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The bridge to possible

Why Coherent Pluggables Revolutionize Optical Infrastructure

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PSOSP-2726

Agenda

- Why pluggable coherent?
- Benefits of pluggable coherent
- Market adoption
- Customer use cases
- What's next?

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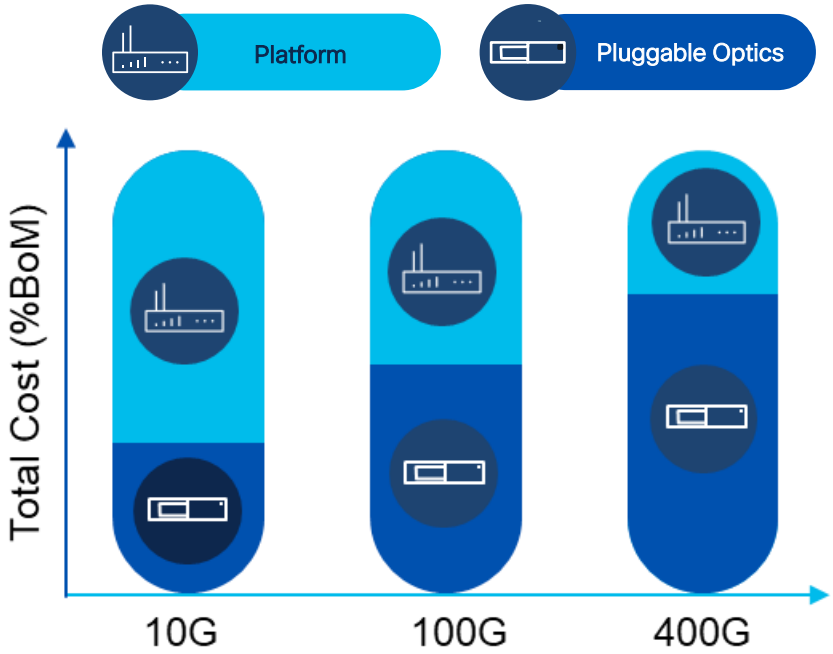
Why are optics becoming more important?

- The economics of networking is changing …
- Reduction of ASIC cost-per-bit has outpaced optics economics
- Silicon + Optics is essential for scaling 400 Gbps and beyond



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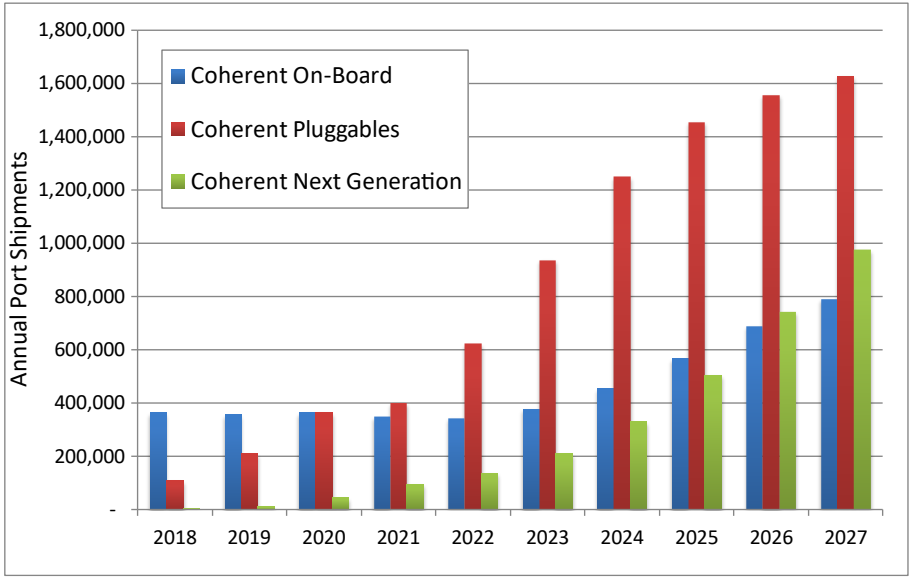
Shifting trend towards Pluggable Coherent Optics

