60 GHz cnWave Field Results

Gino Villarini, Founder & President, Aeronet Wireless Broadband

Allen Yu, Director - Product Management, Cambium Networks

Antony Holmes, VP - Engineering, Cambium Networks

Cambium 60 GHz cnWave

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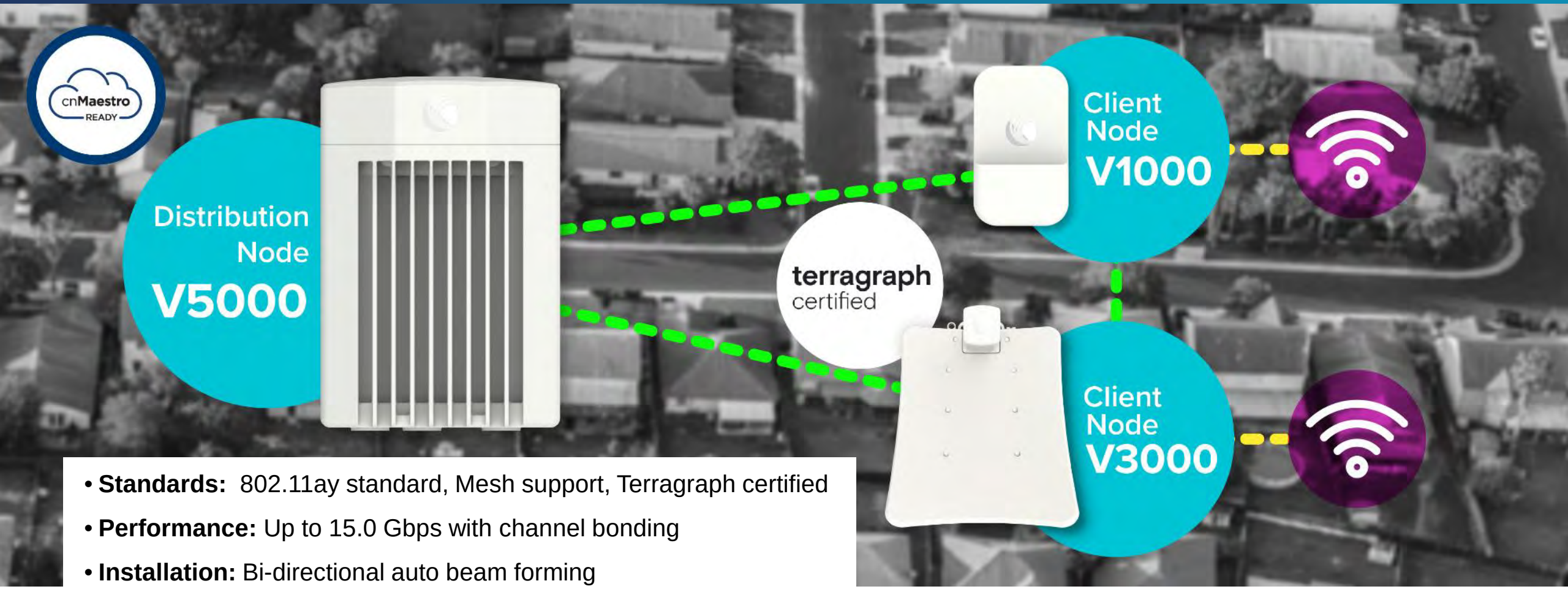

- **Standards:** 802.11ay standard, Mesh support, Terragraph certified
- **Performance:** Up to 15.0 Gbps with channel bonding
- **Installation:** Bi-directional auto beam forming
- **Operation:** Auto expansion, auto healing with Mesh support
- **Configuration:** Point-to-Point, Point-to-MultiPoint, Mesh
- **Management:** cnMaestro™

