



Cambium Networks™

If It Can Be Wireless, It Will Be Wireless

Derek Underwood, Regional VP, NA

Scott Imhoff, SVP, Product Mgmt & Planning

WISPAPALOOZA 2021



Cambium Networks – A Decade of Excellence



10
YEARS
Cambium Networks™
A DECADE OF EXCELLENCE

- Became independent after WISPAPALOOZA 2011
- Industry evolved from Mbps to Gbps
- Deep relationships with WISPs and WISPA
- Customer driven innovation
- Thank YOU for your partnership

2011



2019





HERO OF THE YEAR
EVERT BOPP
Disaster Tech Lab

Semper Wi-Fi
EverestLink
Consulnetworks
DisasterTechLab
Frontiir Communications
Frontera Consulting
Wispa pty

2017



HERO OF THE YEAR
DUDUZILE MKHWANAZI
Project Isizwe

Arnold and Peter Du Plessis
American Wide Broadband
WorldLink
Easyweb Digital
Lifesource
Aristotle Inc
Sacred Wind
OmniLogic
KING IT
Project Isizwe
Wireless Applications Corp

2018



HERO OF THE YEAR
CHRIS HILLIS
Information Technology
Disaster Resource Center
(ITDRC)

ITDRC
Consulnetworks
Countrynet
Mountain Community Network
InfoNet
CasCom

2019



HERO OF THE YEAR
DREW LENTZ
Frontera Consulting

Ibersystems
Ayuntamiento de Villarcayo
de MCV
Maxwire Internet
Resound Networks
Valley Teligence
Skynet
Ibersystems
PB Seguridad
Amplex
WorldLink
EnerTribe
Frontera Consulting
TooMuchWiFi
Elevate Technology Group
FIAM WIFI

2020

Air2bite
Tizeti Network Limited
Alaska Communications
Pentanet
Burke County Public
Schools
International Children's
Care
Tidal Wave Wireless
Calllidus

2021



Cambium's Key Innovations

Our portfolio of innovations and solutions is growing every year



PMP 100



PTP 650



ePMP™ 1000



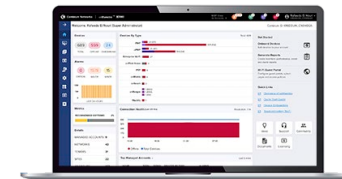
**450 Lineup/
cnMedusa™**



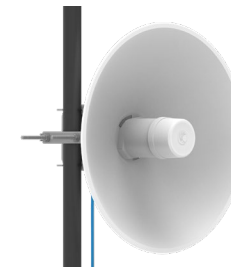
cnPilot™ e400



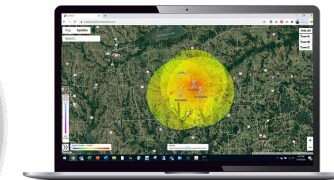
cnMatrix™



cnMaestro™



cnRanger™



cnHeat™



Wi-Fi 6



**60 GHz
cnWave™**

CBRS

2016–2021

2011–2015

Delivering Connectivity that is Easy and Affordable

Maximize throughput from available spectrum

- 6 GHz development

Achieve flexibility from software-defined radios

- Extend PMP 450m to support CBRS

Leverage CBRS with leadership in Spectrum Access System (SAS) via a frequency coordinator using Priority Access Licenses (PAL)



Marketing Resources (co-brandable)

- Case studies & videos
- Solution papers & data sheets
- Brochures/flyers
- Pop-up banner for events
- Email templates

Free Virtual Training

Qualified Leads

Market Development Funds Program



Optimize Broadband Subscriber Acquisition Only Market to Those You Can Serve

Challenge:

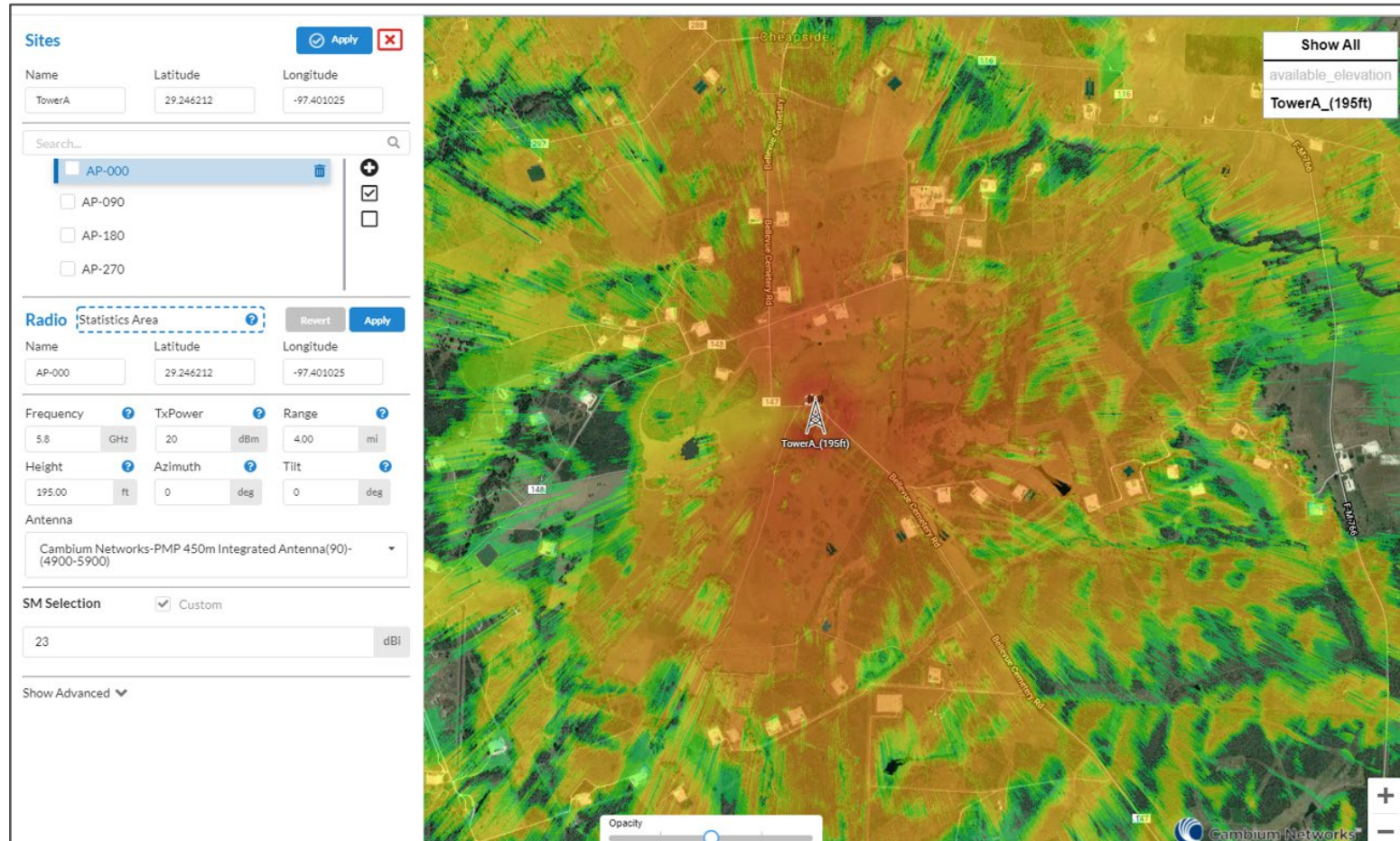
Coverage areas do not map to ZIP codes or cities

Solution:

Send mailings to **ONLY** addresses you know you can cover

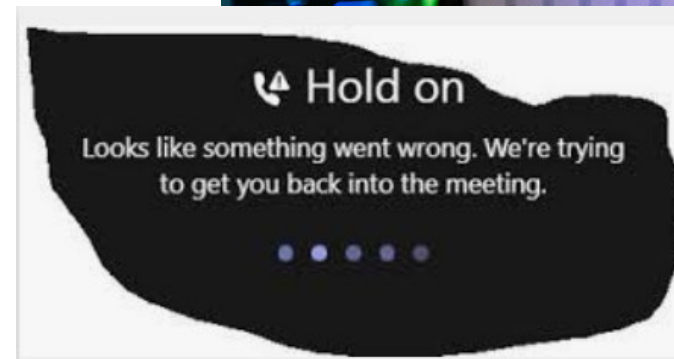
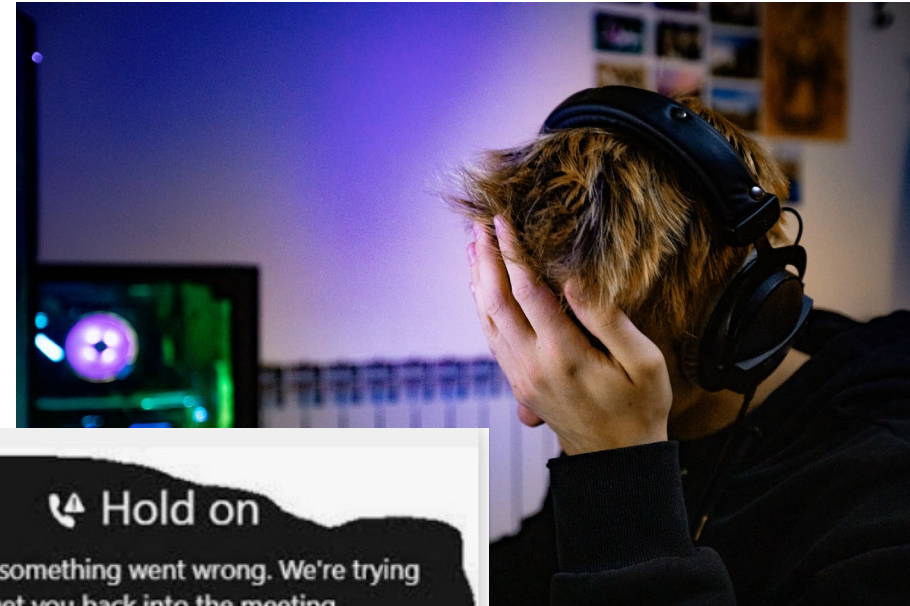
How it's done:

- Deliver **cnHeat** results immediately
- Match results to specific customer addresses



Wireless Network Insight and Automation will Enable You to:

- Improve your upsell effectiveness
- Reduce support calls
- Increase customer satisfaction
- Manage rate limited plans



Server Name	Map
DYSPIKE™ CAUCASUS - Supported by PATREON	Caucasus
Grim Reapers - Playground	PersianGulf
Grim Reapers - RC-1	Caucasus
Grim Reapers - RC-2	Caucasus
Grim Reapers - Stone Burner	Caucasus
	Caucasus
	PersianGulf
	Caucasus
	Caucasus
	Caucasus
	PersianGulf
	Caucasus
	Caucasus
	Caucasus

WARNING
Your ping is too high to fly in this server

OK

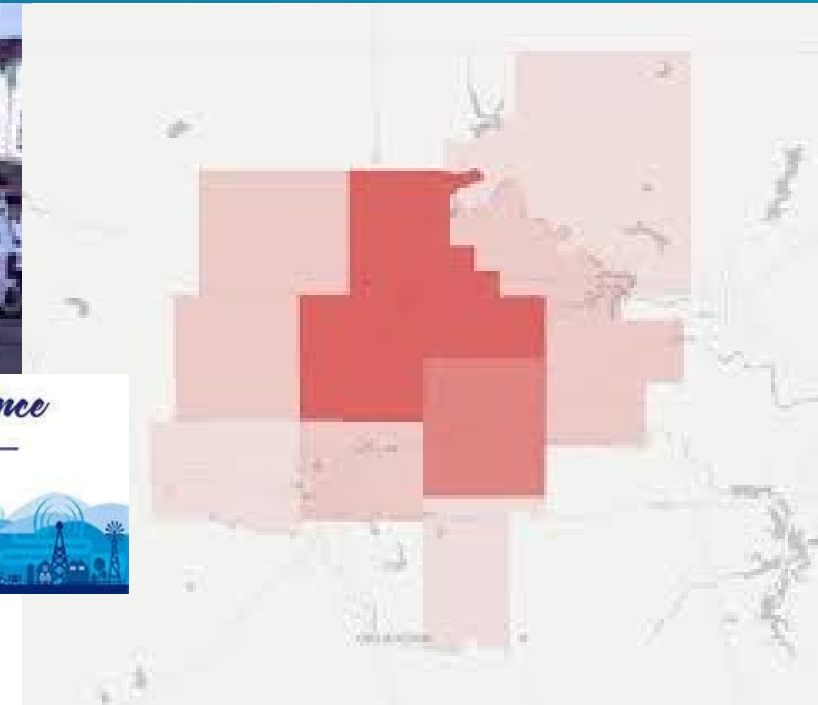
Ask us for a demo!

