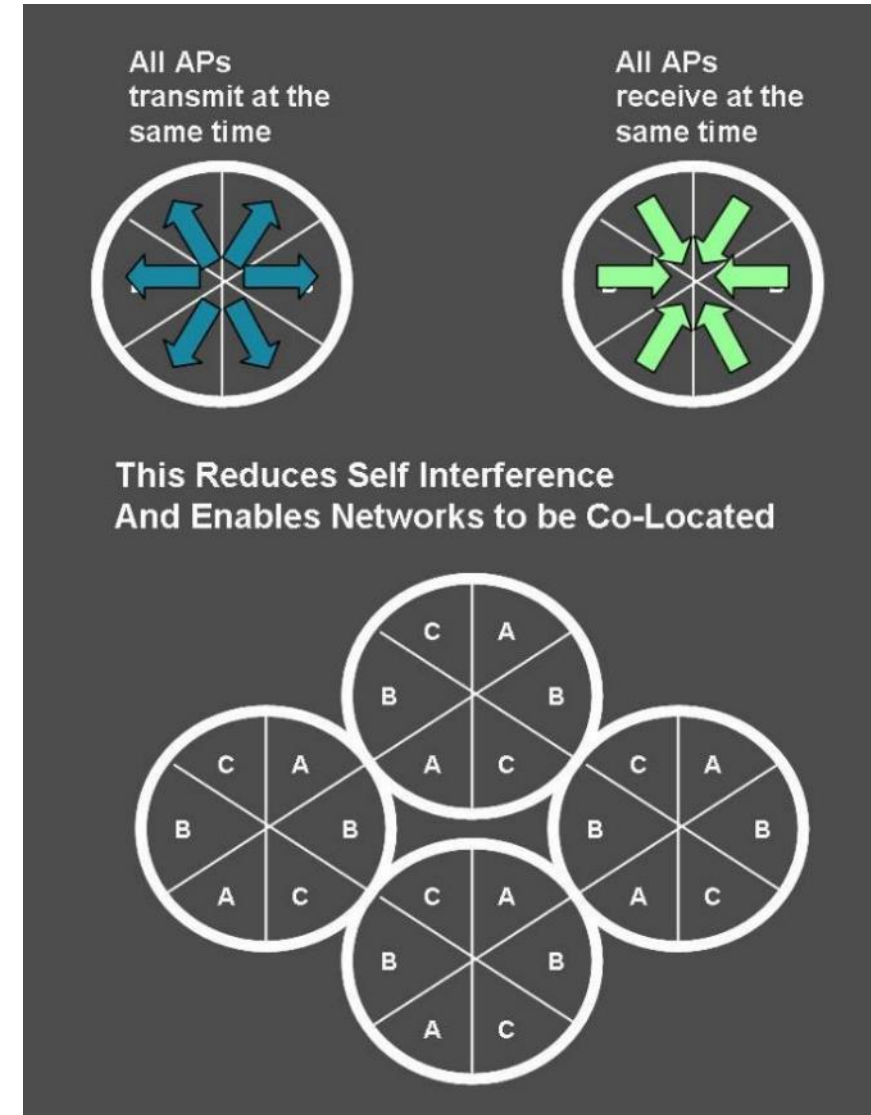# TDD Synchronization with cnPulse

Bruce Collins
Product Management
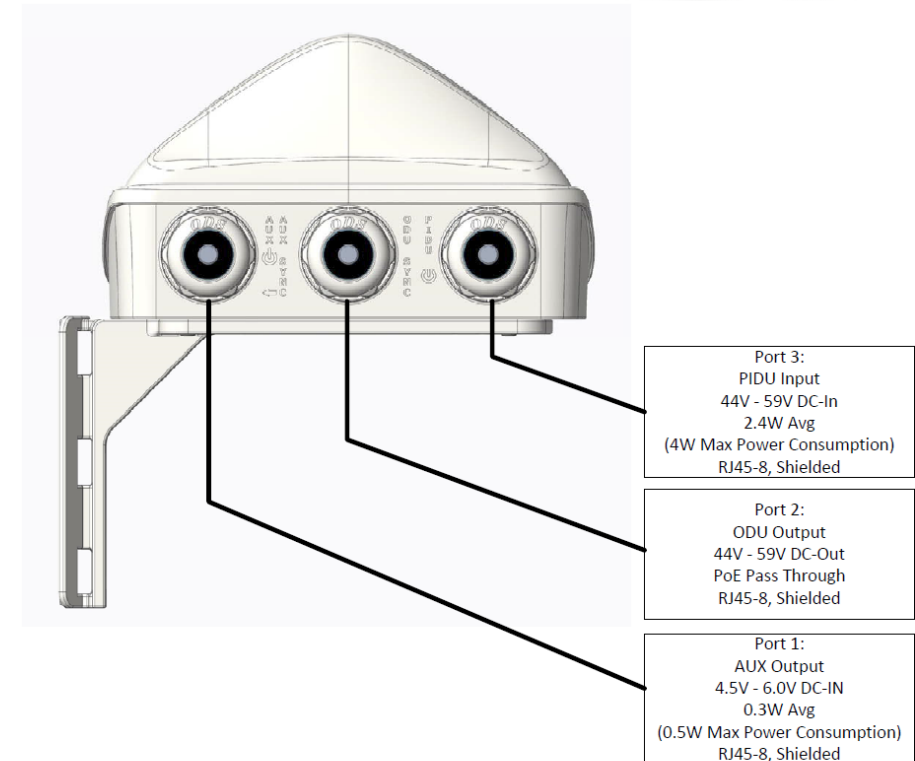
TDD Synchronization with GPS Source

- ## AP and SM communication is synchronized (all APs and SMs have controlled alternating communication) – reducing self interference
    - All SMs within a network
    - All APs within a cluster
    - All APs on a tower (multiple clusters)
    - All APs on all towers in the network

- ## Enables channel re-use and easy to deploy multi-sector, multi tower networks (minimal tower separation)

- ## Use the same number of channels to serve a higher number of users

All APs transmit at the same time

All APs receive at the same time

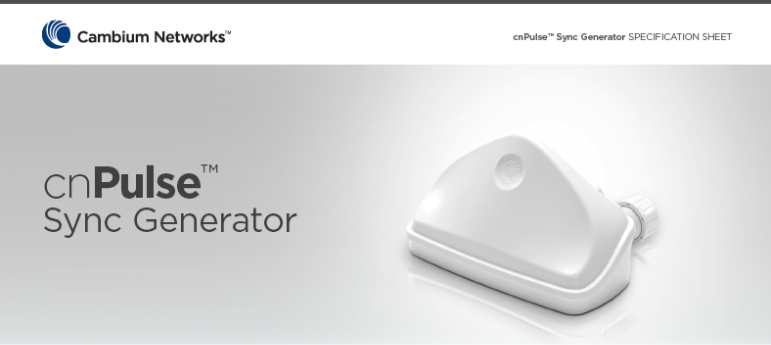This Reduces Self Interference And Enables Networks to be Co-Located

Introducing cnPulse

- Model: C000000L066A

- GPS source for TDD Synchronization

- Three modes of operation
  - AUX port
  - In-line CambiumSYNC
  - CMM5
  - Combine AUX and CambiumSYNC mode for two PMP 450i/450m radios

- Rugged, all-outdoor construction
  - Shielded RJ-45 connections
  - IP67

- Simple deployment
  - Includes right angle bracket
  - No configuration or software required

- Broad portfolio support
  - AUX mode: PMP 450i/450m, PTP 450i
  - In-line CambiumSYNC mode: PTP 550, ePMP 3000
  - CMM5

Port 3:
PIDU Input
44V - 59V DC-In
2.4W Avg
(4W Max Power Consumption)
RJ45-8, Shielded

Port 2:
ODU Output
44V - 59V DC-Out
PoE Pass Through
RJ45-8, Shielded

Port 1:
AUX Output
4.5V - 6.0V DC-IN
0.3W Avg
(0.5W Max Power Consumption)
RJ45-8, Shielded

