



UNLIMITING MOBILE BROADBAND

*iBridge Product Family*

*mimosa*

November 2018



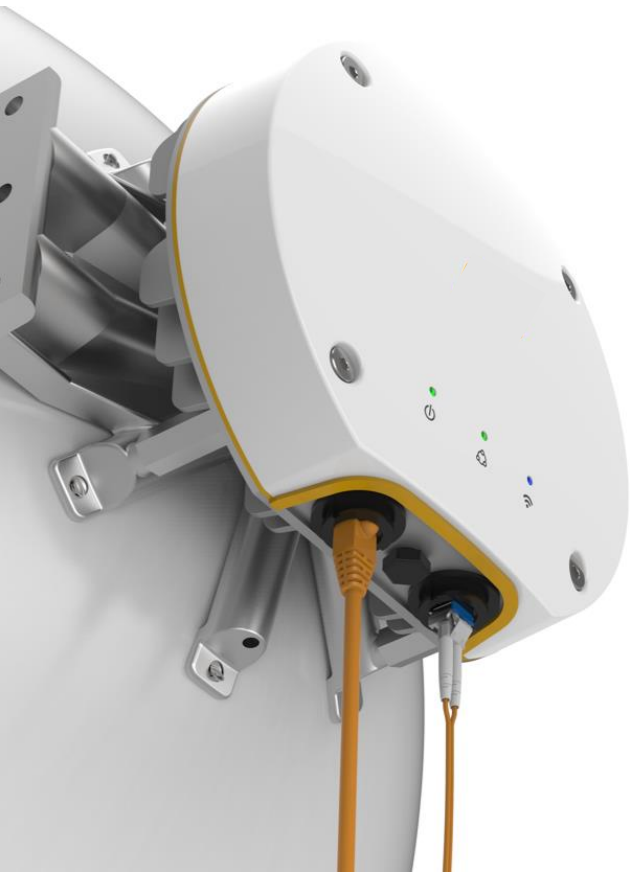
## About

- Member of FCC Broadband Deployment Advisory Committee
- “Reformed” ADSL, VDSL2 & FTTH guy
- Created broadband Wi-Fi RG @ 2Wire
- Drove BBF TR-069 & TR-124
- Inducted into Wi-Fi Now Hall of Fame





# Deployment Experience



- Commercially available for 5 years
- 5000+ ISP & enterprise customers
- Deployed in 160+ countries
- Carrier proven
  - Cellular & Fiber Telco clients
- Global operations
  - Silicon Valley, Santa Clara
    - R&D: Hardware, platform & cloud SW
    - Sales, service and marketing
  - Istanbul Turkey
    - R&D: TDMA software



# Retargeting High-Volume Silicon for Fixed Wireless

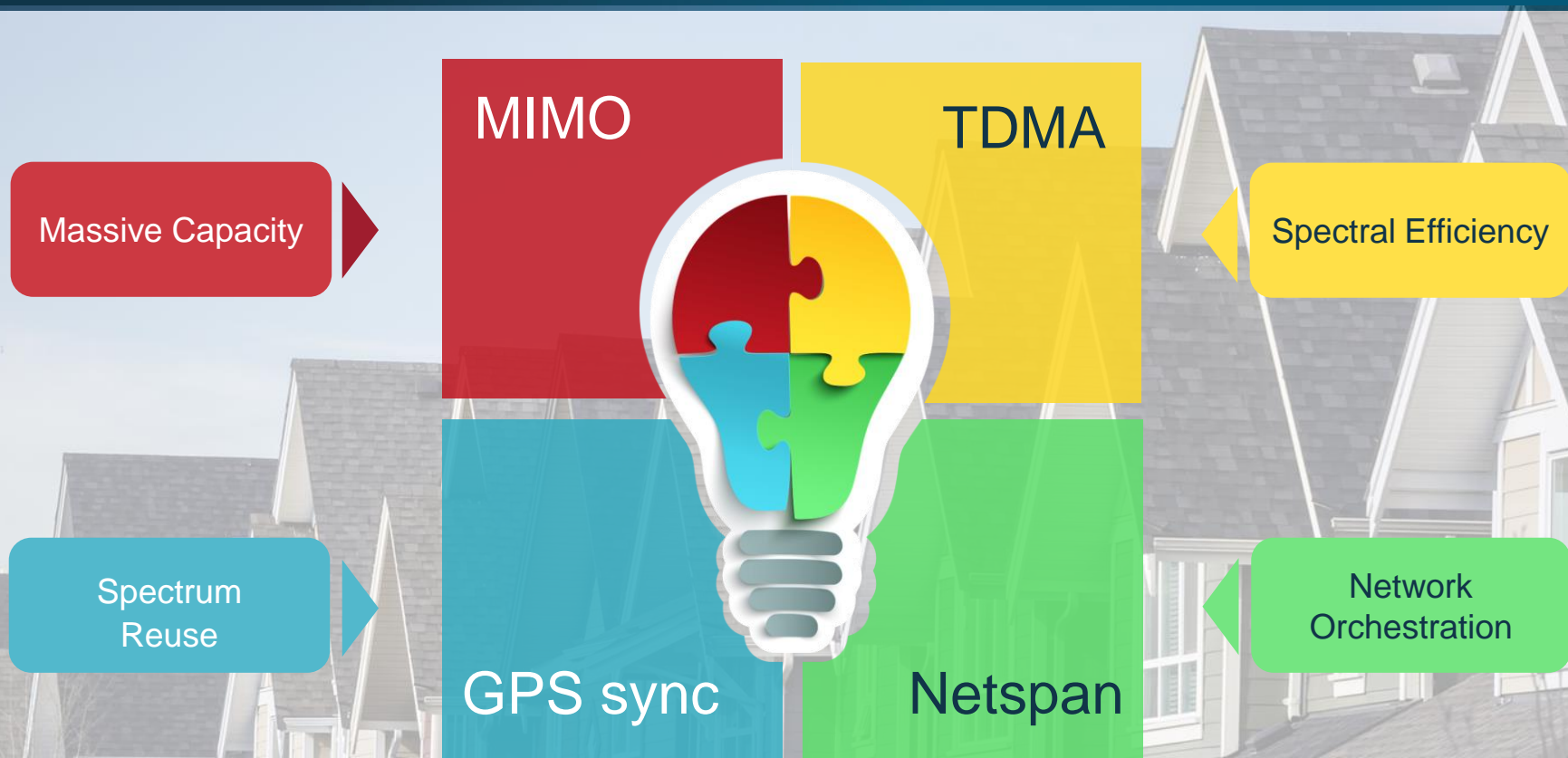


- Currently leveraging 4x4 MIMO chip
- 8x8 MIMO 10 Gbps chip completed
- Stable public company - winning Tier 1 ISPs

- 6+ years joint development for fixed & outdoor Wi-Fi applications
- Source code control - critical for engineering outdoor Wi-Fi and Fixed Access
- Currently developing 8x8 OFDMA beamforming 802.11ax Fixed Wireless



# Modern Fixed Wireless Architecture





# Solutions

A = Access | A5, A5c

B = Backhaul | B5, B5c, C5c, C5x, B11, B24

C = Client | C5c, C5x (N5-X10,X15,X20,X25)

G = Gateway | G2

N = Antenna | N5-360, N5-45x2, N5-45x4





# PTP Overview



# Key Differentiators



## High Reliability

- Unique, dual-channel aggregation
- Noise fighting auto features
- Up to 2x80 MHz, 1.5 Gbps
- IP67 carrier grade
- 4.9-6.4 GHz; 10-11.7 GHz; 24 GHz



## High Value

- Highly flexible radio design with four convenient antenna options
- 700+ Mbps
- Connectorized option for longest distances
- High-performance FTB, and sidelobe antennas reduce noise





# High-Reliability Backhaul – 1.5 Gbps

1+

Gbps



IP67



SRS



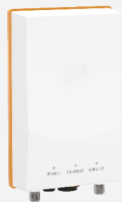
Dual Link

1 ms

Latency

## B5c

Dual Link Connectorized



### Long-Range

- 100+ km link distance

### Customizable

- Flexible antenna options

### Interference avoidance

- GPS sync & auto-channel, bandwidth & power

4950–6200 MHz

## B11

Licensed Long Range



### Licensed Long Haul

- 100+ km link distance

### Flexible Bandwidth

- Dynamic up/down traffic

### Extended Frequency Spectrum

- Unique 10.0-11.7 GHz support

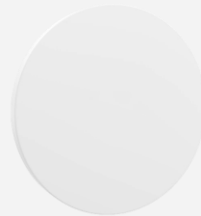
### Low Latency

- 1 ms round trip

10.00–11.70 GHz

## B24

Low Noise, Short Range



### Short Distance Links

- 3 km link distance

### Disruptive Price

- Industry leading price performance

### Light, Compact & Efficient

- 6 lbs, 19.5 W power consumption

24.00–24.05 GHz



# High-Value PTP Solutions – 700 Mbps

**700+**  
Mbps



**1 ms**  
Latency

**4.90-  
6.40**  
GHz

**AUTO**  
Everything

## C5c

Cost-Effective Connectorized



### Long-Range

- 100+ km link distance
- 27 dBm high-conducted power
- Industry-leading connectorized price performance

### Flexible Antenna Options

- Dual RP-SMA connectors

4.90-6.40 GHz with GPS

## C5x

Versatile Modular Radio

### Short to Mid-Range

- Up to 10 km

### Ultra Flexible

- 4 modular twist-on antennas
  - Gain options:  
8, 12, 16, 20, 25 dBi
  - PTP feature key required
- ### Interference Avoidance
- Best in class antenna + radio noise immunity FTB & side rejection



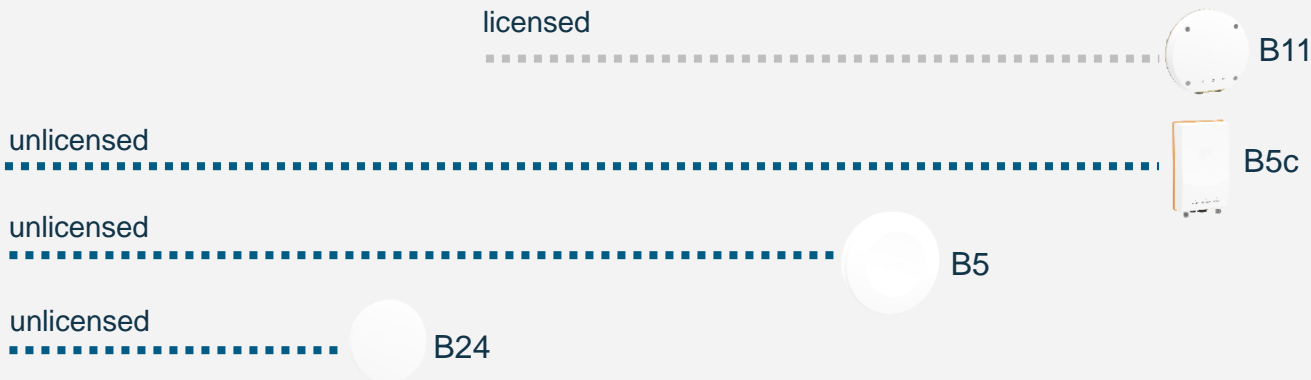
4.90-6.40 GHz



# PTP Portfolio

## HIGH RELIABILITY

- 1.7 Gbps (PHY)
- 1.5 Gbps (IP)
- GPS Sync
- IP67



## COST EFFECTIVE

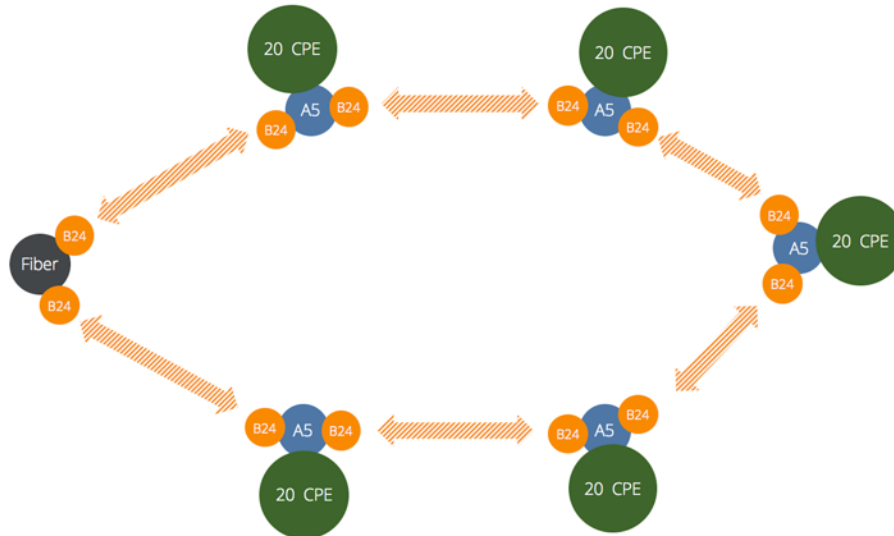
- 866 Mbps (PHY)
- 700 Mbps (IP)
- Low-Power Draw
- IP65





# Rapid & Reliable Fiber Extension for MicroPoP

- Affordable and reliable short range backhaul is critical to connect access points on streets with no fiber
- Competitive microwave alternatives account for 75% of broadband CAPEX and stifles ROI





# Urban MDU Broadband & Backhaul

Stephouse Networks  
Portland, OR





# High Reliability Features





# Ultra Rugged

## Built to Withstand the Harshest Conditions

- B5 and B5c: IP67 Rated + Gas Discharge Tube ESD protection
- C5x and C5c: IP65 Option
- Extended Temperature: -40° C to +55° C
- Extended Windload Handling





