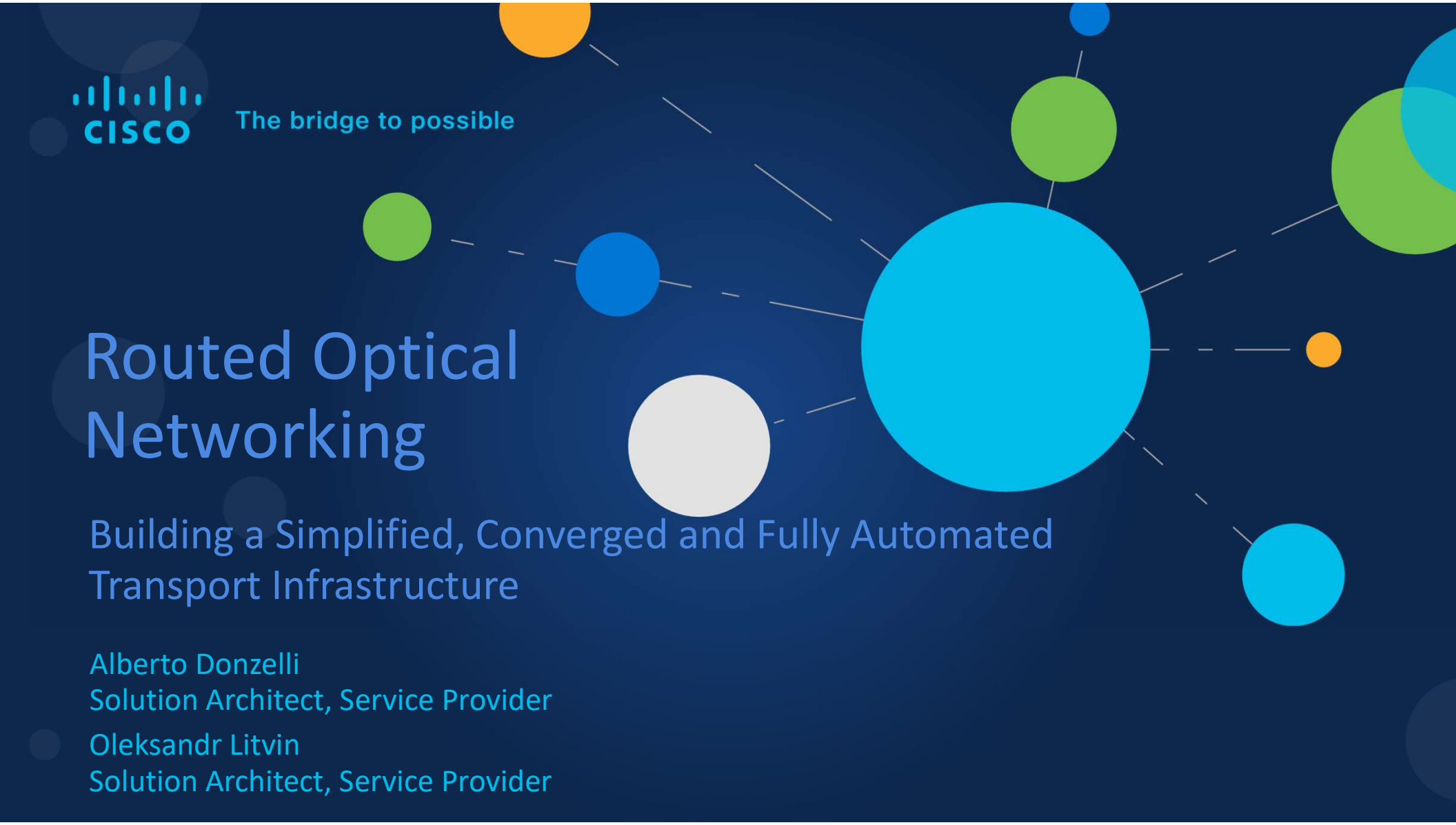


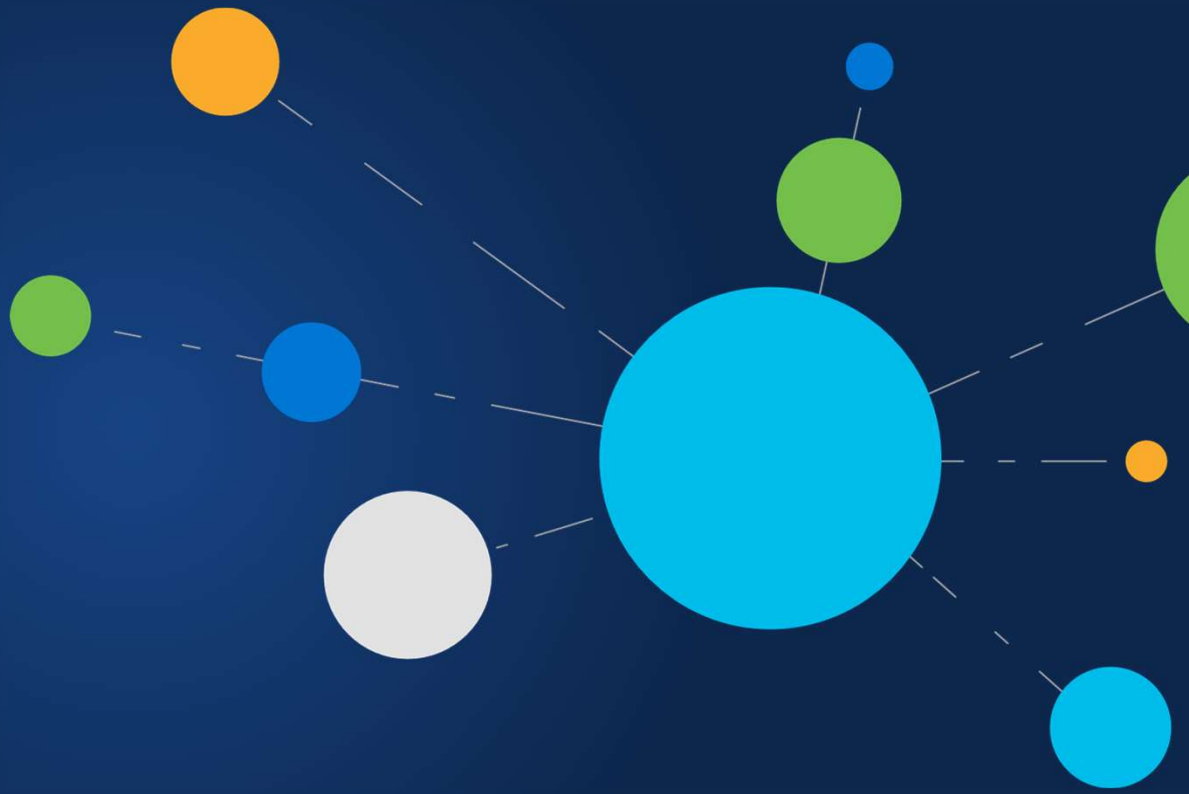
Routed Optical Networking

Building a Simplified, Converged and Fully Automated Transport Infrastructure

Alberto Donzelli
Solution Architect, Service Provider

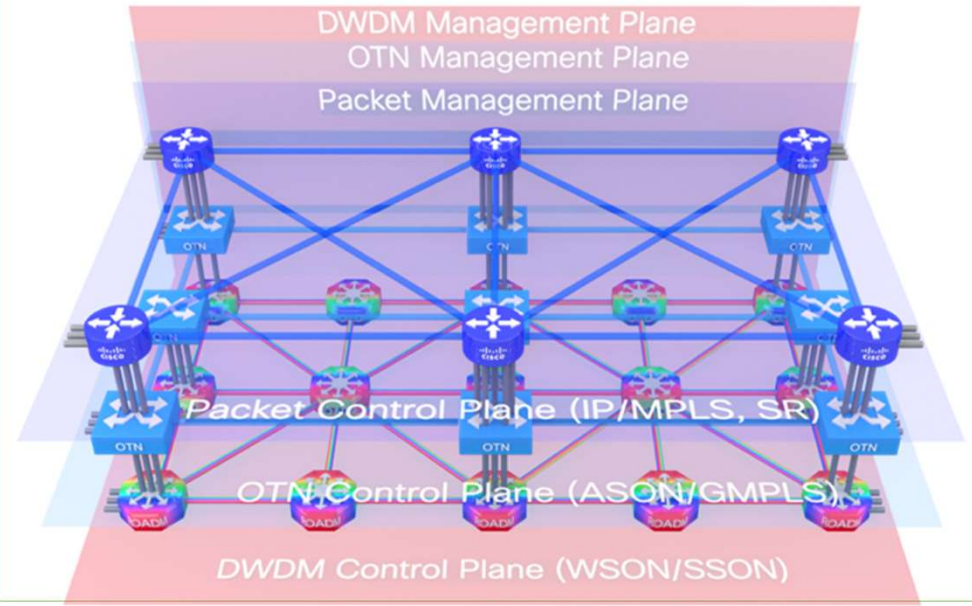
Oleksandr Litvin
Solution Architect, Service Provider

Introduction

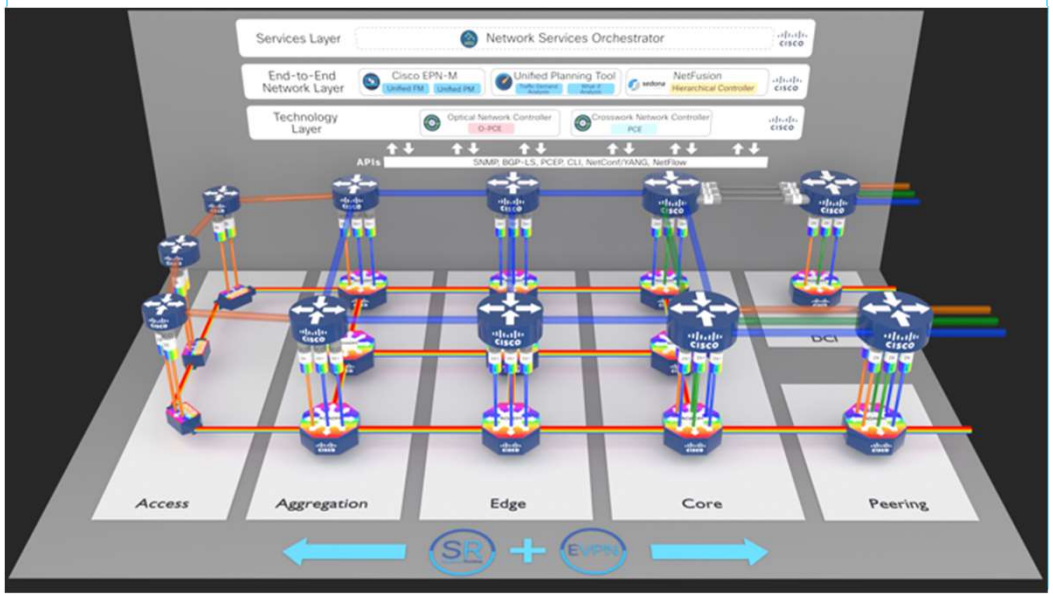


Why Routed Optical Networking?