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3

cnPulse™ Sync Generator

TDD Synchronization is critical for deploying dense scalable wireless networks, whether in a PTP or PMP topology. One typical source for synchronization is the GPS satellite signal which carries a precise one pulse per second (1PPS) clock. Using this clock, PMP and PTP networks can synchronize the start and stop time of all transmissions. By synchronizing the transmit and receive signals, each AP or Access Point isn't transmitting while its neighbor is receiving, thereby reducing self-interference, increasing spectral efficiency and enabling much more dense network deployments.

cnPulse is the latest GPS synchronization generation device designed specifically for Cambium Networks PMP and PTP radios. The cnPulse module is IP67 (weather proof and supports a wide temperature range for rugged environments. The GPS receiver is highly reliable and supports both GPS and GNSS signals. cnPulse gets it power from the ODU AUX port in mode 1 or from the CAT-5 drop cable in mode 2 so no external power supply is required. There are no configuration or software settings required.

cnPulse can be deployed in two alternative ways as shown in the table below. Note that a single cnPulse can provide synchronization to two AP's by leveraging mode 1 on the first ODU and mode 2 on the second ODU.

SPECIFICATIONS

| MODEL NUMBER	C000000L066A
cnPULSE OPERATION	
Mode 1: AUX Serial mode (uses cnPulse port 1)	cnPulse derives power input from the radio or CMM port and returns the 1PPS signal and satellite statistics on port 1. Typically used on CMM5, cnReach and the AUX ports on PMP 450i, PMP450m or PTP 450i
Mode 2: CambiumSYNC In-line mode (uses cnPulse port 2 and port 3)	cnPulse is deployed in-line with the radio's CAT-5 drop cable. cnPulse receives power (and data) from the ODU's PoE power injector on port 3. cnPulse port 2 then outputs PoE+Data+CambiumSYNC to the main input on a radio. Typically used on PTP 550.
COMPATIBILITY	
CambiumSYNC mode	PMP 450i, PTP 450i, PMP 450m, PTP 550, ePMP 2000, ePMP 3000
Aux Serial mode	CMM5, PMP 450m, PMP 450i, PTP 450i
INTEGRATED ANTENNA	GPS L1, 1575.42MHz GLONASS L1, 1598.0625-1605.375MHz
RECEIVER	
Tracking Channels	33 tracking/ 99 acquisition-channel GPS +GLONASS receiver
Update Rate	1 Hz (NMEA)
Timing Accuracy	±20ns RMS
Position Accuracy	3 meter

