CONNECTING AT THE SPEED OF LIGHT
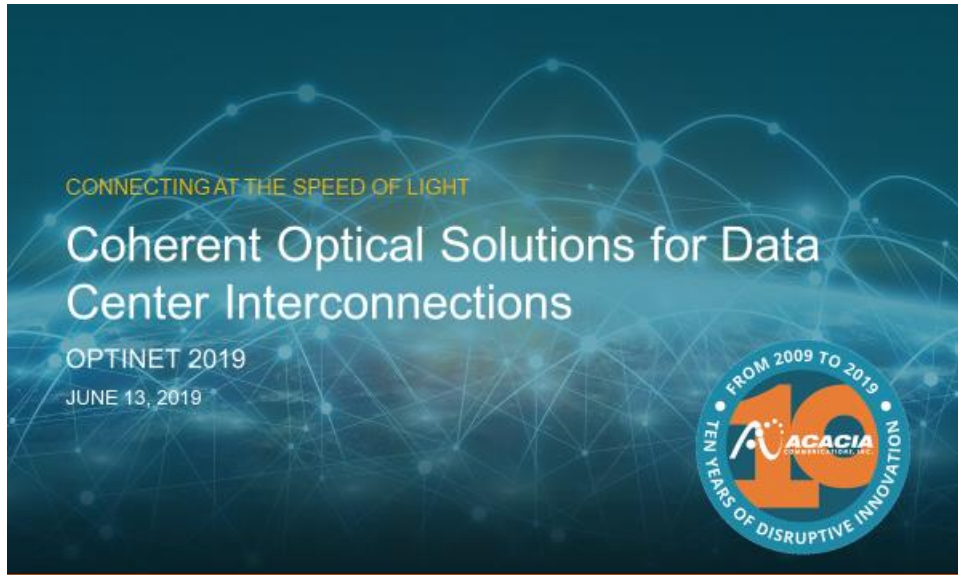
Coherent Solutions Evolving Towards Edge and Access Applications

OPTINET 2020

Fenghai Liu

August 27, 2020

ACACIA
COMMUNICATIONS, INC. ®

Optinet 2019 Review

CONNECTING AT THE SPEED OF LIGHT

Coherent Optical Solutions for Data Center Interconnections

OPTINET 2019

JUNE 13, 2019

FROM 2009 TO 2019 · TEN YEARS OF DISRUPTIVE INNOVATION

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Healthy Eco-system built up around OIF 400ZR

Inphi Sampling New COLORZ® II – Industry's First 400ZR QSFP-DD Transceiver for Cloud Data Center Interconnects

Industry Changing 400ZR Switch and Router Pluggable Modules Dramatically Lower Cost and Power Consumption compared to

SANTA CLARA, Calif., Dec. 19 interconnects, today annou transceiver for cloud data ce to connect metro data cente companies to offer the same network connectivity that w switches.

COLORZ II 400ZR QSFP-DD is

NeoPhotonics ships 400G ClearLight CFP2-DCO coherent optical transceiver

The compa of coherent integrated

Author — Steph

Jan 6th, 2020

II-VI Incorporated Introduces 400G CFP2-DCO Pluggable Transceivers for High-Speed Backbone Networks and Datacenter Interconnects

Acacia Builds Upon its Coherent Pluggable Leadership with a Comprehensive 400G Portfolio

Designed with interoperability support for 400ZR, OpenZR+, Open ROADM and CableLabs to enable customers to address a wide range of applications

