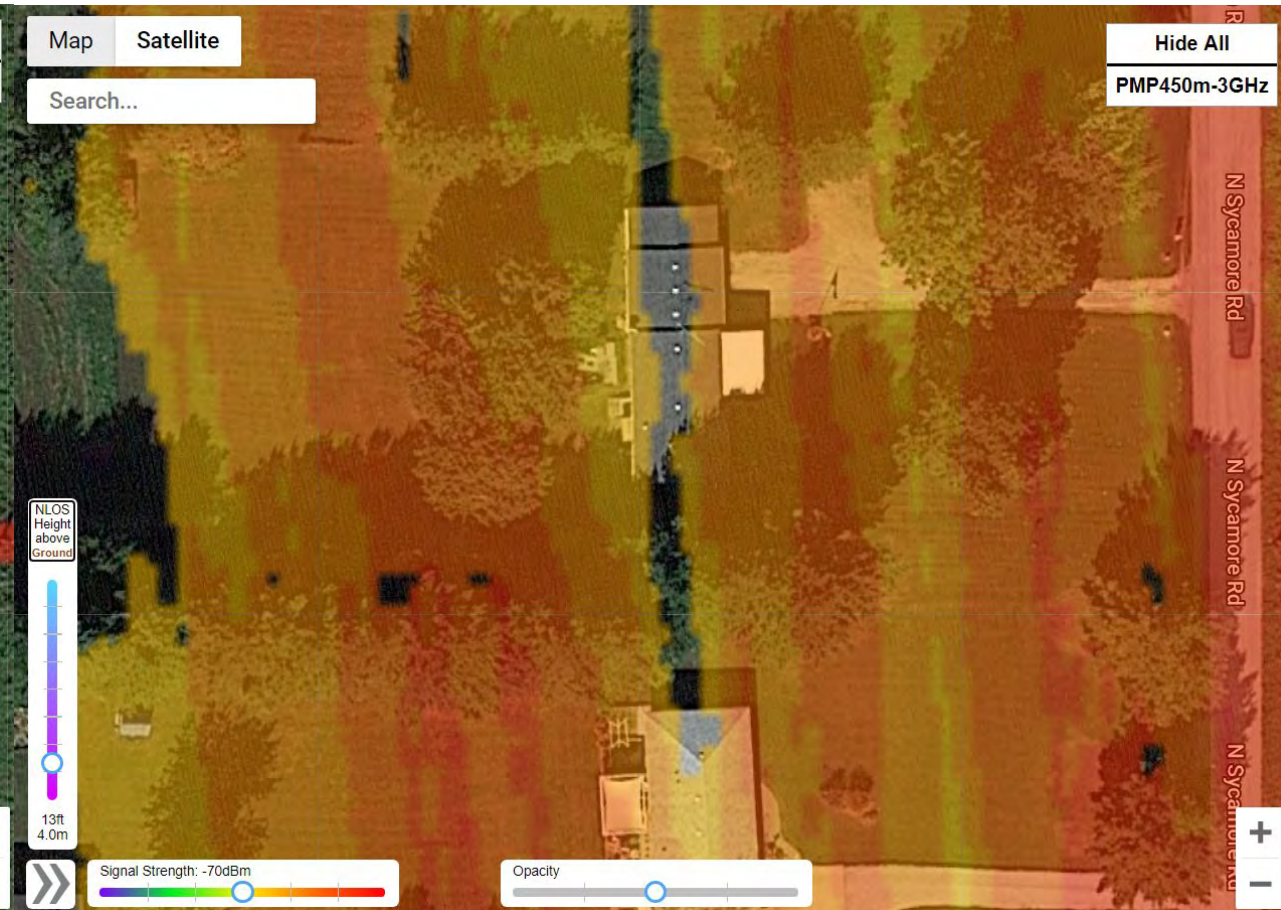
- **Form Factor**
  - High Gain integrated antenna (20 dBi), similar to 5 GHz 450b High gain
  - Up to 29 dBm Tx Power, or 49 dBm EIRP (HUGE Advantage vs. LTE equipment)
- **New FPGA / SoC architecture**
  - Next-gen processor, Enhanced Packet Processing
  - Better support for wider channels → more throughput
  - Wideband support (3.3 – 3.9 GHz) – CBRS Approved!!
- **I/O changes**
  - Single Gigabit Ethernet port
  - Audio jack for alignment tone
- **Re-use of 30 VDC Power scheme**
  - Same power supply as current 450 SM
  - Polarity Agnostic – Both “Canopy” or “UBNT” 30 VDC
- **Considerations**
  - Packaging of devices will follow the 5 GHz version
  - LEDs moved to make more visible and installation-friendly







**LOS Coverage at 13' is non-existent**



**nLOS/NLOS Coverage at 13' is Plentiful**

# 450 Platform

## Enhancing and Expanding





- **Power / Network**

- Gigabit Ethernet PoE
- Standard 802.3af/at PoE IN ( $\pm 48$  VDC)

- **RF Options**

- Integrated: Omni & 90/120° Sector
  - Omni – 9 dBi Gain
  - 90/120° Sector –13 dBi Gain

- **Integrated GPS on all models**

- External GPS antenna port
- Supports sync over power method with cnPulse accessory



# PMP 450 MicroPoP in the Wild



“Like everything about the solution... Easy install, integrated GPS”

“Performance exceeds the price point, a Cambium AP under \$1,000 that you can put on a pole and start receiving revenue. If you outgrow it, you can add or change to 450i/m without changing *anything* at the subscriber.”