# Super Sync

## 4x Channel Reuse on 5 GHz Backhaul

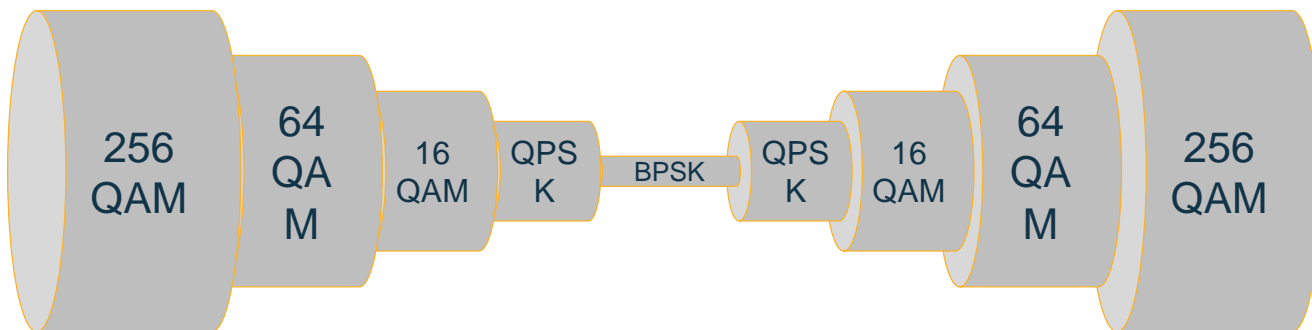
- 1 PPS GPS Sync  
for B5, B5c
- Collocate 4 links per channel  
in different directions





# Reliability Through Rate Adaptation

- Converted to appropriate modulation rate
- 256 QAM down to BPSK
- Modulation supporting all four streams
- Seamless channel width changes





## RF Conditions Change...

## Make Sure Your Radio is Ready to Seamlessly Change with Them

Spectrum

Ch A → Ch B

Channel Width

2 X 80 MHz → 20 MHz

Power

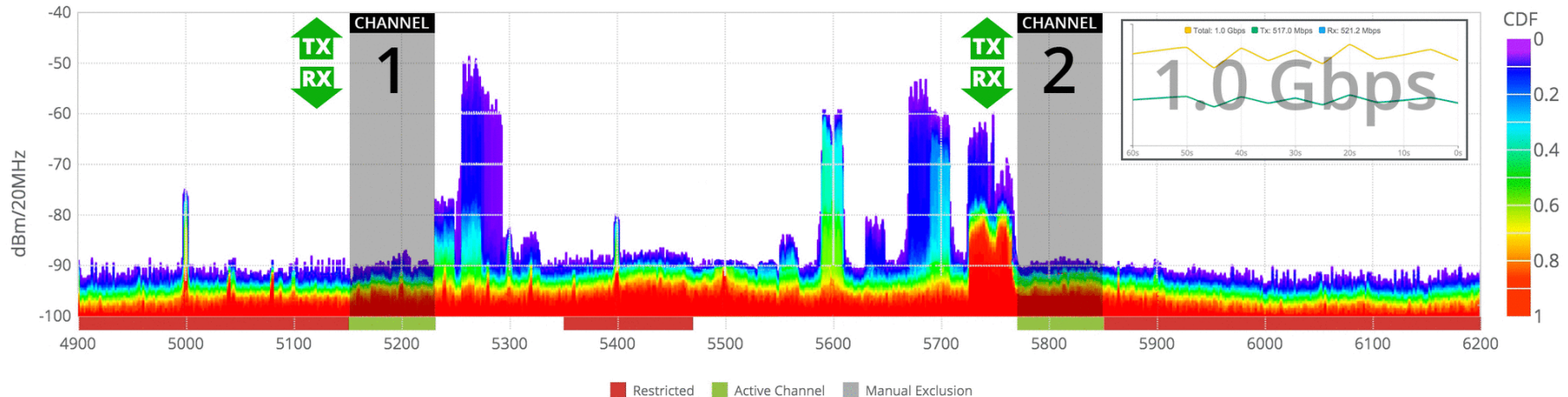
Normal → Increase

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# Double Resiliency with Dual Link

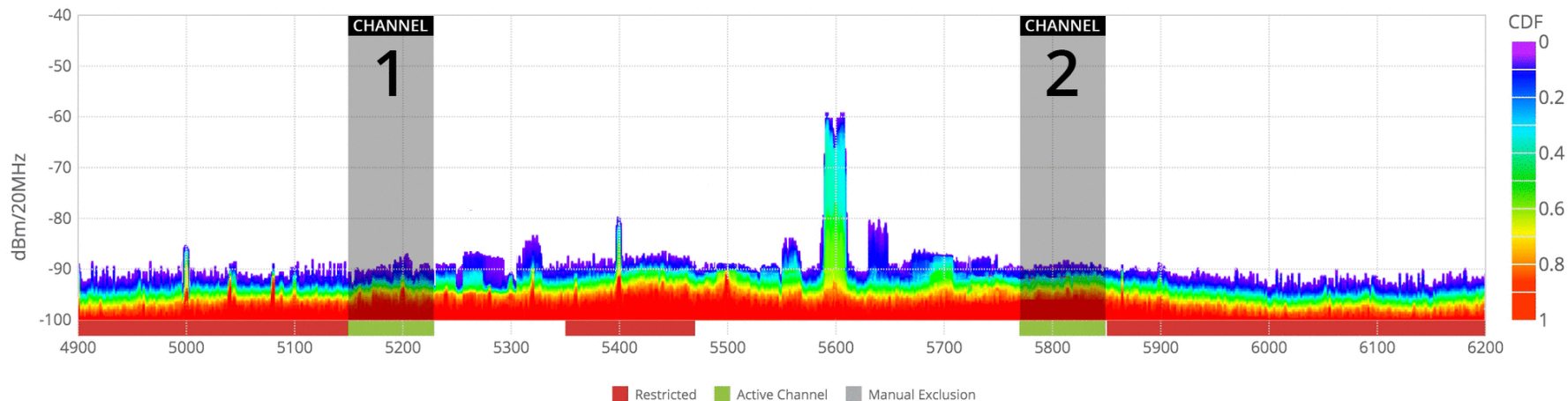
Independent 2x2 channels improve noise immunity, and maintains the link in the toughest of 5 GHz environments.





# Double Resiliency with Dual Link

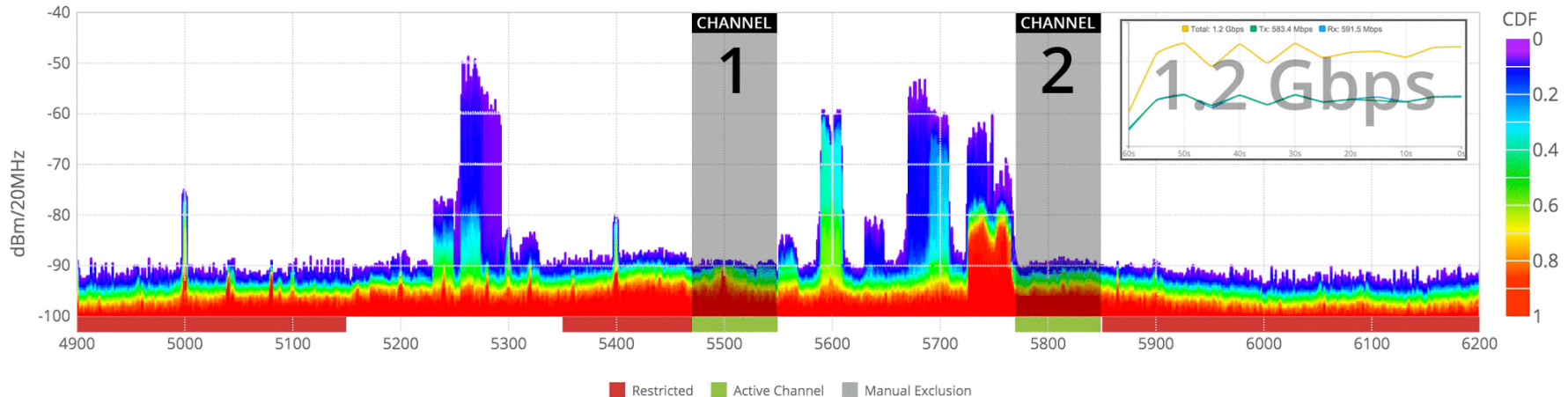
Independent 2x2 channels improve noise immunity, and maintains the link in the toughest of 5 GHz environments.





# Radar Detection Resiliency with DFS+

Constant Spectrum Analysis pre-scans best backup channels, and Dual Link seamlessly maintains link during radar events.





# PTMP Overview



PTMP

## Beamforming Sectors



Highest industry tower scalability maximizes user subscriber capacity and speed

## Urban MicroPoP



Only high-density residential wireless solution to deliver fiber-fast at a fraction of the cost



# PTMP Differentiators

- **Price/Performance Leader**
  - Low-cost CPE – short & long range single CPE flexibility
  - Fastest speeds up to 500 Mbps with 80 MHz support
  - Integrated GPS – no external dongles
- **4x4 Beamforming AP**
  - 3 dB performance gain
  - Per client beamform & auto-TX power adjust
- **Highest-Performance Antennas**
  - Best gain, FTB and sidelobe for fighting noise
- **Unique, Urban/Suburban “MicroPoP”**
  - Only beamforming small-cell like 360° antenna
  - Only distributed field proven solution with Cellular/Fiber Telcos – “5G Fixed”







## High Density MicroPoP - Fiber or PTP Backhaul Fed



Minneapolis, Minnesota



# Rooftop MicroPoP



Prairie Hills Wireless, Nebraska





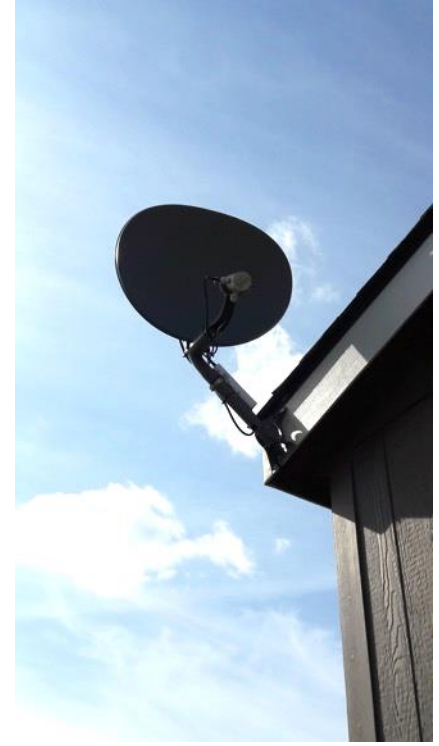
# Rural Telco Tower Application



- 5+ miles
- Sub 6 GHz
- Total CapEx AP + Client < \$300 / user
- Goal of 25/3
- Actual speeds 200–300 Mbps



# Rural Telco Tower Application





# PTMP Access Points

## Scalable, Unlicensed Multipoint Solutions

- Highest capacity/site
- High client capacity
- Network scalability
- Fiber-fast speeds
- Cost-effective

\* For best performance

### A5

Quad Sector Access Point

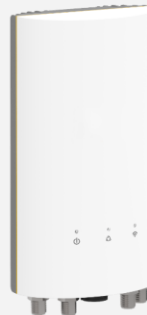


#### Short-Range GPS-Sync

- Suburban applications at 300m\*
- Collocation and network-wide sync enabling channel reuse

### A5c

Connectorized 4x4



#### Long-Range GPS-Sync

- Rural, tower long distance
- Collocation and network-wide sync enabling channel reuse

4.90-6.40 GHz with Spectrum Reuse Synchronization (SRS)

### C5c

Cost-Effective 2x2



#### Value Solution

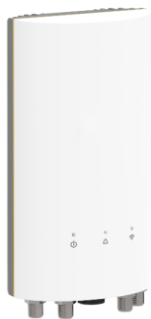
- Sector deployments
- TDD based (no GPS)
- For limited scale

4.90-6.40 GHz



# Extend Frequency Range

- Single product line supporting complete 4.9–6.4 GHz range
- 6 GHz will be allowed for WiFi & Fixed Wireless soon in US/FCC
  - Already used extensively in LATAM
- Unique antenna designs optimized across all bands
  - Competitor only optimize typically for 5.85 GHz



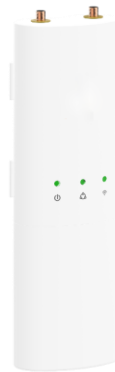
A5c



A5



C5x

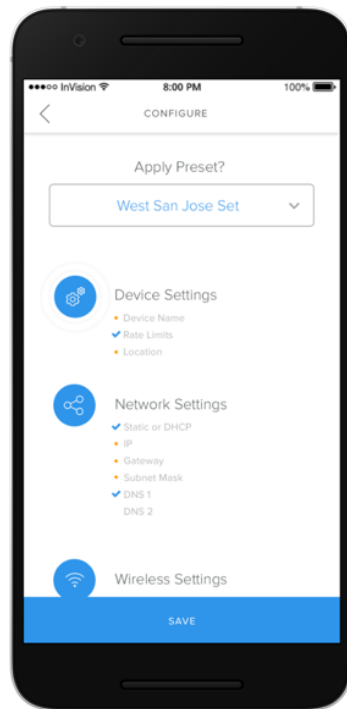


C5c



# Installation & Provisioning

- Easy aiming mobile app
- Subscriber management automation
  - 802.1x auto certificate authorization
  - Radius subscriber service profiles
- Router subscriber IP address auto provisioning
  - DHCP Option 82
- SNMP & REST API
  - Extensive integration for Netspan monitoring and provisioning





# MicroPoP Overview





# MicroPoP Without SRS

- Partial Town Coverage
- 250 Subscribers
- 25+ Mbps Service
- 15 Channels
- 600 MHz of Spectrum

