



Cambium Networks™

Wireless That Just Works
CBRS Updates and Experience

Cambium Networks at a Glance

- Spun out of Motorola Solutions in October 2011
- Pioneer in Point-to-Multipoint & Point-to-Point IP Wireless Broadband Solutions
- Industry leader in High-Density Wi-Fi solutions
- Emerging leader in IIoT and 5G like solutions
- HQ outside of Chicago, IL with 700+ employees across 6 continents
- More than 5,000 channel partners in 150+ countries
- More than 7 million nodes shipped totaling over \$1.5B
- IPO on NASDAQ in June 2019



Cambium Networks™

Wireless That Just Works

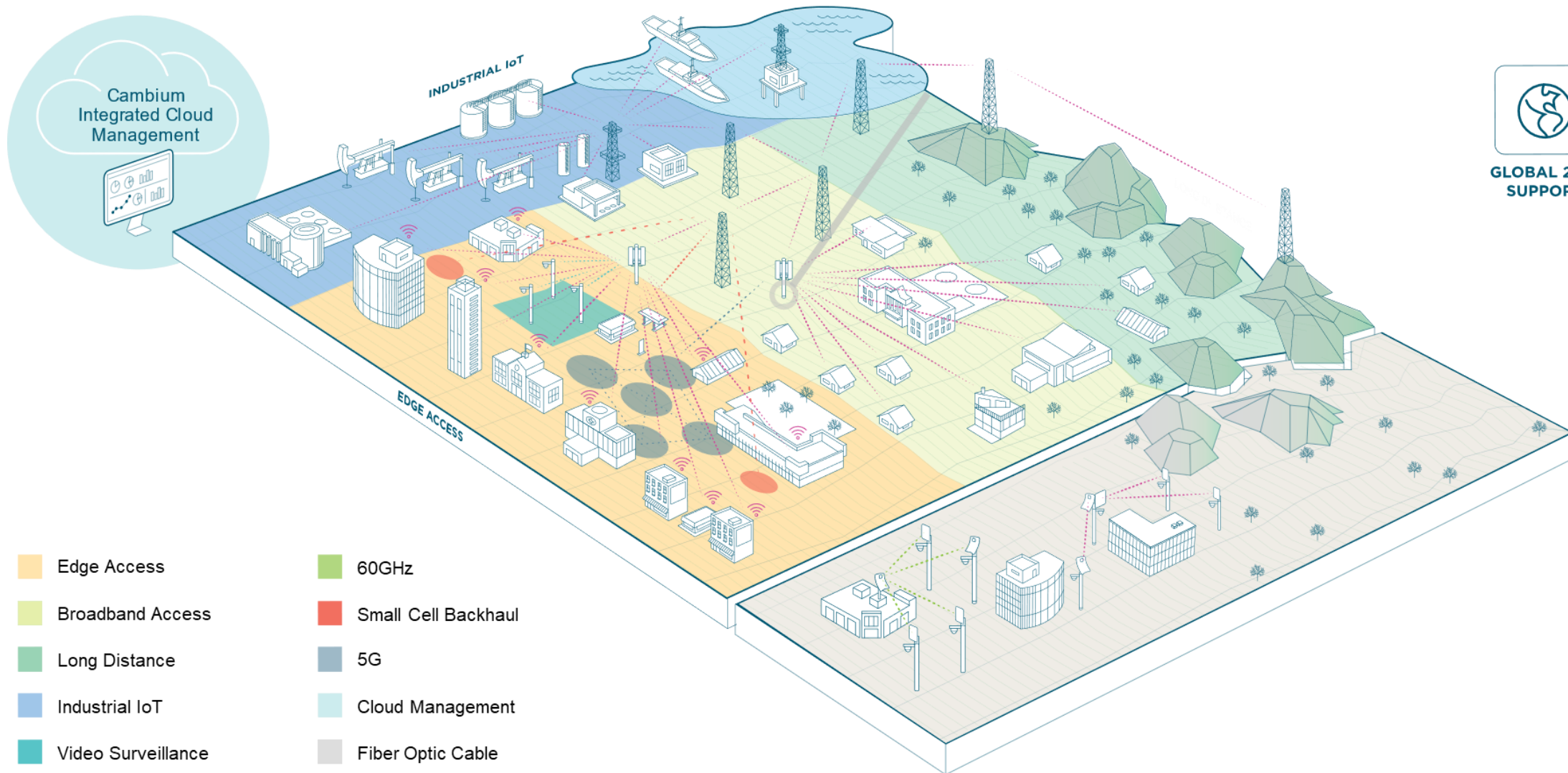


- ✓ Education
- ✓ Enterprise connectivity
 - Federal and defense communications
- ✓ Industrial IoT connectivity
 - Rapid connectivity for disaster recovery
- ✓ Remote facility connectivity
- ✓ Rural connectivity
 - Video surveillance

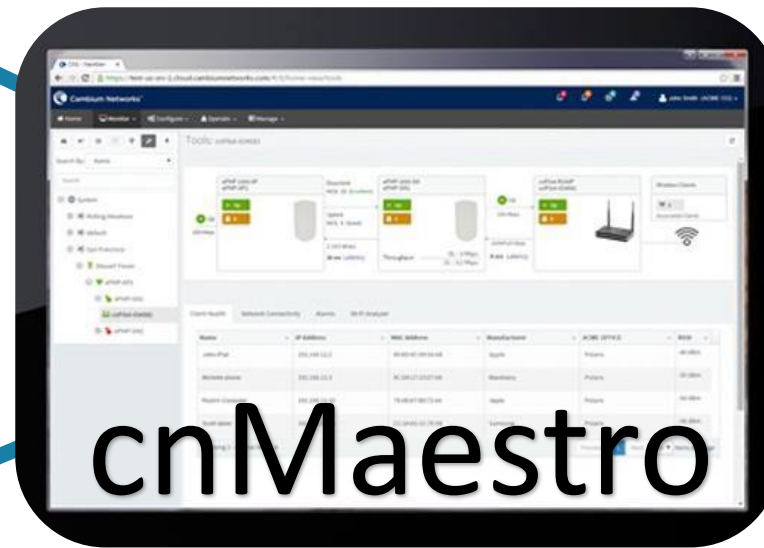
✓ CBRS Solutions



Cambium Networks' Gb Wireless Fabric



Cambium Vision: Convergence, Zero-IT, It Just Works



Connect the Unconnected – People, Places and Things with Proactive Capacity and Automation