f y in G+ p | @ Email | 🖨 Print Friendly | ⋖ Share

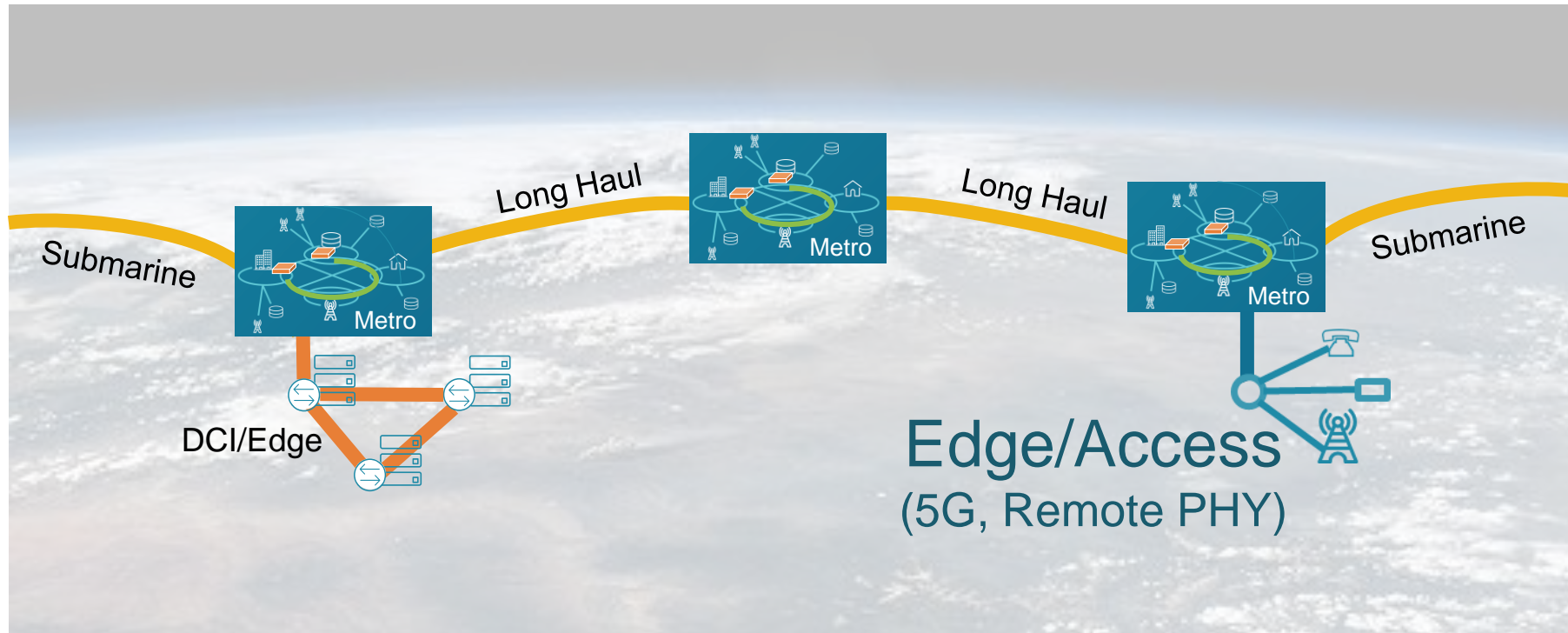March 05, 2020 09:00 ET | **Source:** Acacia Communications, Inc.   📄 photo-release

Acacia's Comprehensive 400G Pluggable Portfolio

MAYNARD, Mass., March 05, 2020 (GLOBE NEWSWIRE) -- Acacia Communications (NASDAQ: ACIA), a leading provider of high-speed coherent optical interconnect products, today announced it is sampling multiple variants in its family of 400G pluggable optical transceiver modules including **400ZR**, **OpenZR+**, and **Open ROADM MSA**. Acacia's 400G pluggable module family features an expansive list of interoperability solutions in **QSFP-DD**, **OSFP** and **CFP2-DCO** pluggable form factors for cloud data center interconnects (DCIs) and service

Network Coherent Requirements Continue to Expand

Submarine · Long Haul · Metro · Long Haul · Submarine

Metro · DCI/Edge · Metro · Metro

Edge/Access
(5G, Remote PHY)

**Coherent technology already in majority of networks;
now moving towards edge and access networks**

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The Time is Right for Coherent in Edge/Access

