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The bridge to possible

The Value of 400G Mass Scale Infrastructure

Bernhard Stascheit, Product Manager, Service Provider Product Management

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Agenda

- Introduction
- The Journey to 400G Optics
- 400G ZR/ZR+ Optics
- 400G use cases
- IP & Optical Convergence Architecture
- Platform implementation
- Summary
- Demo

Market Dynamics

Explosive Internet Growth

2018 Cisco VNI

Economic Challenges

IHS Markit Report

0.5%

Flat Revenue Growth
(2017 – 2022 CAGR: 0.5%)

11X

$1 of CapEx in 2020 has to do 11X the work it did in 2012

5X

Today, operators spend $5 of OpEx for each $1 of CapEx

Want More for Less

Reduce Costs (CapEx, OpEx) and Latency. Increase Capacity.

Create New Revenue. Improve Experiences and Time to Service

Increase Trust and Security

HOWEVER, BUDGETS REMAIN FLAT

The Future of the Internet

New Normals

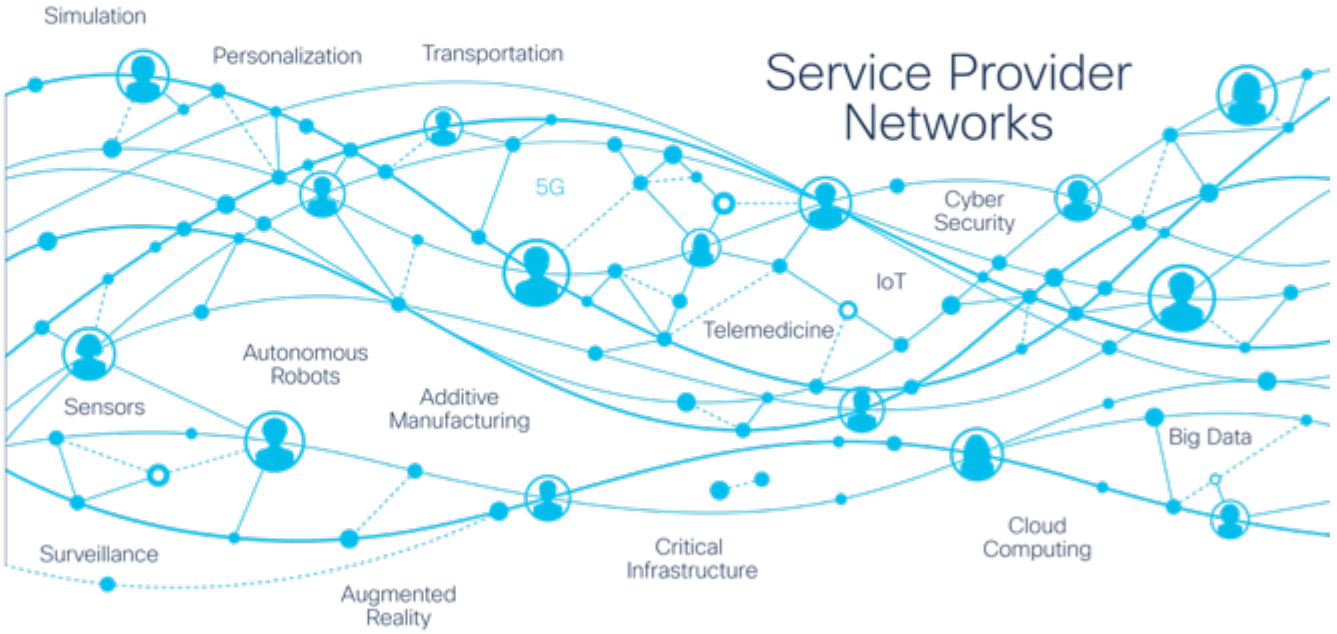
For the way we Work, Live, Play, and Learn