Wireless expertise

Broad portfolio of technology

Centralized cloud management

Global network of partners

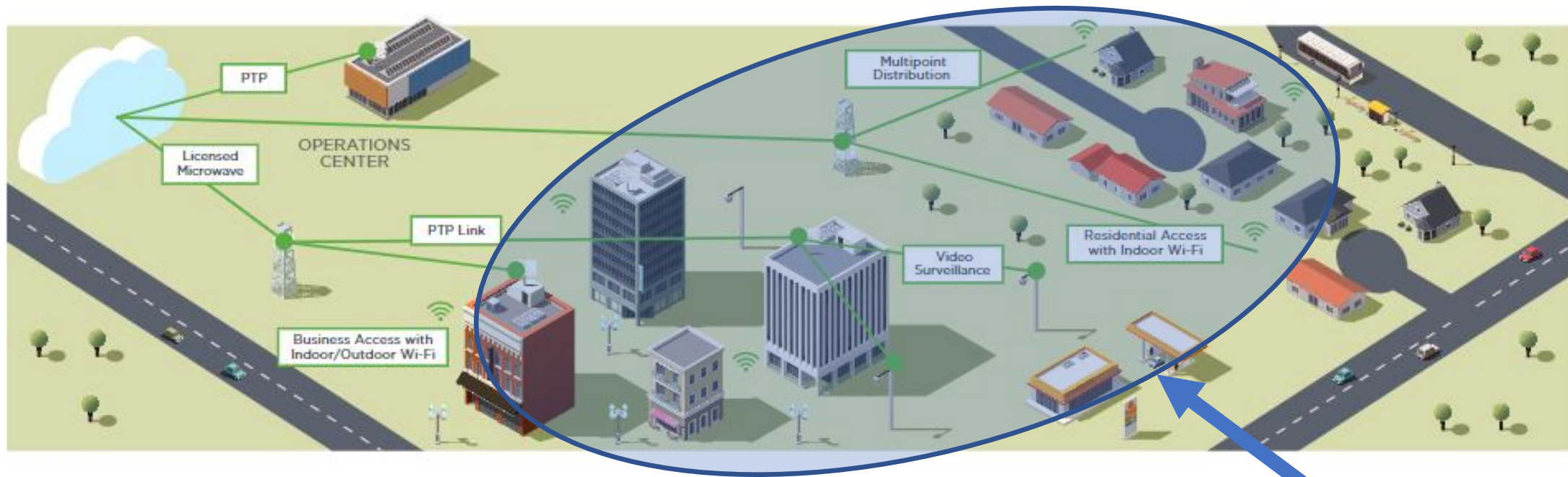
Proven business case and TCO

Wireless That Just Works



Market Solutions





Business and residential access

High capacity connectivity for streaming video, voice, and data

Licensed, unlicensed, and defined use frequencies

Proven reliability with millions of modules deployed

CBRS Solutions

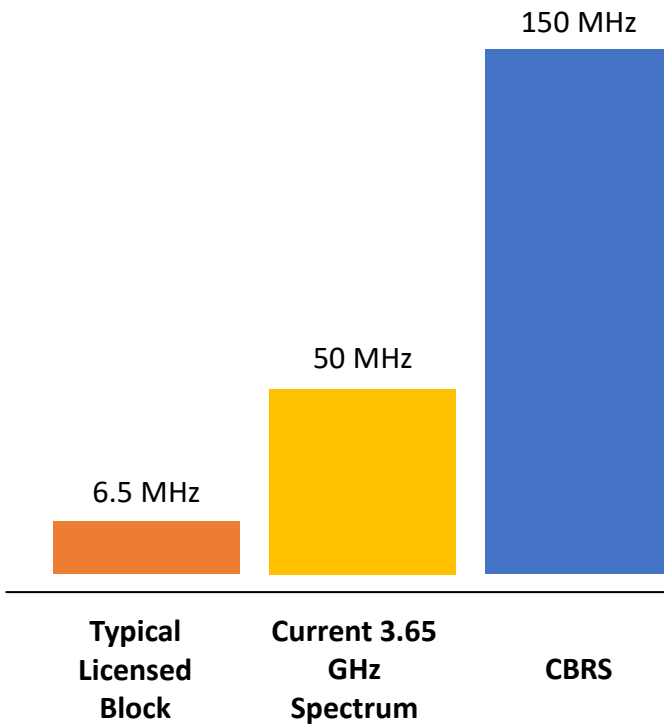
- Dynamic Spectrum Sharing model can be applied to any spectrum globally
 - Tiered approach to protect several classes of users of the spectrum