“Hope to use the lower cost point of these devices as hole fillers for gaps within our network.”



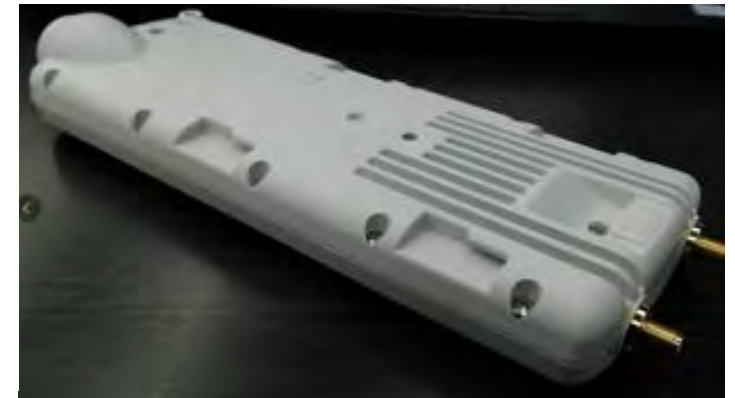
- **9 dBi Integrated**
  - 24 dBi with Reflector Dish
- **New FPGA / SoC architecture**
  - Next-gen processor, Enhanced Packet Processing
  - Wideband support (4.9 – 5.925 GHz)
- **I/O changes**
  - Single Gigabit Ethernet port
  - Audio jack for alignment tone
  - Same antenna focal point – can re-use Reflector Dish
- **Re-use of 30 VDC Power scheme**
  - Same power supply as current PMP 450 SM
  - Polarity Agnostic – both “Canopy” or “UBNT” 30 VDC



# Flexibility with the PMP 450b Connectorized

- **New FPGA / SoC architecture**
  - Next-gen processor, **Enhanced Packet Processing**
  - Better support for wider channels → more throughput
  - **Wideband support (4.9 – 5.925 GHz)**
- **I/O changes**
  - Single **Gigabit** Ethernet port
  - Audio jack for alignment tone
  - IP 67 ruggedized protection
  - 2x RP-SMA connections for external antenna
  - Will fit ePMP1000 twistport adaptor from RF Elements
- **Re-use of 30 VDC Power scheme**
  - Same power supply as current 450 SM
  - Polarity Agnostic – both “Canopy” or “UBNT” 30 VDC
- **Connectorized MicroPoP has same form factor**
  - 48 VDC (PoE 802.3at) input vs. 30 VDC (“Canopy-style”)
  - Onboard GPS

Q1 2021  
Availability





# Protecting and Enhancing Your Investment It is Not All About the Hardware

- **R16.2.3 – Current Release**
- **R20 – Q4 2020**
  - Beta available now
  - Updated secure protocols, including SSH, SCP, TLS 1.3, AES w/SNMPv3
  - Full support of IPv6 (DHCP, DNS, Management)
  - Increased PPS for 450i and 450b beyond 100,000
  - Intermediate Modulation Modes
- **R20.x – Q2 2021**
  - Nomadic Mode / Rapid Re-ranging
  - 40 MHz 5ms frame support (PMP 450m)
  - Multiple Groupings per frame (PMP 450m)
  - CBRS – Coexistence Optimization
  - MAC Filtering
  - BPDUGuard/Filter