- Historically, embedded solutions have been a majority of coherent ports
- CFP2 gained share, but still a minority
- 400G pluggable has flipped the script
  - Support for router form factors (QSFP-DD)
  - Interoperability
  - Reduced performance gap



Going forward, Embedded designs will benefit from alignment with pluggable

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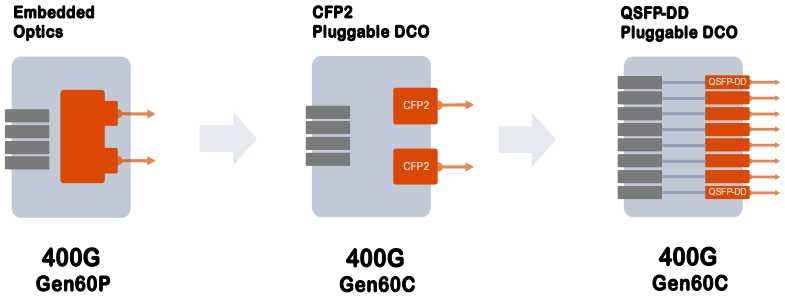
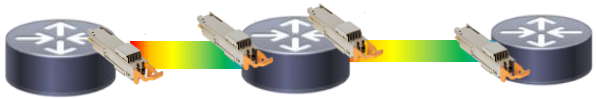
Pluggable coherent – Enabling efficient network architectures



Density is improving many folds;
power per bit coming down dramatically* ….

Routed Optical Networking (RON)

Reduce TCO



Improve fiber utilization

*Source: Cignal AI in PONC 2023

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Cisco/Acacia Coherent Optics Value Proposition

Pioneer in Coherent Pluggables	• 4th generation DSP for MSA coherent pluggables • Market leader >50% market share in 400G pluggable ports
Industry leading performance	• Low power consumption • Designed for C/CD/CDC ROADM architectures over several line systems
Best in class Quality	• MTBF of 450K+ hrs and AFR of 0.157% (400G plugs) • 15M+ service hours without failure for Bright ZR+ (+1dBm)
100% Vertically Integrated	• In-house DSP, PIC, Laser, RF components • Short Lead times
Scalable and Reliable Global Supply Chain	• Fabless Manufacturing • Scalable module build/test capacity to meet demand

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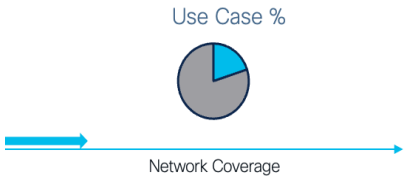
400G QSDD Digital Coherent Optics Portfolio

ER1

Point to Point
Intra-data center, campus interconnect, core-to-edge router

Lowest Cost
Based on fixed laser with simple point-to-point connectivity

Short Reach
Up to 45KM for unamplified at 13dB

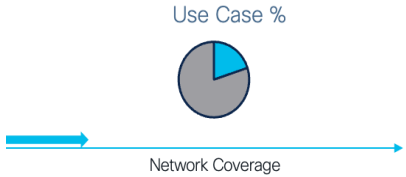


ZR

Point to Point
Web, Data Center Interconnect, Non-SP/SP router interconnect

Low Cost
Lowest cost 400G DCO option for very simple designs

Short Reach
Up to 120KM for P2P amplified links

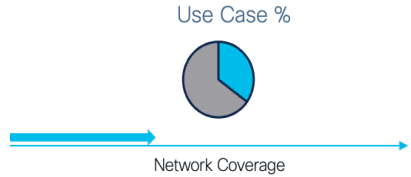


ZR+

Data Centric
Web Scale, DC Interconnect, Non-SP/SP Router Interconnect

Cost Optimized
Essential power and features only to optimize for cost

Simple Features
Designed for open line systems that balance power levels; high-performance forward error correction