New Participants

Many remain unconnected and emerging IoT

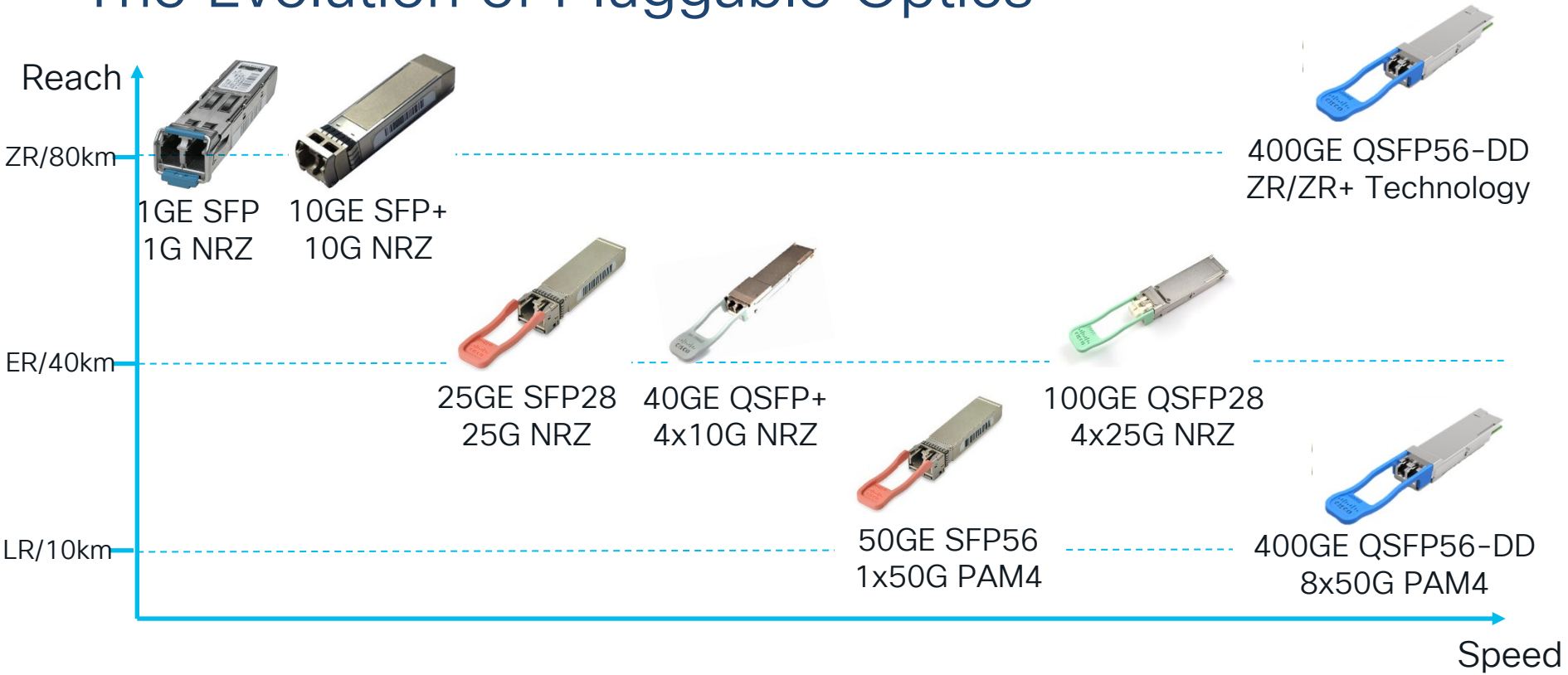
New Potentials

The foundation of economies, governments, and societies



The Journey to 400G Optics

The Evolution of Pluggable Optics



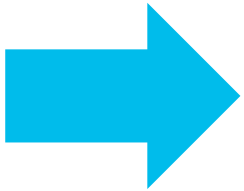
400G Optics Overview

Product ID	Description
QDD-400-CUxM	Passive Copper Cable, x meter
QDD-400G-DR4-S	400GBASE-DR4 QSFP-DD, 500m over parallel SMF
QDD-400G-FR4-S	400GBASE-FR4 QSFP-DD, 2km over duplex SMF
QDD-400G-LR8-S	400GBASE-LR8 QSFP-DD, 10km over duplex SMF
QDD-400G-ZR-S	400G Coherent QSFP-DD, 100km over duplex SMF
QDD-400G-ZRP-S	100/200/300G/400G Metro Coherent QSFP-DD, duplex SMF

400G ZR/ZR+ Optics

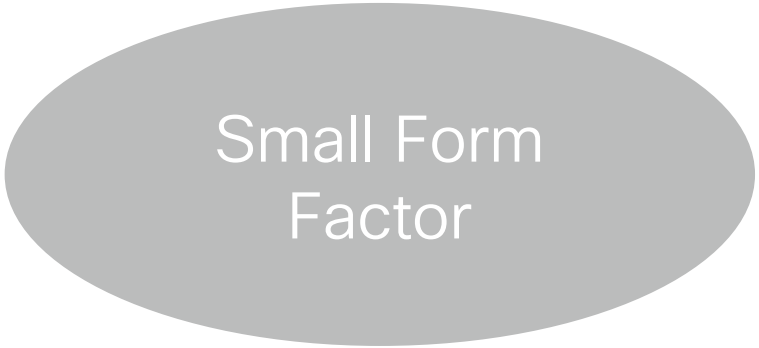
What is 400G ZR/ZR+ Technology

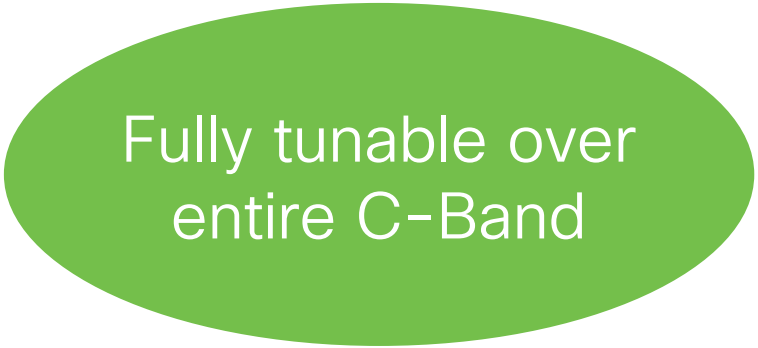
- 400G ZR/ZR+ makes use of Coherent Optical Technology
- It uses QAM Technology to modulate the light in Phase and Amplitude
- It uses Orthoganal Polarization to transport two independant Bit-streams via same wavelength

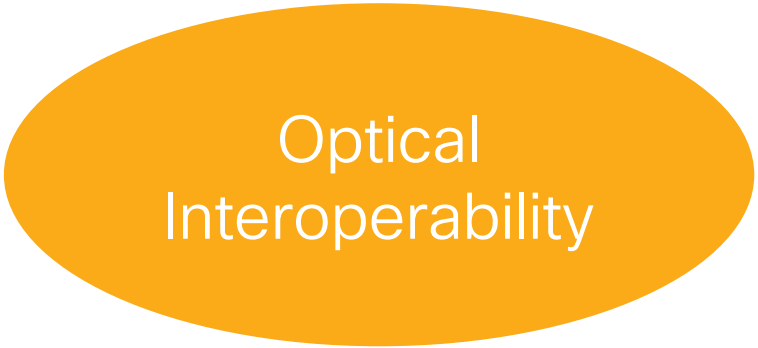


We go directly from Morse Code to ATSC/DVB TV!!