SPECIFICATIONS

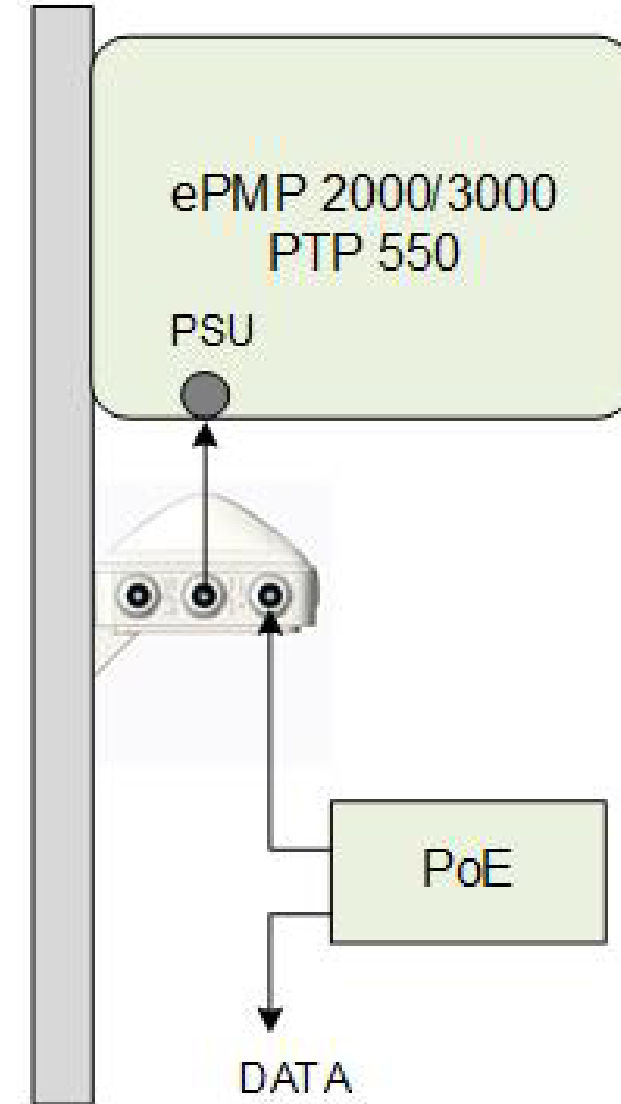| **DATA INTERFACE**	
Communication Standard	NMEA – 0183
Interface technology	1 PPS, Tx GPS Location Data (Serial 8/N/1 9600 bps)
ACQUISITION – COLD START	35 seconds (typical under open clear sky)
SENSITIVITY	
Acquisition	-148 dBm
Tracking	-165 dBm
INPUT VOLTAGE	4.5V to 6.0 VDC at AUX Port (port 1) 44-59 VDC on PoE Input Port (port 3)
MAXIMUM POWER CONSUMPTION	0.3W Avg (0.5W Max @ 6V Aux) 2.4W Avg. (4W Max @ 59V Poe)
ELECTRICAL INTERFACE	
Port 1: AUX PORT	RJ-45 8-pin shielded; AUX output
Port 2: PoE + CambiumSYNC ODU	RJ-45 8-pin shielded; PoE + CambiumSYNC + Data output
Port 3: PoE+ CambiumSYNC PIDU	RJ-45 8-pin shielded; PoE + Data Input
ENVIRONMENTAL	
Temperature	-40C to +85C (-40F to +185F)
Humidity	0% to 95% humidity, non-condensing
Water/Dust Ingress	IP67
SIZE/WEIGHT	
Dimensions	16.8 cm x 9 cm x 10 cm (LxWxH) (6.6" x 3.5" x 4")
Weight	0.42 kg (15 ounces)
MOUNTING	cnPulse ships with a right angle bracket for pole mount applications.
CABLING (not included)	
CMM5 to cnPulse	Optional: N000000L125A cnPulse to CMM5 20m shielded cable (8-pin RJ-45 to 6-pin RJ-12)
AUX port to cnPulse	Recommend to use an 8-pin shielded straight through CAT5 cable
Radio to cnPulse	Recommend to use an 8-pin shielded straight through CAT5 cable
PoE injector to cnPulse	Recommend to use an 8-pin shielded straight-through CAT5 cable
cnReach to cnPulse	Refer to cnReach user guide for pinout.

cnPulse: AUX Mode

- Supports PMP 450i/450m, PTP 450i, PMP 450

- cnPulse receives power from radio's AUX port

- cnPulse sends 1PPS signal and Satellite statistics

- Satellite statistics available in radio GUI
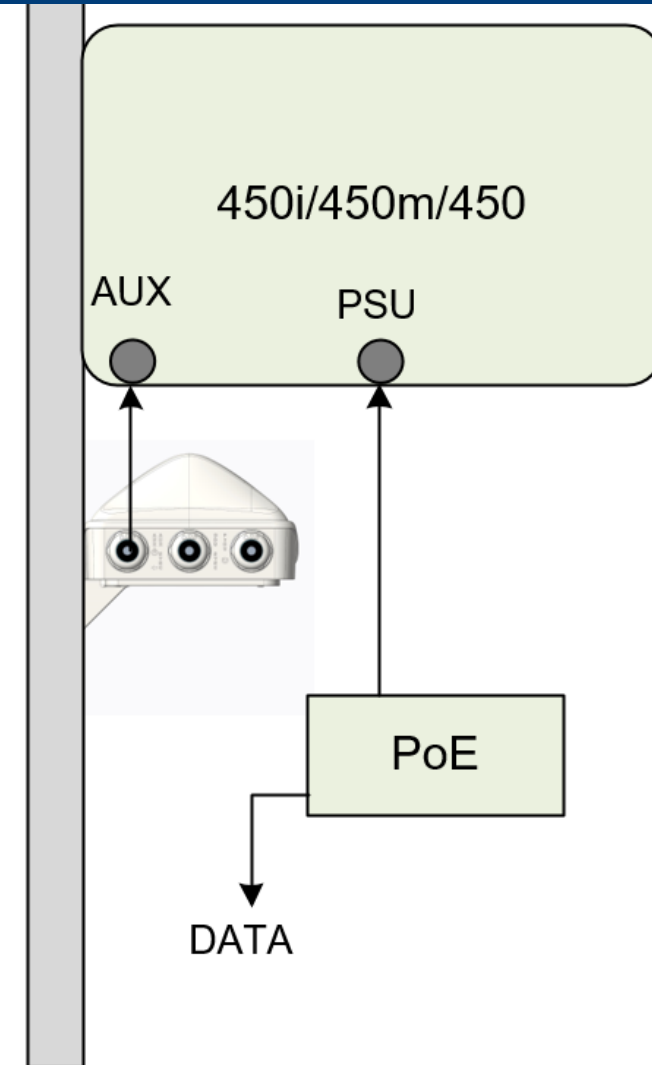
cnPulse: In-line CambiumSYNC Mode

