terragraph certified | Siklu

MULTIHAUL™ TG

Product Introduction

Presented by:

Shimon Hochbaum/ Director PLM – Siklu

David Botha/ Strategic Partnerships – Facebook Connectivity

December 2020

Agenda

01

Introduction

02

Target Applications

03

The Terragraph Story by Facebook

04

MultiHaul™ TG Overview

05

Designing a TG Network

06

Q&A

01

Introduction

Company Snapshot

Siklu is a leading player in mmWave solutions

Founded:
2008

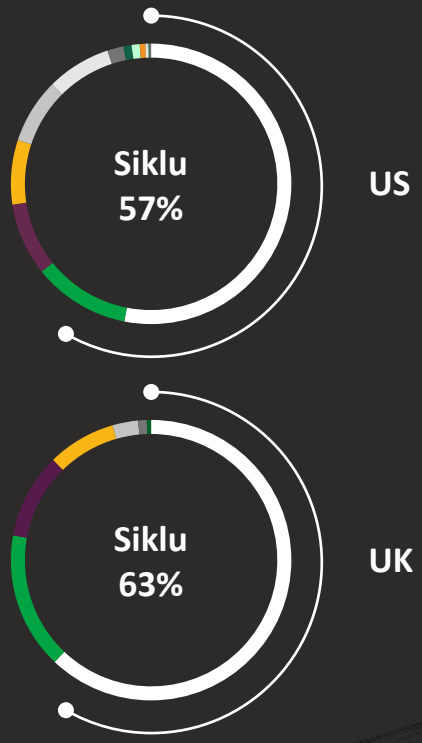
Employees:
+100; Headquarter in Israel; Presence in USA, CALA, EMEA and APAC

Technology:
Groundbreaking all-silicon innovations, mastering the art of millimeter waves fixed wireless networks

AI tools and apps for planning and design of Fixed 5G mmWave networks.

Leading E Band vendor in the US and the UK
According to FCC & OFCOM

2019



Most Comprehensive mmWave offering

60GHz V-band PtP

60GHz V-band PtMP

60GHz V-band L2 mesh with SON/SDN

70-80Ghz E-band PtP

Network Design and Operations Tools

Most Deployed Links

45+
Countries

100K+
Deployed

250+
Smart Cities

40
Patents

Gbps Connectivity Options

Fixed 5G offers the best cost-effective solution vs. Fiber and Cellular

FIBER	Fixed 5G mmWave	5G New Radio
+ Secure	+ Secure	+ Industry standard
+ Multi gigabit capacity	+ Multi gigabit capacity (24GHz of spectrum)	+ Ubiquitous in phones
– Expensive	+ Affordable	– Requires expensive license
– Slow time to market	+ Very low latency	– Limited ~2GHz of spectrum
– Complex implementation	+ Reliable, immune to interference	– Designed for Mobility – complex and expensive
	+ Fast time to market	– Full coverage will take millions of small cells and years to deploy

Siklu Solutions

E-band and V-band PtP / PtMP / Mesh products

Roof Top High-Capacity
Point-to-Point

- Up to 10Gbps full duplex capacity
- 3 mi / 4.8 Km Range (6 mi / 9.6 Km with ExtendMM™)
- Different Antenna sizes

Street-level
Point-to-Point

- Internal Switch with Dual PoE-Out
- Up to 1Gbps aggregated capacity
- 0.6 mi / 1 Km Range

Street-level
Point-to-Multi-Point

- Auto alignment with no setup
- Up to 1.8 Gbps aggregated capacity
- ≤ 0.25 mi / 400 m Range

terragraph
certified

Street-level and Roofs
L2 SDN Mesh

- Self-Organizing (SON) with SDN
- Auto alignment with no setup
- Up to 16 Gbps aggregated capacity
- ≤ 0.3 mi. / 450 m Range