 - Allows sharing of unused portions of spectrum, while mitigating interference caused

- **CBRS** itself is quite complex

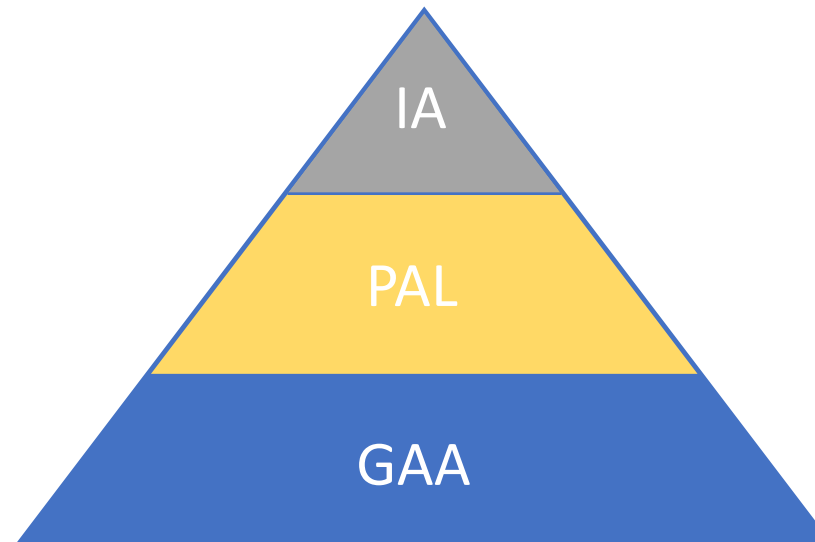
Pros	Cons
Lower Frequency than unlicensed 5 GHz (better penetration)	Spectrum sharing has a cost
Higher EIRP allowed	Hype around uses could cause congestion
Spectrum is actively managed	Equipment in this band slightly more expensive than traditional unlicensed
Incumbents protected	Standards-based (LTE) kit is predominant, and top of mind
Option to purchase license for priority use	Rules and requirements very complex