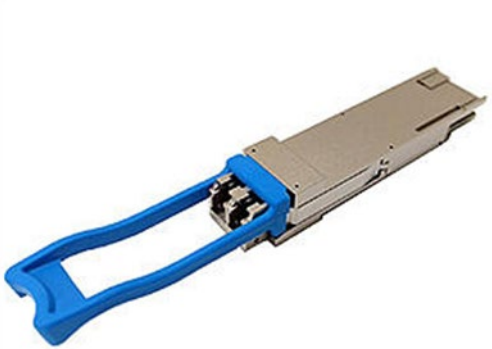
Benefits of ZR/ZR+ Technology







400G QSFP56-DD ZR & ZR+ WDM Pluggable Details



- Supported Trunk Rate:
  - 100G, 200G, 300G and 400G (OpenZR+) 400G (ZR) 59.8 Gbaud
- Channel Spacing:
  - 75GHz (Min)
- Minimum TX Power:
  - ZR: -10 dBm
  - ZR+: -10 dBm @ 400G
    - 6 dBm @ 100G

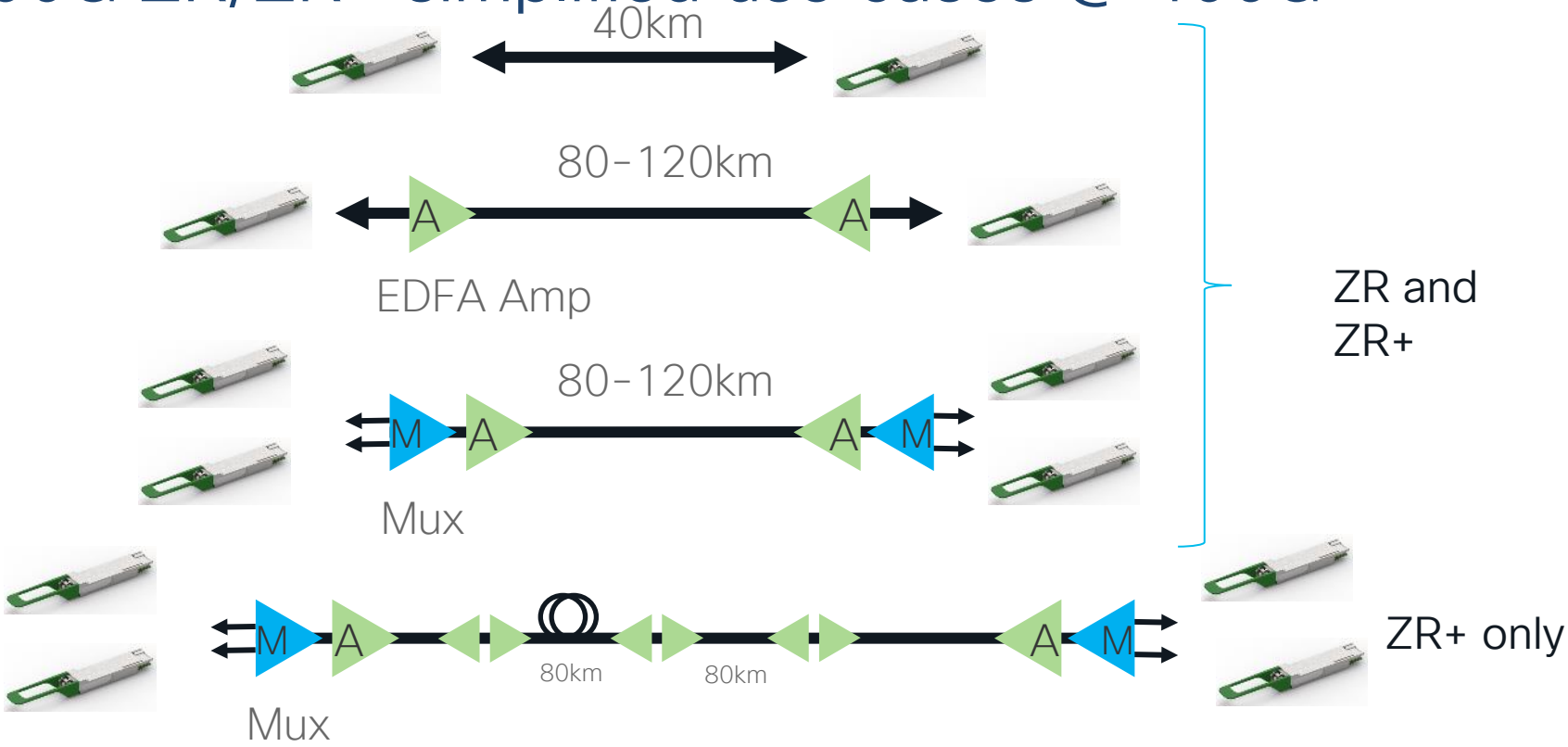
- Worst case Power Consumption:
  - ZR: <20W
  - ZR+: <24W

Important!!

Line Rate	Mode	Modulation Format	FEC	OSNR [dB]	Min RX Sensitivity	Target Reach [km]	Max Reach P2P w/o OLA [km]*
400G	ZR	16QAM	CFEC	26	-20dBm	120	40
400G	OZR+	16QAM	OFEC	22.1	-22dBm	1,400	48
300G	OZR+	8QAM	OFEC	18.7	-23dBm	2,500	52
200G	OZR+	QPSK	OFEC	14.6	-29dBm	3,000 (CD-limited)	76
100G	OZR+	QPSK	OFEC	11.0	-32dBm	4,000	104

