LINDSAY BROADBAND

Keeping You Connected.

3G/4G/5G Small Cell Deployments over HFC

Lindsay Broadband Analysis

Contact: Adrian Acosta
aacosta@lindsaybb.com
+1.647.984.2108

Table of Contents

1- Introduction

2 – Future 5G Traffic Demand Projections

3 – Network Densification & Small Cells

4 – Challenges & Opportunities

    4.1 – Site Acquisition

    4.2 – Backhaul Options

    4.3 – Network Architectures

    4.4 - Synchronization

5 – Real Deployment Metrics

6 – Lindsay's Gateways

7 – New Powering Options over Twisted Pairs

8 - Conclusions

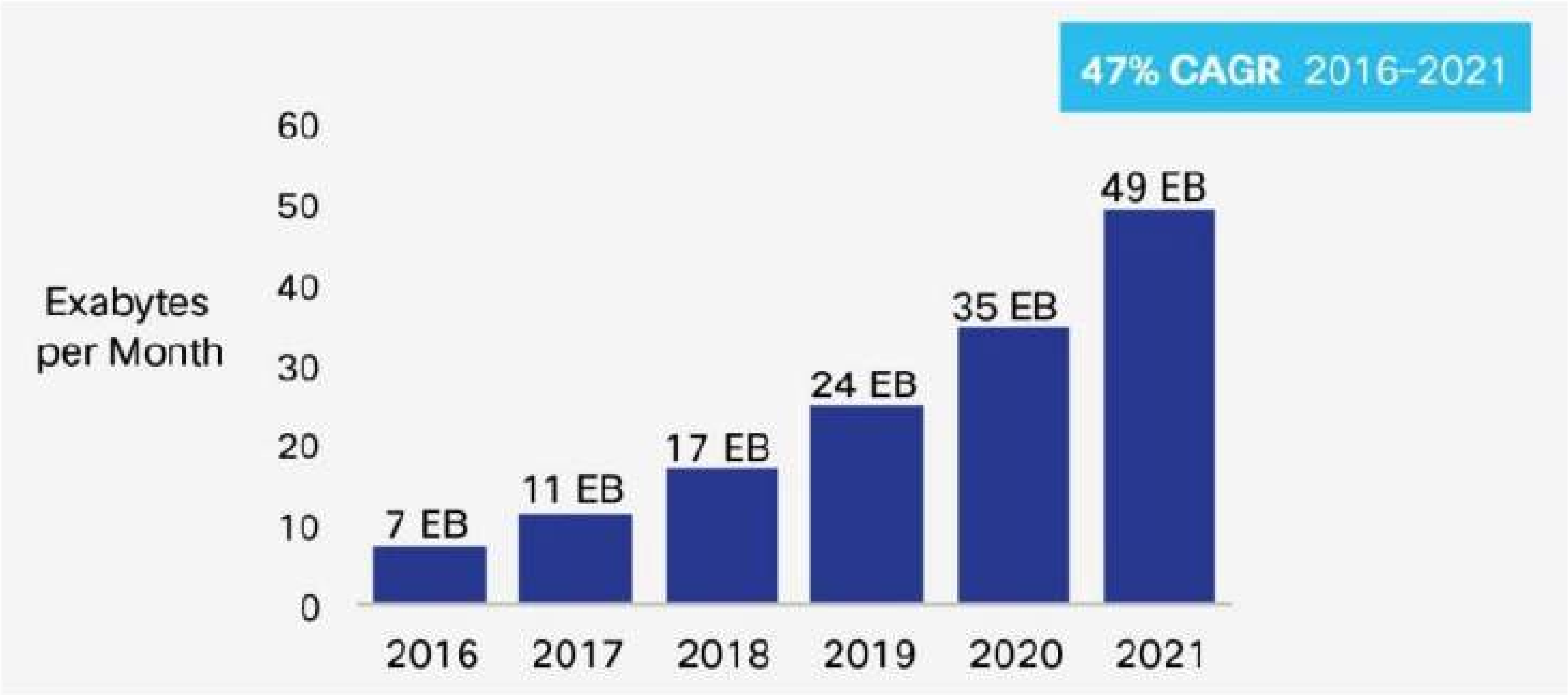
LINDSAY BROADBAND

Keeping You Connected.

Introduction

As wireless networks evolve from 4G/LTE to 5G, small cells will play a critical role in delivering the high bandwidth, low-latency connections required by the myriad of potential 5G use cases. With regulators opening up new low, mid & high-band millimeter wave (mmWave) spectrum for 5G, MSOs are uniquely positioned to create ultra-dense 5G wireless networks by leveraging their existing Hybrid Fiber Coax (HFC) networks & emerging technologies such as Full Duplex DOCSIS® (FDX) & Distributed Access Architectures (DAA). Our objective for this presentation is to show how Lindsay's products can enable MSOs to deploy small cells in a rapid & cost effective manner leveraging their existing networks.