- When success is demonstrated, it's expected that many other regions and bands may adopt similar models

Opportunity



Tiered Flexible Use



Incumbents

- DoD Radars (coastal areas)
- Satellite Earth Stations

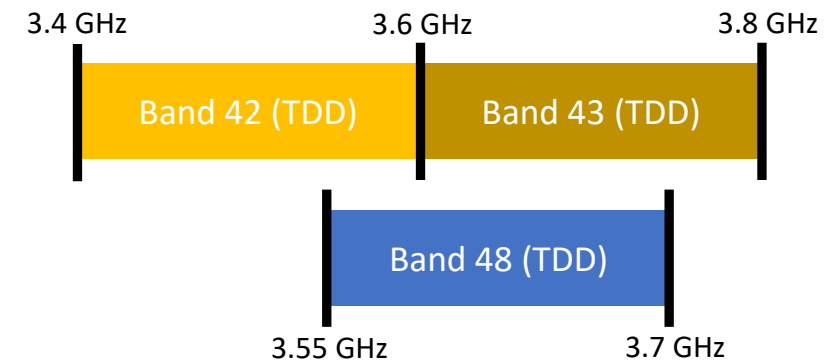
Priority Access Licenses (PAL)

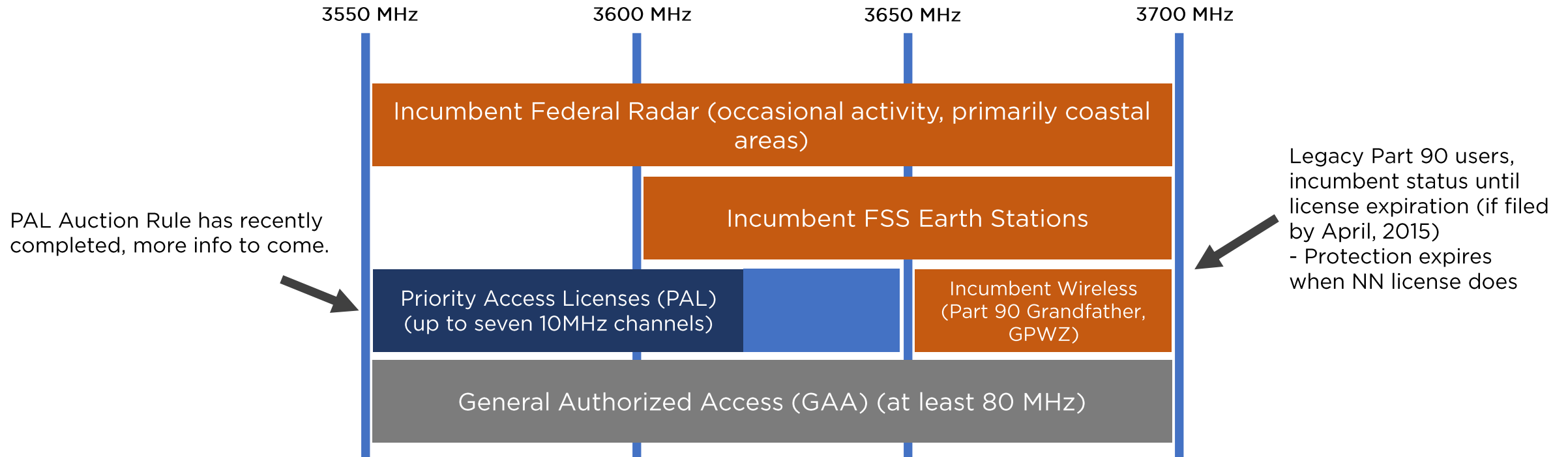
- Up to 70 MHz of spectrum licensed by auction

General Authorized Access (GAA)

- At least 80 MHz nationwide

Establishing a New Common Band





Cambium expects that many of its customers have won PAL licenses in counties in which they are operating, affording them some protection in using CBRS, and assuring the continued use and expansion of their networks.

