Lighting Up Coherent Optics

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Thursday, Oct. 21, 2021

11:00 am – 12:00 pm ET

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Today's Speakers

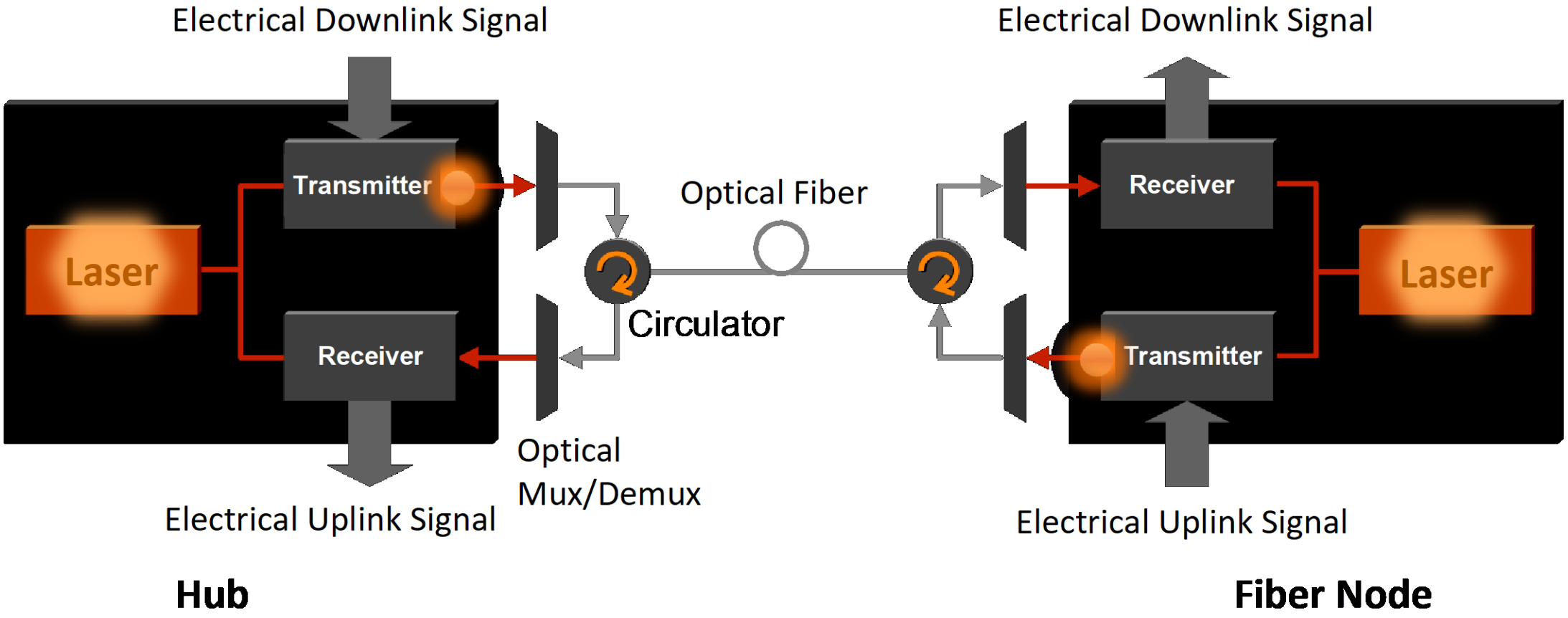
Alan Breznick
Cable/Video Practice Leader
Light Reading

Zhensheng (Steve) Jia
Ph.D., Distinguished Technologist
CableLabs

Agenda

- **Light Reading—**Coherent Optics Overview
- **CableLabs—**Coherent Optical Technology Evolution
- Coherent Optics for P2P Connections
- Coherent Optics for P2MP Access Connections
- Explaining Coherent PON
- Key Enabling Technologies
- CableLabs' CPON Project
- **Audience Q&A**

Full Duplex Coherent Optics



Evolution to Fiber Deeper

N+2

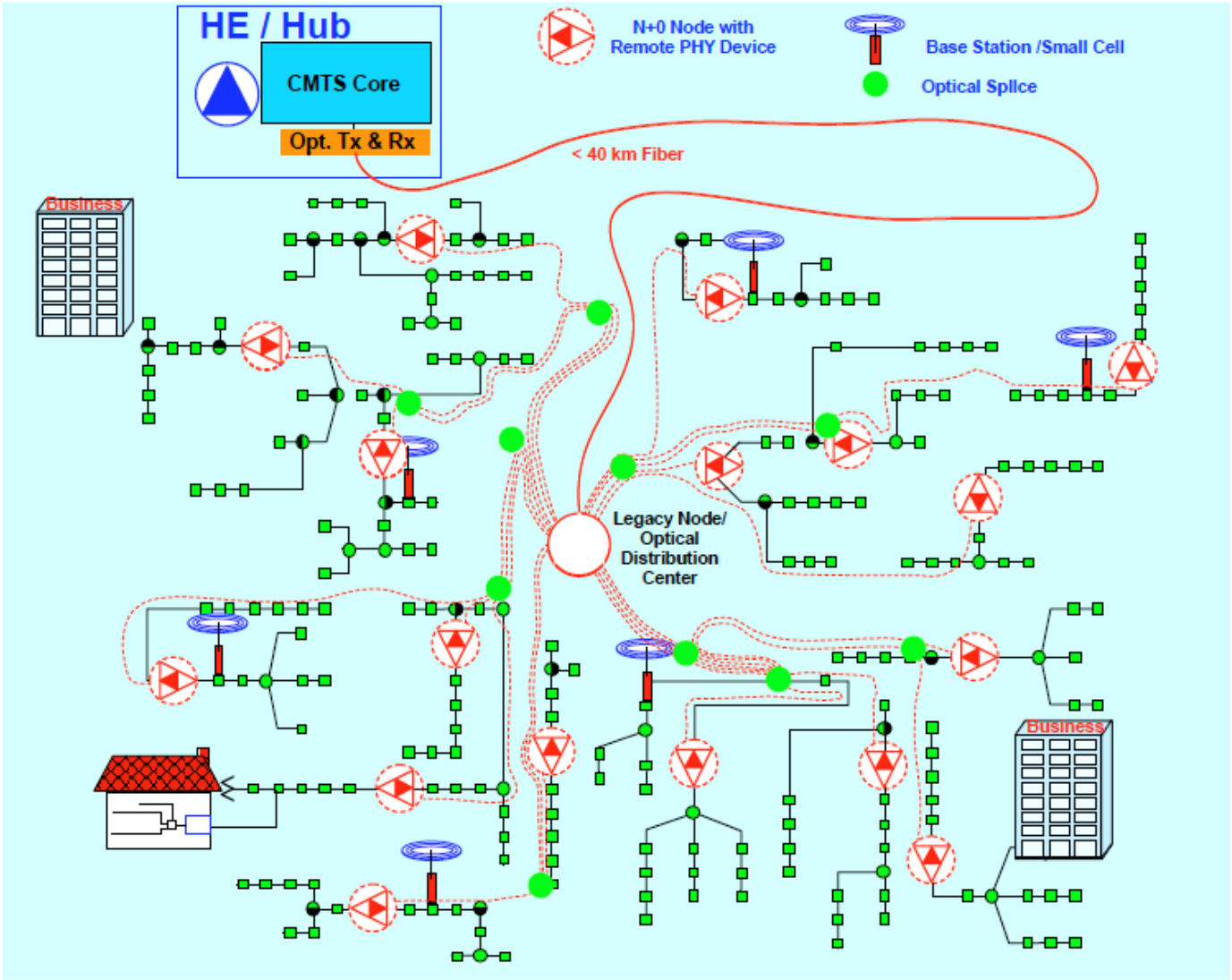
4-8

Child Nodes

N+0

10-18

Child Nodes



Audience Poll I

If you are a service provider, how much aggregate capacity do you need (1-3 years) for optical access/edge networks in support of coax, fiber and mobile services?

- <= 100G
- 200G
- 400G
- >400G

Audience Poll II

If you are a vendor, which PON technologies are part of your product portfolio?

