



**Cambium Networks™**

# 450v Launch and Platform Update

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- **Leverage Existing Deployments**

- Add More Customers, Reach Farther
- Reduce Churn and Stay Competitive
- Increase Bandwidth to End Users

- **How?**

- We Call it:

**30-30-30**



# 30%+

## Sector Capacity Improvement

How:

Feature	Release	Results
Multiple Groups Per Frame	R22.0.2	15-25% Throughput improvement, 30-50% decrease in latency during busy hour
Downlink Slot Optimization	R22.1	7-10% Capacity Improvement



# 30%+

## Subscriber Throughput Increase

### How:

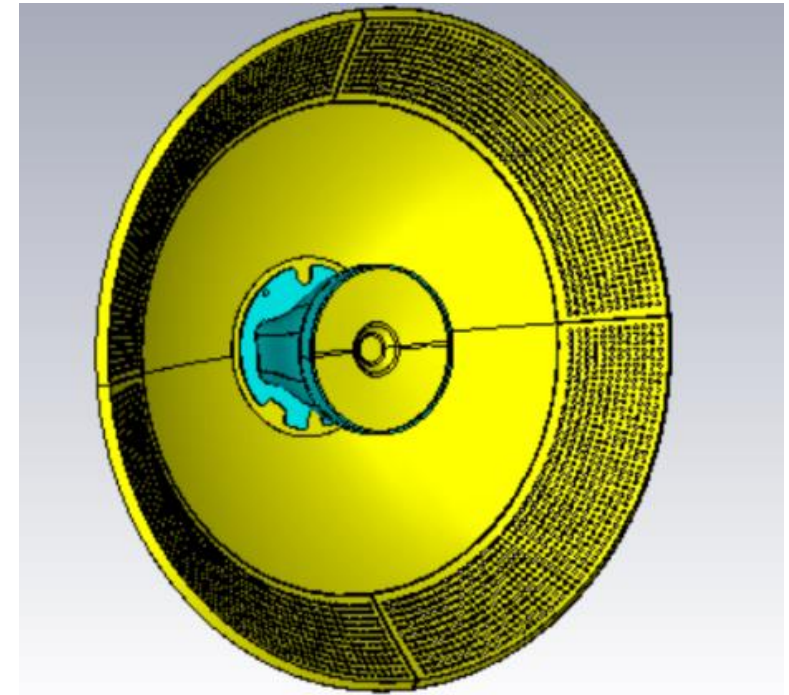


Feature	Release	Method
Deeper Virtual Circuit Queue	June, 2024	Re-architecture of MAC layer to better “fill the pipe” when using wider channel bandwidths, i.e. 40 MHz channels and 5ms frames, enabling 100/20 Mbps packages on all SMs, 450i, 450b and beyond.

# 30% +

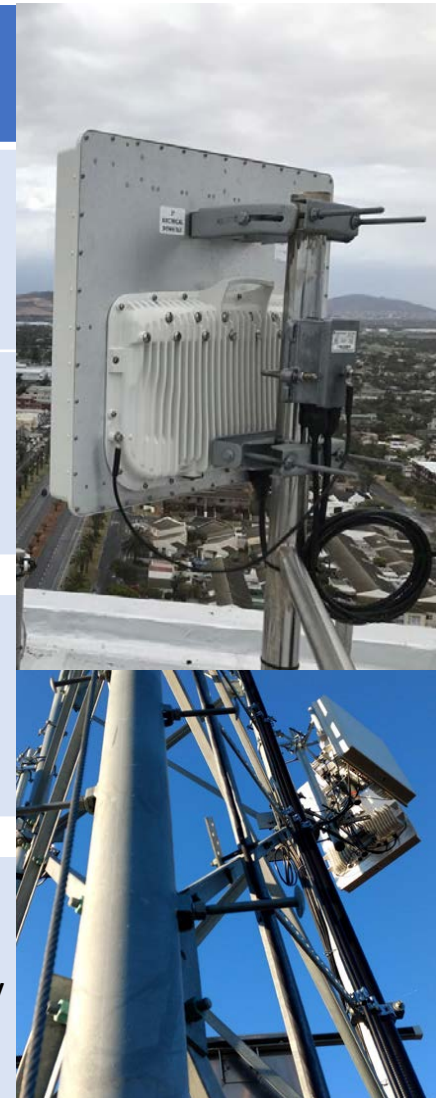
## Range Enhancement

How:

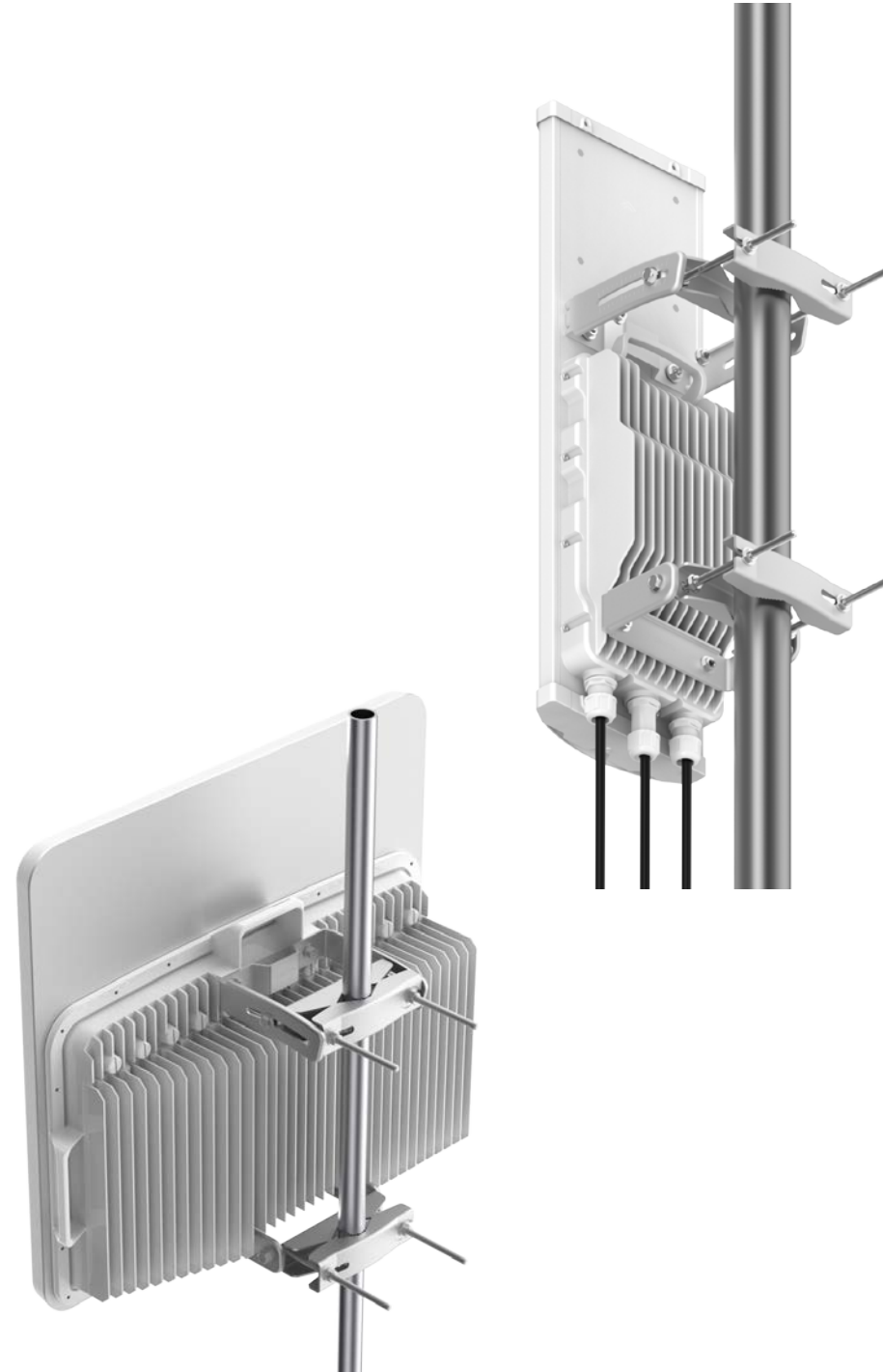


Feature	Release	Tested Results
Optional Enhanced dish for 2x2 450v	Aug, 2024	Provides ~4-6 dB additional gain vs. standard 450v dish, extending range by 30%+