- 450 platform readiness and works with all major SAS providers

federated wireless™ Google COMMSCOPE®

- Customer enters into *direct* business relationship with Cambium, but can choose SAS they like
- Complete 3 GHz portfolio capable of graceful migration to CBRS
 - Continue to operate under Part 90 subpart Z until license expires (Extension to October 17, 2020 imminently approaching)
 - Gracefully transition to Part 96 (CBRS) without changing equipment (clever software makes this easy!)

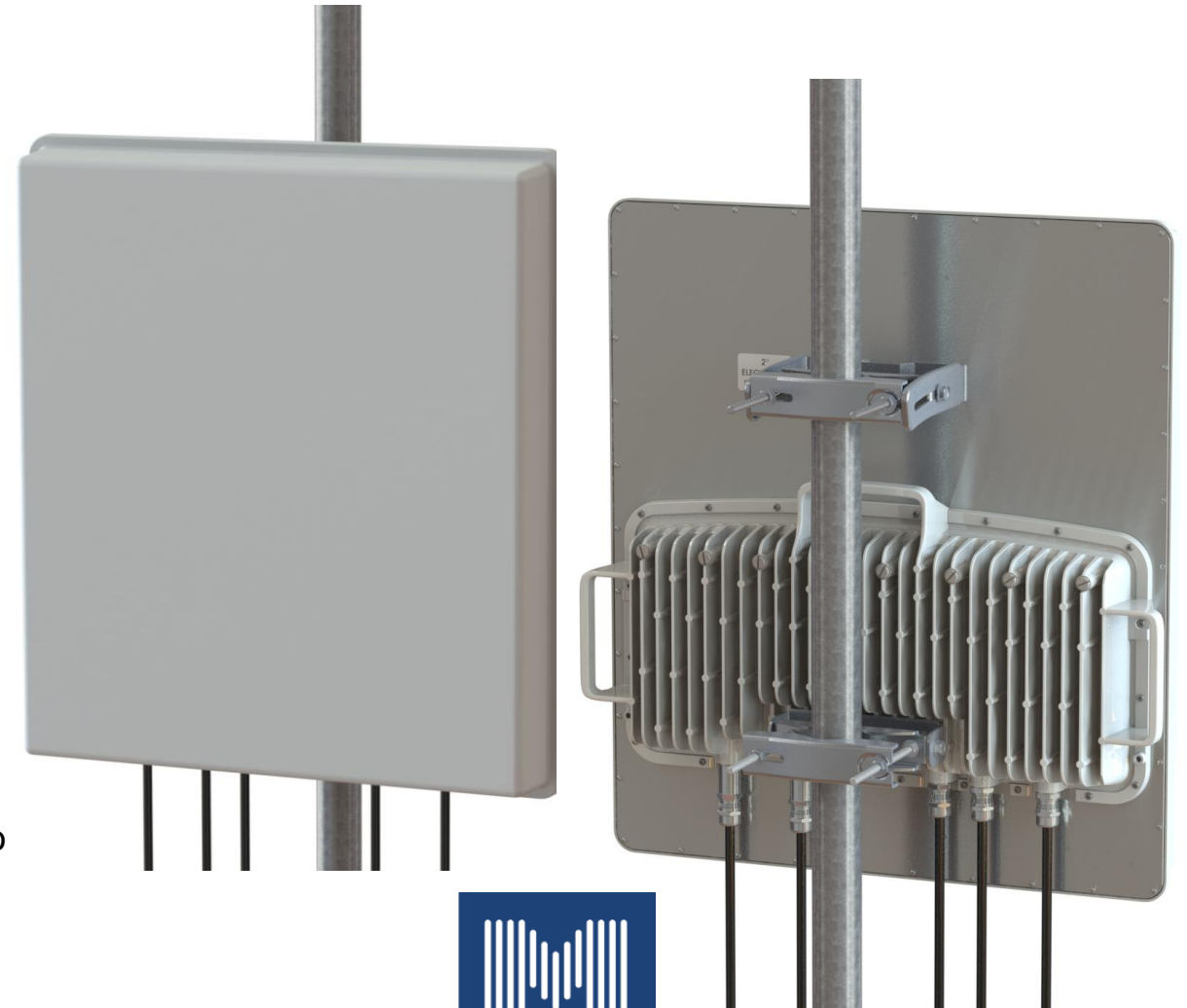


- **Leading-Edge Technical Innovation**

- **More than 3x Capacity vs. 450/450i**
 - *cnMedusa*[™] 8x8 MU-MIMO technology allows simultaneous communication with up to four SMs
- **Supreme Spectral Efficiency**
 - DL and UL MU-MIMO supported
 - Achieve up to 750 Mbps in a 40 MHz channel
- **Protect Your Investment**
 - 3.3GHz to 3.9GHz range
 - >47dBm EIRP
 - Continue using existing SMs
- **Enhanced Link Stability**
 - Uplink Interference mitigation due to beamforming
 - Uplink Rx Sensitivity improvements (4-5 dB better)
- **Advanced Processing Capability**
 - >200k PPS

- **One Simple device to install**

- Simple Installation and Increased Reliability
- Integrated 90° sector beam-forming array, **ZERO** RF cables to connect or weatherproof
- Direct DC powering
- SFP and Gigabit Ethernet Support
- 27" x 24" x 7" (70x61x17 cm)
- 44 lbs. (20 kg)



- **Form Factor**
 - High Gain integrated antenna (20 dBi), similar to 5 GHz 450b High gain
 - Up to 29 dBm Tx Pwr, or 49 dBm EIRP
- **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



High Gain Released March, 2020

Case Study



The banner features a background image of a telecommunications tower against a clear blue sky. The text is overlaid on a white and light green geometric shape.

WIRELESS
Etc.
Wireless ETC

**Internet Service
Real People**

We Understand That Real People
Don't Want Limits When It Comes
To Internet Services.