Today's Network



Routed Optical Network



Routed Optical Networking

IP and Optical Convergence

Sustainable Architecture

OPTICS

High speed pluggable

Small footprint Silicon photonics + CMOS wafer

Low cost

Low power

Standard and interoperable

SILICON

2\Tb in a single chip

Extremely Low power

No compromise on functionalities

3 times more efficient than any other existing chipset

SOFTWARE

IP and Optical

Segment Routing

Openconfig

Telemetry

Packet and circuit transport services

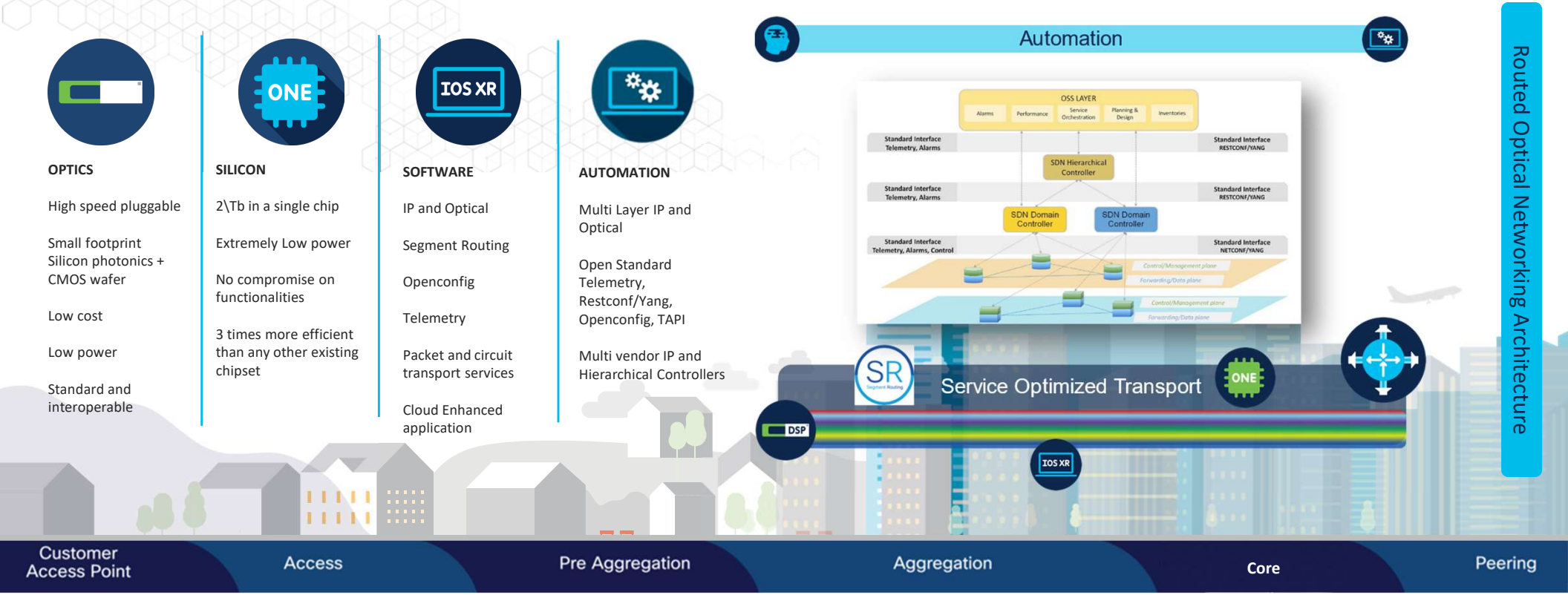
Cloud Enhanced application

AUTOMATION

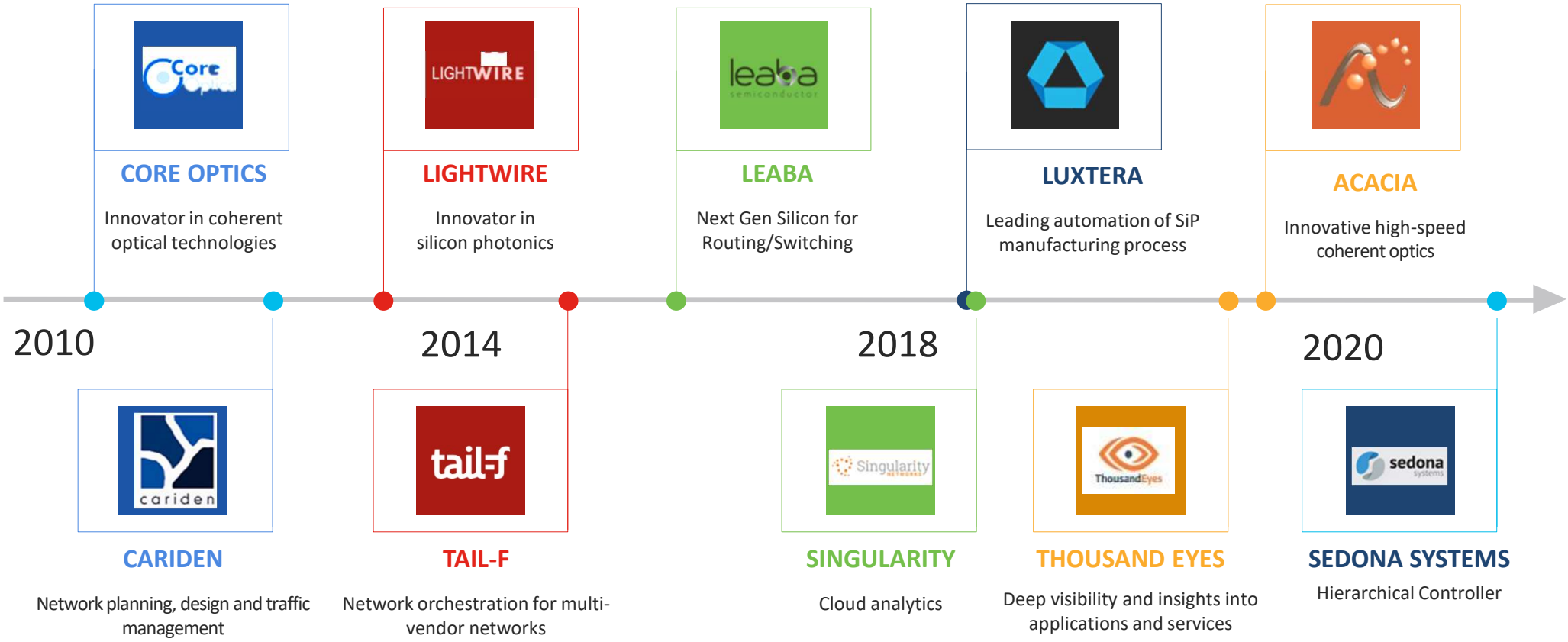
Multi Layer IP and Optical

Open Standard Telemetry, Restconf/Yang, Openconfig, TAPI

Multi vendor IP and Hierarchical Controllers



We Got Here With Over $6 Billion of Investments



Why now

Why now: the checklist
What's different from the old IPoDWDM?

- **No compromise in density** and overall router capacity
- **Universal port** for grey/colored: no dedicated linecard
- It is **standard** and interoperable: framing, FEC, modulation
- Can be **fully automated** with standard/open interfaces
  - It is **standard** it the way it is automated and managed: via Openconfig, Streaming Telemetry, TAPI for multivendor Hierarchical Controller integration
- It is providing a huge saving in TCO, and around **70% cut in power for high *sustainability***

Standardization and OpenZR+ MSA

OIF 400ZR

Edge DCI

Client: *400GE* → Line: *400ZR*

Simplified functionality

Edge optimized FEC (C-FEC)

OpenROADM

SP Metro, Regional, LH

100G
200G
300G
400G
Ethernet
OTN
FlexO

Client → Line: *100G* *200G* *300G* *400G* *OpenROADM*

Flexible Client Mapping +

High Performance FEC (oFEC)

OpenZR+ MULTI-SOURCE AGREEMENT

OpenZR+

Metro and Regional

100GE
200GE
400GE

Client → Line: *100G* *200G* *300G* *400G*

Simplified functionality +

High performance FEC (oFEC)

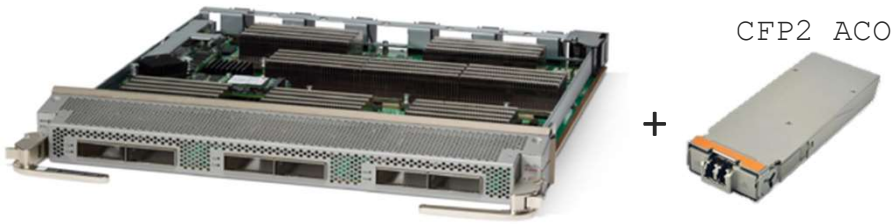
Open ROADM

Combines two standardization efforts to enable high performance pluggable modules that provide multi-vendor interoperability.