- ITU-T PON (GPON, XGS-PON…)
- IEEE PON (EPON, 10GEPON, 25GEPON…)
- both PONs
- none of them

Zhensheng (Steve) Jia

Ph.D. Distinguished Technologist

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Coherent Optics

CableLabs

Dr. Steve Jia | Distinguished Technologist

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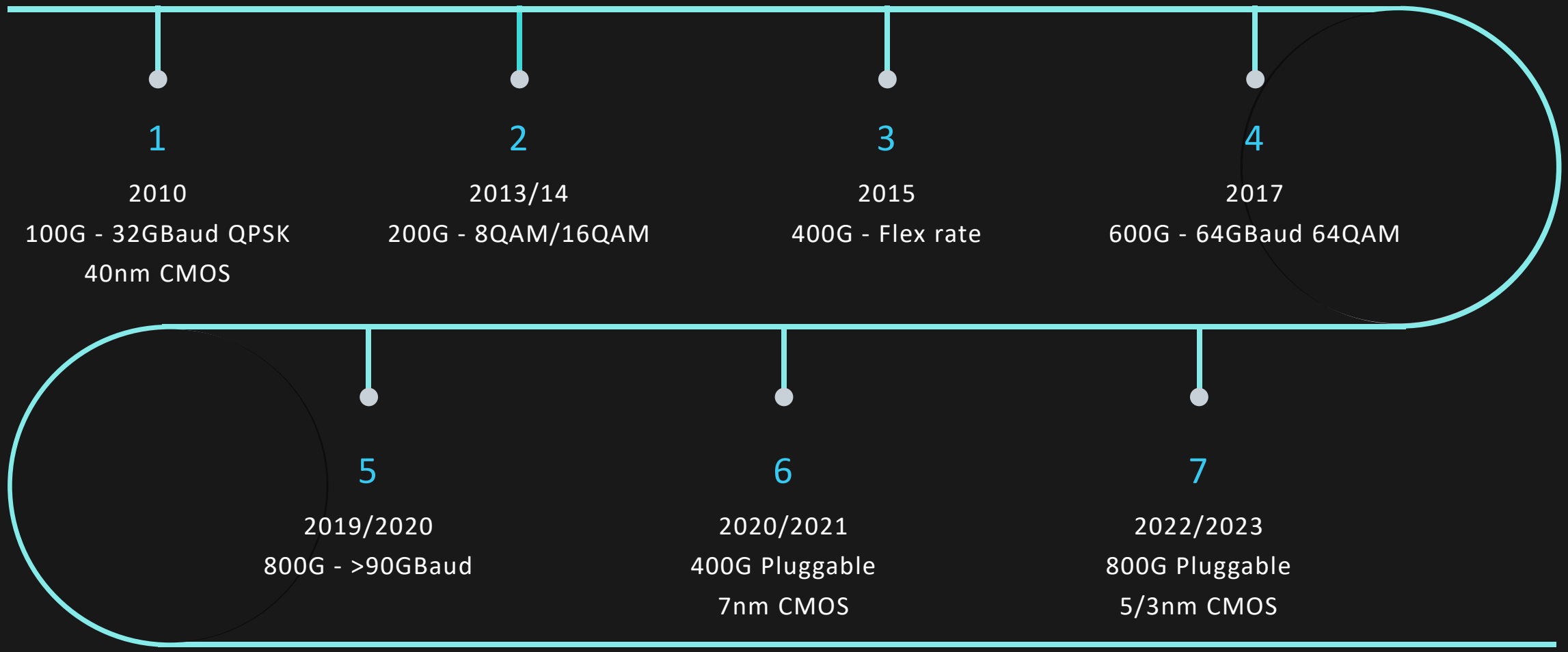
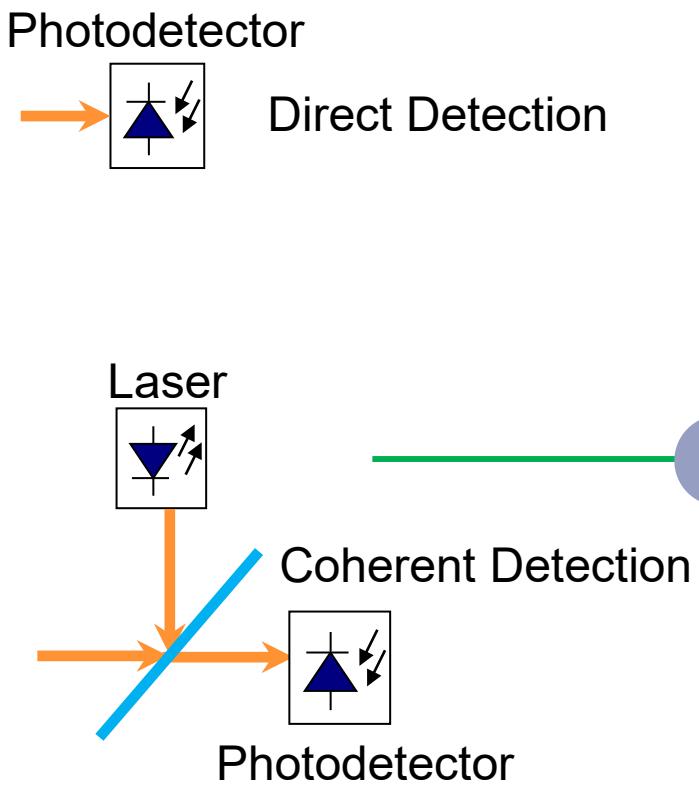
Outline

- Coherent Optical Technology Evolution
- P2P Coherent Optics for Access Networks
  - Access Environment Considerations
- P2MP Coherent Optics for Access Networks
  - Coherent Passive Optical Network

Coherent Optics Technology Development



Why Coherent Solves (almost) Everything?



Linear optical field conversion

Enabling modulation and detection for four independent degrees of freedom with powerful **Digital Signal Processing**

Coherent gain and inherent wavelength tunability

Local Oscillator serving as a clean signal amplifier and synchronizing the desired wavelength channel