Navigation links: Home (with house icon), F.A.Qs (with dropdown arrow), Support (with dropdown arrow), Contact (with envelope icon).

- Problem:
 - Connecting Rural America
- Solution: *cnMedusa* (both 3 and 5 GHz)
- Results: Able to offer high throughput (25/15 Mbps) packages, and increase coverage area with replacement of Base Stations to *cnMedusa*.
- Update: Since CBRS implementation, increased power levels have allowed
 - Enhanced coverage
 - Higher rate plans
 - Allows connection of additional subscribers



Wireless Etc. Powers Their Network With *cnMedusa* Technology

The Challenge

LOCATED IN HOT SPRINGS, ARKANSAS, Wireless Etc. has been providing connectivity to Garland County since 2003. Today, Wireless Etc. sells broadband to local homes & businesses and delivers services to local electric co-ops, industries and hospitals. Some of their solutions include enterprise-class PTP links, managed firewall security updates and indoor, complete Wi-Fi coverage.

Their customers range from families that need Wi-Fi for their homes to businesses that need massive upload capacity to push product designs to satellite companies. An increasing demand for video and voice pushed Wireless Etc. to update their technology, streamlining services to end users.

With little marketing opportunities, Wireless Etc. needed a way to provide for local businesses and industries while maintaining their reputation for reliability and performance. To align with their values, they needed a solution that would keep up with the rising need for Wi-Fi coverage in their area.

The Solution

CAMBIUM NETWORKS' PMP 450, PMP 450i and PMP 450m solutions were Wireless Etc.'s go-to choice for connectivity. A combination of this equipment provided Wireless Etc. with the ability to overcome growth as subscribers' expectations rose, providing both primary service and failover service. As they added each product, it became clear that each one had more capacity and performance to meet those expectations.