Scaling to Serve More Customers – Stillwater, OK



USE CASE

Business and residential connectivity that scales



CHALLENGE

Deliver professional quality internet experience to business and residential customers overlooked by other providers

CAMBIUM NETWORKS SOLUTION

ePMP with synchronization, scalability and centralized management

RESULTS

- Offer meets residential needs
- Cover 55 cities, towns and communities
- 5,500 square miles
- 100 towers

"Best Performing ePMP 3000 Access Points" by Preseem



- USE CASE**
- Rural broadband connectivity
 - Residential, business and school connectivity



CHALLENGE

- Connect nine hard-to-reach counties
- Improve Arkansas' bottom-10 rank in internet connectivity
- Extend the reach of fiber infrastructure

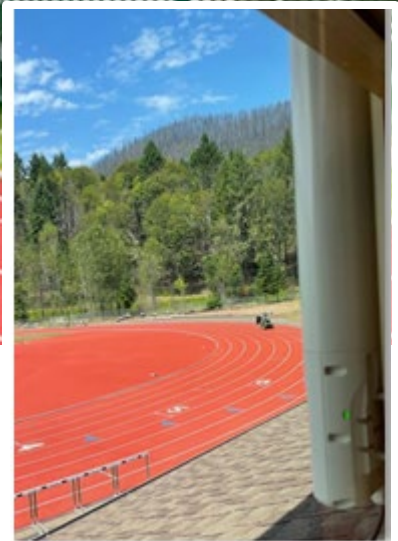
CAMBIUM NETWORKS SOLUTION

- PTP 850 licensed microwave backhaul
- PMP 450m fixed wireless access
- cnMaestro wireless network management system

RESULTS

- Up to 100 Mbps delivered
- Affordable internet provided to rural Arkansas areas

Outdoor Wi-Fi 6 for Olympic Trials – Oregon



USE CASE

- Wi-Fi calls, FaceTime, and event livestreaming
- Connectivity for attendees, athletes and staff

CHALLENGE

- Support hundreds of guests in an area with heavy tree cover
- Previous connectivity in the area was a 5-10 Mbps DSL connection

CAMBIUM NETWORKS SOLUTION

- CBRS solution: 2 PMP 450b units in PTP mode
- XV2-2T outdoor Wi-Fi 6 access point

RESULTS

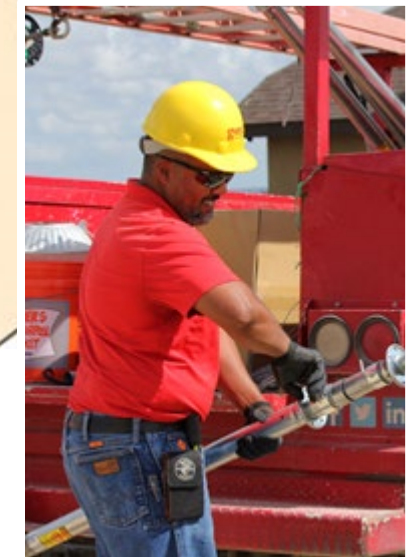
- Aggregate bandwidth of 220 Mbps
- 157 unique devices connected to Wi-Fi
- Thousands watched the livestream online

Expanding Customer Service Offerings – Texas



USE CASE

Expand utility business by offering internet access to power customers



CHALLENGE

- Rural area, low density
- Customers have no available internet options

CAMBIUM NETWORKS SOLUTION

- Planning with cnHeat
- PTP unlicensed wireless backhaul
- PMP licensed and unlicensed distribution network

RESULTS

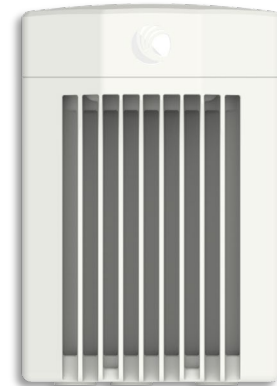
- Offering 25/5 service to residential customers
- Support 125 subscribers per AP

The Future is Bright



2011
Canopy AP

10
YEARS
Cambium Networks™
A DECADE OF EXCELLENCE



2021
60 GHz cnWave™



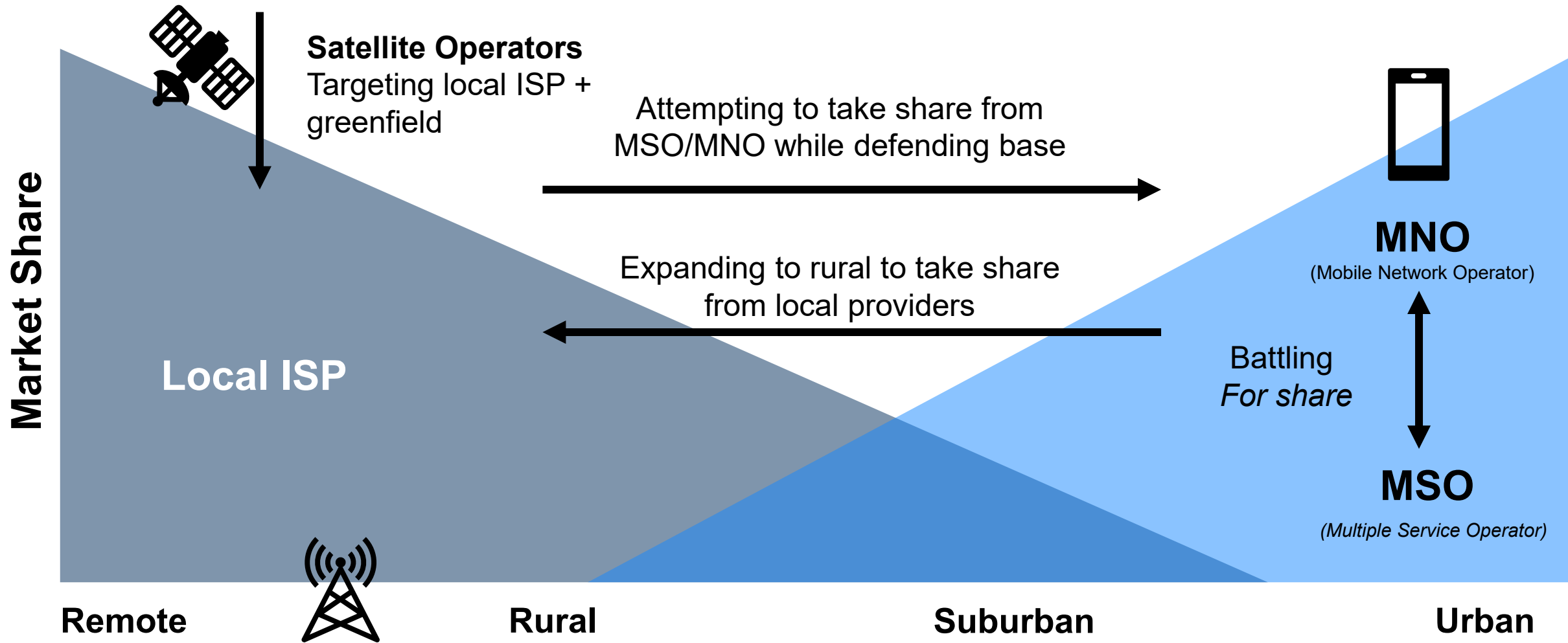
Cambium Networks™

Extending the Wireless Fabric *Market Dynamics and Solutions*

Scott Imhoff

SVP, Product Management & Planning

Fixed Broadband Landscape 2021



- **Where do you see the market going in your coverage area?**
 - I will be able to grow market share from MSO/MNO competition as I expand into suburban and urban areas
 - My market share will stay the same as I defend from MSO/MNO competition
 - I am concerned that MSO/MNO competition will take market share from me

Request Cambium Networks' Assistance in Applying for Government Grants

At the national, state, and local levels, governments around the world are providing financial support and incentives to extend broadband access to unserved and underserved regions and communities.

The objectives in providing the funding range from enabling economic development to providing telemedicine to supporting remote learning, but universally governments recognize that the future demands broadband access. The applications for the programs range from relatively simple to those demanding comprehensive network designs, coverage models, and even impact studies and economic models.

Cambium Networks recognizes that the application process can be daunting for our partners and customers and may even prevent them from seeking the financial support intended for them! Cambium Networks also recognizes the challenges and is prepared to provide our expertise and support to assist with grant applications. If you would like to request support, please complete the following form, and a Cambium Networks team member will be in contact with you.

Complete the form below to request Cambium Networks' assistance in applying for government grants.

* required fields

First Name *

Last Name *

Company *

Email *

Snap QR to request assistance

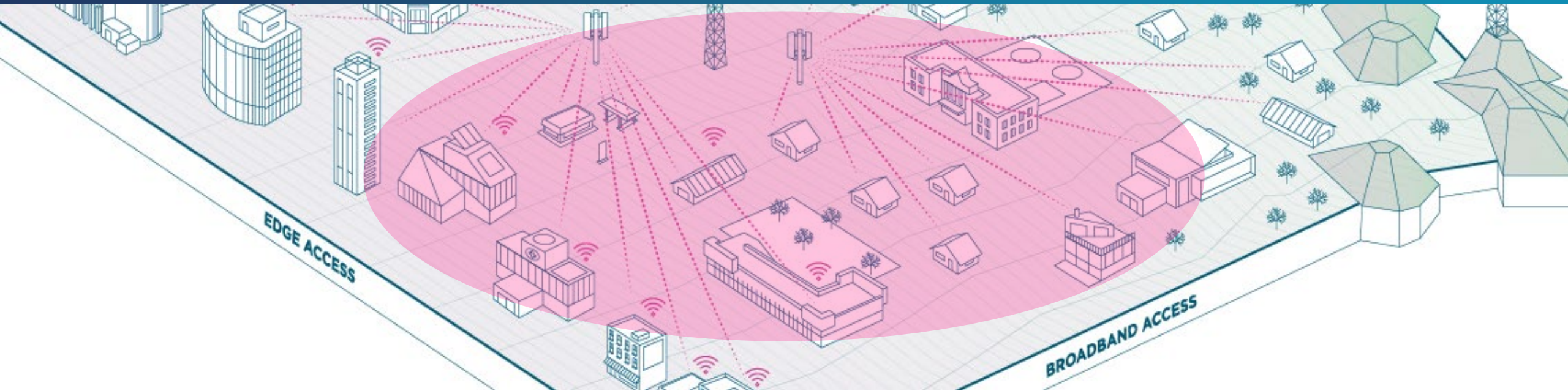




CBRS 2.0 – Extending and Enhancing the CBRS Experience



Cambium Networks™



CBRS Solutions

- CBRS dubbed the “innovation band”
- Most cited use cases have been slow to adopt
- Fixed Wireless Access clearly a good fit, first mover, market share leader

Cambium's CBRS Solution – A Proven Winner



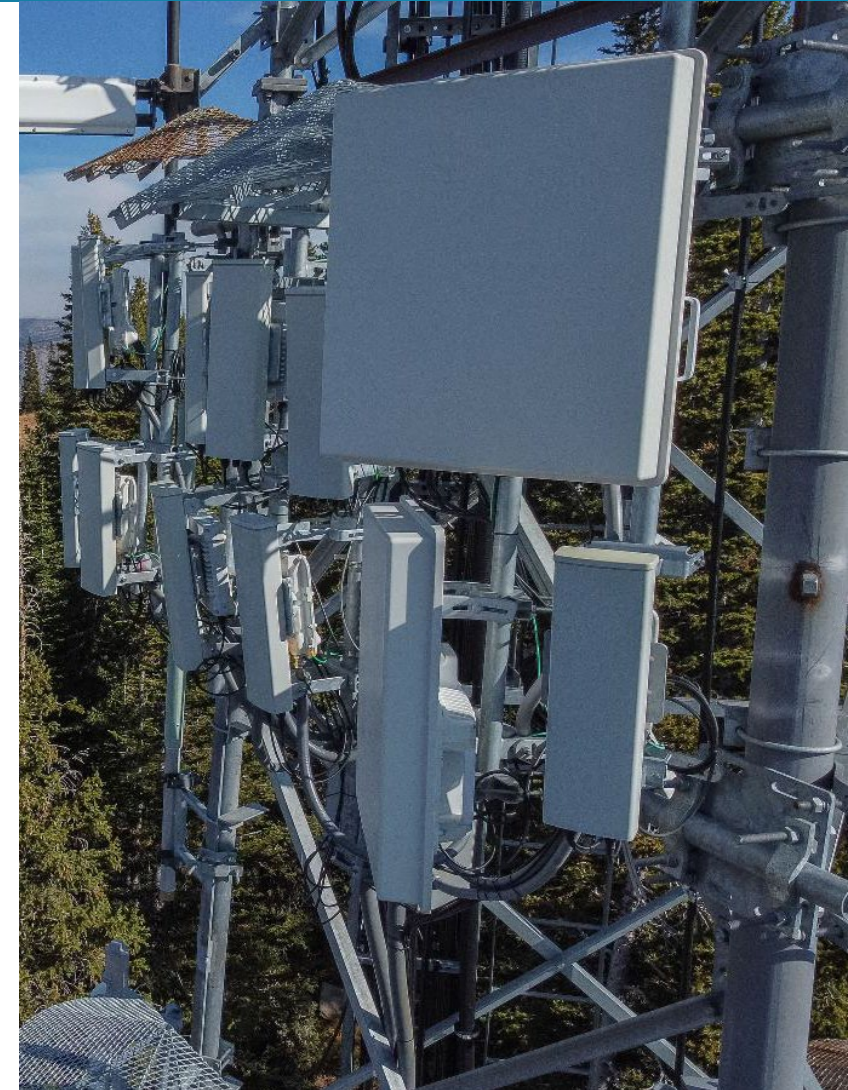
- A complete end-to-end ecosystem and solution
- Operational reliability stable and exceeding expectations
- Cambium CBRS works with all major SAS providers
- Network Operator chooses the SAS they like
- Cambium enables migration from one SAS to another
- Comprehensive pre and post implementation support

Proven Success

- ~90%+ of the Part 90 installed base has now migrated to CBRS
- Over **110,000** devices operating today and networks building out at pace
- Deployed by service providers, government, and industry