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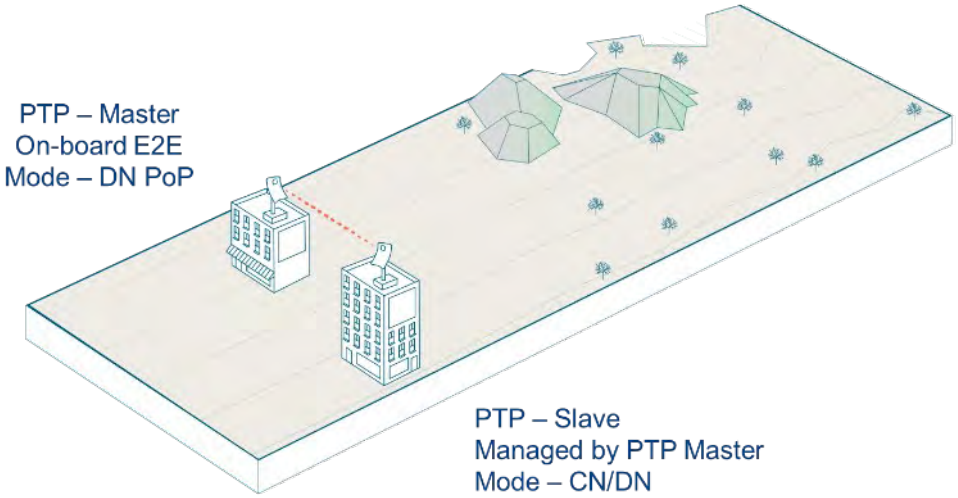
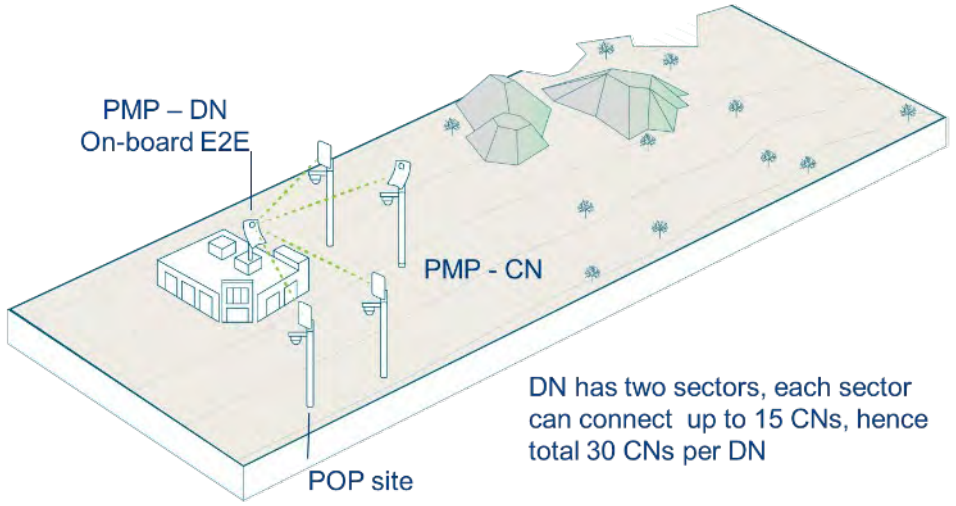
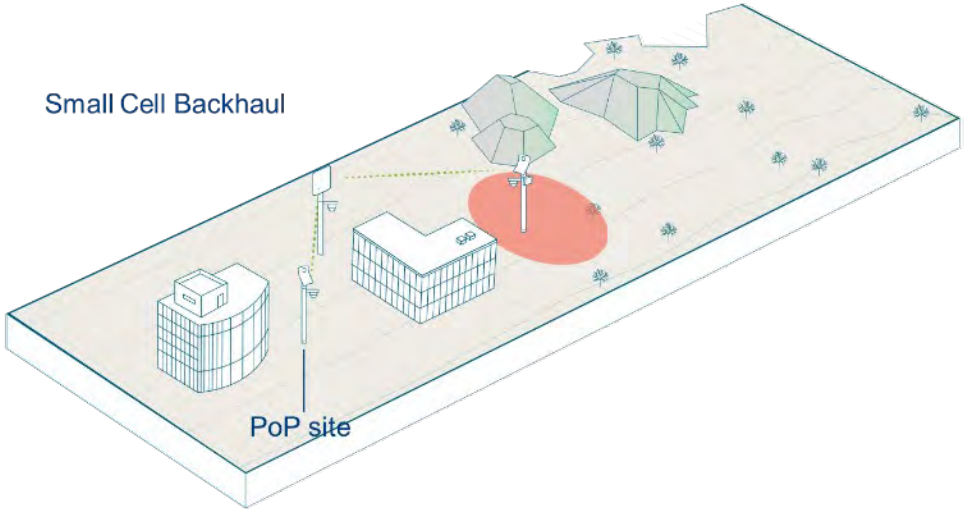
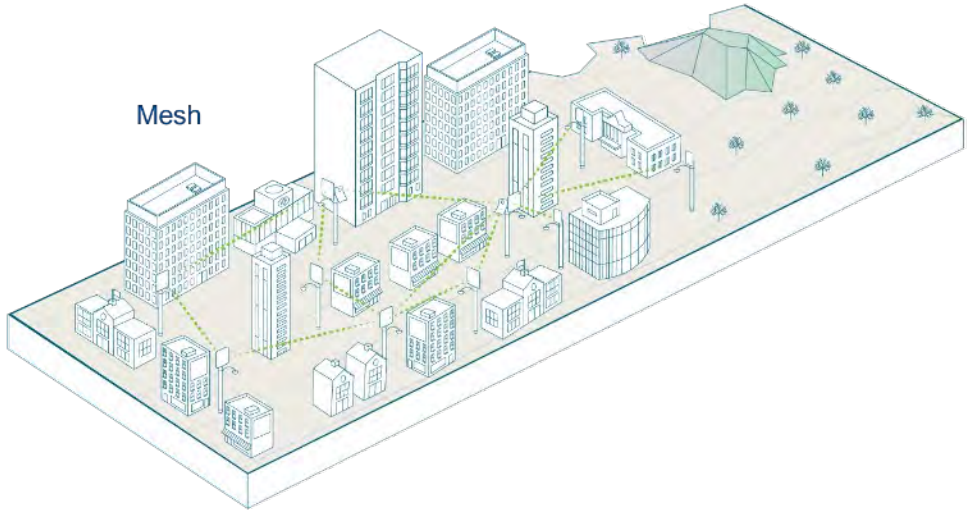
Configuration









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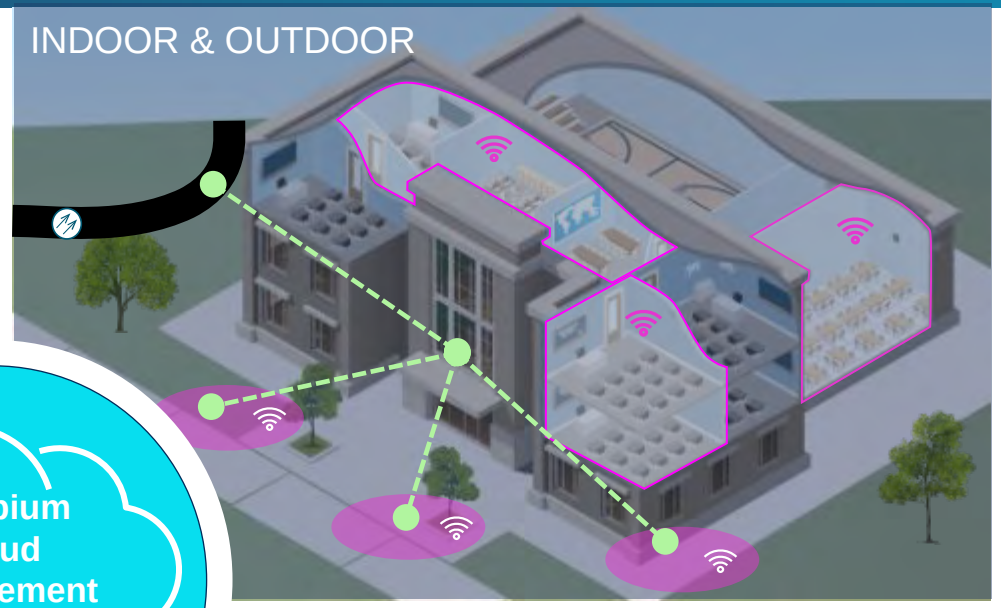
Cambium Networks Multi-Gigabit Wireless Fabric



Cambium Cloud Management

Multi-Gig Wireless from Broadband to the Edge

Proven Lowest Cost per Mbps

One Dashboard for Wi-Fi, Switching and Broadband

- Fixed Wireless 60 GHz Distribution
- Fixed Wireless 60 GHz PTP
- Wi-Fi
- Fiber Ring