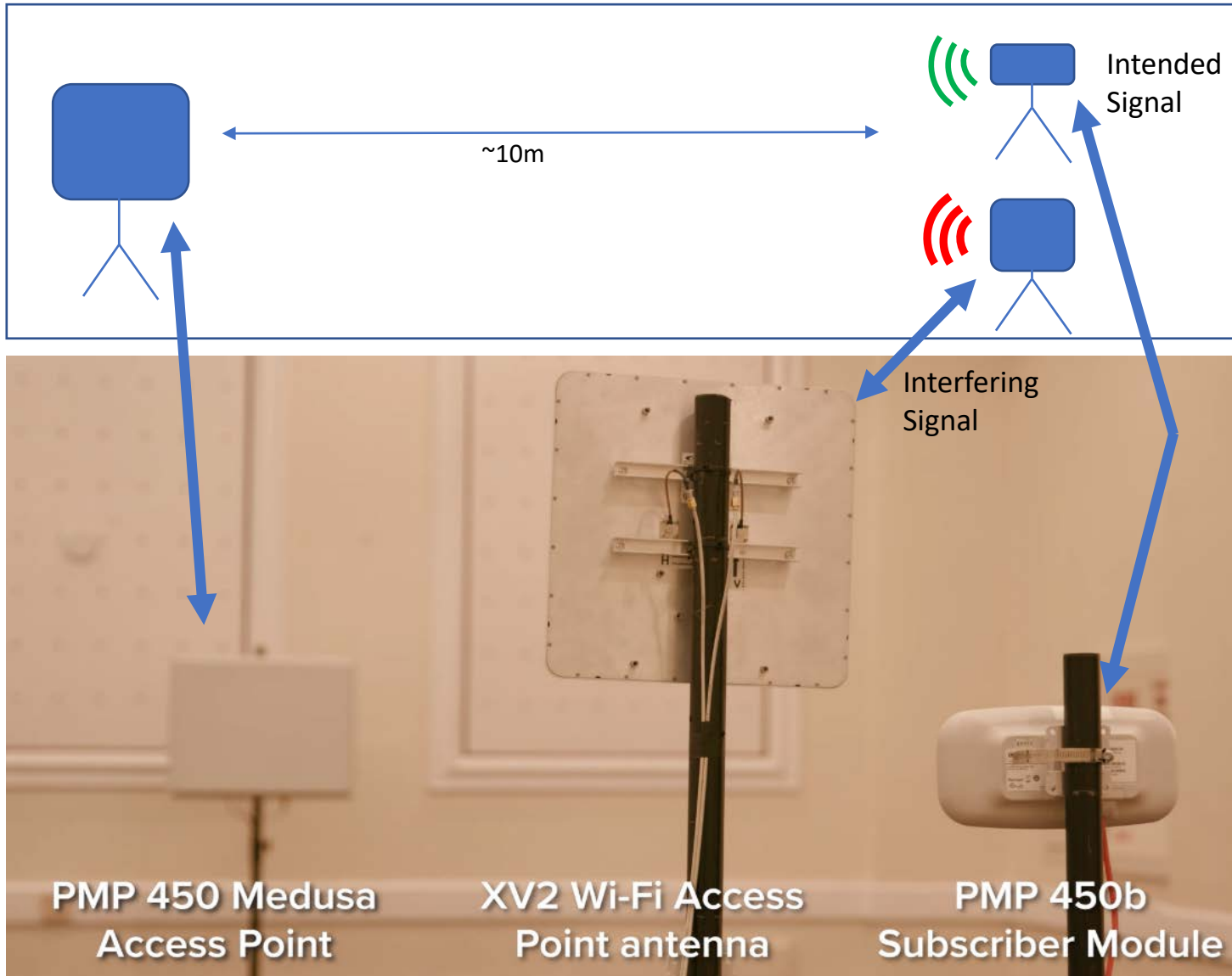
	Feature	Release	Results
<b>First 30 – Sector Capacity</b>	Multiple Groups Per Frame	R22.0.2	15-25% Throughput improvement, 30-50% decrease in latency during busy hour
	Downlink Slot Optimization	R22.1	7-10% Capacity Improvement
<b>Second 30 – Subscriber Throughput</b>	Deeper Virtual Circuit Queue	June, 2024	Re-architecture of MAC layer to better “fill the pipe” when using wider channel bandwidths, i.e. 40 MHz channels and 5ms frames
<b>Third 30 – Enhanced Range</b>	Optional Enhanced dish for 2x2 450v	Aug, 2024	Provides ~4-6 dB additional gain vs. standard 450v dish, extending range by 30%+



# Interference Mitigation



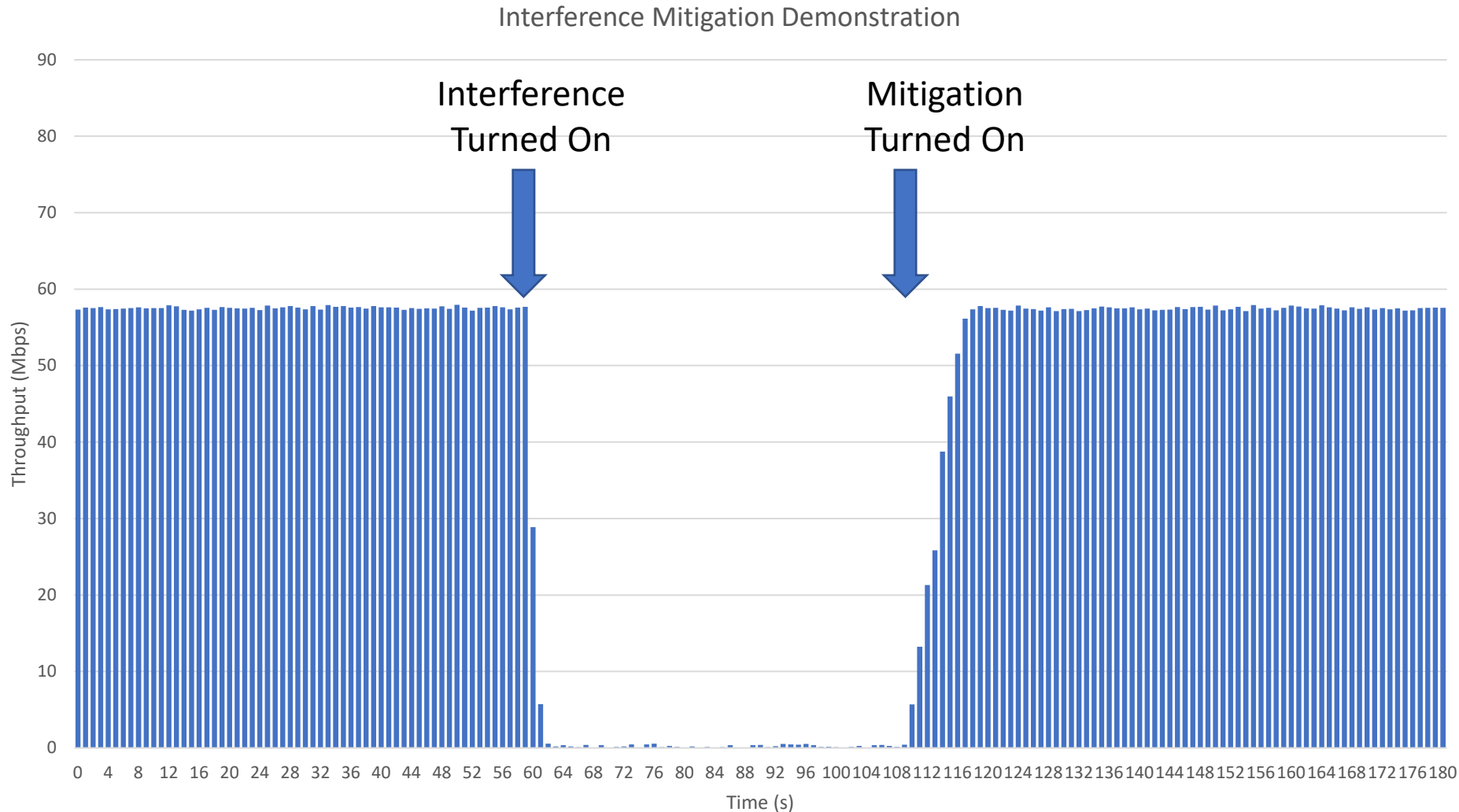
# Demonstration of Interference Mitigation