Leverage Investments in Integration & Vol. Manufacturing
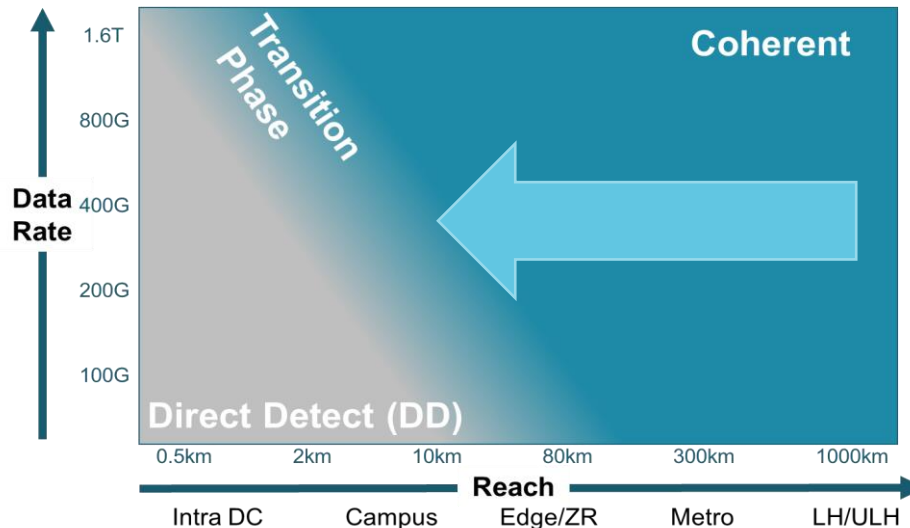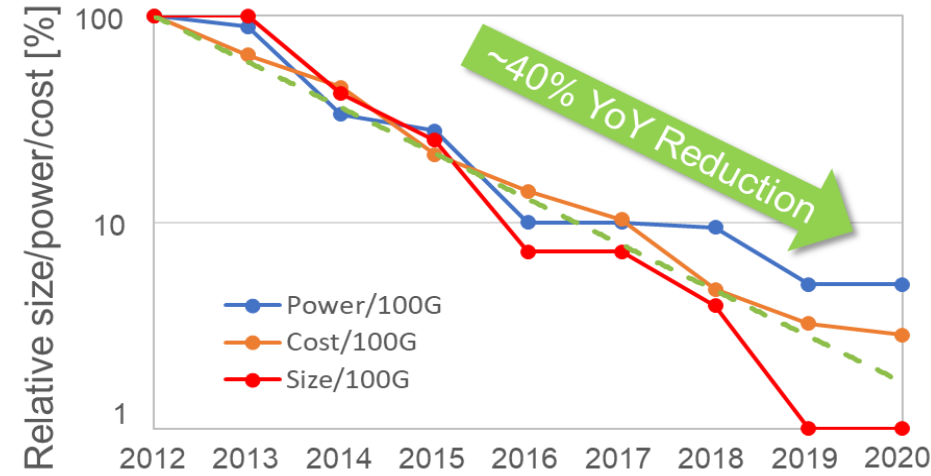