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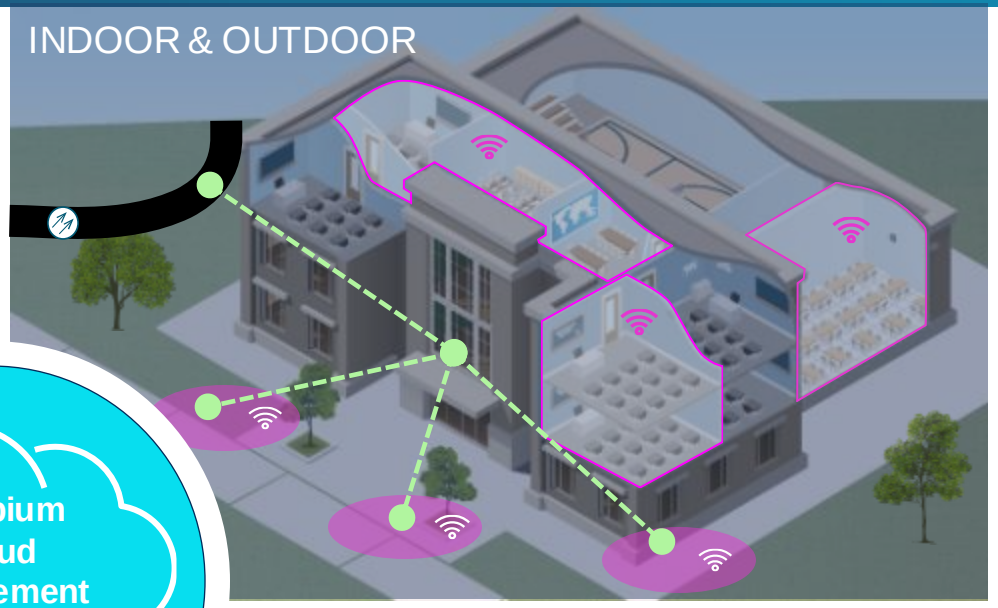
cnWave 60 GHz Overview

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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Cambium 60 GHz cnWave

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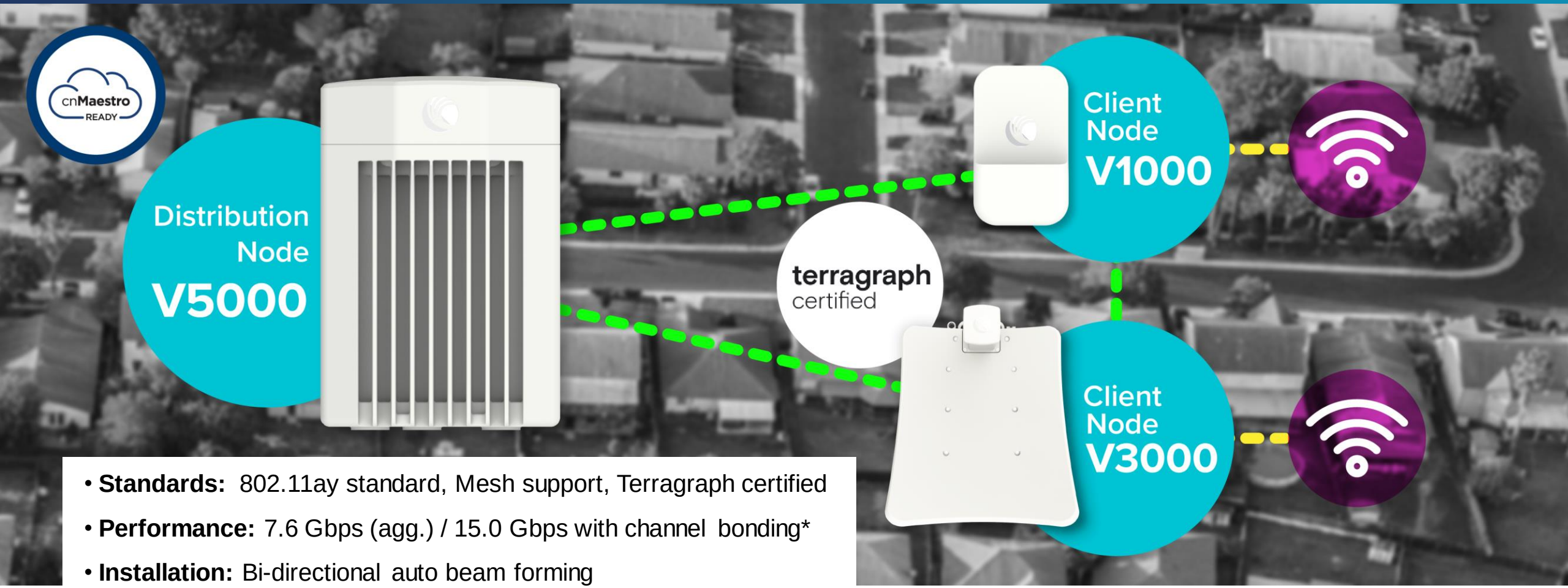

- **Standards:** 802.11ay standard, Mesh support, Terragraph certified
- **Performance:** 7.6 Gbps (agg.) / 15.0 Gbps with channel bonding*
- **Installation:** Bi-directional auto beam forming
- **Operation:** Auto expansion, auto healing with Mesh support
- **Configuration:** Point-to-Point, Point-to-MultiPoint, Mesh
- **Management:** cnMaestro™

[cnWave Introduction Video on Youtube]

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Advantages of 802.11ay (vs .ad)

Advantage	Description	Benefit
TDMA/TDD	• Removed access confliction of CSMA defined in 802.11ad, removed overhead of RTS/CTS etc. • Each CN is assigned specific time slots based on request, which it can transmit and receive	• Maintain high spectrum efficiency even with congestion • Single channel for complete network
Network Synchronization	• All radios are time synchronized • Time Synchronization via GPS	• Ensure Tx/Rx TDD frame alignment across whole network • Minimize interference
Channel Bonding	• Support 4.32 GHz channel by channel bonding	• Double the throughput
Mesh Routing	• Distributed network application platform • Determine appropriate routes between the mesh nodes	• Minimize latency • Auto heal and auto expansion • Efficient usage of DN notes within the mesh

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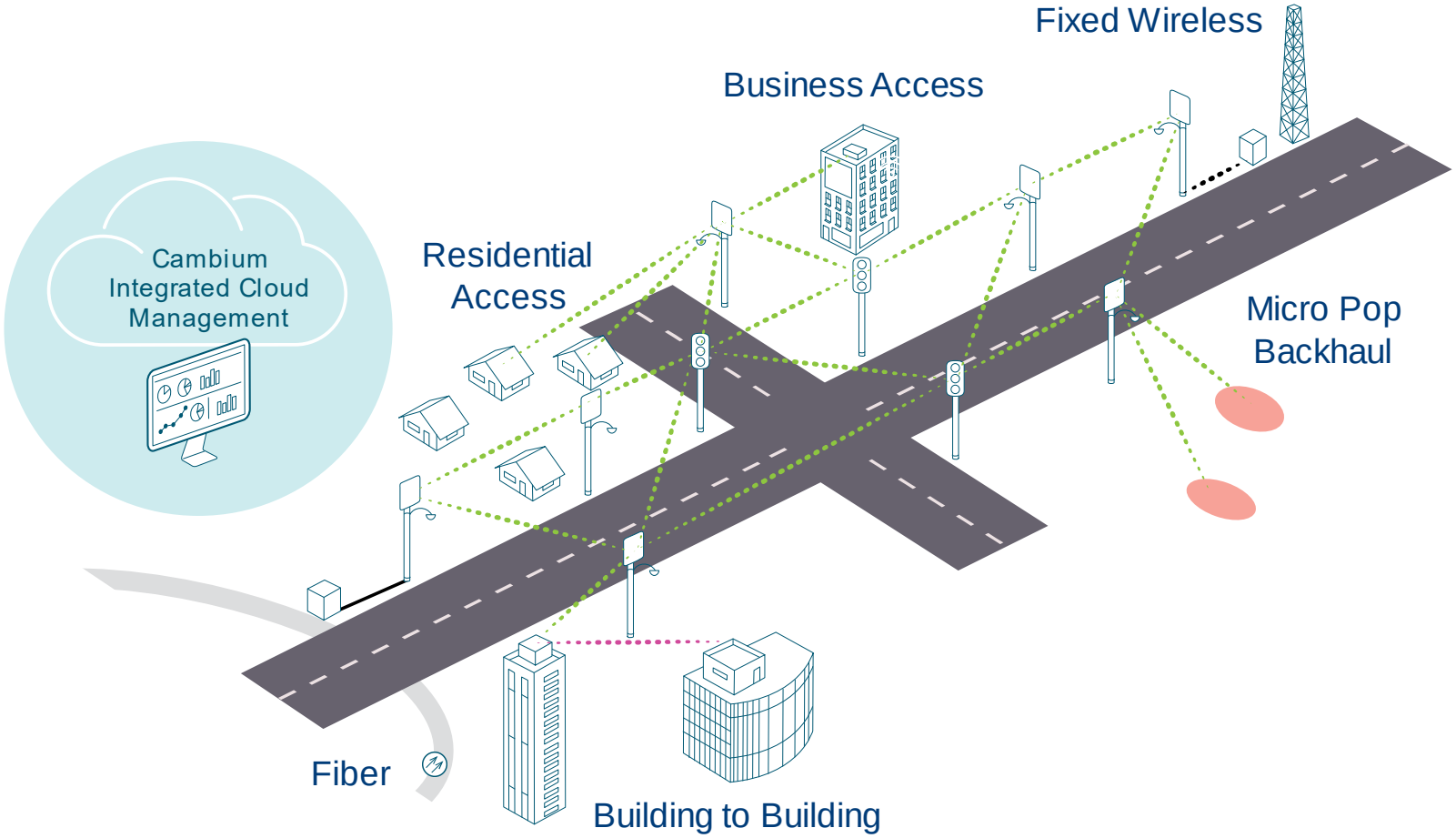
cnWave Deployment Examples