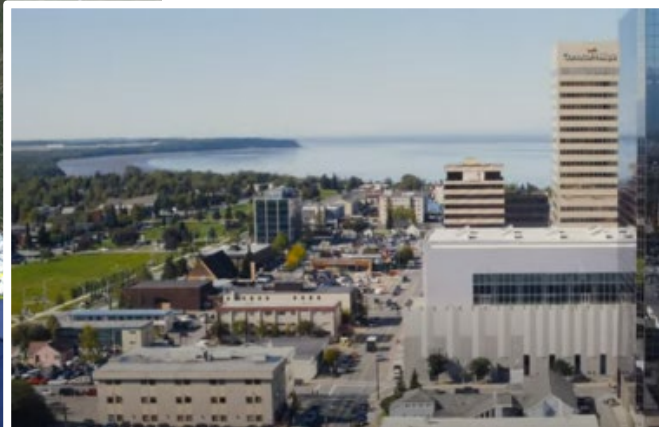
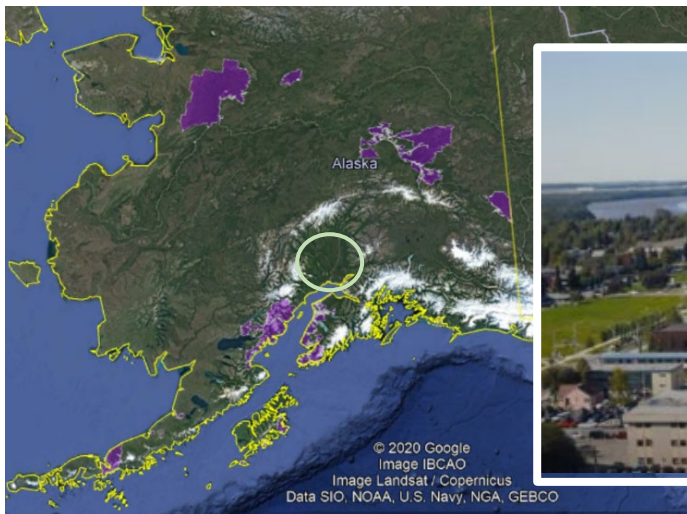
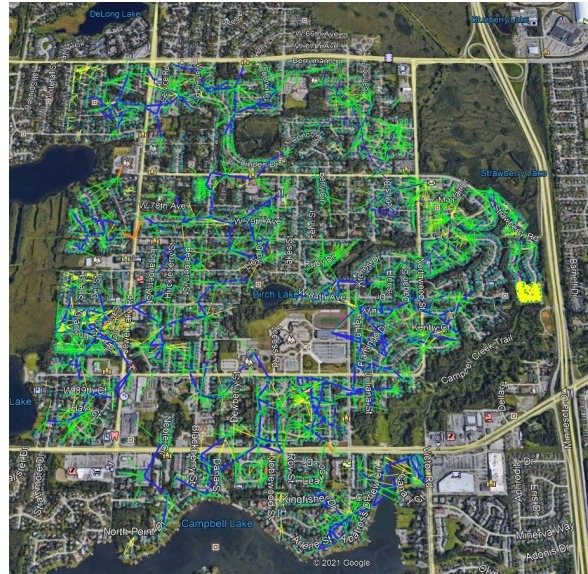
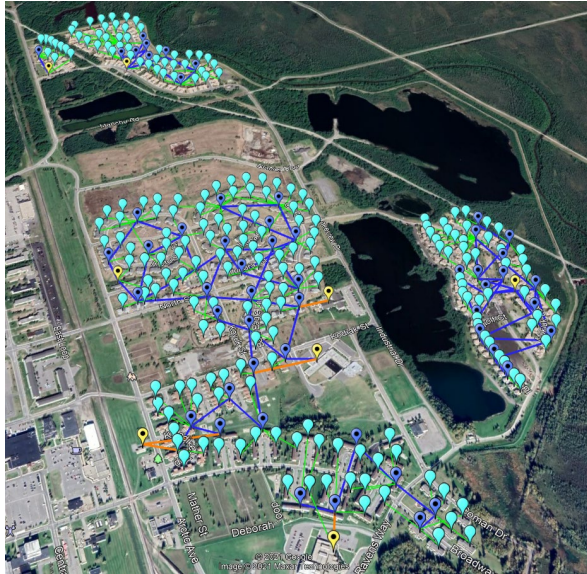
- **Leaders** in **CBRS** Evolution, Cambium is ahead of the curve, and influencing how the SAS Admins implement features
- **Tight integration** with all SAS portals and tools
- Supporting features of **SAS 2.0** 3GPP standards
- **cnHeat** provides unparalleled coverage modeling accuracy
- **cnMaestro** is the **one stop** to plan, deploy and monitor
- **Unmatched support** if issues arise





Cambium Networks™

**Gigabit to the Edge
60 GHz cnWave**



Goals

- Competing with **Cable (DOCSIS) Operator**
- Deliver 50/100/250 Mbps and 1 Gbps residential services
- Upgrade existing DSL wireline network and leveraging fiber assets
- Three pilot areas ahead of network wide rollout (Eielson AFB housing, Fairbanks and Anchorage neighborhoods)

Solution

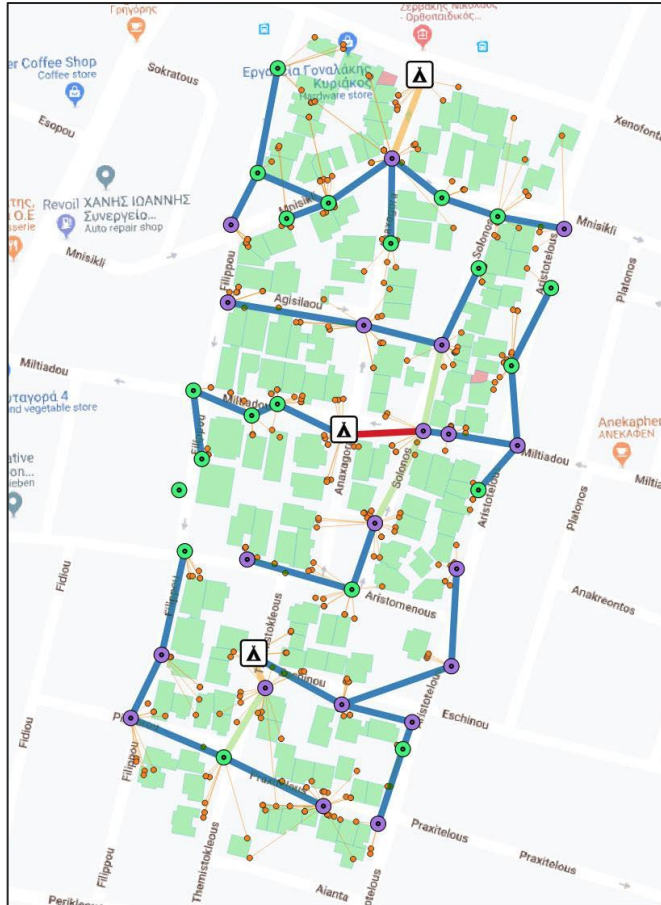
- Deploy 60 GHz cnWave V5000 and V3000 with distributed configuration to handle the high-density area
- Leverage existing fiber rings and PoPs
- ACS also deploys PMP 450 CBRA and PTP 8xx licensed microwave from Cambium

Status

- 340 DN's, 1,500 Client Nodes in the initial deployment
- 6,500+ homes and businesses covered

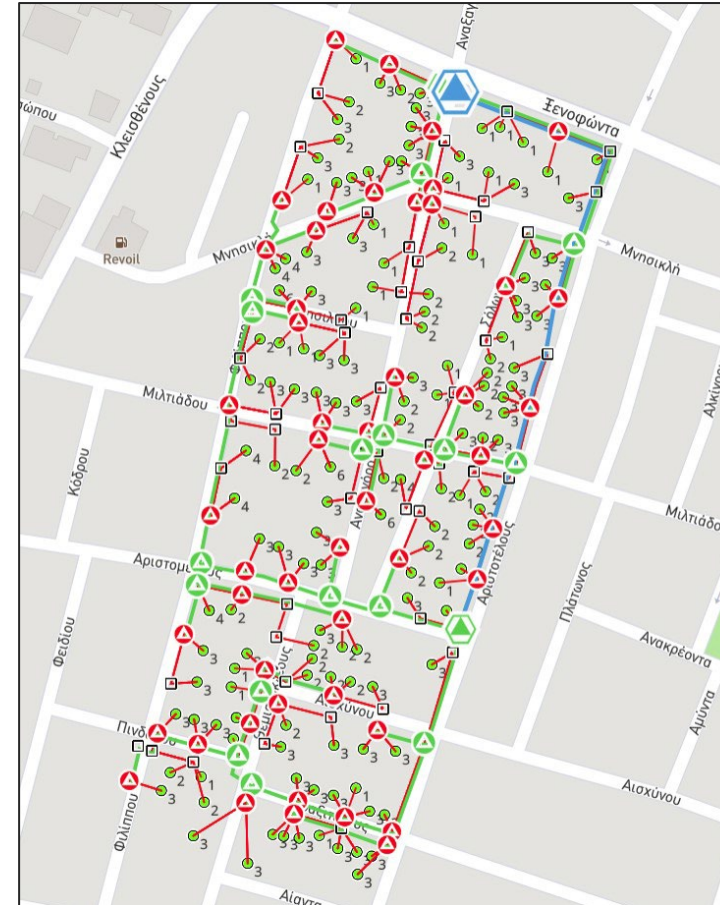
60 GHz cnWave Cost per Home Passed is 41% of Fiber

**Wireless
Coverage
breakeven
at 14
months**



cnWave plan showing: wireless DN and POP locations

**Fiber
breakeven
at 30
months**



FTTH Plan showing: trenches, closures, cabinets, splice points, underground cable

Actual Field Results at 1.2 km Distance



POP - POP | Problem loading page | tcp_results_last_16_hours | +

https://[2001:470:685b:a::1]/dashboard

60 GHz cnWave™ V3000

Disable E2E Controller | Reboot | admin

Dashboard

Links	Nodes	Sites	Wireless Throughput
1 Total	2 Total	2 Total	2.65 Gbps RX
1 Online	2 Online		2.61 Gbps TX

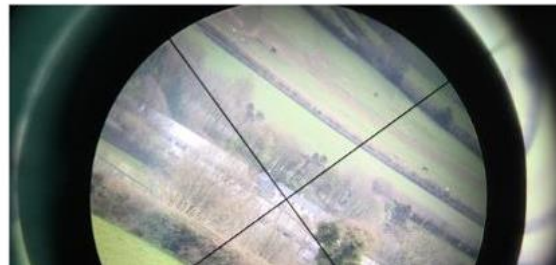
Device Information

Type	POP
Name	POP
E2E Controller	Running Onboard
cnMaestro Connection Status	Not Connected (Remote Management is disabled)
cnMaestro Account ID	admin
MAC Address	00:04:56:88:39:FF
Serial Number	V5WM01K0CSXL
Model	V3000
Software Version	1.0.1
Firmware Version	10.11.0.87
Wireless Security	None
Layer 2 Bridge	Disabled
System Time	May 24, 2021, 11:56:23 AM
Uptime	0d 2h 8m

GPS

Fix Type	3D
Satellites tracked	16
Latitude	50° 31' 24.955" N
Longitude	2° 44' 27.576" W

Map | Show Names: Yes No



Fully Terragraph-certified Networking Your Way

- IPv4 or IPv6: Your Choice
- Layer 2 or Layer 3: Your Choice

Client Flexibility and Pricing

- V1K: Gbps in the palm of your hand
- V3K: Auto-aligning range and performance

Proven Distributed Networking

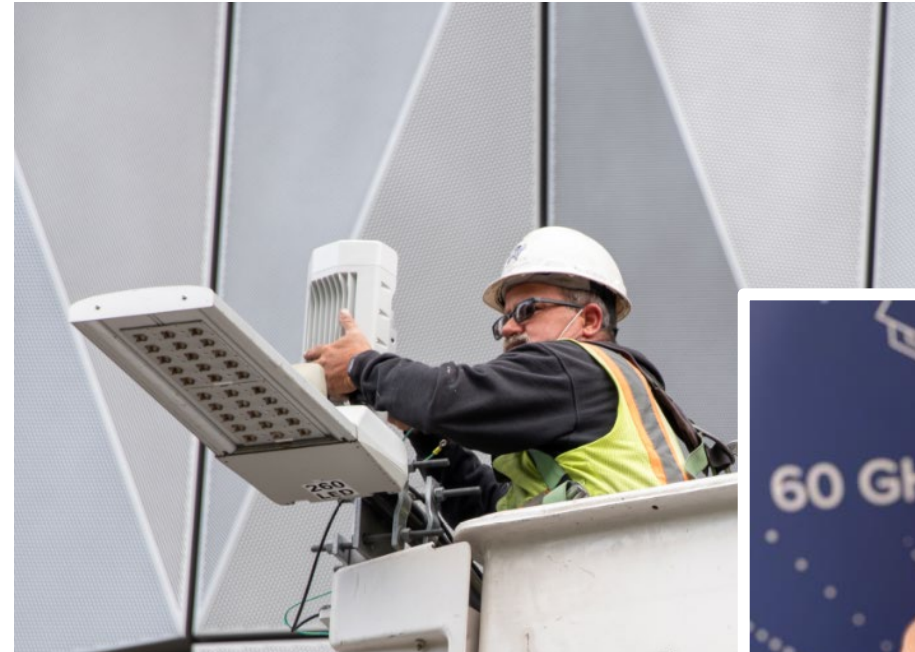
- < 1 ms latency per hop
- 250 ms resilience / re-convergence

Fast Alignment

- Graphical alignment tools and automatic beam-steering

Tools for Success

- LINKPlanner, cnHeat, ANP and cnMaestro



Gbps Changes your Business

60 GHz cnWave Starter Kit



Each starter kit contains:

One (1) V5000 Distribution Node

Two (2) V3000 Client Nodes with High-Gain Antennas

Two (2) V5000 Client Nodes

Power Supplies, Line Cords, Mounting Brackets



Snap QR to learn more about this starter kit

Blazing Speed and Gbps Performance

Cambium's 60 GHz cnWave platform helps you grow your business with an alternative to fiber

Get your Starter Kit at 55% off list price, while supplies last



What can I do with this kit?