Without  
SRS





# MicroPoP With SRS

- Full Town Coverage
- 1000+ Subscribers
- 200+ Mbps Service
- 2 Channels Across Area
- 160 MHz of Spectrum

With  
SRS

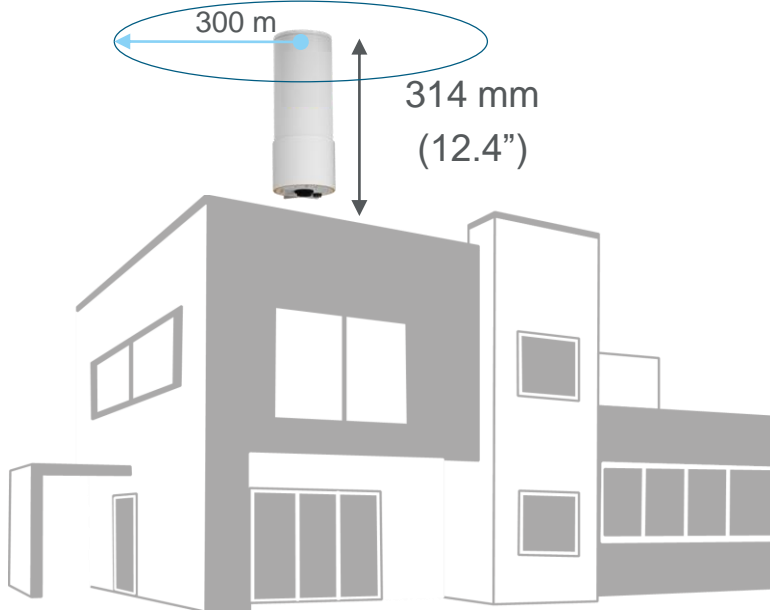




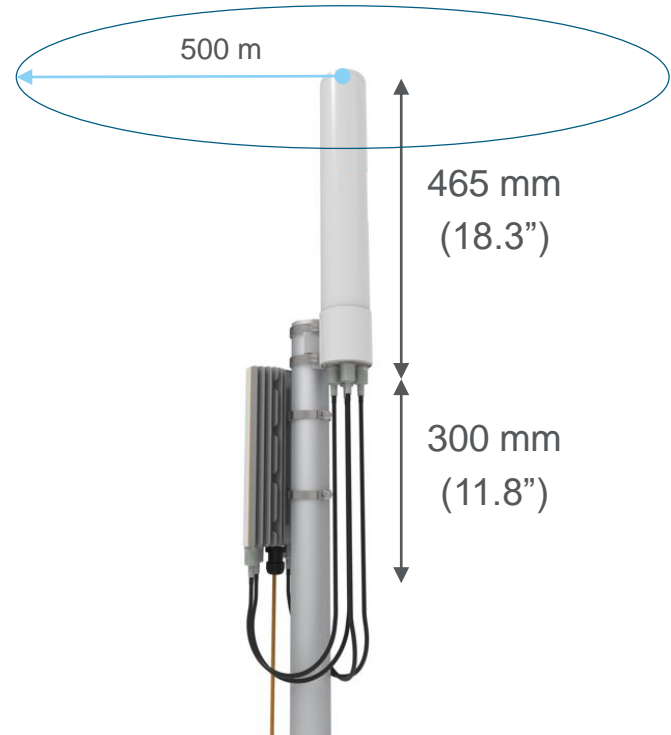
# Comparing the A5 vs A5c + N5-360

## A5

- Larger MicroPoP (40% more coverage)
- Coverage radius of 500m ~ 1 km
- Maximum performance where space allows

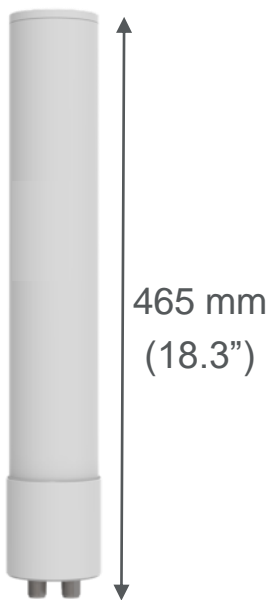


## A5c+N5-360





# N5-360° 15 dBi MicroPoP Antenna



- 4 stream beamforming 360° antenna
- Ensures 2 equal MCS streams/client
- Beamforming via even patterns across antenna polarizations
- Longer range 500m – 1km coverage
- Similar cost structure to A5 but with A5c
- Designed for the A5c access point

4.9-6.4 GHz with GPS Sync







# A Look Inside

**4** N-type antenna connectors

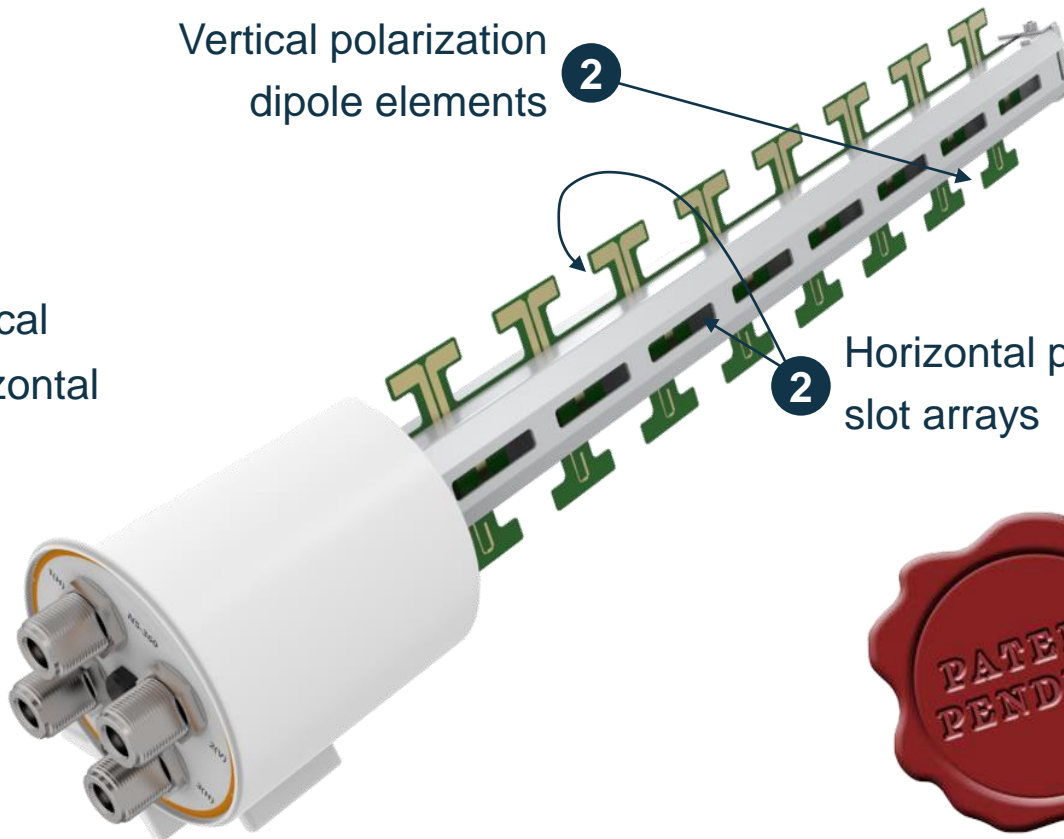


**2** Vertical  
**2** Horizontal

Integrated pole mount  
(Max 2.25 in diameter)

Vertical polarization  
dipole elements

**2**

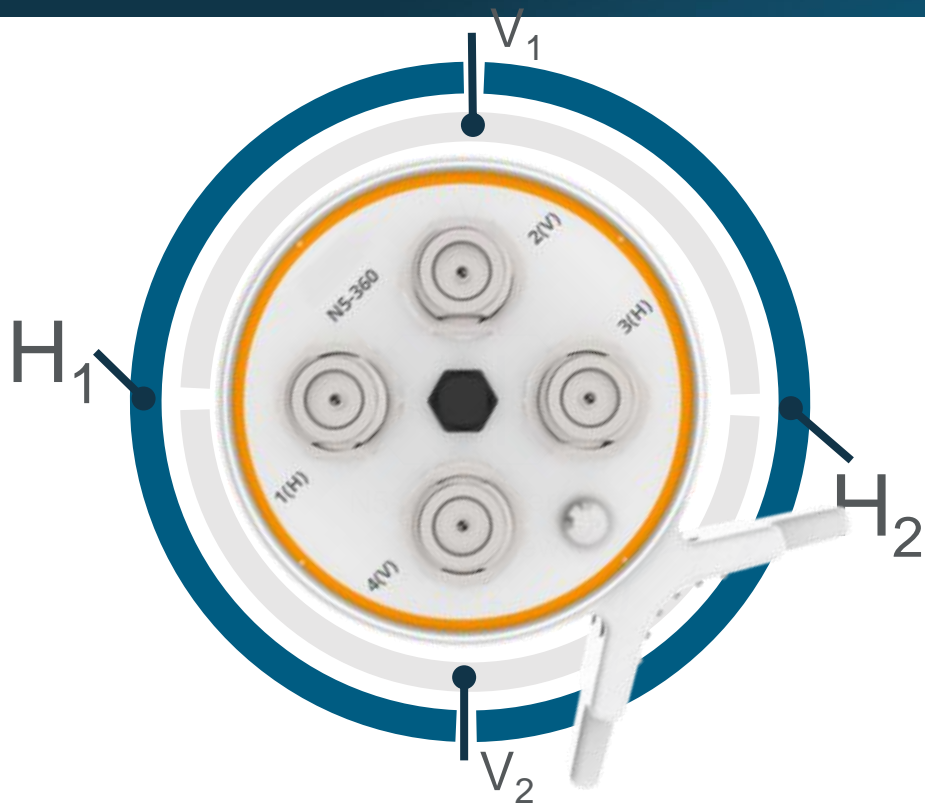


**2** Horizontal polarization  
slot arrays

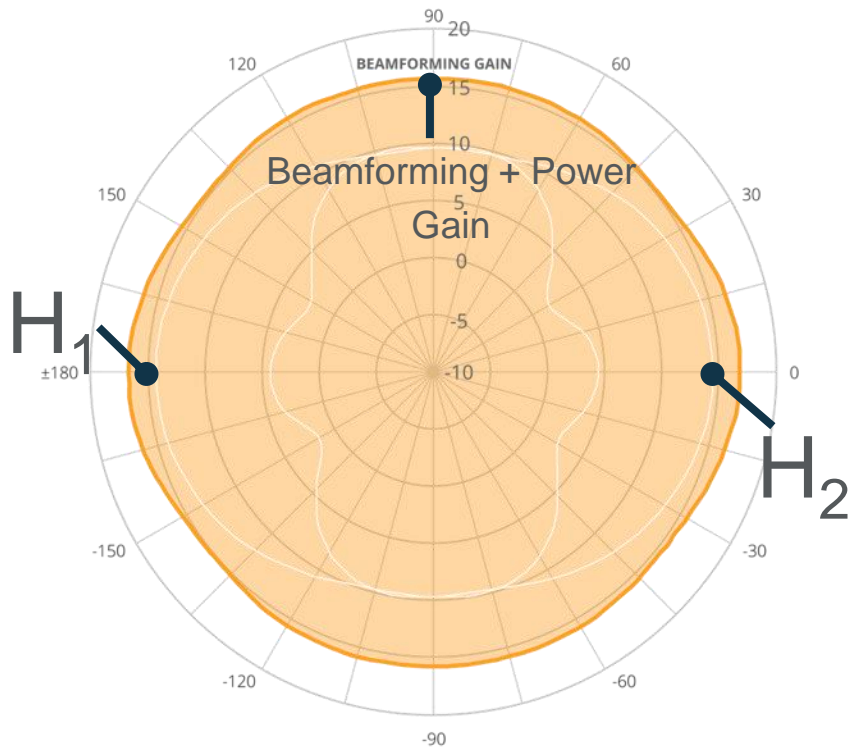




# Advanced 180° Overlapping Patterns



Overlapping V & H patterns  
ensure balanced dual stream



Uniform pattern for both H & V polarizations  
15 dB beamforming Gain



# Rural Towers & Sectors



## N5-45 Key Differentiators

- Only Extended Frequency Sectors
- Industry Leading 43 dB FTB Ratio
- Incredible Sidelobe Suppression







## N5-45 Collocation Benefits



- Sidelobe suppression like a horn
- Gain and ground coverage of a sector
- Enables 2x (back-to-back) spectrum reuse
  - 4 channels with best noise isolation



# N5-45x2



Slant 45°



IP55



2 Type-N

Gain	19 dBi
Azimuth	42° (HPBW)
Elevation	9° (HPBW)
F/B	43 dB
Downtilt	2°
Polarization	Dual Slant 45°
For use with Mimosa or any 2x2 radio	

Frequency 4.9 – 6.4 GHz





# N5-45x4

**X**

Slant 45°

Gain 22 dBi (with 3 dB BF gain)

Azimuth 42° (HPBW)

Elevation 9° (HPBW)

F/B 43 dB

Downtilt 2°

Polarization Dual Slant 45°

Designed for beamforming with Mimosa 4x4 A5c  
or two 2x2 radios on separate channels