No power fading and no powerful information-less carrier

Coherent Optics Technology – DSP Flow

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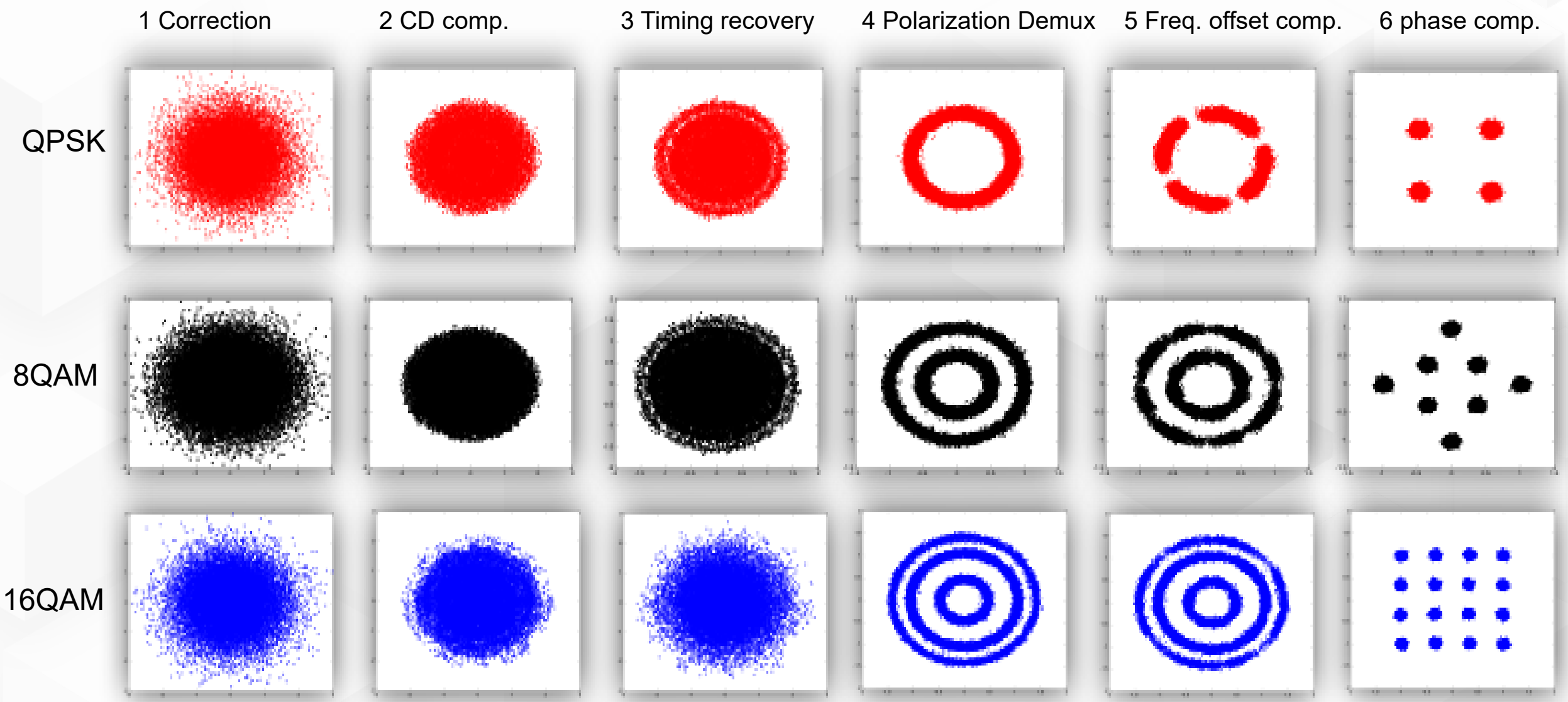
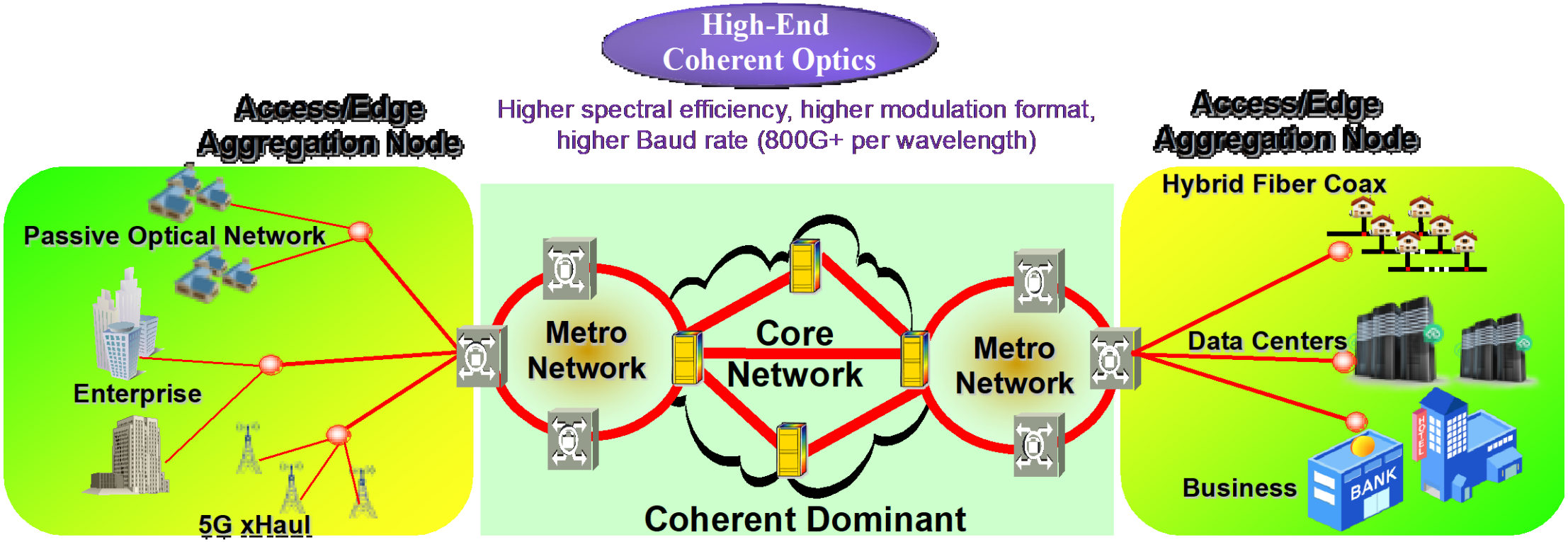
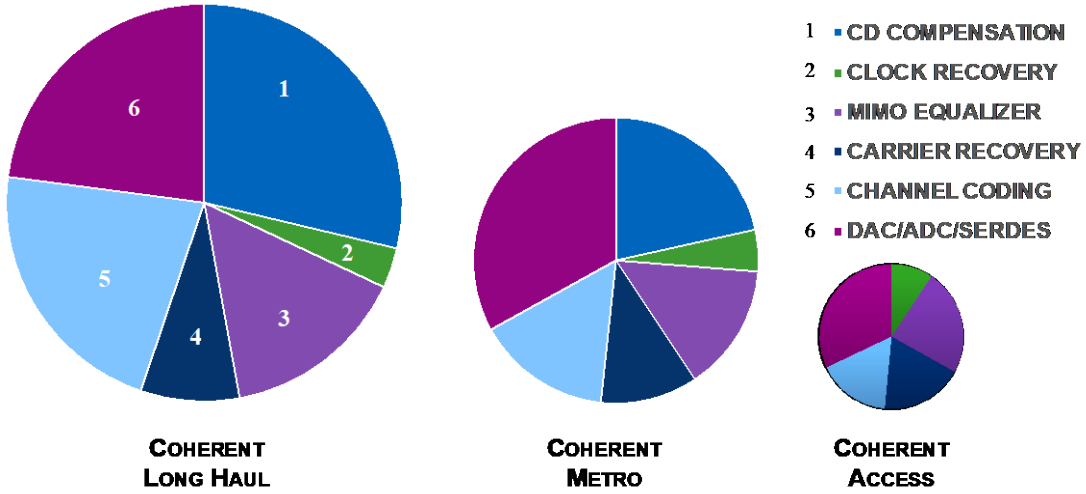


Coherent Optics Evolution



Coherent Optics for P2P Connections

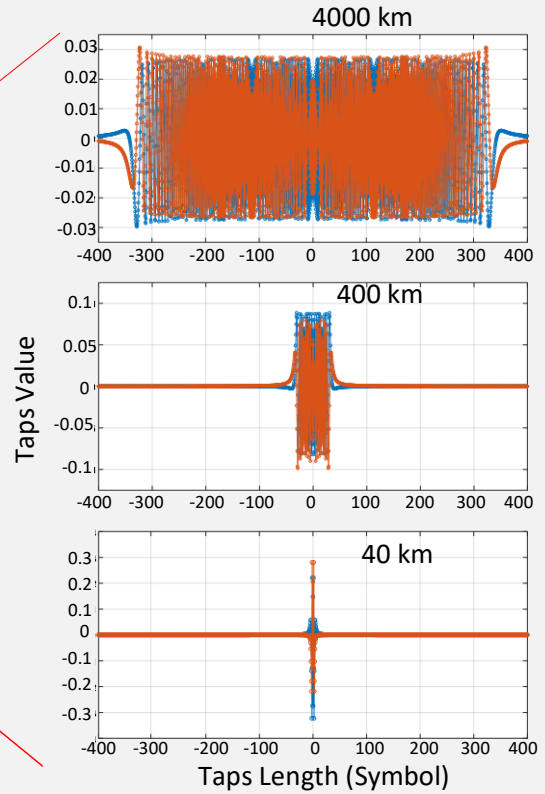
Adaptation and Optimization of Coherent Optics for Access Networks



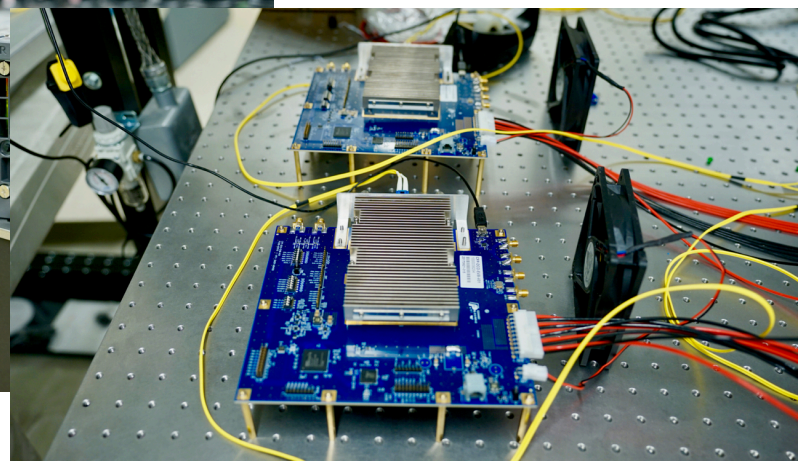
Distribution analysis of the ASIC power consumption