- Supports PTP 550, ePMP 3000, PMP 450i/450m

- cnPulse receives power and data from power injector

- cnPulse sends power, data and 1PPS signal to radio's PSU/power input port

- No GPS statistics available in this mode

ePMP 2000/3000
PTP 550

PSU

PoE

DATA

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cnPulse: SYNC input for CMM5

- Supports CMM5 56V and 29V injectors

- cnPulse receives power from CMM5 injector's uGPS port

- cnPulse sends 1PPS signal and Satellite statistics

- Satellite statistics available in CMM5 GUI and SNMP interface

- Optional: N000000L125A cnPulse to CMM5 20m shielded cable (8-pin RJ-45 to 6-pin RJ-12)
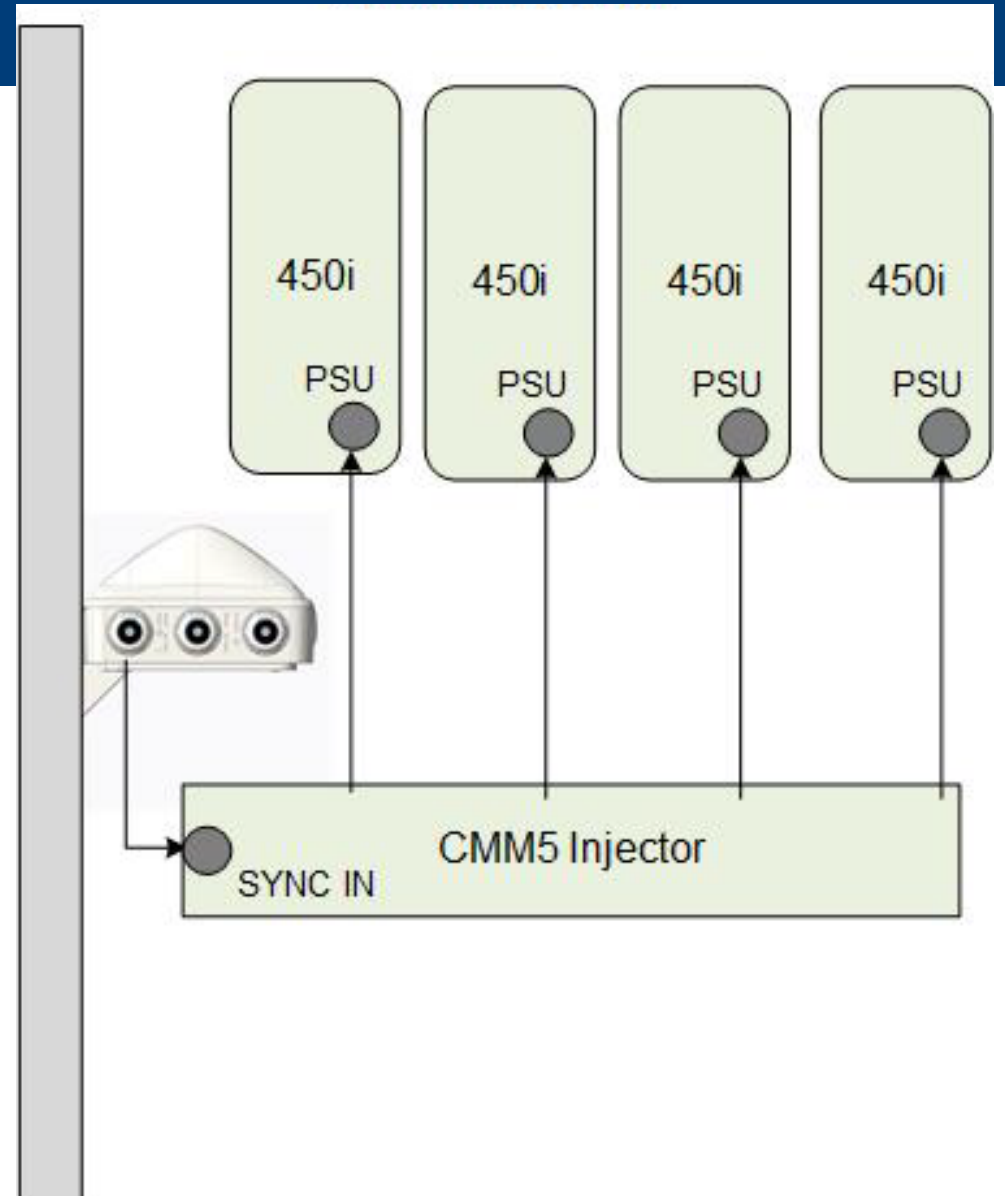
cnPulse: Two Radios with Single cnPulse