IP55



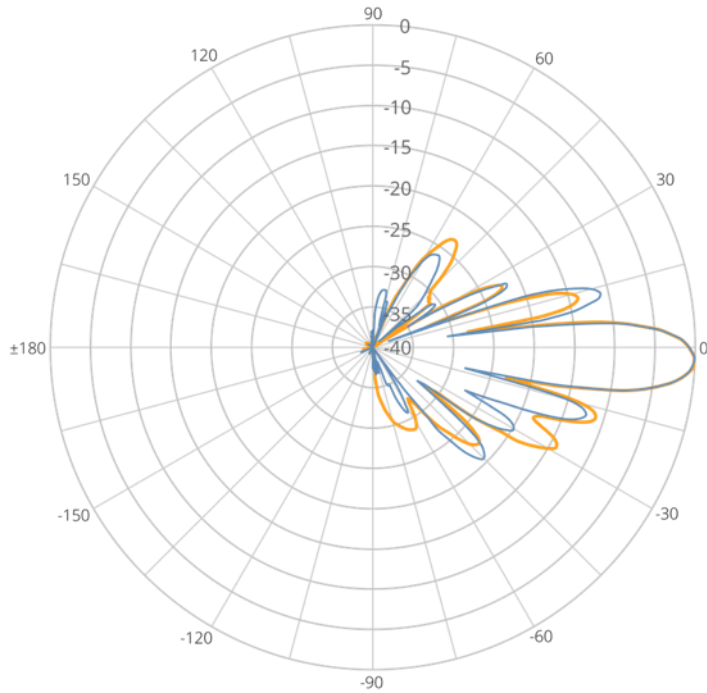
4 Type-N

Frequency 4.9 – 6.4 GHz

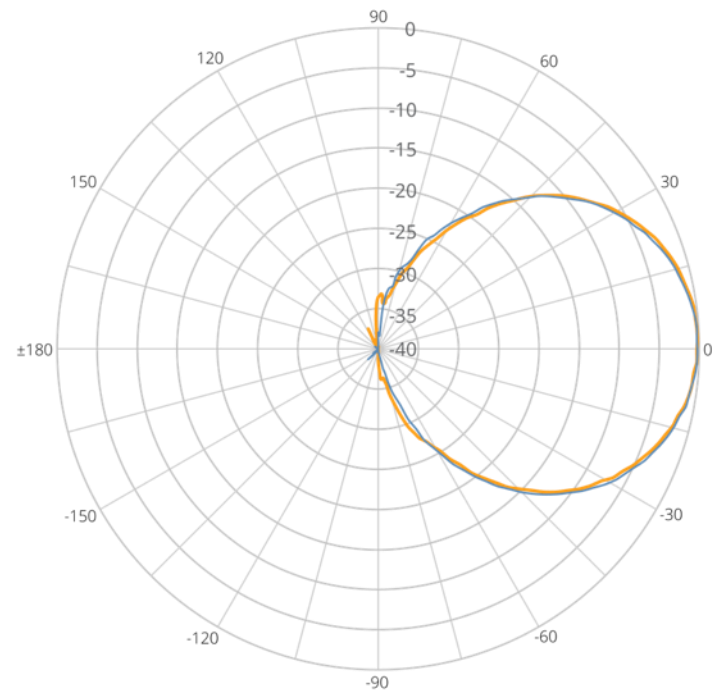




# N5-45 Polar Plots



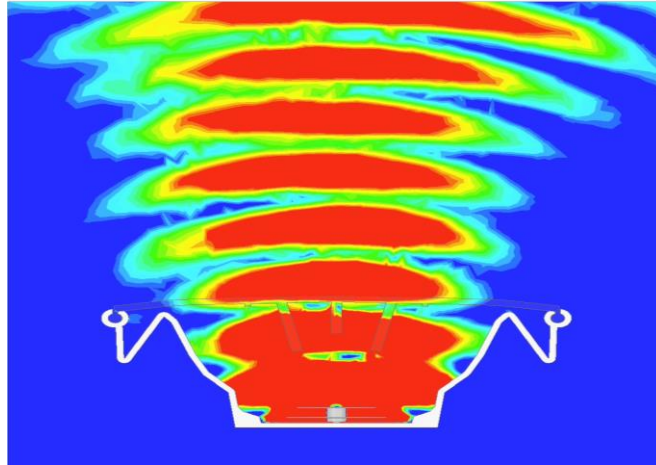
Vertical/Elevation  
2° Downtilt



Horizontal/Azimuth



# Incredible Sidelobe Rejection



Top View



# N5-45 Deployment Models

## Long Range High Capacity



N5-45x4

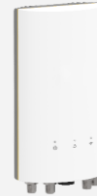
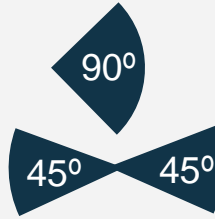


Mimosa  
A5c

## Cost-Effective Coverage



N5-45x2



Mimosa  
A5c

## 3<sup>rd</sup> Party Access Point



N5-45x2



3<sup>rd</sup> Party  
2x2 AP

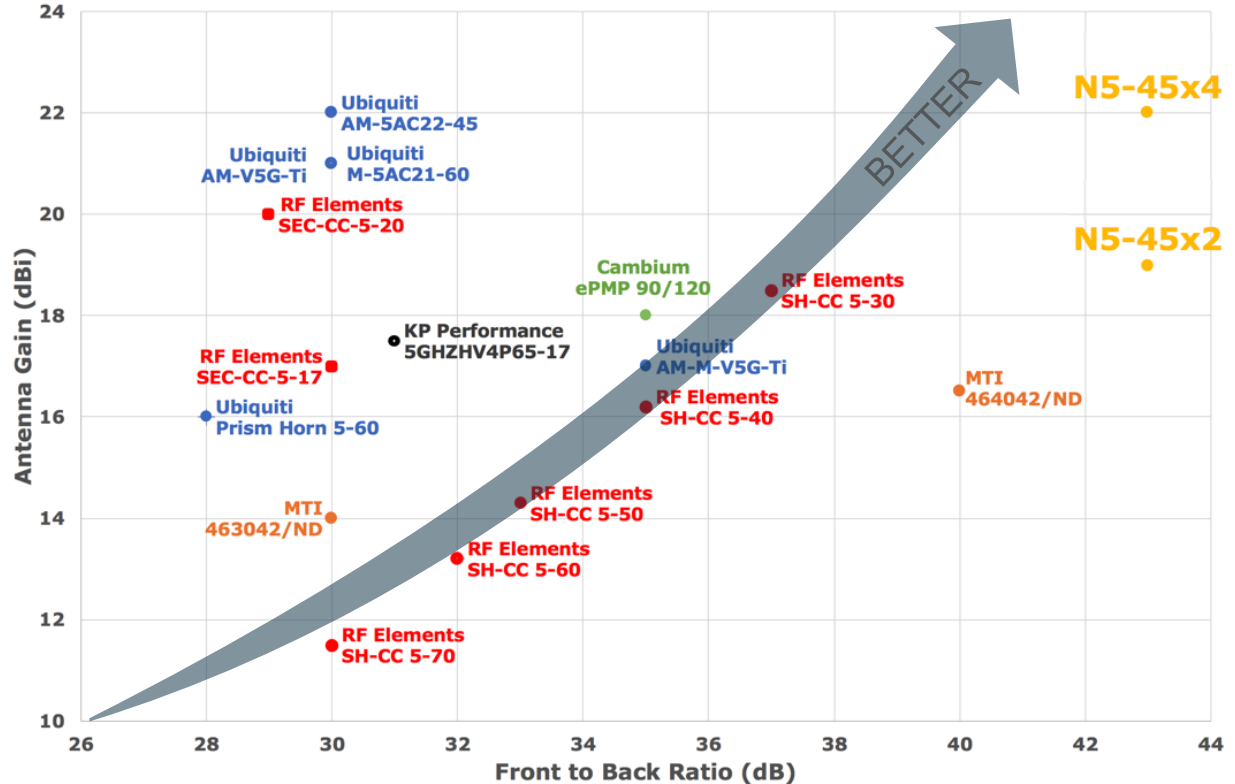


# Leading Sector Performance

The N5-45 is the industry leader in FTB ratio and gain



## Antenna Gain vs. FTB Ratio





# Competition





# Key Competitive Points

Features	A5/A5c	Ubiquiti AC Gen 2	MikroTik NetMetal	Cambium ePMP 2000	Cambium ePMP 450m	Radwin Jet Air
High-Density Suburban (MicroPoP)	✓					
Rural Solution (Tower)	✓	✓	✓	✓	✓	✓
Integrated Network Sync	✓	External		External	External	External
Beamforming	✓				✓	✓
Ruggedized IP Rating	✓		Not Rated	✓	✓	✓
Wideband Support: 4.9–6.2 GHz	✓	5.15-5.85	5.15-5.875	4.9-5.925	5.15-5.85	4.9-5.8
Aggregate Subscriber Client Speed	500	150	200	140	90	100 or 200
Aggregate Potential Capacity	500	150	200	140	500	250 or 750
Recommended Max Clients	44	25	25	30	100	50



# PTMP AP - Airspan vs. Cambium

Features	A5/A5c	Cambium ePMP 2000	Cambium ePMP 3000
High Density Suburban (MicroPoP)	✓		
Rural Solution (Tower)	✓	✓	✓
Integrated Network Sync	✓	External	External
Beamforming	✓		✓
IP Rating	IP 67	IP 55	IP 55
Channel Width (MHz)	20, 40, 80	5, 10, 20, 40	20, 40, 80
Streams/Modulation	4/256 QAM	2/64 QAM	4/256 QAM
Max Transmit Power	30 dBm	30 dBm	32 dBm
Noise Filtering	Software AGC	Dynamic Filtering	Dynamic Filtering
Wideband: 4.9 – 6.4 GHz	✓	5.15-5.925	4.910-5.970
Interfaces	(1) GE	(1) GE	(1) GE + SFP
Aggregate AP Capacity	500 Mbps (SU-MIMO)	140 Mbps (SU-MIMO)	1.2 Gbps (MU-MIMO)
Aggregate Client Speeds	500 Mbps	140 Mbps	600 Mbps
Max Clients	44	120 (10 for lite)	120



# PTMP Client - Airspan vs. Cambium

Features	C5x	Cambium Force 180	Cambium Force 300
Gain Options (dBi)	8, 12, 16, 20, 25	16	16, 25
Beamwidth (deg)	58, 38, 22, 12, 8	30 el, 15 az	16: 30 el, 15 az, 25: 10° sym
Front to Back (dB)	21, 29, 50, 35, 40	20 dB	16: 26 dB, 25: 25 dB
Front to Side (dB)	21, 27, 43, 37, >45	17	16: 15, 25: 14
Antenna Type	Twist On Horn, Dish	Integrated Dish	Integrated Dish
IP Rating	IP 55	IP 55	IP 55
Channel Width (MHz)	20, 40, 80	5, 10, 20, 40	20, 40, 80
Streams/Modulation	2/256 QAM	2/64 QAM	2/256 QAM
Max Transmit Power	27 dBm	30 dBm	29 dBm
Power Consumption	12.9 W, Ave 9.2W	12 W	12 W
Frequency Support (GHz)	4.900 – 6.400	4.910-5.970	4.910-5.970
Interfaces	(1) GE	(1) GE	(1) GE
Aggregate Client Speeds	500 Mbps	140 Mbps	600 Mbps

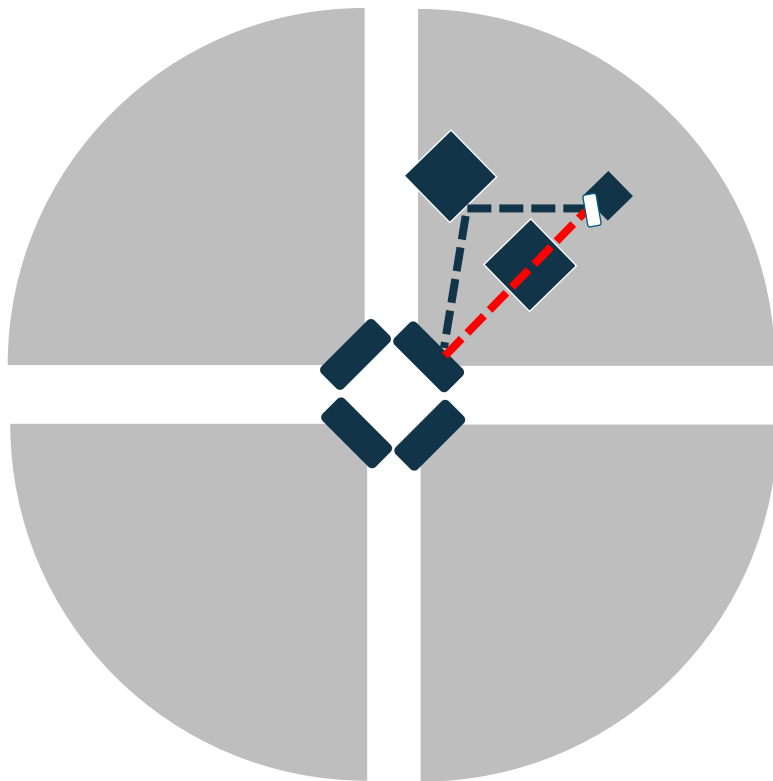


# Real World Beamforming Questions

- **Urban – no foliage NLOS**
  - Useful for primary reflection off a building
  - Client and AP require extremely wide-angle to be truly self organizing – reduces system gain performance
  - Alternative is to have Airspan beamforming 360° antennas to maximize reflections and have installers aim the directional clients to the primary reflection based on signal level
- **Suburban/Rural – foliage, LOS & near-LOS**
  - Higher cost beamforming solutions such as Radwin & Cambium have demonstrated NO benefit when there are no reflective surfaces – adds significant cost to any LOS and nLOS scenario
  - Example – Frontier & C-spire in the US stopped active deployments of Radwin & Cambium because they could not achieve NLOS as hoped