- Test and deploy a PTP link with 2x V3K
- Test and deploy a PMP link with V5K and 1-4x CN's
- Manage the network with cnMaestro
- Take the on-line training and become certified on the cnWave 60 GHz solution



Cambium Networks™

**Business Expansion as a
Managed Service Provider –
aka an “Indoor” WISP**

- **Do you plan to become or do you currently act as an MSP?**
 - Yes, we are an MSP now
 - Yes, we plan to become an MSP within 6 months
 - No, we do not plan to become an MSP

Top factors for choosing an outsourced service provider

- Return on investment
- Meeting stated requirements
- Effective use of prebuilt assets/platforms to support service delivery, and suitability to a department or functional area

When asked to rate the importance of various IT services for the overall success of the organization:

- 87% of users rated managed services in the top two box of a 7-point Likert scale
- 90% of global enterprises rated IT managed services as top two box choices of “very important” and “critically important”

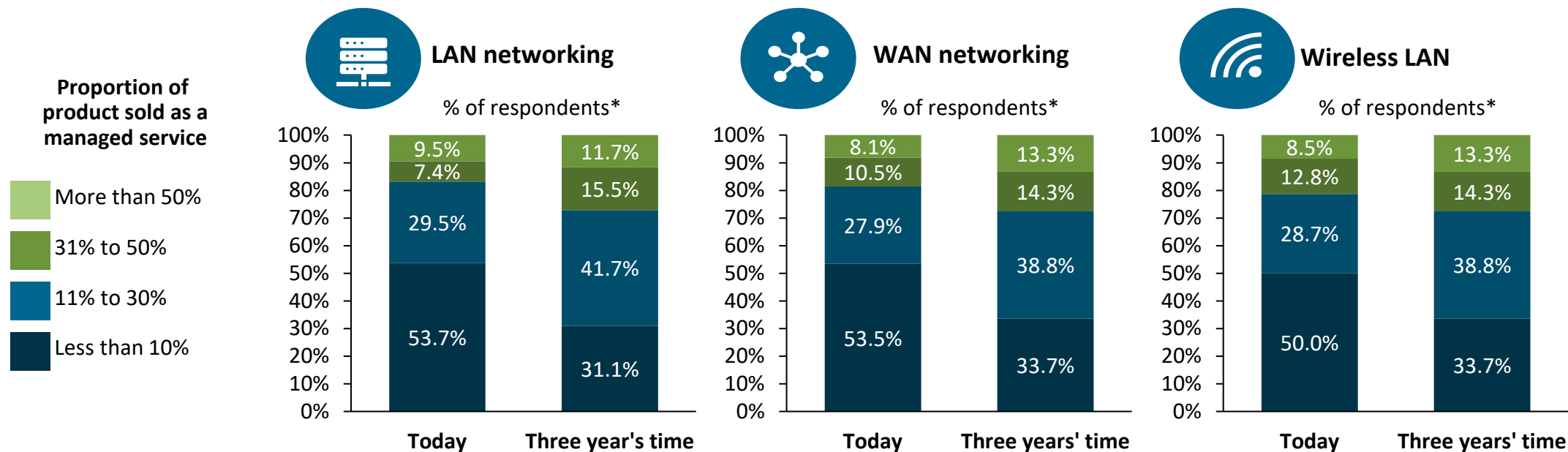
Reliance on consulting or outsourcing providers for digital business infrastructure operations will increase over the next two years (41% “somewhat higher” and 20% “significantly higher”)

Nearly half of all respondents expect the reliance on IT services for their digital initiatives to be permanent

Managed Services is a Growing Trend

WISPs will increase revenue and ROI by expanding to managed LAN and WLAN as an MSP, aka Indoor WISP

What proportion of the following product categories you sell **today** and in **three years' time** are part of a managed service contract sold to business customers?

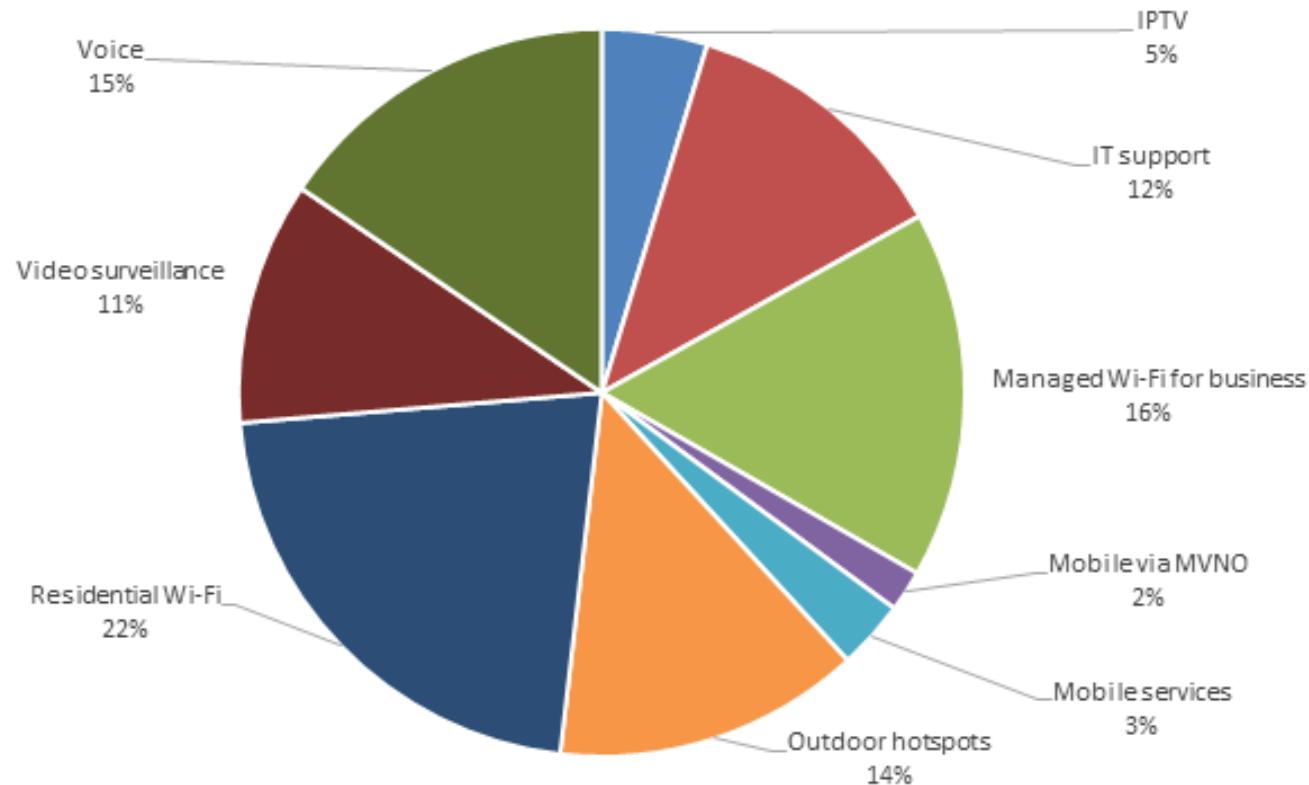


*Excludes do not sell

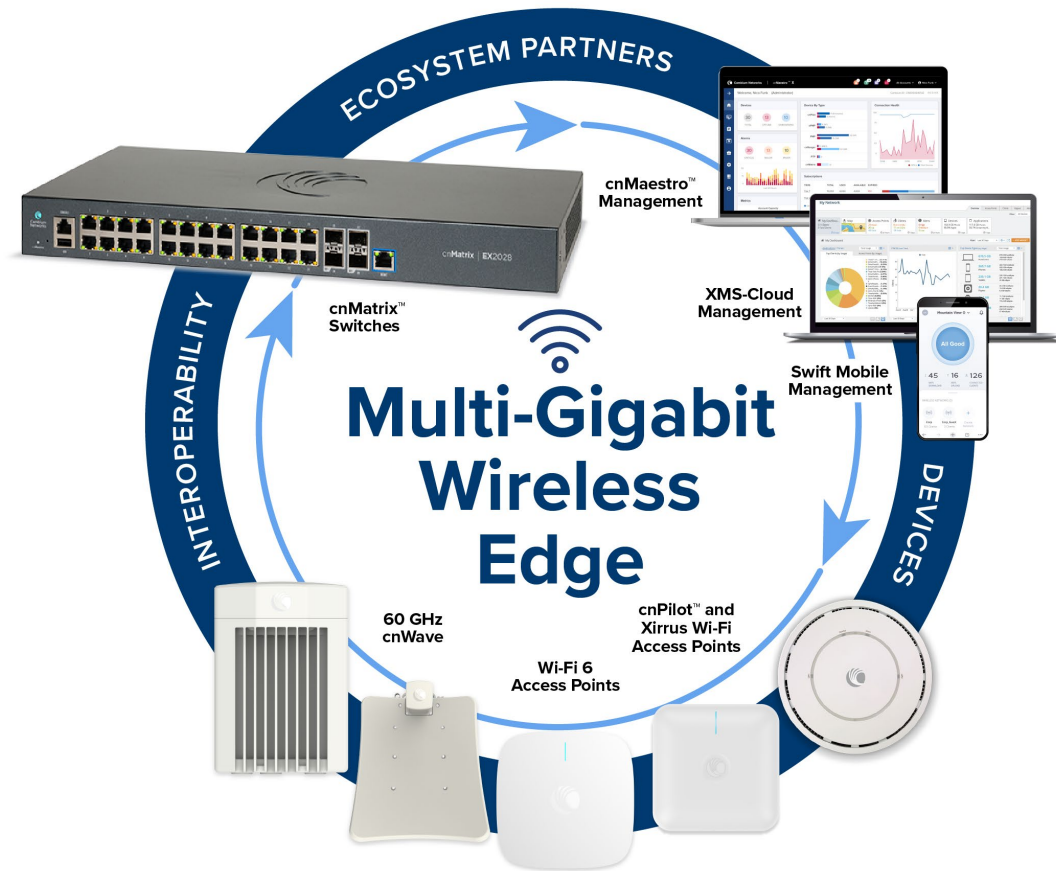
Source: Candefero channel survey (127 respondents, March 2020)

Many of You Have Recognized the Opportunity and Embarked on the Journey

In addition to broadband, which other services do you offer?

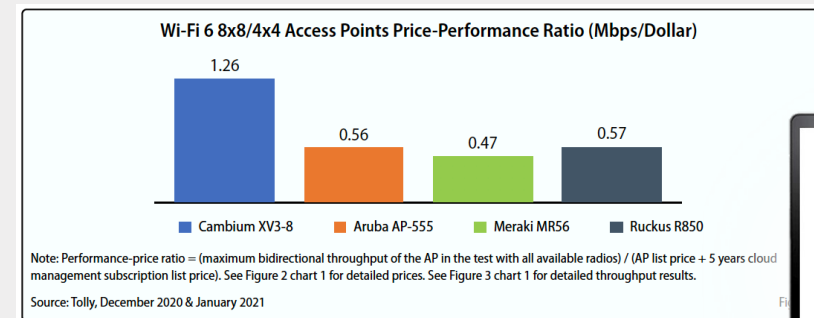


- 16% Managed Wi-Fi for Business
- 12% IT Support
- 11% Video Surveillance

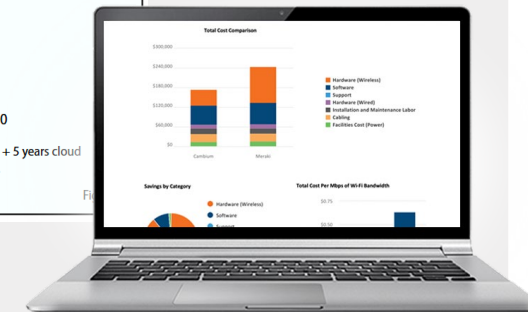


- Industry-Leading Price/Performance
- Freemium, Feature-Rich Cloud
- Platform for Business-Critical Services
- Industry-Leading TCO
- Compelling Partner Program Benefits

Cambium Performance Advantage



Cambium TCO Advantage



Online TCO Profiler

Tolly Performance Report: <https://www.cambiumnetworks.com/download-wi-fi-6-access-point-tolly-report/>