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15+ cnWave Trials Deployed

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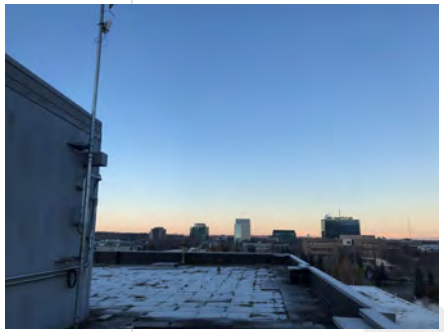
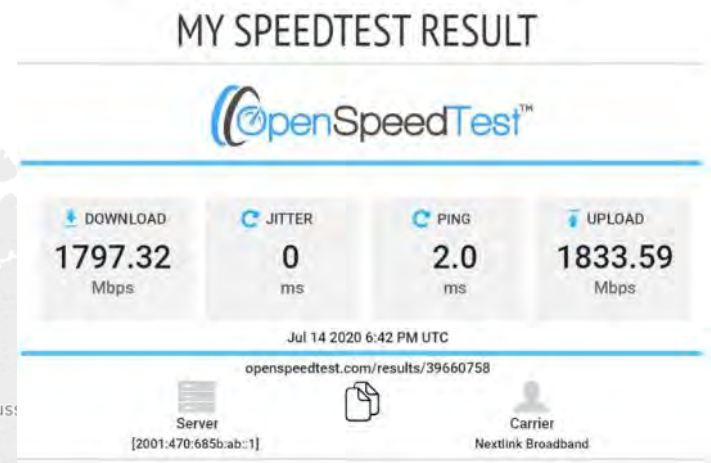
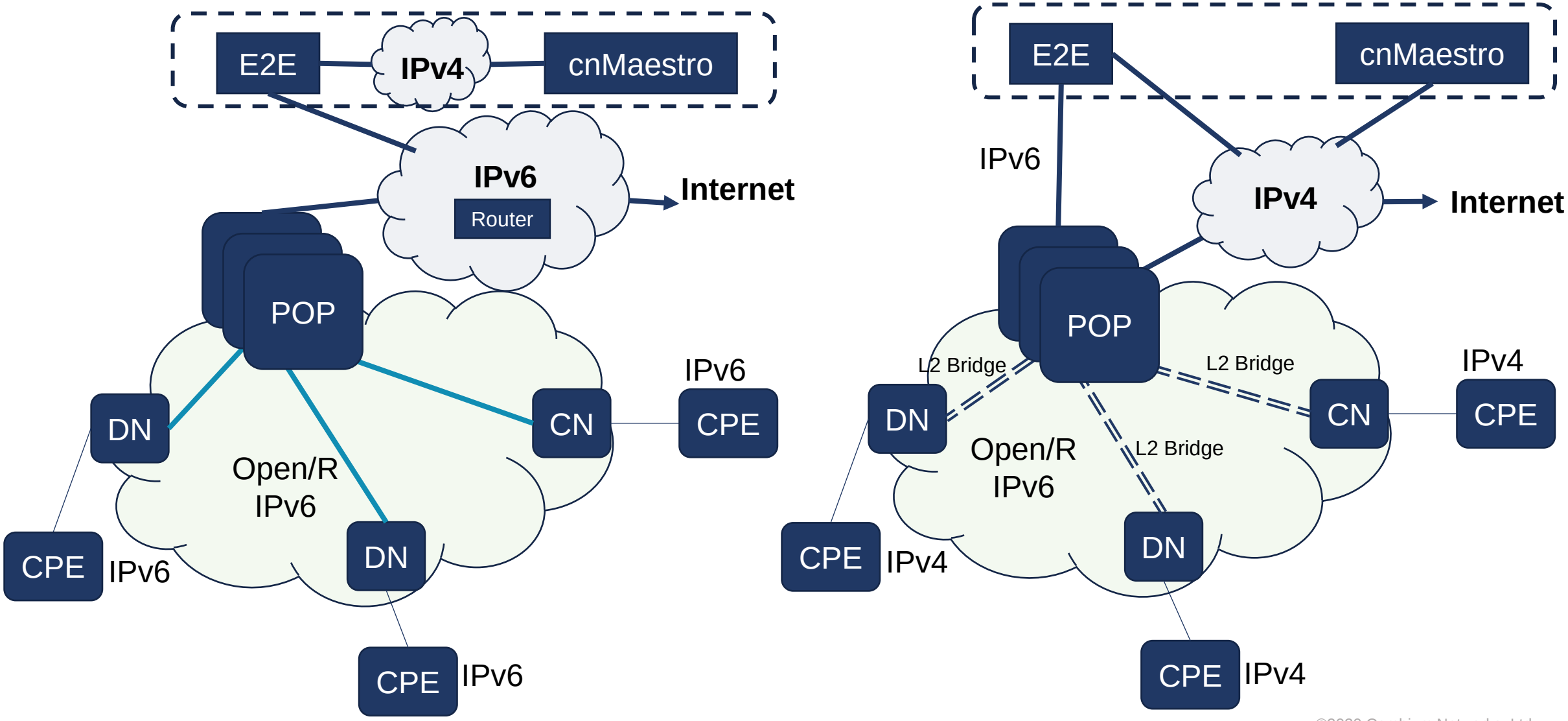




IPv6 and IPv4 support



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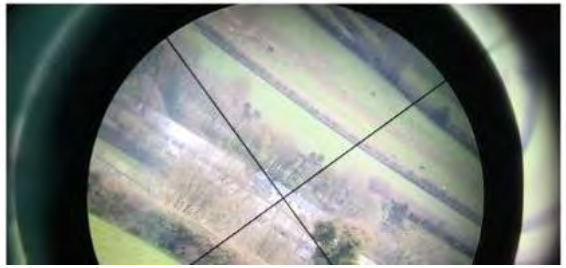
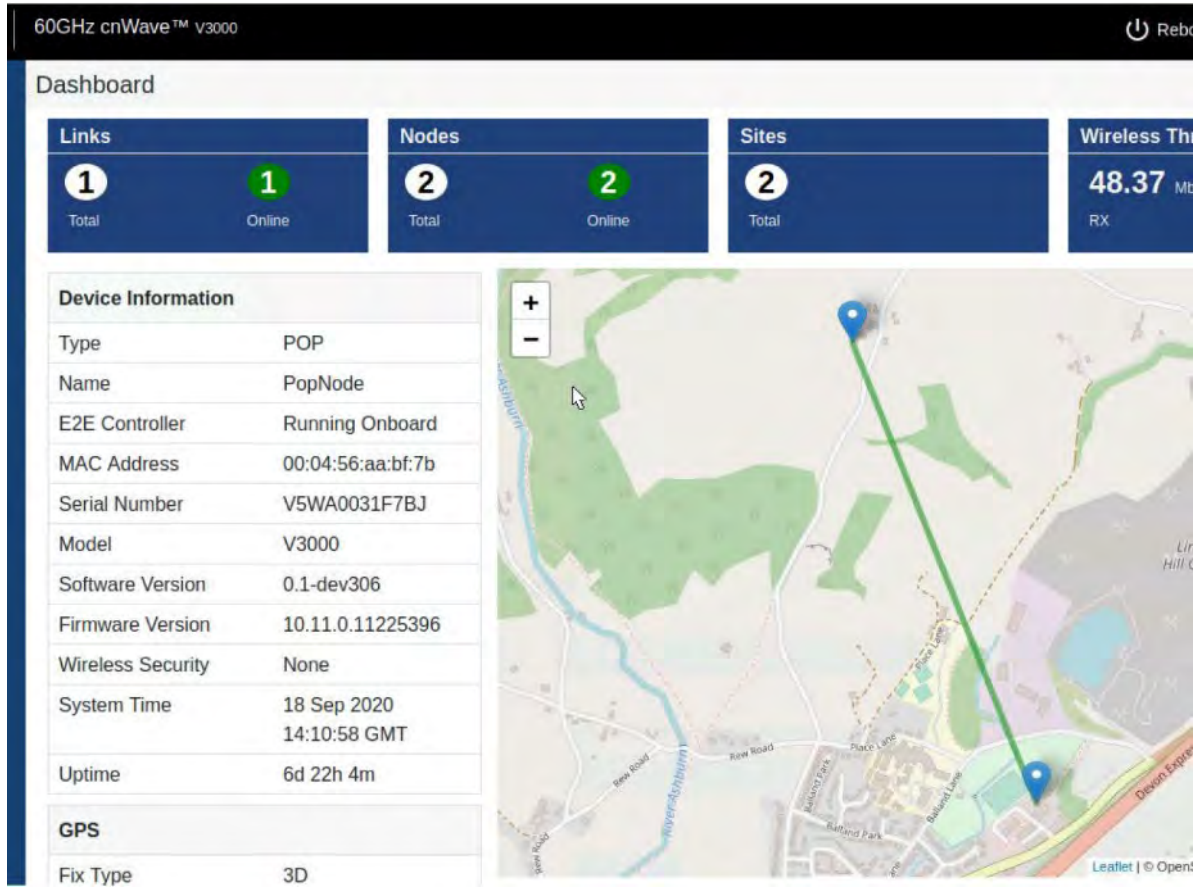
1.2km PTP link in operation