- Demonstration performed indoors
- Radio System is 450 platform
- Interferer is Wi-Fi 6 radio on same carrier at 2 dBm higher power than intended signal
- Interferer Turned on after 60s and remains on
- Mitigation on the 450 platform engaged at 110s and remains on



# Interference Mitigation using Unlicensed Spectrum



- Over 30dB of noise cancellation
- Effectively cancels external interference
- Beta Trials ongoing
- Implementation and release as 450m License Key in Q1, 2024
- Noise cancellation being planned for 450mv

- **Implementation on *existing* 450m**

- Will be enabled via License Key on existing hardware
- Evaluation of effectiveness ongoing via Beta trials
- Target Release 22.2 in January, 2024
- Demo mode will be available to determine (on a sector-by-sector basis) where the feature will be effective

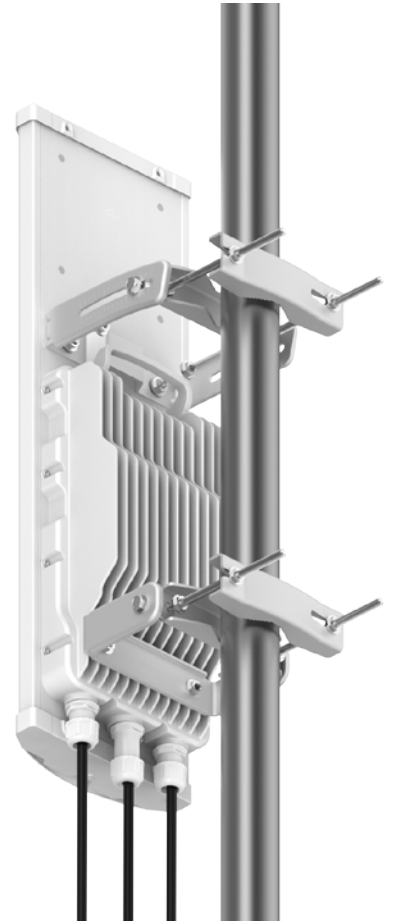
- **Possible Future Implementation on 450v**

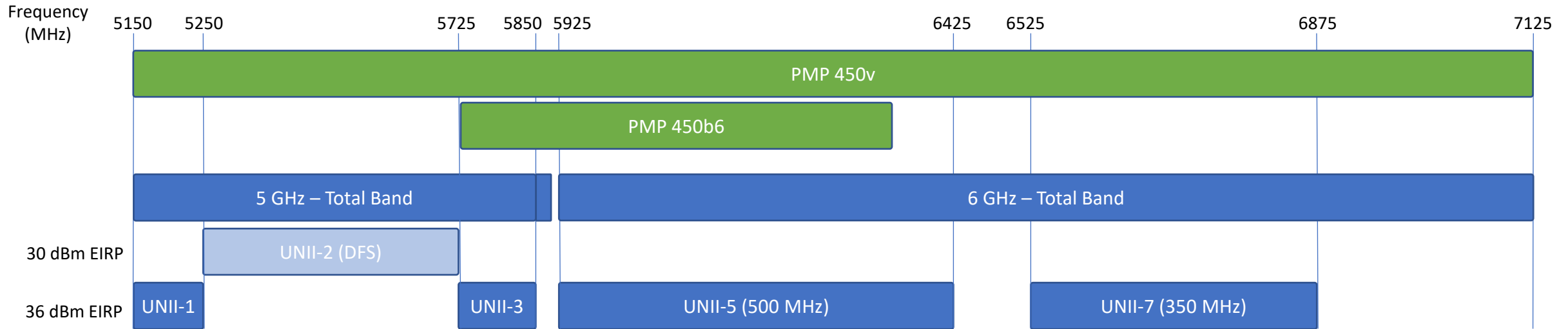
- 4x4 Radio, so one chain can be used for data, and one to null interferer, or
- 2 Carrier Aggregation to transmit data where possible

- **Implementation on 450mv**

- 12x12 MU-MIMO: Radio can dynamically assign chains to maximize throughput while assigning other chains to mitigate interferers
- Based on groupings available, and interference detected, capabilities can shift very quickly to optimize performance