TCO Profiler: Register to use at: <https://viewer.mediafly.com/cambium>

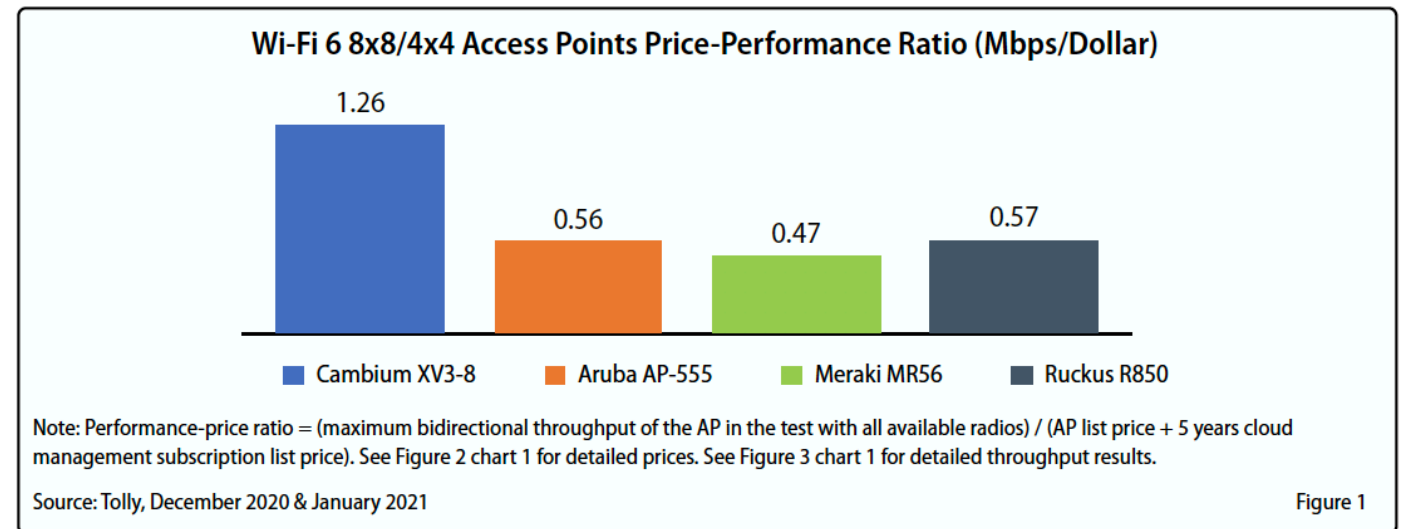
Test report by the Tolly Group compares Cambium to other major brands

Solutions tested:

- Cambium XV3-8 & XV2-2
- Aruba 555 & 505
- Meraki MR56 & MR36
- Ruckus R850 & R550



Price-Performance

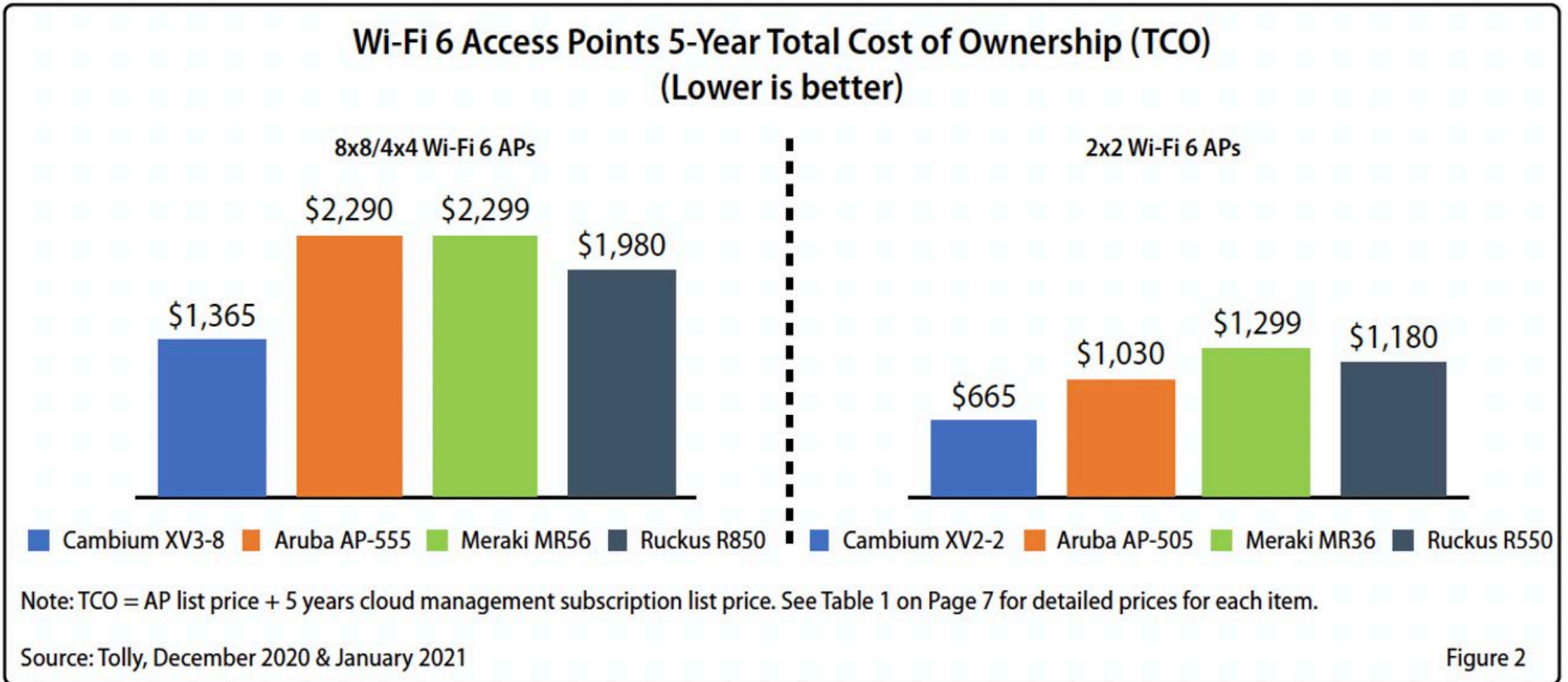


Snap QR to view report



Tolly Group Report #221110

Cambium Delivers Superior TCO





Multi-Tenant Cloud Architecture

- Role-based access control
- Customizable dashboard



Flexible Deployment Options

- SaaS, private cloud, or on-premise
- Same experience across different modes



Persona-Based Dashboards

- MSP, tenant views, branded dashboard
- Hierarchical topology



Advanced Capabilities

- 1028 ePSKs per WLAN, 50k per account
- Mac Authentication bypass for IoT devices



Remote Troubleshooting

- Root cause analysis
- Accelerated Access to Level 3 Support



Analytics and Insights

- 2-year data on the cloud
- Actionable insights



Automation and Telemetry API

- Programmatic interface to configure AP
- 3rd party application integration



Webhooks

- Real-time notifications
- Out-of-box integration for web services, such as Pagerduty Slack, Zapier, Twillio, Datadog, etc.

End-to-end Operational Efficiency for MSPs

Cambium Managed Service Provider Program

- MSP structured pricing
- Access to enhanced technical assistance to manage complex networks
- Take advantage of other programs for hardware, software, and support as a service to avoid high upfront capital investment



**Deliver Managed Services Easier
with Cambium Networks**

Snap QR to view
MSP Program Flyer



The Time is Right

- Network is a mission critical asset for organizations of all sizes
- Organizations with < 300 employees represent a sweet spot for MSP services
- Cambium has the solution, economics, platform, and program to help WISPs embrace the MSP movement
- **WISPs have the technical acumen, the local presence, the practical experience, and a differentiated service with WAN Access**



Expand your business with
Enterprise Managed Services –
Cambium can help!



Cambium Networks™

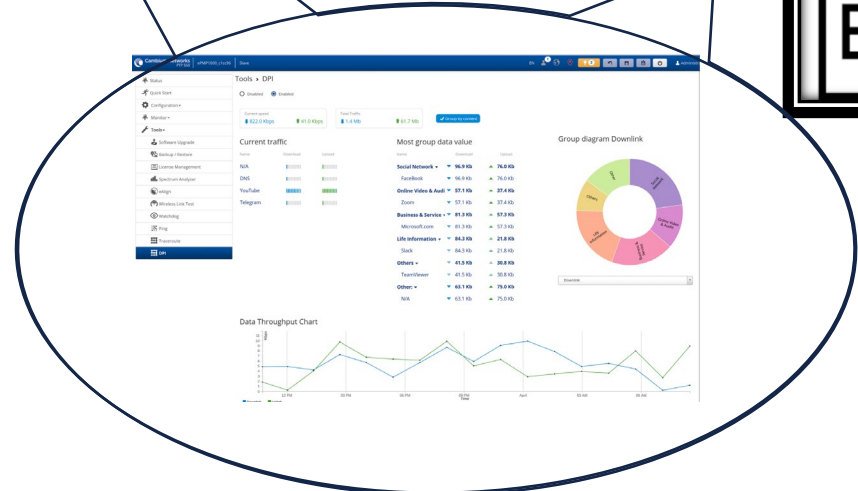
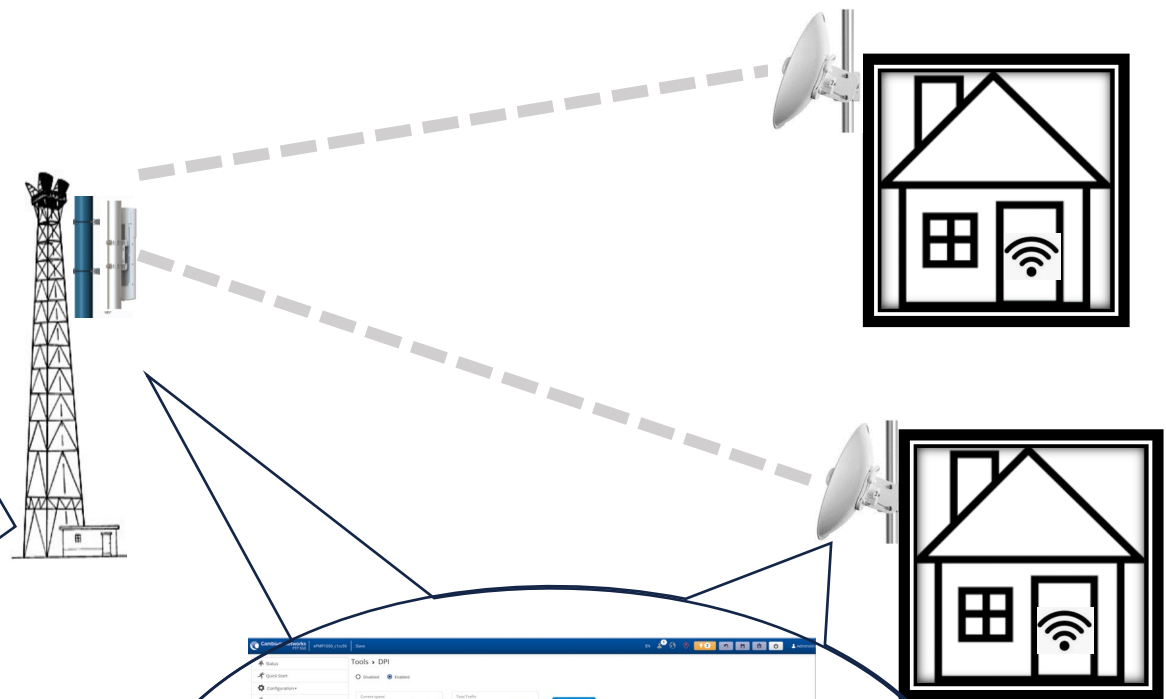
**Quality of Experience – Making
the Most of your Network**

An approach to focus on the Quality of Experience for end users in a wireless and wired network via:

- ✓ TCP optimization at the network edge, focusing on **Application Quality of Experience**
- ✓ Traffic shaping based on application
- ✓ Rate limiting
- ✓ Denial of Service prevention
- ✓ Application insights
- ✓ Tight integration with wireless scheduler to improve MU-MIMO performance
- ✓ Useful statistics driving quicker resolution and prevention of issues
- ✓ Integration with **cnMaestro**

QoE Solution from Cambium Networks

Edge Intelligence – Edge Action – Edge Impact



Tower* based appliance close to wireless APs

*Additional deployment models in Plan of Intent
 ** Additional products in Plan of Intent

- Application insight with ePMP** devices
- QoS priority based on application

TCP Optimization at the Network Edge Focusing on Application Quality of Experience

- Reduce support calls pre-emptively and lower customer churn

Traffic Shaping Based on the Application

- Manage wireless bandwidth based on application needs and service packages

Rate Limiting

- Manage subscriber Service Level Agreements

Denial of Service Prevention

- Network uptime, customer satisfaction

Application Insights

- Upsell based on usage patterns and consumption

Tight Integration with Wireless Scheduler to Improve MU-MIMO Performance

- Increase AP SM density and offer higher throughput packages

Useful Statistics Driving Quicker Resolution and Prevention of Issues

- Get insight into problem customers and address issues quicker

Integration with cnMaestro

- Get network-wide intelligence to make proactive decisions towards customer QoE



Cambium Networks™

**Exploiting 6 GHz to Deliver
Gb to the Edge**

ePMP 4000 Platform

Gigabit at the Edge with 6 GHz

2021

4X4 MU-MIMO AP
~700 Mbps sector
600 Mbps SM
20/40/80 MHz Channels
AX based ~1Gbps PTP

ePMP 3000, 3000L, MicroPoP,
Dual Horn Antenna

300-13, 300-16, 300-19, 300-25,
Force 425/400C

MU-MIMO
Flexible scheduler
Application insight (4.7)
Granular TDD ratio

2022

ePMP 4K 6 GHz
4X4 MU-MIMO AP
5.9 to 7.1 GHz
>2 Gbps SM capacity
6 GHz spectrum support (AFC)

ePMP 4600 AP

Force 600C, 625

5.9 to 7.1 GHz support
20/40/80/160 MHz support
1024QAM/4096 QAM
OFDMA, DL & UL MU-MIMO
>5 Gbps Capacity