8

From integrated IPoDWDM to… pluggable IPoDWDM

IPoDWDM Card (DSP on-board)



- **Dedicated Ports**: DSP on-board
  - All 6 ports dedicated to DWDM
- 100G/200G CFP2 based
  - Analog pluggable (ACO)
- **33.3% Throughput (DWDM dedicated only)**

Universal Linecard

- **Universal Ports**: DSP on pluggable
  - Any port can be grey, DWDM and supports 400GE, 2x100GE, 100G
- 400G QSFP-DD based
  - Digital pluggable (DCO)
- **100% Throughput (as combination of grey and DWDM)**

Shipped more than 60k 400G ZR/ZR+ units
Support over the entire Cisco Routing and DC portfolio

Cisco 8000

ASR 9000

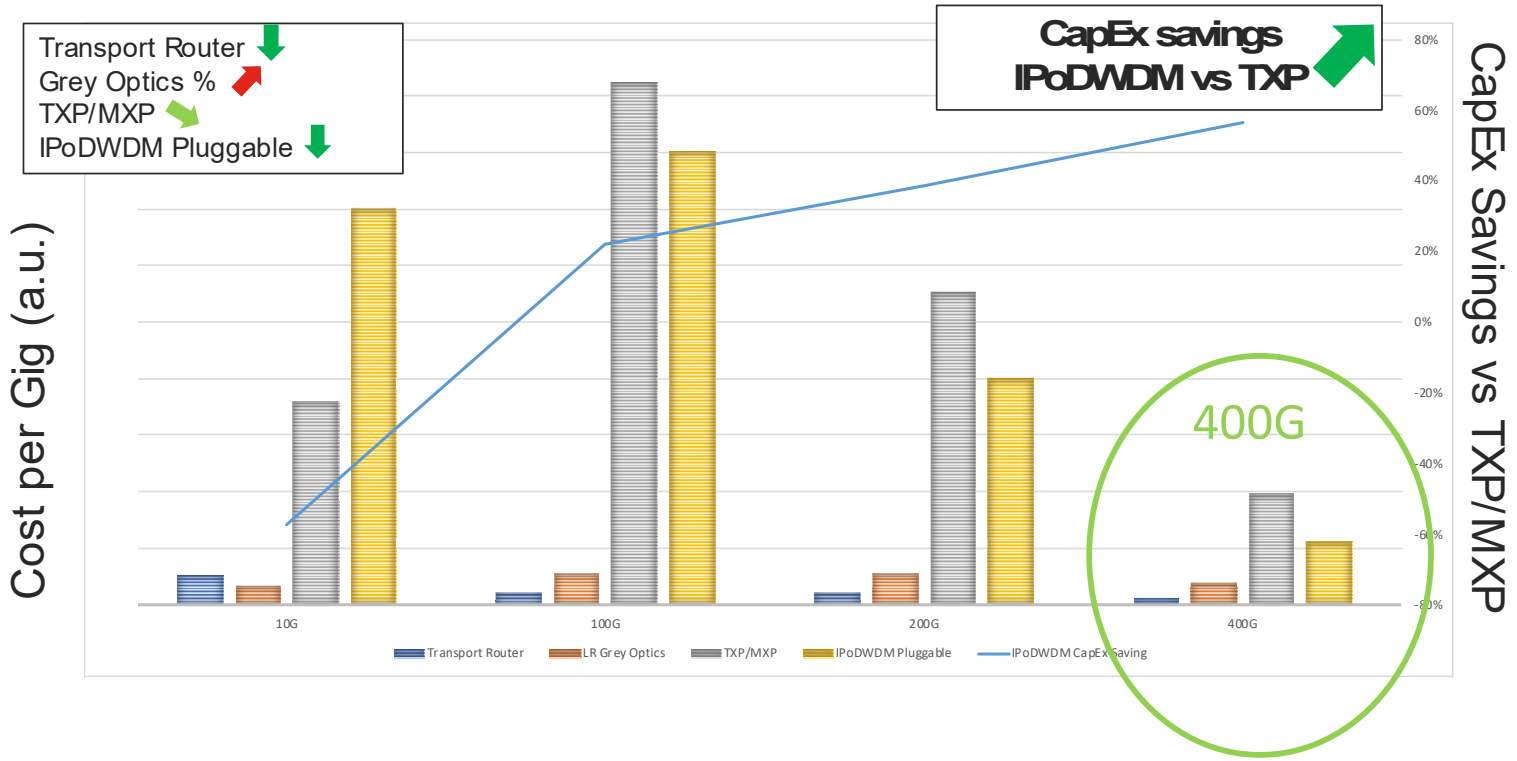
NCS 5700

ACACIA COMMUNICATIONS, INC.
now part of Cisco

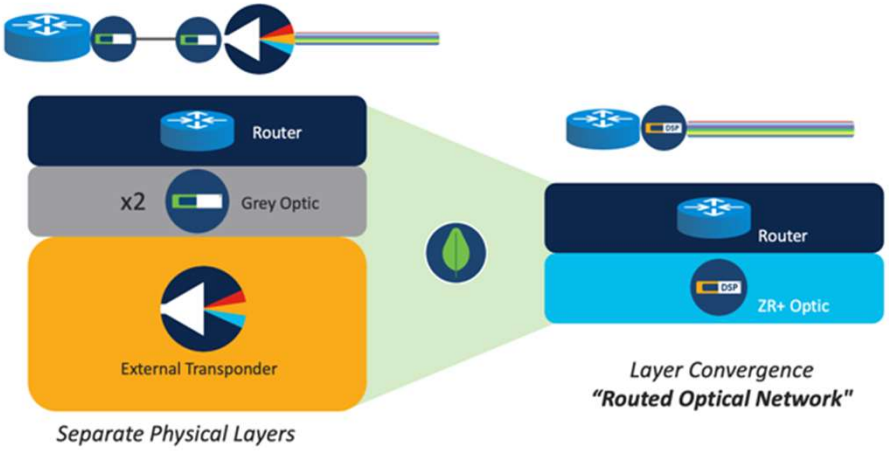
Main OEM supplier in the ZR/ZR+ market

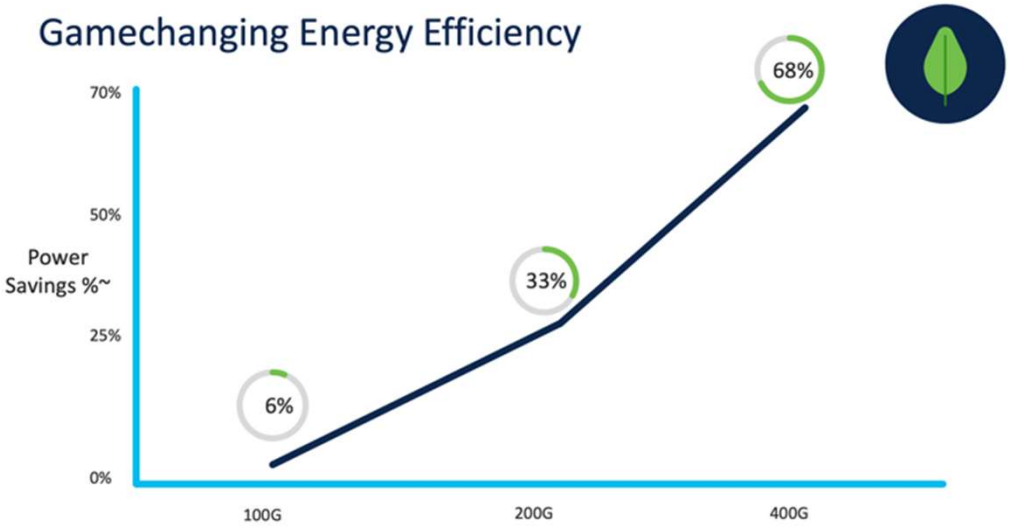
Why RON is so compelling

Pluggable vs. External Transponder
up to 50% Capex Savings



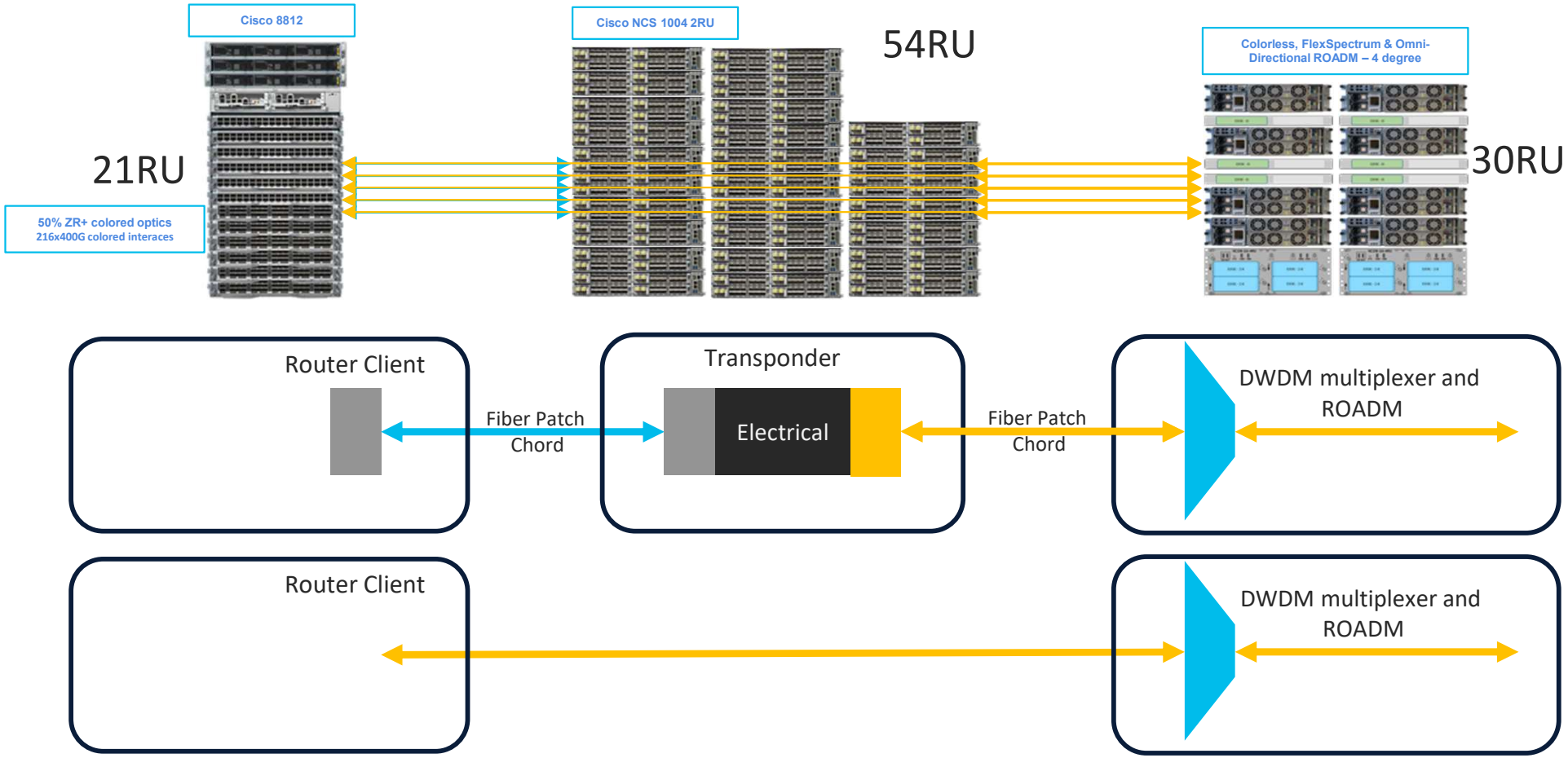
Pluggable vs. External Transponder
Power (space) Savings