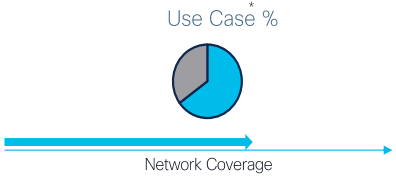


Bright ZR+

Transport Centric
Service Providers, Routed Optical Networking

High TX Power
+1dbm for difficult spans; interop with brownfield transponder & legacy line systems

Advanced Features
TOF, OTN and L1 Encryption features; integrated optical amplifier



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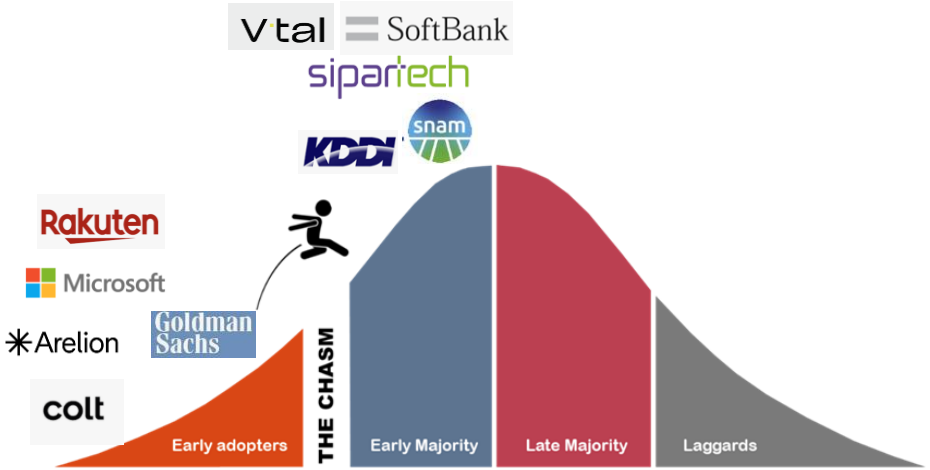
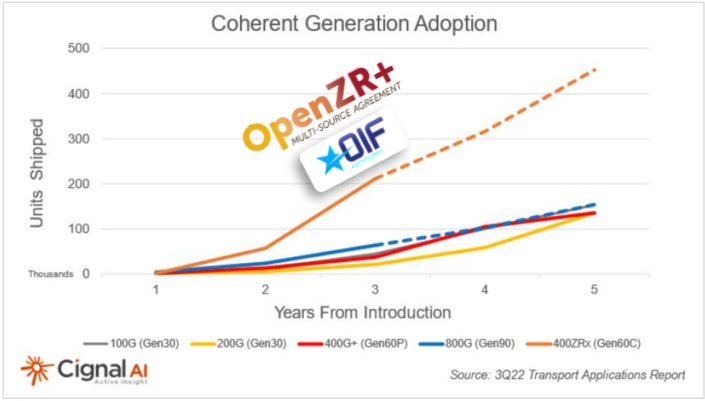
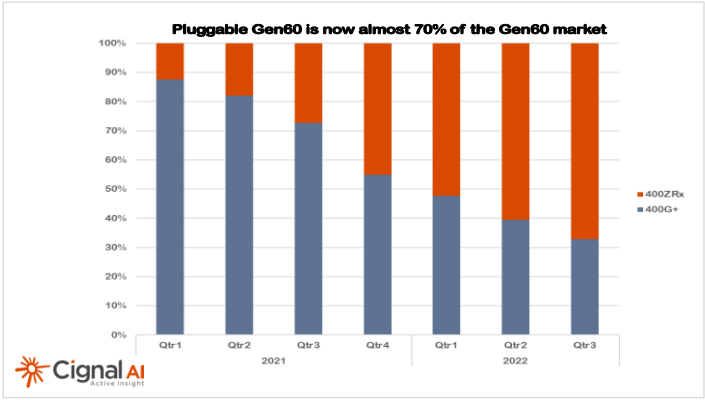
Market adoption: 400G DCO

- 400G pluggable coherent optics (400ZRx) is the fastest adopted coherent technology
- 400G ZRx represents 70% of total deployed 400G coherent interface
- Open line system is accelerating the adoption of 400G DCOs as alien wavelengths without reengineering the photonics layer



Source: Cignal AI





Source: 3Q22 Transport Application Report

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Routed Optical Network (RON)

Use cases and deployment models

TCO* 46%
CapEx* 35%
OpEx* 57%

Different use cases and deployment models

1 QDD-ZR/ZR+ over third-party OLS

2 QDD-ZR over dark fiber or passive DWDM

3 QDD-ZR+ over Cisco OLS

>75% of the RON deployments are over third-party line system!