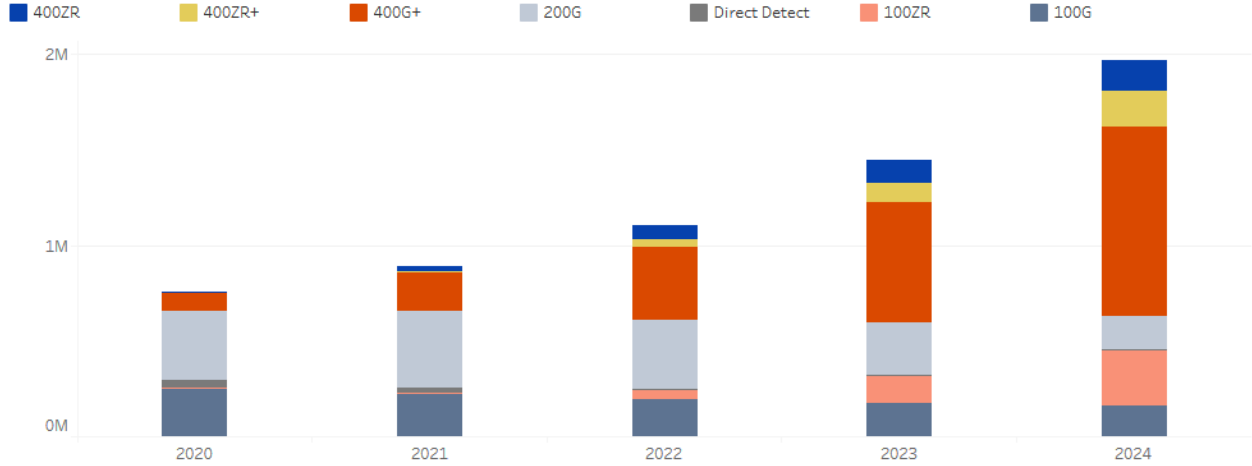
* Engineered link @ 0,25dB/km

400G ZR/ZR+ simplified use cases @ 400G



Market outlook

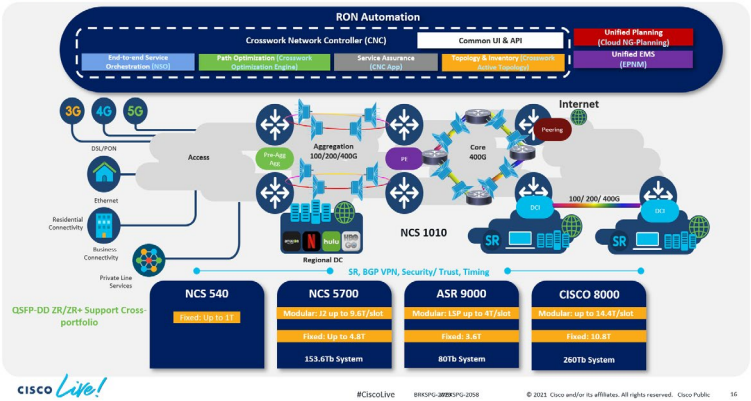
	2020	2021	2022	2023	2024
100G	254,700	226,400	193,600	174,700	159,200
100ZR	25	3,400	48,400	142,900	295,700
Direct Detect	40,500	21,500	5,500	2,400	0
200G	362,900	406,000	361,400	276,300	172,400
400G+	95,000	203,000	384,000	629,300	991,100
400ZR+	100	6,100	34,900	98,000	187,300
400ZR	900	26,900	74,700	124,100	164,500
Grand Total	754,125	893,300	1,102,500	1,447,700	1,970,200



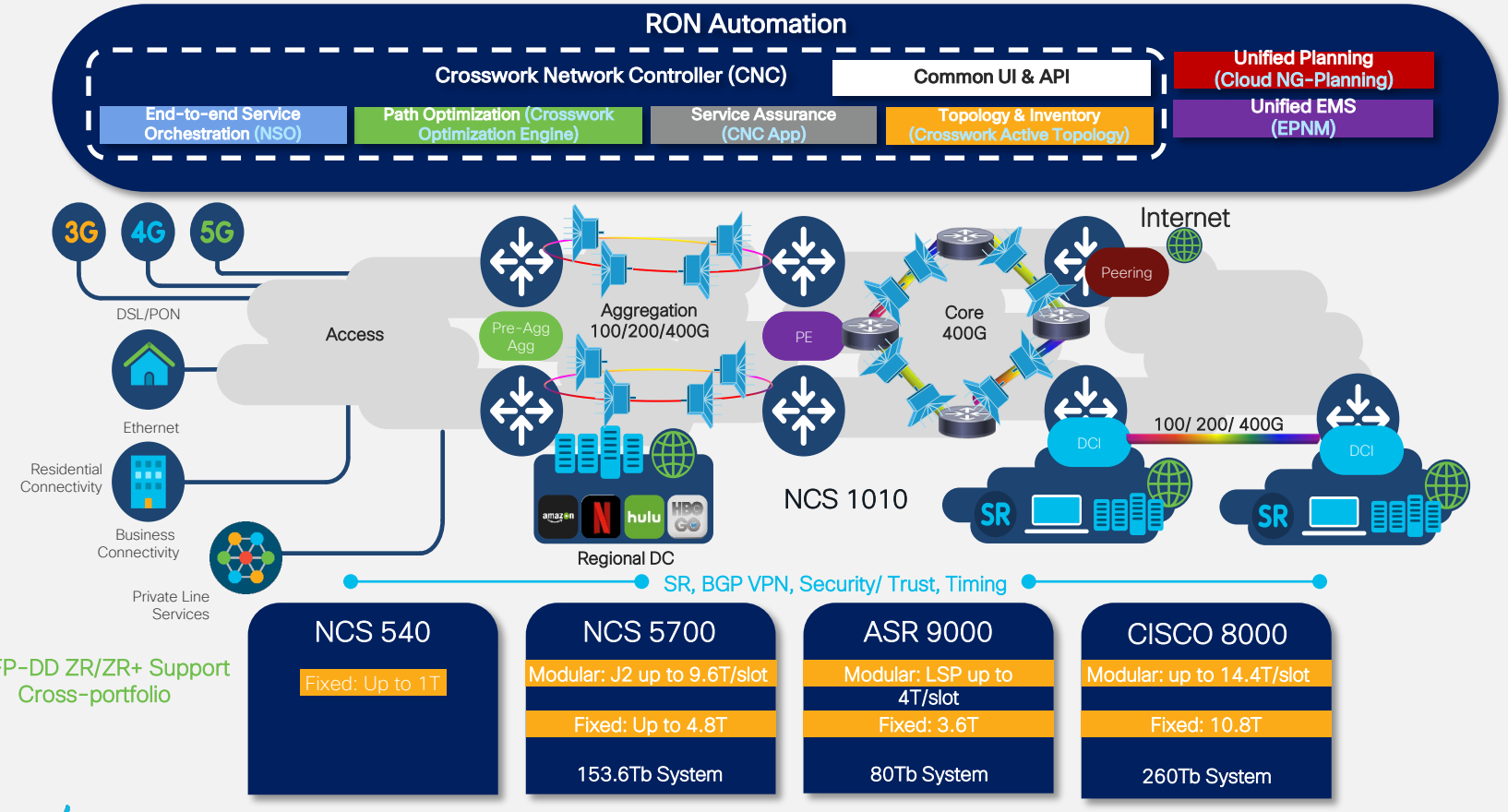
Source: Cignal Coherent Pluggables to Transform Optical Transport Market by 2024, Nov 2020