- Combines AUX mode and in-line CambiumSYNC mode simultaneously

- ODU 1 (left) gets input via AUX port and can display statistics

- ODU 2 (right) gets input via CambiumSYNC
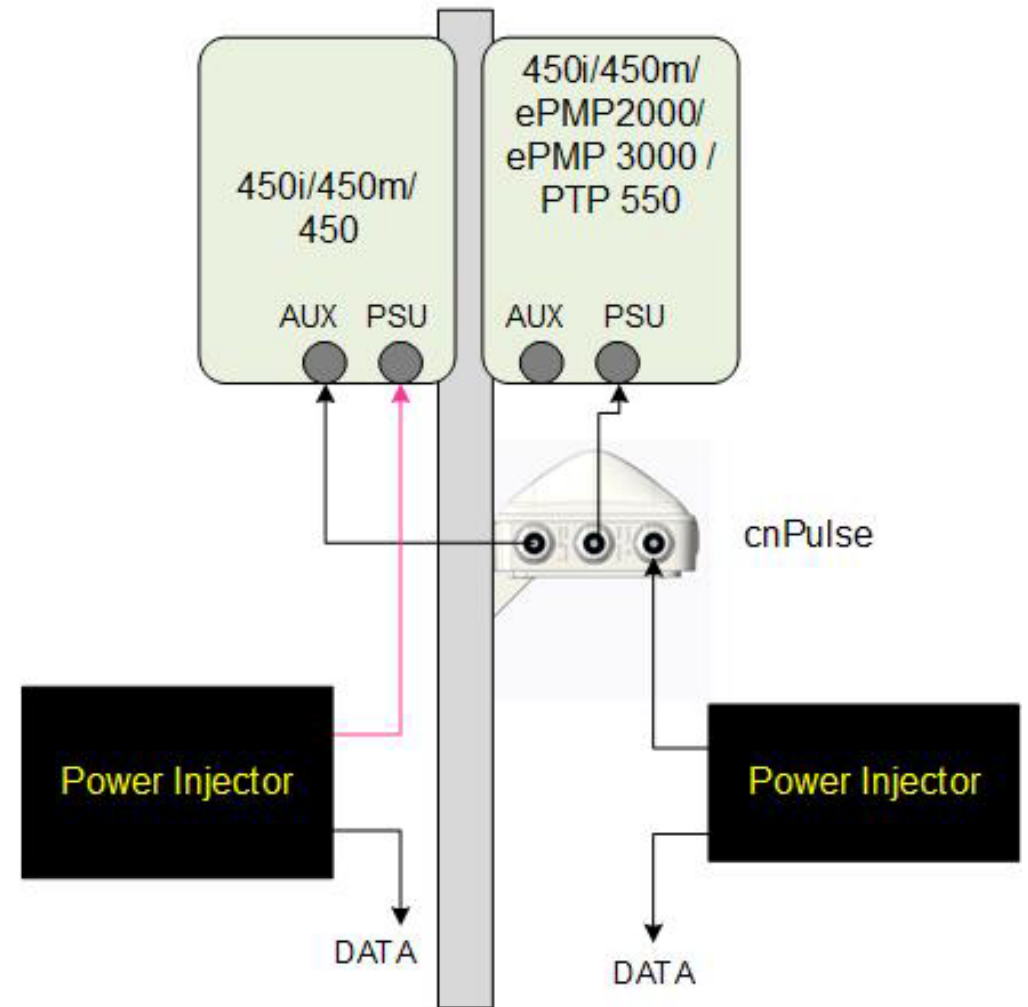
cnPulse vs. uGPS