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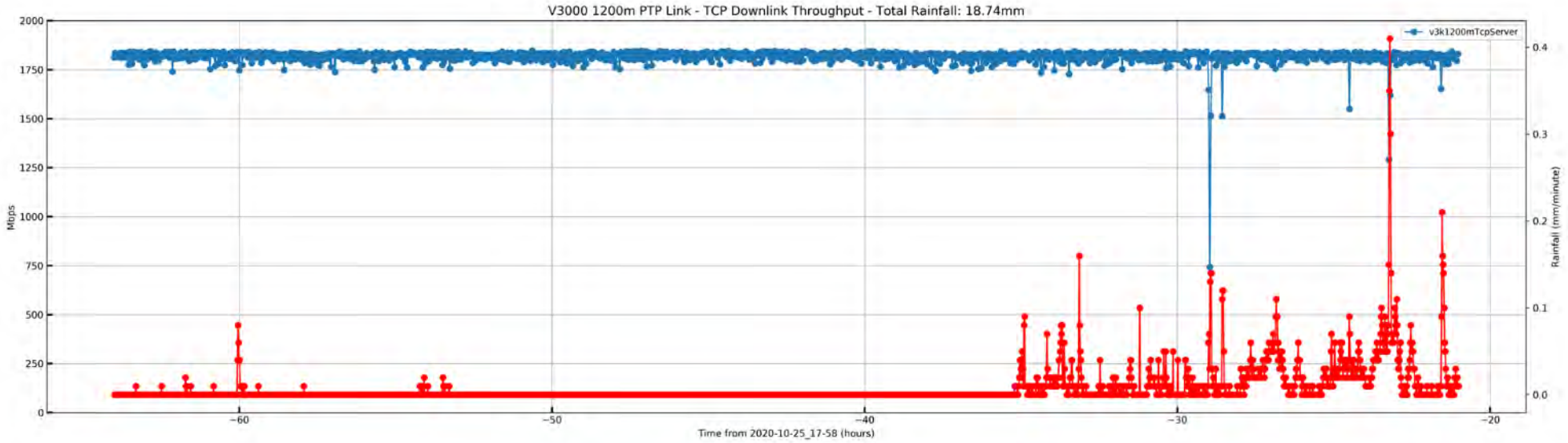
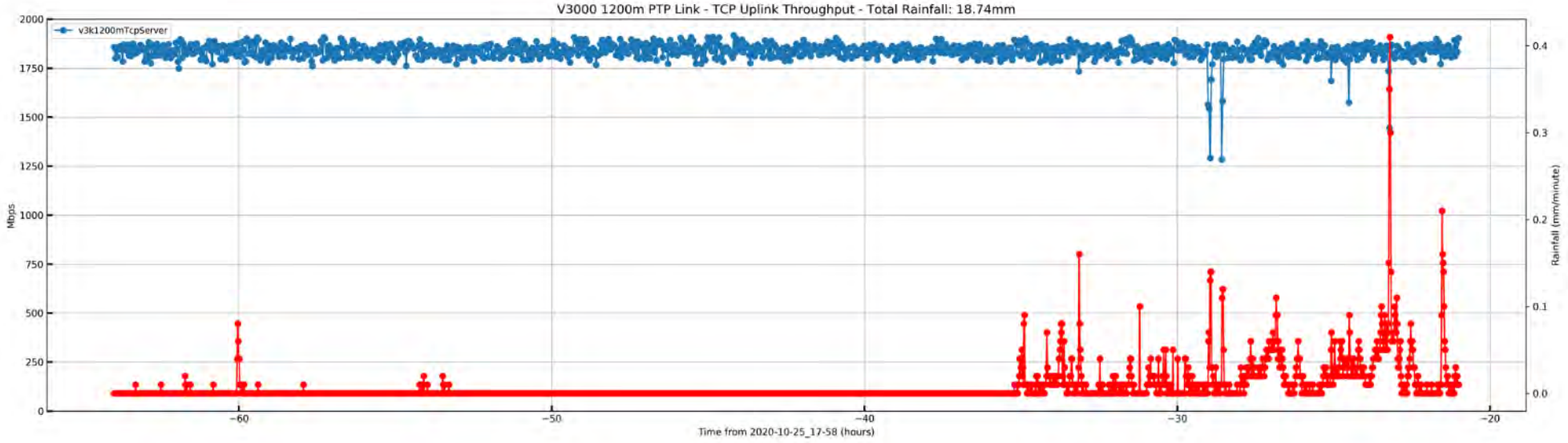
PTP - Rain Fade