* ACG Research 2023

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400G DCO can go the distance

SP in Norway

- Bright 400ZR+ QSFP-DD
- Alien λ over third-party line system
  - CDC ROADM, EDFA only
- >2.5 dB margin
- Plug-and-play

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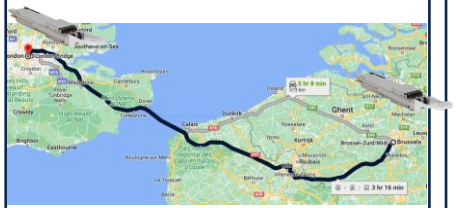
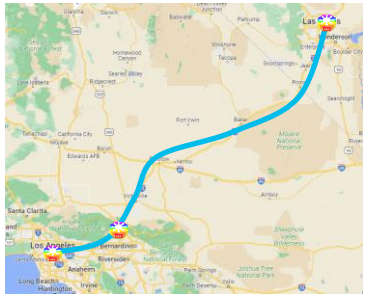


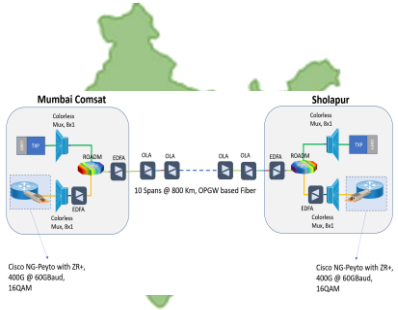
- Bright 400ZR+
- Across the English Channel with challenging high loss span
- Trial 1 at 430 km; Trial 2 at 640 km
- >2.5 dB margin

Tier 1 U.S. cable operator



- Bright 400ZR+ with 8201
- 520 km high loss E-LEAF fiber, span >26.5 dB
- Two different OLS vendors
- Error free with margin

Tier 1 SP in India



- 400ZR+ with Cisco routers
- >800 km longest route
- Core network over third-party ROADM OLS

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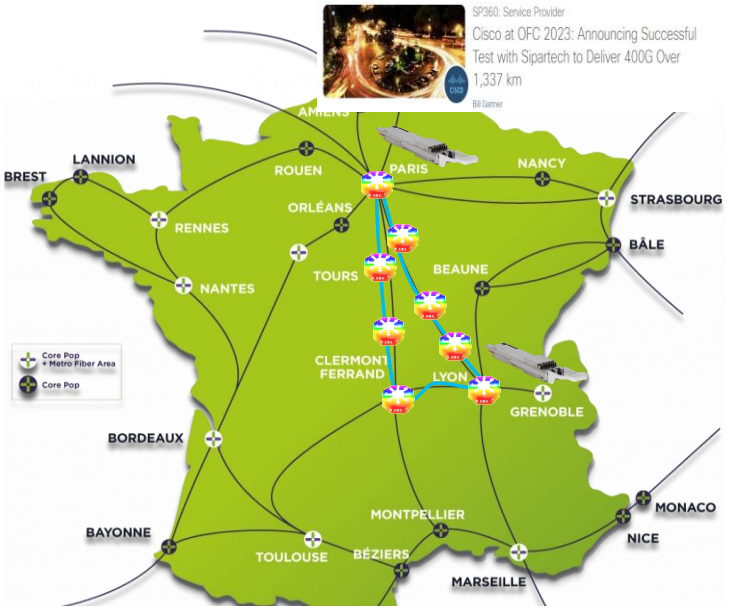
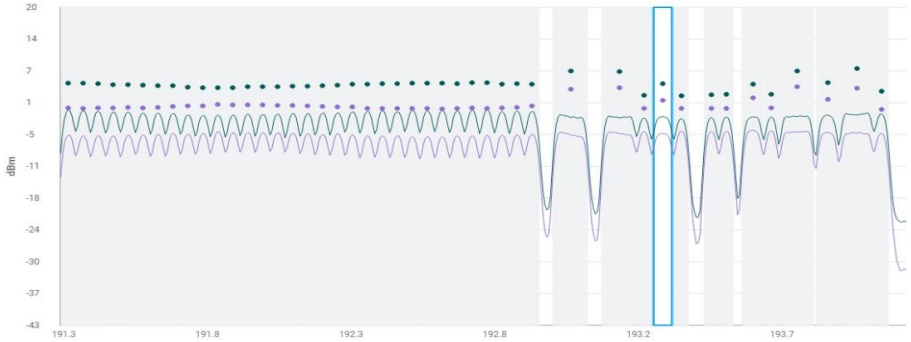
Sipartech—400 GbE over 1,337 km with Bright ZR+