In the 3 GHz band, the PMP 450m Access Point (AP) with *cnMedusa*™ Massive MU-MIMO technology allows Wireless Etc. to quickly connect more people, places and things. Not every site requires a PMP 450m, and a PMP 450i or PMP 450 can handle almost any quantity of subscribers in their area. To ensure successful network design and paths for backhaul services needed by each sector, Wireless Etc. uses Cambium Networks' LINKPlanner™.

Capacity Increase Compared to Previous Service

Service	Capacity Increase
Post-PMP 450 Average	2x
Post-PMP 450i Maximum	5x

The PMP 450 platform provides high-performance, cost-effective wireless broadband connectivity.

Narrow beams created in MU-MIMO mode increase coverage and throughput while reducing system's interference.

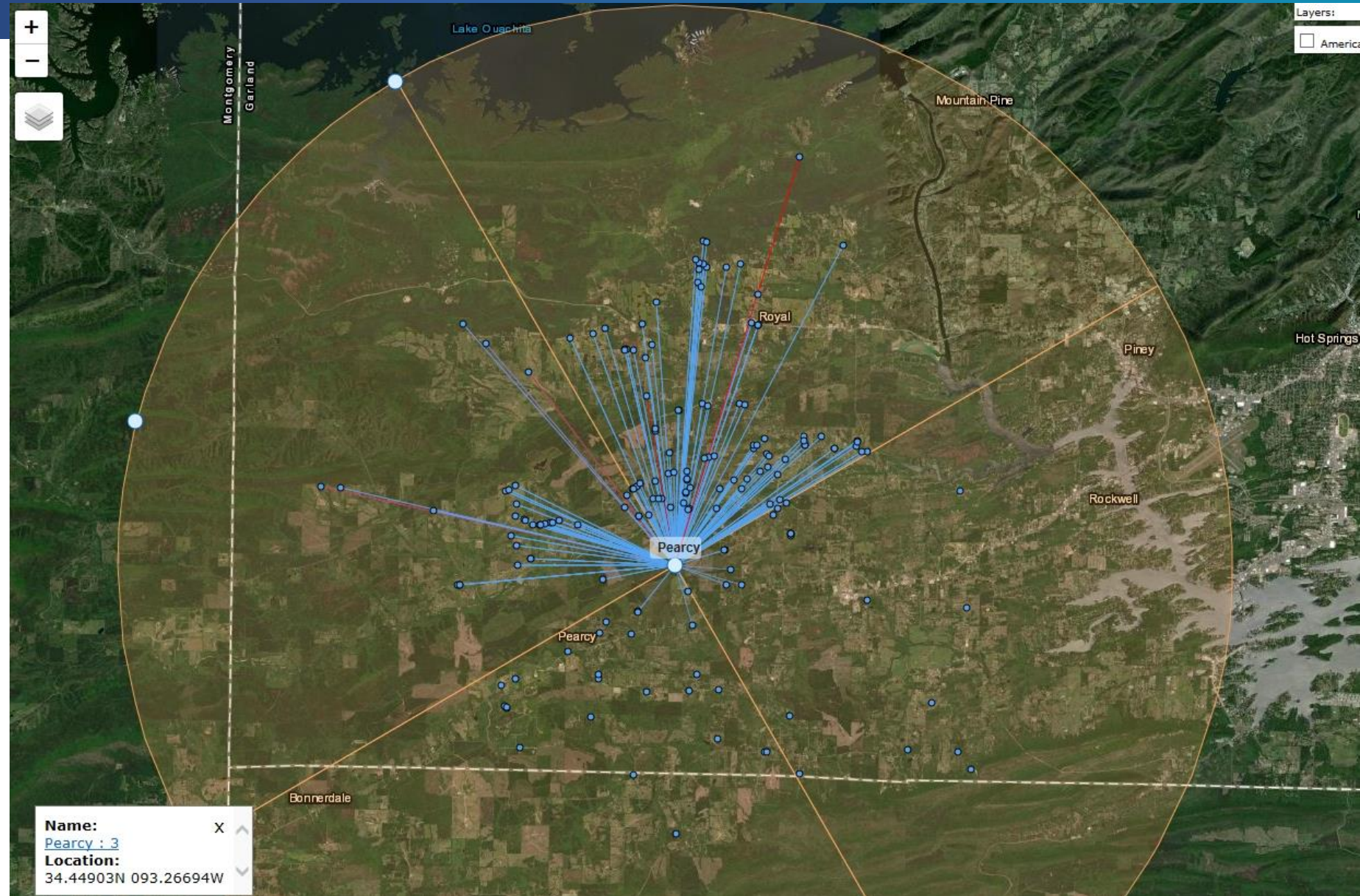
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Main BTS Site