02

Target Applications

Key Applications for MultiHaul™ TG

Gigabit capacity is a key enabler of the connected society

Smart Cities

Municipal Networks

Video Security

IoT Wireless

Video Surveillance

Public Safety

Critical Infrastructure

Education

Backhaul Networks

Small Cell & Mobile BH

Enterprise Connectivity

Public Wi-Fi

Internet Access

Community Connectivity

Residential SFU

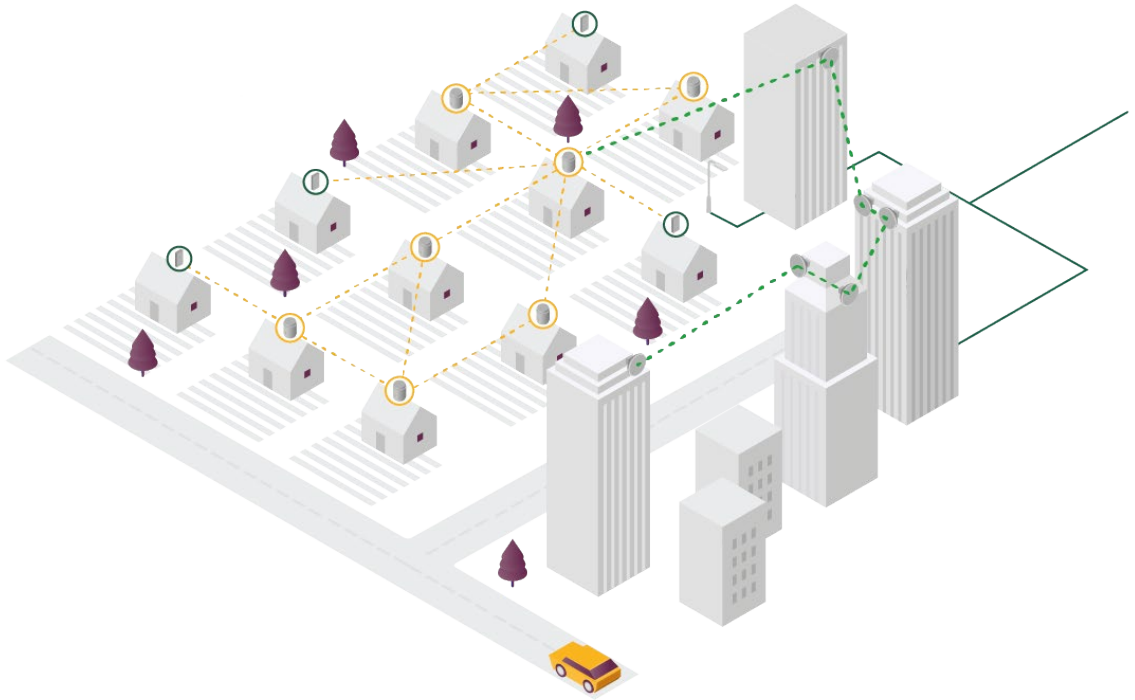
Rural Connectivity

Gigabit Internet Access

End-to-End solutions with Siklu PtP / PtMP portfolio

WiNDE

EMS



PtMP Terminal

Compact Node 360°

Mesh Node 360°

Fiber

PtMP

PtP up to 10Gb FD

PtP up to 1Gb

Mobile and Small Cell Backhaul

End-to-End solutions with Siklu PtP / PtMP portfolio

WiNDE **EMS**

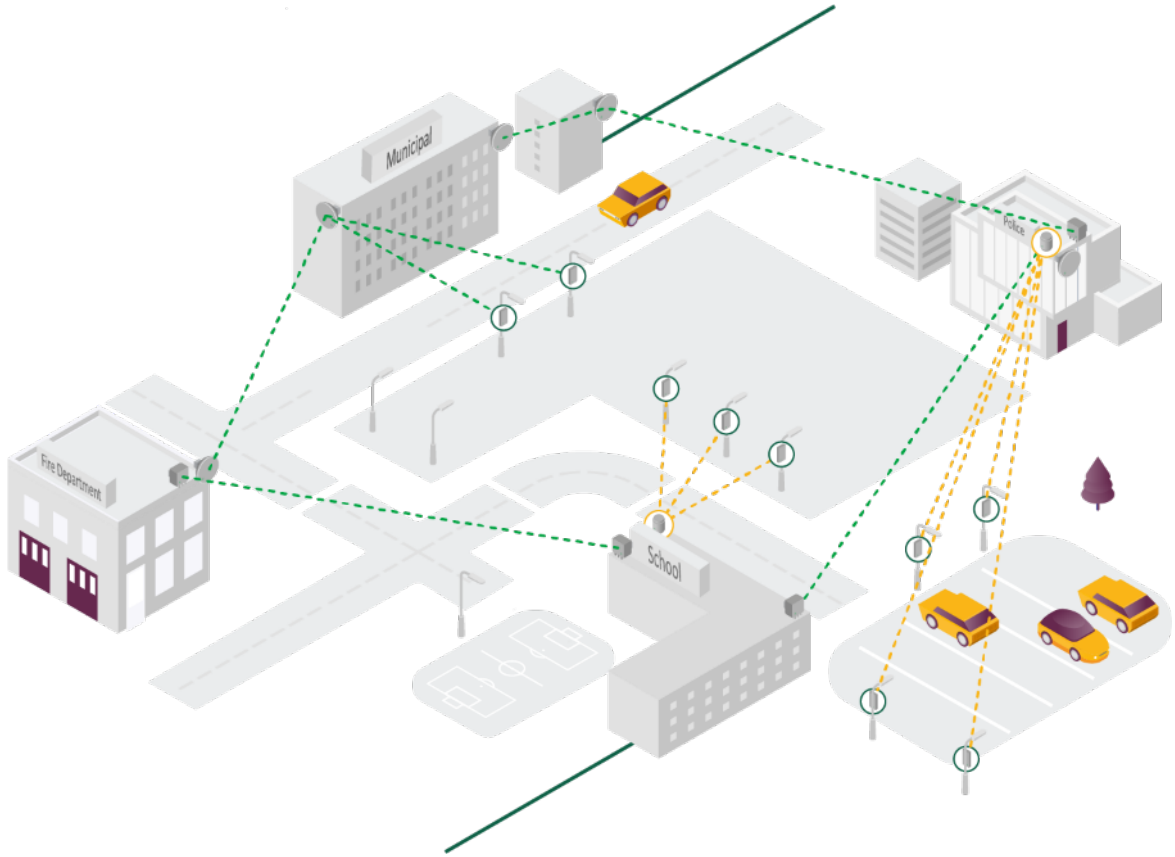
PtMP Terminal | Compact Node 360° | Mesh Node 360° | Fiber | PtMP | PtP up to 10Gb FD | PtP up to 1Gb

Smart Cities

Gigabit Wireless Everywhere

WiNDE

EMS



PtMP Terminal | Compact Node 360° | Mesh Node 360° | Fiber | PtMP | PtP up to 10Gb FD | PtP up to 1Gb

Bridging the Digital Divide: Cleveland, US

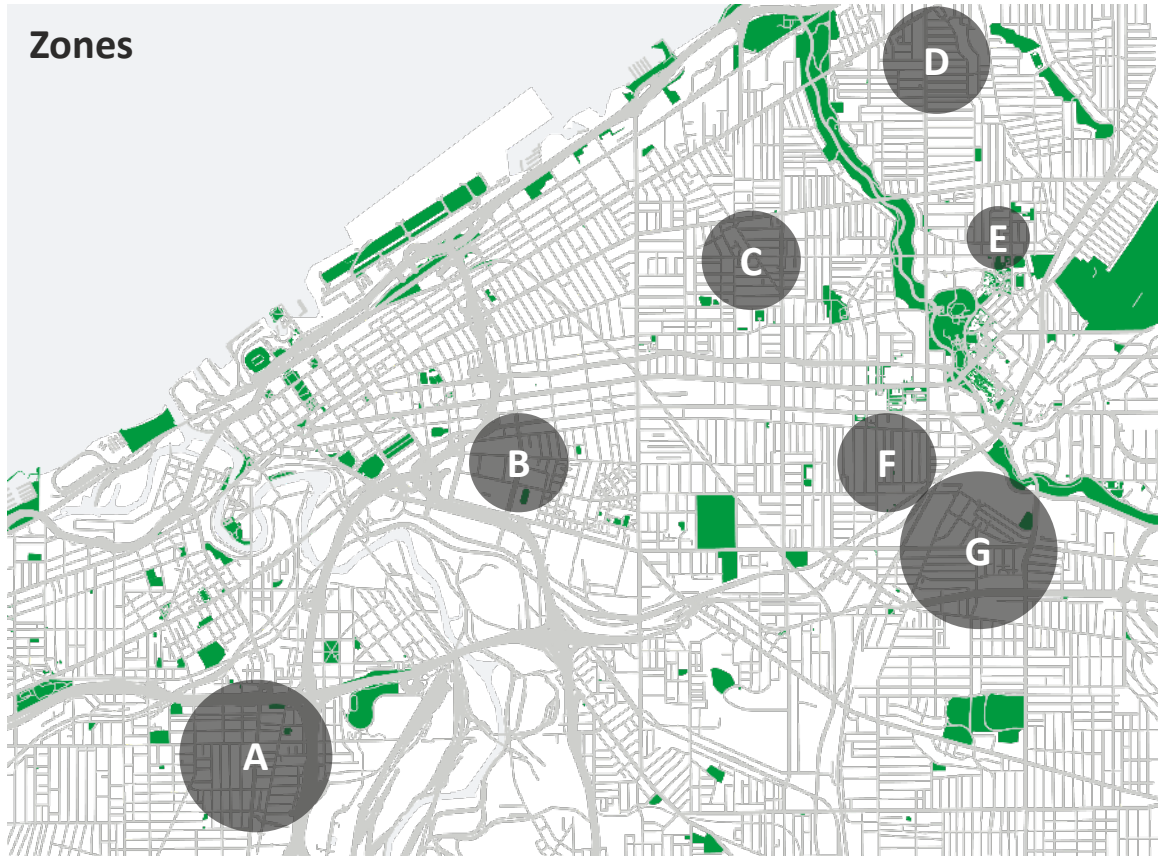
THE solution: 60GHz and MultiHaul™ TG

Cleveland is the 3rd Worst Connected City in America (Detroit and Memphis are even worse)

In 2019, there were approximately 50,000 households with no internet access

EmpowerCLE+, spearheaded by DigitalC (a nonprofit organization), is providing access to the internet, accompanied by digital skills training and access to devices

Target: connect first 1,000 homes in time for start of new school year in September!



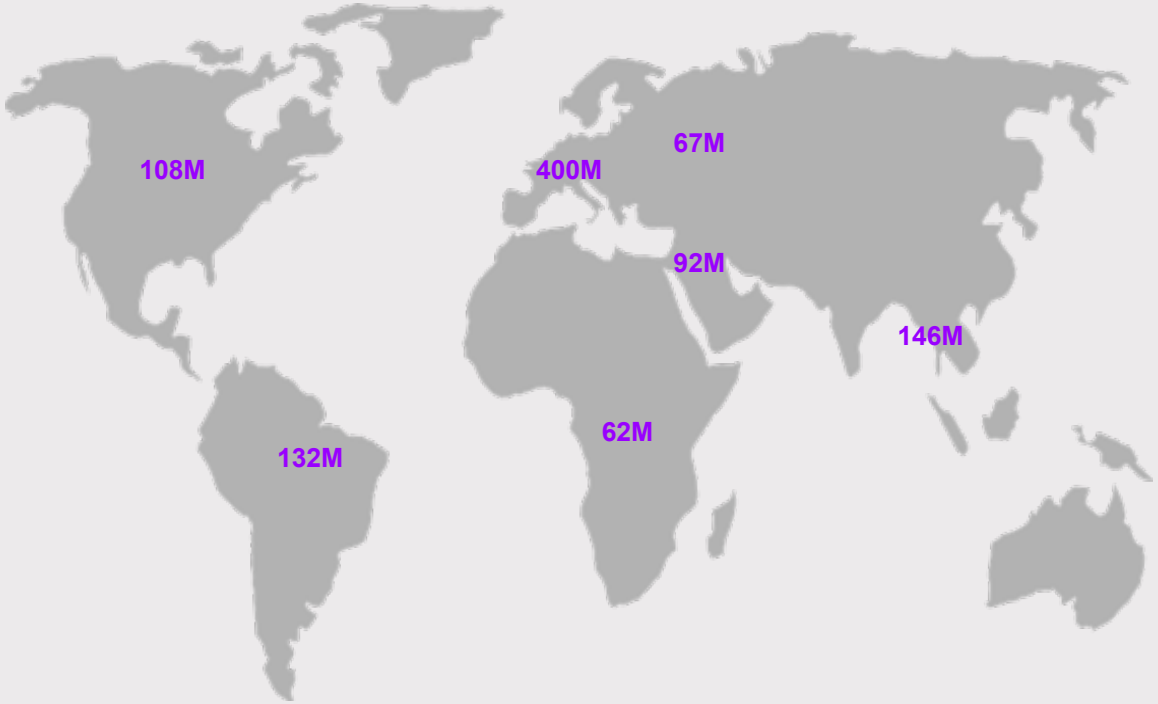
Its not about connecting houses, buildings or even schools. Its about connecting people. In the age of COVID19 with isolation and quarantining, being able to do so virtually is not just a convenience it's a necessity. This gentlemen and his family now have gigabit access thanks to Siklu and DigitalC.