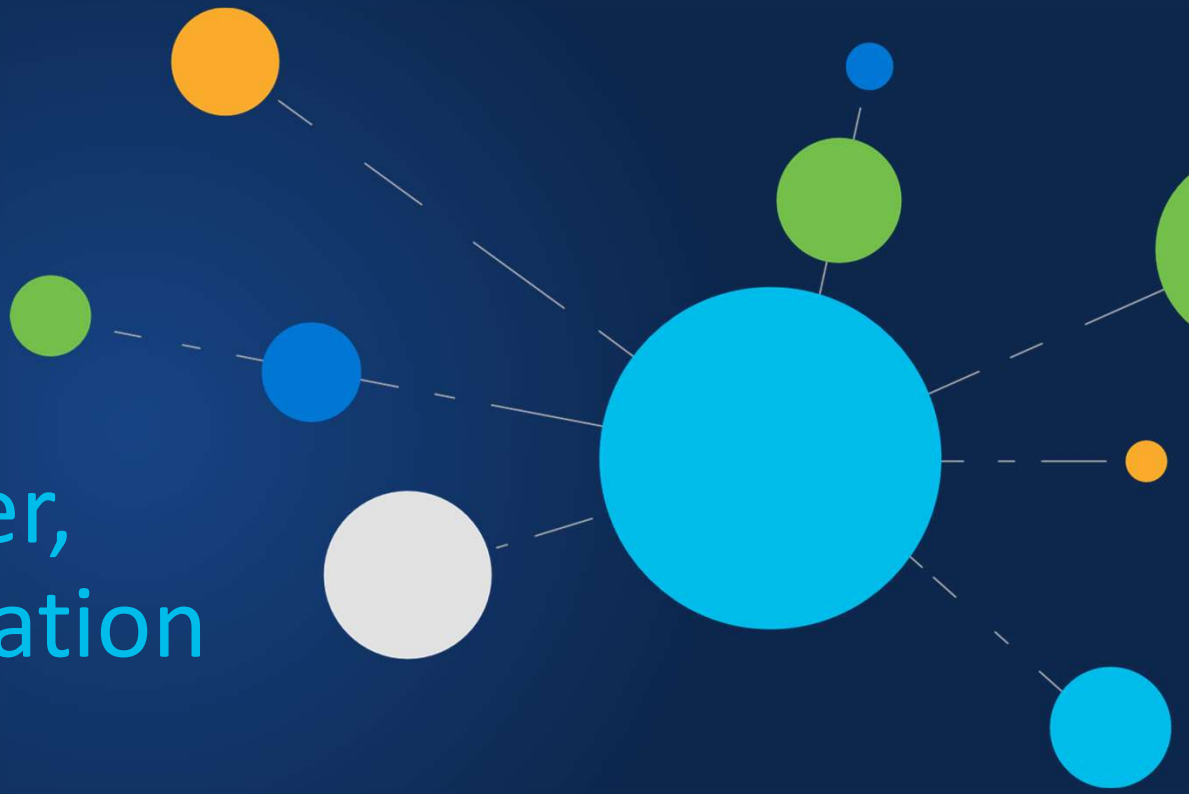


* Power comparison between *Router + Transponder* and *Router IPoDWDM*

Getting rid of transponders and transponder chassis



Integrated multi-layer, multi-vendor automation



Using our customers needs as design reference

- Optical SDN Controller typically per-vendor
- IP SDN controller can be multi-vendor
- HCO has complete visibility into the network and run multi-layer analytics
- Not all calls needs to pass via HCO

Please join the conversation!

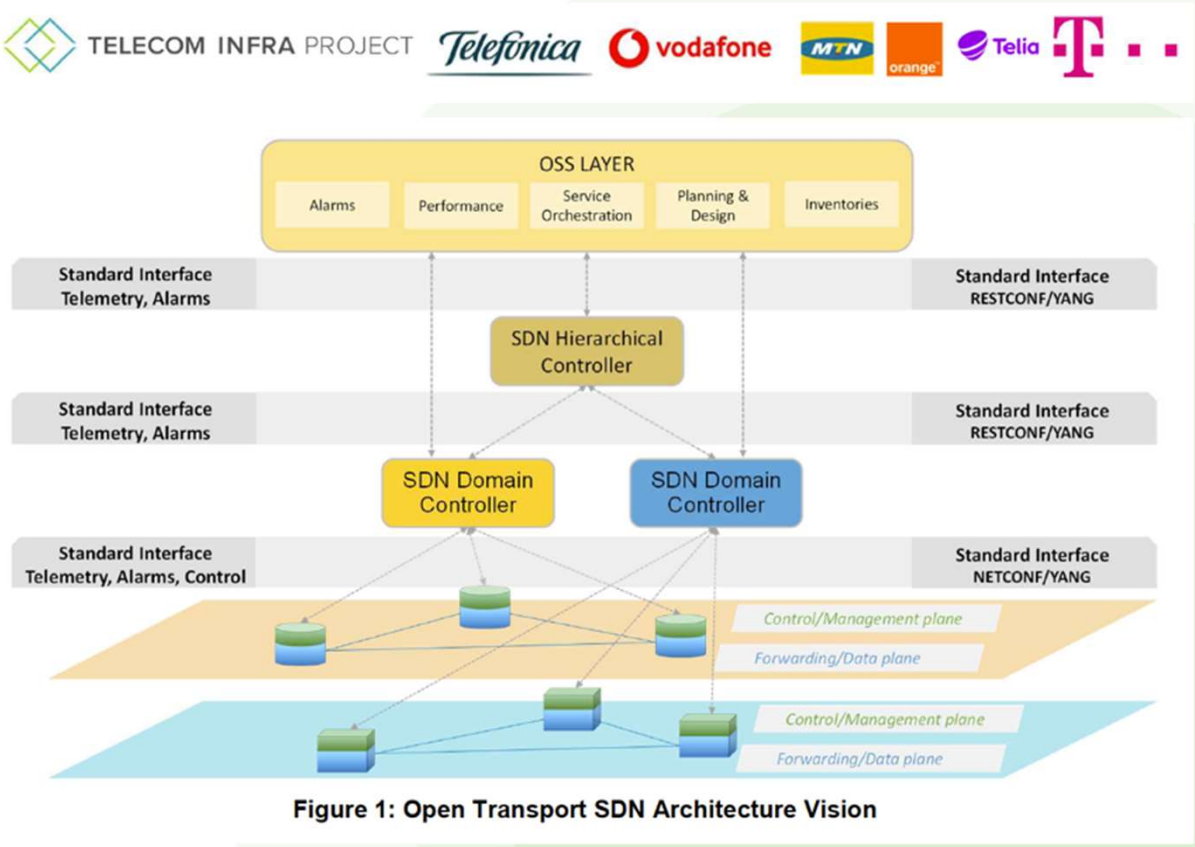


Figure 1: Open Transport SDN Architecture Vision

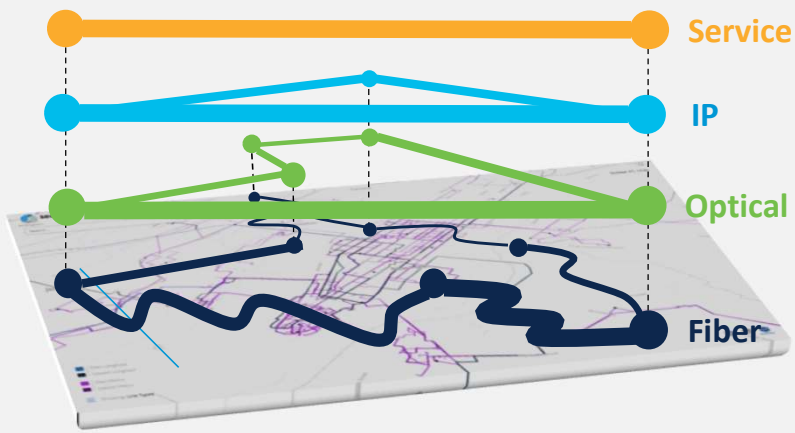
Crosswork Hierarchical Controller

Service-to-fiber visibility

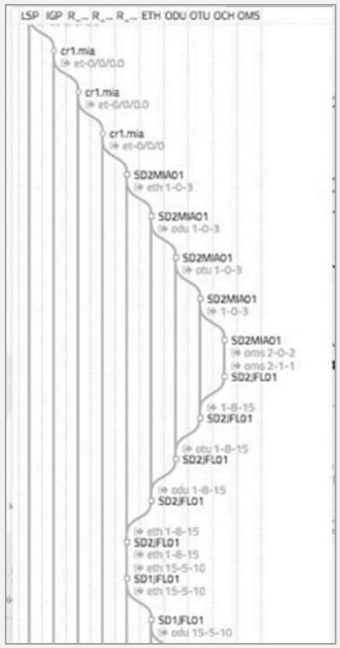
sedona systems

Sedona Systems is now part of Cisco.

The Crosswork Hierarchical Controller Network Model – from service to fiber



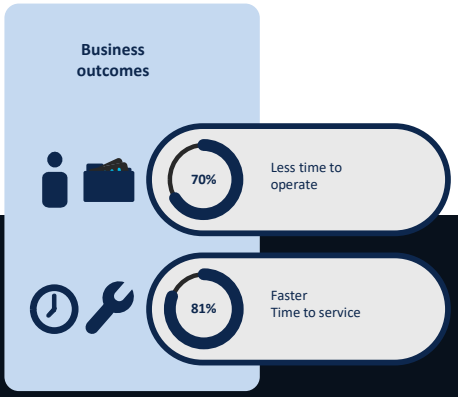
Layered service view in Crosswork Hierarchical Controller UI