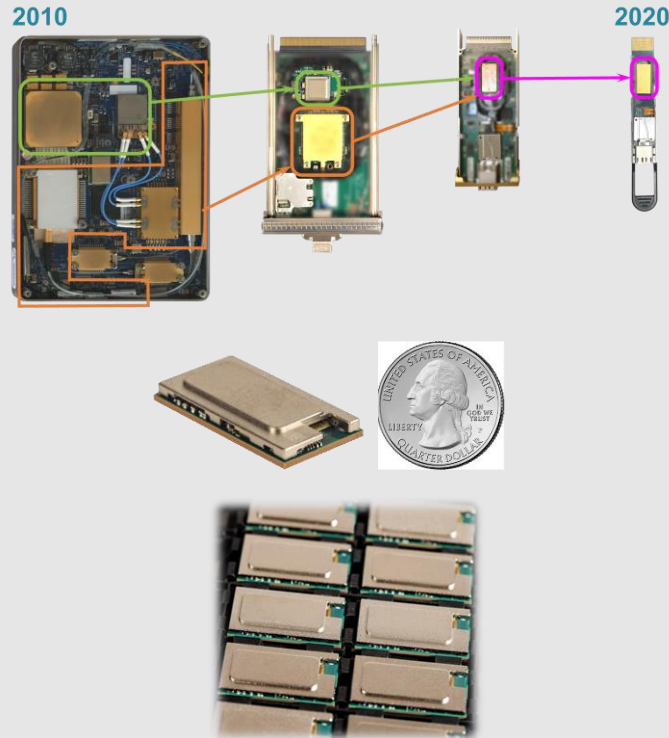
Key Benefits of Coherent in Edge/Access
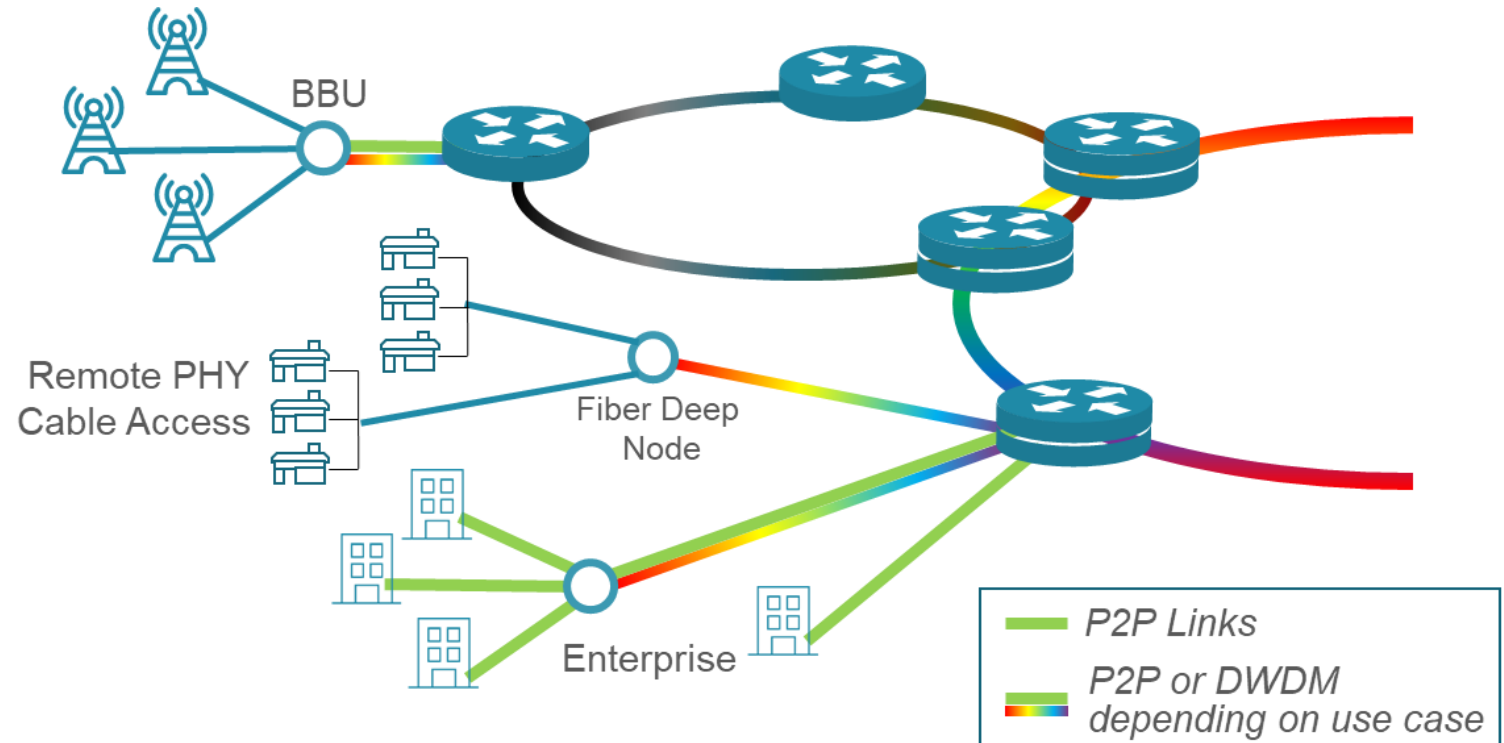
Operational Simplicity