03

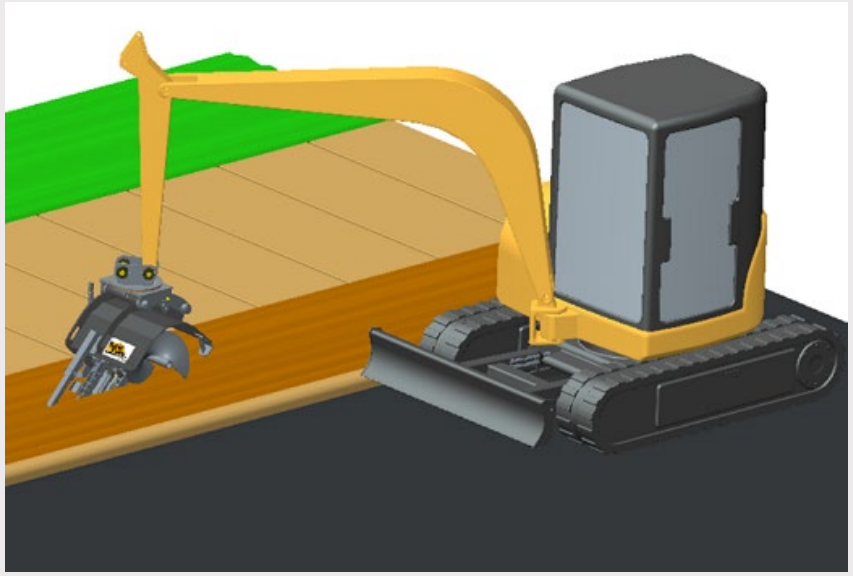
The Terragraph Story, By Facebook

Bringing more people online
to a faster internet

Poor last mile connections are detrimental to high speed broadband availability

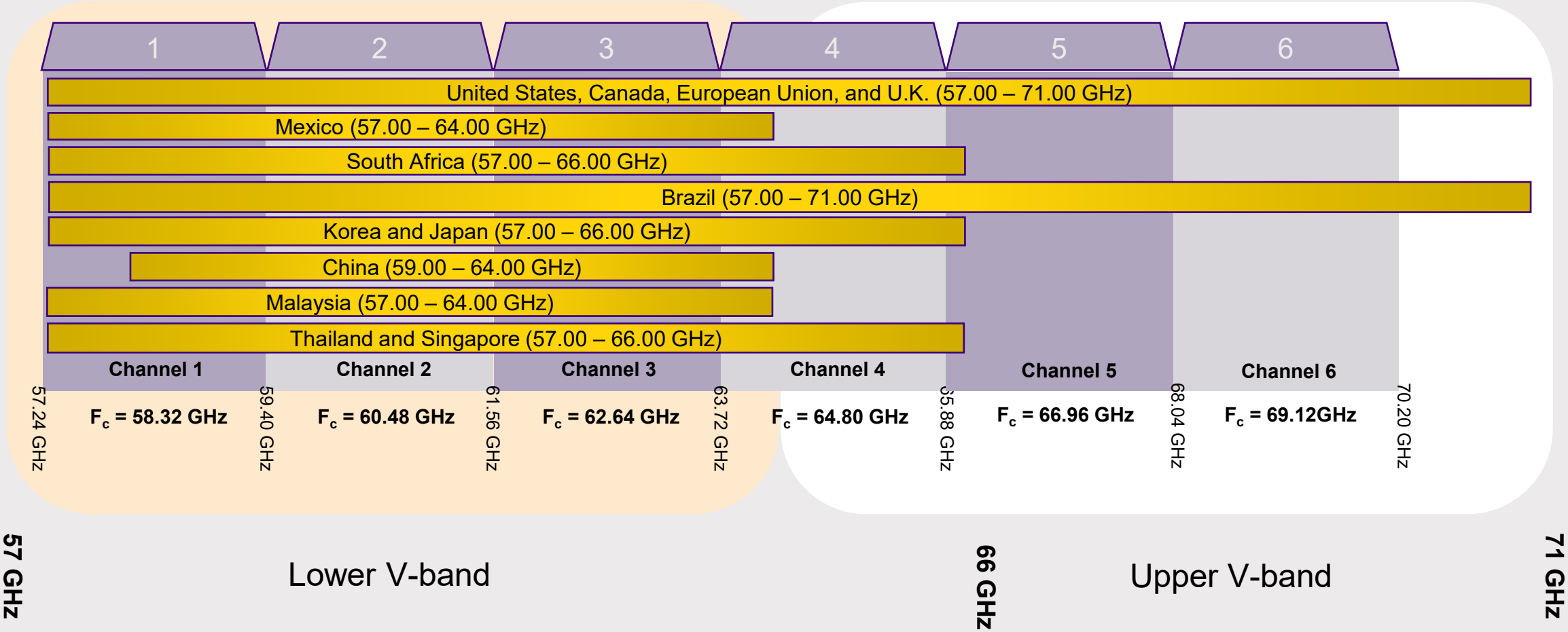


1B+ people on outdated last mile infrastructure

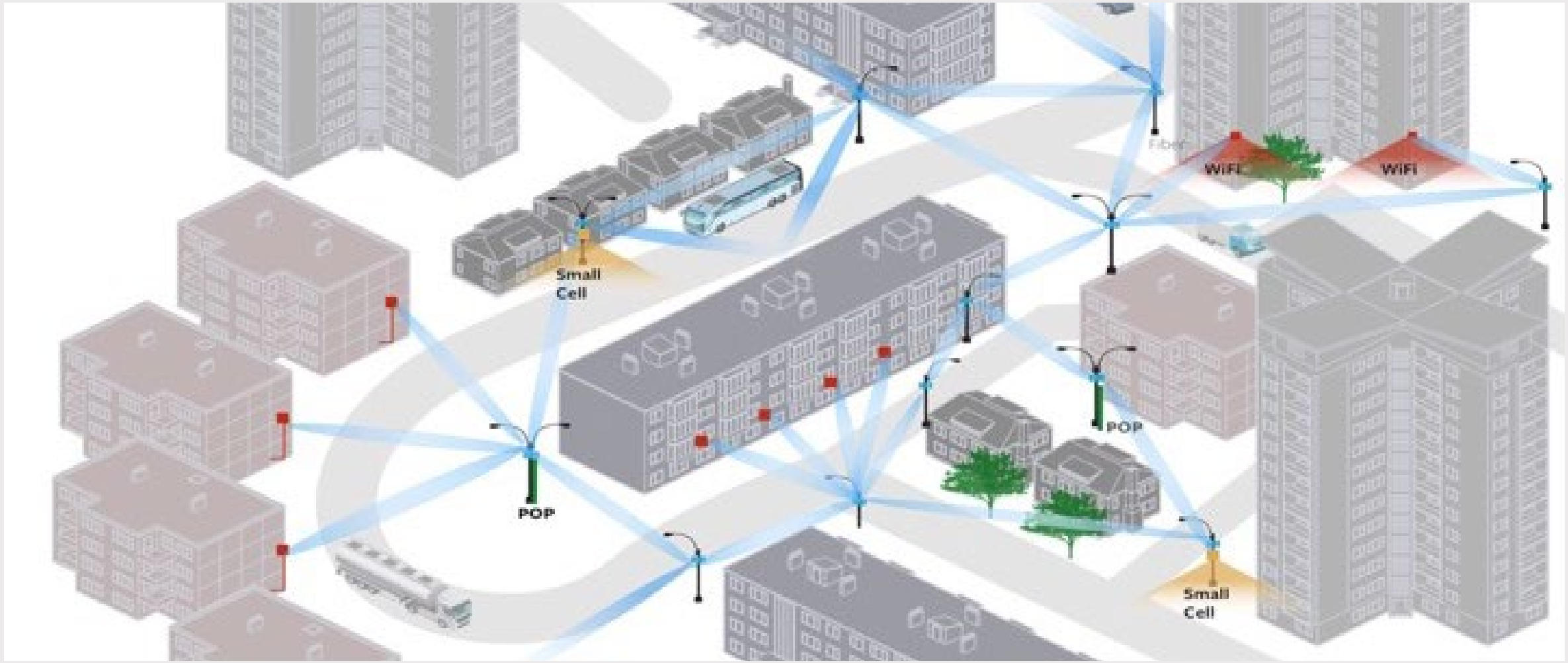


Fiber is cost-prohibitive and slow to deploy

60GHz Band Is Widely Available



The Vision: High-Capacity Wireless Mesh for Last-Mile Distribution



Research & Development Begins at Facebook…

The Concept Is Contributed to IEEE 802.11ay

November 2017 doc.: IEEE 802.11-17/1640r0

IEEE P802.11
Wireless LANs

Scheduling for mmWave Distribution Networks

Date: 2017-11-07

Author(s):

Name	Affiliation	Address	Phone	email
Carlos Cordeiro	Intel	Portland, OR, USA		Carlos.cordeiro@intel.com
Djordje Tujkovic	Facebook	Menlo Park, CA, USA		djordjet@fb.com
George Cherian	Qualcomm	San Diego, CA, USA		gcherian@qti.qualcomm.com
Cheng Chen	Intel	Portland, OR, USA		Cheng.Chen@intel.com
Payam Torab	Facebook	Menlo Park, CA, USA		ptorab@fb.com
Solomon Trainin	Qualcomm	Haifa, Israel		strainin@qualcomm.com
Carlos Aldana	Intel	Santa Clara, CA, USA		Carlos.Aldana@intel.com
Nabeel Ahmed	Facebook	Menlo Park, CA, USA		nabeel@fb.com
Saehee Bang	LG	Seoul, South Korea		Saehee.Bang@lge.com
Michael Grigat	Deutsche Telekom AG	Deutsche-Telekom-Allee 7,64295 Darmstadt, Germany		m.grigat@telekom.de

Abstract

[This document proposes draft changes to include scheduling mechanism for mmWave Distribution Networks as described in 17/1323r2.]

Insert the following subclause

10.36.6.2.2 SP with TDD channel access

A DMG AP or DMG PCP shall set the AllocationType subfield to 0 and the TDD Applicable SP subfield to 1 in an Allocation field within an Extended Schedule element to indicate a TDD SP allocation.

When allocating a TDD SP, the AP or PCP shall set both of the Source AID and Destination AID subfields in the corresponding Allocation field to 0.