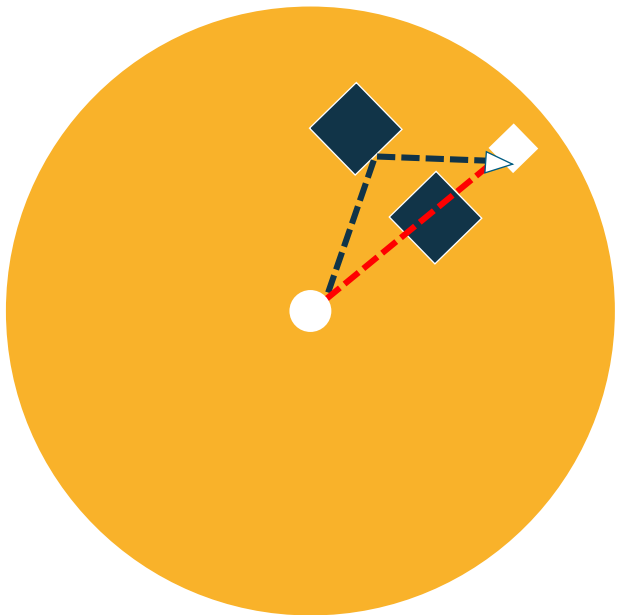
# Radwin in MicroPoP Situations



- Jet series was designed for towers, not MicroPoP sites
- Limited to 2x2 MIMO per AP
- Limited AP beamwidth 90°
  - Requires 4 APs per site
- Requires more spectrum
  - Horrible 25 dB FTB ratio may limit back-to-back channel reuse
- CPE still must be aimed with typical 17° beamwidth
  - Poor sidelobe and FTB ratio
- CPE is low-gain @ 16 dBi
- Best benefit comes from sectorized beamformed solutions, but extensive cost for achieving narrower beam
- Extensive cost for little practical benefit



# Airspan in MicroPoP Situations

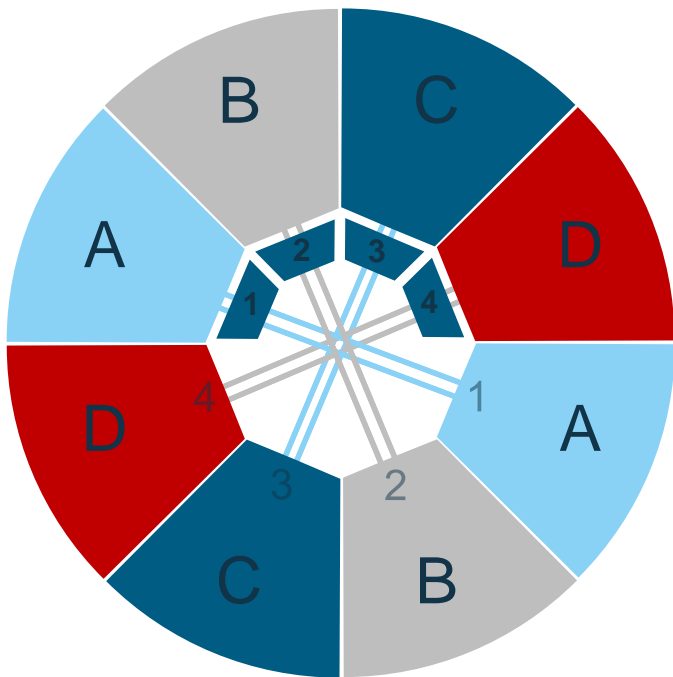


- Easy site install with 360° coverage
  - 1 channel & 1 AP/site
- Improved FTB and sidelobe CPE rejection from indoor noise
- High gain CPE integrated low-cost options (8-25 dBi)
- Similar reflection benefits in urban areas assuming CPE is aimed at high signal reflections





# Airspan Sector Example



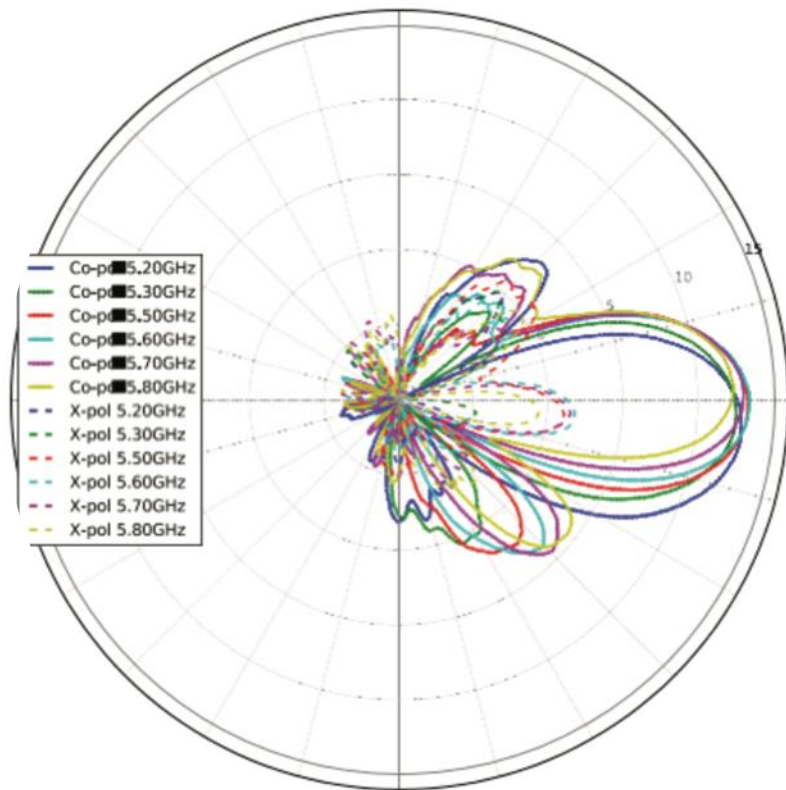
8 sectors – 4 A5c - 4 channels  
240 subscribers (SRS)

- Better isolation FTB and sidelobe than Radwin
- Narrower beam 45° isolates more noise
- Better back-to-back channel reuse due to higher performance antenna
- Still 1/3 the cost of the extended beamforming solutions

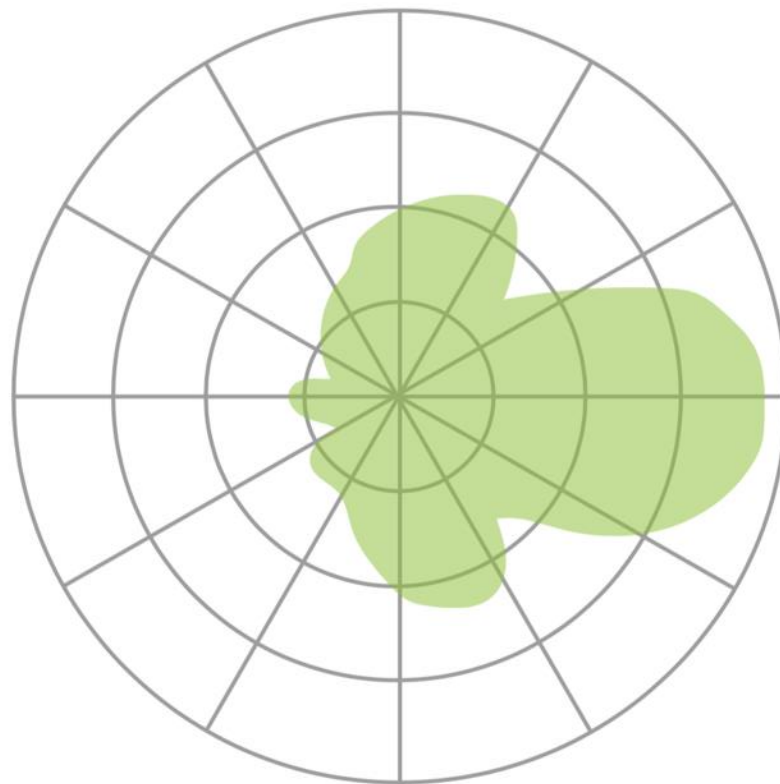


# Airspan N5-X16 16 dBi versus Cambium Force 180 & Albentia

## Cambium Force 180



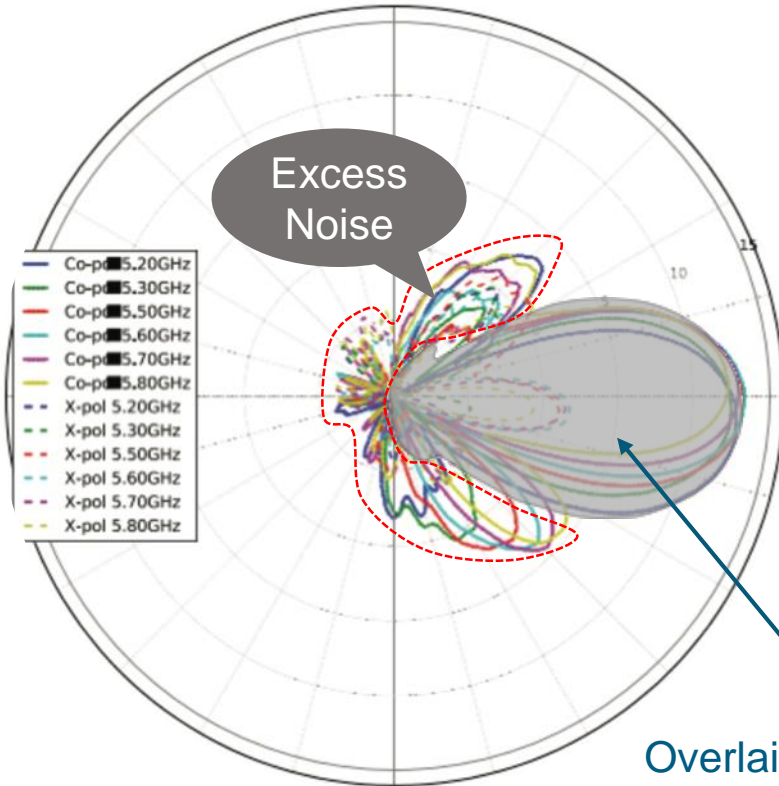
## Albentia CPE-150-15



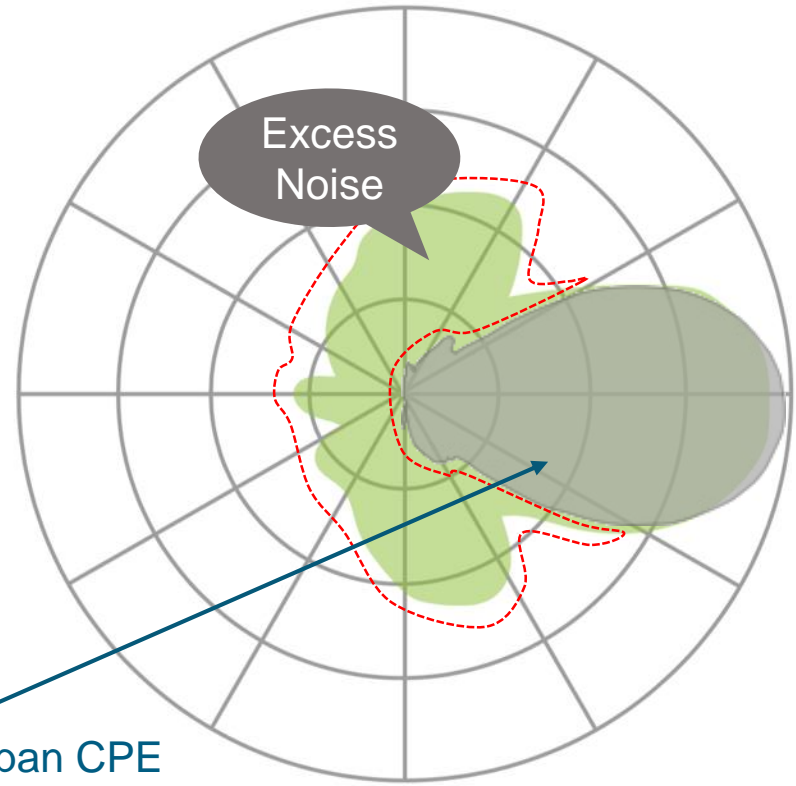


# Airspan N5-X16 16 dBi v Cambium Force 180 & Albentia Patterns

## Cambium Force 180



## Albentia CPE-150-15



Overlaid Airspan CPE  
antenna pattern



# Base Station Key Specs Comparison

	Airspan PTMP	Cambium ePMP 2000	Albentia Alba
Frequencies	4.90-6.40 GHz	4.91-5.97 GHz	4.9-5.875 GHz
Max Channel Size	Up to 80 MHz	Up to 40 MHz	10 MHz (up to 4 ch.)
Max Modulation	256-QAM	64-QAM	64-QAM
Max Client TCP speed	500 Mbps	200 Mbps	35 Mbps
Max Base Station Capacity	500 Mbps	200 Mbps	140 Mbps
IP Rating	IP65	IP55	IP67
Antenna Interface	Connectorized	Connectorized	Connectorized
Output Power	27 dBm	30 dBm	23 dBm
IP protocols	IPv4/IPv6*	IPv4/IPv6	IPv4/IPv6
Management Protocol	SNMP v1/2c/3*	SNMPv2c	SNMP v1/2c/3
GPS sync	Not required – option in alternate base station	Included	Included

\* Roadmapped end of 2018



# CPE Key Specs Comparison

	Airspan Air5-PTMP-CPE	Cambium ePMP 2000	Albentia Alba
Frequencies	★ 4.90-6.40 GHz	4.91-5.97 GHz	4.9-5.875 GHz
Max Channel Size	★ Up to 80 MHz	★ Up to 40 MHz	✗ 10 MHz (up to 4 ch.)
Max Modulation	★ 256-QAM	★ 64-QAM	★ 64-QAM
Max Client TCP speed	★ 500 Mbps	★ 200 Mbps	✗ 35 Mbps
IP Rating	★ IP65	★ IP55	★ IP55
Antenna Type	★ Integral 8/12/16/20/25 options 16 dBi horn proposed	Integrated 16 dBi patch/panel	Integrated 15 dBi patch/panel
Output Power	★ 27 dBm	★ 30 dBm	✗ 23 dBm
Max Beamwidth	★ 22°	✗ 30° ELE, 15° AZ	✗ >40
Antenna Noise Isolation	★ 50 dB Front to Back 43 dB Front to Side	Excessive side and backlobe (see patterns)	Excessive side and backlobe (see patterns)