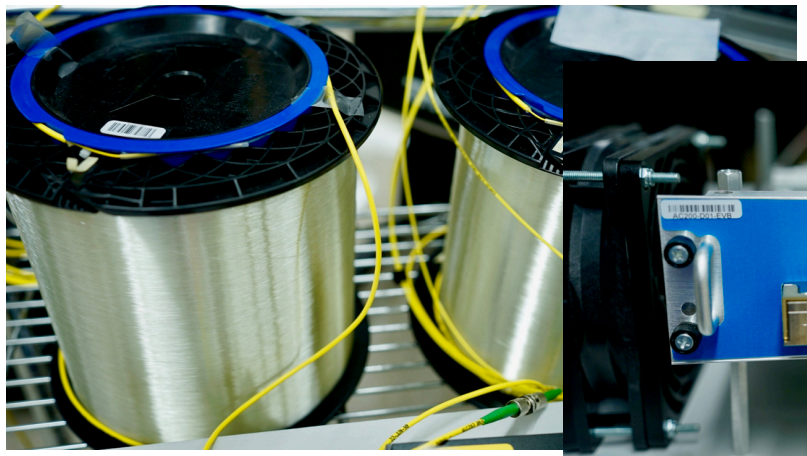
Example: number of digital filter taps for different distance introduced chromatic dispersion

The number of required digital taps increases with the transmission distance



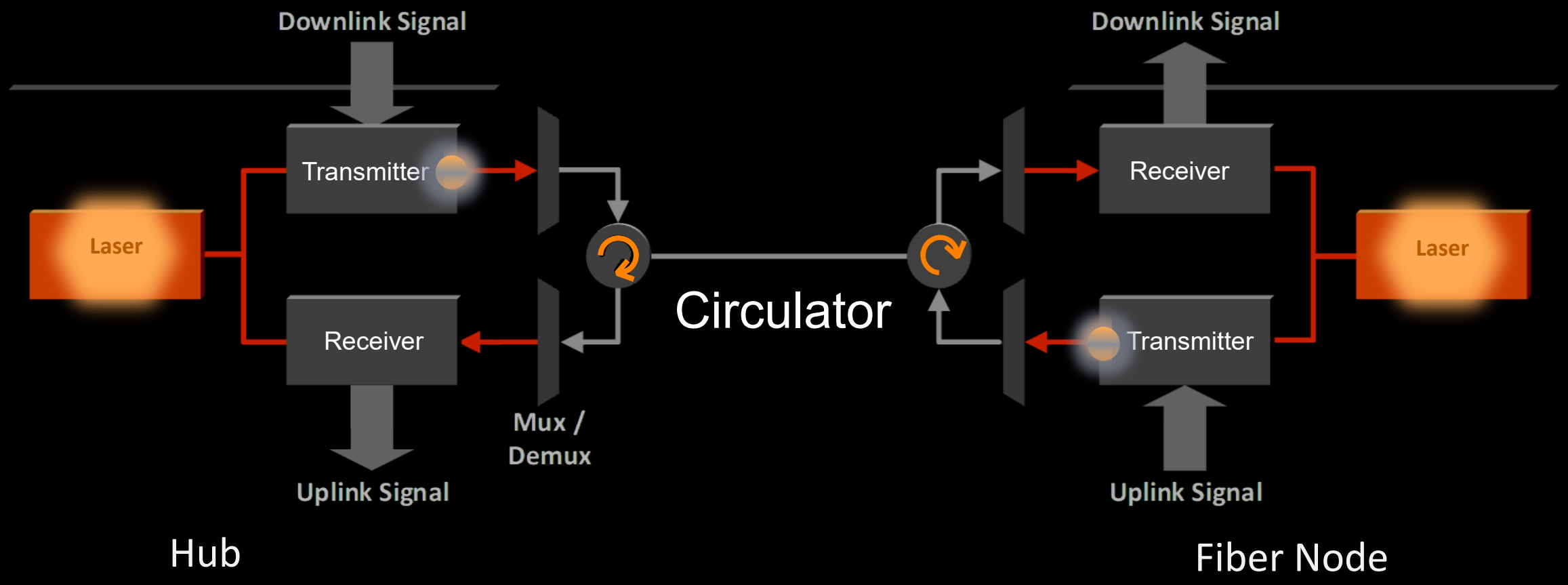
Signal Coexistence Over Fiber



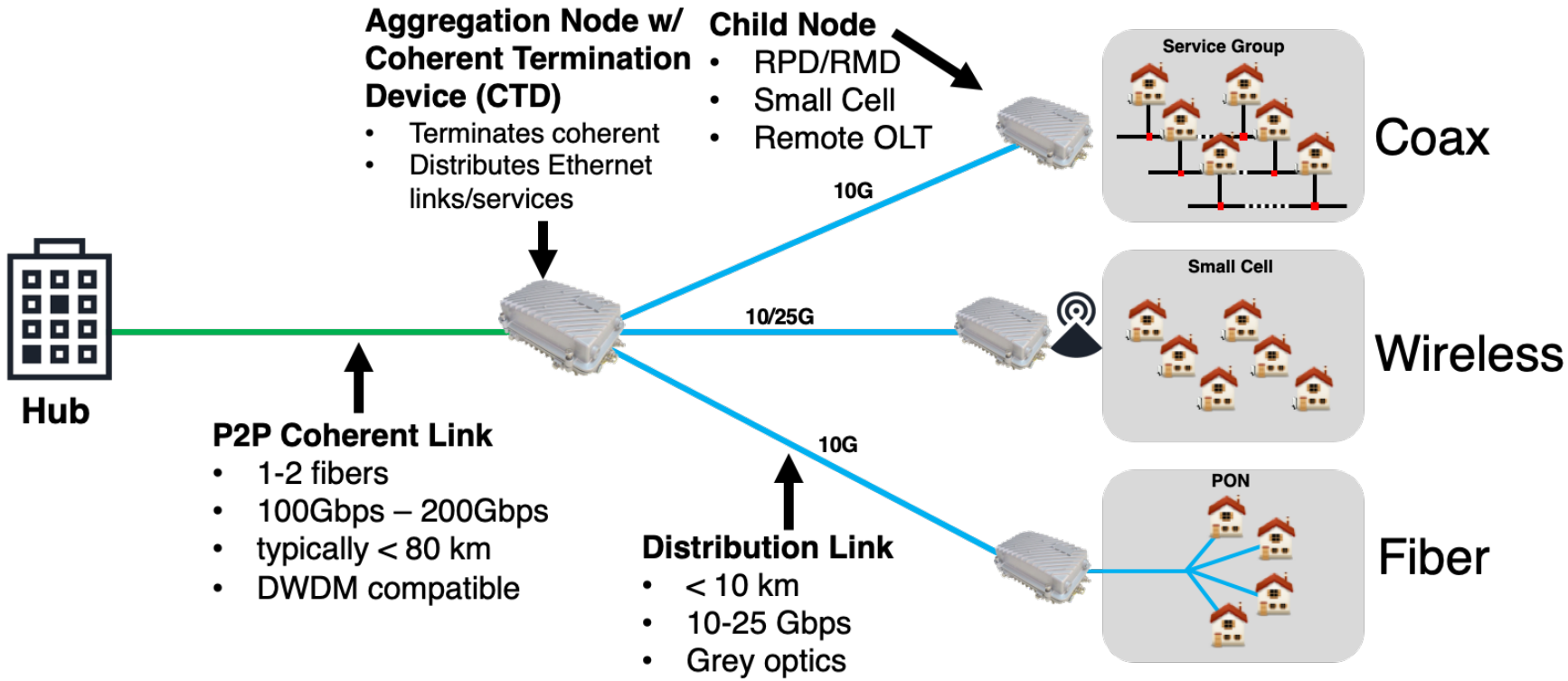


- [x] Analog Channels
- [x] 10G Digital Channels
- [x] Coherent CFP2 100G
- [x] Coherent 400G

Full Duplex Coherent Optical System



The 10G Converged Optical Network



- Network provides high bandwidth Ethernet services deep into the field
- Supports numerous applications in addition to residential broadband over coax, such as wireless xhaul, remote PON, P2P fiber services, etc.