If an Extended Schedule element includes at least one TDD SP, a DMG PCP or DMG AP shall include the Extended Schedule element in each transmitted DMG Beacon frame.

The structure of TDD SP is shown in Figure 89. A TDD SP consists of one or more consecutive identical TDD intervals. A TDD interval comprises one or more TDD slots.

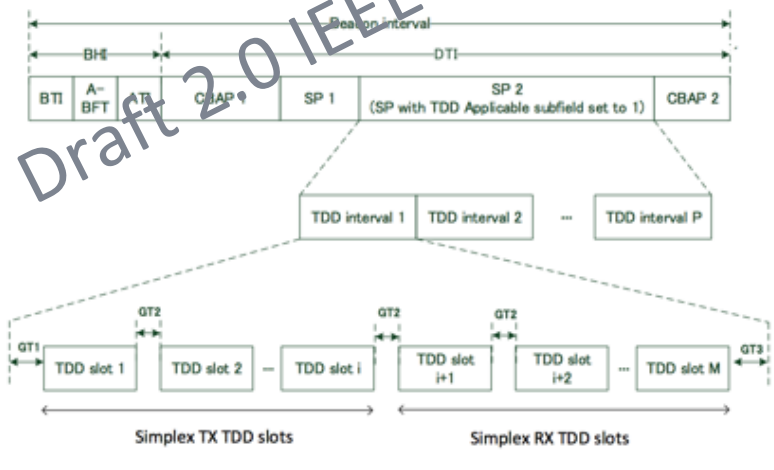


Figure 89—Example of a TDD SP

A Deployable Reference Design is Created To Prove the Concept in Networks

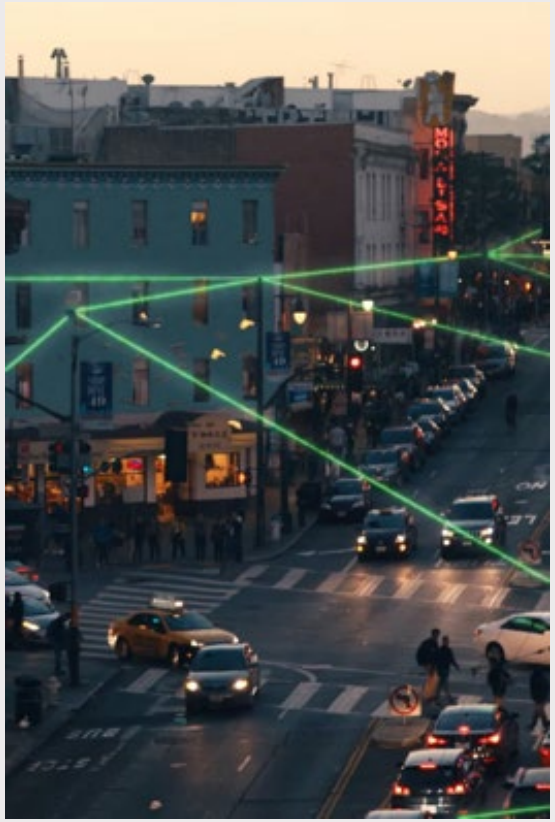
terragraph | facebook connectivity

“Real World” Deployments Begin, e.g. San Jose

terragraph | facebook connectivity

Operator Trials Using the Facebook Reference Platform

Magyar Telekom, Hungary



YTL, Malaysia

Aeronet, Puerto Rico

An Ecosystem is Born!

terragraph | facebook connectivity

6 OEMs licensed to commercialize Terragraph technology

Supply chain for critical components is established, e.g. chipsets, antennas

7 Facebook-led trials with operators worldwide

OEM engagements with **100+ operators** worldwide

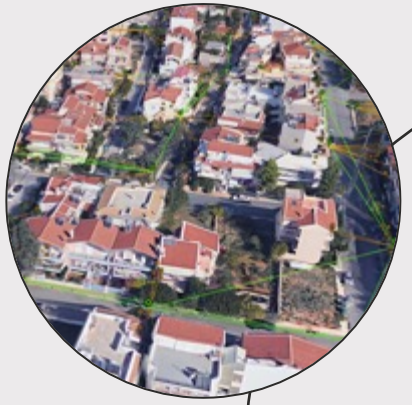
Terragraph expertise spreading among **Systems Integrators**

Tools for **automatic network planning**, including Facebook's

The Road Ahead…Millions Connected

terragraph | facebook connectivity

FIXED WIRELESS ACCESS



SMALL CELL BACKHAUL

WI-FI BACKHAUL

CAMPUS CONNECTIVITY

04

MultiHaul™
TG Overview

Siklu’s MultiHaul™ TG Product Line

Best in Class: Integration and Wireless Performance

Highest level of integration

360° coverage (4 x 90° sectors)

Simple single-cable installation

Built-in switch eliminates the need for external switch or 3rd party box

Integrates with billing and OSS practices (network name/ID assigned by the user, and not MAC address)

Best in-class radio performance

Short or Long range

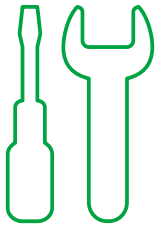
Beam-forming, 0.5ft, 1ft or 2ft antennas (field installable)