- **WTTH** – **W**ireless **T**o **T**he **H**ome
  - Providing Wireless Broadband access directly to the home.
- **WTTB** – **W**ireless **T**o **T**he **B**uilding
  - Wireless Broadband access provided to rooftops or side of buildings, which then get distributed to individual offices and homes via wire.
- **RTTRT** – **R**oof-**T**op **T**o **R**oof-**T**op
  - Long range Point to Point with high gain dish
  - Multi Dwelling Distribution
- **Fiber Extension**
- **Backhaul** for 5G Small Cell, outdoor Wi-Fi, MicroPoP and CCTV

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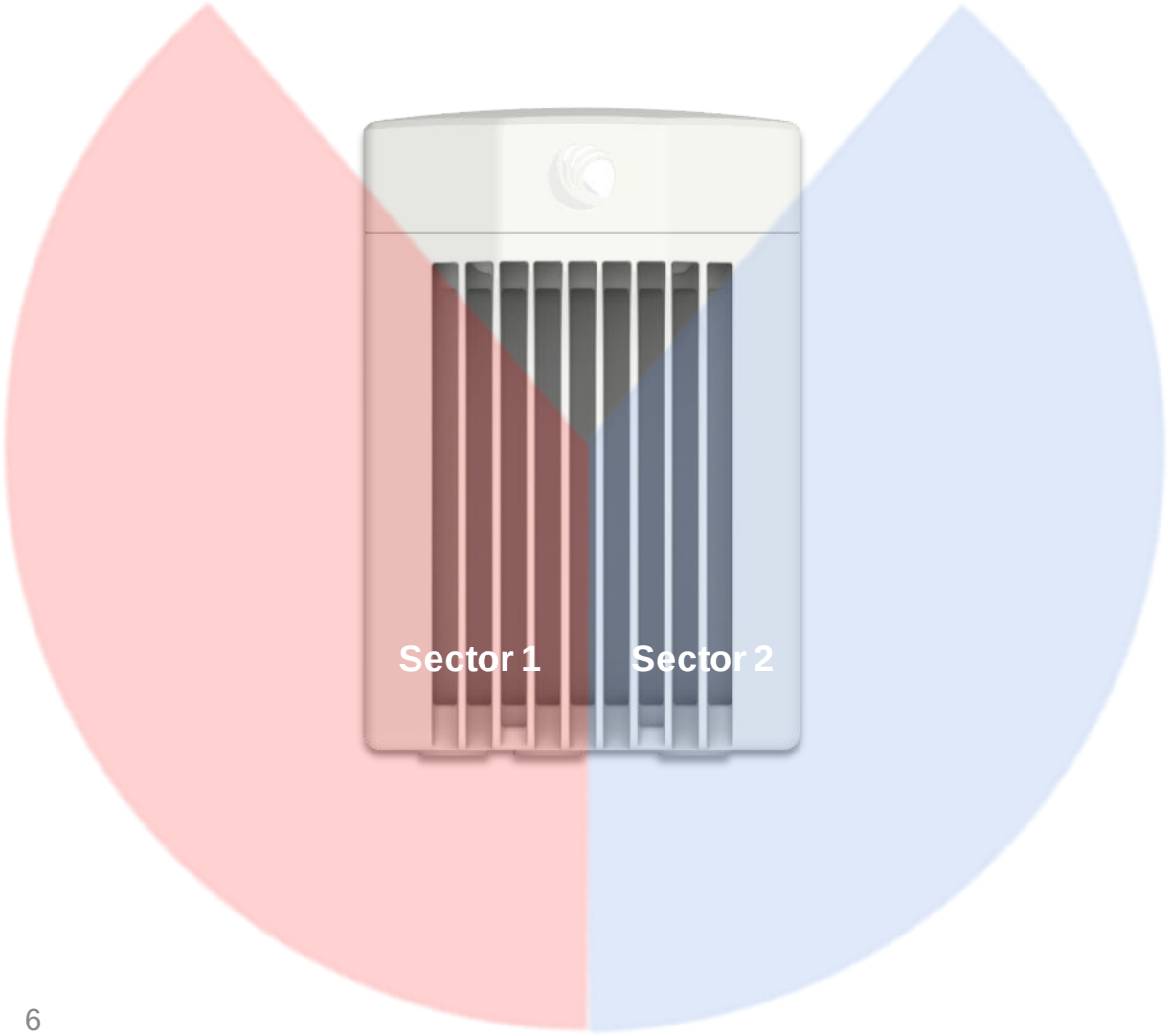
cnWave V5000 Distribution Node (DN)



Dual Radio / Dual Sector 280 Degree Coverage with Beam Forming

Versatility / Low TCO: Connects to additional distribution nodes and client nodes to form endless variety of hybrid mesh/PMP networks. No need for site router, simple installation.

Throughput up to 7.6 Gbps per sector:

- 1.9 Gbps Uplink + 1.9 Gbps Downlink
- 3.8 Gbps Uplink + 3.8 Gbps Downlink with channel bonding*

Connections: Up to 30 CNs or 4 DNs + 26 CNs

Multiple Data Ports: 10GE +PoE in, SFP+, 1GE PoE Out

Latency: < 1 ms

Compact: 11” x 7.3” x 4”

Durable: IP66/67, -40ºF to +140ºF

* - Available in future

V1000 – Mid Gain Client Node (CN)

Compact & Cost Effective

Bi-directional Gigabit Performance

- 1 Gbps Uplink + 1 Gbps Downlink

Mid Gain Antenna with Beam Forming

- +/- 40.0 (Azimuth), +/- 20.0 (Elevation)
- EIRP 38 dBm

Versatile: Deploy as Client Node or low cost Gigabit PTP

Low Latency: < 1 ms

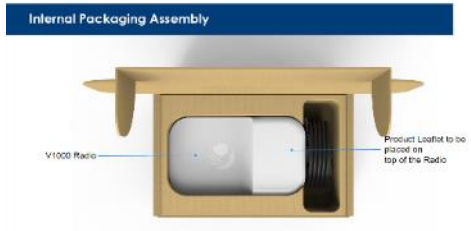
Single Data Interface: GE + PoE in (802.3af)

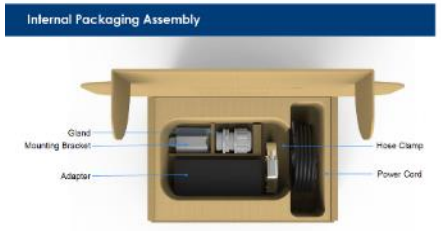
Low Power Consumption: 10 W

Dimensions: 5.5 x 3.3 x 1.6 Inches

Durable & Reliable: IP66/67 Enclosure -40 to +140ºF

Complete Kit: Includes radio, PoE, hose clamp, power cord





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V3000 – High Gain Client Node

Ultra High Antenna Gain with Beam Forming

- 44.5 dBi and 40.5 dBi antenna
- +/- 2.0 (Azimuth), +/- 1.0 (Elevation)

Throughput

- 1.9 Gbps Uplink + 1.9 bps Downlink
- 3.8 Gbps Uplink + 3.8 Gbps Downlink with channel bonding*