400G Use cases

Routed Optical Network

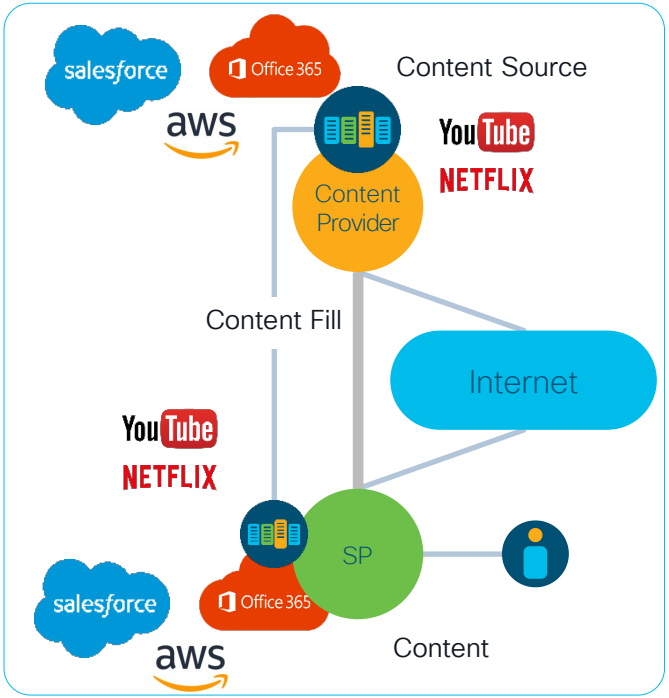


Routed Optical Network



Distributed Peering for Content Providers

Enabled by increased peering locations and dedicated peering routers



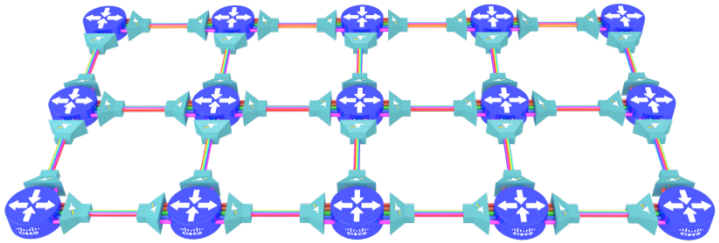
For users

- Lower latency
- Higher reliability
- Better performance

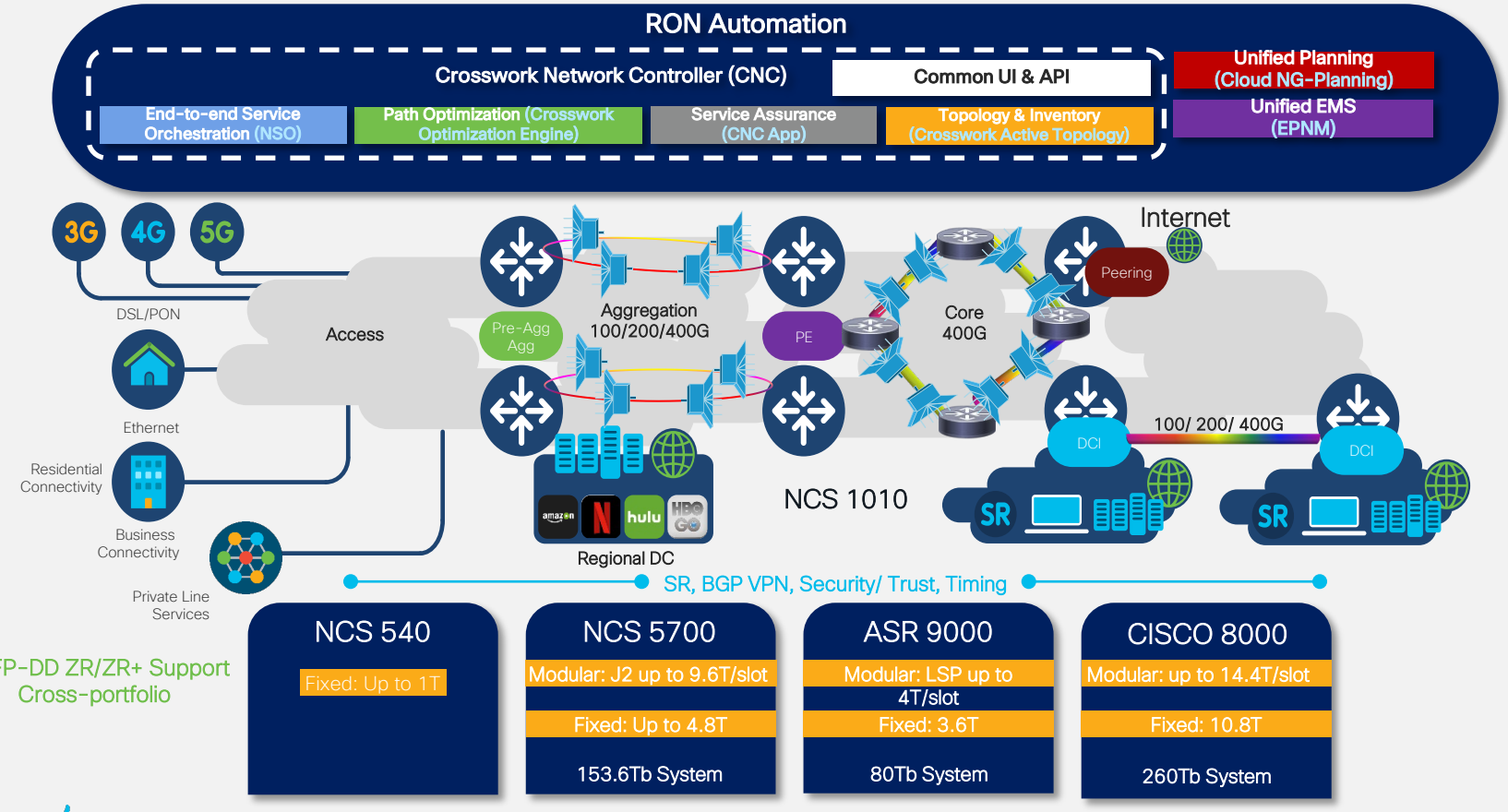
For network operators

- Less network congestion
- Better performance for customers
- Lower costs with automation and data center operations
- Greater flexibility in route controls
- Mutually beneficial relationship with partner