Future 5G Traffic Demand Projections

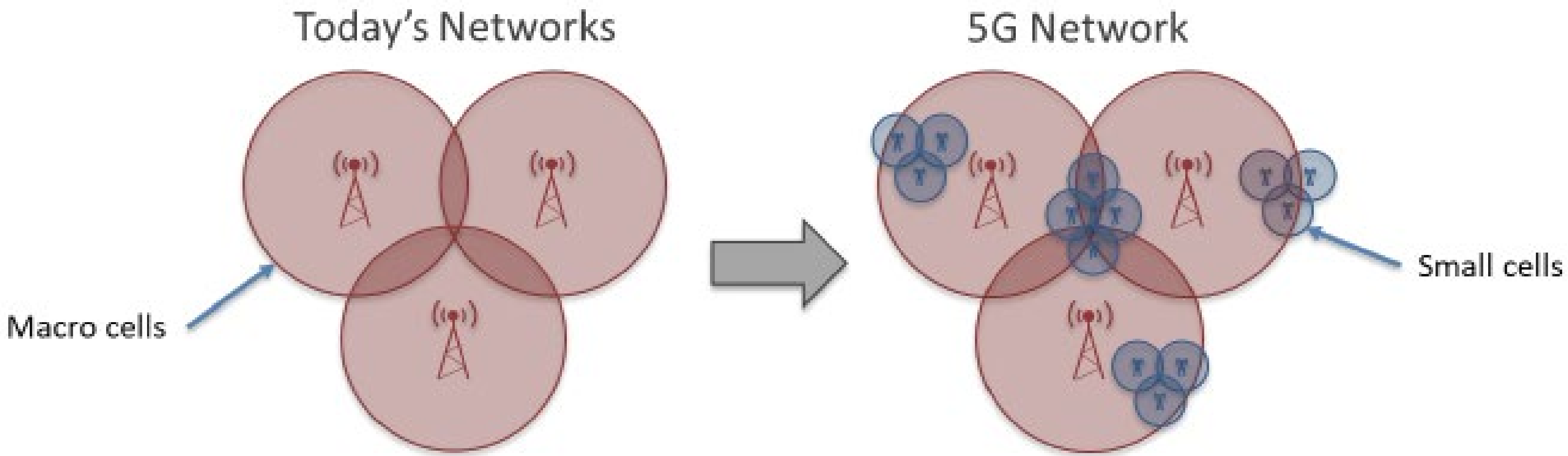


1 - Global Mobile Data Traffic (Source: Cisco Visual Networking Index 2017)

LINDSAY BROADBAND
Keeping You Connected.

Network Densification & Small Cells

While 5G opens up a world of new use cases, it also comes with a number of important implications. One that represents both a challenge and an opportunity, particularly for MSOs, is network densification. That is, to realize the higher data rates & area traffic capacities promised by 5G, operators will need to deploy much denser network topologies using small cells. The figure below illustrates the transition that needs to be made from today's networks, which are larger composed of macro cells, to 5G networks of the future with the targeted deployment of small cells.