# Intermediate Modulation Modes

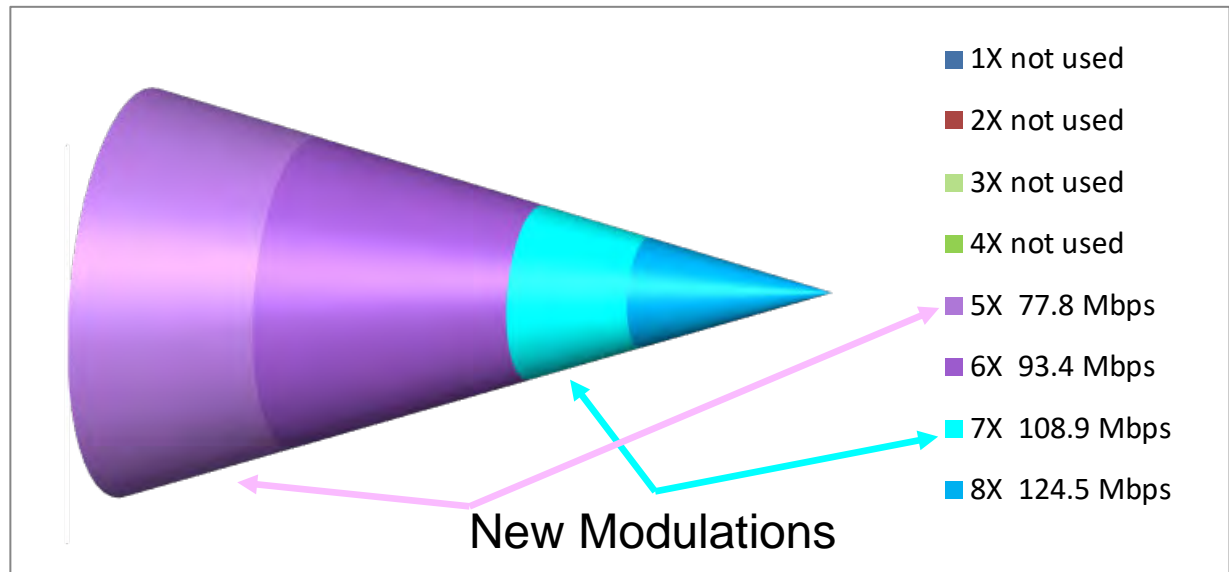
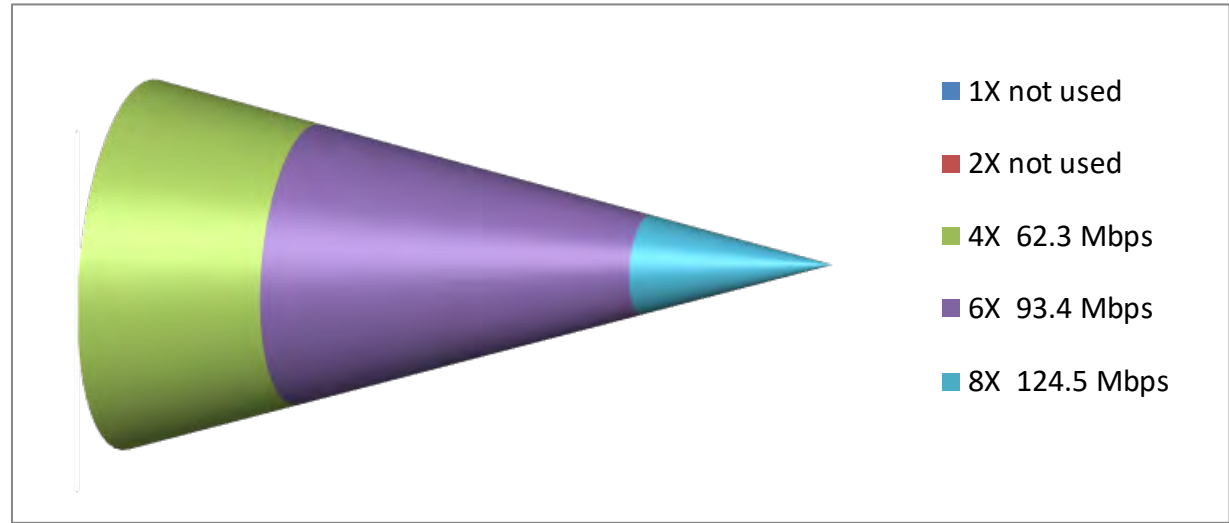
@ 6 mile range	Existing Aggregate	78.2
	With IMM	88.8
	Difference	10.6
	% Difference	13.50%

@ 8 mile range	Existing Aggregate	70.3
	With IMM	76.4
	Difference	6
	% Difference	8.60%

@ 10 mile range	Existing Aggregate	67.2
	With IMM	70.6
	Difference	3.4
	% Difference	5.10%

@ 12 mile range	Existing Aggregate	50.7
	With IMM	61.6
	Difference	10.9
	% Difference	21.50%

@ 14 mile range	Existing Aggregate	43.5
	With IMM	56.8
	Difference	13.3
	% Difference	30.70%