Siklu’s inhouse RF designs

Siklu’s MultiHaul™ TG Product Line

Best in Class: Ease of Operations and Networking Performance

Easiest to Operate

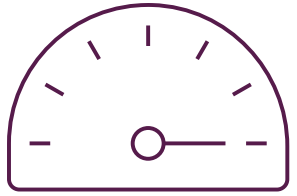


Works out of the box (NW controller is optional)

Ethernet only (like DSL/fiber/GPON; no routing), simplest to deploy or troubleshoot

IPv4 or IPv6, for management only

Best in-class networking performance



Lowest latency

Highest PPS

Full VLANs support

Provider bridge

MultiHaul™ TG for Scalable Networks

Neighborhood Coverage

- Fast, Flexible, Pay-as-you-grow

Self-backhauling

- Simple deployment

Redundancy

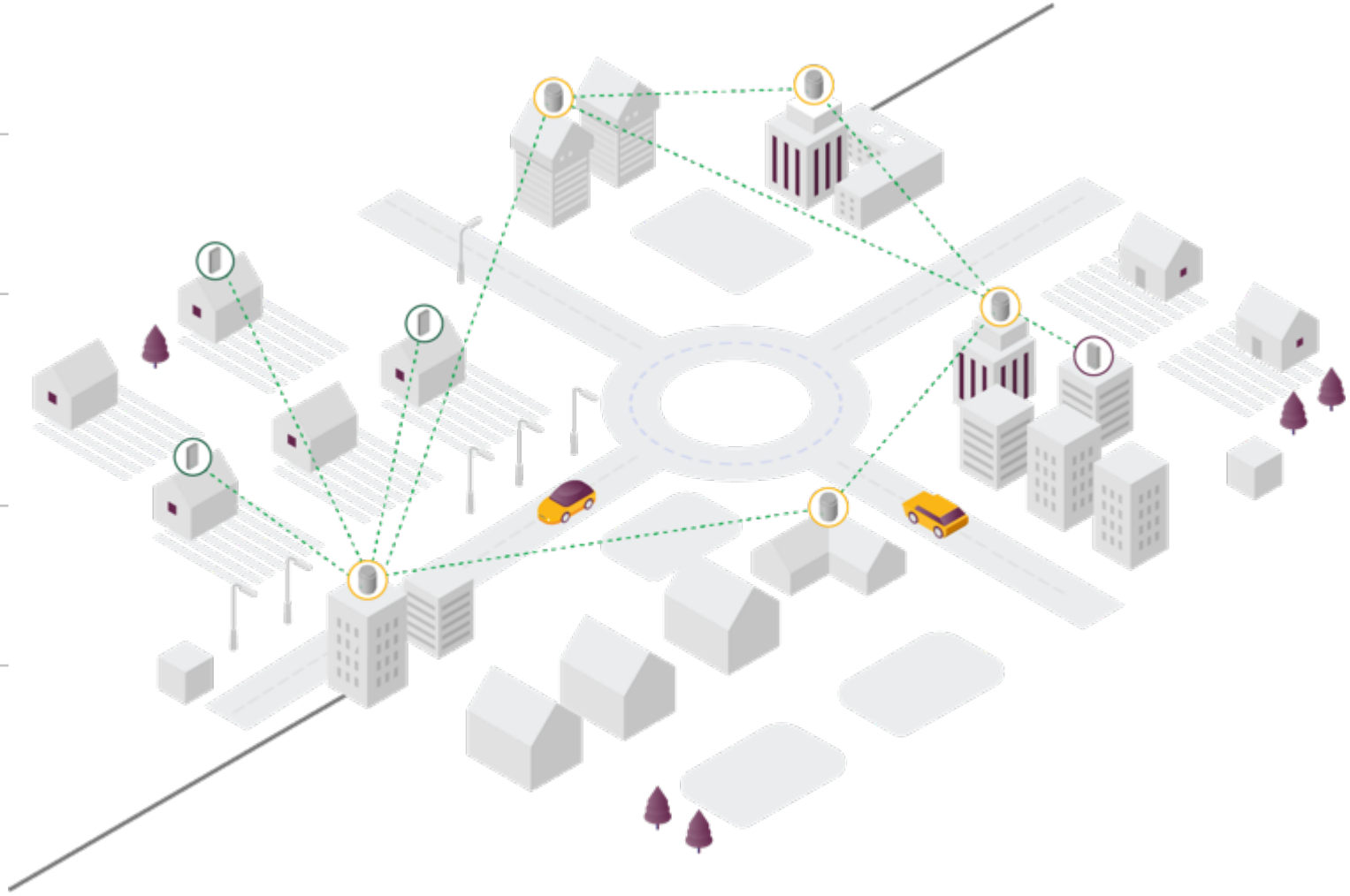
- Backhaul
- Access

Service with Nodes or TUs

- Series of TU models on the roadmap

Cloud Ready SON

- Integrated with SmartHaul™ WiNDE, ENMS & Runner
- Streamlined Planning, Deployment and Operations



MultiHaul™ TG and Terragraph

	Terragraph (other vendors)	Siklu MultiHaul™ TG
Physical Layer	802.11ay	802.11ay
Networking	• L3 routed network • Optional L2 encapsulation	• L2 switched network (service provider MOP, DSL, fiber or GPON) • Native layer 2 services (low latency and high PPS)
Node unit	Up to 5 boxes (4 sectors, optional aggregator)	One integrated box, 4 sectors (360°), 1 management, 1 install, 1 power
Terminal unit(s)	Functional reference only	TU-TG series, cTU-TG, LU-LR/PtMP (and N366)
Out of Box experience	Out-of-band comms between mobile and NMS to report on MAC of new unit (No OoB automatic connectivity)	• auto-connect (traditional Siklu) • SON management (Runner) based on Network Name/ID, MAC or serial#
NMS/SDN	Facebook EMS and E2E controller (Open/R)	• Optional • SmartHaul™ ENMS and Runner SDN controller
Other	N/A	Backhaul solutions, to and in the network (10G E-band, V-Band multi-gig LU-LR/PtP)

MultiHaul™ TG - N366

Siklu 3rd generation PtMP 60GHz products (5th gen. 60GHz)

Terragraph (TG) compliant

+15Gbps L2 (+3.8Gbps per sector)

- 15 TUs per sector
  (2 self-backhaul links)
- latest QCOM 802.11ay chipset (SW upgrade to full 802.11ay in 2021)

Managed TDD 50:50

Guaranteed latency, 0.1ms (100µs)

Integrated L2 Switch

Support of PtMP, self-backhaul or mesh

- Full VLAN suite: C- or S-VLAN, QinQ and Provider Bridge

Self-align up to 450m

High or medium densities

- To other N366 or to T265

MultiHaul™ TG - N366

360° coverage from single pole / single box

4 independent 90° sectors

- Flexible RF channel assignments in the 60GHz band (AAAA, ABAB, etc.)

Ports & PoE:

- 10 / 5 / 2.5 / 1GbE copper (802.3bz/an) with PoE-in (802.3bt, 55W / 90W)
- 1GbE copper + PoE-Out 35W
- 10GbE SFP+
- fiber backhaul, drop & insert, management, service drop

Future-safe

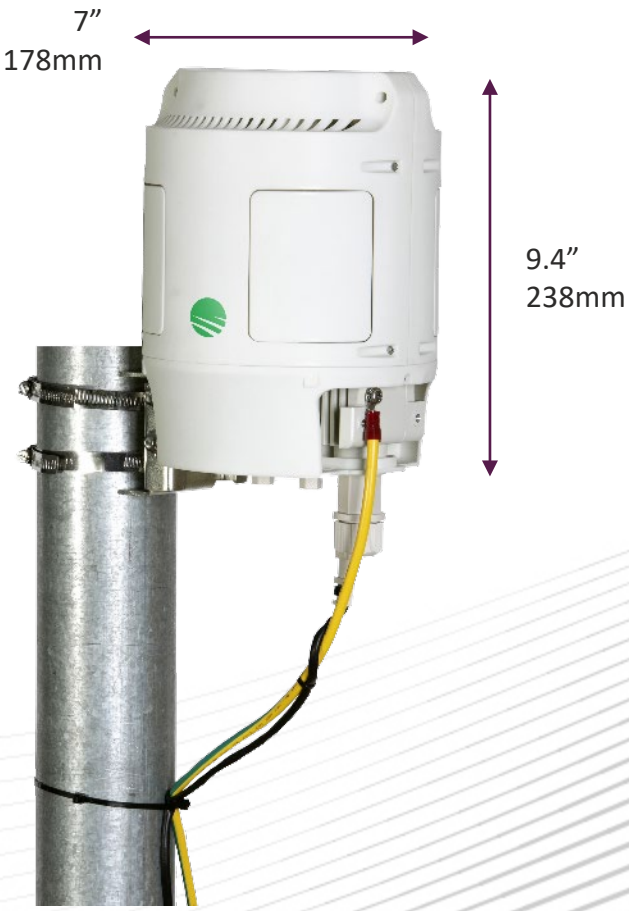
- HW ready for CB2, +5.5Gbps per sector >> 2.5Gbps services
- (SW upgrade in 2021)