- Four 90 degree sectors using 3GHz 450m for increased range / coverage
- Two 5 GHz 450m sectors to supplement bandwidth requirements for LOS customers



- Over 300 customers are currently connected, with capacity to service many more
- Service is available out to >8 miles from tower using CBRS



Rate Plans and ARPU

(501) 318-1300 PO BOX 2600 Hot Springs, AR 71913 Search... INFO@WLETC

WIRELESS Etc. Home F.A.Q.s Support Contact Service Info

PLANS RATES AND PRICING

Home / Plans Rates and Pricing

ESSENTIALS	BASIC	STANDARD	PREMIUM
Streaming	Streaming	Streaming	Streaming
SD Stream: 1 Device	SD Stream: Up to 3 devices OR HD Stream: 1 device	SD Stream: Up to 6 devices OR HD Stream: 2 devices	SD Stream: 10+ devices OR HD Stream: 4+ devices
<i>Unlimited usage</i>	<i>Unlimited usage</i>	<i>Unlimited usage</i>	<i>Unlimited usage</i>
Voip 1x phone	Voip	Voip	Voip
Gaming 1x device	Gaming	Gaming	Gaming
Video Security Minimal	Video Security	Video Security	Video Security
Includes Gateway	Includes Gateway	Includes Gateway	Includes Gateway
Managed	Managed	Managed	Managed
\$40.00	\$67.00	\$92.00	\$167.00
Basic install \$250.00 which includes single band router			
All installs include Cambium Networks Router Service			
A two year contract is required			

PACKAGE TECHNICAL SPECS

Home / Package Technical Specs

Internet Services				All packages include unlimited downloading and uploading			
Tech Specs				NO DATA CAP			
Download speeds are maximum speeds; they may vary & are not guaranteed.				NO DATA CAP			
Essentials	Basic		Standard		Premium		
Capacity Avg Availability	8Mbs@25s	Capacity Avg Availability	13Mbs@25s	Capacity Avg Availability	20Mbs@25s	Capacity Avg Availability	30Mbs@25s
Ping Speed Avg RTT	15ms	Ping Speed Avg RTT	15ms	Ping Speed Avg RTT	15ms	Ping Speed Avg RTT	15ms
Sustained up	1Mbs	Sustained up	5Mbs	Sustained up	5Mbs	Sustained up	15Mbs
Sustained Down	5Mb	Sustained Down	8Mb	Sustained Down	15Mbs	Sustained Down	25Mbs

- Customers choice varies widely among subscribers, but we can service any of them

Upcoming Deadlines and Dates to be aware of:

- **Commercial Operations for Cambium Networks started in April**
 - There are tens of thousands of subscribers taking full advantage of additional spectrum and higher power!
- **Transition Waiver has been granted, allowing Part 90 to continue until **October 17, 2020****
 - This is good for some, bad for others!
 - GPWZ (GWBLs) are actually hampering the use of Part 96 for some
 - **IMPORTANT NOTES:**
 - While the waiver is in place, NO ADDITIONAL Part 90 sites are being approved
 - For anyone with license issued or renewed after January 8, 2013 – Part 90 operation ends on October 17, 2020.
- **PAL Auctions**
 - Auction Completed 8/26/2020 – Winners announced and published.
 - PAL commercial operations expected in Q4.
 - Many WISP and service providers have won licenses, and this gives assurance when utilizing CBRS.
 - Those that did not participate or win may still have ability to take advantage of “secondary market”



Cambium Networks™

Questions