Versatile: Deploy as Client Node or low cost multi-Gigabit PTP

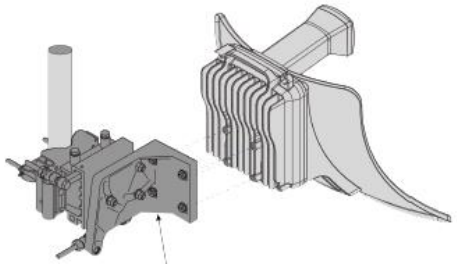
Low Latency: < 1 ms

Data Interface

- 1 x 10 GE + PoE in (Passive)
- 1 x 1 GE + PoE out (802.3at)
- 1 x SFP+

Physical / Environmental

- IP 66/67
- -40 to +140ºF
- 13.6 x 16.3 x 13.5 Inches without mount (sold separately)



* - Available in future

V3000 with 44.5 dBi Antenna

V3000 with 40.5 dBi Antenna

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Endless Deployment Scenarios

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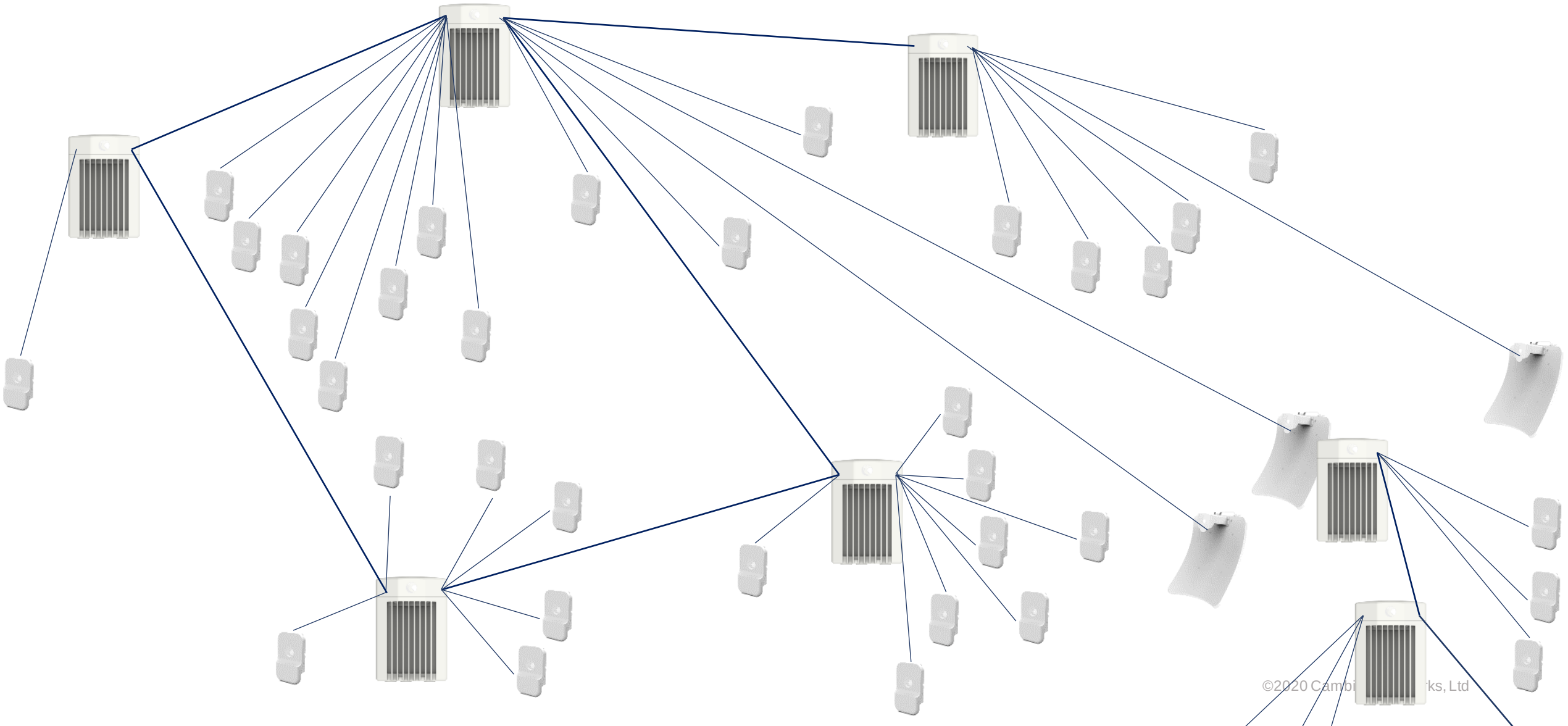

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Service Provider: City center deployment network

Roof Top to Roof Top

PMP with Mesh

Wi-Fi

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WISP Suburban deployment

DN-DN

DN-CN

Wi-Fi

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Service Provider Suburban Deployment

Roof Top to Roof Top

DN-CN, PMP with Mesh

Wi-Fi

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Enterprise Deployment

Roof Top to Roof Top

Multipoint with Mesh

Wi-Fi

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Service Provider: 5G Small Cell Backhaul

Point to Point

Point to Multipoint

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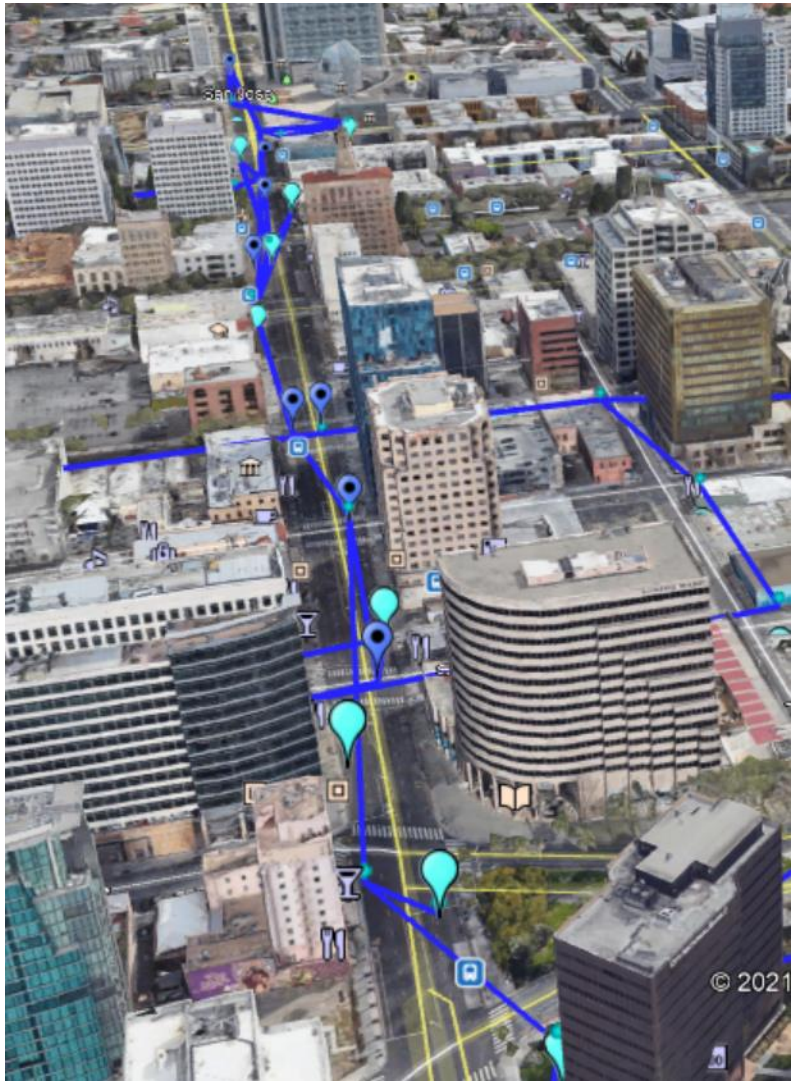
City of San Jose