Carrier grade

- Temperature: -49° ÷ +131°F / -45° ÷ +55°C
- IP67

Weight

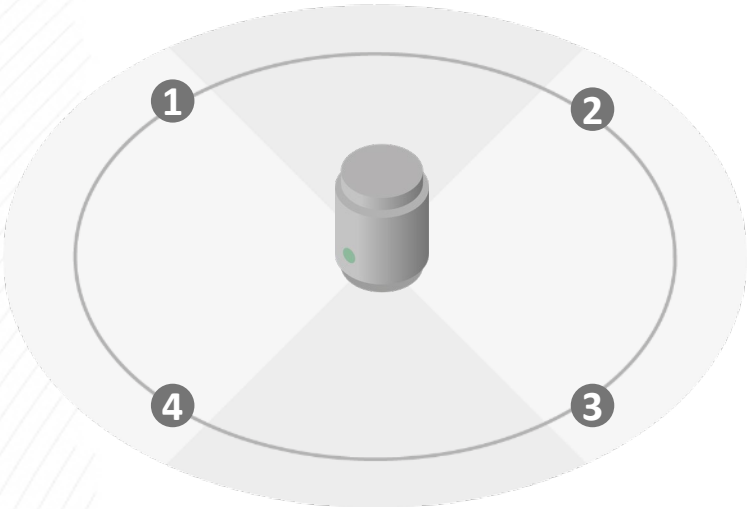
- 7.9 lbs. / 3.6 Kg



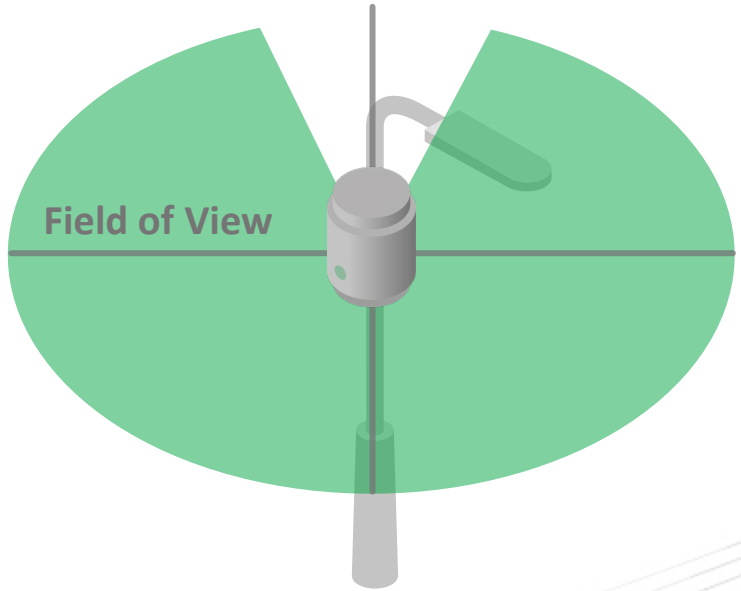
N366 Installation & field of view

Full performance (up to 60 subs, up to 8 links, up to 16Gbps)

Top of pole: no obstruction



Middle of pole: partial obstruction



MultiHaul™-TG Terminal Units (T265)

(1Gb capacity, roadmap to 2.5Gb)

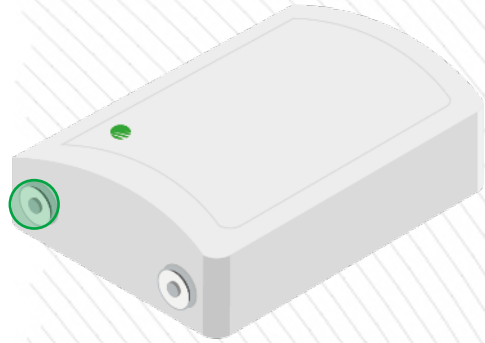
PoE-In, ETH1:

- 34W (no PoE-Out)
- 90W (w/ ETH2 PoE-Out)

3 or 5 LEDs:

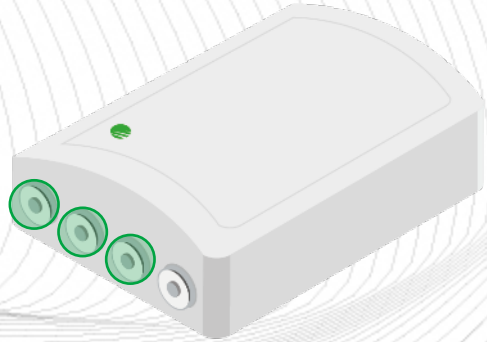
- Power
- RF/Link
- 1 or 3x ports (Ethernet, SFP)

1x RJ-45 (2.5GbE)



2x RJ-45 (2.5GbE, 1GbE) & SFP+ (10GbE)

PoE-Out: ETH2 (55W, eg PTZ camera)



Simple Out-of-the-Box operations

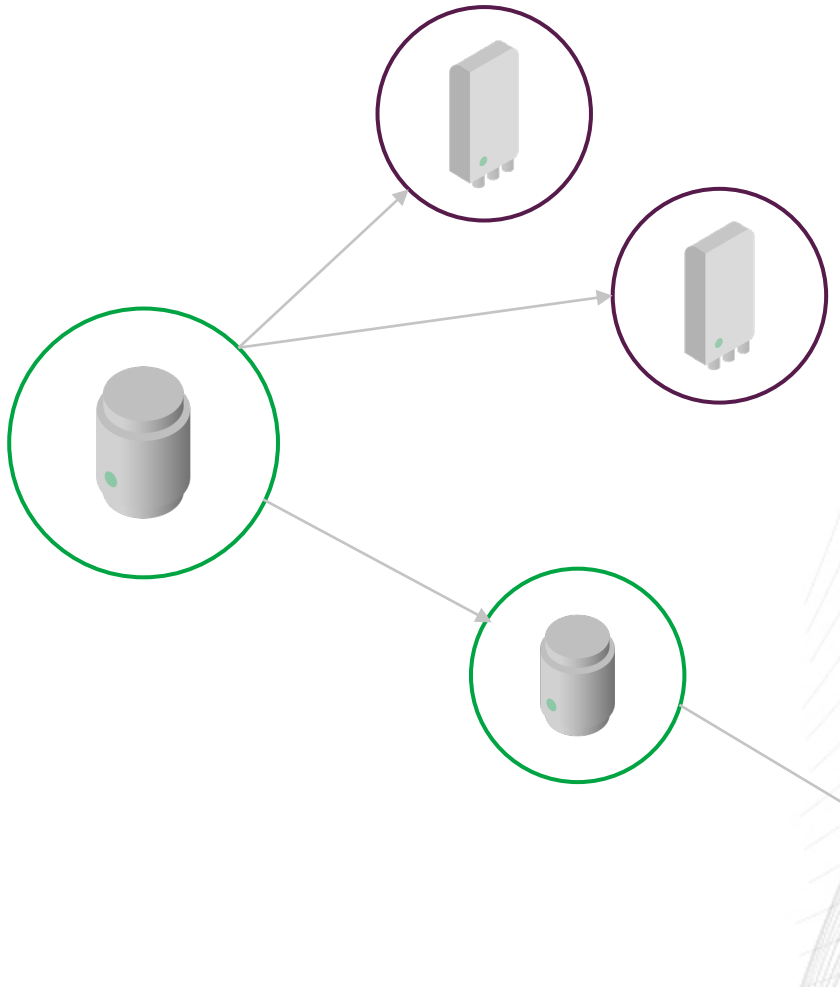
No controller needed!