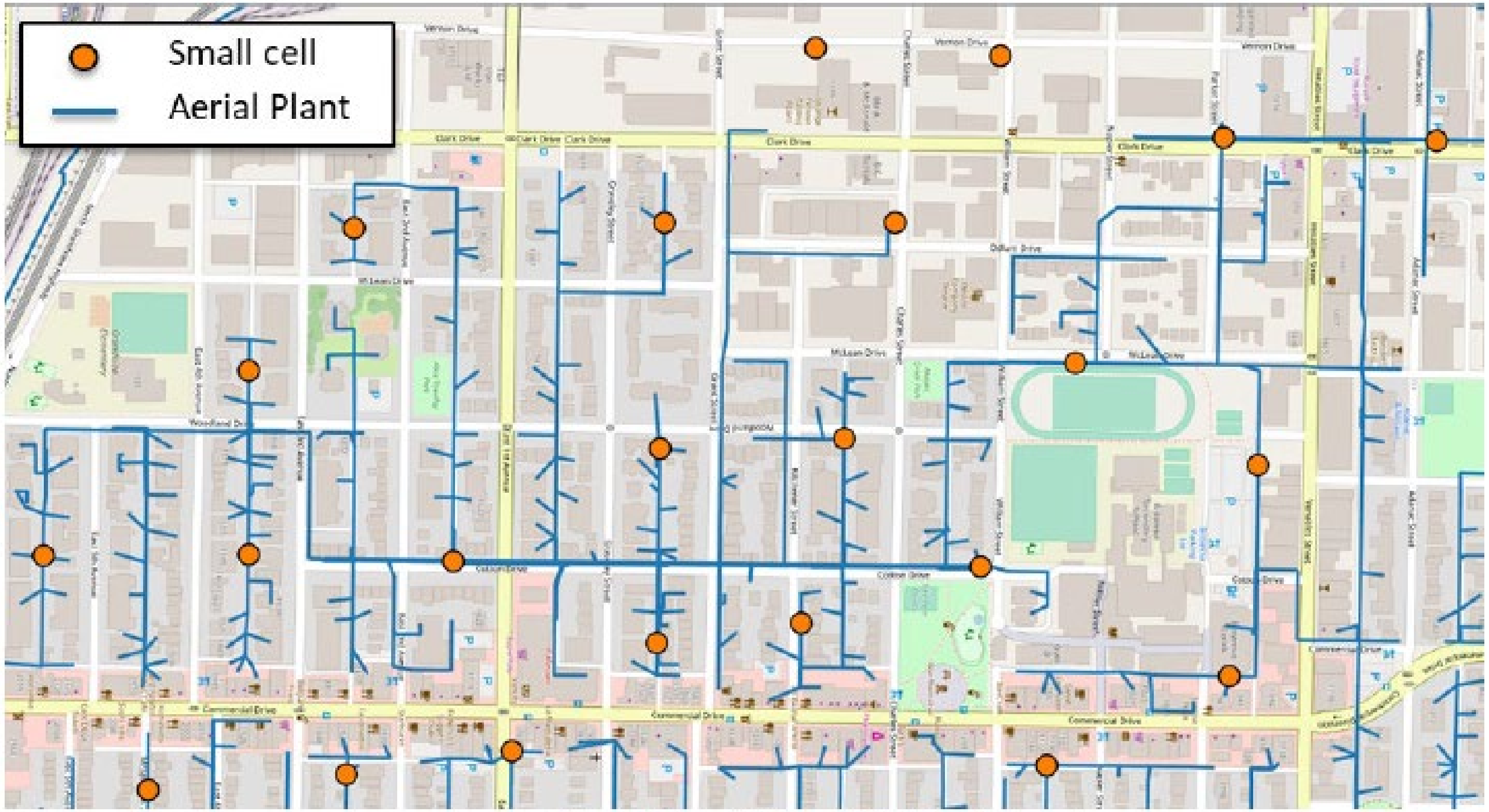
- Network Densification

Challenges & Opportunities (Site Acquisition)

There is no doubt site acquisition & everything that implies is by far the biggest challenge MNOs will have to deal with when thinking of high density networks. Government permits, hydro projects & construction of the new site are only a few of the tasks to consider per site. On the contrary, the opportunity for the cable industry is to leverage their existing Wi-Fi® hotspot and/or existing HFC infrastructure to deploy 4G/5G small cells. With access rights to millions of public Wi-Fi hotspots, often in prime “beach front” properties, the cable industry is uniquely positioned to capitalize on this opportunity, either as a wireless player or a wholesale provider to existing MNOs.