- Mixed SMF28 and E-LEAF fiber with eight ROADM sites
- Alien λ over third-party CDC ROADM line system, plug-and-play



"With the interoperability of Cisco's equipment, we can deploy our next-generation 400G+ services with speed, simplicity, and flexibility to meet our customers' needs, while optimizing energy expenditure and our carbon footprint as part of our global strategy," – Julien Santina, CEO, Sipartech .

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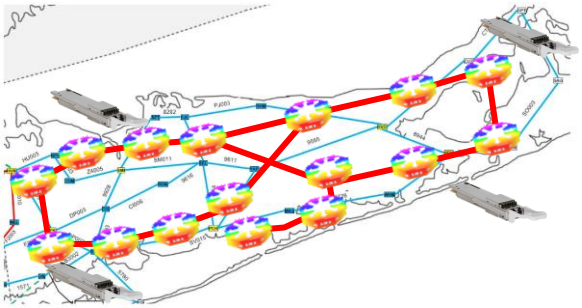
Expanding 400G DCOs to ROADM-rich networks

Tier 1 North American carrier

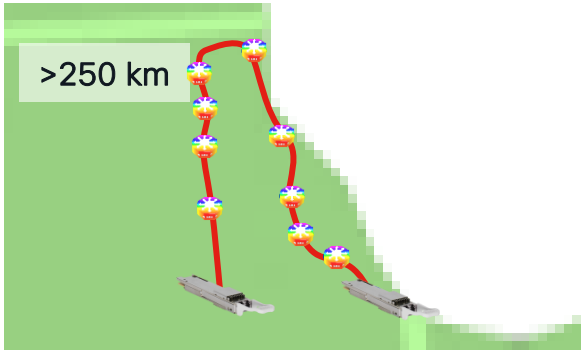
20 x CDC ROADMs



- Bright 400ZR+ QSFP-DD
- 16 NCS 2000 ROADM nodes w/ CCOFS
- Dense metro ROADM network
- POC conducted directly in Viavi tester

North American T1 cable operator

20 x CDC ROADMs



- Bright 400ZR+ QSFP-DD + 8201
- Alien λ over third-party CDC ROADM line system
- 75 GHz ROADM pass band
- Plug-and-play with deployment margin