# Next Generation 6 GHz



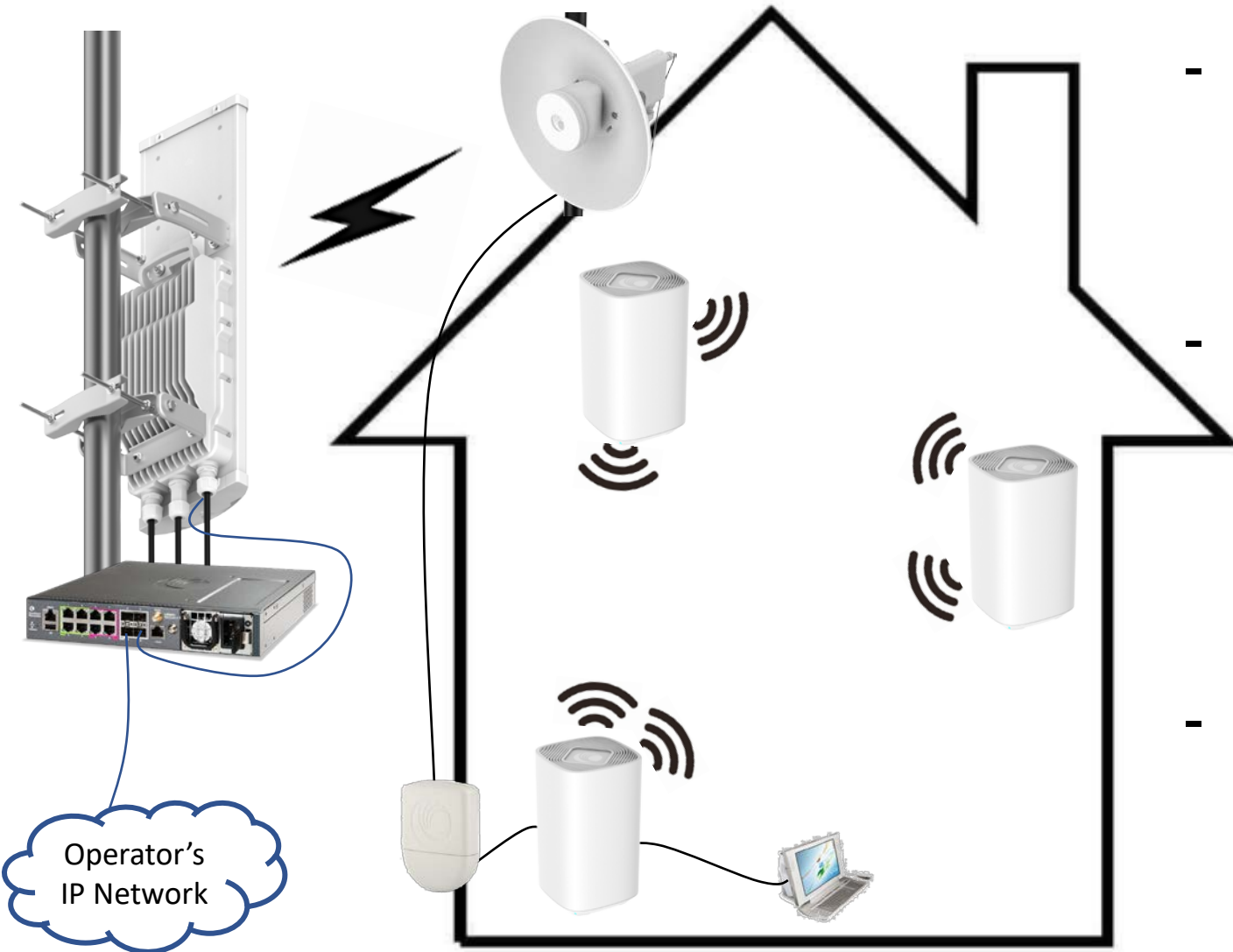


- In the US, FCC has allowed usage of 5850-5895 MHz (likely they will soon allow up to 5925 MHz)
- 6 GHz will open soon but will require the use of Automated Frequency Coordination (AFC).
- UNII-5 and UNII-7 will be allowed for outdoor use at “standard power” (36 dBm EIRP)
- UNII-6 and UNII-8 will be restricted to LPI (Low Power Indoor) use
- 450v can operate anywhere from 5.15 to 7.125 GHz
- 450b6 will operate from 5.725 up to 6.3 GHz

- **Deliver Extreme Performance to business and residential locations**
  - Extend the life of deployed PMP 450 gear
  - Reduce Churn, remain competitive
  - Enhance service plans, provide more bandwidth than ever
- **Operates from 5.15 to 7.125 GHz** in a single SKU
- **Backward and Forward Compatible *and* Future proof**
  - Purpose-built Software Defined Radio platform
  - Utilize existing investment in 450 platform
  - Extend and enhance performance using wide channels in 6 GHz
- **4x4 MIMO Access Point**
  - Use more bandwidth, up to 200 MHz
  - Dual Sector mode or Carrier Aggregation
  - 1.5 Gbps total capacity
- **4x4 (High Performance), 2x2 Subscriber Module or 450b6**
  - 4x4 SM capable of carrier aggregation and Gigabit speeds
  - 2x2 SM capable of 100 MHz channel support and 700+ Mbps
  - 450b6 capable of 40 MHz and 250+ Mbps



Feature	Operator Benefit
5 GHz to 7 GHz support in same hardware	Single SKU to stock and maintain
Backward <i>and</i> Forward compatibility	Leverage existing platform investment, migrate gracefully to next generation
Ultra-Wideband support (2x100 MHz channels)	Total Capacity Increase, more bandwidth
Dual Sector Mode	Can operate 2 carriers independently (i.e. one 5 GHz and one 6 GHz), very flexible
Carrier Aggregation – - The two carriers can have different bandwidths	Flexibility in spectrum usage - 5 GHz may be congested and require smaller channel while 6 GHz can utilize larger channel



- **Simple, flat Architecture**
  - AP at Tower location, all outdoor
  - Tx Switch to provide uplink to PoP
- **Flexible Deployment**
  - High gain SM options, available as:
    - 450b6 (up to 300 Mbps)
    - 2x2 450v (up to 700 Mbps)
    - 4x4 450v (up to 1.5 Gbps)
- **Synergy with Fabric**
  - Add cnPilot, cnMatrix and cnMaestro to complete the solution
  - Seamless operation, single pane of glass

- **Next Generation 450 Access Point**

- 5.15 to 7.125 GHz frequency support
- 4x4 MIMO
- 90 Degree Sector Antenna integrated