- Same form factor and size

- uGPS (list price $349)
  - Two output AUX ports only (no CambiumSYNC)
  - Separate power input required when used with two radios
  - No support for PTP 550 or ePMP
  - No longer available
  - RJ-12 6 pin connectors

- cnPulse (list price $279)
  - Adds support for CambiumSYNC
  - No external power supply required
  - All RJ-45 8-pin connectors

CAT5 Cable Options
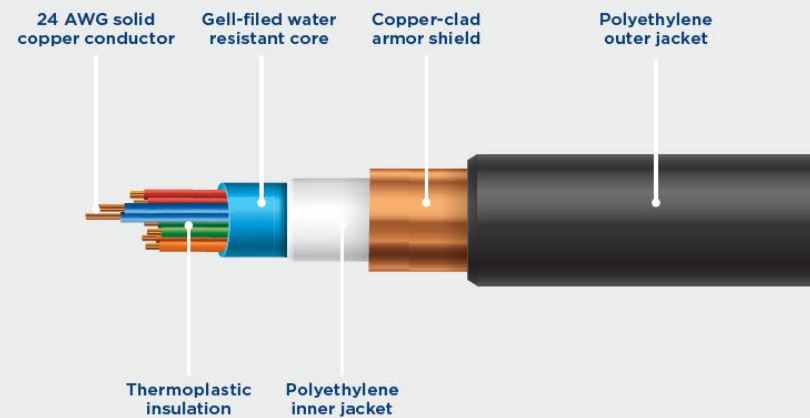
Choose the Right Solution

Industrial Grade

- Bonded pairs for consistency in performance on long drop cables

- Sunlight and oil resistant industrial grade PVC jacket

- 24 gauge solid copper conductors
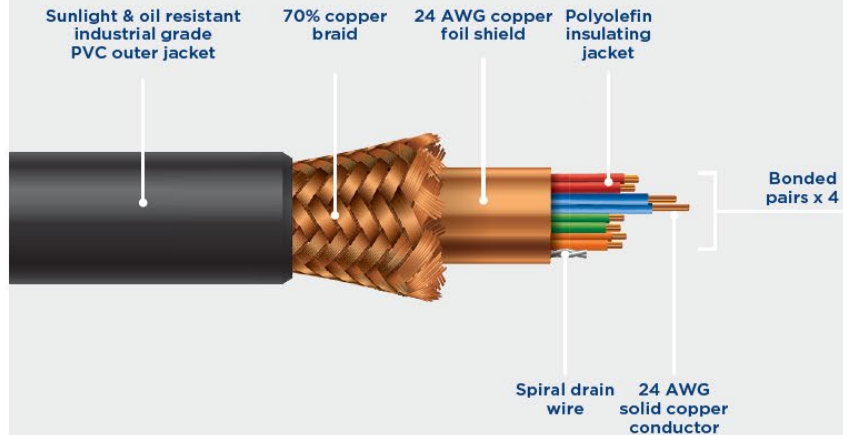
Infrastructure Grade