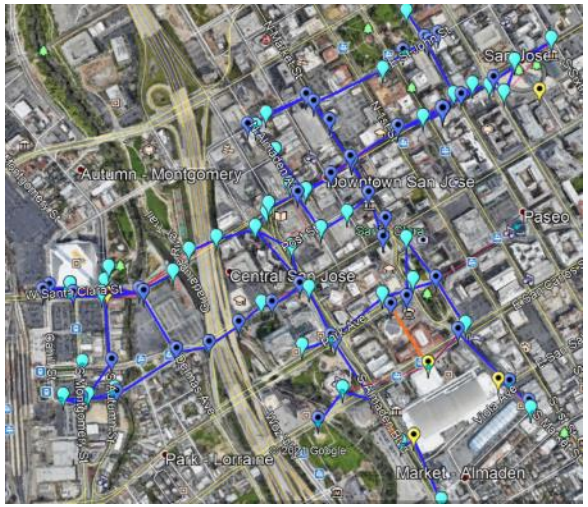


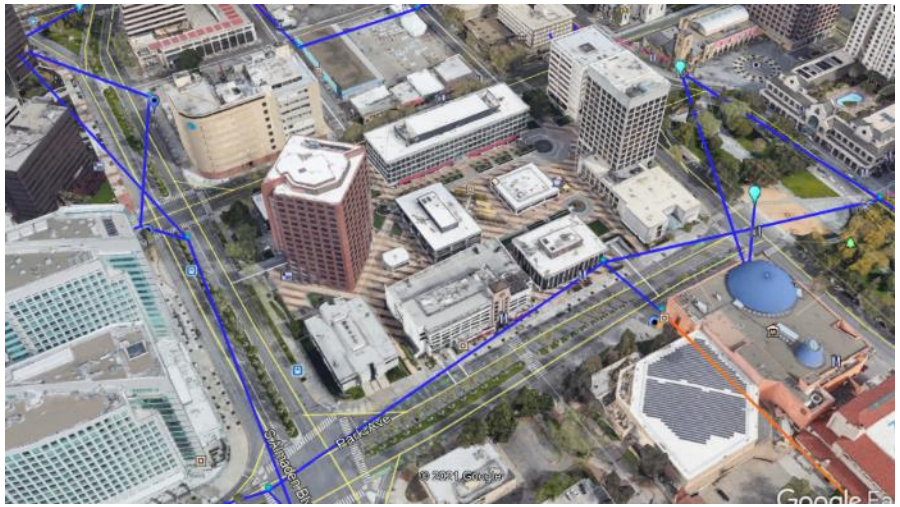
REQUIREMENTS

- Improving the City's existing digital infrastructure to support San Jose's Smart City Vision and improve digital inclusion.
- Initial Deployment of cnWave scheduled for spring 2021 as backhaul solution for downtown wifi at 90+ locations
- Promoting availability of gigabit level broadband internet to support economic development and inclusion.
- Facebook Terragraph Partnership Project

SOLUTION

- Deploying Cambium 60 GHz cnWave V5000 and V1000, provide multi gigabit backhaul solution for City Wi-Fi network transport and campus area networking.





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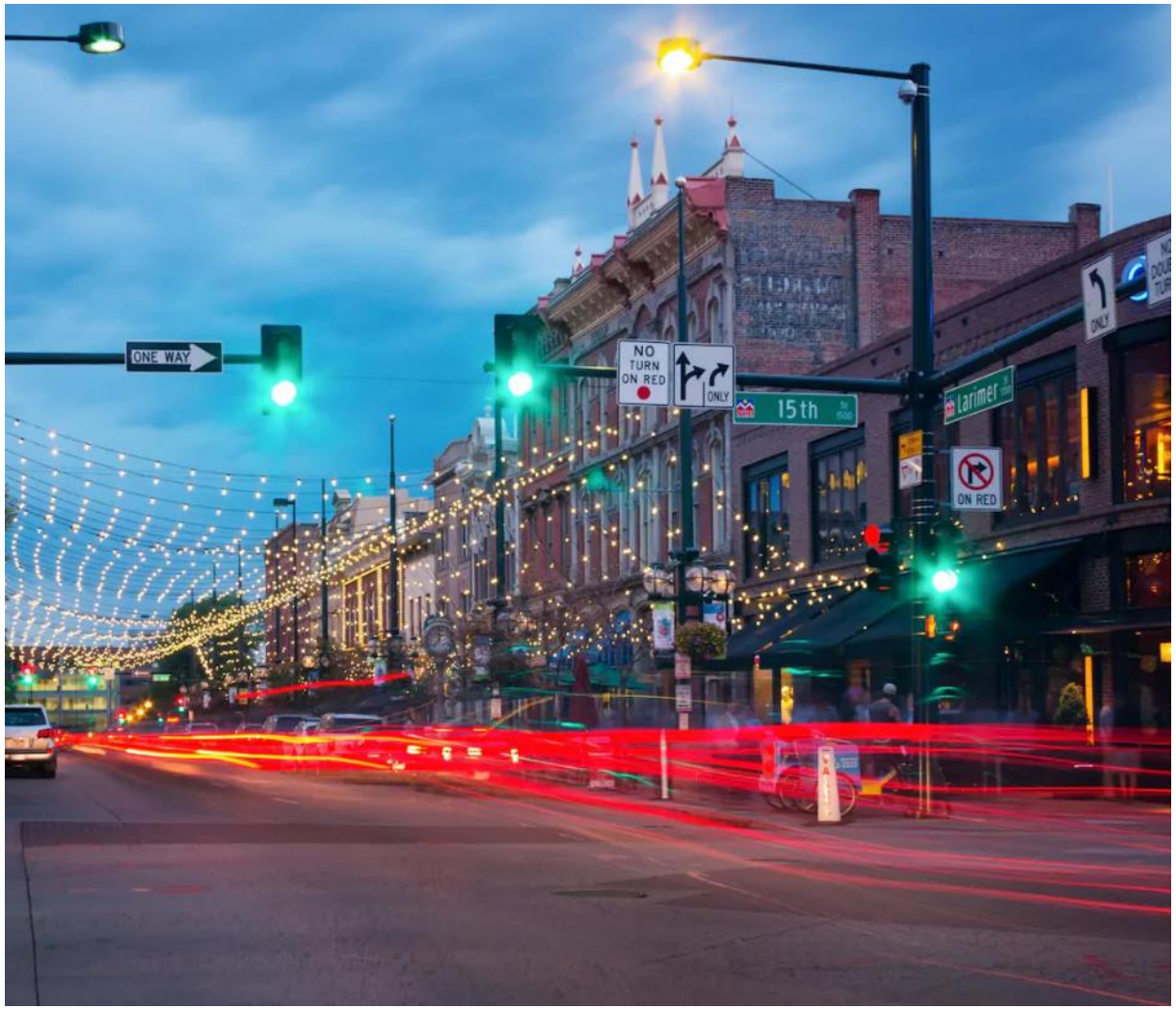
City of Aurora, CO



REQUIREMENTS

- Improve IT infrastructure, which would benefit public safety, voice and data, LAN extension, video applications and credit card processing.
- With the increasing demand for capacity, City of Aurora desired to deploy a gigabit speed solution to replace existing 50 Mbps links.

SOLUTION

- Deploying 60 GHz cnWave V5000 and V3000 with Mesh configuration to handle the high-density areas.

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CN Rail - Canada

Extending to 14 rail yards and 3 intermodals

REQUIREMENTS

- Provide backhaul for Wi-Fi coverage and video surveillance network.
- Off load large telemetry and video data payloads (Gigabyte/Terabyte) from the train.

SOLUTION

- Deploy 60 GHz cnWave V5000, V3000, and V1000 with Point-to-Point, Point-to-Multipoint, and Mesh configurations.

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WiFinity - UK

- **REQUIREMENTS**
- Wifinity is a fast-growing, innovative Wi-Fi Managed Service Provider. Wifinity provides superfast, robust WiFi connections to businesses in some of the UK's most remote and hard-to-reach campus-based locations, such as schools and holiday parks.
- Provide gigabits broadband internet to holiday parks.

SOLUTION

- Deploying 60 GHz cnWave V5000, V3000, and V1000 together with 5 GHz PMP 450 with cnMedusa technology to provide comprehensive coverage for holiday parks in United Kingdom.

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ACS Alaska – Anchorage & Fairbanks

REQUIREMENTS

- Anchorage ~3 square miles / 2500+ buildings (4000 housing units). Mesh to provide full coverage throughout the area with estimated 40% market penetration. ACS Fiber routes through various parts of these neighborhoods and there are several schools and other fiber-lit buildings which will serve as initial POP locations.
- Fairbanks ~1 square mile 800+ buildings in service area. Mesh to provide full coverage throughout the area. We may be able to use existing telephone pole infrastructure. ACS fiber rings the area for potential POP sites.

SOLUTION

- 60 GHz cnWave Mesh Network with V5000, V3000, and V1000.