2023

ePMP 4K 5 GHz
8X8 MU-MIMO
1 Gbps SM capacity

ePMP 4500 AP, integrated 8x8,
8X8 Horn

Force 4525, Force 4525L

20/40/80 MHz support
1024 QAM, OFDMA
UL & DL MU-MIMO
>3 Gbps AP capacity
Backwards compatibility

ePMP Force 425 and Force 400C

Gigabit Last-Mile Performance

Industry-first purpose-built PTP product based on 802.11ax

Shipping Today

Target Markets / Applications

- High-capacity enterprise point-to-point
- Low-cost backhaul
- GPON last mile

Key Specifications

- Up to 1 Gbps usable throughput
- Sub-5 ms latency
- 4.9 to 6.135 GHz – **an additional~230 MHz for ROW!**
- 25 dBi integrated dish – **optional 28 dBi range extender**
- IP67
- GigE and SFP port – **optional GPON module**



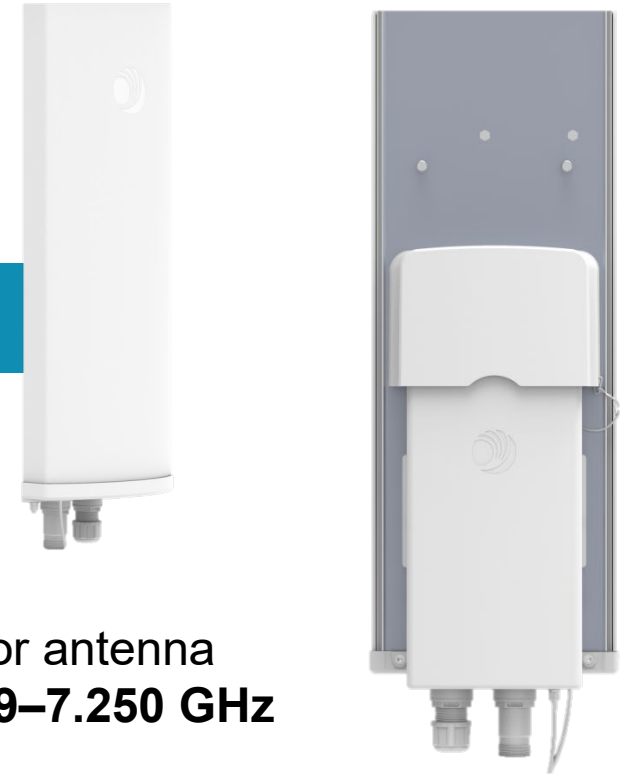
8x8 5 GHz



Features

- Integrated 8x8 Sector Antenna
- Freq Support **4.9–6.135 GHz**
- 48V PoE/ and 4 wire DC in
- SFP+ interface
- IP67
- 636 mm x 485 mm
- 80 MHz Ch, 1024 QAM
- TX Power 25 dBm/Chain

4x4 6 GHz



Features

- 4x4 6 GHz sector antenna
- Freq Support **5.9–7.250 GHz**
- 48V PoE in
- SFP+ interface
- IP67
- Radio – 235 mm x 125 mm, Antenna 594 mm x 157 mm
- 160 MHz Ch, 4096QAM support
- TX Power 24 dBm/chain

6 GHz PTP/SM



Features

- Supports RFE Twistport
- Freq Support **5.9–7.250 GHz**
- 48V Active PoE in
- SFP+ interface
- IP67
- 256 mm x 125 mm
- **160 MHz Ch, 4096 QAM**
- TX Power 24 dBm/Chain
- Internal GPS

6 GHz SM



Features

- 25 dBi Antenna
- Freq Support 5.9–7.250 GHz
- 48V Passive PoE in
- IP55
- 450 mm Diameter
- 160 MHz Ch, 1024 QAM
- TX Power 24 dBm/Chain
- USB GPS Accessory

5 GHz SM



Features

- 25 dBi Antenna
- Freq Support 4.9–5.9 GHz
- 48V Passive PoE in
- IP55
- 450 mm Diameter
- 80 MHz Ch, 1024 QAM
- TX Power 25 dBm/Chain

5 GHz SM (ROW)



Features

- 25 dBi Antenna
- Freq Support 4.9–5.9 GHz
- 30V Passive PoE in
- IP55
- 450 mm Diameter
- 80 MHz Ch, 1024 QAM
- Peak tput of 400 Mbps
- TX Power 25 dBm/Chain

PMP 450 Platform

The Path to Higher Order MU-MIMO and Fixed 5G

2021

1.2 Gbps sector
300 Mbps SM
40 MHz Channels

450 MicroPoP (omni, sector,
connectorized)

450b High Gain, Mid-gain, Retro,
Connectorized

Nomadic mode
Intermediate Modulation Modes
BPDUGuard Filter
MAC Filter

2022

Next Gen 450
6 GHz Spectrum Support

450v 6 GHz AP (4x4)

450v 6 GHz SM (2x2)

5 to 7 GHz support
5 to 200 MHz channel bandwidth
2 Carrier Aggregation
Interoperable with other 450
>1 Gbps Capacity

2023

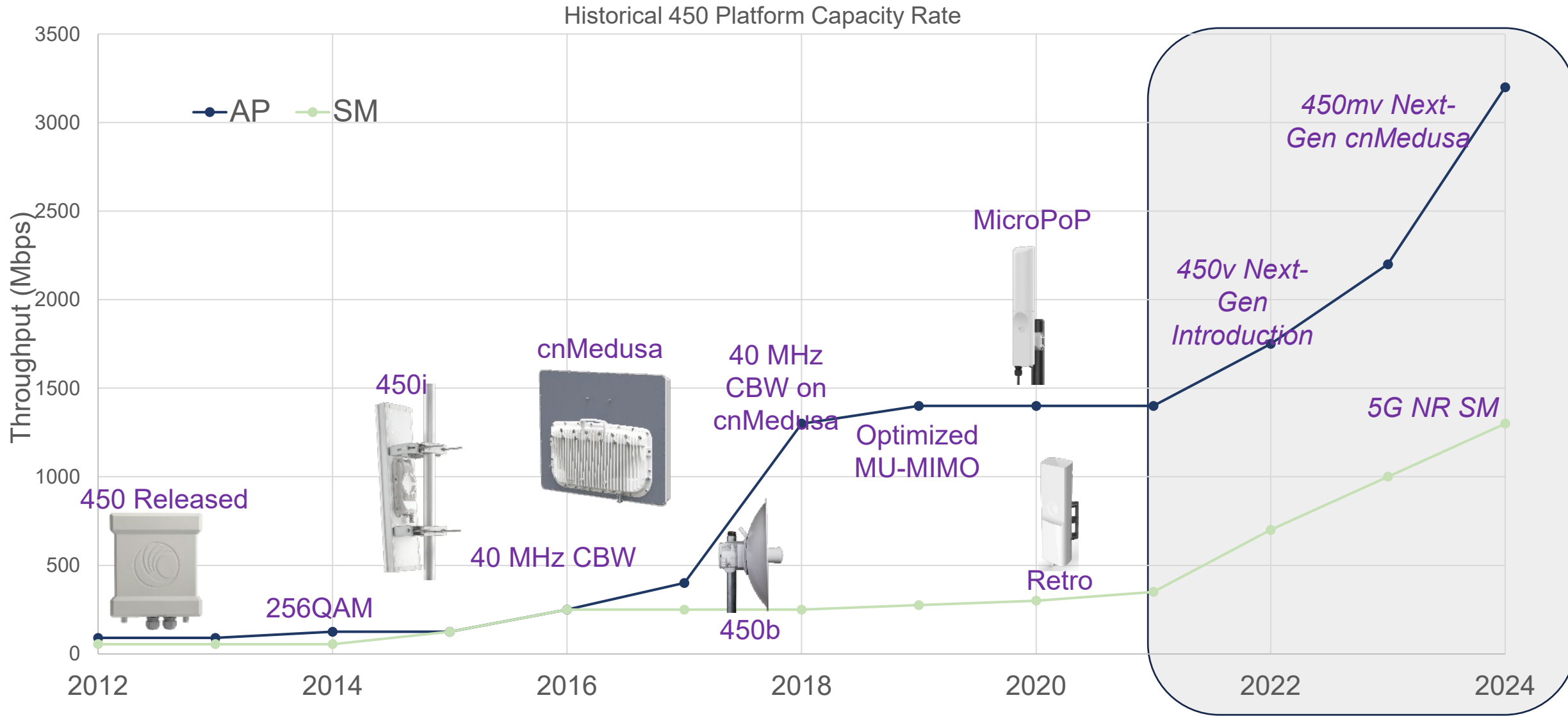
Next-Gen cnMedusa™
6 GHz support, hardware 5G capable
Next Gen SM (5G-NR)

450mv cnMedusa (22x22)

450v2 SM (5G-NR)

5 to 7 GHz support
24x24 MU-MIMO
Supports all 450 hardware
>3 Gbps Capacity
System can migrate to 5G NR
operation
Subscriber Densification
Enhanced Latency

450 Platform Performance Steps





Cambium Networks™

**28 GHz cnWave –
Leveraging Standards in a
WISP-Friendly Platform**

Most Common 5G NR Bands Worldwide

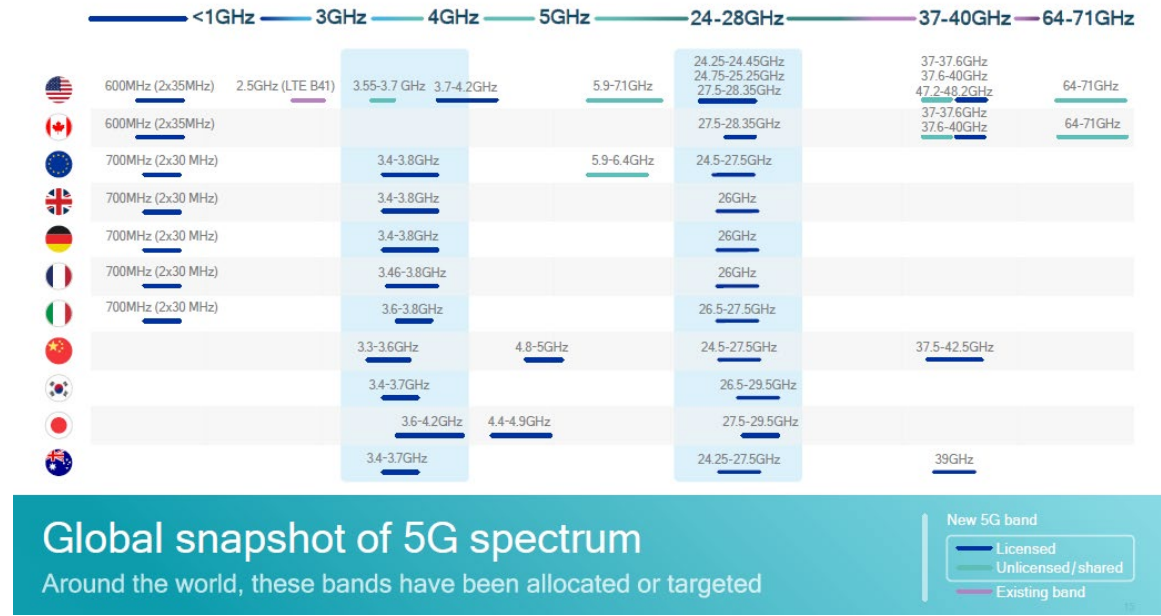
- 24.25–29.50 GHz (TDD)
 - n257 (26.50 - 29.50 GHz), 28 GHz, TDD
 - n258 (24.25 - 27.50 GHz), 26 GHz, TDD
 - n261 (27.50 – 28.35 GHz), 28 GHz US, TDD
- UMFUS Bands in the US (Auctions 101 & 102)

Commercially

- Wide spectrum enables high-capacity network
- Security of **licensed** spectrum
- **5G NR** has driven investment in cost-optimized, integrated RF front-end modules (chipsets)

Technically

- Propagation allows **5+ km range** even in rain condition
- Medium antenna aperture results in high antenna gain → better range/coverage



Future Proof Investment

- Standard 3GPP 5G air interface
- Cambium **SDR architecture** enables future enhancements

5G NR / 3GPP Release 15

- Designed for mmWave frequency (“FR2”)
- More suited to FWA than 4G / LTE

Enables Cost-Effective CPE Based on 5G Chipsets

- Cambium BTS will support Cambium and third-party 5G NR CPEs
- Multiple types of CPEs can co-exist in same sector



Optimized End-to-End for Fixed Wireless Access

- Benefits from **cnMedusa™** world-class MU-MIMO expertise and field-proven performance
- No Mobility – lower cost and complexity solution with laser focus on FWA
- Optimized to exploit good signal quality and provide high throughput

Simple to deploy and operate

- Cambium 5G NR network infrastructure is as simple as 450 Series!
- BTS can be stand-alone, no SIM card required on CPE
- Mobile operator core network not required!