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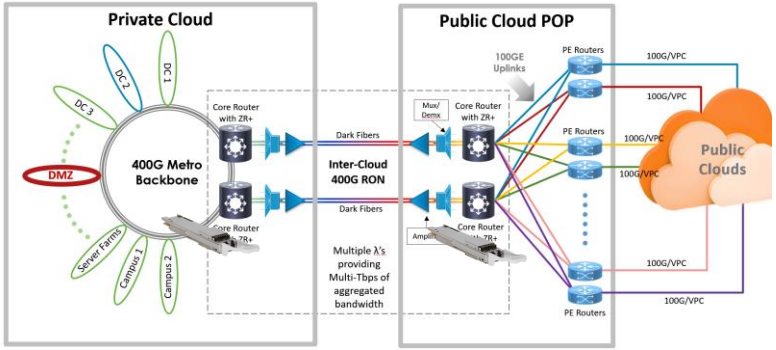
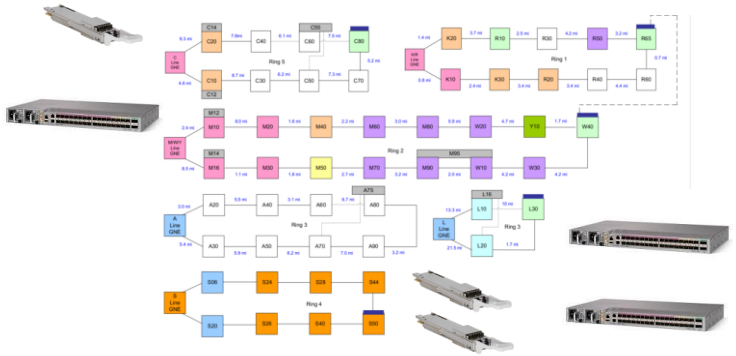
400G DCOs for Enterprise

Tier 1 financial institution



- 400ZR+ QSFP-DD + Cisco routers
- Interconnect private and public cloud via dark fiber
- Forklift upgrade of legacy transport gear
- CapEx and OpEx savings

Regional Transit System Network



- Bright 400ZR+ QSFP-DD + NCS540
- Existing NCS 2000 ROADM network
- High availability RON network

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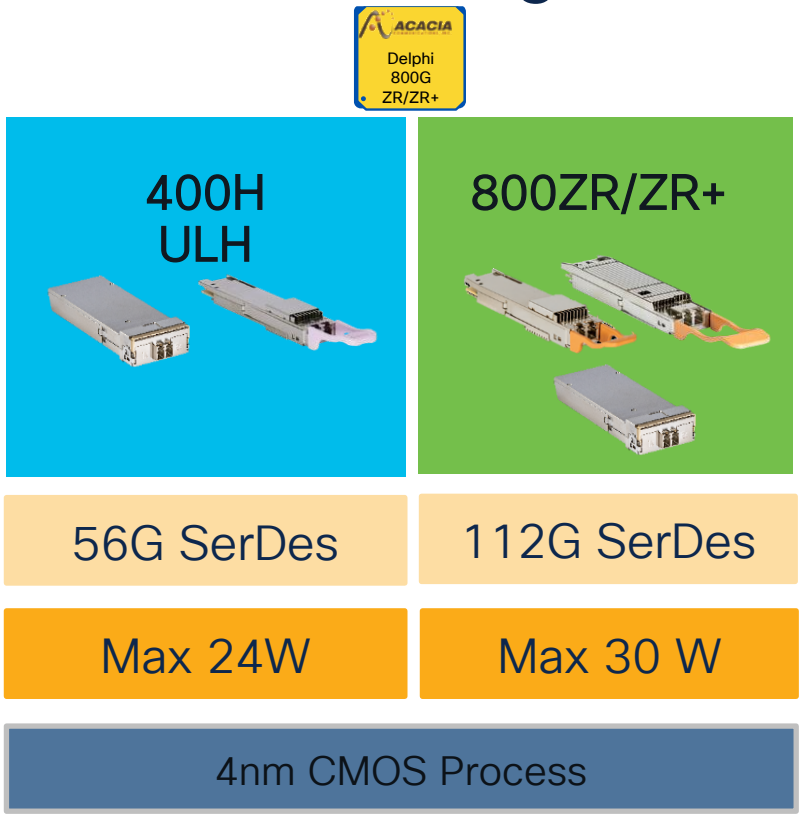
Next-Gen Coherent Optics – RON building blocks

- Module Portfolio
  - 800ZR in QSFP-DD/OSFP
  - 800ZR+ in QSFP-DD/OSFP/CFP2
  - 400G Long-haul in QSFP-DD and CFP2
- Low Power 4nm DSP – Delphi
- Up to 130Gbd Optics
- 400G ULH Pluggables:
  - Designed for existing 400G platforms
  - Integrated EDFA and TOF
  - Flexible line side modes with PCS
- 800ZR/ZR+ Pluggables:
  - Comply to OIF 800ZR
  - Comply to 800G OpenROADM