Each unit is configured with Network Assigned Name/ID

- Factory default = serial number
- Configurable in the CLI/GUI/Wizard
- Any identifier that operator wants or needs: phone number of the user, circuit id, service id, street address
- Integration with all systems such as EMS, billing or OSS

User configures the N366(s) to setup links to other units

- N366 or T265
- Only 1 of the pair of N366 needs to be configured to set up a backhaul link



T265 discrete installation, with MH-AX-AWS-CVR6

Hiding the cables yields a more eye-pleasing installation

05

Designing a TG Network

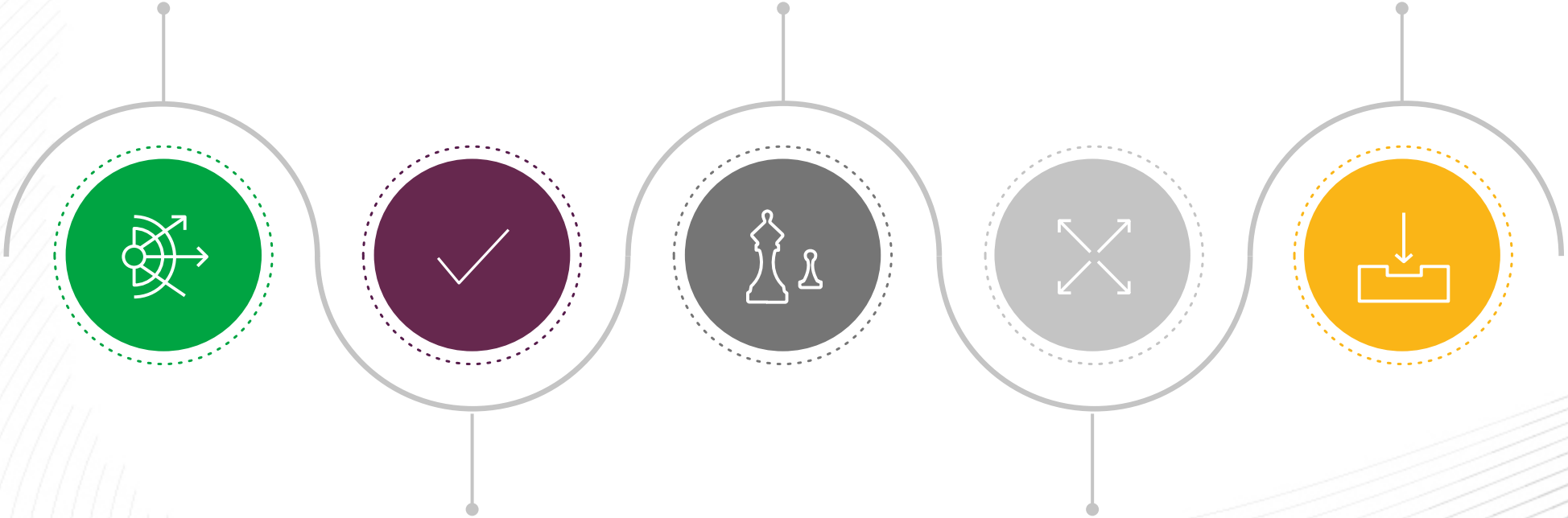
Design and Rollout Methodologies

Minimize equipment deployed and get maximum coverage

LoS analysis

Rollout strategy

Densify



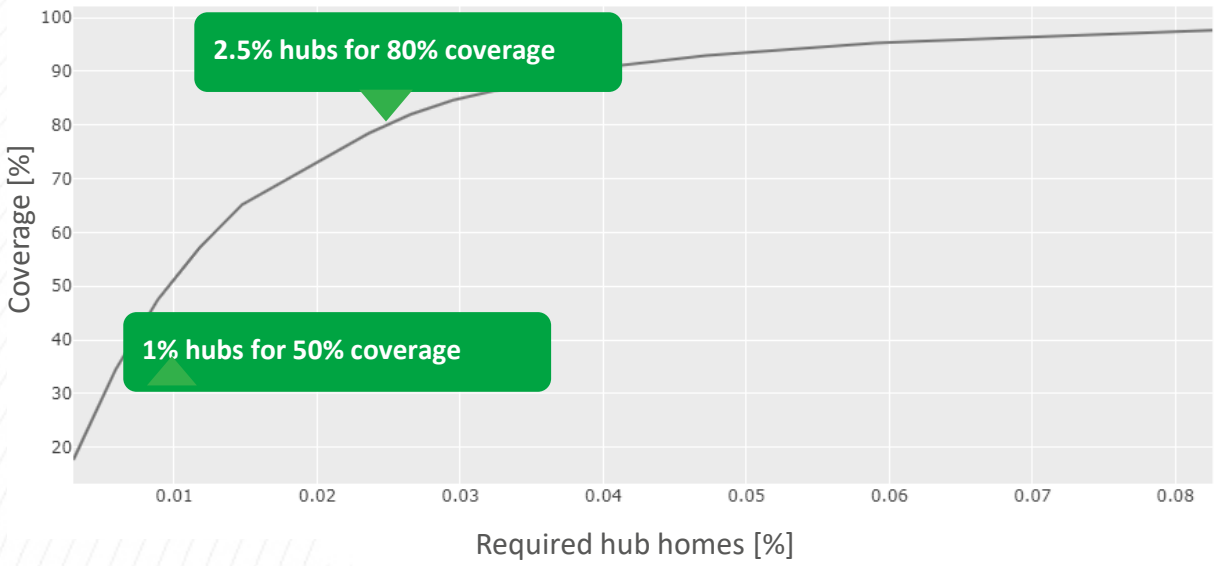
Go/No go

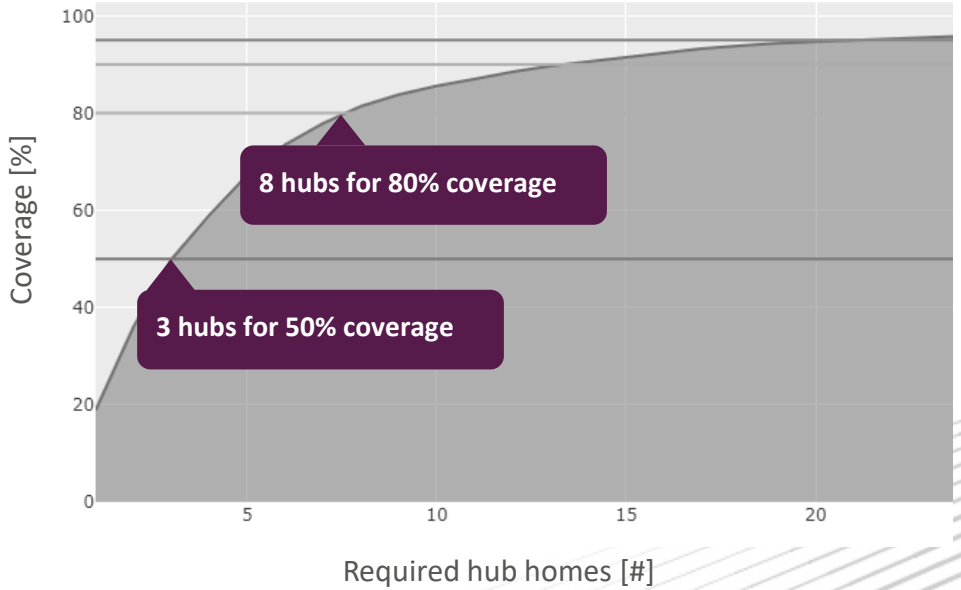
- Required density/coverage
- Business parameters