Challenges & Opportunities

Overlapping Wireless Needs with Existing HFC Networks



Strand-Mount 4G Small Cell Deployments

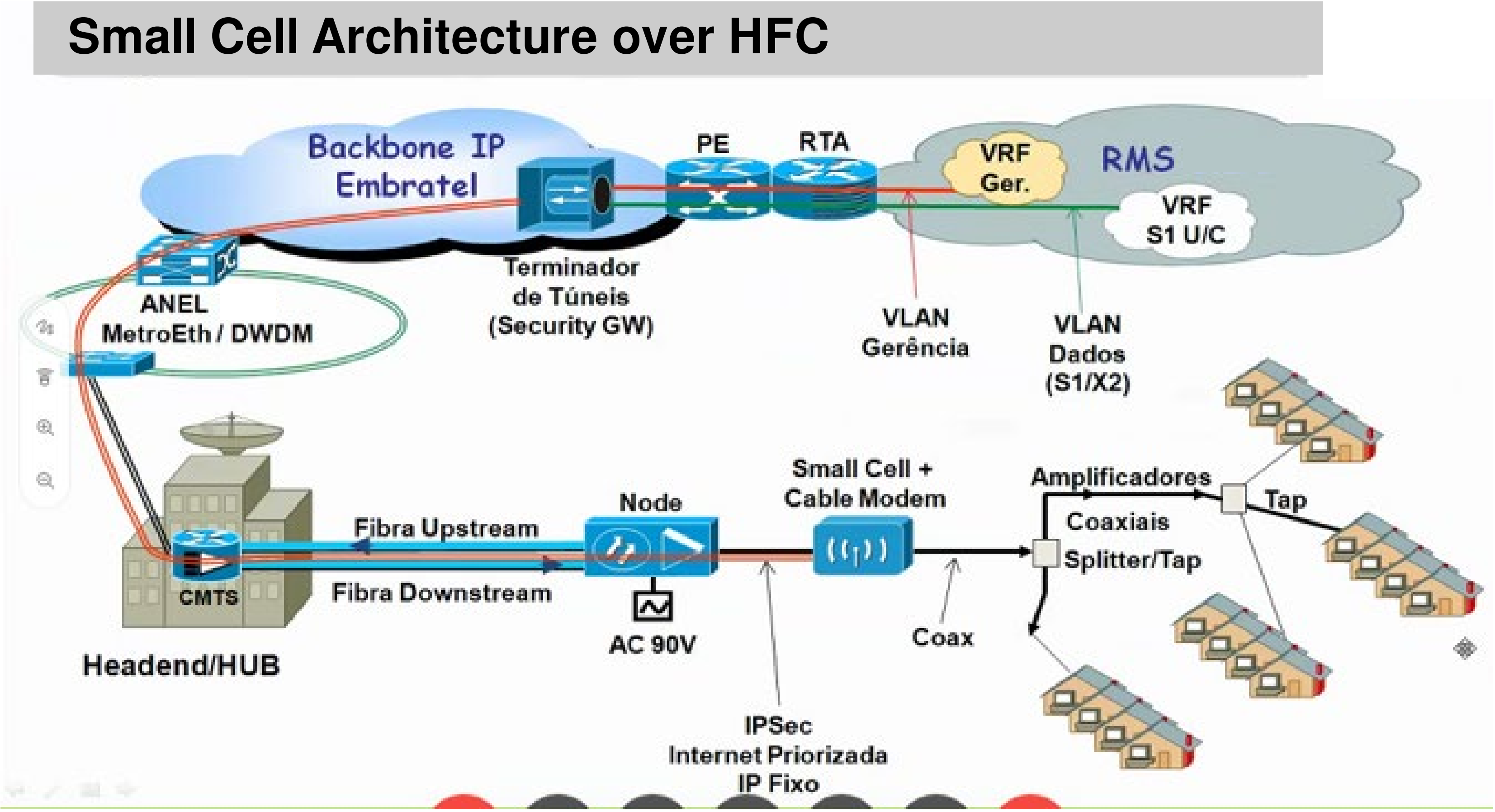
Challenges & Opportunities

Backhaul Options (DOCSIS, Fiber, PON)

Traditionally in 3G deployments with Macro cells, only fiber optic connections & microwave links are considered. Now with 4G / 5G networks, DOCSIS 3.1 & PON are very reliable options allowing gigabit connectivity. Additionally, aspects such as the complementary traffic peaks of wireless/cable TV networks must be considered. Typically the traffic peaks of the DOCSIS network do not coincide with the traffic peaks of the mobile network

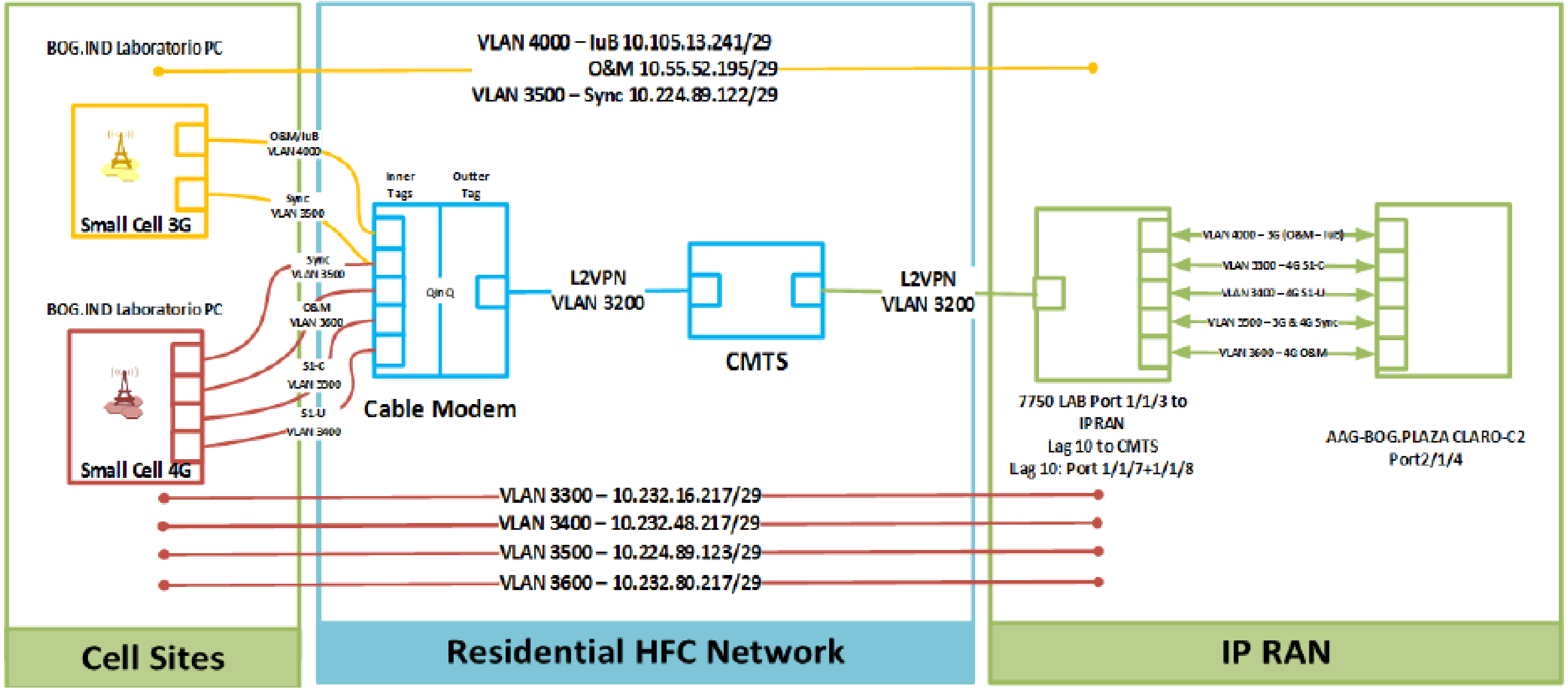
Challenges & Opportunities

Network Architectures (Ipsec Tunnel)