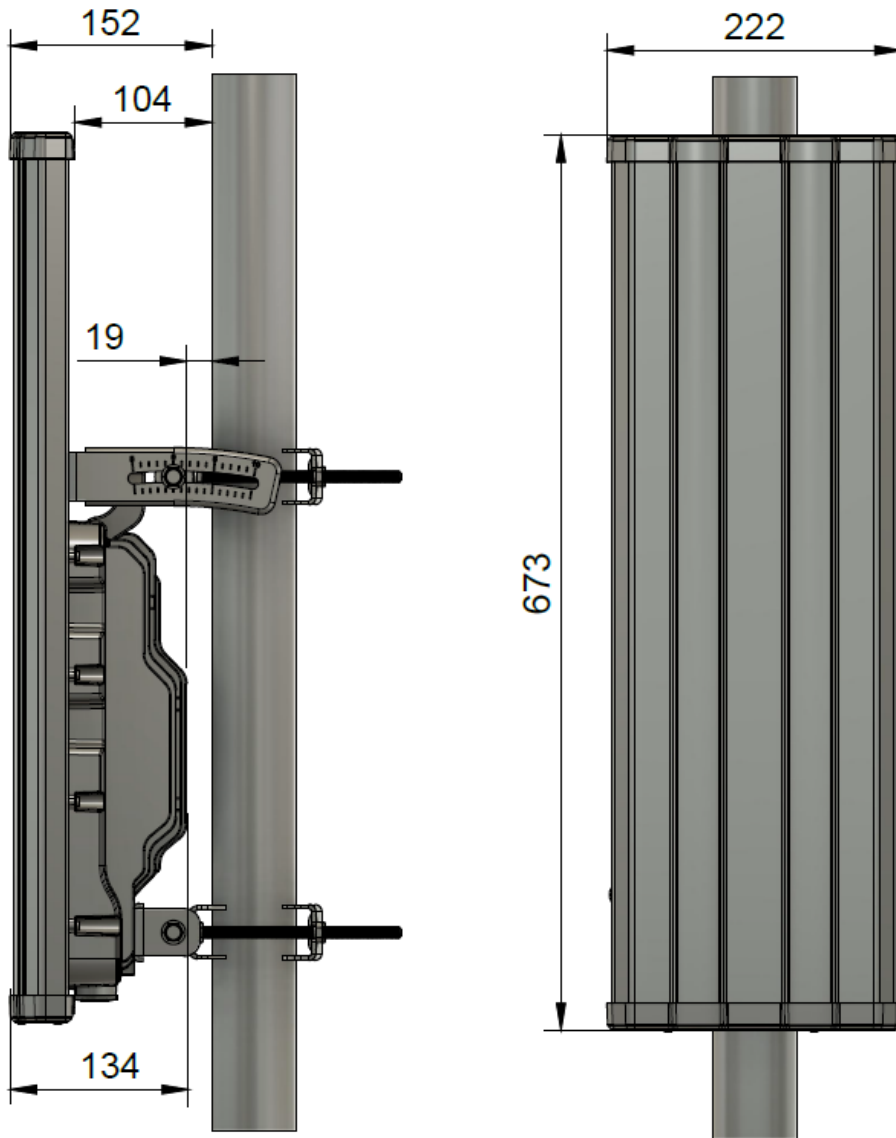
- **Scale and Enhance**

- Backward *and* Forward compatible
- Protect your investment but move into new spectrum and higher performance
- Capable of 1.5 Gbps capacity
- Carrier Aggregation and Dual Sector Mode
- Ports:
  - 1 Gbps Main Ethernet port
  - 1 Gbps AUX port (RJ-45 with 802.3at PoE Out)
  - 10/1 GbE SFP port





# 450v 4x4 Access Point – Dimensions and Weight

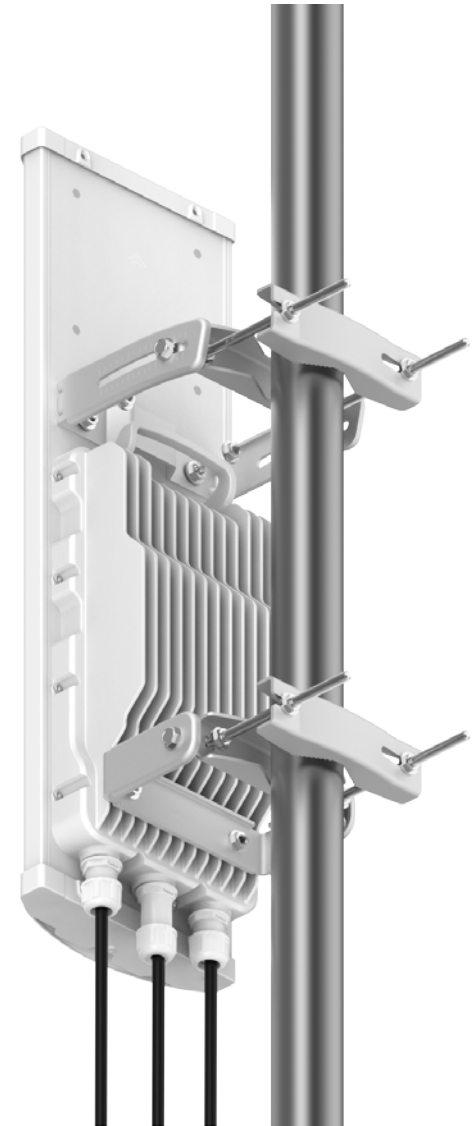


All pictured measurements in mm  
(24.5" H x 8.74" W x 5.3" D)

**Weight:**

Radio/Antenna Only: 6.3 kg (13.9 lb)

Complete Unit (w/bracket): 9.1 kg (20 lb)



- **High-capacity Subscriber Module (SM)**

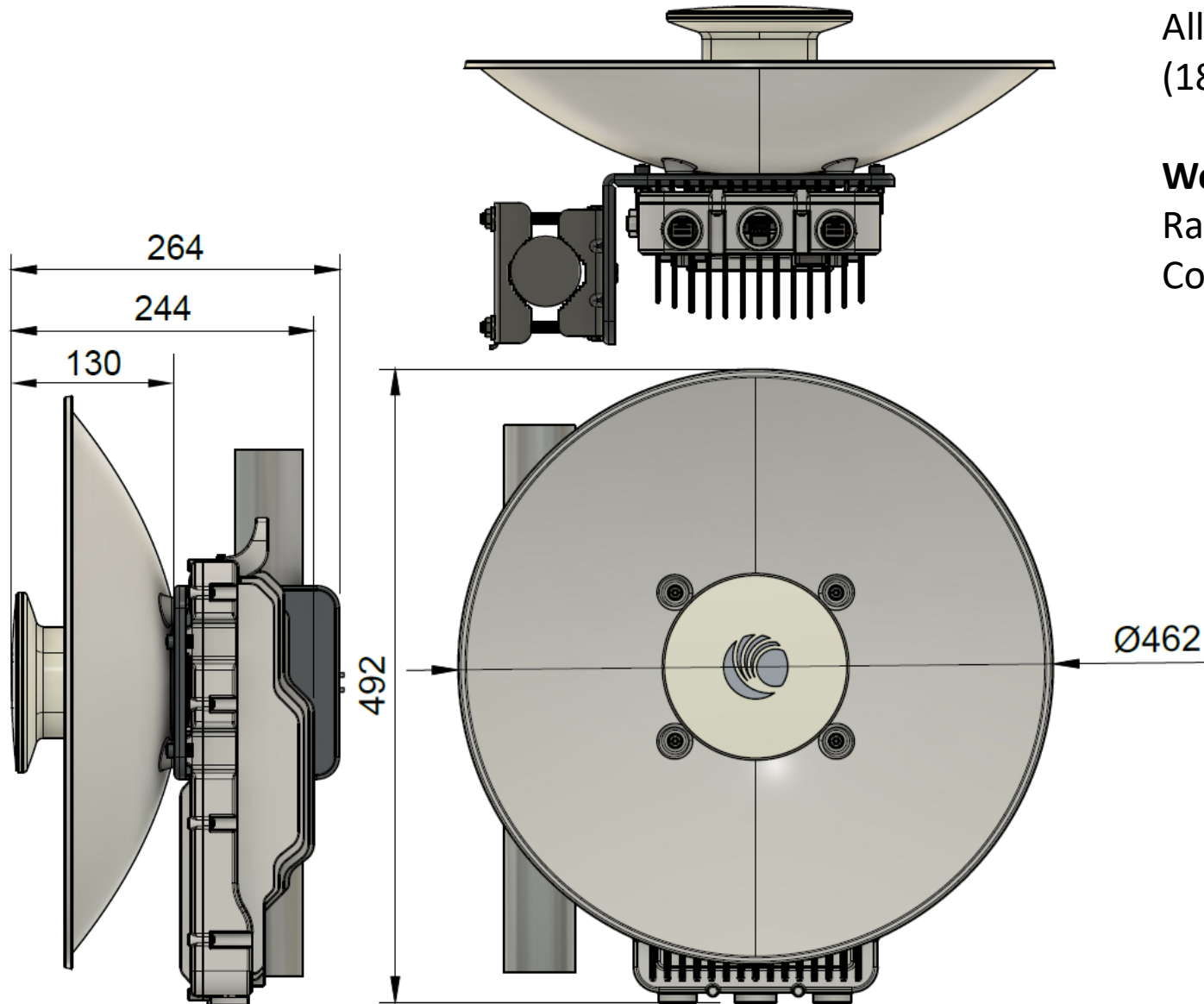
- 5.15 to 7.125 GHz frequency support
- 4x4 MIMO SM
- Capable of 2x100 MHz carrier aggregation
- Up to 1.5 Gbps capacity
- Will also become available as high-capacity PTP link