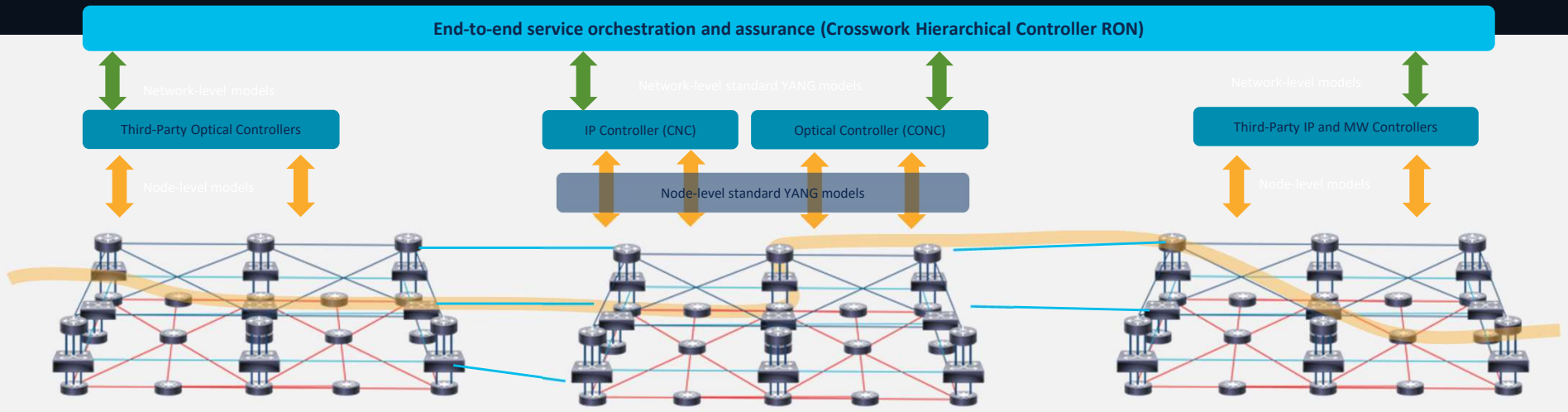
Visualization of a protected private line service – zoom-out and zoom-in views

Crosswork Network Automation

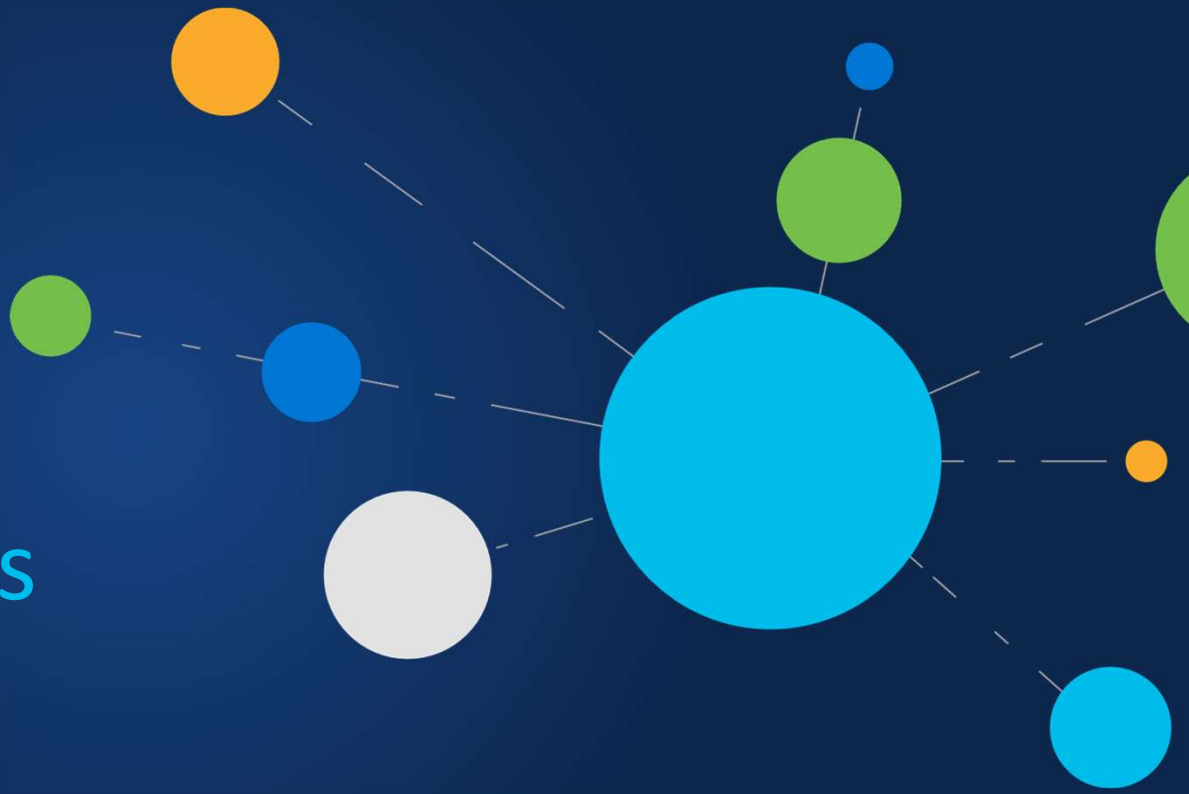
Your Technology choice in a single multi-layer topology



- Deployment scenarios:
  - RON is deployed in part of the network (e.g., core) but other parts stay as they are
  - RON routers are deployed over legacy WDM systems
- Role of Crosswork Hierarchical Controller RON: control and assure the entire network in a unified and easy manner