# Intermediate Modulation Modes

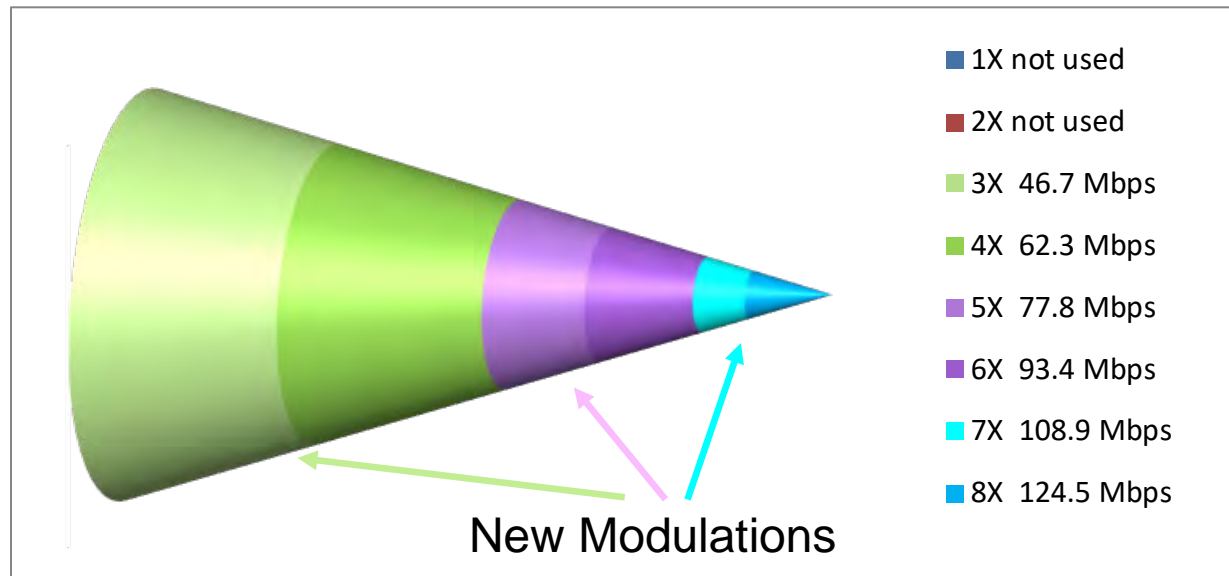
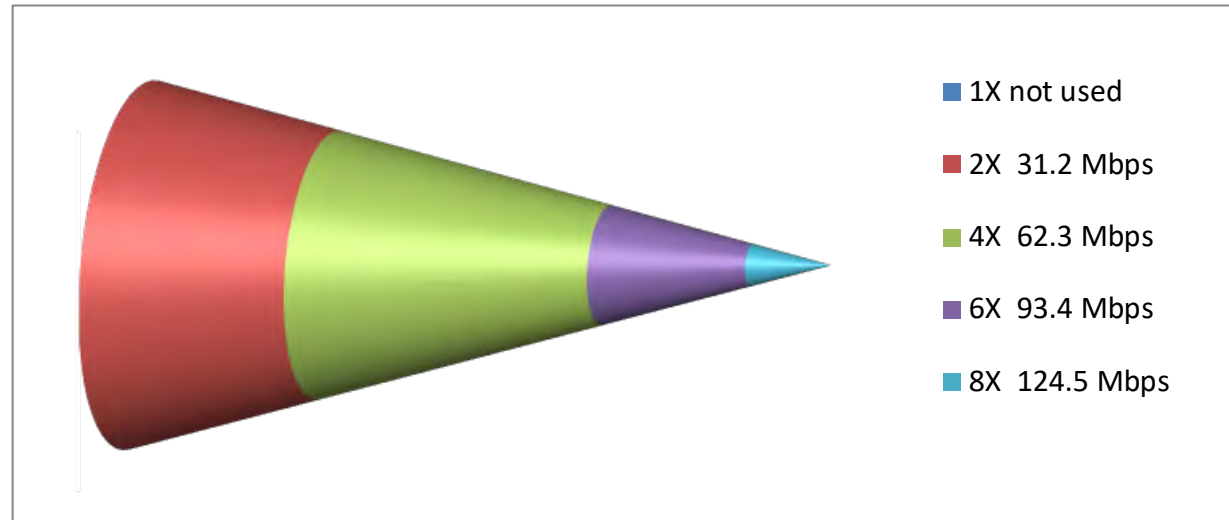
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	With IMM	61.6
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@ 14 mile range	Existing Aggregate	43.5
	With IMM	56.8
	Difference	13.3
	% Difference	30.70%



**ePMP**

**The Next Generation**





## 1. MU-MIMO is a field proven technology and the industry standard in maximizing performance in a given channel

- ePMP 3000 supports 4x4 MU-MIMO
- Wider Channels
- Higher Modulation
- Real AP providing **240Mbps** to **50SMs** in a 40MHz channel
- Start with ePMP 3000L but grow with ePMP 3000
- Support of STA frequencies

## 2. Leader in scalability and interference tolerance

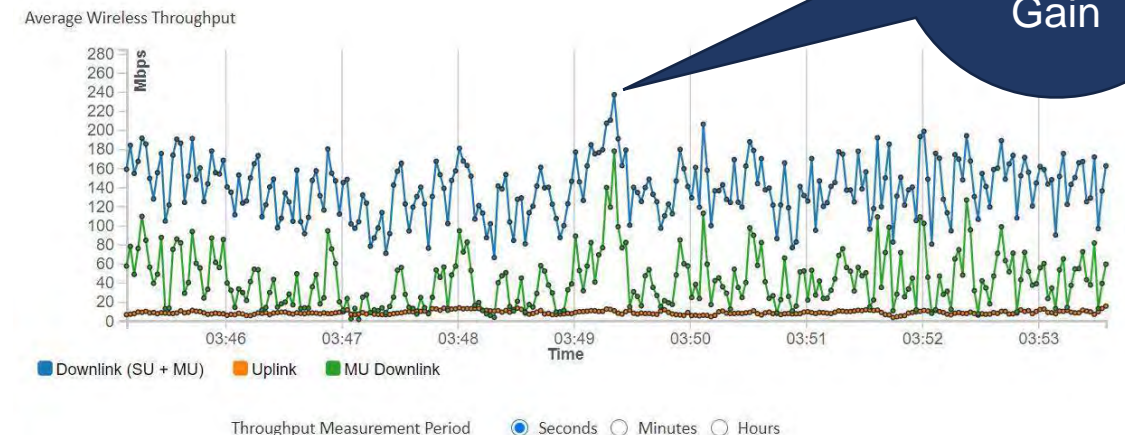
- Uplink and Downlink beam-steering
- Dynamic Filtering
- Synchronization

## 3. Protects your investment

- Compatibility with 11n devices and future 11ax AP



240 Mbps  
and MU-  
MIMO  
Gain



# Dual-Horn Case Study – Mountain West



“The dual-horn antenna allows us to take advantage of a narrower beamwidth while leveraging the benefits of superior noise rejection of a horn. This helps us get a better signal to a tighter grouping of users in high-noise areas.”