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YTL – Malaysia (Urban deployment /FWA)

- *"We are excited to be the first in the world to deploy Cambium's 60 GHz technology to our Terragraph gigabit wireless network in Penang. Like many cities with heritage structures, fiber deployment is quite difficult, and many businesses are stuck with legacy copper wires" – Wing K. Lee, CEO of YTL*

- Key Application:
  - Metro wireless broadband service to residential and enterprise customer.
  - Backhaul for city Wi-Fi coverage

- Solution:
  - PMP with Mesh using cnWave V5000, V3000 and V1000

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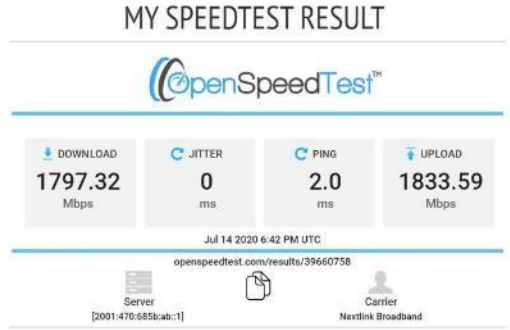
NextLink – USA (Suburban / Rural FWA)

- *"In our field test in Weatherford, Texas, we achieved close to 1.8 Gigabit uplink and downlink speeds using Cambium's 60 GHz cnWave solution in a single channel configuration," said Cameron Kilton, Chief Technology Officer of NextLink.*



- Key Application:
  - +100Mbps high speed internet broadband service to residential customers.
- Solution:
  - PMP with Mesh using cnWave V5000, V3000 and V1000

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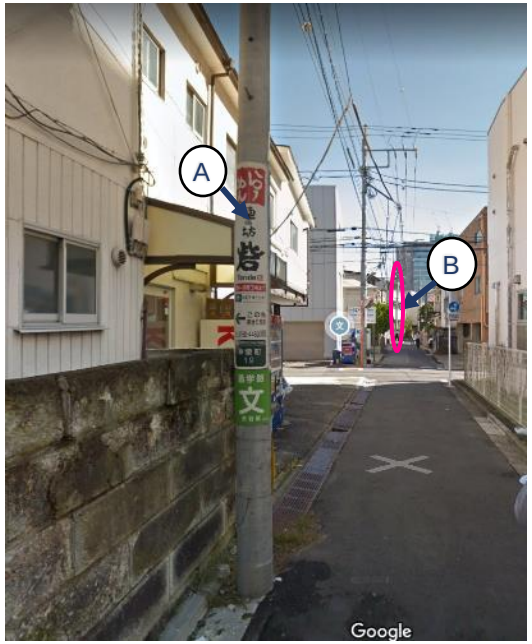
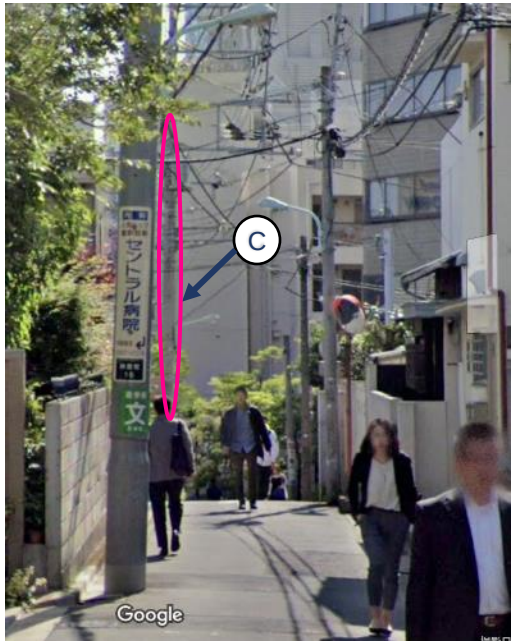
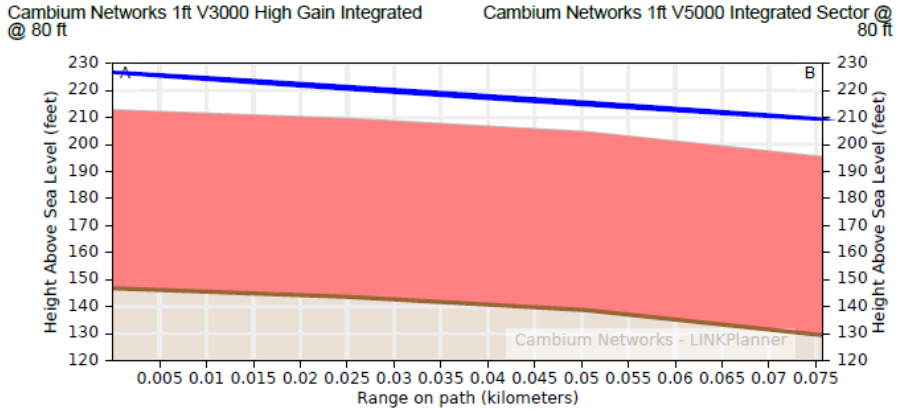
4G/5G Small Cell Backhaul

A⇒B



B⇒C





	Performance to A	Performance to B
Mean IP	1.920 Gbps	1.920 Gbps
IP Availability	99.9999 % for 0.1 Gbps	99.9999 % for 0.1 Gbps

Link Summary			
Link Length	0.076 km	System Gain	140.00 dB
Band	60 GHz	System Gain Margin	33.07 dB
Regulation	Japan	Mean Aggregate Data Rate	N/A Gbps
Modulation	Adaptive	Annual Link Availability	99.9999 %
Bandwidth	2.16 GHz	Annual Link Unavailability	20 secs/year
Total Path Loss	106.93 dB	Prediction Model	ITU-R P.530-17

- Key Application:
  - 4G/5G Cellular Backhaul
- Solution:
  - PTP with V3000, or PTP relay using V5000 and V3000

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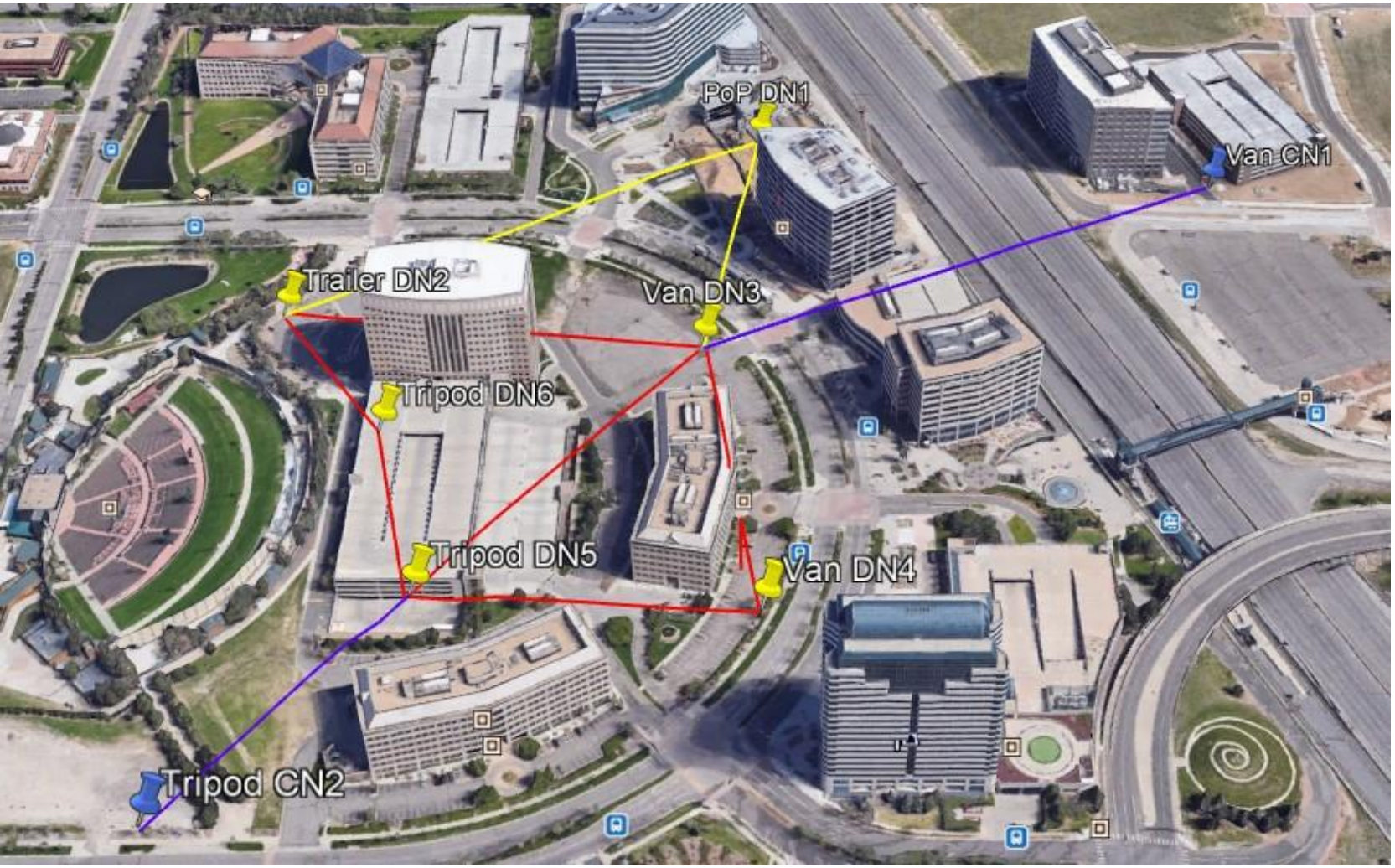
Use Case - Campus Connectivity