Presell/Deploy

Number of hubs/homes vs Coverage Tradeoff

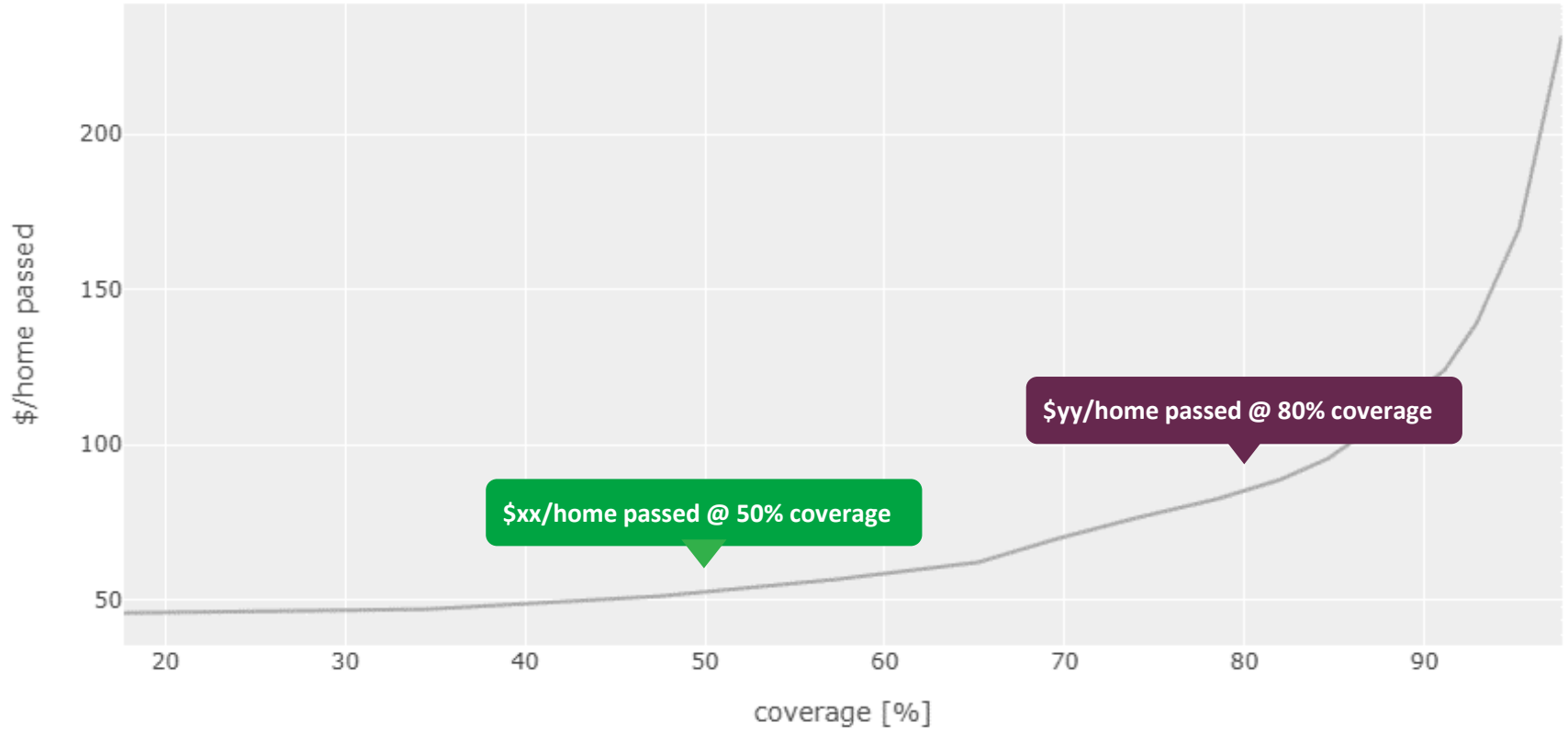
50% coverage, with just 3 hubs/homes out of 339!





Business Case

360°/hub, $xxx/sector + $yyy labor per hub



Siklu’s MultiHaul™ TG Product Line

Best in Class Integration and Performance

Node with 360° coverage & simple single-cable installation

Works out of the box (NW controller is optional)

IPv4 or IPv6, management only

Short or Long reach (beam-forming or future dish antennas)

Lowest latency

Highest PPS

Full VLANs support

Summary

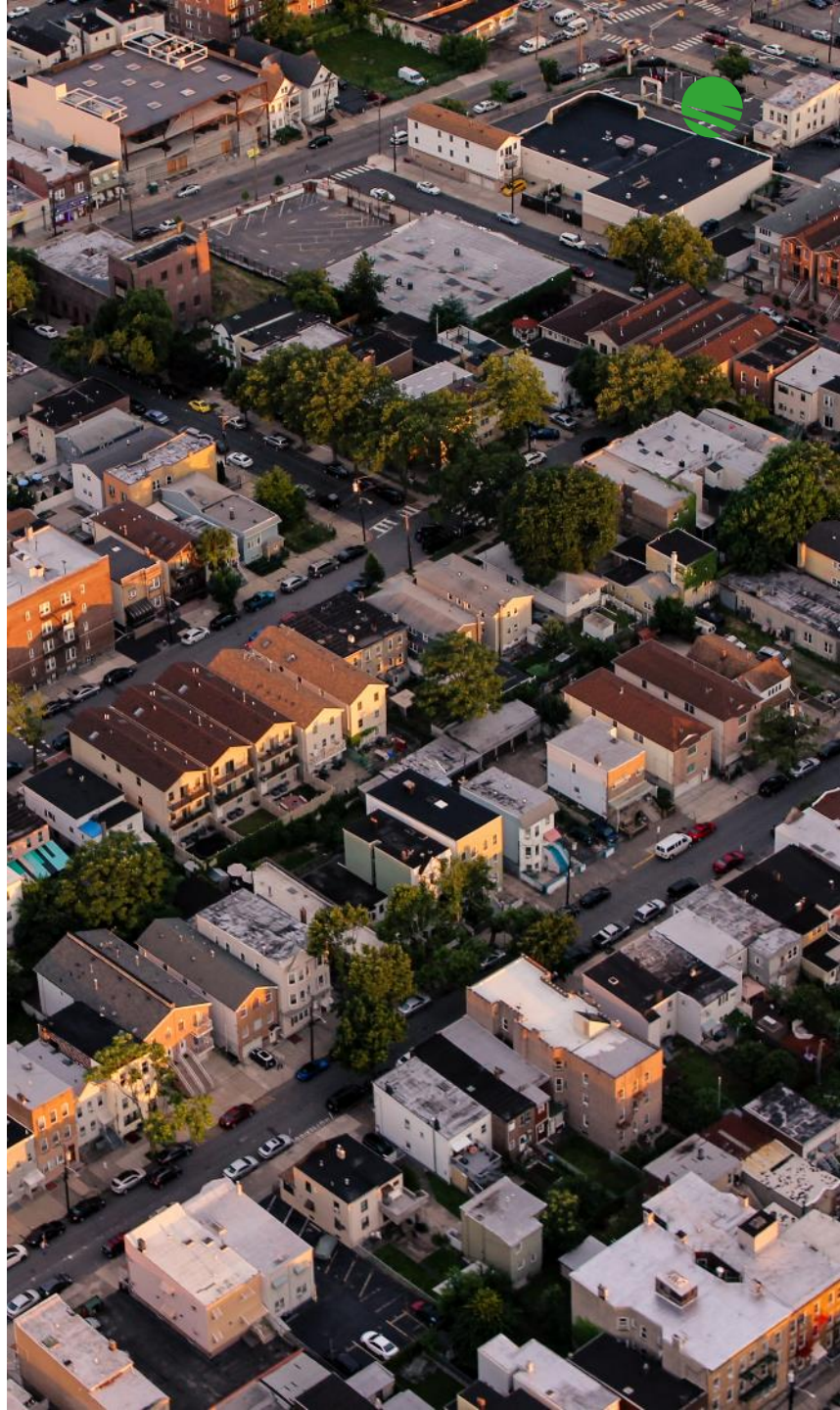
Siklu is the **leader** in mmWave solutions covering **hw** and **sw** and we extend that to the **terragraph market**

It’s a gigabit **world** and **mmWave** is the only frequency that can **deliver**

Key Applications are **Smart Cities**, **Video Surveillance, Small Cell BH** and **Internet Access**

Successfully deployed **+100,000 units globally-** MH TG represents **our 5th** generation 60GHz product

Fiber performance with Wireless flexibility and cost saving



06

Q&A


Thank you