- TIM MEADS, NETWORK/INFRASTRUCTURE MANAGER, MOUNTAIN WEST TECHNOLOGIES



ePMP 3000 Dual-Horn MU-MIMO Antenna Allows Mountain West Technologies to Leverage the Benefits of Superior Noise Rejection and Improve Uplink SNR



“The dual-horn antenna allows us to take advantage of a narrower beamwidth while leveraging the benefits of superior noise rejection of a horn. This helps us get a better signal to a tighter grouping of users in high-noise areas.”

TIM MEADS,  
NETWORK/INFRASTRUCTURE  
MANAGER,  
MOUNTAIN WEST TECHNOLOGIES



CS Mountain West

### Overview

**BASED IN WYOMING, UNITED STATES**, Mountain West Technologies is an internet provider known for the high speeds they deliver to their residential and business customers. They have provided dependable wireless internet services for over a decade in the Casper, WY area, reaching speeds of up to 500 Mbps on wireless. Their customers experience incredibly smooth streaming and gaming on their broadband network thanks to these speeds. Mountain West Technologies uses wireless technologies from industry-leading partners like Cambium Networks to reduce infrastructure costs and offer a cutting-edge service to their customers. Cambium Networks' ePMP 3000 MU-MIMO solution is one of the latest technologies that Mountain West Technologies decided to deploy in their network.

### The Challenge

**MOUNTAIN WEST TECHNOLOGIES USES** a 90-degree sector antenna but dealt with poor signal-to-noise ratio (SNR) on the uplink direction. They searched for a better solution that would improve the uplink throughput. Eventually, they started looking for an antenna solution which would attract less noise from all sides except the intended direction.

### The Solution

**CAMBium NETWORKS' NEW SOLUTION**, ePMP 3000 Dual-Horn MU-MIMO sector antenna, proved to be a good choice for such conditions. Horn antennas have the key advantages of focusing higher gain in the main bore-sight while minimizing side lobes in the propagation pattern. These side lobes further reduce the generation and susceptibility to noise. A small form factor dual-horn sector antenna also simplifies installations at the base station site.

Their approximate total subscriber base of 10 is expected to grow in the near future. Most of these subscribers are within two miles of the base station. Mountain West Technologies was less concerned about high antenna gain, but high radio throughput in noisy environments was critical.



Fight interference with horn but get the benefits of MU-MIMO



# Access Point Topologies to Fit the Application

## ePMP MicroPoP



## ePMP 3000L



Sector



Omni



Twist-Port Adaptor  
RF Elements

## ePMP 3000



MU-MIMO  
Sector



MU-MIMO Omni  
KP Performance



MU-MIMO  
Omni  
ITELite



MU-MIMO  
Dual Horn

# 1 Gbps ePMP PTP on the Horizon!

- **Target Markets / Applications**

- **Enterprise Access** – 500Mbps+ Service Packages
- Low-cost **WISP Backhaul** – small cells / MicroPoP's
- **Fiber Extension** – GPON last mile
- **Wi-Fi/Video Surveillance Backhaul**

- **Key Specifications**

- Gbps usable throughput
- Sub 5 ms latency
- 4.9 to 6.135 GHz
- IP67 Ruggedization
- 25 dBi integrated dish (optional 28 dBi range extender)
- GigE and SFP port (optional GPON module)



Q1 2021  
Availability

Learn more at #WirelessWednesday  
Webinar on November 11<sup>th</sup>



# cnPilot

## At the Edge





# Meeting your Home Gateway Performance Needs

	Model	Wi-Fi Technology	Ethernet	Voice Ports	30VDC Power Out	Key Value for Home Network
	r195W	11ac dual band (a.b.g.n.ac)	5 x GE			Best coverage and capacity 30% > than r201 >900Mbps throughput (GE↔GE)
	r195P	11ac dual band (a.b.g.n.ac)	5 x GE	✓	✓	Voice ports, power out Improved power surge protection >900Mbps throughput (GE↔GE)

**30%**

*greater coverage than r201*

**>20%**

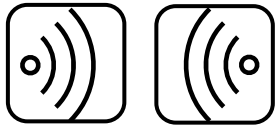
*faster than r201*

r195P same price as r201P  
 r195W sweet spot for price/performance  
 WDS MESH for large homes



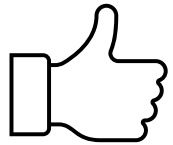
## Wi-Fi 6 Residential Routers

- Modern 'bookshelf' design plus hard mount attachment
- Future-proof and pandemic-proof Wi-Fi, backward compatible
- Low latency, high speed network optimal for AR/VR, streaming video, concurrent voice/video