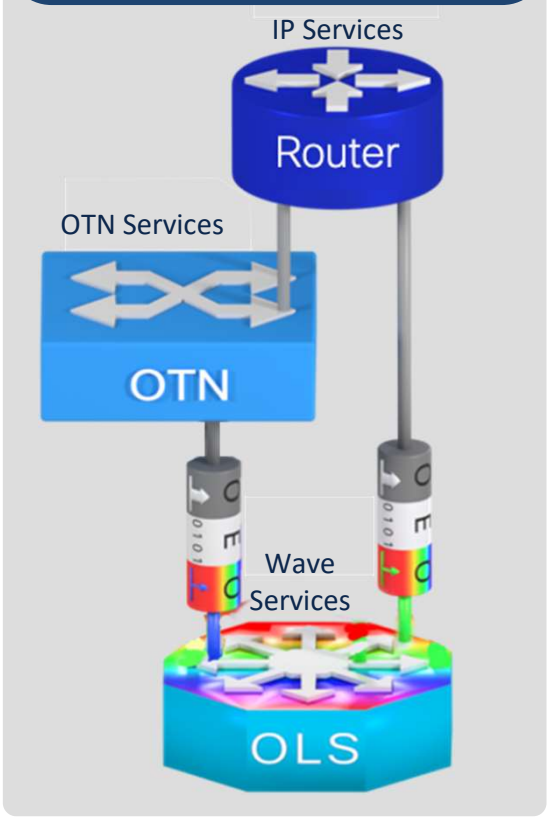


Architectural Options

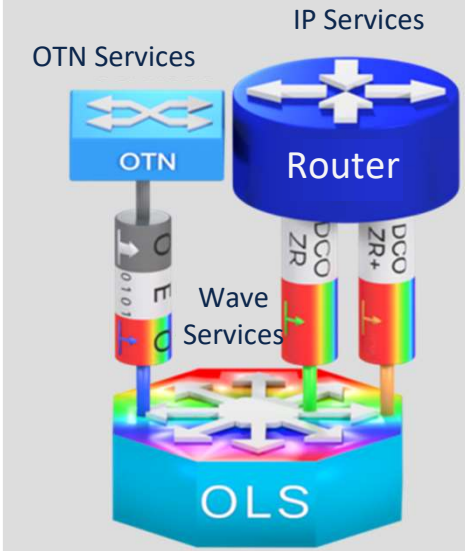


Architectural Options

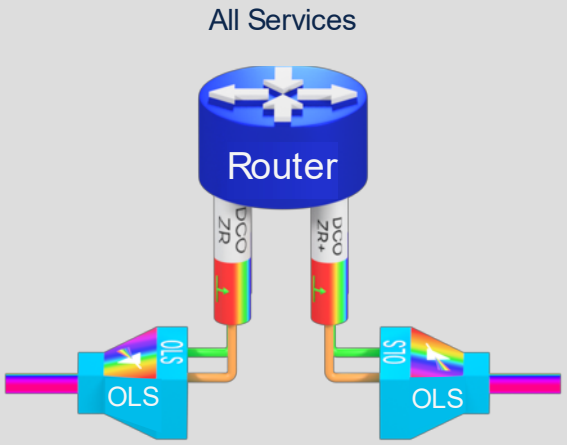
Legacy

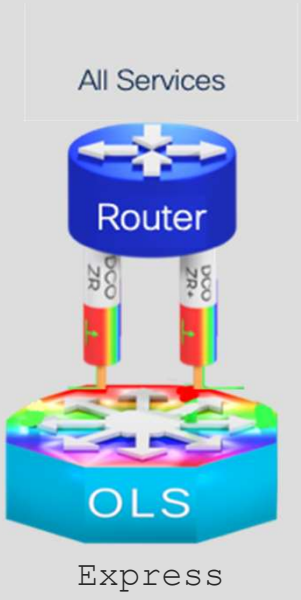


Brownfield



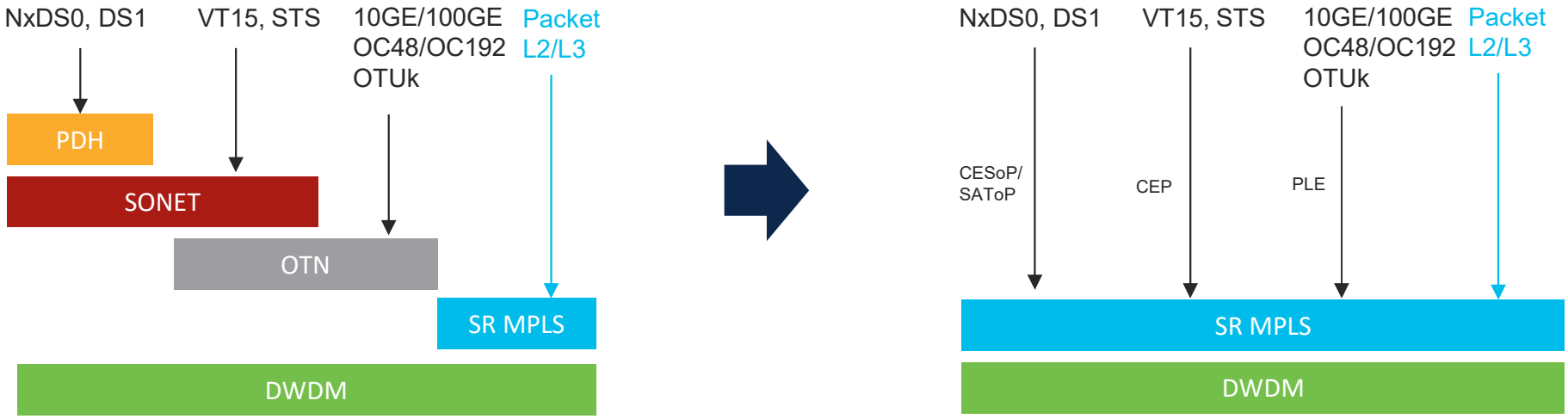
Optimized



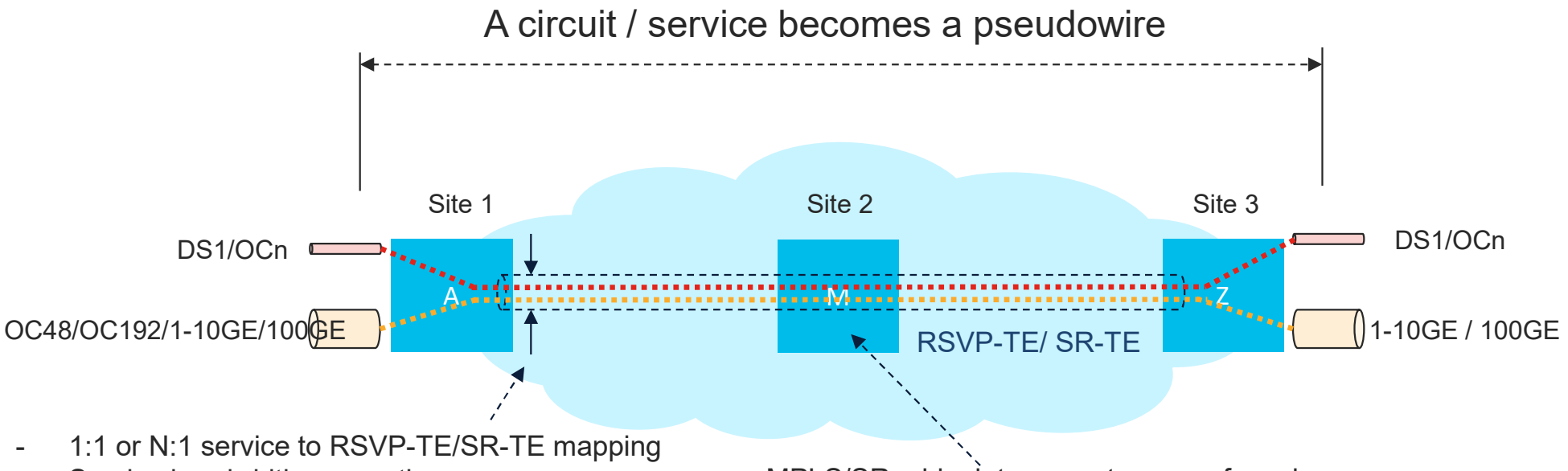


Service convergence option: Private Line Emulation

Transformation through unified MPLS Switching Layer



Providing a point2point pipe using packet transport



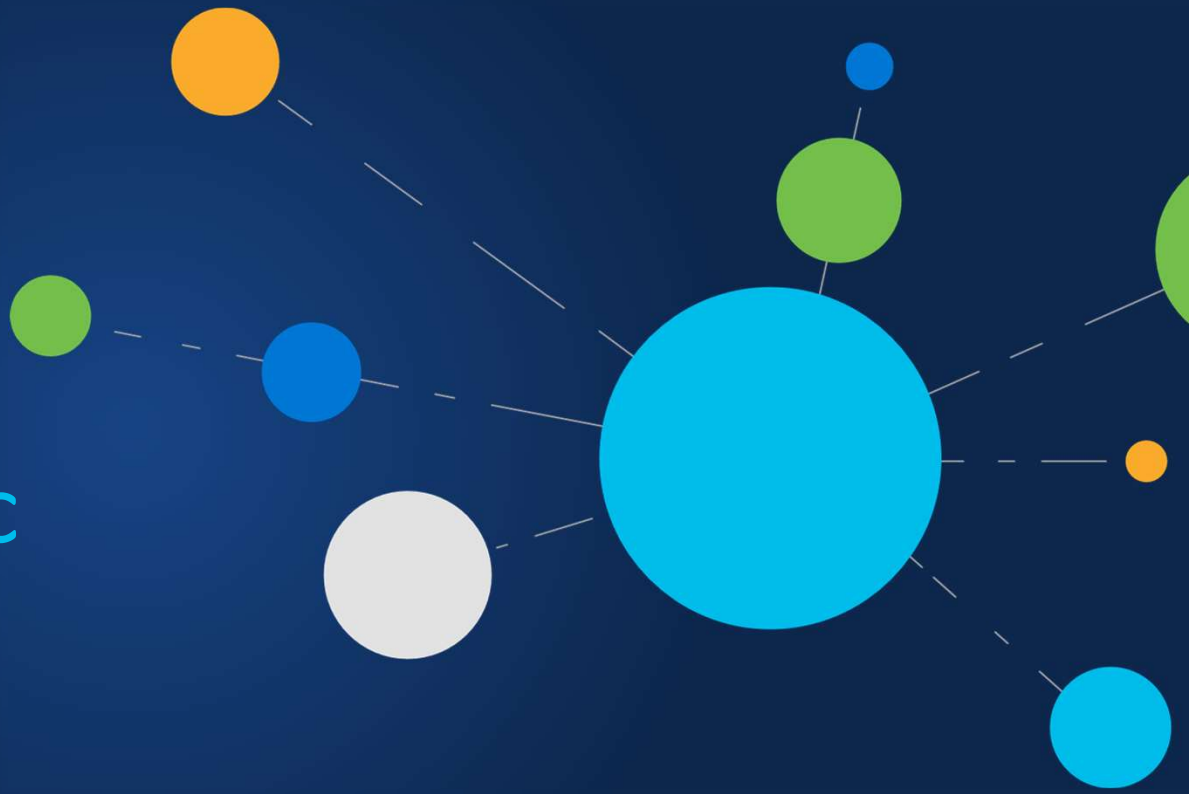
- 1:1 or N:1 service to RSVP-TE/SR-TE mapping
- Service bandwidth accounting

- MPLS/SR midpoints are not aware of services
- all they know how forward RSVP-TE/SR-TE traffic