Scalability

Better TCO

Edge & Access Network – Wireless Backhaul/Aggregation

- Existing solutions
  - 100G LR4/ER4/ZR4
  - Nx10G DWDM

- Coherent solutions
  - Hot Pluggable
  - Fixed Wavelength or DWDM
  - 100G/200G/400G

BBU

Remote PHY
Cable Access

Fiber Deep
Node

Enterprise

- *P2P Links*
- *P2P or DWDM
depending on use case*

Cable Access Network Using Coherent Optical Solutions

- Cable Access Networks

- Existing solutions
  - Nx10G DWDM

- Need cost-effective upgrade
  - Increased "work from home" requires more bandwidth

- Multiple coherent choices to realize Fiber Deep:
  - Aggregation device (AGG) can be passive MUX or OTN Muxponder or Packet Switch
  - Coherent (100/200/400G)
  - I-temp
  - BiDi
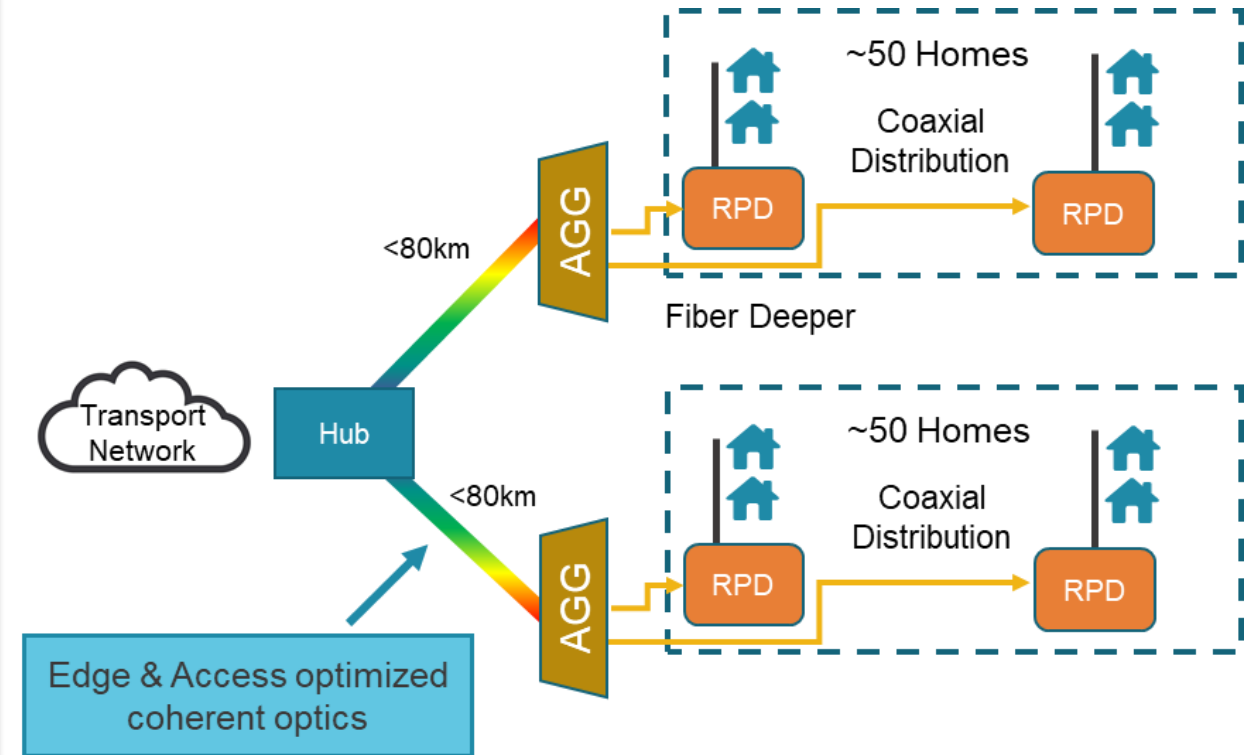
Converged Edge Using Coherent Optical Solutions

- Converged Interconnect Networks
  - Wireless backhaul services
  - Enterprise/Private network services
  - Residential Internet services
    - Data/Video/Voice
  - Most of links between hub and AGG are <120km