# PTMP CPE



# PTMP Clients

## C5x

Integrated Modular Client



Short to Mid-Range

- Up to 10 km distance

Ultra Flexible

- 5 gain options: 8, 12, 16, 20 & 25 dBi

Incredible Noise Immunity

- Minimizes in-home local interference

## C5c

Connectorized Client



Long-Range Client

- Antenna gain defines distance

Bring Your Own Antenna

- Dual RP-SMA

Sync Compatible

- A5 GPS sync client

4.90–6.40 GHz with Spectrum Reuse Synchronization (SRS)

## Blazing-Fast, Rugged Clients

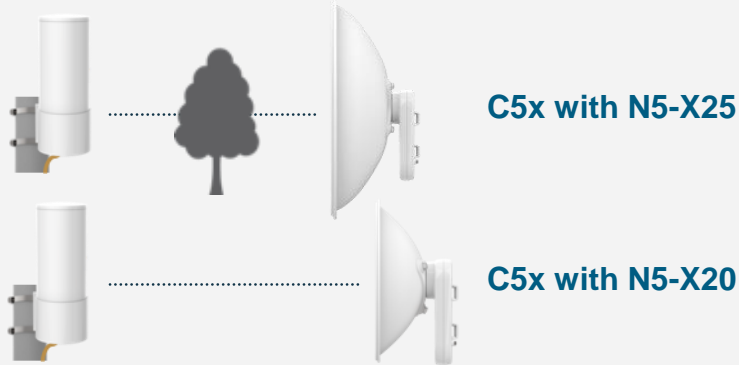
- Fiber speeds to the home
- TDMA GPS sync client
- Rugged and affordable
- Mounting options galore
- Compact and powerful
- Flexible antenna options



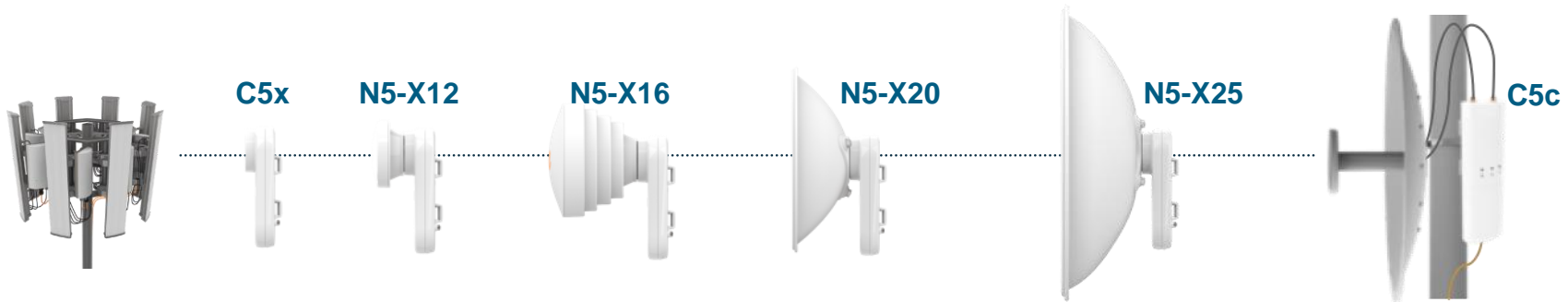


# PTMP Product-Distance Relationships

A5 or  
A5c+N5-360  
**Suburban**



A5c  
N5-45  
**Rural**





## C5x and N5-X

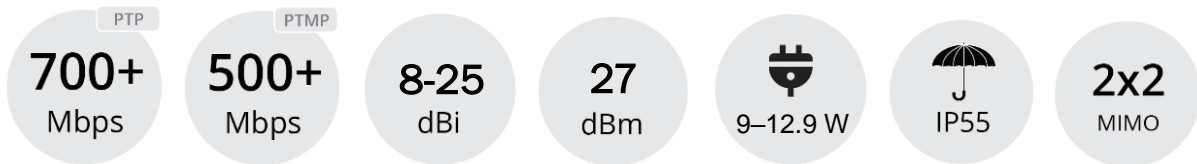


Modular radio designed  
for PTP and PTMP  
performance with twist-  
on antennas



## C5x Specs

- Integrated Radio with Modular Antennas
- Incredible RF Performance
- Extended Frequency 4.9 to 6.4 GHz
- Ultra-Rugged – All Metal Radio & Antennas
- C5x, N5-X Antennas, PoE and Mounts Sold Separately



4.9–6.4 GHz Extended Frequency





# Rugged

# Industrial Design





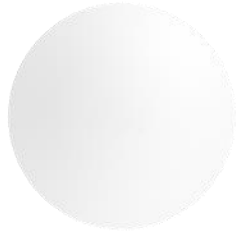
# C5x and N5-X Antenna Models

## C5x Radio

8 dBi  
27 dBm



**N5-X12**  
Horn  
12 dBi



**N5-X16**  
Horn  
16 dBi



**N5-X20**  
Dish  
20 dBi

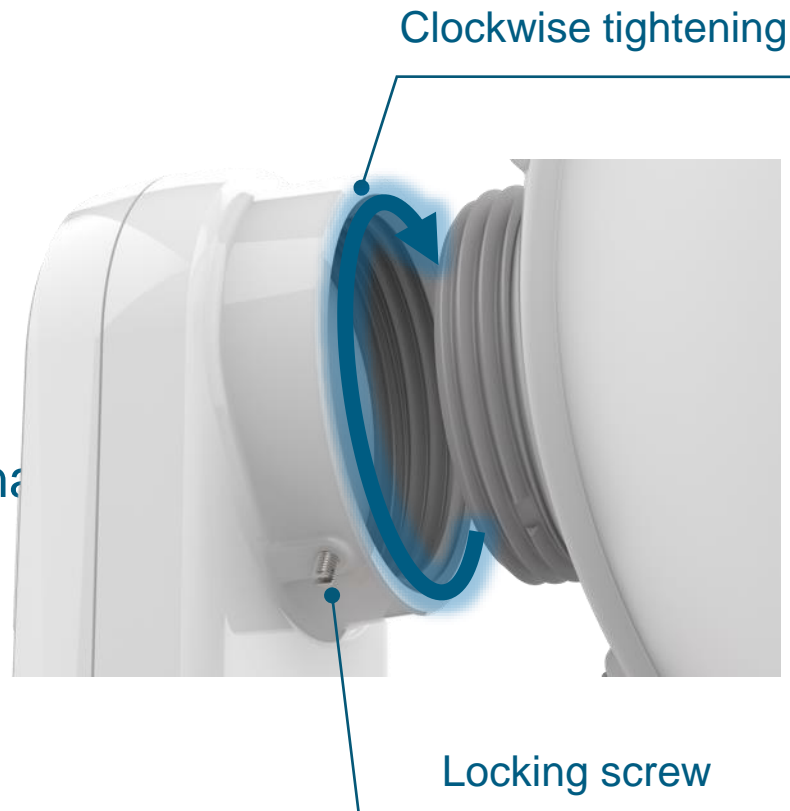


**N5-X25**  
Dish  
25dBi



## Unique Twist-On Design

- Single C5x radio supports five configurations
  - 8, 12, 16, 20, 25 dBi
- Field-installable antenna
- Locking screw for final installation
- Metal radio connects to metal antenna





# C5x Radio

Native antenna gain: 8 dBi  
System Power: 27 dBm

## Ultra Rugged

- Aluminum fabrication
- Supports wind loading over 120 mph
- Two-strap design for secure mounting
- Flexible mounting options
- IP65

## Low Power Consumption

- 12.9 Watts
- 9 Watts typical

Integrated  
Sealed Radome



175mm length

3<sup>rd</sup> Generation  
Ethernet Design

Dual-Slant 45°



Dual Hose Clamp

Pole Mount

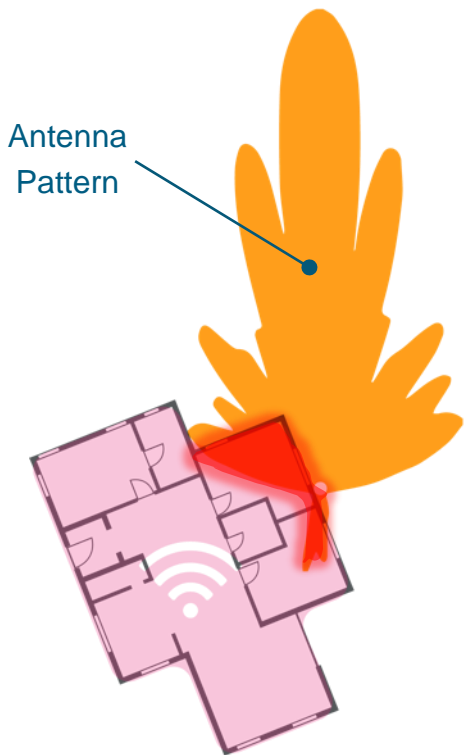
Grounding Screw

Cable Sealing Door





# Incredible Interference Mitigation



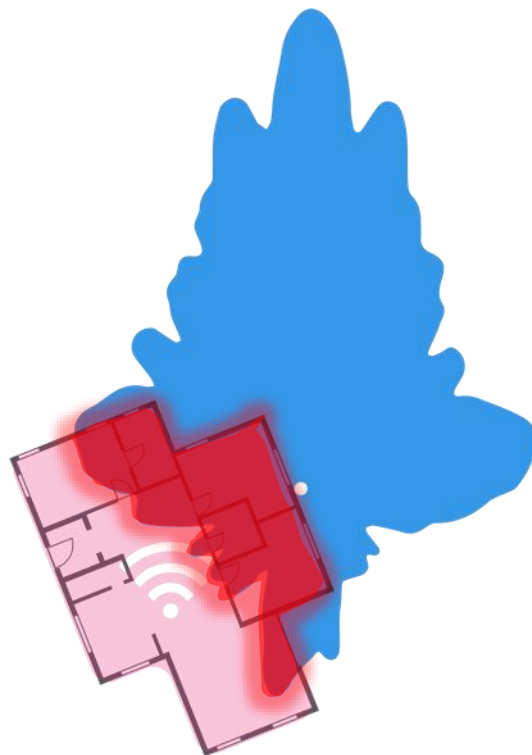
Airspan C5x

## 10 dB SINR

Signal to Interference  
Plus Noise Improvement

### What is 10dB?

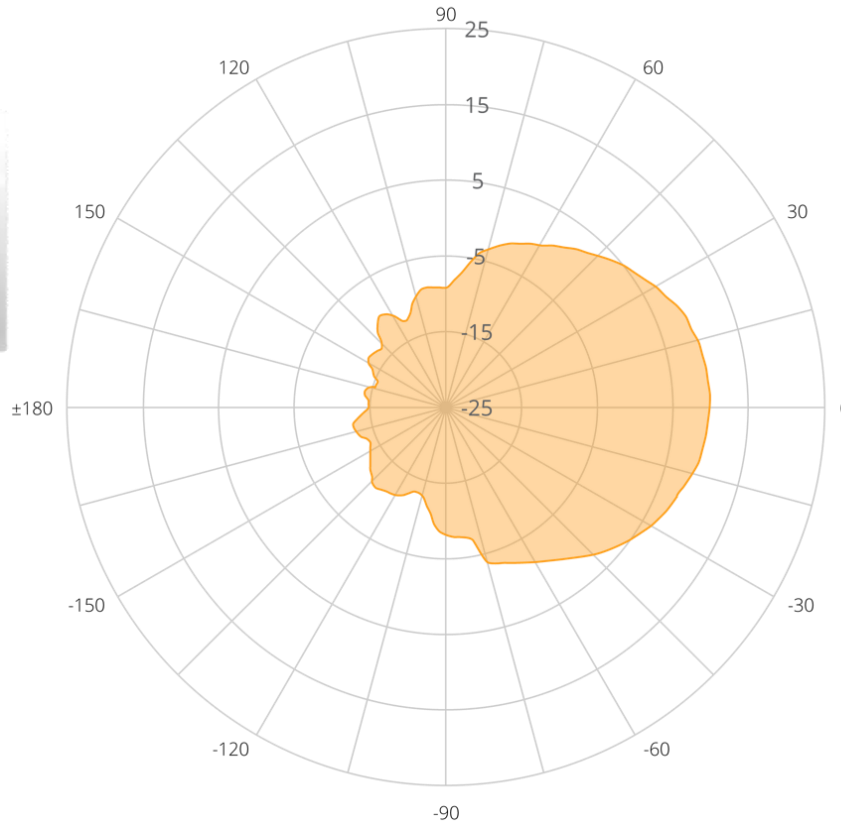
- 10x Improvement
- Increase 4 MCS Rates
- PHY Rate + 370 MB