CableLabs' P2P Coherent Optics Specifications

Access Focused Specifications

Incorporated Full Duplex Coherent Optics into specs

1 **Architecture**

Application Scenarios

2 **100G**

DP-DQPSK, SD-FEC

3 **200G**

DP-QPSK, open FEC

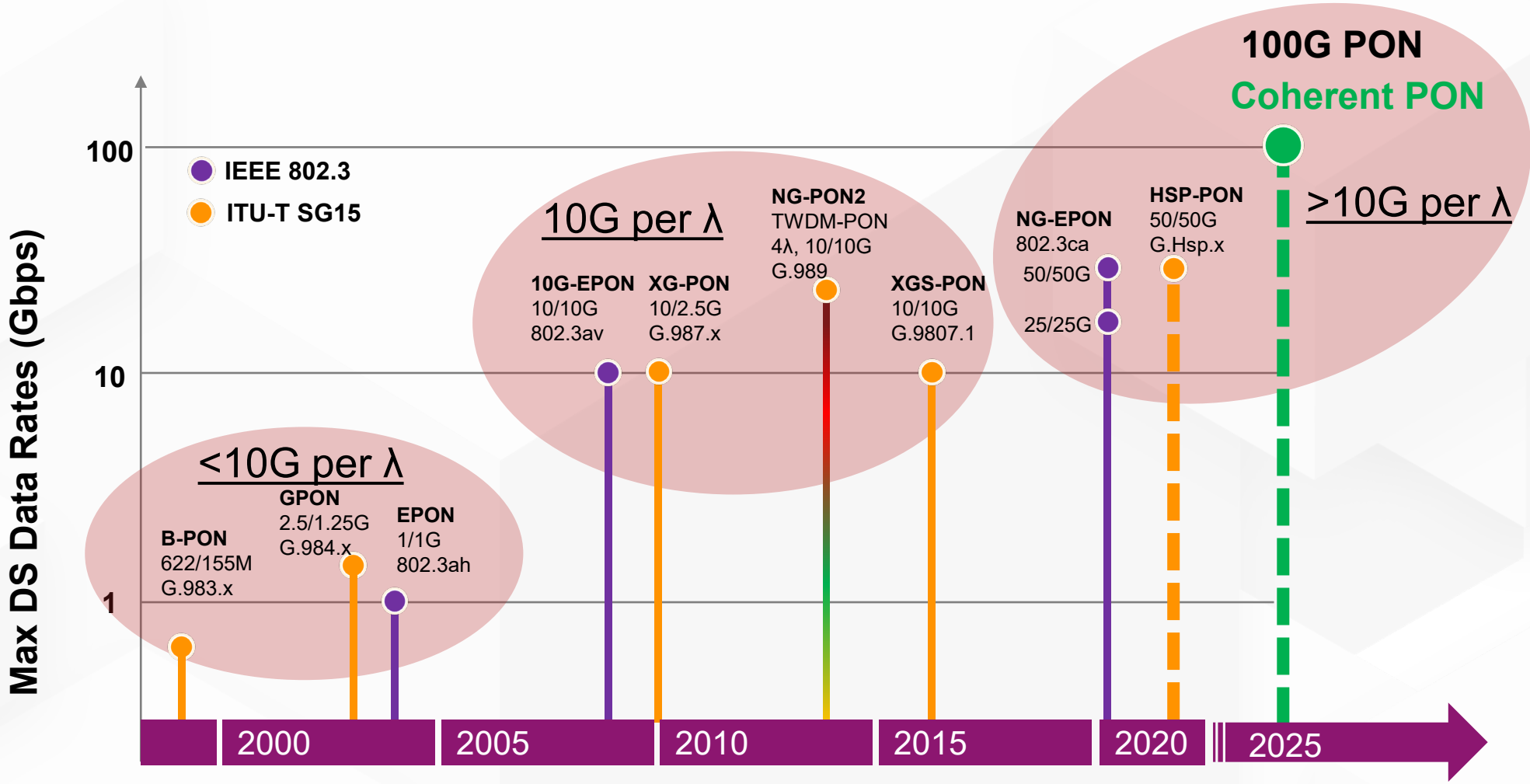
4 **OSSI**

Management & Control

2 successful Interops for 100G (December 4-6, 2018, April 23-25, 2019)

Coherent Optics for P2MP Access Connections

Evolution to 100G TDM-PON

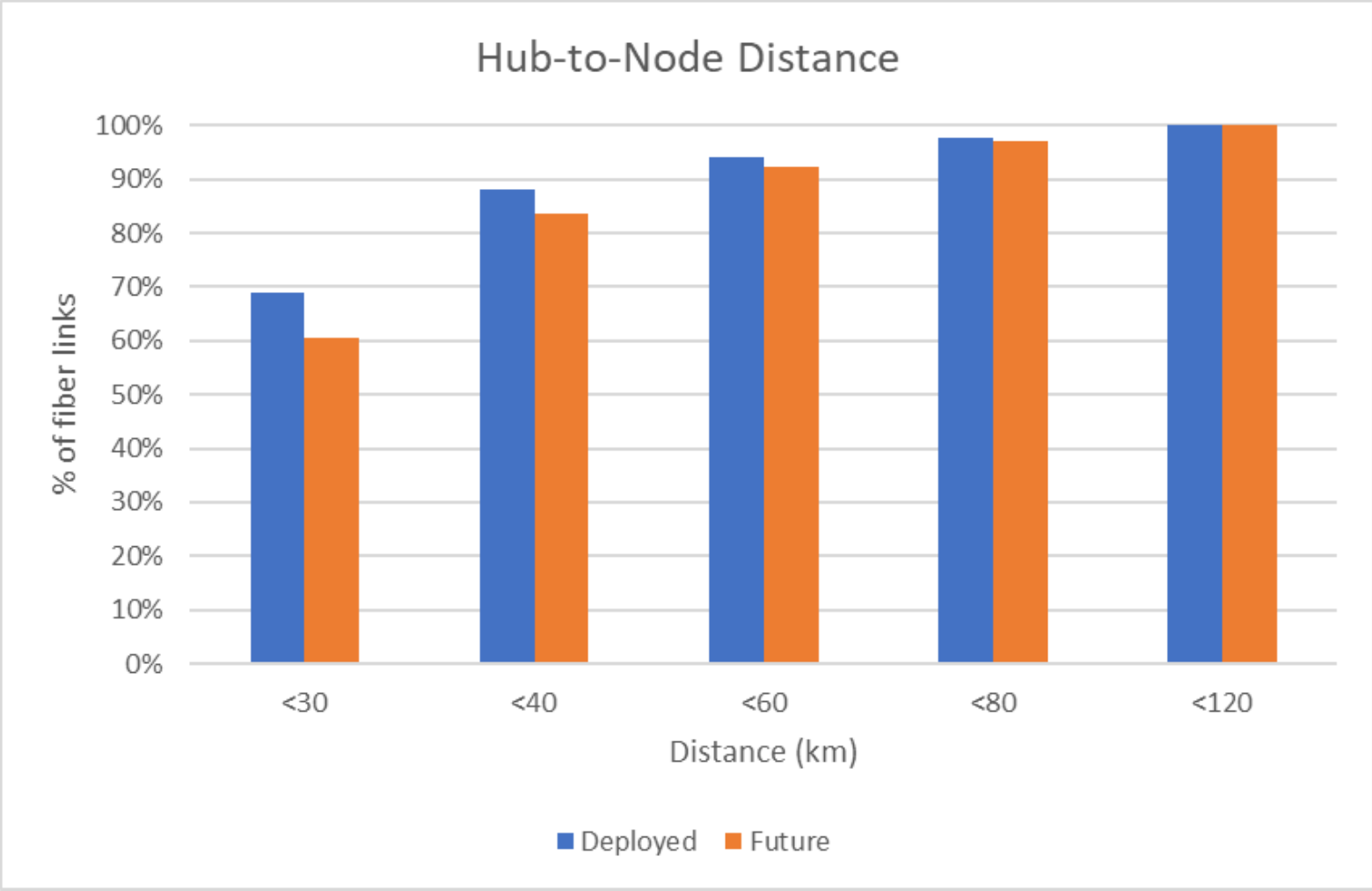


What is Coherent PON?