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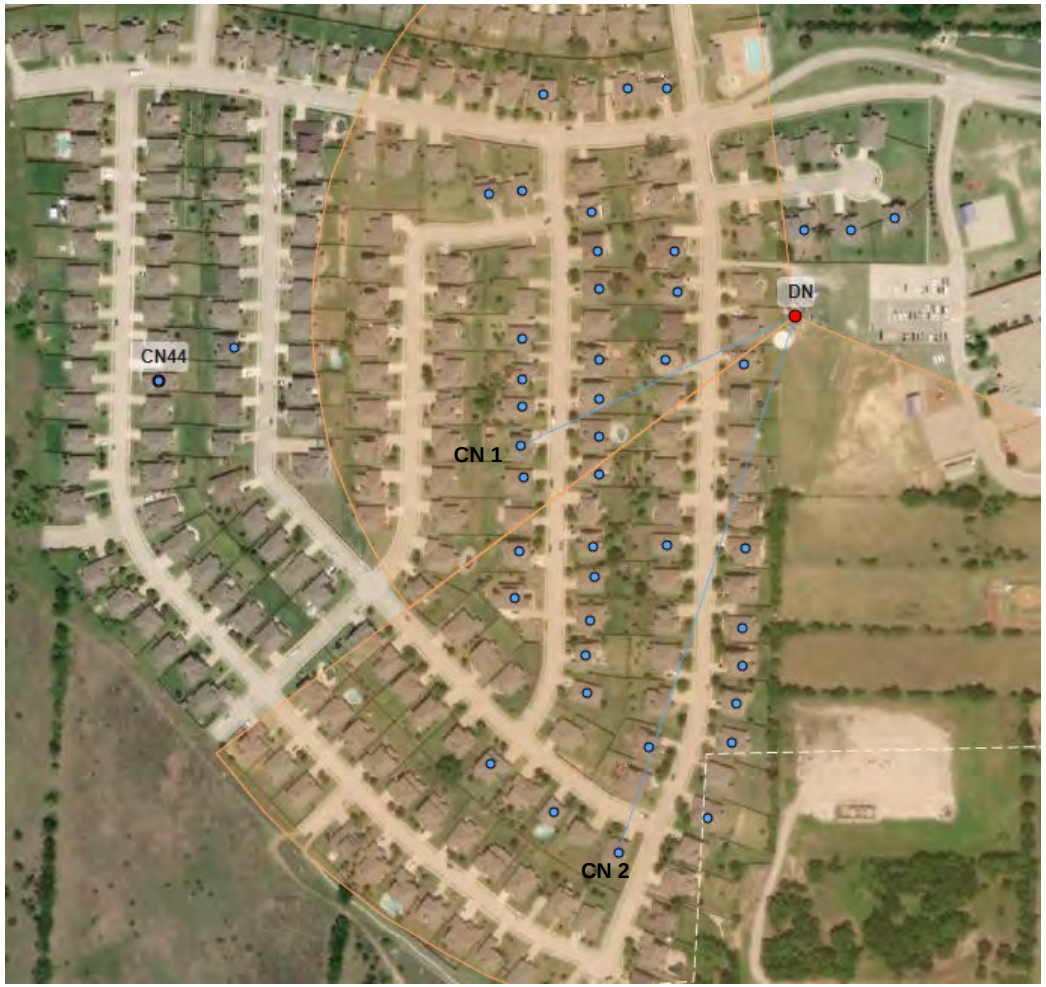
PMP – 1



MY SPEEDTEST RESULT

OpenSpeedTest™

DOWNLOAD	JITTER	PING	UPLOAD
1797.32 Mbps	0 ms	2.0 ms	1833.59 Mbps

Jul 14 2020 6:42 PM UTC

openspeedtest.com/results/39660758

Server
[2001:470:685b:ab::1]

Carrier
Nextlink Broadband

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PMP – 2

	DN - CN1		
	Downlink only	**Uplink only**	**Both Direction**
UDP	1026 Mbps	1026 Mbps	995/999 Mbps
TCP	959 Mbps	960 Mbps	851/899 Mbps
	DN - CN2		
	Downlink only	**Uplink only**	**Both Direction**
UDP	1945 Mbps	1968 Mbps	1805/1851 Mbps
TCP	1785 Mbps	1514 Mbps	1209/849 Mbps
	DN - CN1+CN2 simultaneously		
	Downlink only	**Uplink only**	**Both Direction**
UDP	812 + 1105 Mbps	1025 + 1966 Mbps	(756+971)/(971+1836) Mbps
TCP	897 + 812 Mbps	961 + 1514 Mbps	(44+345)/(948+1348) Mbps