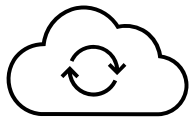
## Whole House Wi-Fi

- Automatic MESH connectivity, purposely designed for Internet Service Providers



## Quality of Experience

- Integrated network health monitoring, speed tests, whole house quality of experience



## cnMaestro Cloud integrated

- Home user accounts managed on cnMaestro, designed for Internet Service Providers

Designed for service providers to deliver managed whole home Wi-Fi

App-based and cloud-enabled network health tools empower the consumer, and give the service provider more tools to reduce truck rolls and improve quality of experience

Learn more at [#WirelessWednesday](#)  
Webinar on December 16<sup>th</sup>

# Indoor Wi-Fi 6 Access Points

Cloud / On-Prem Management | Wi-Fi 6 | 802.3bz Multi-gig Uplink | Application Control



Optimized for High Density

MSRP: \$1095

	<b>XV3-8</b>	<b>XV2-2</b>
Unique Value	Tri-Radio 11ax with Software Defined Radios and Dedicated Sensor	High performance 2x2, cost effective 11ax, standards-compliant
802.11 Radios	2 or 3 (Software Defined Radio)	2
Streams	4x4 in 2.4G; 8x8 in 5GHz; or dual 4x4 5GHz	2x2 in 2.4G; 2x2 in 5GHz
Antennas	Internal	Internal
Bluetooth	Yes, BLE 4.0	No
Sensor	Dedicated dual-band sensor radio. 2x2:2 for WIPs / Location services / RF scan / Network scan	Shared sensor with data radios. WIPs / Location services / RF scan / Network scan
Security	WPA3	WPA3
Wired	1 x GigE + 1 x 5GigE	1 x 2.5GigE
Power	802.3at (without USB, 35W with USB)	802.3at
Management	XMS-Cloud or cnMaestro	XMS-Cloud or cnMaestro
Use Cases	Education, Public Venues, Enterprise	SME, Education, Hospitality, Retail



Cost-effective performance for a broad set of use cases

MSRP: \$395

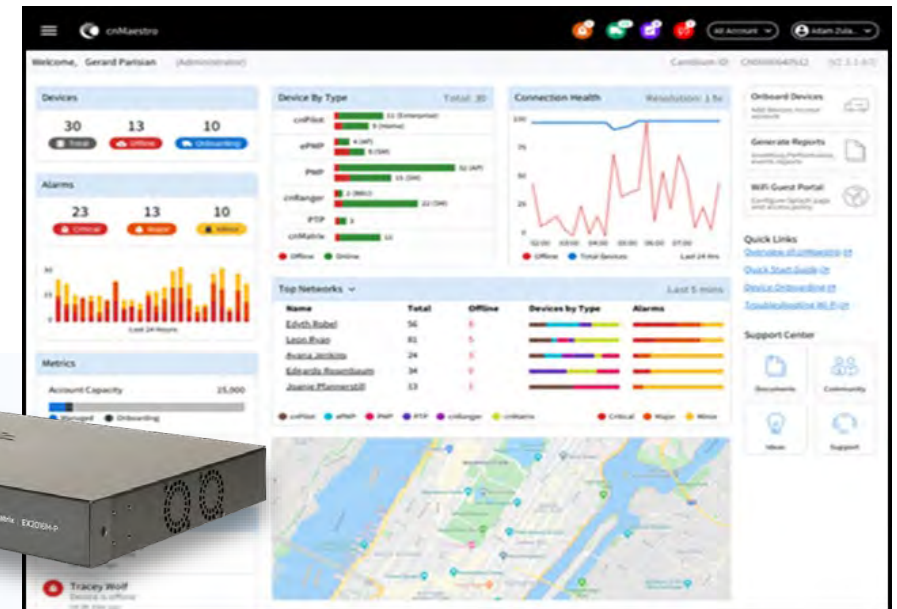


**Simplify operations** with *Policy Based Automation & Zero Touch Provisioning*

**Improve security** with *Auto Segmentation, Device Profiling & Policy Enforcement*

Improve **network resiliency**, reduce manual configuration errors

cnMaestro Cloud Dashboard



**Multi-gigabit Ethernet**  
**EX-2016M** – 2.5GbE, 60w per port



**Wi-Fi 6 Edge Access Point**

**XV3-8** – Multi radio with SDR, dedicated sensor, 8x8

**XV2-2** – Dual radio 2x2

Learn more at [#WirelessWednesday](#)  
Webinar on November 18<sup>th</sup>

**cnMatrix**

**Wireless Aware  
Switching for the WISP**



# Wireless Aware Switching Purpose Build for the WISP Industry

## Introducing the cnMatrix TX2020R-P Tower Switch



**cnMatrix TX switch**, purpose built for WISP Tower deployments, is a fully integrated solution that includes intelligent PoE, Cambium Sync and a comprehensive set of Layer 2/3 switching functionality