Other Integrated Radios



# C5x Pattern

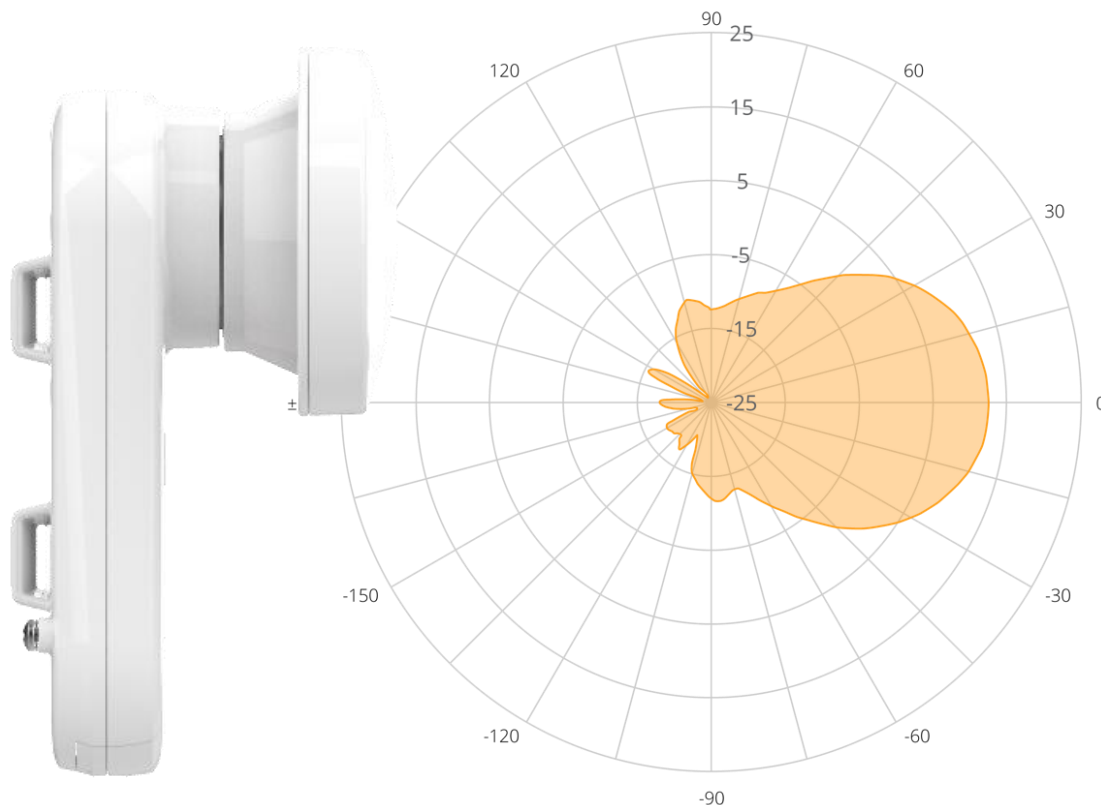


- Integrated radome seals radio
- 8 dBi native antenna
- Dual slant 45°





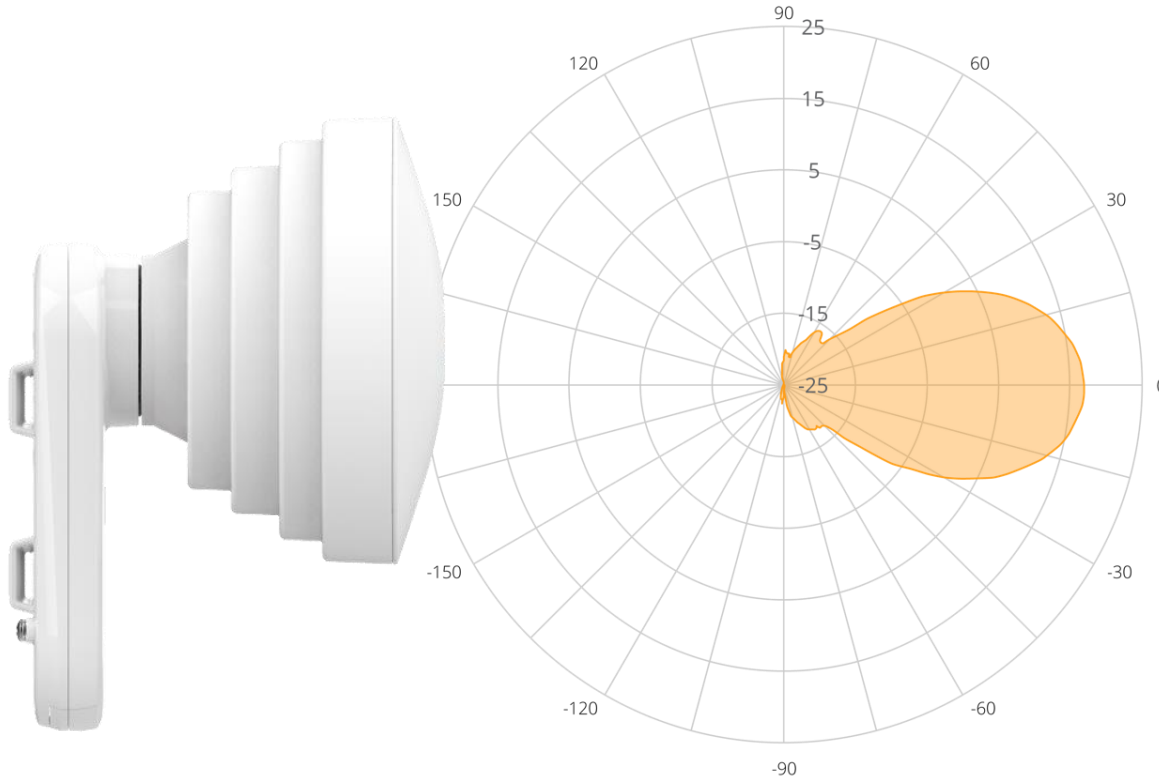
# N5-X12



- No connectors, no losses
- Small horn form factor
- 90 mm aperture
- Best in class FTB & front-to-side rejection



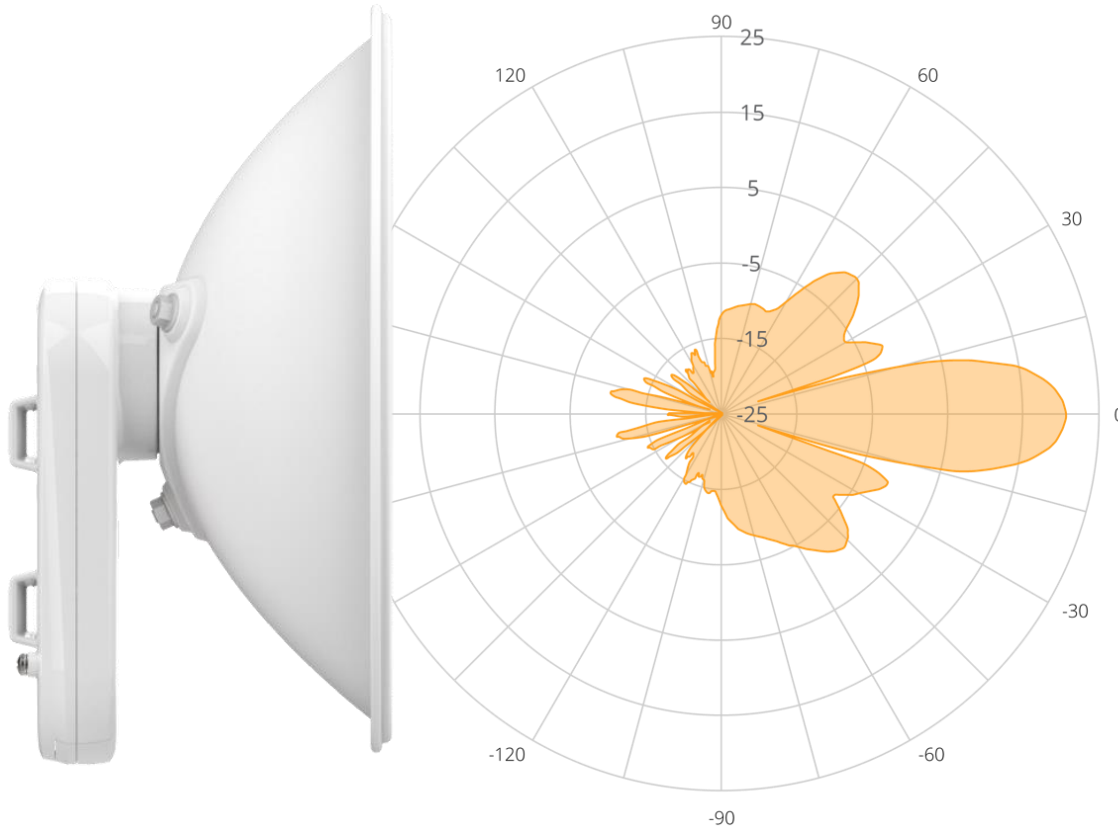
# N5-X16



- No connectors, no losses
- Horn form factor
- 150 mm aperture
- Best in class FTB & front-to-side rejection



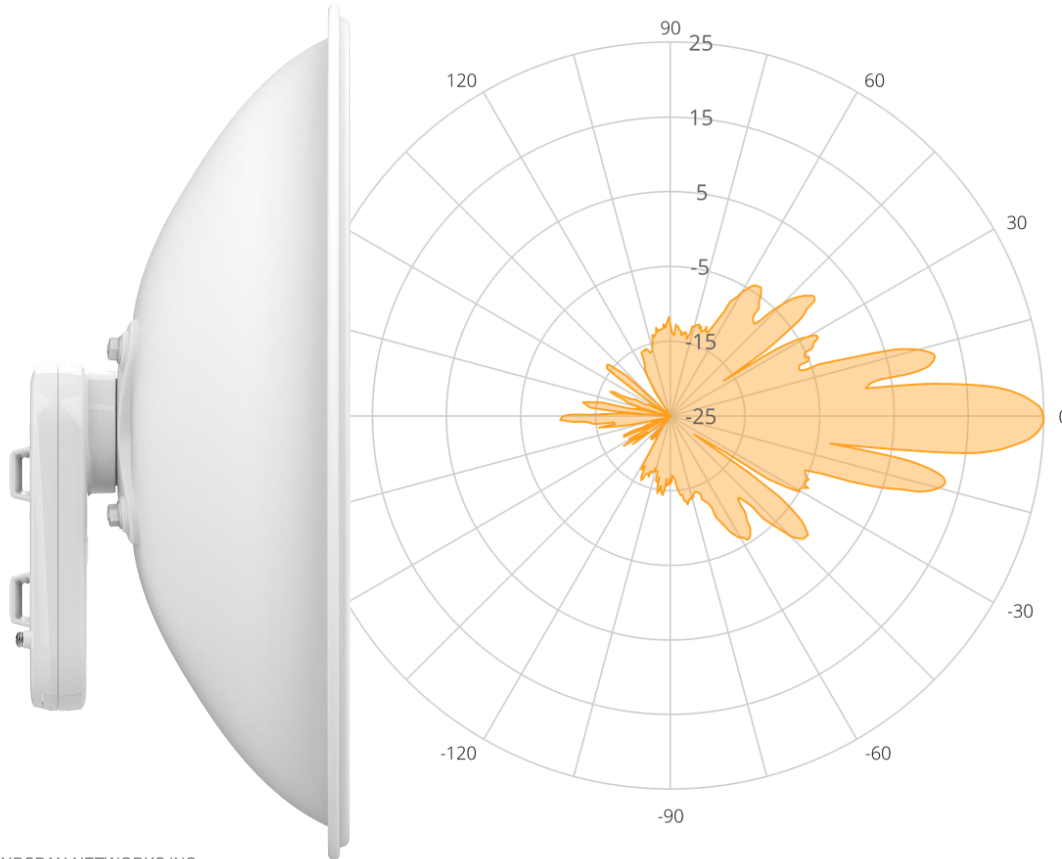
# N5-X20



- No connectors, no losses
- Cassegrain reflector
- 250 mm aperture
- Best in class FTB & front-to-side rejection



# N5-X25



- No connectors, no losses
- Cassegrain reflector
- 400 mm aperture
- Best in class FTB & front-to-side rejection



# Subscriber Home Installation Details

- Subscriber Installation Process

Client Radio

C5 Integrated

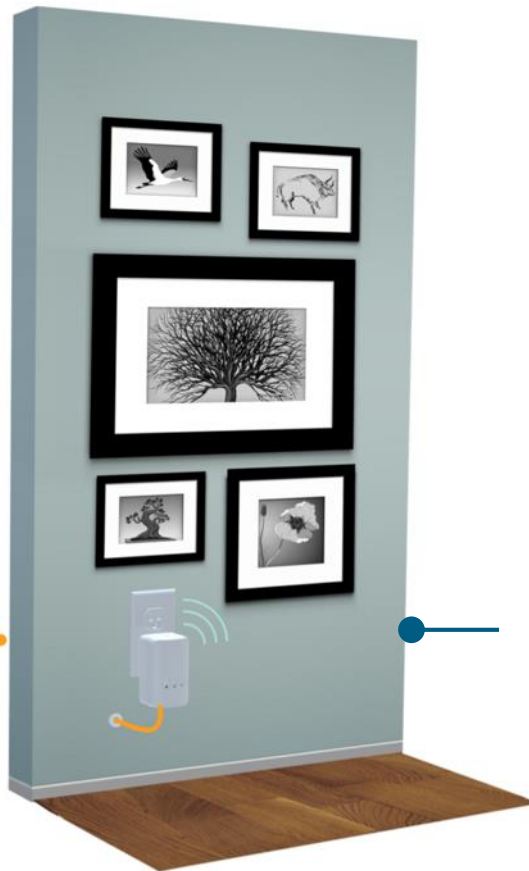
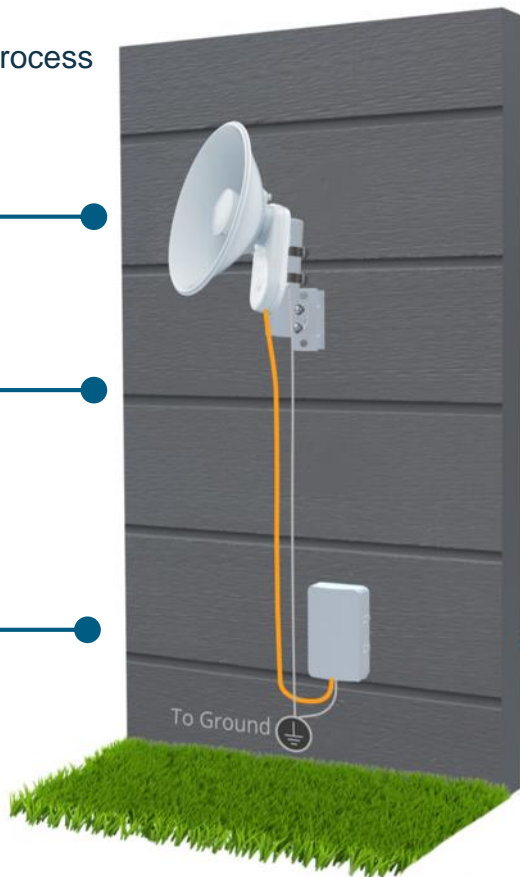
Mounting