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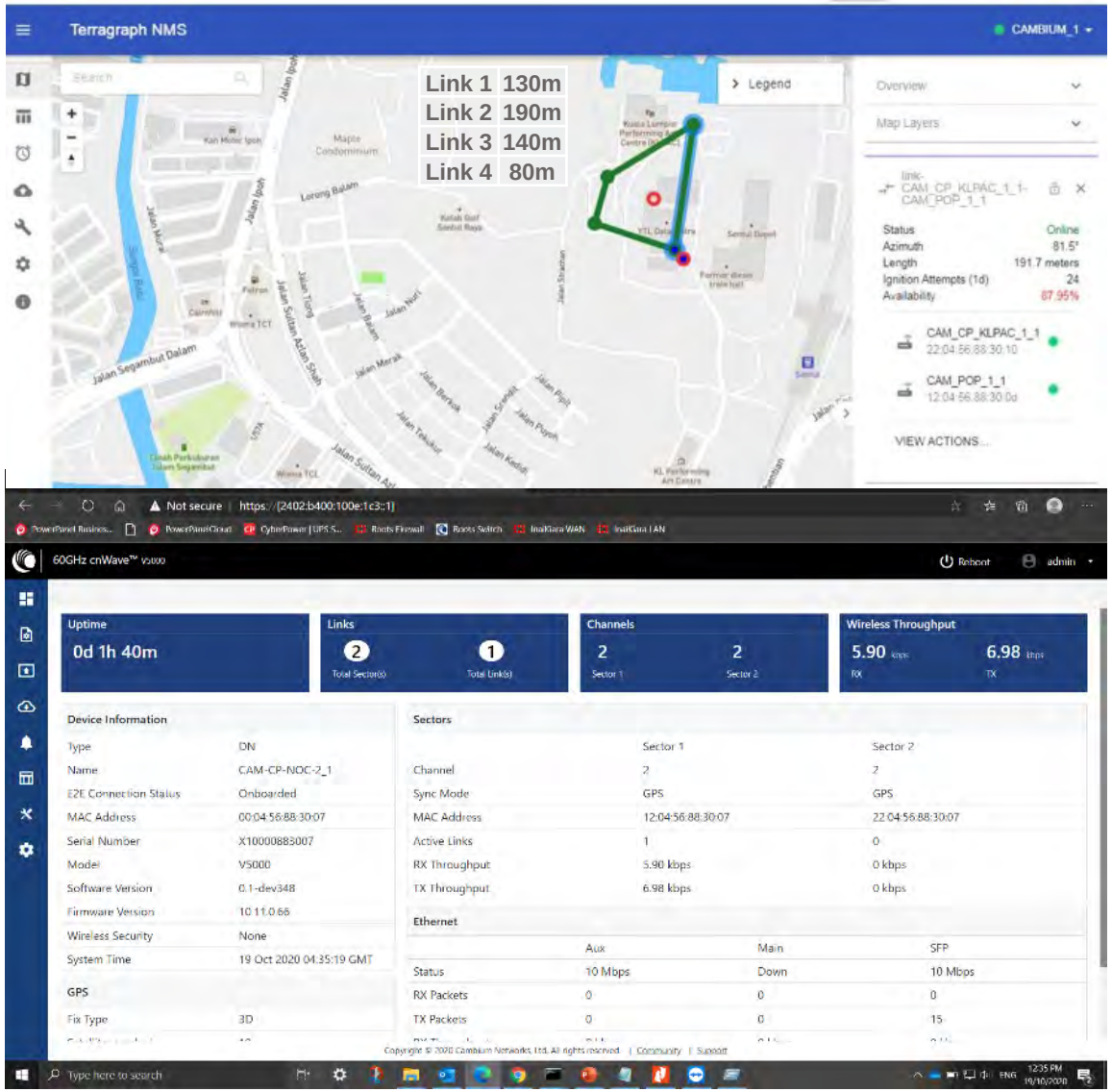
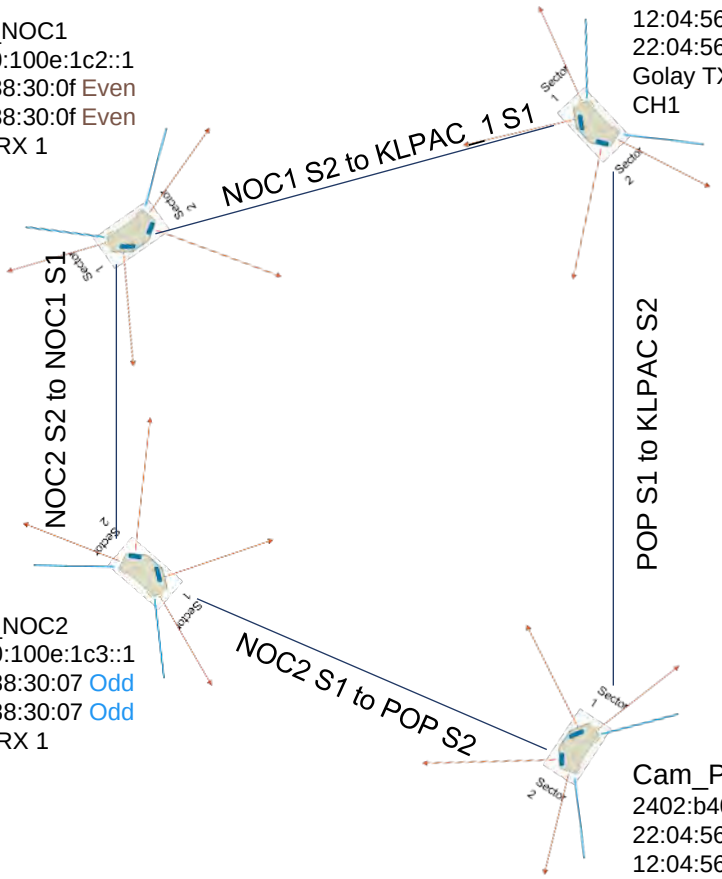
Mesh



CAM_CP_NOC1
2402:b400:100e:1c2::1
12:04:56:88:30:0f Even
22:04:56:88:30:0f Even
Golay TX/RX 1
CH1

KL_PAC_1
2402:b400:100e:1c1::1
12:04:56:88:30:10 Odd
22:04:56:88:30:10 Odd
Golay TX/RX 1
CH1



CAM_CP_NOC2
2402:b400:100e:1c3::1
22:04:56:88:30:07 Odd
12:04:56:88:30:07 Odd
Golay TX/RX 1
CH1

Cam_POP_1_1
2402:b400:100e:1c0::1
22:04:56:88:30:0d Even
12:04:56:88:30:0d Even
Golay TX/RX 1
CH1

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Mesh Throughput and Latency

Cambium Networks™

- link-CAM_CP_KLPAC_1_1-CAM_POP_1_1

```
[ ID][Role] Interval Transfer Bitrate Retr
[ 5][TX-C] 0.00-30.00 sec 2.81 GBytes 804 Mbits/sec 0 sender
[ 5][TX-C] 0.00-30.05 sec 2.81 GBytes 803 Mbits/sec receiver
[ 7][RX-C] 0.00-30.00 sec 2.86 GBytes 818 Mbits/sec 0 sender
[ 7][RX-C] 0.00-30.05 sec 2.85 GBytes 815 Mbits/sec receiver

--- 2402:b400:100e:1c0::1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9179ms
rtt min/avg/max/mdev = 0.353/0.623/1.230/0.277 ms
```

- link-CAM-CP-NOC-2_1-CAM_POP_1_1

```
[ ID][Role] Interval Transfer Bitrate Retr
[ 5][TX-C] 0.00-30.00 sec 3.41 GBytes 977 Mbits/sec 19 sender
[ 5][TX-C] 0.00-30.04 sec 3.41 GBytes 975 Mbits/sec receiver
[ 7][RX-C] 0.00-30.00 sec 3.45 GBytes 987 Mbits/sec 0 sender
[ 7][RX-C] 0.00-30.04 sec 3.44 GBytes 984 Mbits/sec receiver

--- 2402:b400:100e:1c3::1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9176ms
rtt min/avg/max/mdev = 0.484/0.664/0.706/0.079 ms
```

- link-CAM-CP-NOC-1_1-CAM-CP-NOC-2_1

```
[ ID][Role] Interval Transfer Bitrate Retr
[ 5][TX-C] 0.00-30.00 sec 4.26 GBytes 1.22 Gbits/sec 0 sender
[ 5][TX-C] 0.00-30.04 sec 4.25 GBytes 1.22 Gbits/sec receiver
[ 7][RX-C] 0.00-30.00 sec 4.29 GBytes 1.23 Gbits/sec 0 sender
[ 7][RX-C] 0.00-30.04 sec 4.28 GBytes 1.22 Gbits/sec receiver

--- 2402:b400:100e:1c2::1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9224ms
rtt min/avg/max/mdev = 0.648/0.698/0.712/0.023 ms
```

- link-CAM-CP-NOC-1_1-CAM_CP_KLPAC_1_1

```
[ ID][Role] Interval Transfer Bitrate Retr
[ 5][TX-C] 0.00-30.00 sec 3.35 GBytes 960 Mbits/sec 0 sender
[ 5][TX-C] 0.00-30.04 sec 3.35 GBytes 958 Mbits/sec receiver
[ 7][RX-C] 0.00-30.00 sec 3.05 GBytes 874 Mbits/sec 0 sender
[ 7][RX-C] 0.00-30.04 sec 3.05 GBytes 872 Mbits/sec receiver

--- 2402:b400:100e:1c2::1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9020ms
rtt min/avg/max/mdev = 0.788/1.234/1.948/0.282 ms
```