- **Ports**

- 1 Gbps Main Ethernet port
- 1 Gbps AUX port (3.5mm audio)
- 10/1 GbE SFP port



# 4x4 450v SM – Dimensions and Weight



All pictured measurements in mm  
(18" diameter x 10.4" depth)

## Weight:

Radio Only: 4.5 kg (9.9 lb)

Complete Unit (w/ dish & brackets): 8.5 kg (18.7 lb)



- **2x2 450v Subscriber Module (SM)**

- 5.15 to 7.125 GHz frequency support
- Up to 100 MHz channel bandwidth
- >700 Mbps capacity

- **Ports**

- 1 Gbps Main Ethernet port
- AUX port 3.5mm audio jack
  - required for GPS active antenna



- To use 6 GHz, a GPS Active Antenna must be used with both the 4x4 and 2x2 450v SM
- There is a different GPS receiver kit for the 450b6



Part Number	Description
N000045L003A	GPS Active Antenna with mount
N000045L004A	GPS puck kit for PMP 450b6

# PMP 450v – Power Supply Options

**N000000L142A**

56 VDC, 60 W, 5 GbE



C6 AC INLET

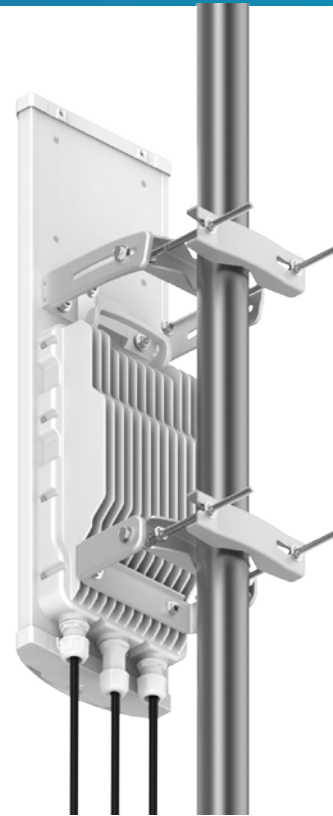
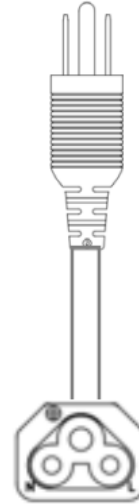


**N000900L031A**

US TYPE B

0.72 m LENGTH

C5 AC Line Cord



4x4 450v Access Point can also be powered by the TX series cnMatrix switches



## **C000000L033A**

Gigabit Surge Suppressor (56V), 10/100/1000 BaseT

Volts: 56V

Type: DC Power over Ethernet (PoE)

Env Protection: IP54

Transfer Rate: 1000 Mbps

Connectors: Two x RJ-45

Protection Mode: Line-to-ground

Surge Rating: 172A, 10/1000us(L-G)

230A, 5/320us (EN61000-4-5)

Mounting: Pole mount or wall mount

Operating Temperature: -40°C to +60°C

Grounding Accessories: M5-Termination ring included, C000000L138A (not included)

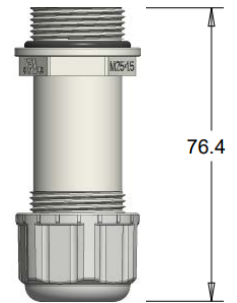


# PMP 450v – SFP Modules

Part Number	Description
SFP-1G-LX	1G SFP SMF LX Transceiver, 1310nm, -40C to 85C
SFP-1G-SX	1G SFP MMF SX Transceiver, 850nm, -40C to 85C
SFP-10G-LR	10G SFP+ SMF LR Transceiver, 1310nm, -40C to 85C
SFP-10G-SR	10G SFP+ MMF LR Transceiver, 1310nm, -40C to 85C
SFP-1G-COPPER	1000Base-T (RJ45) SFP Transceiver, -40C to 85C
SFP-10G-COPPER	10G Base-T (RJ45) SFP Transceiver, 0C to 70C



Use for either the 450v AP or SM



**C000000L124A** - extended glands for 450v Radios



Part Number	Description
C060045A401A	6 GHz 450v 4x4 Integrated Access Point, 90 Degree - ROW
C060045A402A	6 GHz 450v 4x4 Integrated Access Point, 90 Degree - FCC
C060045A405A	6 GHz 450v 4x4 Integrated Access Point, 90 Degree - No Encryption
C060045C401A	6 GHz 450v 4x4 SM – Radio Only
N060045D401A	6 GHz 450v 4x4 BH-SM Mechanical Dish Assembly, 4-pack, priced per unit
N000045L003A	GPS Active Antenna Kit (w/mount)

## IMPORTANT NOTES:

- Mounting brackets and hardware are included with AP
- Subscriber Modules are sold in multiples of four (4)
- The Dish Assembly kit must be purchased with each radio (i.e. 1:1 ratio)
- A GPS kit is required for each SM (in order to operate in 6 GHz using the AFC)

# PMP 450v – Warranty Part Numbers

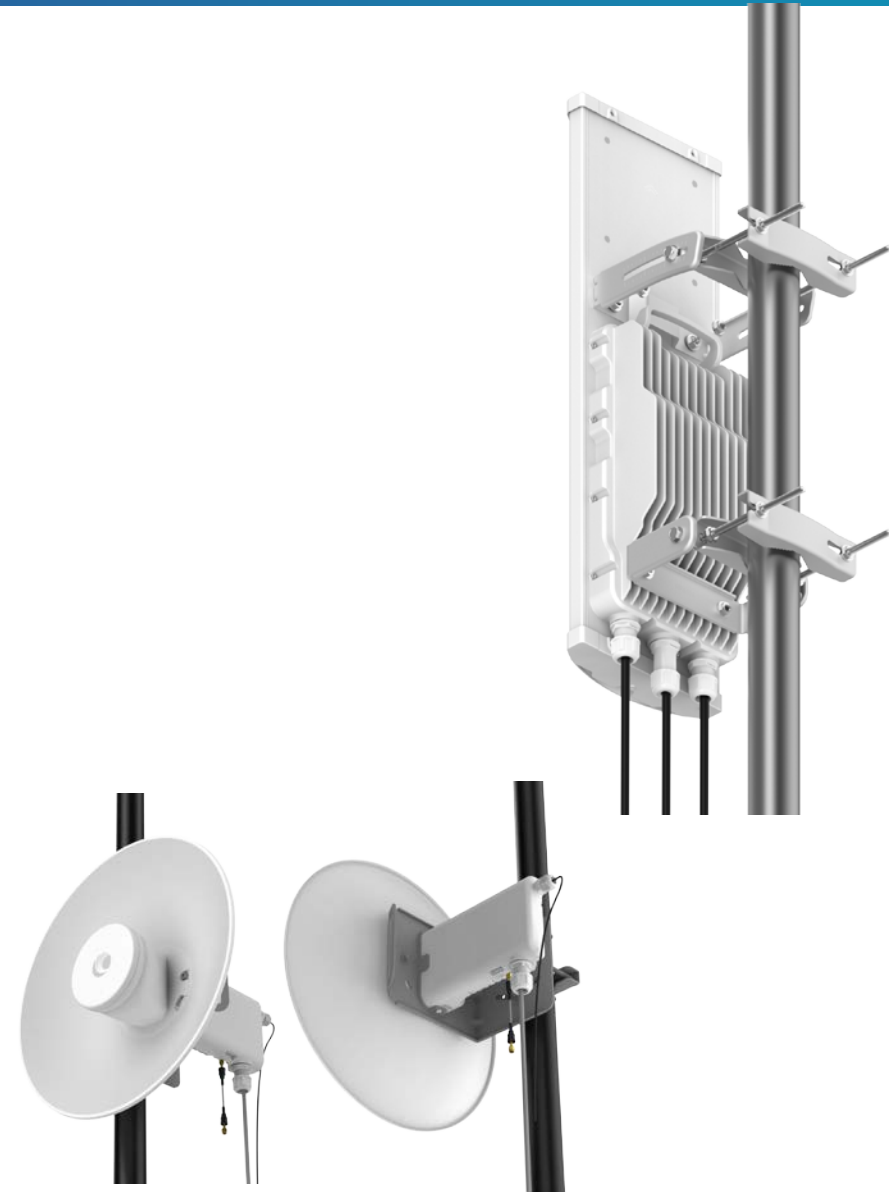
Part Number	Description
EW-450V4X4IAP-1	6 GHz 450v 4x4 Integrated AP Extended Warranty, 1 Additional Year
EW-450V4X4IAP-2	6 GHz 450v 4x4 Integrated AP Extended Warranty, 2 Additional Years
AR-450V4X4IAP-0	6 GHz 450v 4x4 Integrated AP Upgrade to All Risks Advanced Replacement Program during 3 year standard warranty
AR-450V4X4IAP-1	6 GHz 450v 4x4 Integrated AP All Risks Advance Replacement, 1 Additional Year
AR-450V4X4IAP-2	6 GHz 450v 4x4 Integrated AP All Risks Advance Replacement, 2 Additional Years
EW-450V4X4SM-1	6 GHz 450v 4x4 SM Extended Warranty, 1 Additional Year
EW-450V4X4SM-2	6 GHz 450v 4x4 SM Extended Warranty, 2 Additional Years
AR-450V4X4SM-0	6 GHz 450v 4x4 SM Upgrade to All Risks Advanced Replacement Program during 3-year standard warranty
AR-450V4X4SM-1	6 GHz 450v 4x4 SM All Risks Advance Replacement, 1 Additional Year
AR-450V4X4SM-2	6 GHz 450v 4x4 SM All Risks Advance Replacement, 2 Additional Years