- Key Application:
  - Building to Building connectivity, Wi-Fi coverage for parking lots
- Solution:
  - Mesh network with V5000, V3000 and V1000

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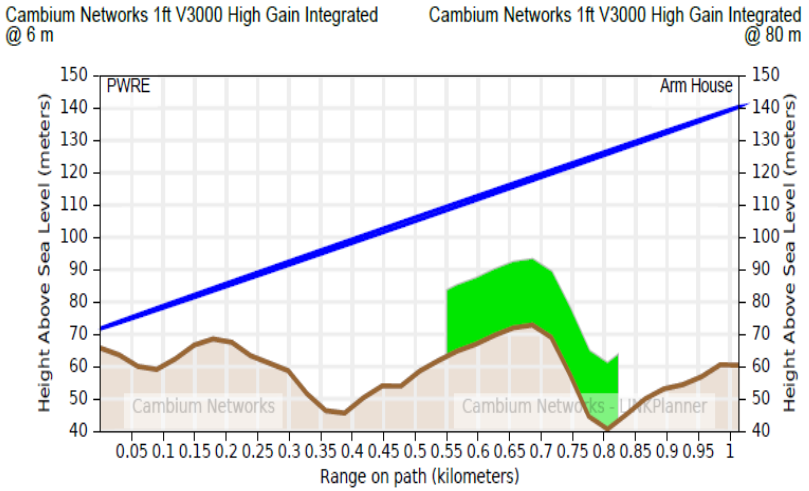
Digi – Malaysia (Cellular Backhaul)

Equipment: Cambium Networks V3000 (Preliminary) Integrated



	Performance to PWRE	Performance to Arm House
Mean IP	1.919 Gbps	1.919 Gbps
IP Availability	99.9708 % for 1.0 Gbps	99.9708 % for 1.0 Gbps

Link Summary			
Link Length	1.015 km	System Gain	169.00 dB
Band	60 GHz	System Gain Margin	28.47 dB
Regulation	Other	Mean Aggregate Data Rate	3.837 Gbps
Modulation	Adaptive	Annual Link Availability	99.9819 %
Bandwidth	2.16 GHz	Annual Link Unavailability	1.6 hrs/year
Total Path Loss	140.53 dB	Prediction Model	ITU-R P.530-17

- Key Application:
  - 4G/5G Cellular Backhaul
- Solution:
  - PTP with V3000

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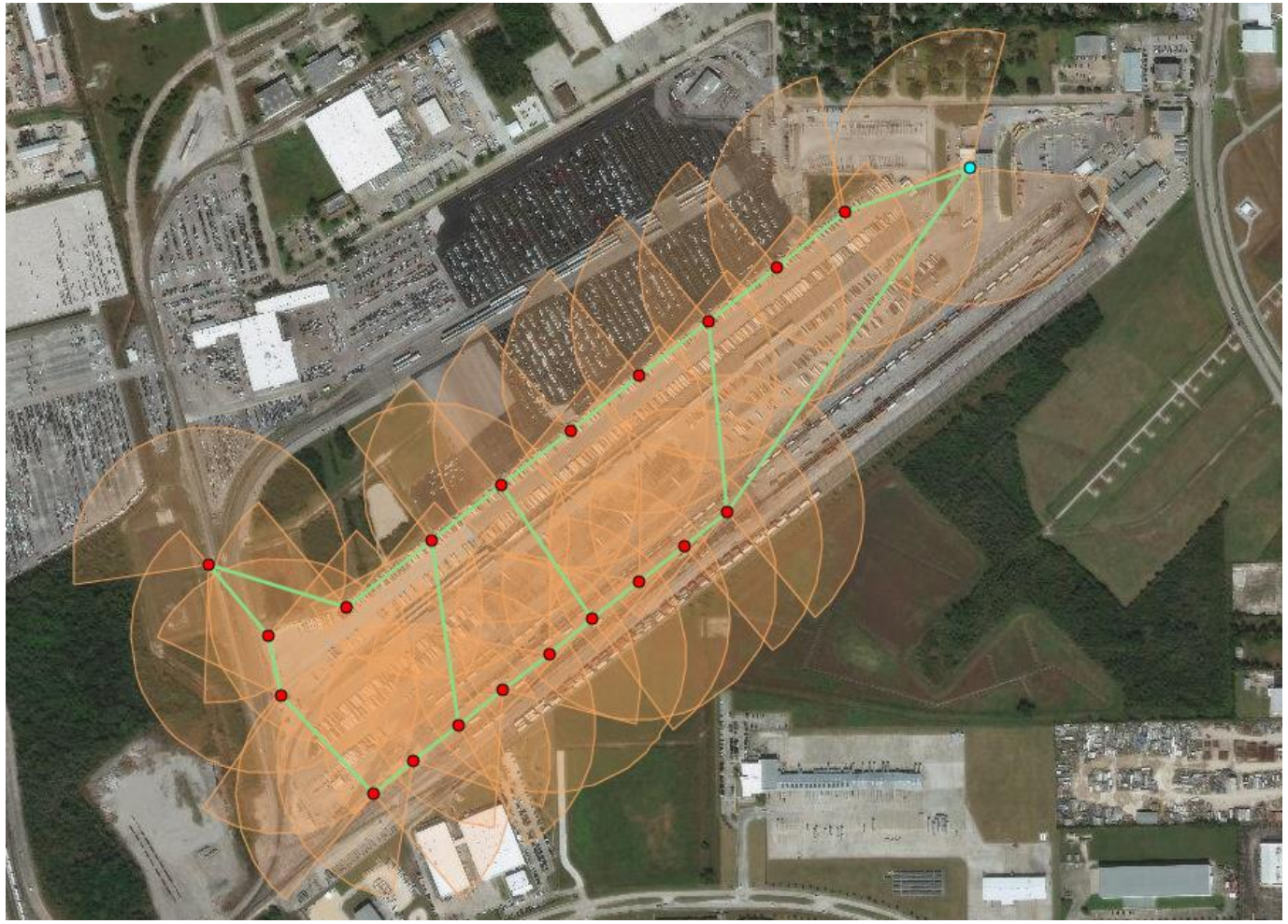
Use Case - Rail Yard Coverage



- Key Application:
  - Backhaul for Video and Wi-Fi
- Solution:
  - Mesh network with V5000

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Use Case – Wireless Connectivity for Smart City

- Key Application:
  - Backhaul for Smart City outdoor Wi-Fi
- Solution:
  - Mesh network with V5000 and V1000

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Use Case – Industry IoT

- Key Application:
  - Backhaul for I-IOT for production plant.
- Solution:
  - Mesh network with V5000