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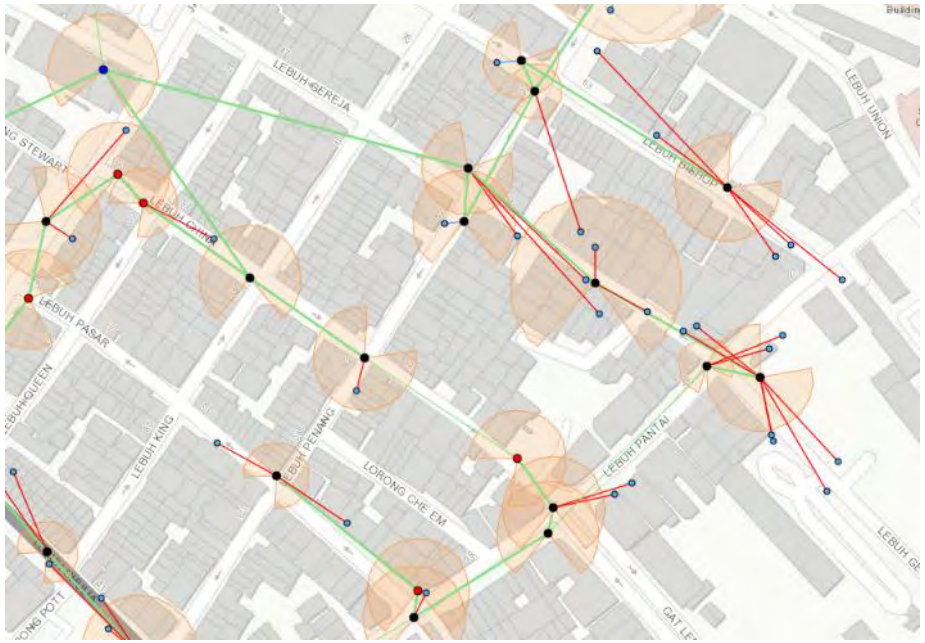
City Coverage with cnWave

- <100 DN's
- Lamp post and Roof tops
- Outdoor Wi-Fi backhaul, >30,000 users
- FWA, >110 local business and government offices
- CCTV backhaul options



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AeroNet
Cambium Networks
terragraph
PARE
PARE

About Us

- Founded in 2001
- Hybrid ISP : 80% FWA, 20% Fiber
- Markets: Puerto Rico, USVI, South FL
- Segments: Enterprise, SMB, Wholesale, Residential
- Only PR ISP in INC 5000
- WISPA's ISP of the Year 2012 & Triumph Award 2018
- Spectrum Assets: 2.5 GHz & 3.5 GHz

Go Faster!

Terragraph

What happened?
Market trial in Old San Juan connecting friendly customers with premium FWA.
Terragraph was also deployed as a reliable transport solution for Cambium Wi-Fi APs.

Trial Details
- 14 Nodes
- 50+ Total Units
- Deployed in 4 weeks

Why Terragraph?
- mmWave technology with fiber like speeds
- Quick time-to-market. Deployments in few days
- Cost effective solution alternative and complementary to fiber
- Increased network resilience through mesh
- Unlicensed spectrum

What's next?
Aeronet was the first Service Provider issuing a PO for a Terragraph certified cnWave.

Aeronet is planning to scale cnWave deployments in the island, focusing on bringing high speed broadband services to thousands of customers.

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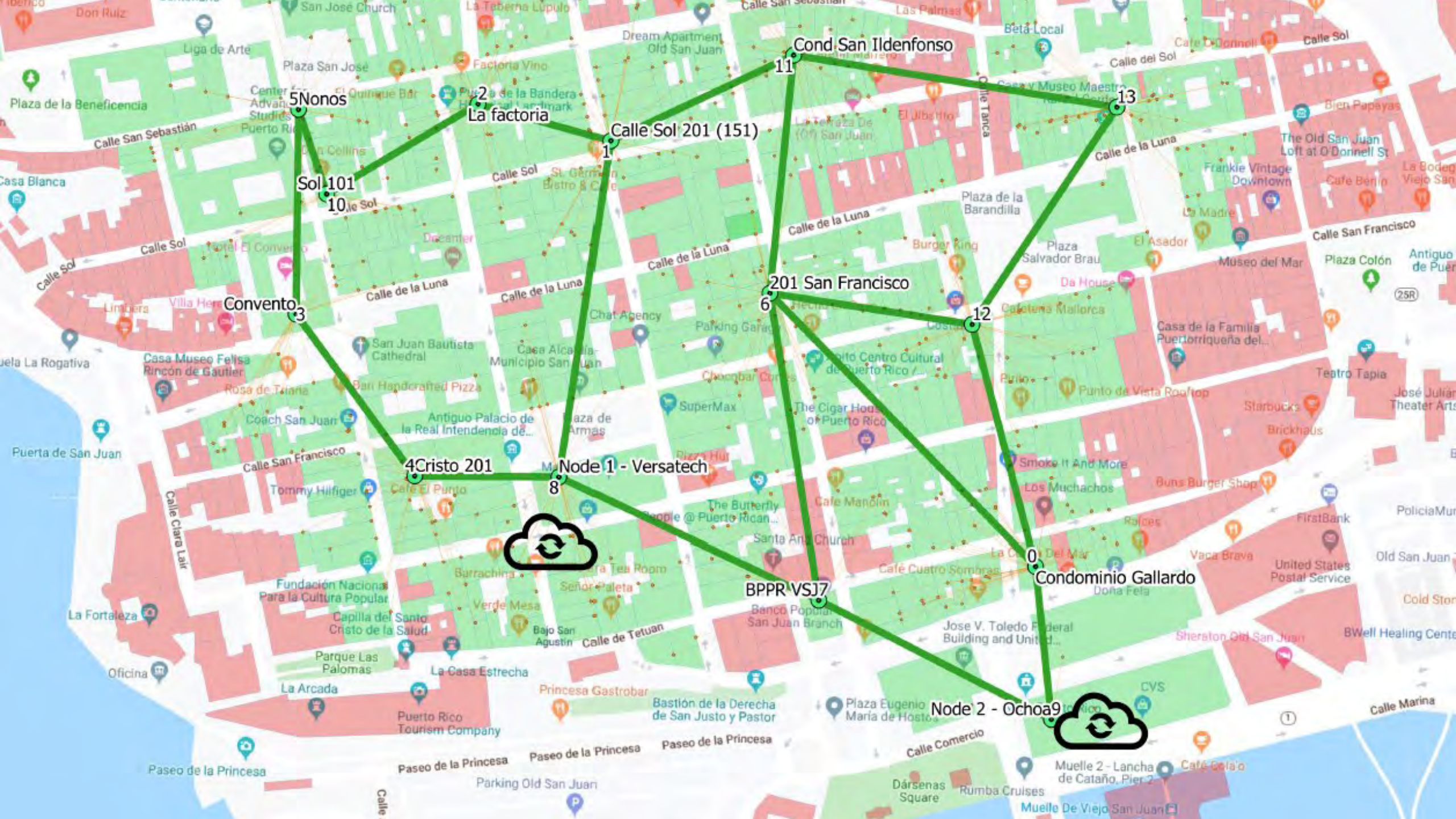
Cond San Ildenfonso
11
5Nonos
2
La factoria
Calle Sol 201 (151)
1
13
Sol 101
10
Convento
3
201 San Francisco
6
12
4Cristo 201
8
Node 1 - Versatech
BPPR VSJ7
0
Condominio Gallardo
Node 2 - Ochoa
9