- **Dual redundant AC/DC removable power supplies** that deliver intelligent, flexible PoE options: 802.3af/at/bt, low voltage Passive PoE, & High Power 4PPoE
- **Cambium Sync:** Dual redundant GPS synchronization sources
- **Fully Featured Switch:** Enterprise grade, non-blocking, Layer 2 & Layer 3 features with Cambium Policy Based Automation that improves security and simplifies operations
- Cloud/On-premises management with **cnMaestro** for the end-to-end Cambium **Wireless Fabric** experience

cnMatrix TX2020R-P



Removable Power Supplies



cnMaestro Dashboard



Learn more at #WirelessWednesday  
Webinar on December 9<sup>th</sup>

Available  
Q1 2021





# COVID Induced Service Plan Impact Poll

**cnWave**

**Gb to the Edge**





Distribution  
Node  
**V5000**



terragraph  
certified



Client  
Node  
**V1000**



Client  
Node  
**V3000**



- **Standards:** 802.11ay standard, Mesh support, Terragraph certified
- **Performance:** Up to 15.0 Gbps with channel bonding
- **Installation:** Bi-directional auto beam forming
- **Operation:** Auto expansion, auto healing with Mesh support
- **Configuration:** Point-to-Point, Point-to-MultiPoint, Mesh
- **Management:** cnMaestro™



# Cost and Space Efficient Coverage

## cnWave V5000 – 280° Coverage with a Single Node



Sector 1

Sector 2

**Frequency:** 57 to 66 GHz

**Modulation:** BPSK to 16 QAM (MCS 0 to MCS 12) with ACM

**Throughput:**

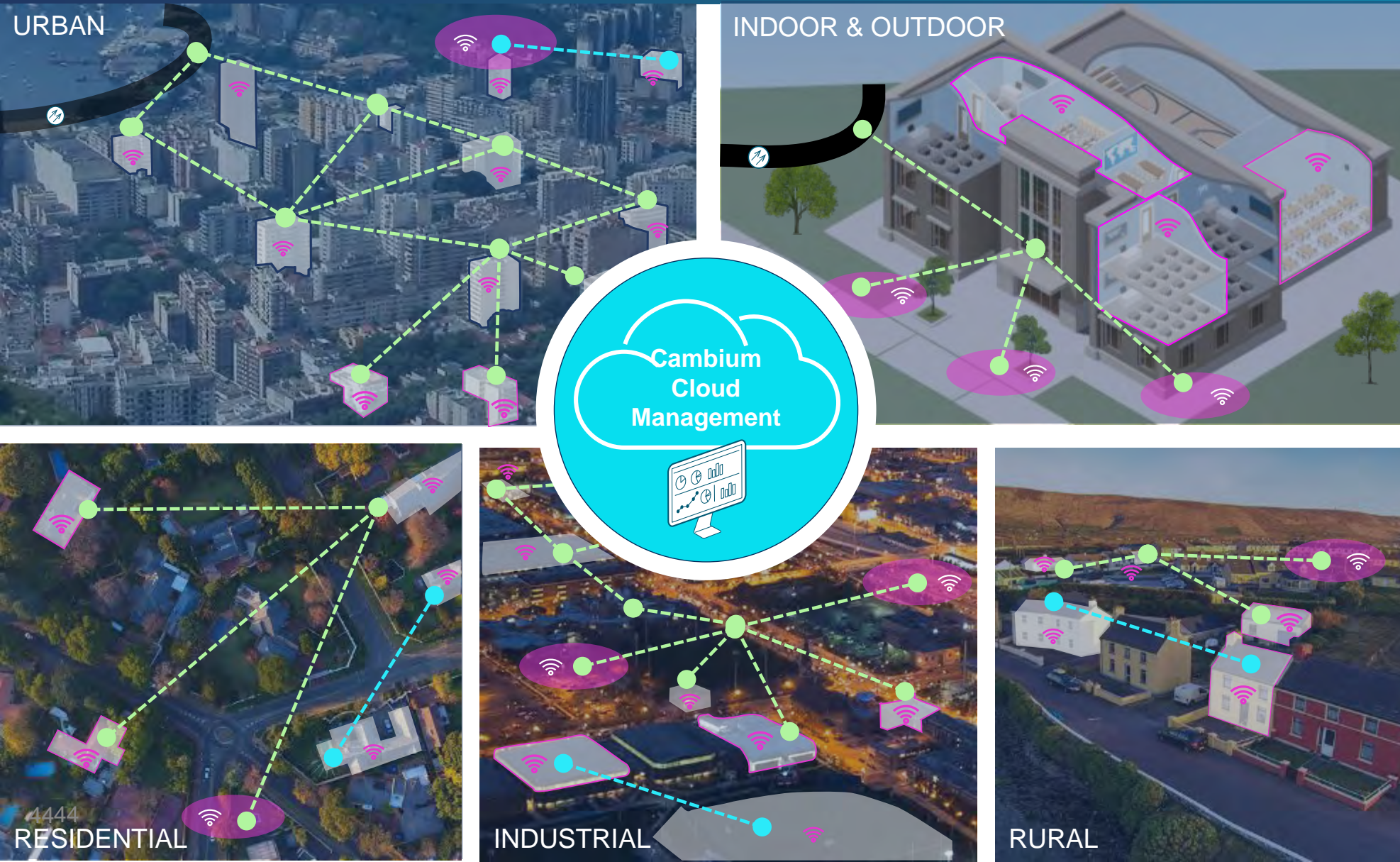
- 1.9 Gbps Uplink + 1.9 Gbps Downlink per sector
- 3.8 Gbps Uplink + 3.8 Gbps Downlink with channel bonding\* per sector