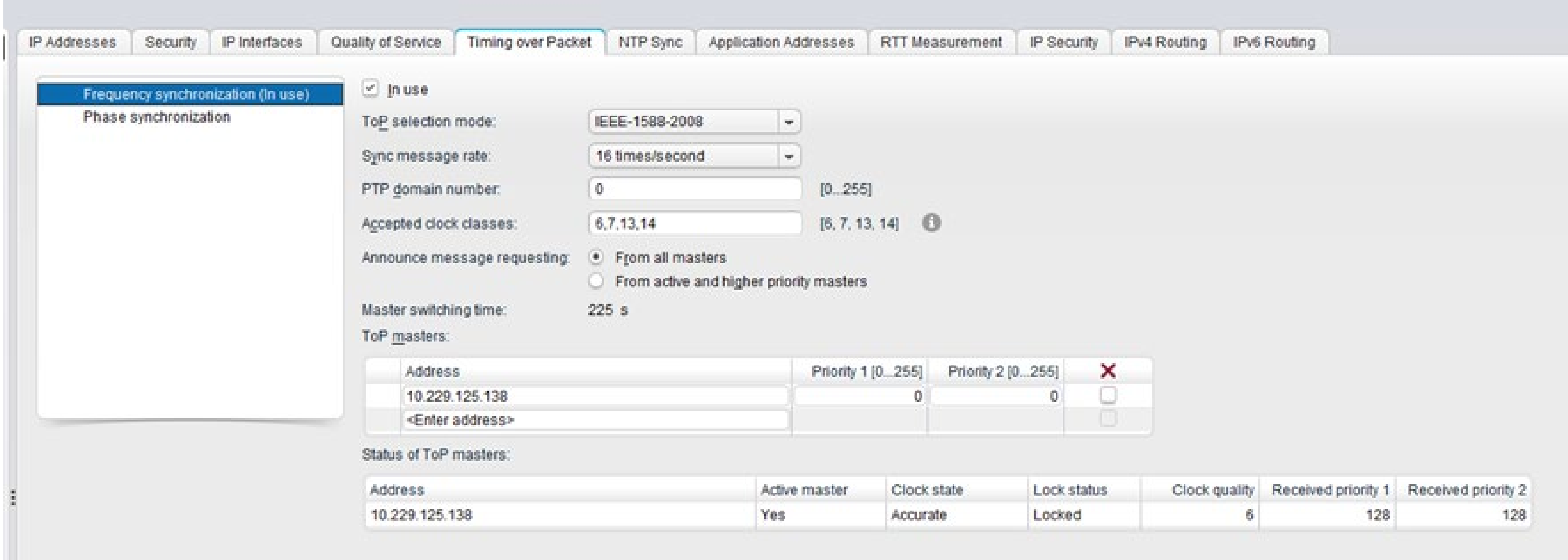
Challenges & Opportunities

Network Architectures (BoDOCSIS)



Challenges & Opportunities

Synchronization (IEEE 1588)



LINDSAY BROADBAND

Keeping You Connected.

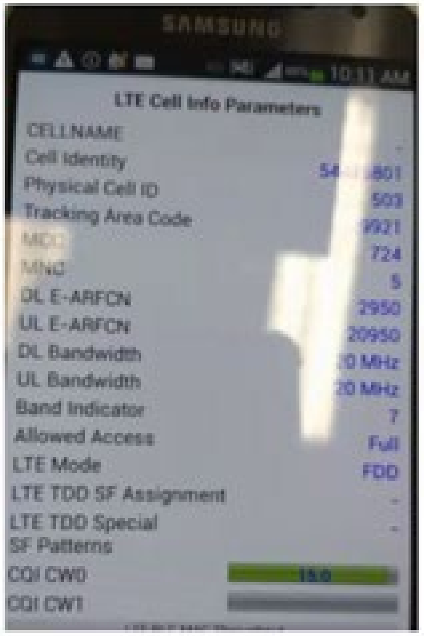
LINDSAY BROADBAND
Keeping You Connected.