- Existing solutions
  - Nx10G DWDM

- Coherent solutions
  - Significant boost of capacity
 - N x 100G/200G/300G/400G
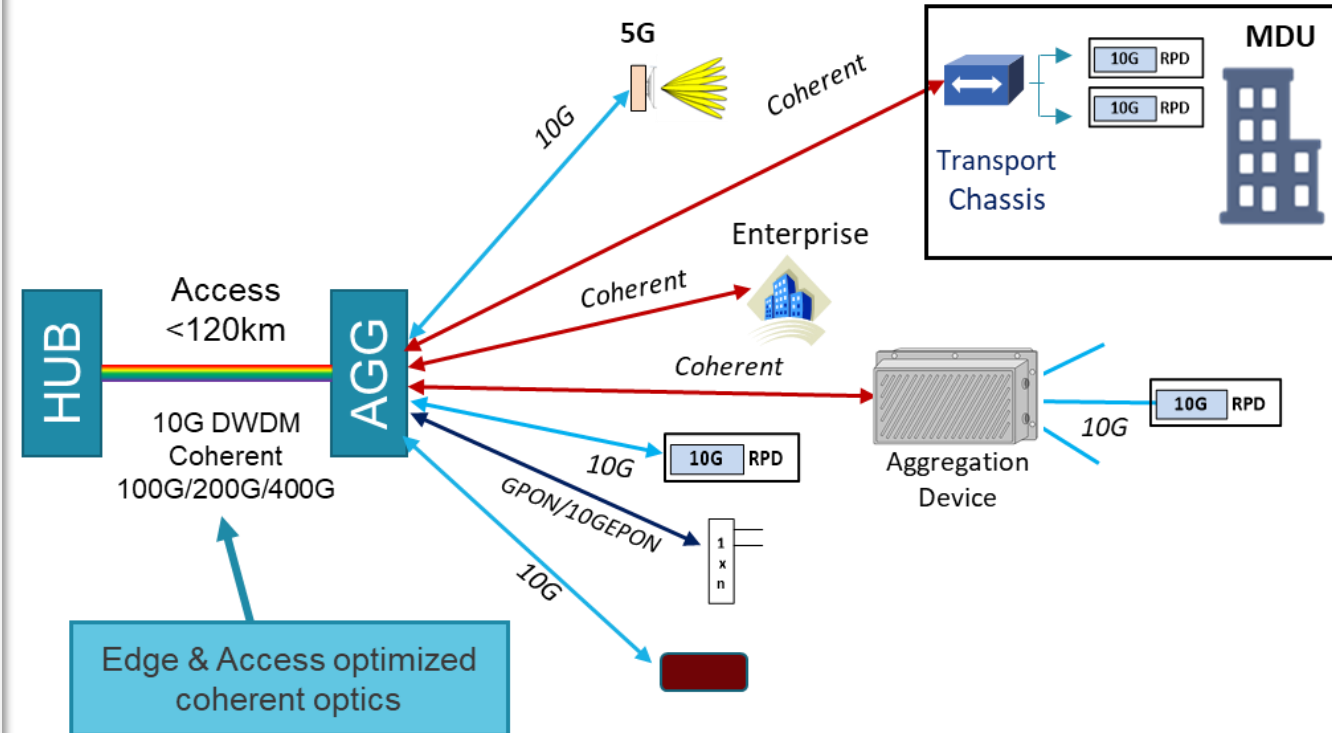
- Diagram based on SCTE-ISBE contributed paper by Cox Communications

Moving into the Edge/Access: Why Coherent?

- High-level of Rx sensitivity – Coherent detection
  - Superior to APD or OA

- Operating @1550nm – Significant low loss window in fiber
  - ~ Half of the fiber loss/km @1310nm
  - Line optical amplifier available if needed
  - Capacity scalable with DWDM

- Electrical compensations – Negligible penalty from impairments (Components, CD, PMD, reflection,…)
  - Works on all types of fiber and challenging links

- Cost-effective scalability to higher data rates
 - Using higher order constellations instead of higher counts of components