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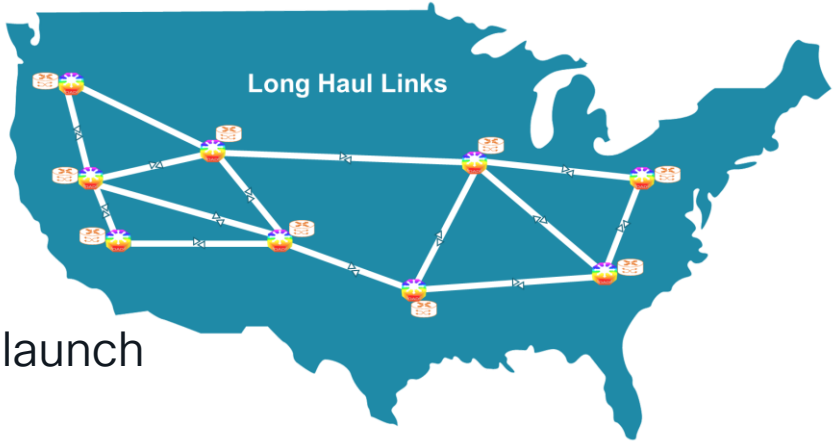
RON building blocks–400 ULH pluggables

- 400 ULH
  - Full terrestrial network coverage with interoperable PCS
    - Supporting long-haul reaches
      - Multiple baud rates to align with existing channel plans*
    - Bright configuration available at initial launch



*Transport use cases that can be addressed by Routed Optical Networking (Cignal AI and Cisco Approximations)

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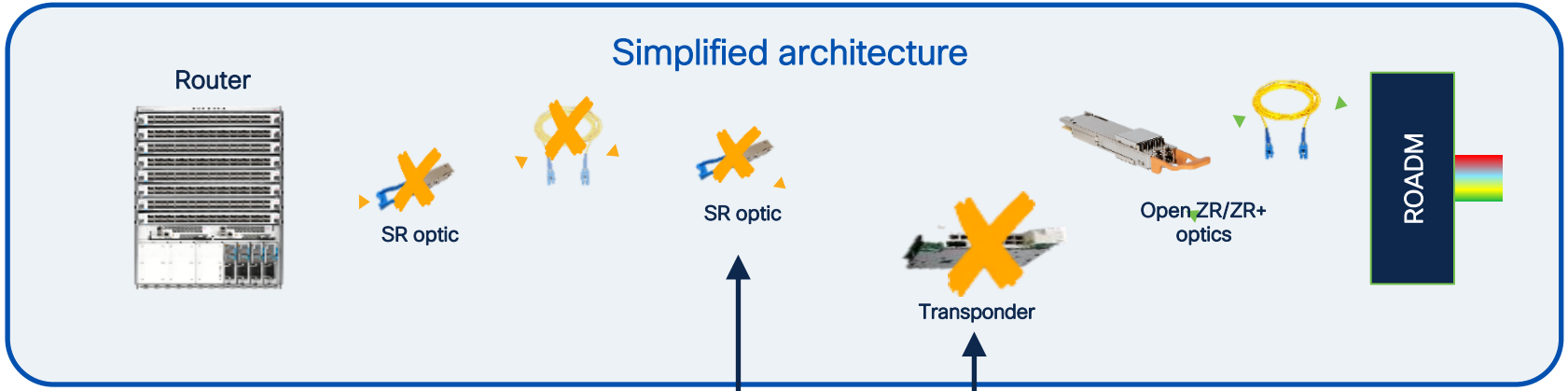
Summary: Coherent optics enables IP-optical convergence



- Eliminate transponder and associated shelf/chassis
- Eliminate client optics

"Simplicity is the ultimate sophistication."
Leonardo da Vinci

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