Real Deployment Metrics

Small Cell Integration Over HFC Backhaul

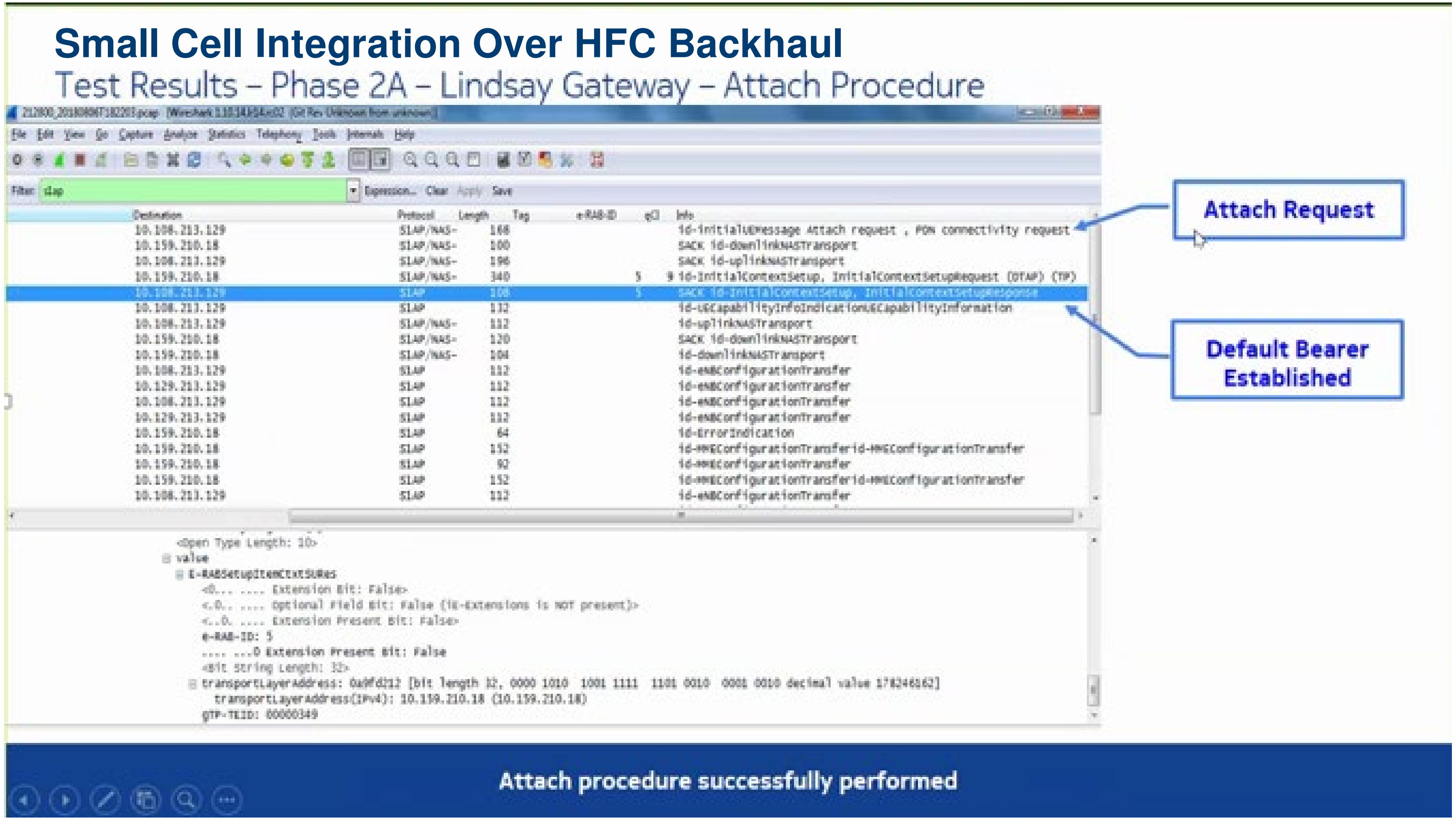
Test Results – Phase 2A – Lindsay Gateway

Test Case	Results
Attach Procedure	Traces next slides
Latency	79 ms
Throughput	28 Mbps
	9.9 Mbps
Mobility Test	Traces next slides
Web Browsing	Pass
Video Streaming	https://photos.app.goo.gl/QZwbdvNFCe9C6wUL8