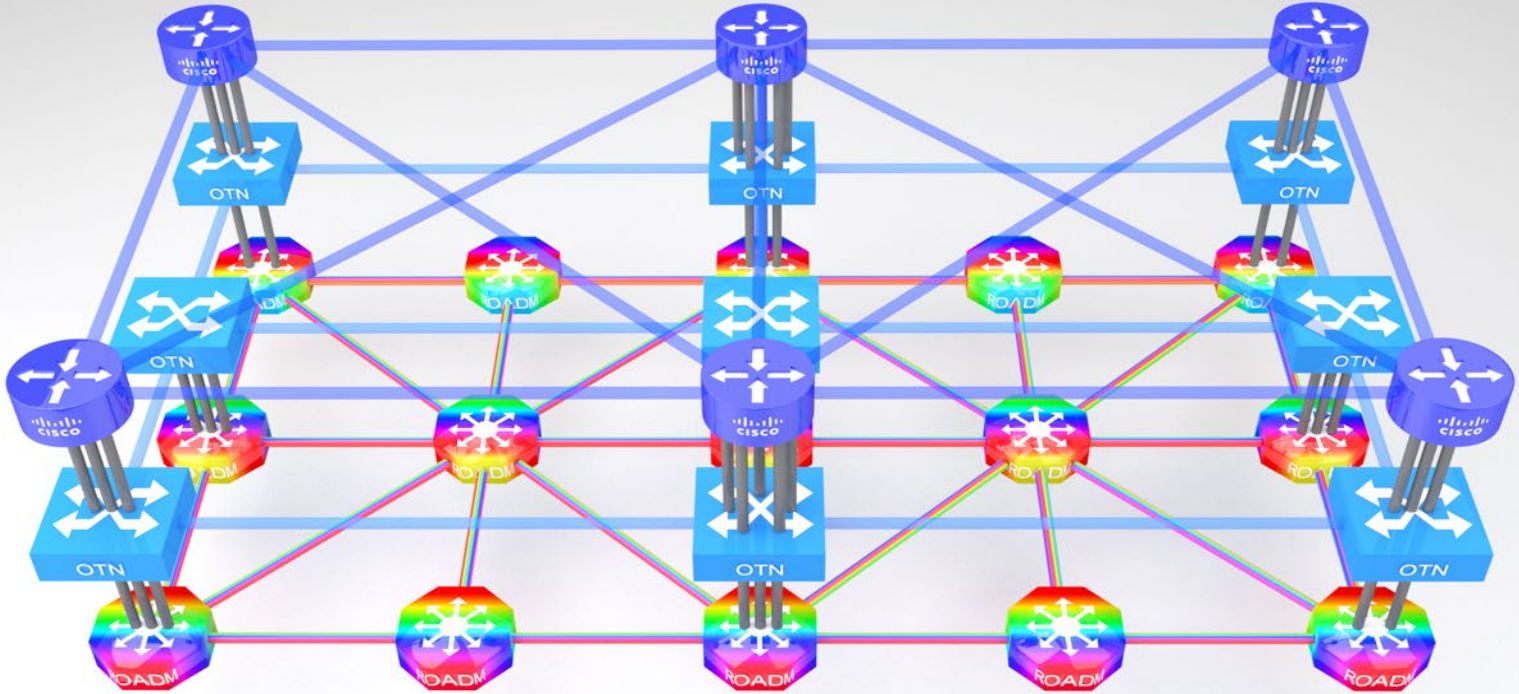
IP & Optical Convergence Architecture



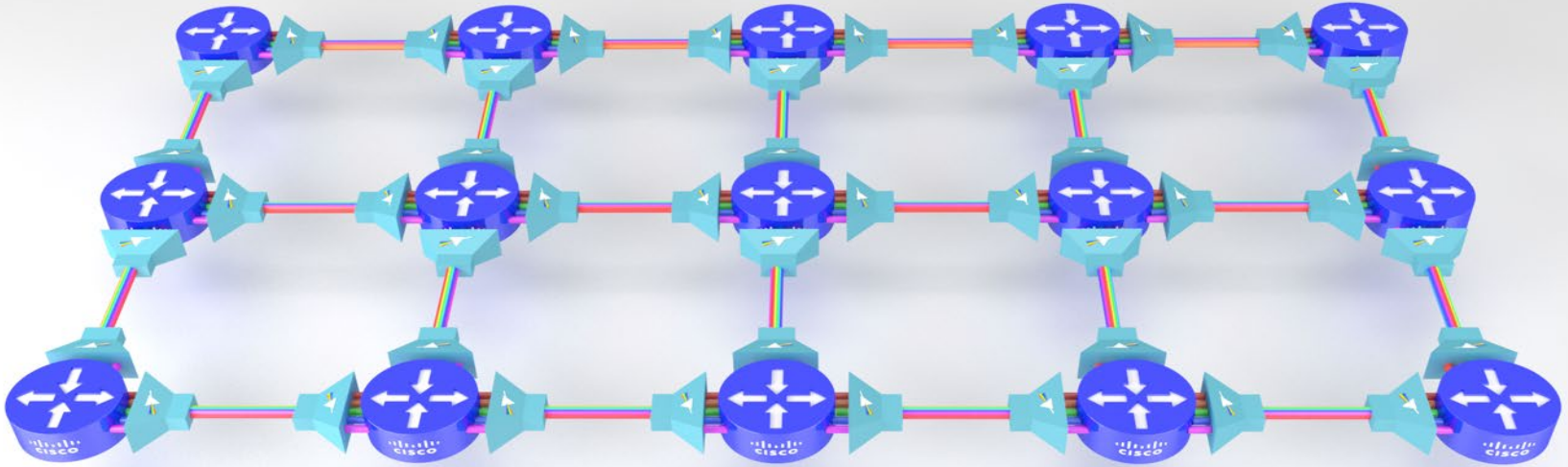
Routed Optical Network



Instead of building this...

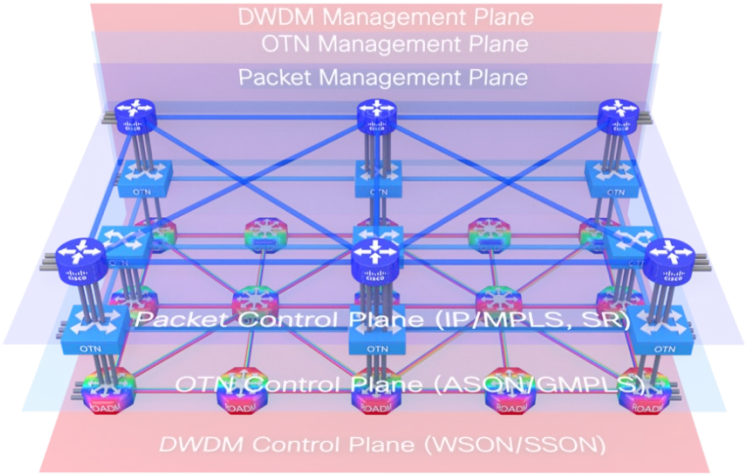


.. we can simplify the design by building a converged hop-by-hop IP+Optical network architecture - IPoEoF



Simplified Architecture delivering up to 45% TCO Savings

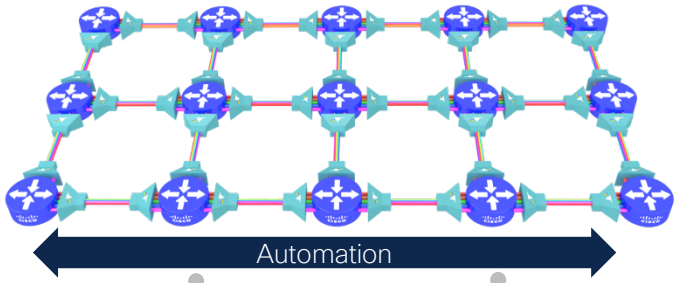
Today's Network
Layered Architecture



Tomorrow's Network
Flat Hop-by-Hop Architecture

Lower TCO with highest fiber utilization