- Sunlight and weather resistant polyethylene jacket

- Copper-clad armor for shielding, mechanical protection and rodent resistance

- Gel-filled for preventing water intrusion

- 24 gauge solid copper conductors

Sunlight & oil resistant industrial grade PVC outer jacket   **70% copper braid**   **24 AWG copper foil shield**   **Polyolefin insulating jacket**   **Bonded pairs x 4**

Spiral drain wire   **24 AWG solid copper conductor**

24 AWG solid copper conductor   **Gell-filed water resistant core**   **Copper-clad armor shield**   **Polyethylene outer jacket**

Thermoplastic insulation   **Polyethylene inner jacket**

New CAT-5E Cable Option

	Industrial Cable	Infrastructure Cable
Recommended Applications	PMP 450i SM's, ePMP 1000/2000, cnPilot, Tactical Installations of PTP links	PTP 670, PTP 700, PMP 450m, PMP 450i AP's
Construction	70% Copper Braid Mesh and 100% Copper Foil	100% Copper Clad and Gel-filled
Conductors	24 gauge solid copper	24 gauge solid copper
Jacket	Industrial Grade PVC	Polyethylene
Diameter	8.4 mm	9.1 mm
Model Numbers		
1,000 ft. / 300 meter	N000000L108A	WB3175A
328 ft. / 100 meter	N000000L107A	WB3176A
50 meter	N000000L106A	Not available
Recommended RJ-45 Connectors	C000000L109A (100 pack shielded)	WB3177B (100 pack unscreened)
Recommended RJ-45 Crimp Tool	C000000L110A	WB3211A

30V and 56V Gigabit Ethernet Surge Suppressor

- 1000BaseT Lightning and Surge protection

- Models:
  - 56V: C000000L033A
    - PMP 450i/450m
    - PTP 450i/450m
  - 29V: C000000L065A
    - PMP 450 and 450b (subscriber modules)
    - ePMP F180, F200
    - Any other 30V devices

- Long Life / High Performance
  - TVS Diodes (Transient Voltage Suppression)
  - Faster response time than GDT's
  - -40C to +60C

- Easy Install
  - Two x RJ-45 Connections
  - Ships with wall and pole mount hardware

APPLICATION ALERT:

3rd party testing confirms that Surge Suppressors based on GDT's (Gas Discharge Tubes), such as the Mimosa Networks NID, will NOT protect PMP 450i and PMP 450b Subscriber Module or Access Point radios from lightning or other surges.

1. Protecting radios from lightning and other electromagnetic surges is a key aspect in deploying reliable and profitable wireless communication systems. System downtime, tower climbs and the cost to replace damaged equipment can have a significant impact on customer satisfaction and the ROI on network deployments.

2. Cambium offers a set of field-proven and lab-tested surge suppressors based on best-practice design methodologies that include fast-firing TVS diodes. TVS diodes respond to surges more than 100x faster than gas discharge tubes with response times on the order of 10 to 100 nS. GDT's also have the downside that they become less effective over time as they absorb periodic surges.

3. There are several surge suppressors on the market, such as the Mimosa Network Interface Device, that exclusively use GDT's (Gas Discharge Tubes) as the active component. This style of surge suppressor should NOT be used to protect PMP 450i or PMP 450b radios.

4. Cambium Networks' testing at an external test lab has demonstrated that surge suppressors based on GDTs alone are insufficient to protect PMP 450i and PMP 450b radios. A summary of the results are below. The detailed test report can be made available on request.

   a. Testing was done per the IEC Standard EN61000-4-5:2014 (1.2 μs x 50 μs surge waveform) with 2kV pulses.

   b. Using a Mimosa NID (Gas Discharge Tube) device, system damage occurred on the PMP 450b and the PMP 450i.

   c. Using a Cambium Networks Gigabit Surge Suppressor, no damage occurred to the radios or the Cambium Networks surge suppressor when tested against the IEC Standards.

5. More information on proper lightning protection is on the Cambium Networks Community HERE.

RECOMMENDATION:

Cambium Networks does NOT recommend deploying Gas Discharge Tube-based surge protection (such as the Mimosa NID) on PMP 450i or PMP 450b platforms. Instead, the Cambium Networks Gigabit Surge Suppressors should be used (for 56V devices use C000000L033A; for 30V devices use C000000L065A).