SAToP/CEP pseudowire

Private Line Emulation pseudowire

Use Cases and Public References

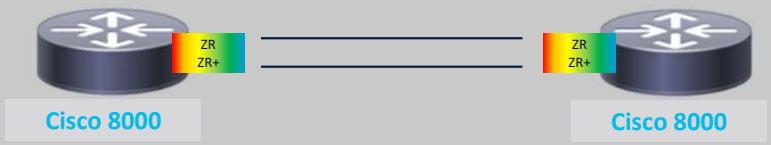


RON
Use Cases

Different Use Cases and Deployment Models

01 QDD-ZR/ZRP P2P over 3rd party OLS

02 QDD-ZR P2P over dark fiber or passive DWDM



03 QDD-ZRP over Cisco OLS

RON
Public References

Different Use Cases and Deployment Models

01 QDD-ZR/ZRP P2P over 3rd party OLS

02 QDD-ZR P2P over dark fiber

03 QDD-ZRP over Cisco OLS

5 Press Releases around value and benefit with technology innovation and layers convergence

Arelion
Formerly Telia Carrier

colt

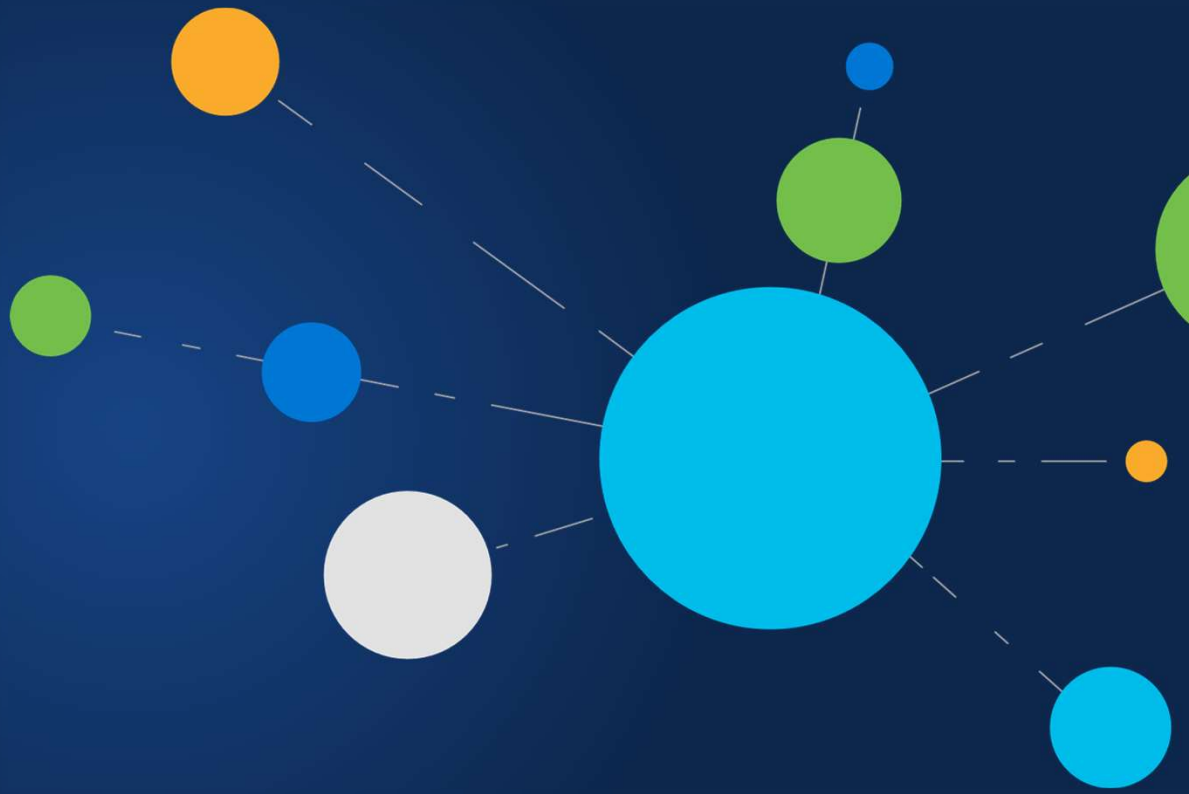
WebSprix

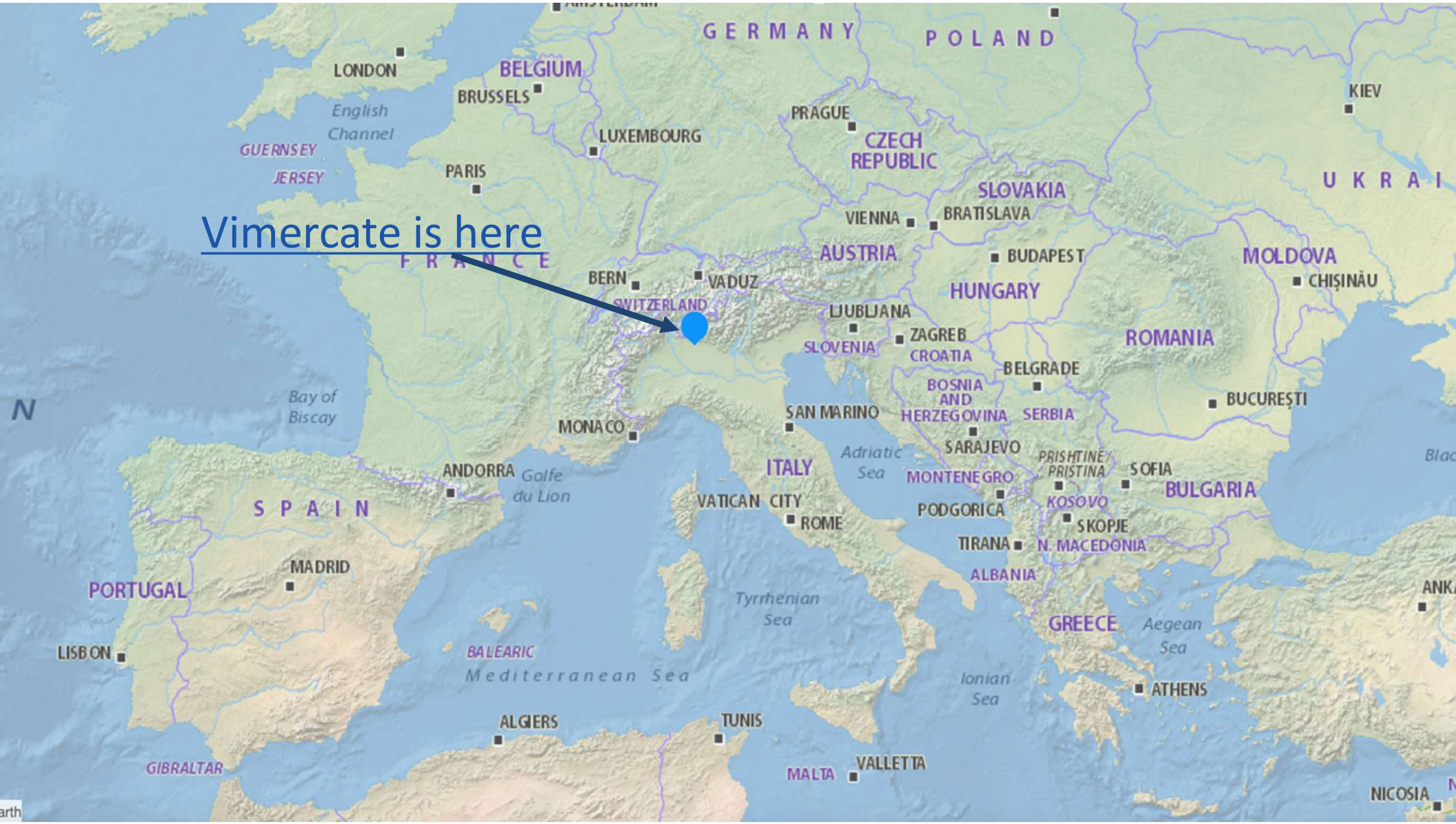
zain

DATA GROUP

Demonstration

- SP EMEAR Innovation Lab

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GERMANY
POLAND
LONDON
BELGIUM
BRUSSELS
English Channel
GUERNSEY
JERSEY
PARIS
LUXEMBOURG
PRAGUE
CZECH REPUBLIC
KIEV
SLOVAKIA
VIENNA
BRATISLAVA
AUSTRIA
BUDAPEST
MOLDOVA
CHIȘINĂU
FRANCE
BERN
VADUZ
SWITZERLAND
HUNGARY
LJUBLJANA
ZAGREB
SLOVENIA
CROATIA
ROMANIA
BELGRADE
BOSNIA AND HERZEGOVINA
SERBIA
BUCUREȘTI
Bay of Biscay
SAN MARINO
MONACO
SARAJEVO
Adriatic Sea
ITALY
PRISHTINË / PRIŠTINA
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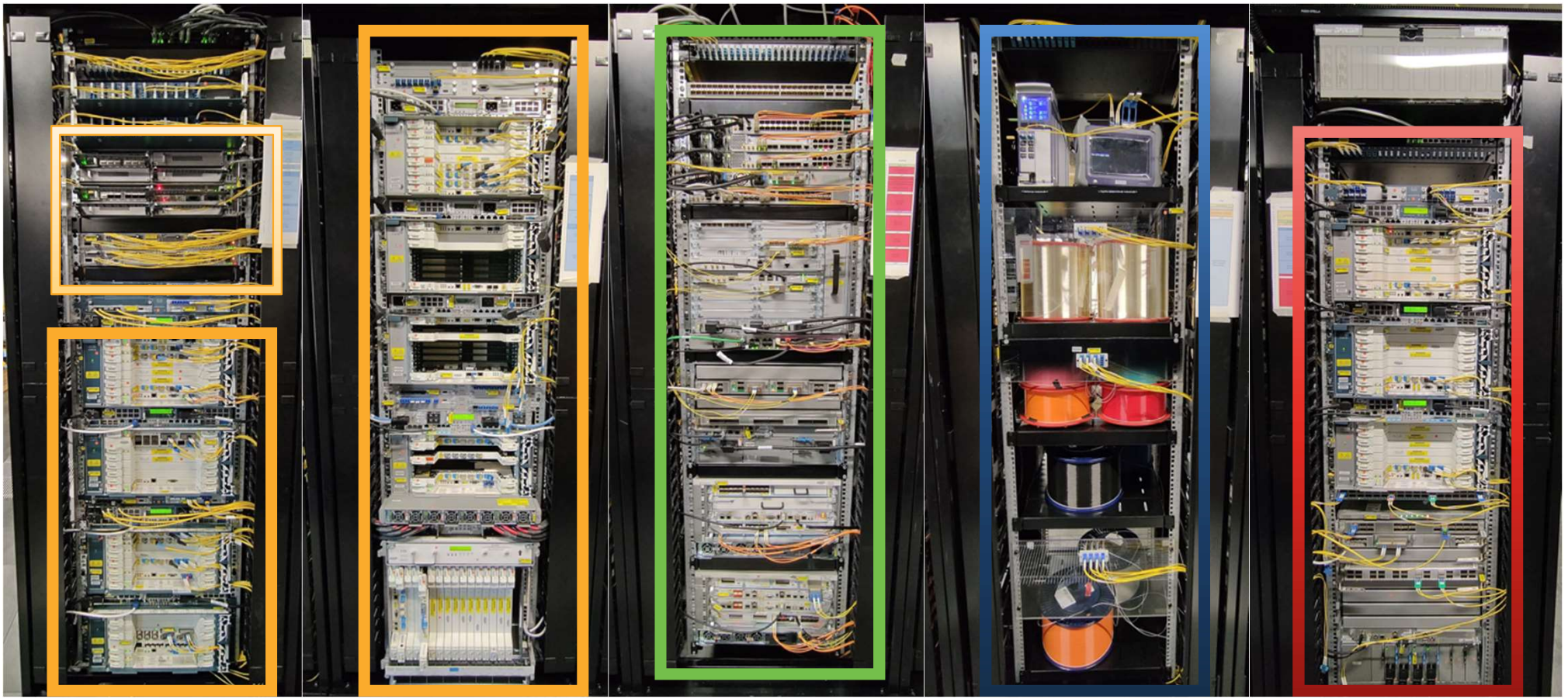
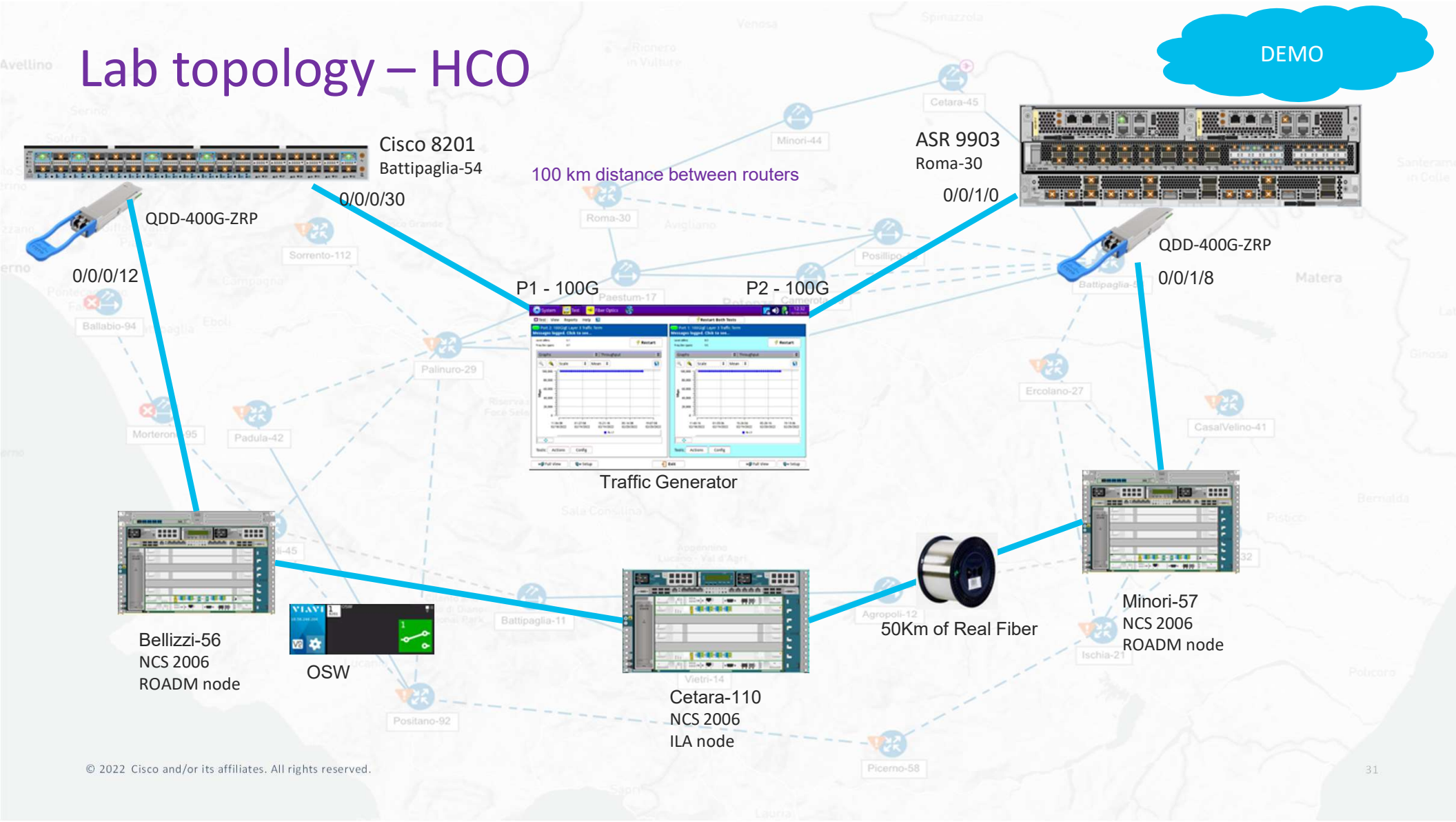
N. MACEDONIA
MADRID
ALBANIA
PORTUGAL
Tyrrhenian Sea
GREECE
Aegean Sea
LISBON
BALEARIC
Mediterranean Sea
Ionian Sea
ATHENS
ALGIERS
TUNIS
GIBRALTAR
MALTA
VALLETTA
NICOSIA