- Coherent PON is like traditional PON:
  - Passive optical distribution network
  - Point-to-multipoint topology

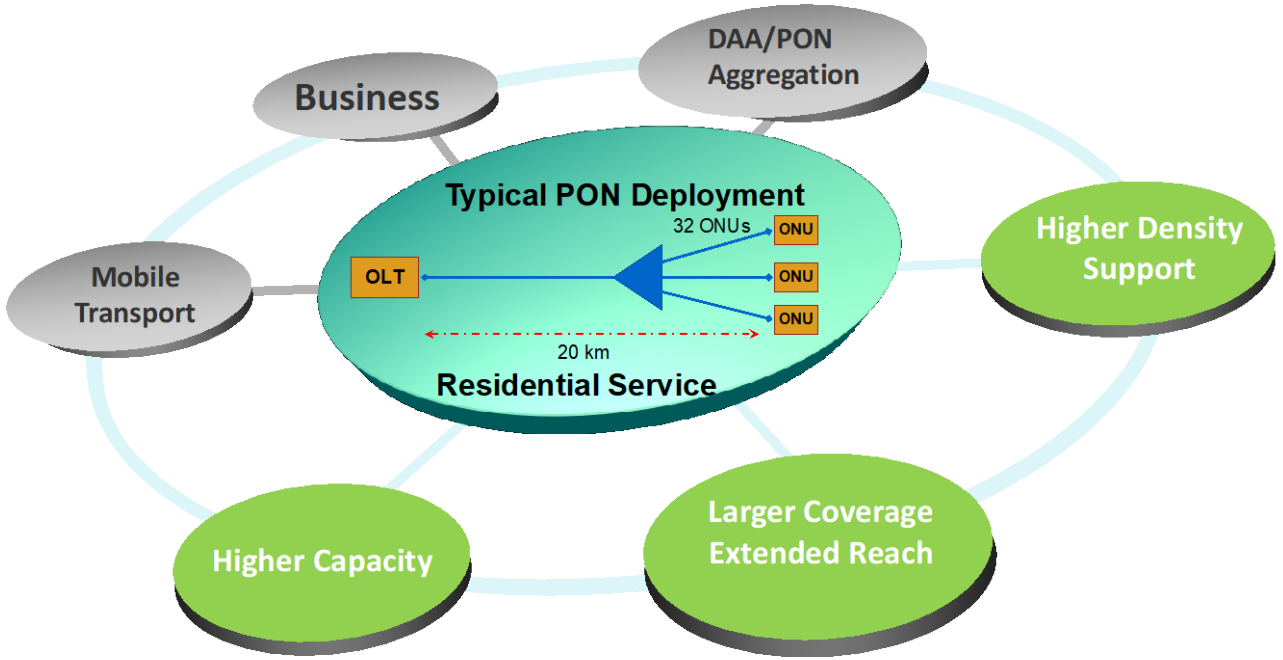
- Yet, Coherent PON is different:
  - Uses coherent modulation and detection instead of IM-DD
  - Optimizes optical power distribution
  - Provides longer reach & higher split ratio with improved power budget
  - Enables 100 Gbps and beyond data rate (per lambda)

PON Technology Reach Increases



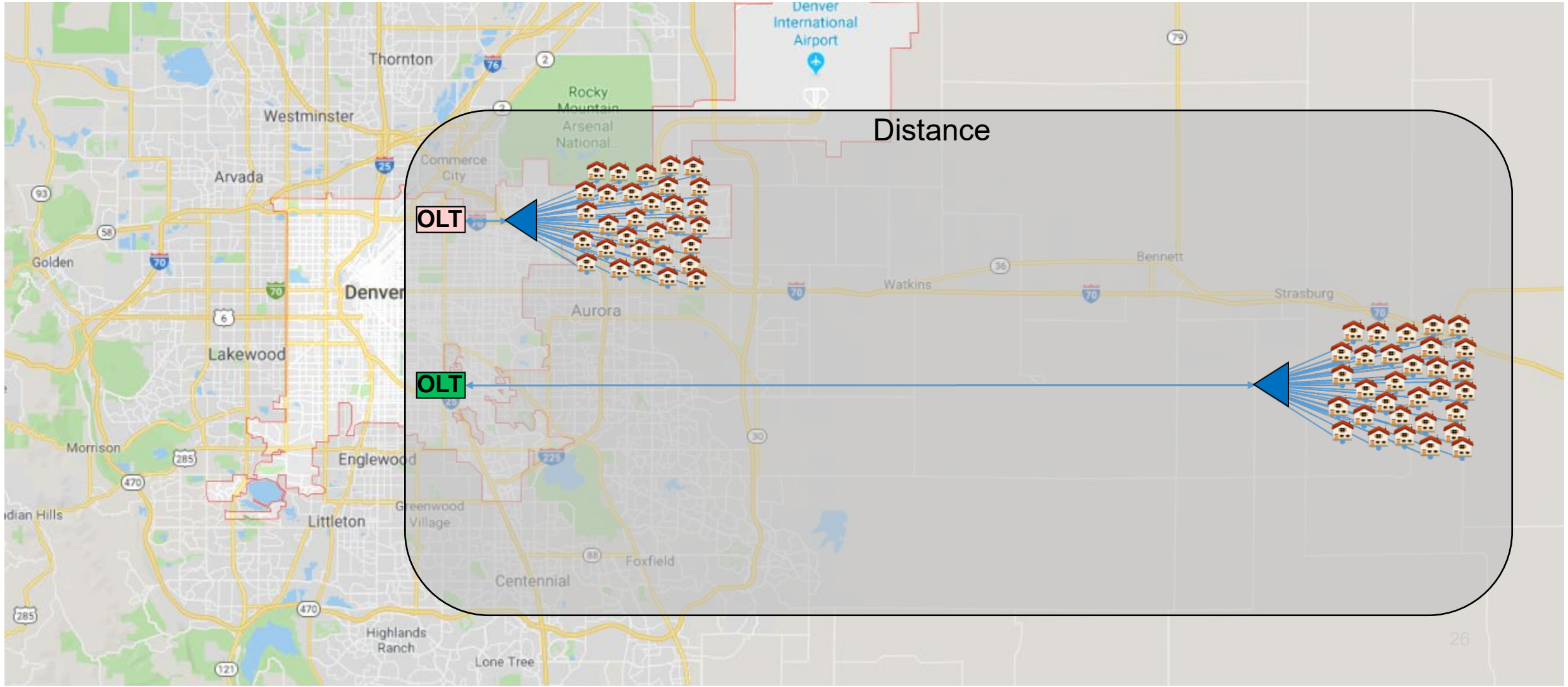
Traditional PON won't reach ~50% of homes from cable hub without intermediate active component…