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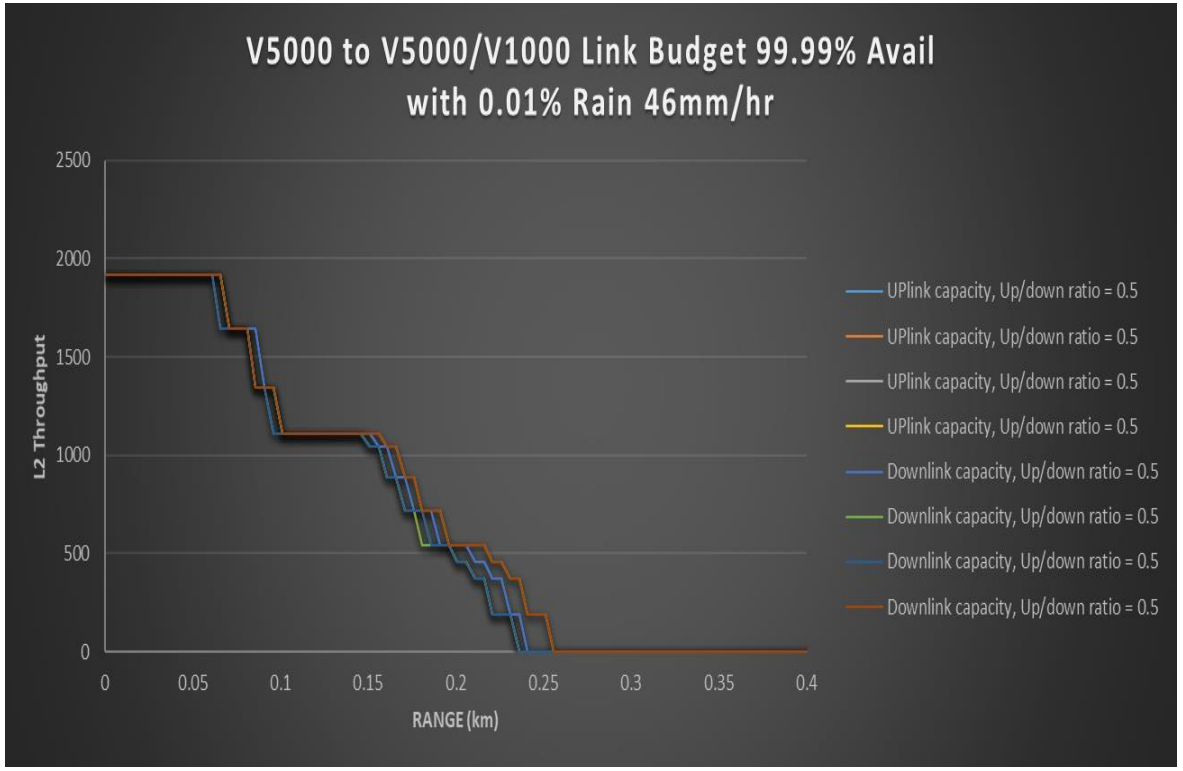
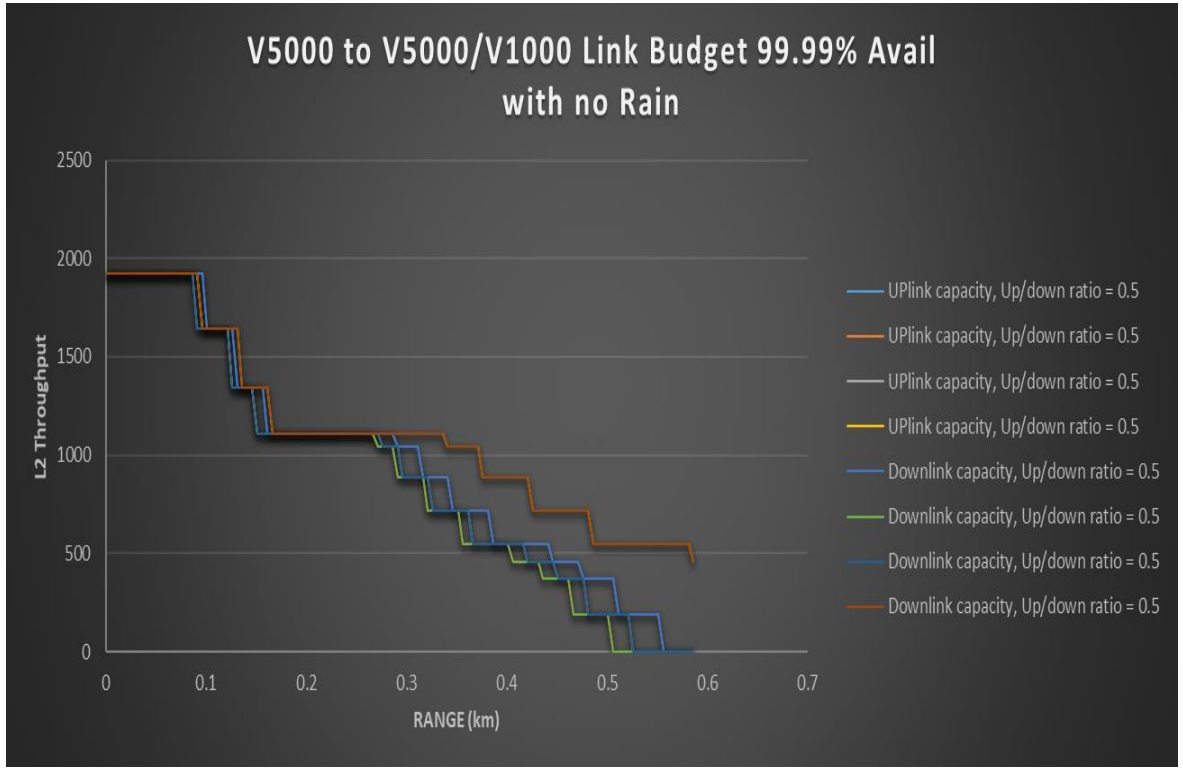
Link budget, V5000 to V5000/V1000, 99.99%





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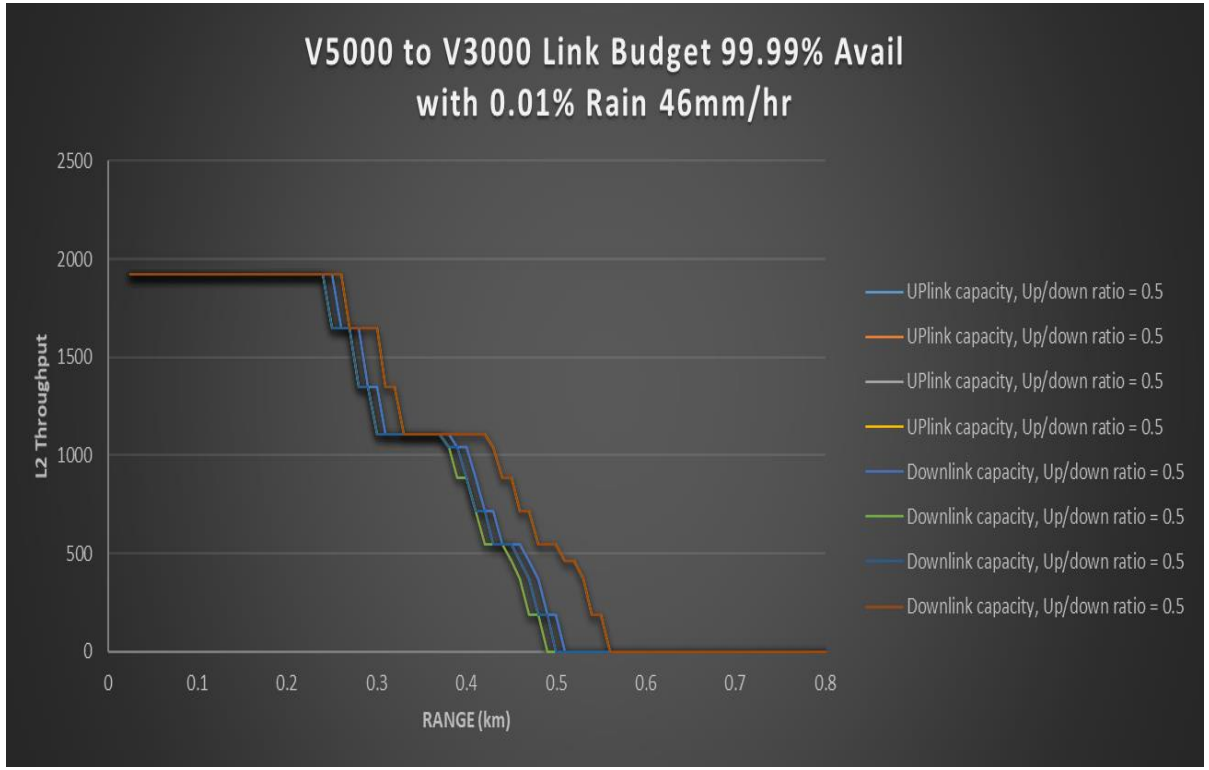
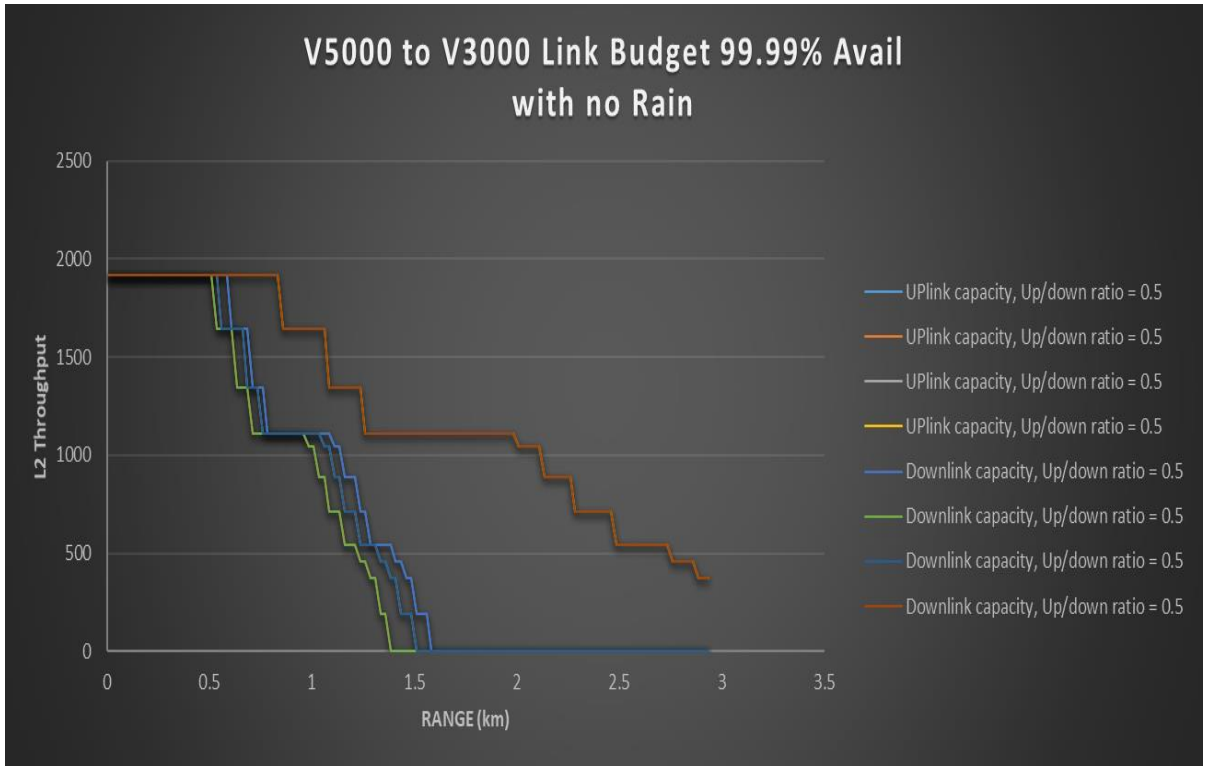
Link budget, V5000 to V3000, 99.99%