**Coverage:** Dual Sector 280 Degree Coverage with Beam Forming

**Configurations:** Up to 30 CNs or 4 DN + 26 CNs

**Latency:** < 1 ms

# Multi-Gigabit Wireless Fabric



Multi-Gig Wireless from Broadband to the Edge

Proven Lowest Cost per Mbps

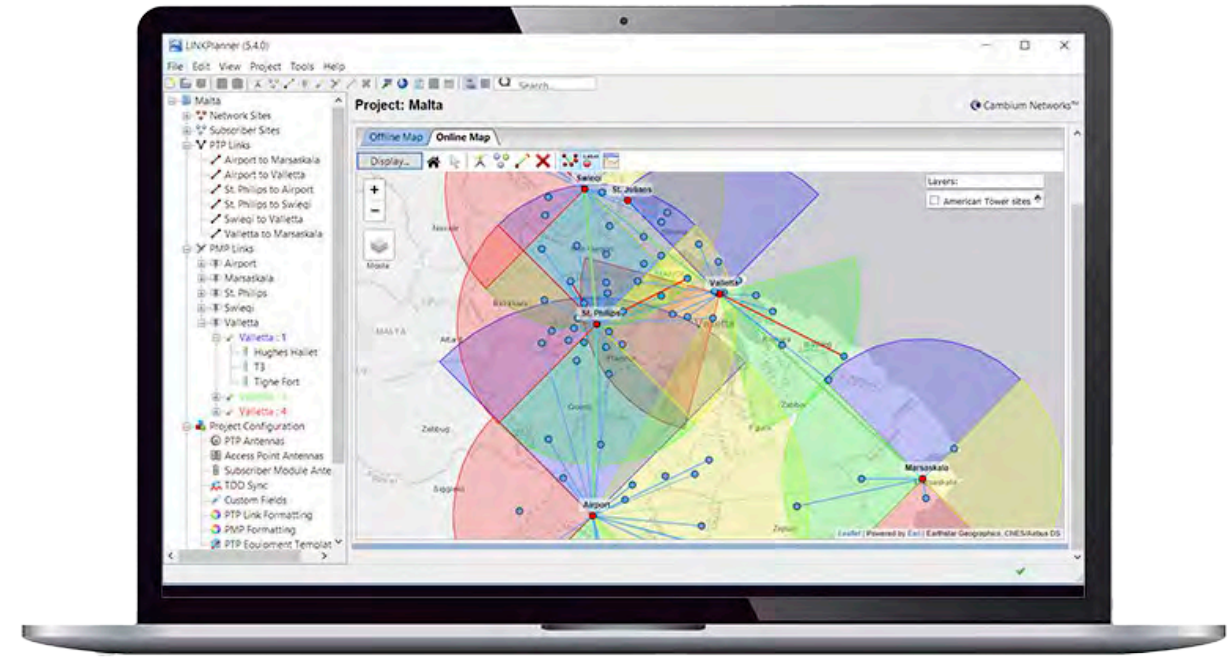
One Dashboard for Wi-Fi, Switching and Broadband

- Fixed Wireless 60 GHz Distribution
- Fixed Wireless 60 GHz PTP
- Wi-Fi
- Fiber Ring

Learn more at [#WirelessWednesday Webinar, October 28<sup>th</sup>](#)



- **LINKPlanner**
  - Support PTP/PMP configuration with BOM creation
  - Engineering report for
- **Advanced Network Planer**
  - Mesh network designing
  - Site identification and preparation
  - LOS identification & optimization
  - Build-in TCO/CAPEX calculator





*Topic:* **60 GHz cnWave Field Results**

*Date:* Wed 28 Oct, 9:00 AM CT

*Topic:* **The Future of Shared Access Spectrum: Lessons from the FCC's CBRS Plan**

*Date:* Wed 4 Nov, 9:00 AM CT

*Topic:* **ePMP Updates & Product Sneak Preview**

*Date:* Wed 11 Nov, 9:00 AM CT

*Topic:* **Enterprise Wi-Fi 6 for WISPs**

*Date:* Wed 18 Nov, 9:00 AM CT

*Topic:* **Build New Revenue Streams with Express Wi-Fi**

*Date:* Wed 2 Dec, 9:00 AM CT

*Topic:* **Introducing the WISP Switch**

*Date:* Wed 9 Dec, 9:00 AM CT

*Topic:* **Managed Services for Residential Wi-Fi with Wi-Fi 6**

*Date:* Wed 16 Dec, 9:00 AM CT

For more detail and registration links, visit the WISP Solutions page on the Cambium Community:

<https://community.cambiumnetworks.com/t/webinar-series-virtual-open-house-and-wirelesswednesday-webinars/73024>

PMP 450 MicroPoP Omni



PMP 450b Retro



cnMatrix TX2020R-P Tower Switch



# Questions?



**Cambium Networks™**





Cambium Networks™

THANK YOU

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