# PMP 450v – Cambium Care Part Numbers



Part Number	Description
CCPRM-SUP-450V4X4IAP-1	Cambium Care Prime, 1-year support for one PMP 450v 4x4 AP. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCPRM-SUP-450V4X4IAP-3	Cambium Care Prime, 3-year support for one PMP 450v 4x4 AP. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCPRM-SUP-450V4X4IAP-5	Cambium Care Prime, 5-year support for one PMP 450v 4x4 AP. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCADV-SUP-450V4X4IAP-1	Cambium Care Advanced, 1-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-SUP-450V4X4IAP-3	Cambium Care Advanced, 3-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-SUP-450V4X4IAP-5	Cambium Care Advanced, 5-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4IAP-1	Cambium Care Advanced Add-on to cnMaestro X, 1-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4IAP-3	Cambium Care Advanced Add-on to cnMaestro X, 3-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4IAP-5	Cambium Care Advanced Add-on to cnMaestro X, 5-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCPRO-SUP-450V4X4IAP-1	Cambium Care Pro, 1-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates
CCPRO-SUP-450V4X4IAP-3	Cambium Care Pro, 3-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates
CCPRO-SUP-450V4X4IAP-5	Cambium Care Pro, 5-year support for one PMP 450v 4x4 AP. 24x7 TAC support, SW updates
CCPRM-SUP-450V4X4SM-1	Cambium Care Prime, 1-year support for one PMP 450v 4x4 SM. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCPRM-SUP-450V4X4SM-3	Cambium Care Prime, 3-year support for one PMP 450v 4x4 SM. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCPRM-SUP-450V4X4SM-5	Cambium Care Prime, 5-year support for one PMP 450v 4x4 SM. 24x7 TAC SLA support, SW updates, and ARAR for HW
CCADV-SUP-450V4X4SM-1	Cambium Care Advanced, 1-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-SUP-450V4X4SM-3	Cambium Care Advanced, 3-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-SUP-450V4X4SM-5	Cambium Care Advanced, 5-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4SM-1	Cambium Care Advanced Add-on to cnMaestro X, 1-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4SM-3	Cambium Care Advanced Add-on to cnMaestro X, 3-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCADV-UPG-450V4X4SM-5	Cambium Care Advanced Add-on to cnMaestro X, 5-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates, and NBDS advance replacement for HW
CCPRO-SUP-450V4X4SM-1	Cambium Care Pro, 1-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates
CCPRO-SUP-450V4X4SM-3	Cambium Care Pro, 3-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates
CCPRO-SUP-450V4X4SM-5	Cambium Care Pro, 5-year support for one PMP 450v 4x4 SM. 24x7 TAC support, SW updates

- **November 15, 2023**
  - Product Announcement, Pre-Orders are opened for 450v hardware
- **December 15, 2023**
  - Product Shipment begins
  - At launch, **product feature set is limited**: 5 GHz only, up to a single 40 MHz channel, no backward compatibility
- **January, 2024**
  - 24.0 Beta Software release
  - Features Enabled: Backward compatibility, 2x40 MHz Carrier Aggregation, 6 GHz support for FCC
- **March, 2024**
  - 24.0 Official Release
  - Unlock the real power of this platform
- **June, 2024**
  - Target for release of the 450b6 – Variant of the 450b SM that can extend to 6.3 GHz
- **August, 2024**
  - 2x2 450v – 700 Mbps, Up to 80 MHz channel, 5-7 GHz operation

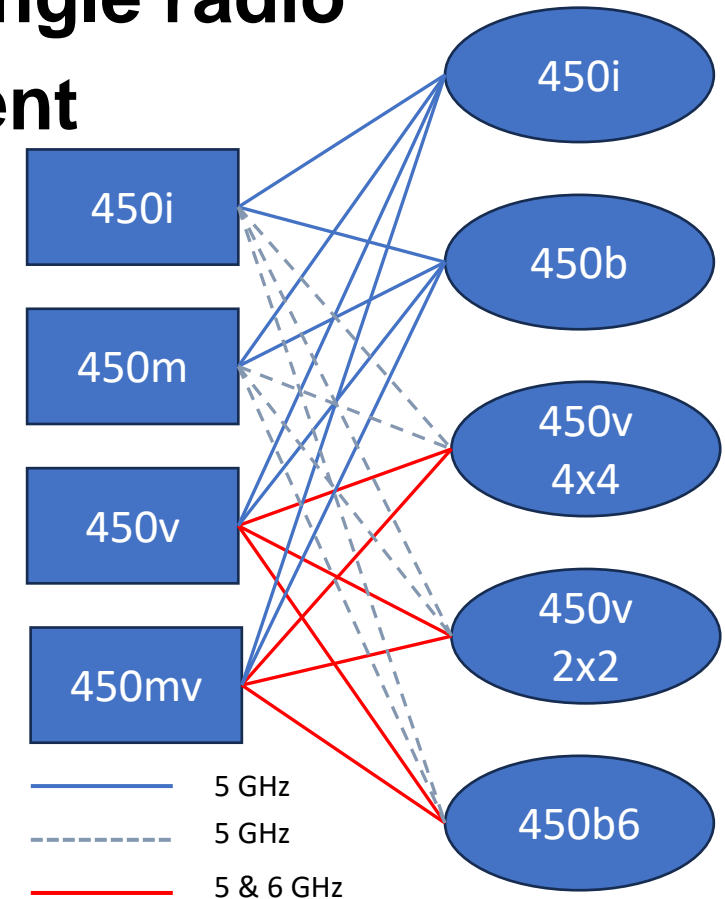


# 450v Use Cases



- Anywhere tower space requirements are tight, achieve deployments in BOTH 5 GHz and 6 GHz in a single radio
- 1.5 Gbps total capacity, very flexible deployment