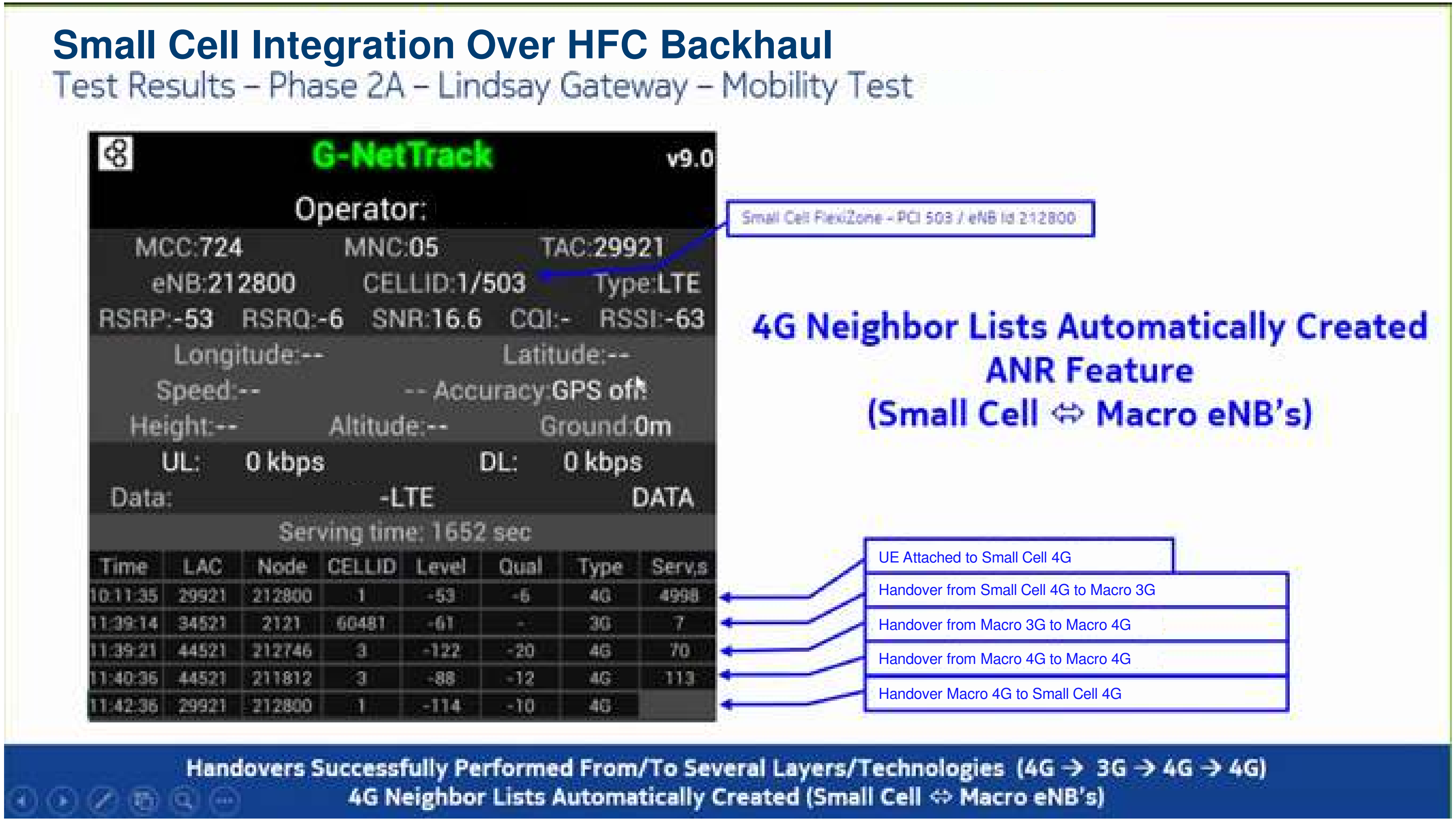
DL/UL Throughput is limited by the CMTS Profile (30/10Mbps DL/UL)

Real Deployment Metrics



LINDSAY BROADBAND
Keeping You Connected.

Real Deployment Metrics



LINDSAY BROADBAND
Keeping You Connected.

Lindsay’s Gateways (Power Only)

LBPS-250-DC = 250 Watts, 2 Outputs DC

LBPS-250-AC = 250 Watts, 2 Outputs AC

LBPS-400-DC = 400 Watts, 4 Outputs DC

LBPS-250-AC = 400 Watts, 4 Outputs AC

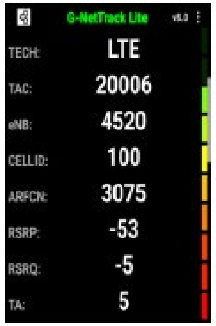
Lindsay’s Gateways (Power & DOCSIS)

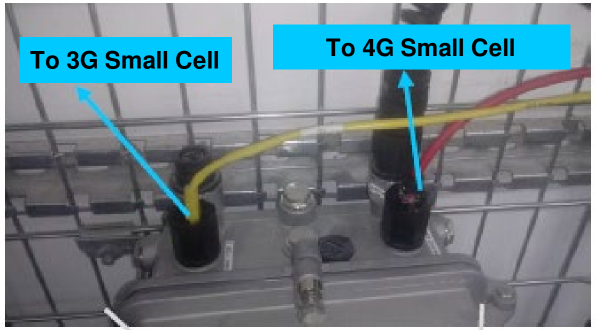
LBDG-250-DC = 250 Watts, 1 Output DC + 1 GigE Port

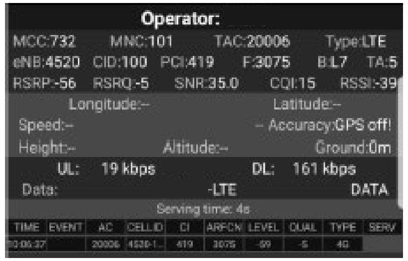
LBDG-250-AC = 250 Watts, 1 Output AC + 1 GigE Port