Fewer platforms: easier to manage, more secure



Reducing space and power requirements

Intermediate success: alien wavelength support

OpEx Savings – Simplify & Automate
CapEx Savings – Spend on a Single Converged Network Layer

IP and Optical Networks Evolution
Converged SDN Transport

High Density Routers Up to 260 Tbps

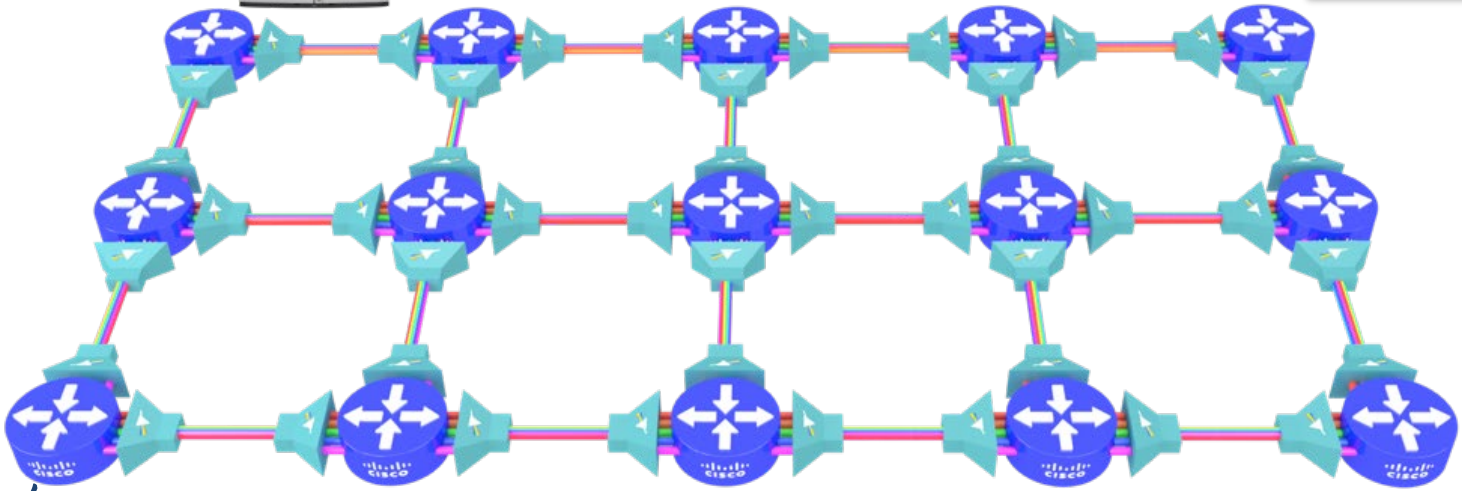
400GE ZR/ZR+

Simple Line System Mux/ Demux/ Amplifier

Automation

Single Layer Hop-by-hop Design

- Unified Capacity Planning
- Unified Path Optimization
- Orchestration & Assurance
- Unified EMS