Extended PON Application Scenarios

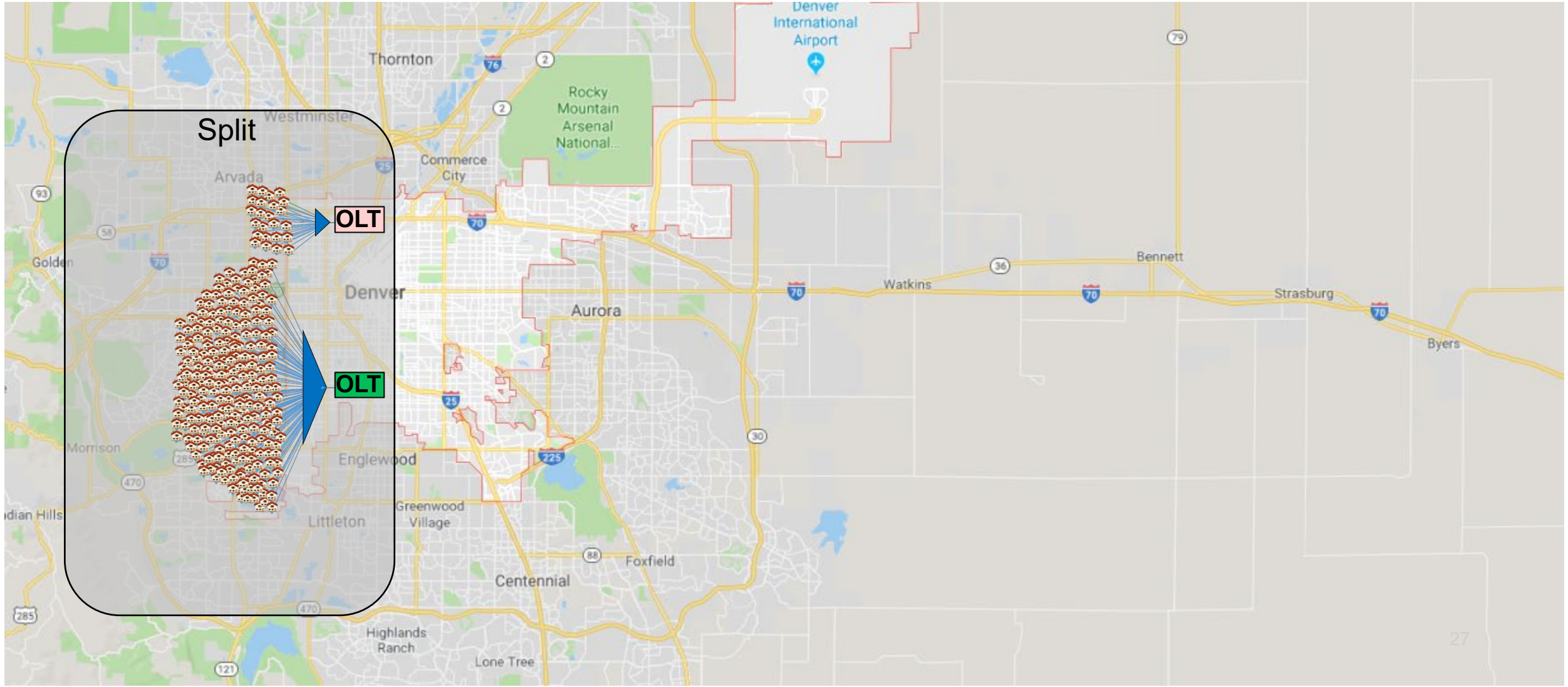


- R-PHY/RMP Connectivity & Backhaul
- Mobile Backhaul
- Mobile Fronthaul
- Remote OLTs
- WiFi Backhaul
- Fixed Wireless Backhaul
- Residential/FTTH MDU
- Residential/FTTH SFU
- Deep Diversity (Equipment and Path)
- Edge Computing
- Network as a Platform