cnWave Trial Details:

- V3000 PTP Link between 2 AeroNet facilities
- 660 Meters
- Rain Zone N

Installation Feedback:

- Solid design and hardware
- Standard POE procedure
- Used Shielded CAT5
- Scope Needed, Alignment tone or App would help

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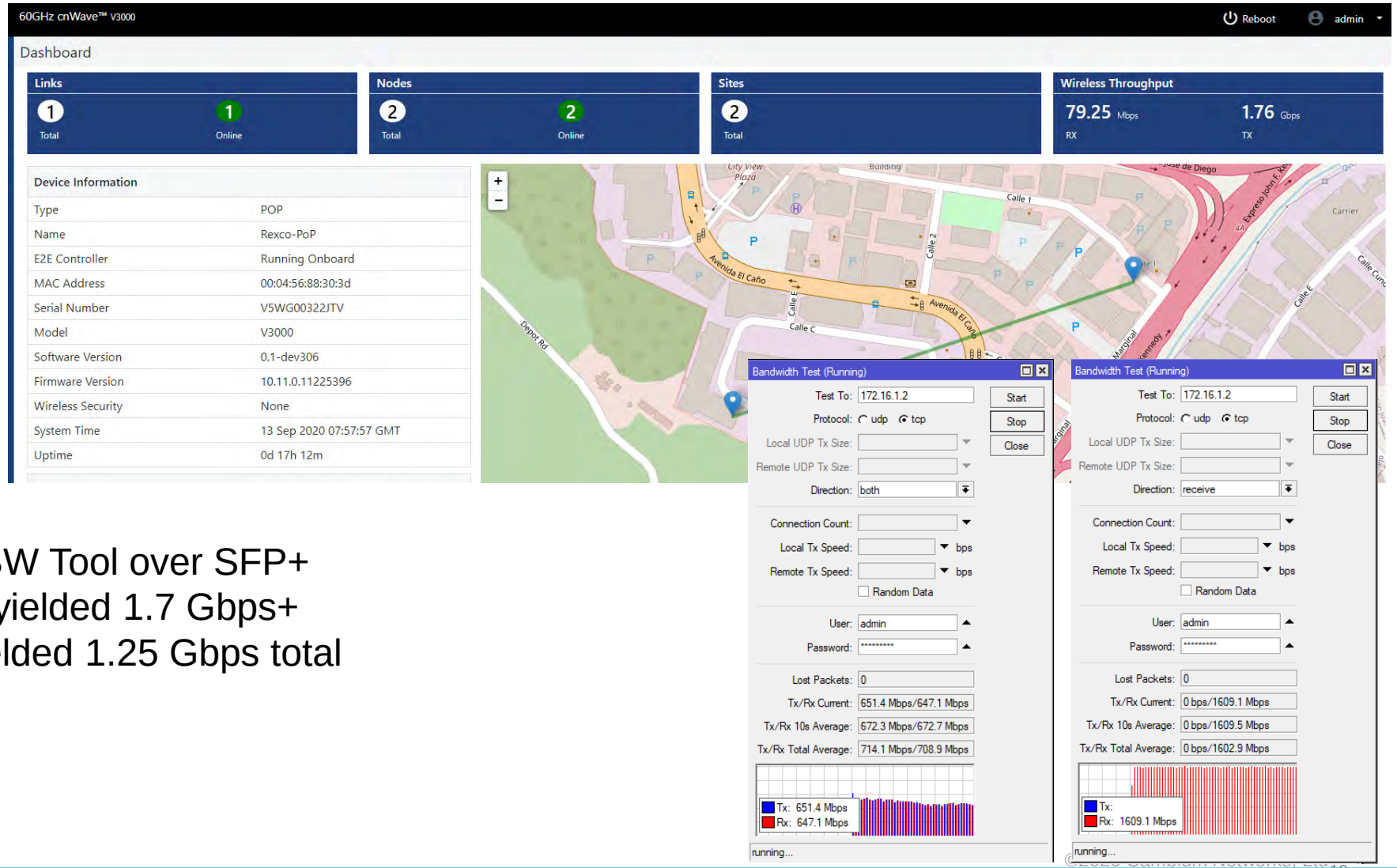
Performance Experiences:



- RB4011 to RB4011 Mikrotik BW Tool over SFP+
- Asymmetric Bandwidth tests yielded 1.7 Gbps+
- Symmetric Bandwidth test yielded 1.25 Gbps total
- Latency: 1-2ms

Deployment scenarios being evaluated:

- Point to Point
- Multipoint
- Multipoint to Multipoint (All Mesh)
- Industrial Indoor
- Residential Indoor (Last Feet)

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Cambium Networks Partnership for Terragraph

- Integration with other Cambium Network Tools:
  cnMaestro, Link Planner, cnHeat?
- Tested track record.
- Converged Support between platforms.
- Open to Feedback and Suggestions.

What's Next?

- Multipoint Trial – HW expected this week.
- Symmetrical Speed issue ID and resolution.
- Field Deployments

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Cambium 60 GHz cnWave

- **Low Total Cost Ownership (TCO)**
  - **V5000** 280-degree coverage with dual sector - No need for site router, simple installation
  - **V1000 + V3000** to meet various range challenge
  - Auto Beamforming for easy installation
- **Super-long range V3000** with beamforming
- **Channel Bonding H/W ready**, double the capacity with F/W upgrade
- **IP 66/67 rated enclosure**
- **High density deployment**, each DN can support up to 30 CNs or 26 CNs + 4 DNs
- **cnMaestro cloud management** – one panel for NMS
- **Easy planning** (Advanced Network Planning + LINKPlanner)

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