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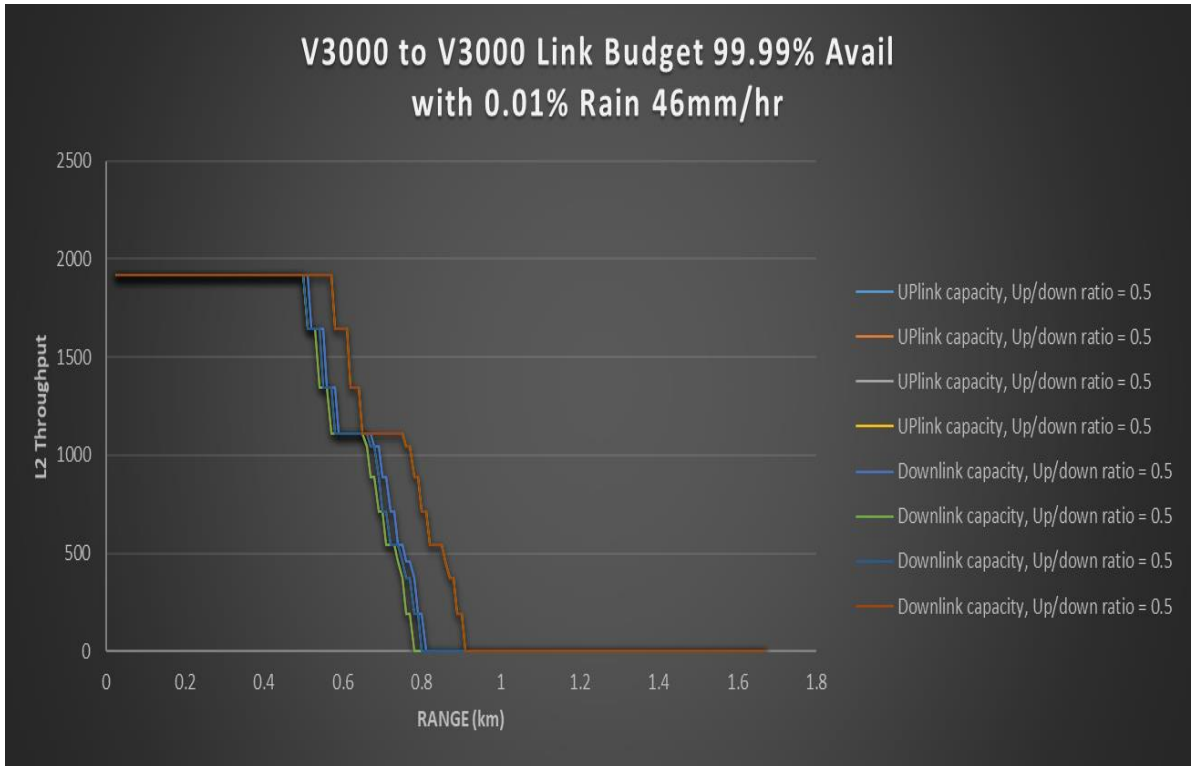
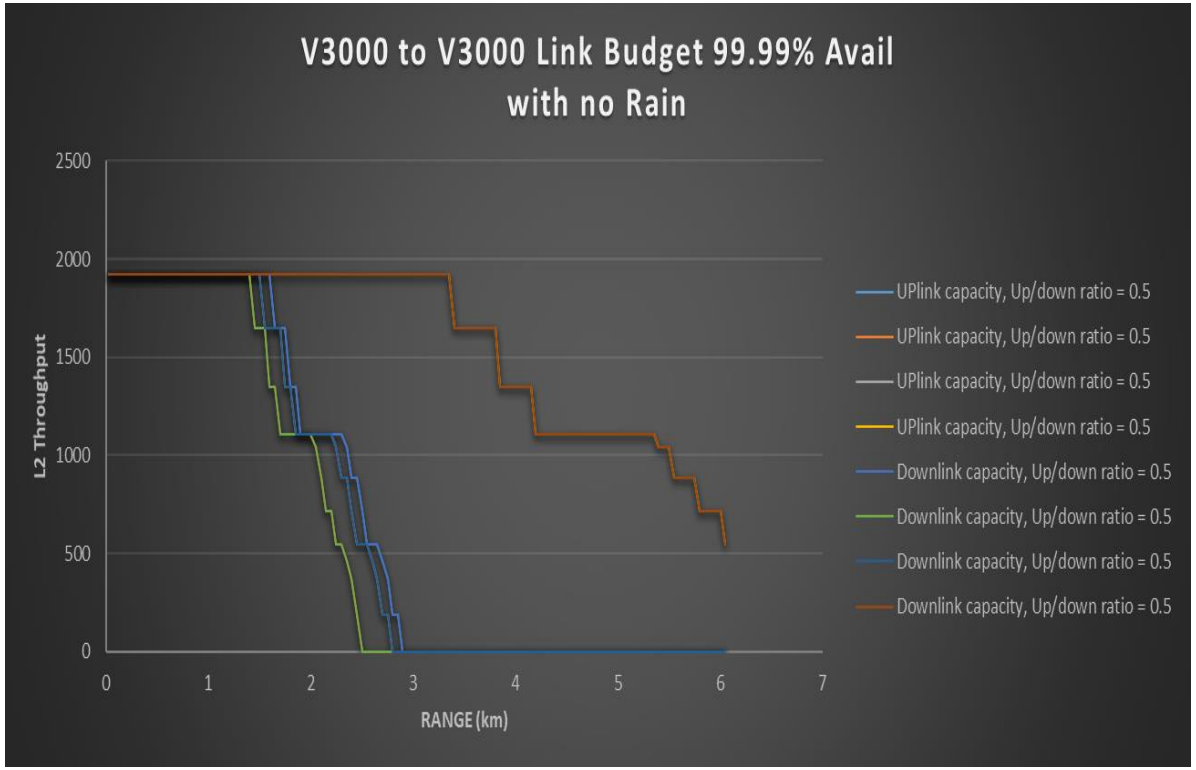
Link budget, V3000 to V3000, 99.99%





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