Use Case: Rural (Long Reach) FTTH

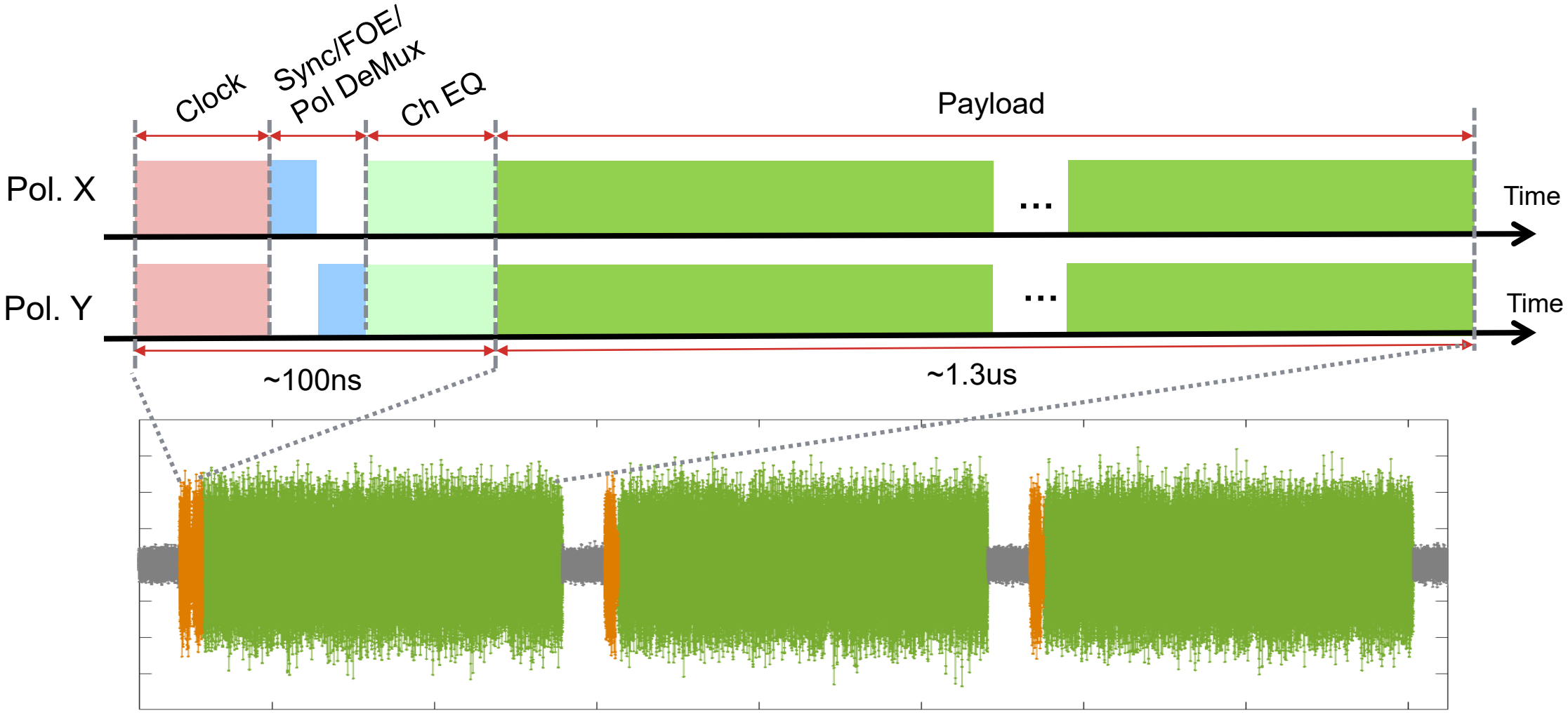


Use Case: Urban (High Density) FTTH

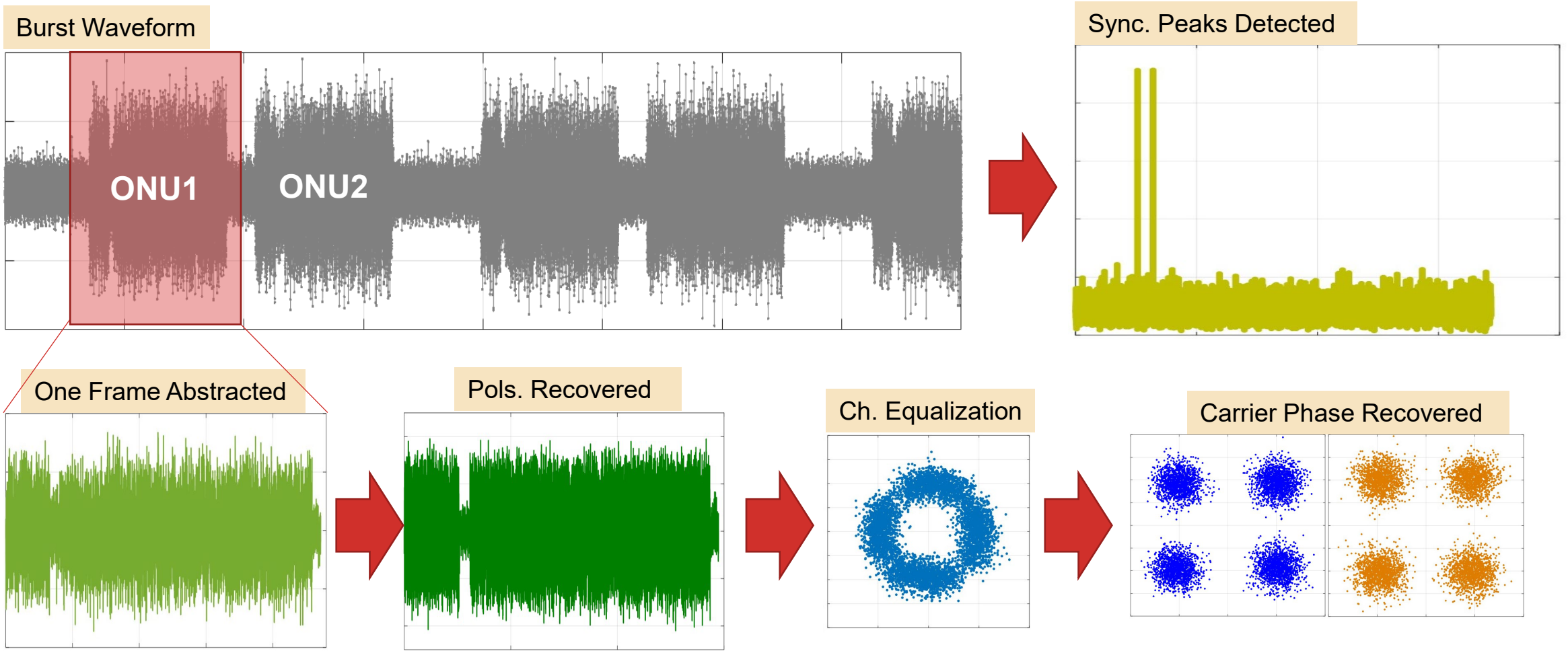


Key Enabling Technologies

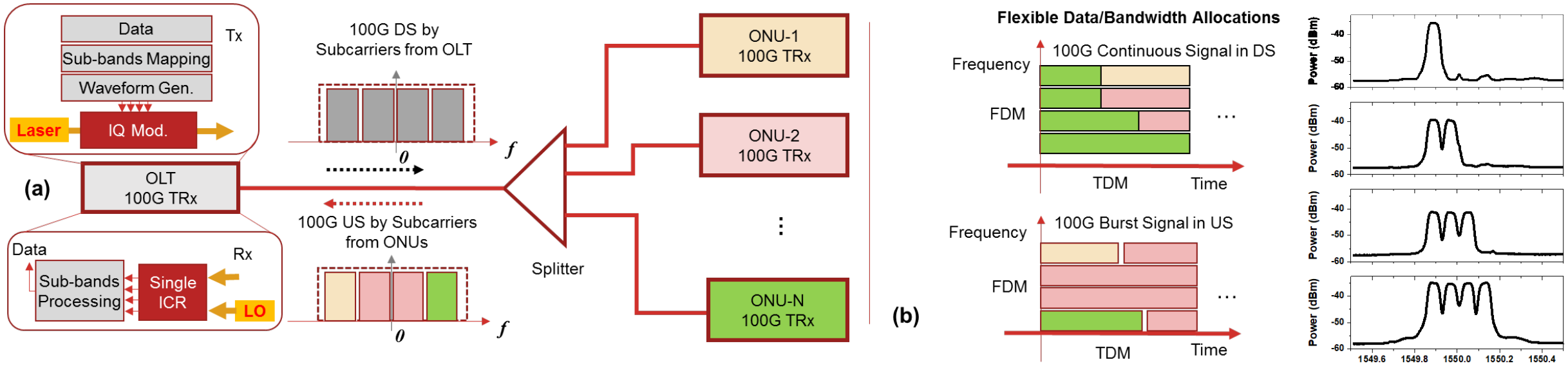
Transmitter Burst Frame Structure



Receiver Burst Processing



Rate-Flexible Symmetric 100G Coherent PON

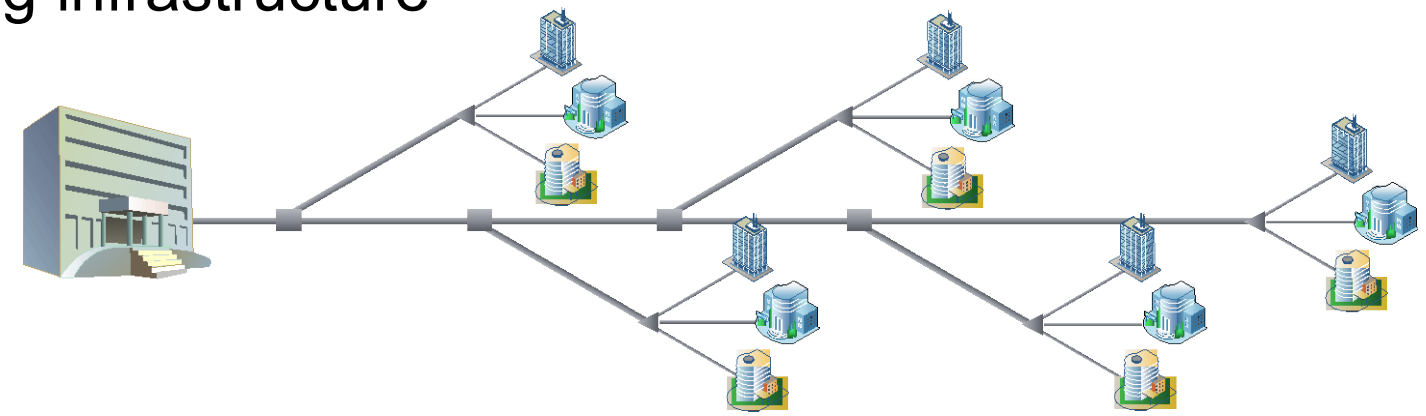


Digital subcarrier multiplexing in both time and frequency domain over a single optical wavelength, enabling 25G, 50G, 75G, and 100G flexible data rate.

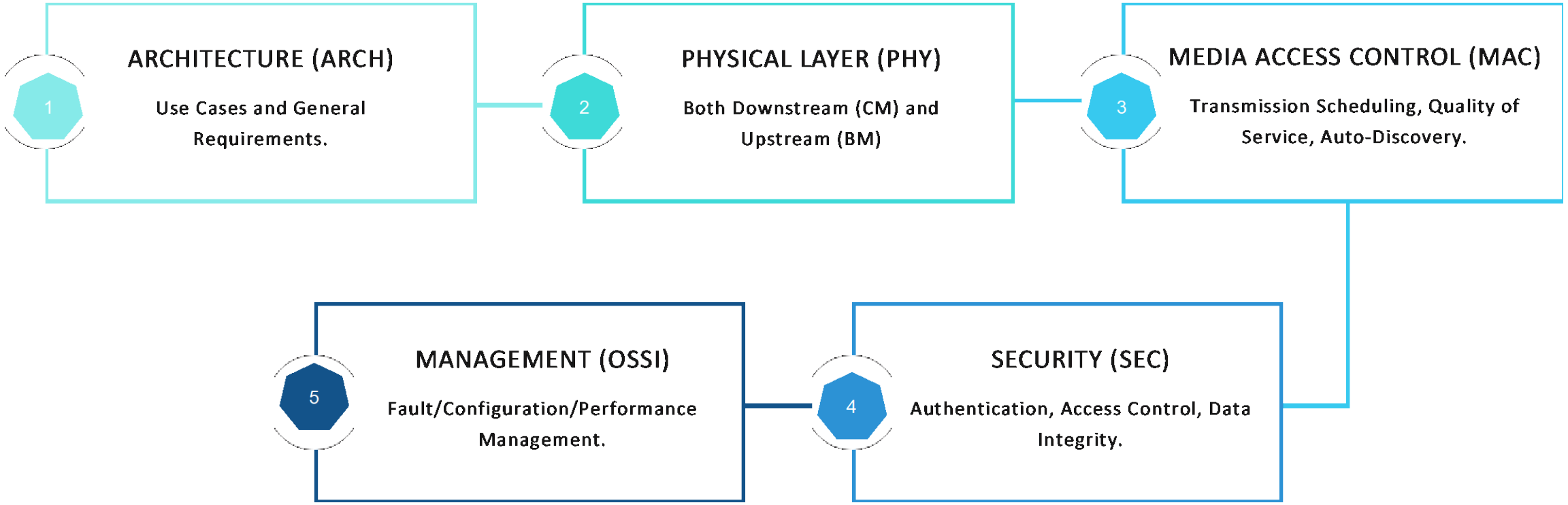
CableLabs' CPON Project

Project Objectives

- Develop specifications for Coherent Passive Optical networks and devices that:
  - Are multi-vendor interoperable
  - Can be developed and deployed at scale at reasonable cost
  - Support a wide range of applications and use cases, including cable operators and others such as mobile operators, telcos, etc.
  - Coexist with existing infrastructure



CPON Specifications



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Audience Q & A

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Next Months Webinar

How to Test the Next-Gen Cable Network

11/18/2021 11:00 am New York / 8:00 am Los Angeles

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