LBDG-400-AC-2 = 400 Watts, 2 Output AC + 2 GigE Ports

Lindsay's Gateways (Power & DOCSIS)

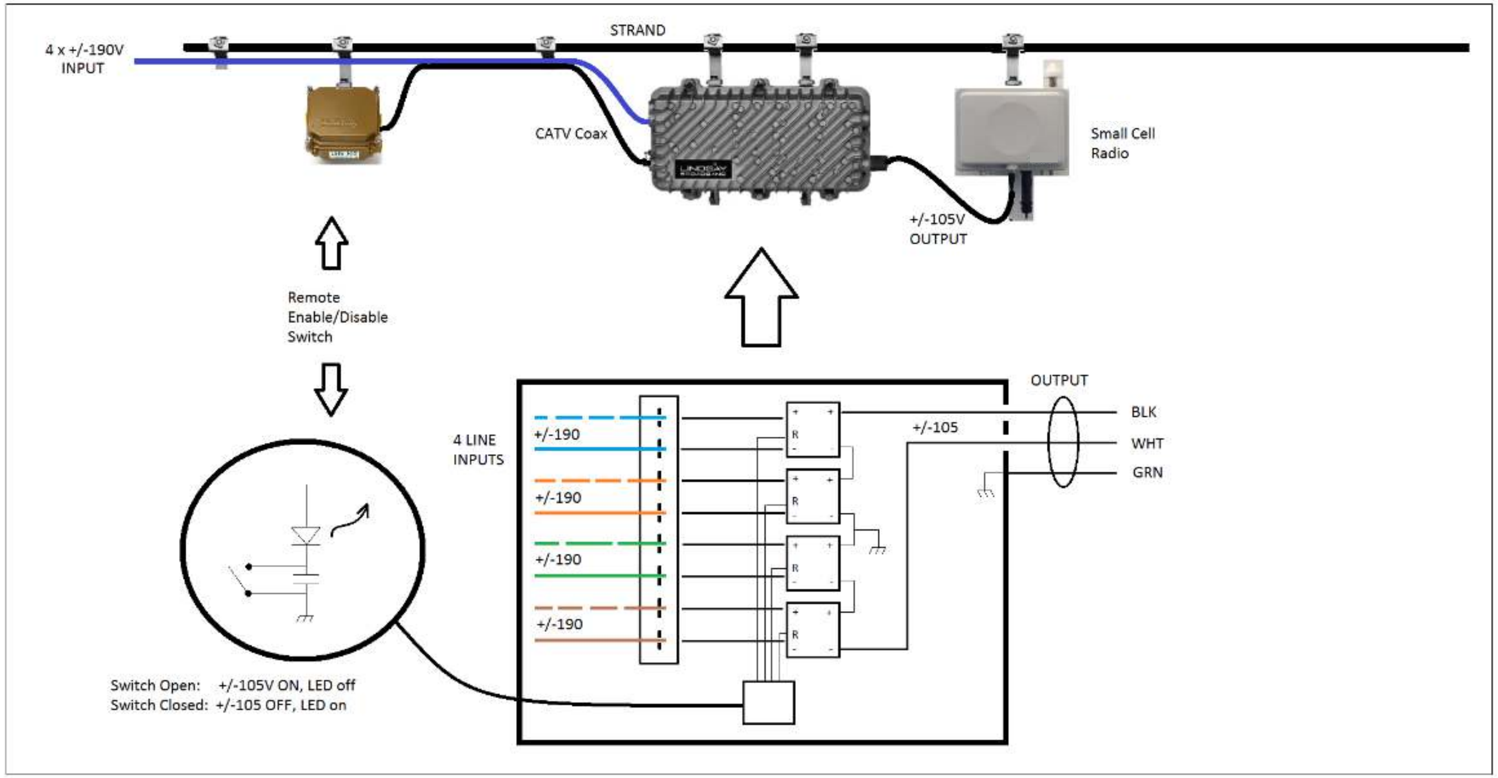






Pictures show a Lindsay Gateway LBDG-400-AC-2 in a lab environment being used to power & backhaul 3G & 4G Nokia small cells. The gateway integrates a DOCSIS 3.1 cable modem enabling enough bandwidth for both radios to operate simultaneously. BoDOCSIS implements 6 VLANs for different traffic segmentation.

New Powering Options over Twisted Pairs



Lindsay recently developed a new family of gateways to power small cells leveraging twisted pair networks. This new gateway takes +/- 190 VDC (380 VDC) already present on most twisted pair networks & turns it into +/- 110 VDC (220 VDC).

New Powering Options over Twisted Pairs

Pictures show a Lindsay 4TP-PSU deployment powering small cell radios. The backhaul of the cell is handled via fiber optics.

Thank you

2-2035 Fisher Dr, Peterborough, ON K9J 6X6 Canada
+1.705.742.1350 • 1.800.465.7046 • info@lindsaybb.com • lindsaybb.com

All information is subject to change without notice.
Rev. 03/19 (LBB0183)