Similar building blocks for 100G+
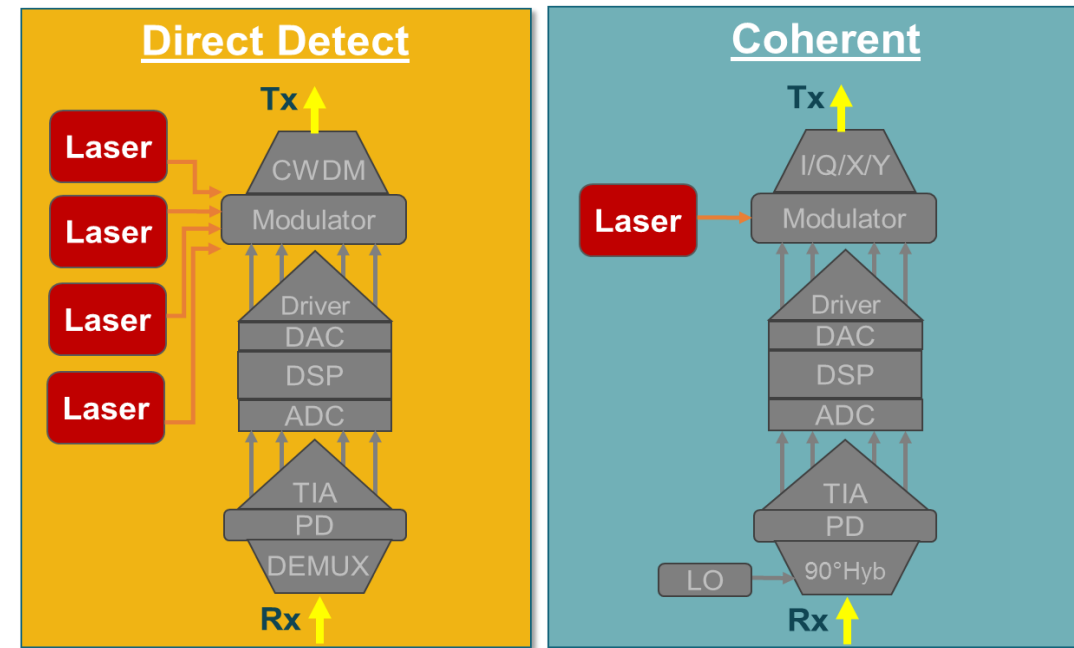
**"We'd love to use it if you can make it."**

Moving into the Edge/Access: How Coherent?

- Fits into small hot pluggable module
  - Required by multi-functional platforms
  - Innovations from high-density photonic integration (SiP and InP)
  - Innovations from advanced packaging (3D OE-MCM, ICTROSA)

- Low power consumption
  - Required by system cooling
  - Smaller CMOS node: 7nm/5nm
  - Low power Driver/TIA and laser designs
  - Co-design on RF signal paths

- Cost competitive
  - Required by cost-sensitive market, powered by volume
  - High level of vertical integration
  - Leveraging CMOS processes
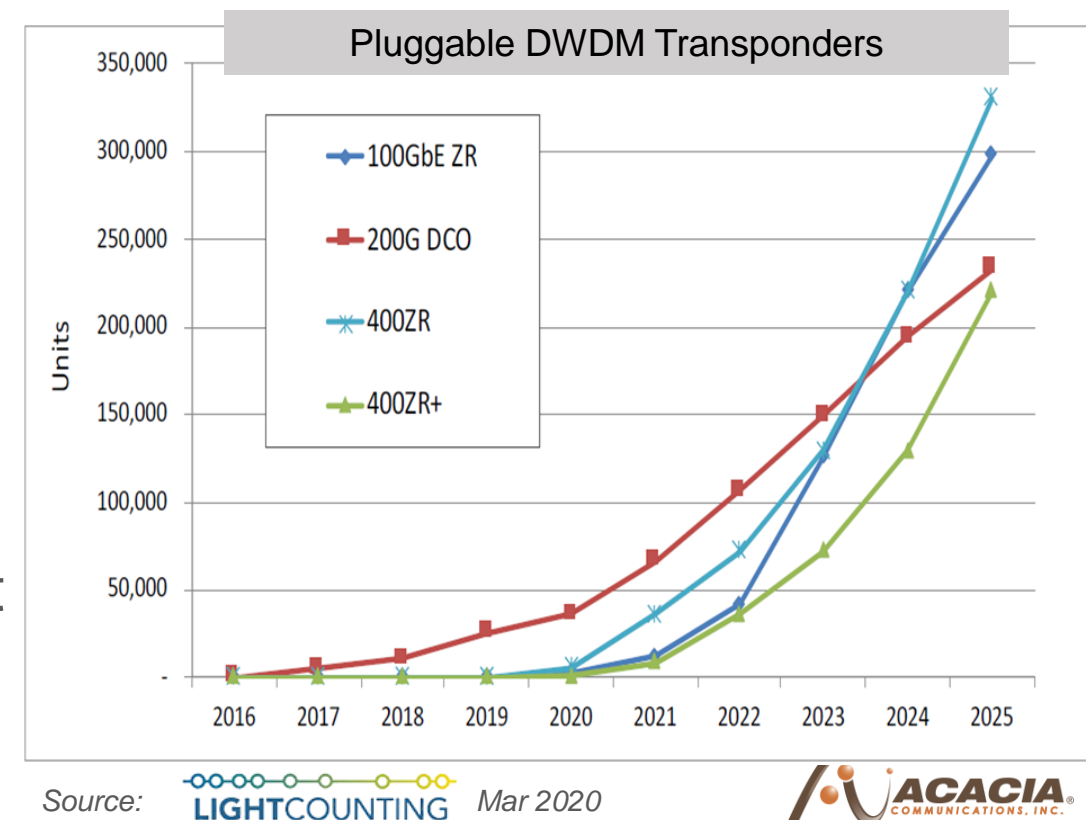 - High-volume packaging
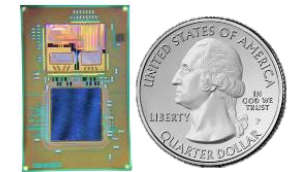
Moving into the Edge/Access: Other Requirements