Band	Channels	Range (Modulation)	Aggregate Cap Gbps
5 GHz	2x100 MHz	1.3 mi. (8x, 256-QAM)	1.5
5 GHz	2x100 MHz	2.9 mi. (6x, 64-QAM)	1.1
6 GHz	2x100 MHz	1.2 mi. (8x, 256-QAM)	1.5
6 GHz	2x100 MHz	2.6 mi. (6x, 64-QAM)	1.1
Mixed	2x100 MHz	1.2 mi. (8x, 256-QAM)	1.2
Mixed	40 MHz in 5GHz, 100 MHz in 6 GHz	1.2 mi. (8x, 256-QAM)	1.1
Mixed	40 MHz in 5GHz, 100 MHz in 6 GHz	3 mi. (6x, 64-QAM)	0.8



# 6 GHz PMP 450 Subscriber Map

	450b6	450v 2x2	450v 4x4
Frequency Support (GHz)	5.7 to 6.3	5.15 to 7.125	5.15 to 7.125
MIMO	2x2	2x2	4x4
Channel Bandwidth (MHz)	40	100	2x100 (Carrier Aggregation)
Capacity (Gbps)	0.300	0.750	1.5
EIRP in 6 GHz (dBm)	36	36	36
1 Gbps Ethernet Port	Yes	Yes	Yes
AUX port (3.5mm audio)	Yes	Yes	Yes
10/1 GbE SFP Port	No	No	Yes
GPS	External <sup>+</sup>	Internal <sup>++</sup>	Internal <sup>++</sup>

<sup>+</sup> Requires GPS receiver connected to AUX for AFC

<sup>++</sup> Requires GPS antenna connected to AUX for AFC

1. Existing PMP 450/450b subscriber modules connect to PMP 450v on the existing 5 GHz channel
2. Provision the second channel in 6 GHz, enhancing sector capacity
3. Increase ARPU with higher capacity subscriber modules on 6 GHz and 5 & 6 GHz channel bonding
  - Swap PMP 450/450b subscriber module with PMP 450v 4x4 subscriber module
  - PMP 450v net new subscribers on higher SLAs
  - PMP 450b6 and 2x2 PMP 450v subscriber modules in the future to improve ROI





The addition of 80 MHz of clean 6 GHz spectrum results in a significant increase in sector capacity

Moving the “top talkers” in the sector (typically 5–8 users) to 6 GHz by replacing existing subscriber modules with PMP 450v subscriber modules will alleviate congestion and allow remaining users a better experience

Enables sales of higher tier packages within the sector by using the PMP 450v 4x4 subscriber module on 6 GHz



**Rule of Thumb, if MUX gain is less than 2, consider upgrading to PMP 450v, and redeploy the 450m**

## PMP 450m AP @ 30 MHz

- 75% duty cycle, 10-mile range
- 40 Subscriber Modules
- MUX gain = 1.66
- MU-MIMO
  - Sector capacity: **131 Mbps**
- SU-MIMO
  - Sector capacity: 79 Mbps
- Delta traffic:  $131 - 79 = 52$  Mbps

## PMP 450v AP @ 30 + 80 MHz

- Top 6 SMs that generate about 52 Mbps of throughput
- Replace them with PMP 450v Subscriber Modules
- 30 MHz channel
  - Remaining legacy subscriber modules
  - Sector capacity: **79 Mbps**
- 80 MHz channel
  - Canopy V SMs + capacity for expansion
  - Peak throughput: 229 Mbps
  - Sector capacity: **155 Mbps**

 Rule of Thumb, if MUX gain is less than 2, consider upgrading to PMP 450v, and redeploy the 450m

- **Total Capacity**
  - $79 + 155 = 234$  Mbps
  - Improvement of 103 Mbps

**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



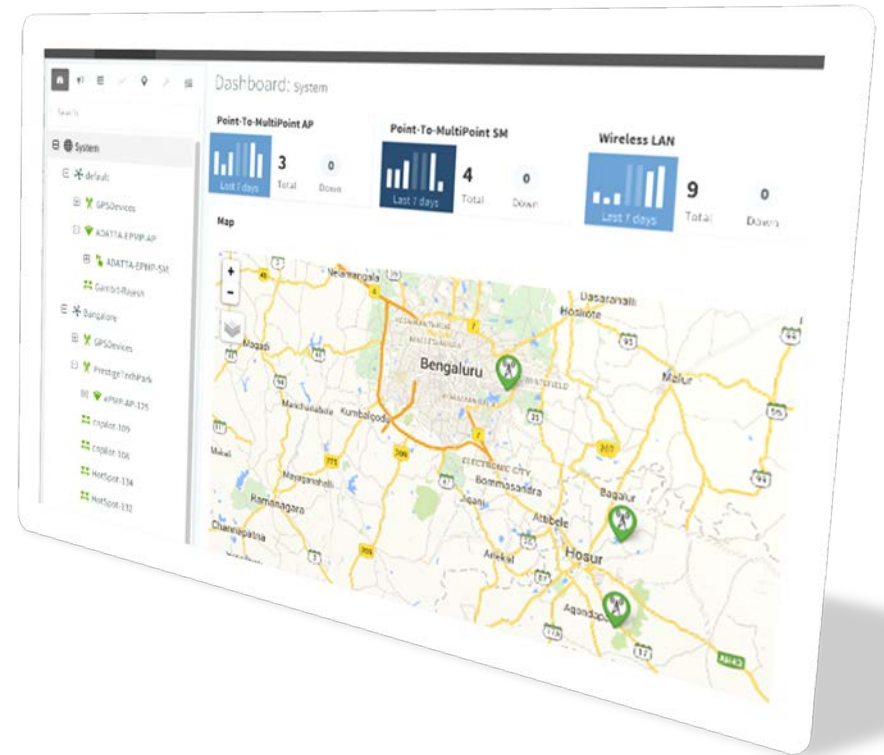
**Configure devices** – Automatically provision devices upon registration, or group devices and apply configuration parameters across your network



**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





## cnHeat

Improve the precision of site surveys while saving time and money. Heat map displays provide the exact antenna location that offers the best connectivity.



## cnArcher™

Improve installation accuracy with the free Android™ app that gives field techs the information they need to configure and properly align PMP subscriber modules.



## LINKPlanner

Quickly and easily design networks for optimal deployment and cost effectiveness.

### Typical Application

Quickly pre-qualify new customers saving time and money. Identify and market to addresses of unserved customers. Determine optimal greenfield site placement.

**LOCATE** subscriber installations

**IDENTIFY** unserved customers

**OPTIMIZE** greenfield site placements

Designed with input from field technicians and years of experience on our millions of wireless broadband modules deployed, cnArcher validates configuration and alignment in seconds.

Boost the number of installs done right the first time and increase customer satisfaction. Eliminate problems and focus your manpower on connecting new subscribers as your network grows.

LINKPlanner allows you to model scenarios, based on geography, distance, antenna height, transmit power and other factors, to optimize system performance before purchase. Quickly design networks for optimal deployment and cost effectiveness with ease. Available for Microsoft® Windows® and Mac® systems, LINKPlanner is a free, user-friendly link-design tool.



**Cambium Networks™**

**Thank You**  
Questions?