FlexiMount

J-Mount

Gigabit NID

ESD Protection



Power  
and WiFi

G2 PoE Gateway  
Mimosa PoE





# G2 2.4 GHz WiFi PoE Gateway

- Simple Integrated PoE + Great WiFi
- Add Multiple G2 Devices to Expand Coverage
- Cloud Monitoring for In-Home WiFi Support
- Totally Integrated Experience with Mimosa C5

**100+**  
Mbps

**2.4**  
GHz

**PoE**  
48 V

**2x2**  
MIMO



GigE



Router



Repeater

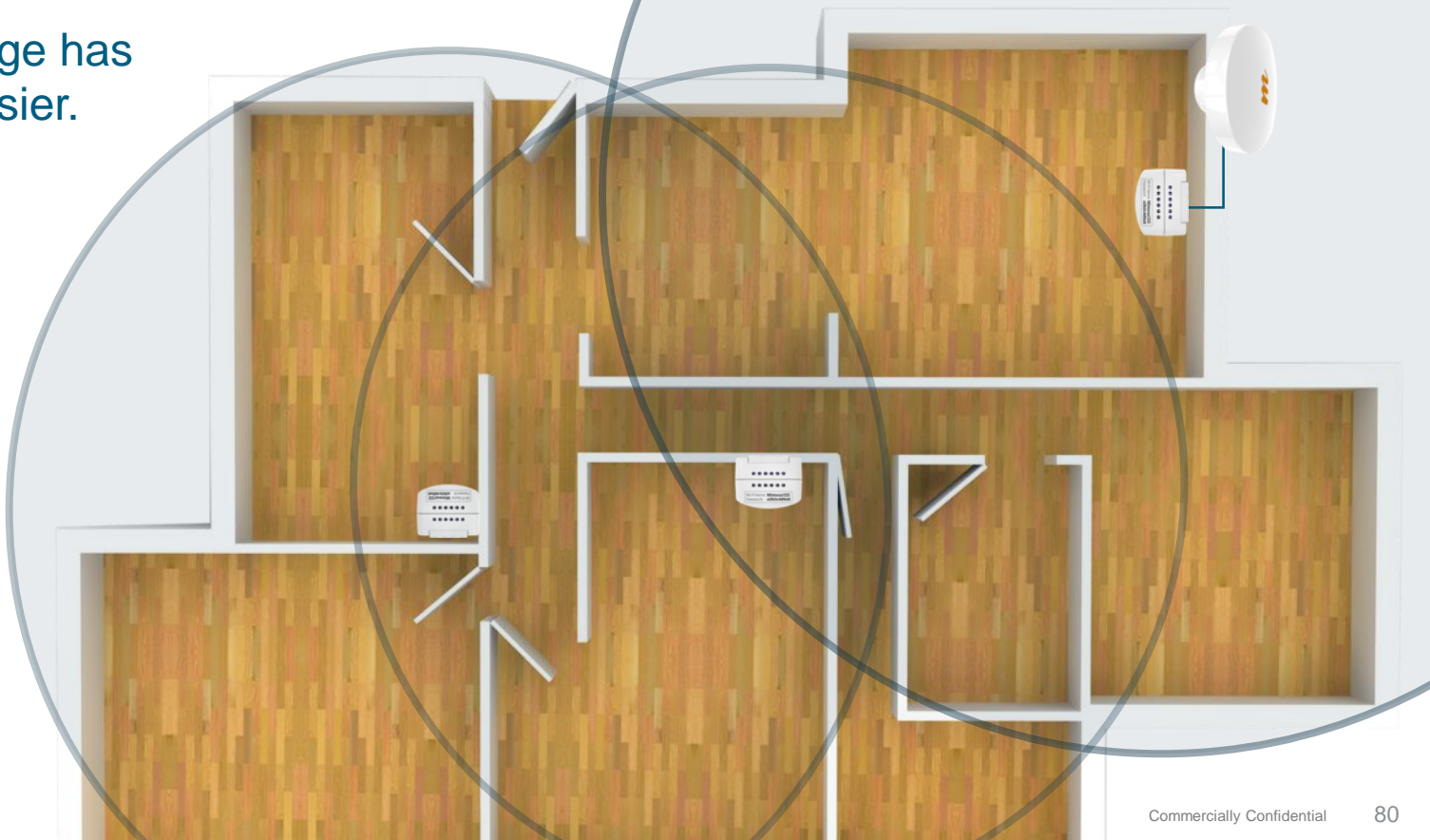




## G2 2.4 GHz WiFi PoE Gateway

Adding coverage has  
never been easier.

Simple wired  
and wireless  
repeater auto-  
configuration.





## Simply Smarter WiFi

Automatically picks the cleanest channel on startup.

Changes channels when interference slows down performance.



Reduces impact of noisy WiFi neighbors with intelligent clear channel assessment.



# G2 Key Features



## Two GigE Ports

WAN/POE, HOME/LAN

## POE Out

48v PoE on WAN for Client devices

## SSID Support

Predefined Home & Guest

Guest isolation

Up to 4 SSID

## Channel Management

Startup auto selection of best channel

Automatic interference avoidance

## Routing

Permit/Deny

Remark Layer 2 and Layer 3 traffic

## Security

WPA/WPA2 Personal (PSK)

WPA/WPA2 Enterprise (802.1x)

AES, TKIP, WEP 64/128

## QoS

EDCA WMM 4 level QoS

Rate Limiting

WMM Power Save

## Tunneling/Authentication

PPPoE, PPTP

## Management Services

Cloud monitoring

Disable configuration from LAN

Management Access Control Lists

SNMP v2, v2c, v3

Syslog



# Next-Gen Platform



# The Only Cost-Effective & Scalable Next-Gen, Fixed Wireless Roadmap

**8x8  
MIMO**

**160  
MHz**

**10  
Gbps**

**OFDMA  
Tone Masking**

**1024  
QAM**



# Key PTMP Enhancements from 802.11ax Quantenna Chip

- Significant latency improvement from upstream OFDMA
- Per CPE tone masking based on noise
- Improved memory management for up to 500 clients
- Custom channel sizes with OFDMA masking
- More MIMO means more AP antenna options:
  - 8x8 advanced directional beamforming sectors
  - Potential more advanced custom beamforming MicroPoP 360° antennas







# Key Backhaul Enhancements from 802.11ax Quantenna Chip

- More channel aggregation potential
- OFDMA dramatically improves interference performance with tone pruning
- Low-cost 3-4 Gbps backhauls
- Will require 2 x 160 MHz
- Initial focus on 17/18/19 GHz spectrum





# Network Design Tool



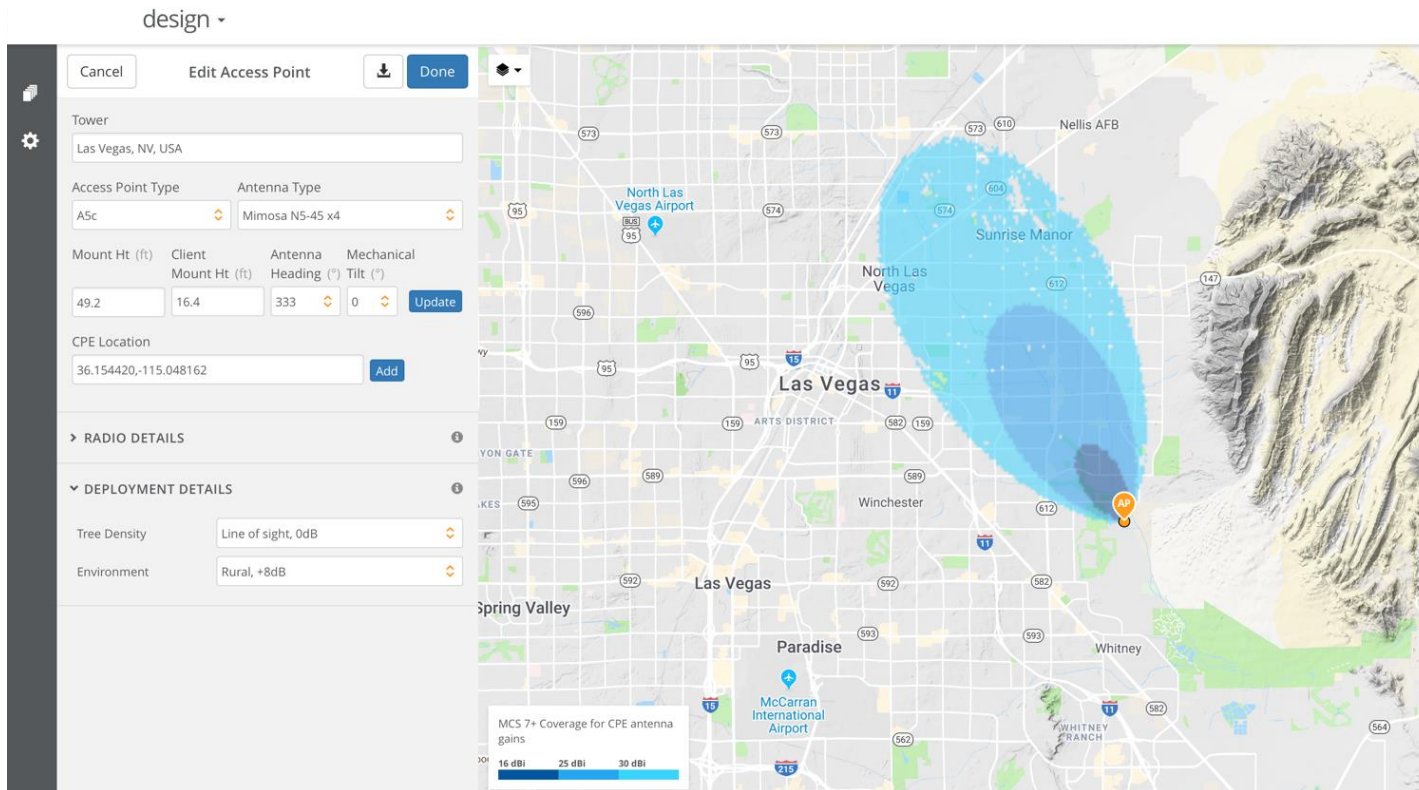
# Coverage Planning & Service Estimation

- 3D AP antenna modeling
  - Nasa/STM data based (topology only)
  - Multi-AP simultaneous supported
- Integrated localized ITU rain-fade data
- Foliage estimation options
- CPE estimation and topology LOS path





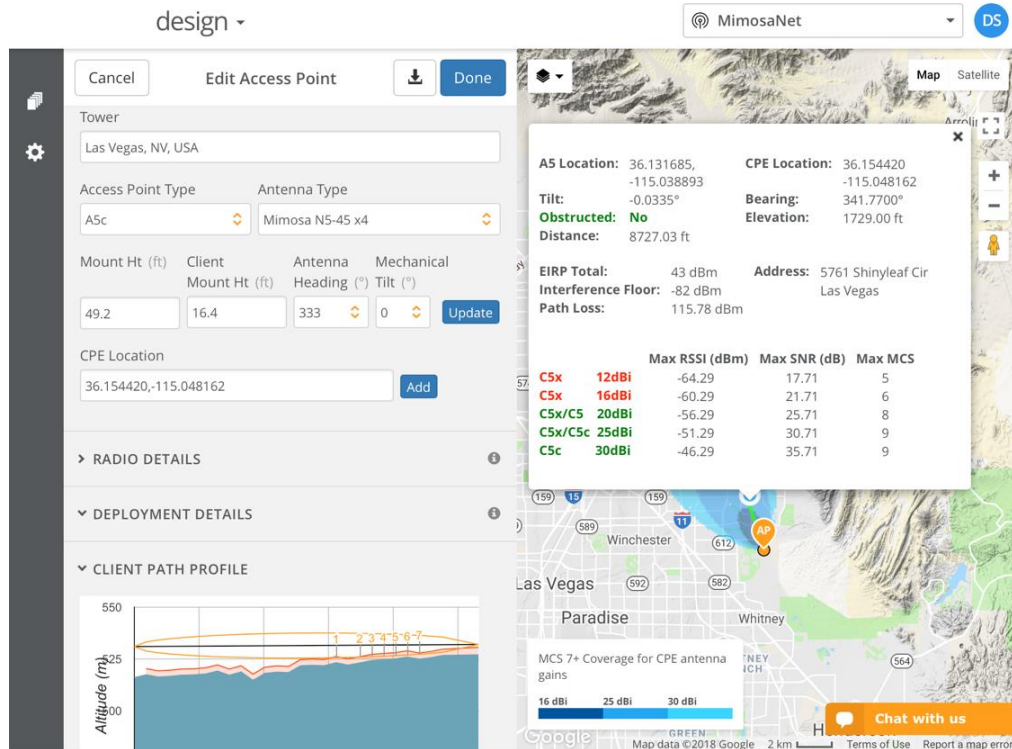
# 3D Topology Coverage





# Client Path and Link Details

Client  
Path



Link  
Details



# Thank You