Myths about Purpose-Built Solutions

- Micro
- Typ
- E
- M
-
-

Purpose-Built, yet Standards-Based

- SDR architecture enables future enhancements
- Elimination of complexity to support mobility

h CPE cost which is a

Facts about Mobile 5G Systems

-
-
- H
- Sh
- Fit for
- Require

- TDD system optimized for range and throughput
- Enables support for low cost 5G chipset CPE when available, including standards-based CPE that can co-exist

nnexion and mmW to
e for next 18/24 months



Cambium Networks™

Managing the Wireless Fabric

cnMaestro provides an integrated, intelligent, easy way to manage your network in the cloud or On Premise



Easy onboarding – Claim devices in the cloud or on-site



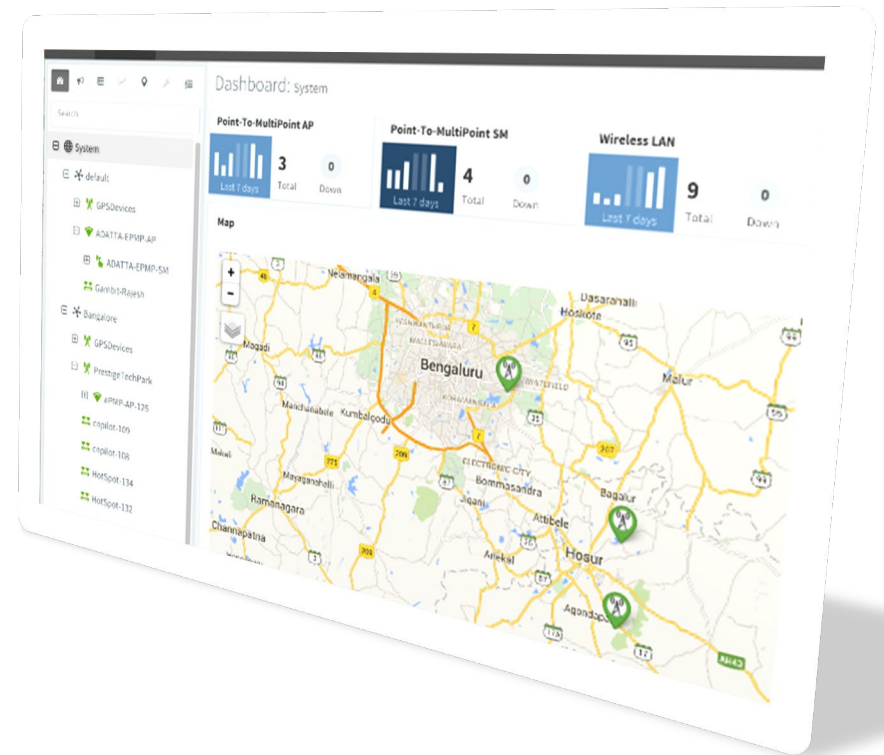
Configure devices – Automatically provision devices upon registration, or group devices and apply configuration parameters across your network



Monitor your entire Cambium network – Leverage hierarchical dashboards, statistics, and maps to view status and drill into problem areas



Intuitive end-to-end troubleshooting – Visualize tower-to-edge device health and evaluate real-time client network connectivity



Day **Zero**: Pre-adopt, pre-configure, pre-assign

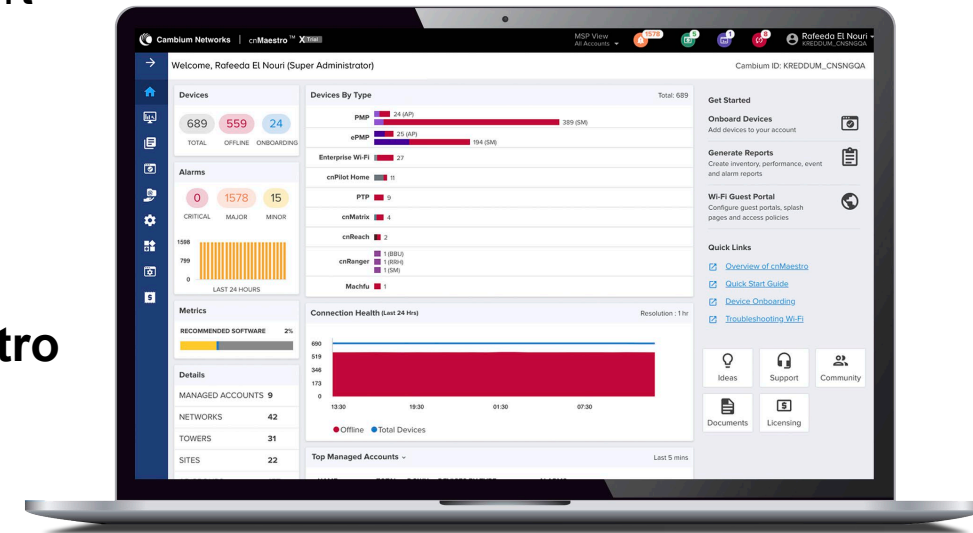
- Pre-adopt devices one at a time, or in bulk using a CSV file import
- Pre-configure the AP Group and the Site
- Pre-assign devices to the proper Group and Site

Day **One**: Deployment Day

- Monitor devices as they come online and on-board with **cnMaestro**
- Verify correct configuration and operation

Day **N**: Any day after that, if ever the need arises...

- Run reports
- Remotely check RF conditions; noise floor, channel utilization
- Remote packet capture, remote network diagnostics



cnMaestro Essentials

Comprehensive Network Management

- Device onboarding and discovery
- Configuration template push
- Firmware upgrade

cnMaestro X

Comprehensive Network Management and Improving Network Capacity While Delivering Operational Benefits

- *Device onboarding and discovery*
- *Configuration template push*
- *Firmware upgrade*
- **Concurrent jobs**
- **API and Webhooks**
- **PMP installation summary (Q4 2021)**
- **Self-Optimizing NW (Q4 2021)**
- **Scheduled Spectrum Scan (Q2 2022)**



visp.net
BILLING and AUTOMATION

- Subscription Service Billing
- Customer Resource Management
- Infrastructure Resource Management
- Extensions & APIs

Available November 15th 2021

How important is your success?

cnMaestro X
Cambium Networks™

- Advanced Device Management
- 24-hour Technical Support - Cambium Care Pro
- Accelerated L2 Engineer Access
- Updates & Upgrades for Advanced Features

Visp.net/cnMaestro

Eliminate
Revenue Leakage
Accounting for Inventory with Subscriptions

Optimize
Service Quality
Packages Automate Quality of Service

Expedite
High Quality Installs
Visp Tickets Sync with cnArcher™ Work Orders

Illuminate
Network Operations
CRM + Analytics = Superior Service

Q3 2021 → Q4 2021 → Q1 2022 → Q2 2022

- **Intelligent exchange of data**
- **Elimination of data entry errors**
- **Efficient operations**
- **Superior outcomes**
- **Service Provider and Enterprise Ecosystem Partners in flight**

cnHeat

Plan with Confidence, Market with Results

cnHeat 2.0

- Direct input of site information and kick off prediction
- 3D heat map and covered buildings count provided
- Rerun as frequently as needed
- Plan sites with confidence

Best-in-Class mmWave Planning

- ANP <-> LINKPlanner <-> cnHeat 2.0

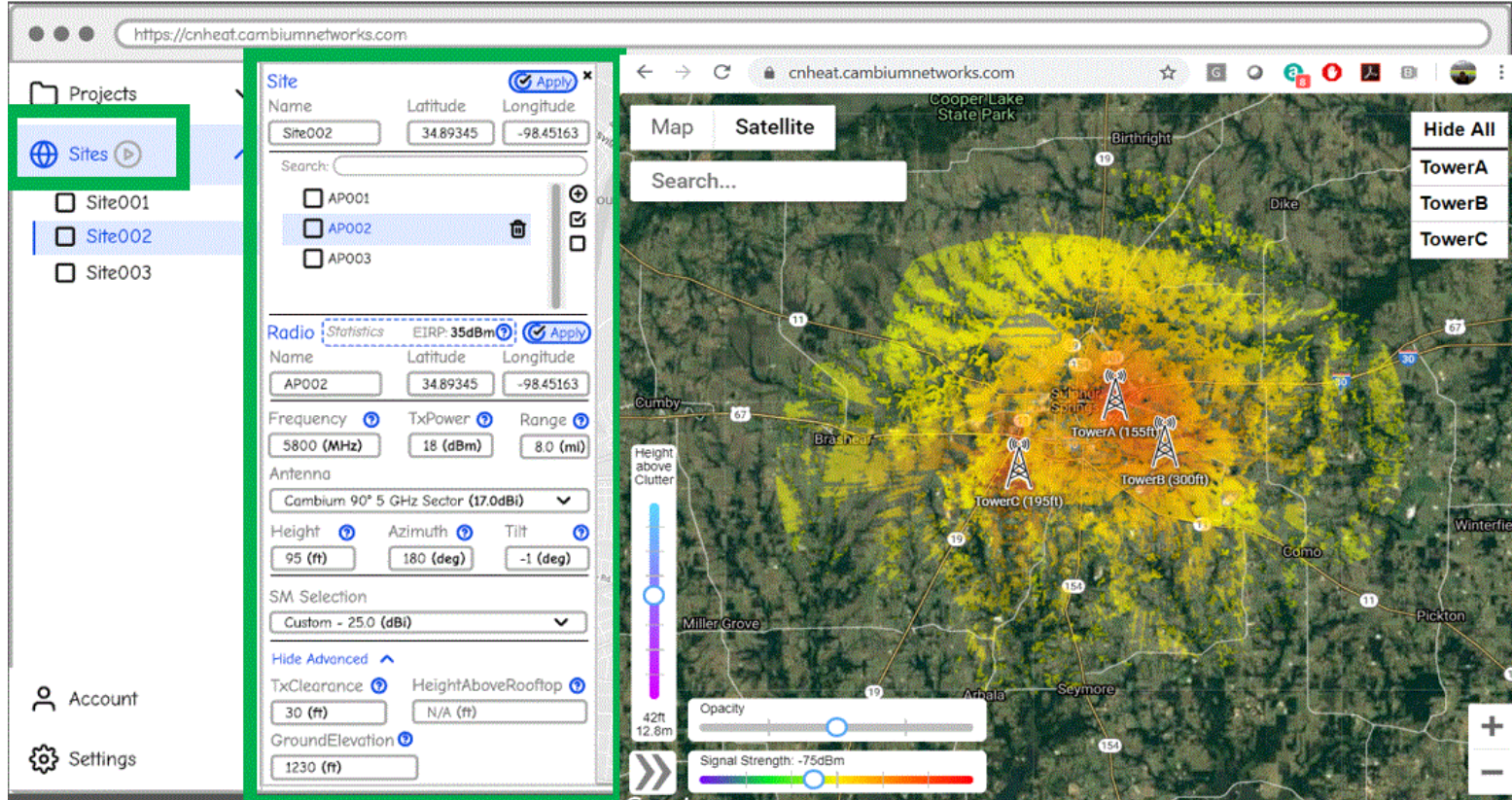
Free IDENTIFY building locations marketed via Market Broadband.com

Subscriber Module Location Heat Maps (Q1 2022)

- Coverage for specific Subscriber Module locations

Website Marketing (Q1 2022)

- cnHeat heat map embedded in WISP web page
- End User Submission entered after verifying coverage



- **Which marketing services would you most likely utilize if it were available from Cambium?**
 - Advise clients on the best package for them based on their actual usage
 - Simplify marketing by integrating your subscriber data into digital marketing tools
 - Easily customize Cambium Networks collateral for your brand
 - Tips and tricks for managing marketing agencies

- ✓ Supports PMP 450, ePMP, and cnRanger
- ✓ Upgrade, Configure, Align and Link Test the Subscriber Module
- ✓ Automatically Populate GPS Coordinates on the Subscriber Module
- ✓ Onboard Subscriber Module to cnMaestro

Enhancements on the Horizon

- 60 GHz cnWave support – November 2021
- Upload installation summary to cnMaestro X – November 2021
- Unified app for Android and iOS with feature parity – Q1 2022
- Download workorder from cnMaestro X – 2H 2022



- Investing in spectrum and regulatory advocacy
- Supporting access to government funding programs and initiatives
- Complete solution enablement from concept to service delivery to customer delight
- Expanding WISP business opportunities beyond concentration in rural broadband residential access
- Taking advantage of standards to enhance, and proprietary innovation to accelerate and differentiate, superior wireless networking solutions for our customers



Cambium Networks™
A DECADE OF EXCELLENCE

10

YEARS

Cambium Networks™

A DECADE OF EXCELLENCE





Cambium Networks™



Goals

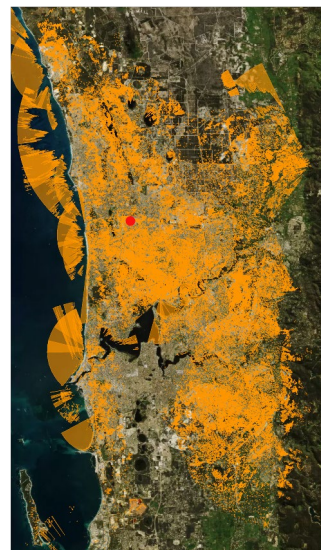
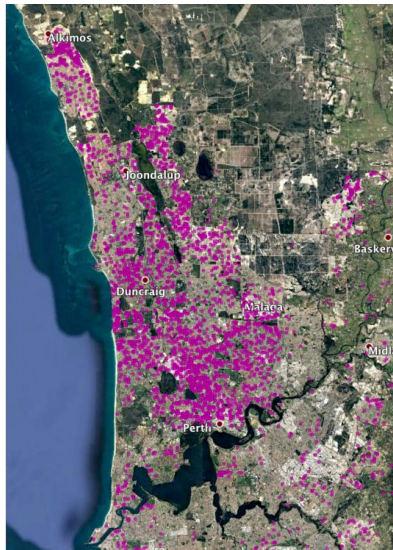
- Deliver Gigabit speed by overlaying an existing UBNT 5 GHz network
- Complete coverage of the greater Perth metropolitan area
- Leverage 300 km+ of **dark fiber** around Perth