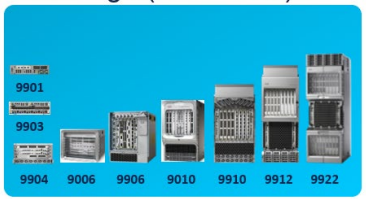


Platform implementation

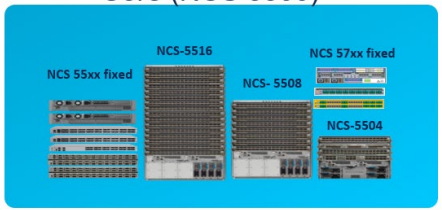
Cisco Service Provider Platform Portfolio

Access (NCS 5xx)

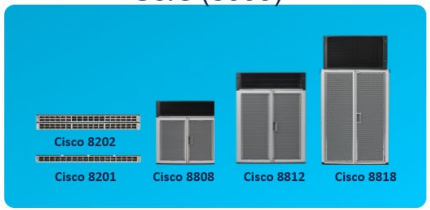
Edge (ASR 9000)



Core (NCS 5500)



Core (8000)



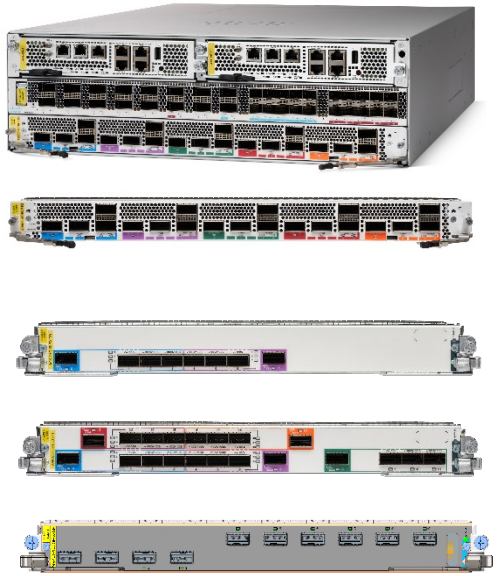
Access: NCS 540

- First 400G capable HW to FCS in 3 months (Code Name „Arches“)
- Others to follow where needed
- Access will benefit from new 100G optics as side effect of 400G ZR/ZR+

Edge: ASR 9000

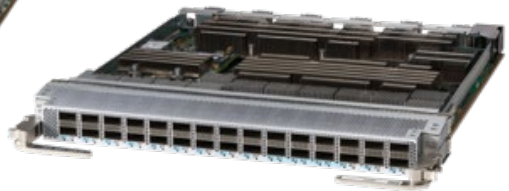
- All new HW developments with QSFP56-DD (QDD) ports do support ZR/ZR+

- ASR 9903
  - With 2T PEC: 5 x QDD-400G Ports + 15 x 100G Ports
- Modular
  - 0.8T LC with 2 x QDD-400G Ports + 6 x 100G Ports
  - 2T LC with 5 x QDD-400G Ports + 15 x 100G Ports
  - 4T LC with 10 x QDD-400G Ports



Core: NCS 5500

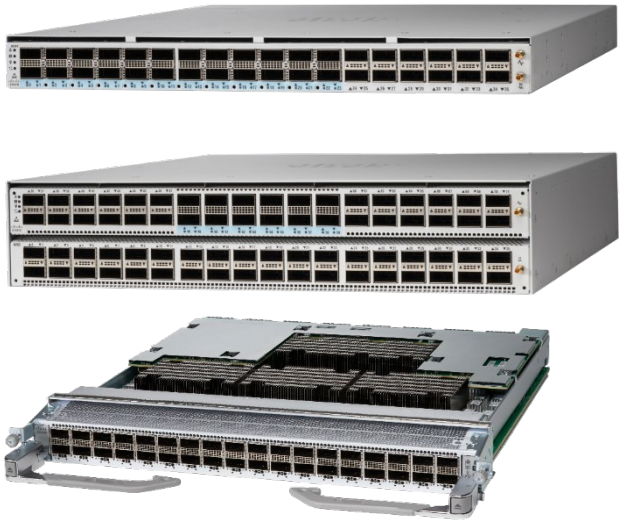
- All new HW developments with QSFP56-DD (QDD) ports do support ZR/ZR+
- Vigor-400
  - 24 x QDD-400G Ports
- Vigor-400-SE
  - 18 x QDD-400G Ports + 12 x 100/200G Ports
- Shadow Tower
  - Base: 6 x QDD-400G Ports + 24 X 100G Ports
  - Scale: 5 x QDD-400G Ports + 24 X 100G Ports



Core: Cisco 8000

- All new HW developments with QSFP56-DD (QDD) ports do support ZR/ZR+

- 8201
  - 24 x QDD-400G Ports + 12 x 100G Ports
- 8202
  - 12 x QDD-400G Ports + 60 x 100G Ports
- Modular
  - 36 x QDD-400G Ports



Summary

Summary

- 400G ZR and ZR+ are real
- This finally brings ZR reach and DWDM technology into a small size form factor for speeds >10G
- All major routing platforms support already today 400G optics including 400G-ZR and -ZR+
- The technology enables a shift in architecture beyond IPoDWDM to IPoEoF

Need for Speed !

The bridge to possible

Thank you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