- Laser safety
  - Coherent needs much less Tx power than DD
    - Well within Class 1 (EN 60825-1)

- Operation in I-temp outdoor environment
  - Harsh temperature range: -40°C to +85°C
  - Outdoor air quality (GR-63-CORE outdoor)

- Single fiber Bi-directional transmission
  - Fiber resource limited
  - Upgrade with minimal interruption to existing service
  - Tunable Coherent provide BiDi DWDM with a single part

- Easy operation
  - Build in rich diagnostics for terminal as well as fiber link
  - Working over loopback to maximize distance
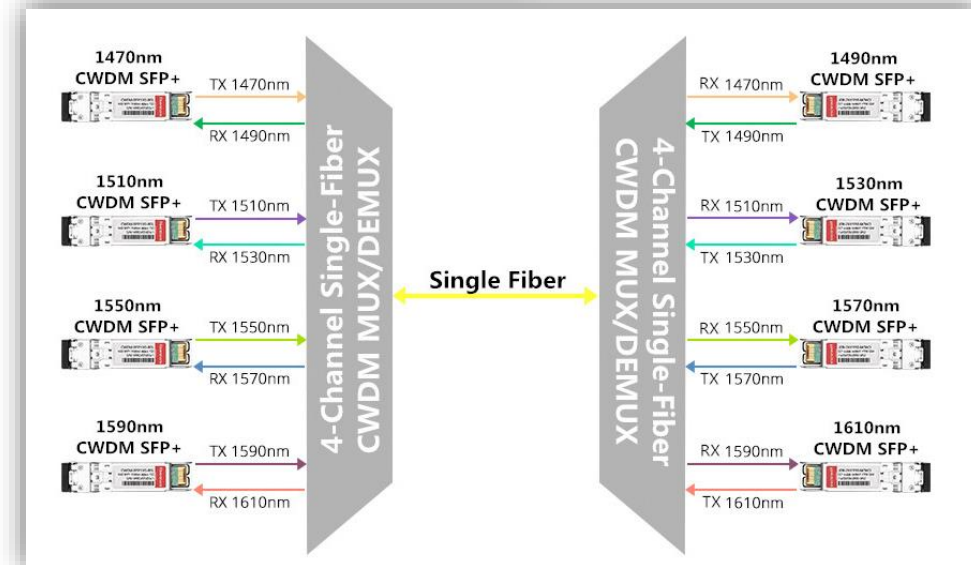
Summary

- Edge/Access networks need coherent solutions in order to rapidly grow traffic
  - 5G Xhaul/ Enterprise/ Residential

- Recent innovations make coherent viable solutions for Edge/Access networks
  - 7nm DSP
  - High density Photonic Integration
  - Small footprint package

- Leveraging DCI eco-system
  - Similar hot pluggable module requirement
  - High volume
  - Reuse components

- Accelerate coherent in Edge/Access market
  - Products are becoming available

Pluggable DWDM Transponders

- 100GbE ZR
- 200G DCO
- 400ZR
- 400ZR+

Source: **LIGHT**COUNTING *Mar 2020*

Thank You

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