Solution

- cnWave 60 GHz distributed network architecture
- PTP 8x0 licensed for backhaul
- Exercising dark fiber throughout the network deployment

Status

- 40 operational towers and growing
- LoS to 32% of addresses in the Perth metro area
- Deploying one > DN per day and > 130 CNs per month



6 GHz ePMP 4000 Preliminary Specifications

6GHz ePMP 4000 headline data rates for UDP

MCS11, 1024 QAM	HE160	HE80	HE40	HE20
AP capacity (4X4)	4083	2042	975	487
SM capacity (2X2)	2042	1021	487	244
MCS13, 4096 QAM	HE160	HE80	HE40	HE20
AP capacity (4X4)	5431	2715	1296	647
SM capacity (2X2)	2715	1357	648	323

Hardware Specs

- Proven ePMP air interface
- Qualcomm 802.11ax family of chipsets
- 4x4 MU-MIMO AP w/ 90° beamforming sector
- **6 GHz band: 5.925 – 7.125 GHz**
- 20 / 40 / 80 / 160 MHz channel bandwidth
- 1024 QAM / 4096 QAM
- Ethernet ports:
 - 1G RJ-45
 - 10G SFP+ for AP and F600C
- PoE IEEE 802.3at – 56V
- GPS on AP: built in and external
- Optional external GPS Rx on SM to comply with AFC

Performance Specs

- Concurrent 4x4 MU-MIMO & DL/UL OFDMA
 - Double spectrum efficiency with MU-MIMO
 - OFDMA efficiently uses bandwidth for short transmissions
- Higher efficiency of AX with less overhead
- Three QoS Levels: VoIP, High & Low
- Priority-based air-fairness scheduling with starvation avoidance
- TDD scheduling with GPS Sync
 - 5 & 2.5 ms frame duration
 - Flexible duty cycle (DL/UL) from 75/25 – 30/70
- TDD Scheduling w/o GPS sync
 - Flexible frame duration
- AFC support based on GPS/GNSS geolocation.
- ACS (Automatic Channel Selection)

Tower Switches: TX2000 Series



- 8-port, 16-port, 24-port Models
- PoE & Passive PoE, High Power PoE (90w) Options
- Dual Redundant Field Replaceable Power supplies
- Cambium (GPS) Sync – dual sources
- Hardened with extended temperature range: -10°C to 65°C

Switch Capabilities

- Enterprise-grade, non-blocking architecture, comprehensive Layer 2-3 features
- Dual Redundant AC/DC Power Options (400-1000W)
- Comprehensive & Intelligent PoE Modes
 - 802.3af/at/bt – up to 90W
 - Passive 54V - up to 90W
 - Passive 24V - up to 15W
- Full Control and Statistics

Purpose
Built

Policy Based Automation

- **Enhanced Security:** Automatic device profiling, network segmentation, policy enforcement. Automatic port configuration clean-up on device disconnect
- **Extreme Simplicity:** Zero-Touch Provisioning, Zero Touch Adds, Moves, Changes eliminates the need to color code ports
- **Error-free operations:** Reduce time, effort and human errors by eliminating the need for manual configuration

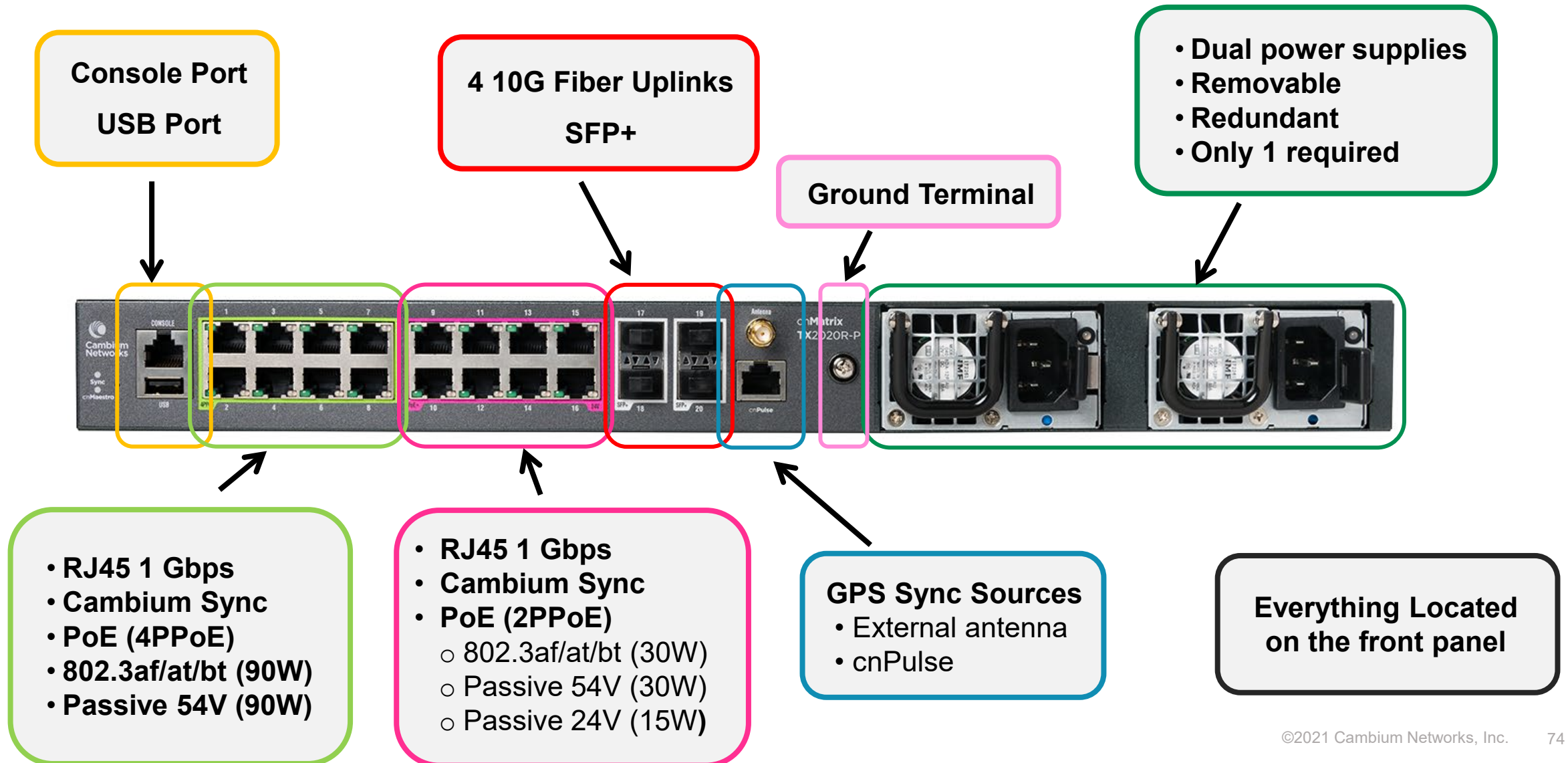
Simplified
Operations

Best in Class TCO

- **Free Cloud**, Swift Mobile App Management, Competitive Hardware Pricing
- Intuitive Cloud Dashboard & Automation reduces OPEX

Reduced
Cost

cnMatrix – TX2020R-P – Front Panel Interfaces



cnMatrix TX Series – Purpose-Built Tower Switches

TX2012R-P



Shipping Now

Coming Dec 2021

TX2028RF-P



TX2020R-P



Models	Ports			Dual Power Supplies
	1 Gbps RJ45	1 Gbps Fiber SFP	10 Gbps Fiber SFP+	
TX2012R-P	8	0	4	No
TX2020R-P	16	0	4	No
TX2028RF-P	16	8	4	Yes

Highly Scalable Architecture

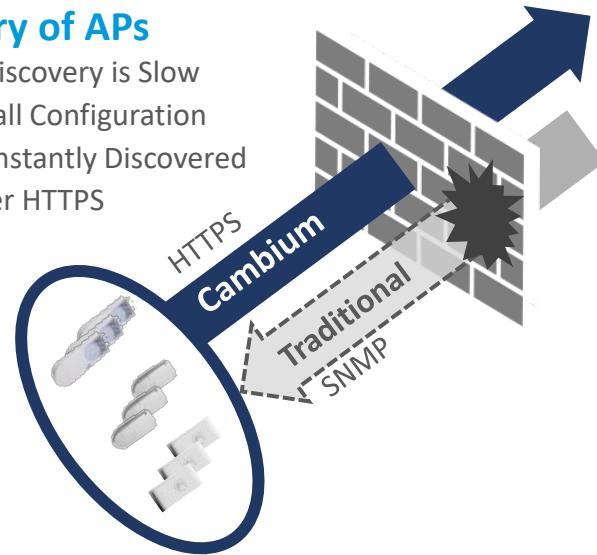
New UI Architecture

- Support of Various Devices



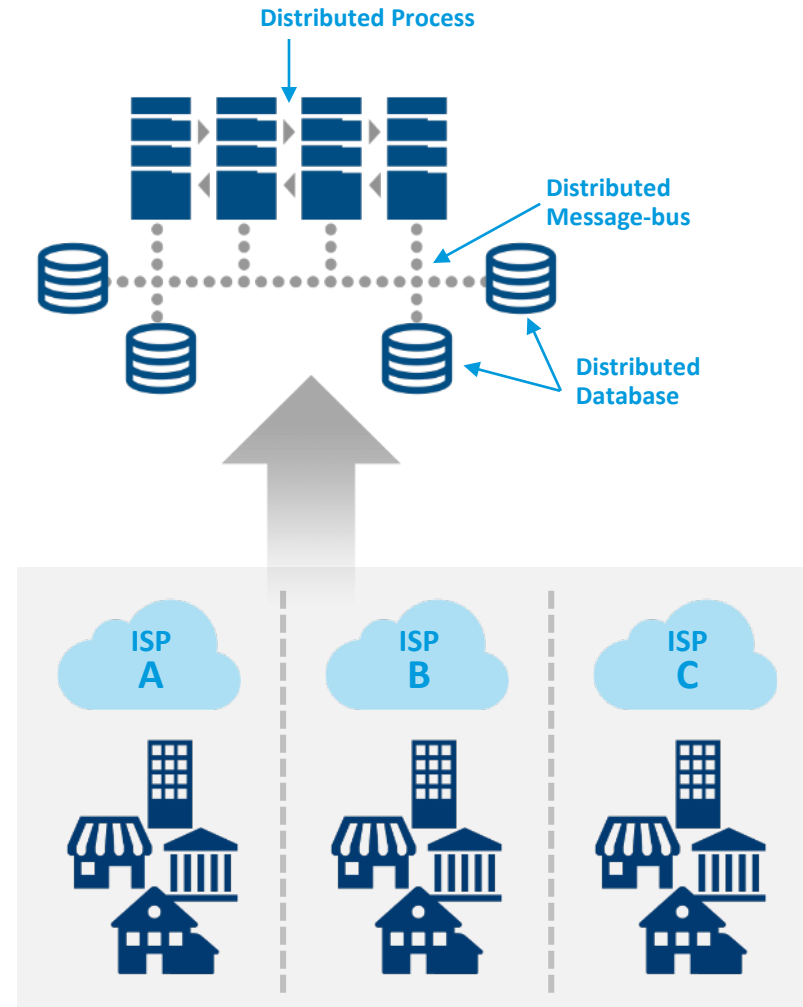
Instant Discovery of APs

- Traditional SNMP Discovery is Slow and Requires Firewall Configuration
- Cambium Devices Instantly Discovered Communicating over HTTPS



Multi-Tenancy

- Cambium Cloud Serves Multiple ISPs Securely
- ISPs can Serve Multiple Networks and Customers with Privacy and Security



cnMaestro: Freemium Cloud or On-Premises Platform



	cnMaestro Essentials (Included with Hardware)	cnMaestro X (Subscription)
Dashboard view for alarms, key performance metrics	✓	✓
End-to-End status visualization for Wireless Broadband, Wi-Fi and Switching	✓	✓
Detailed network statistics	✓	✓
Scan, Packet Capture	✓	✓
Self-organized portal management	✓	✓
Configuration and site reports	✓	✓
	✓	✓
		✓
		✓
		✓
		✓
		✓
		✓
		✓
		✓
		✓
		✓
Payment Gateway		✓
Unique PSKs supported: 1,024		✓
Number of Guest Portals: 500		✓
Max number of login events: 2,000 event records for 1 year		✓
Maximum session limit: 10,000		✓
Number of Management Users: 100		✓
Cambium Care Pro – 24/7 technical support, accelerated access to L2 engineers and software updates/upgrades		✓

Regular functional and performance enhancements to both Essentials and X