SP EMEAR Innovation
Lan is here
cisco

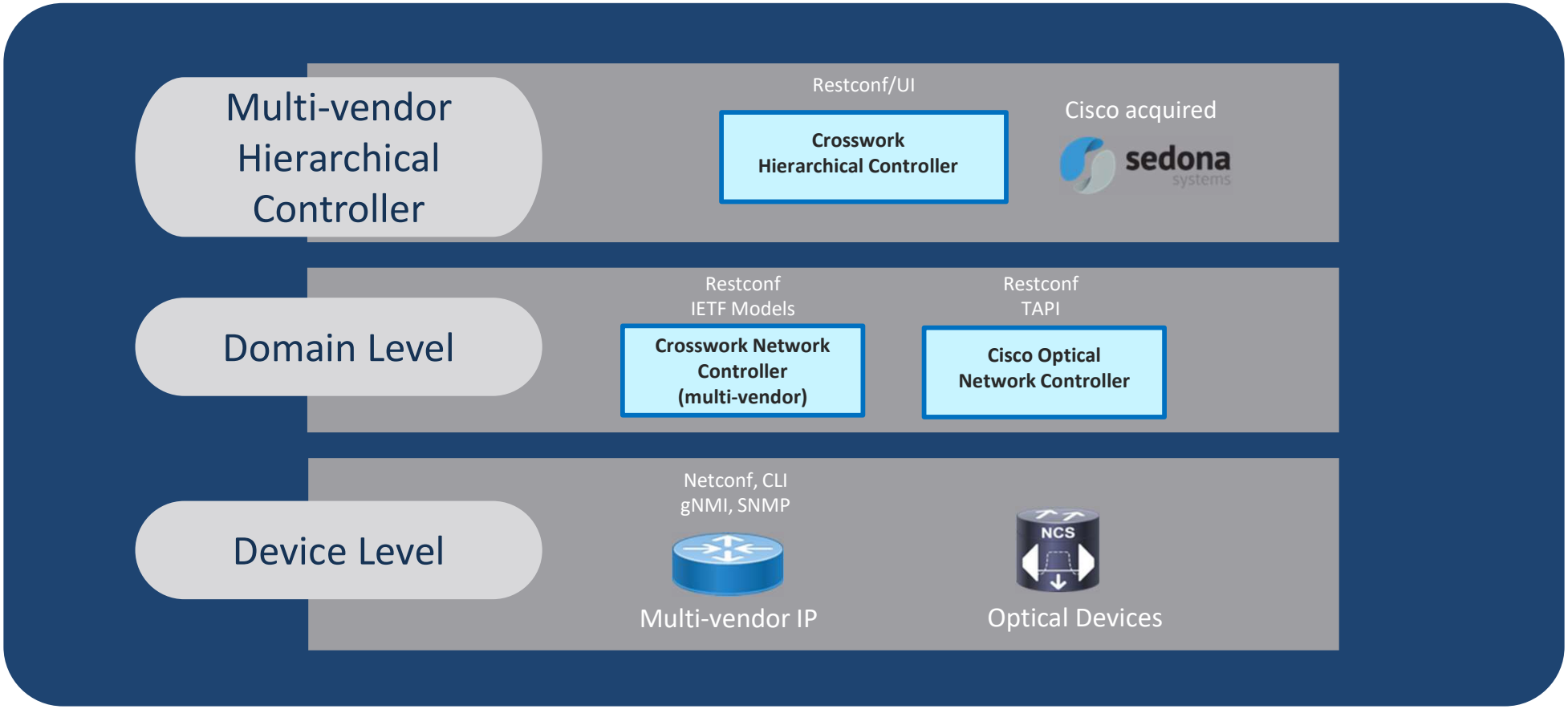
SP Routing – IPoDWDM / Routed Optical Networking LAB



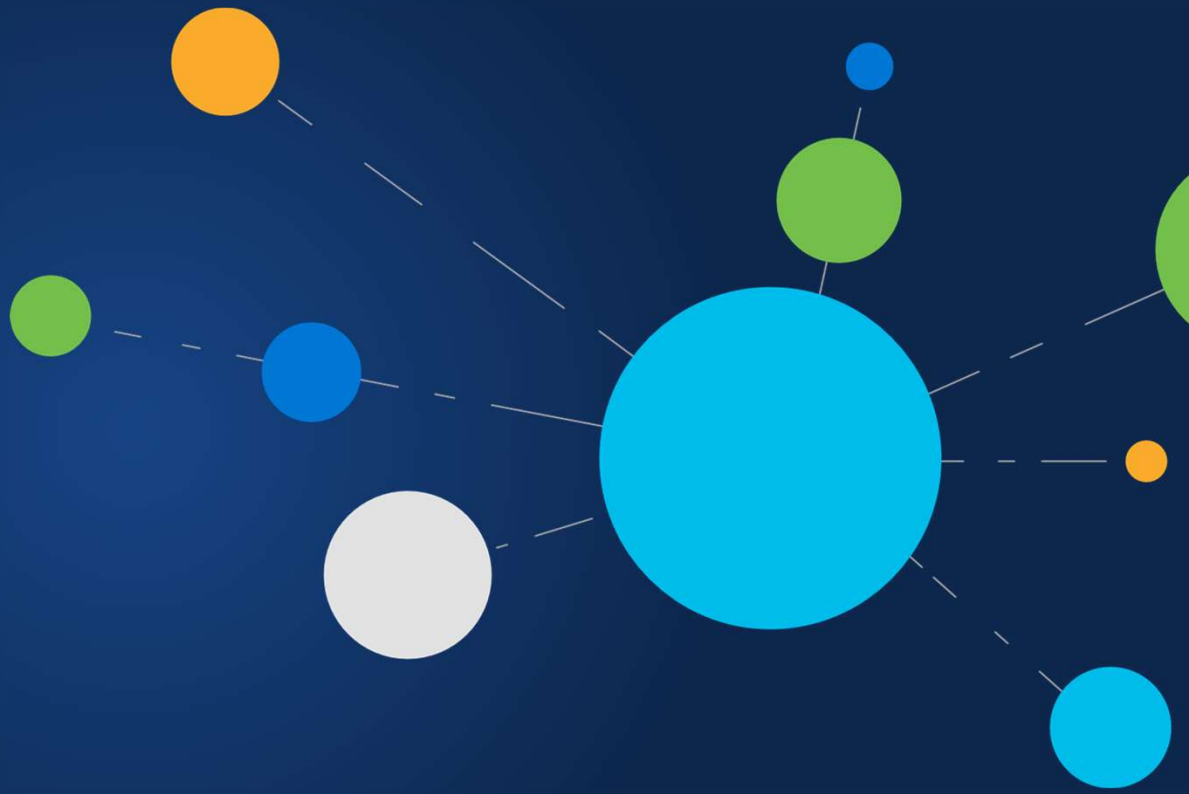
Lab topology – HCO



Cisco Open automation at each level



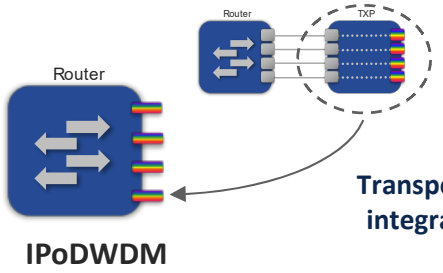
Conclusions



Animated

Routed Optical Networking

Cost Saving Factors and Benefits



CapEx Savings
Opex Savings,
including Power and Space

46% TCO reduction

THE ECONOMIC BENEFITS OF IP TRANSPORT AT 400G*

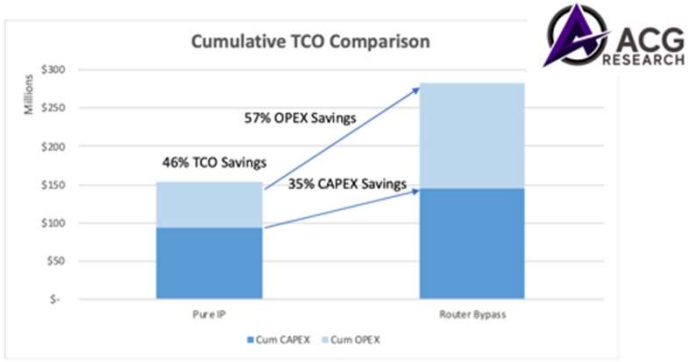
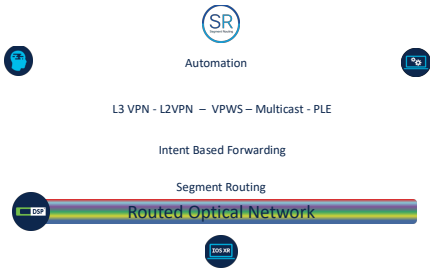


Figure 5. Five-Year TCO Comparison of IP Transport to Router Bypass

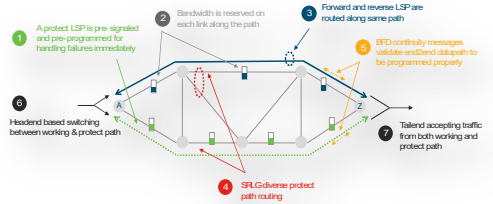
Multi- layer Automation

- Visibility
- Analytics
- e2e mgmt



Network de-layering

- Simplified IP infra for SR MPLS and SRv6
- BGP signaled VPN/EVPN
- Intent based forwarding
- Transport orientated P2P services 1+1+R



Service Convergence

IP L2 L3 and TDM/PLE

The bridge to possible