The bridge to possible

# Network Automation with Routed Optical Networking (RON) Architecture

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BRKSP-2637

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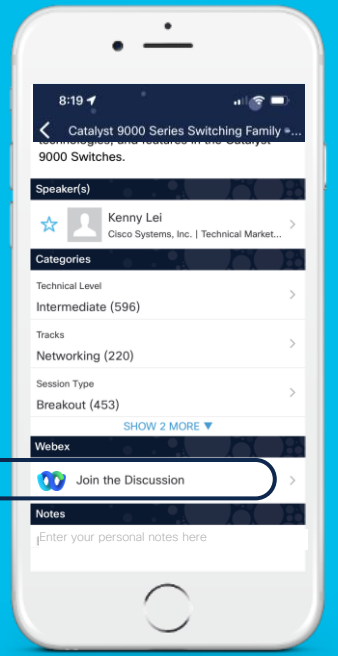


“Simplicity
is the ultimate sophistication”

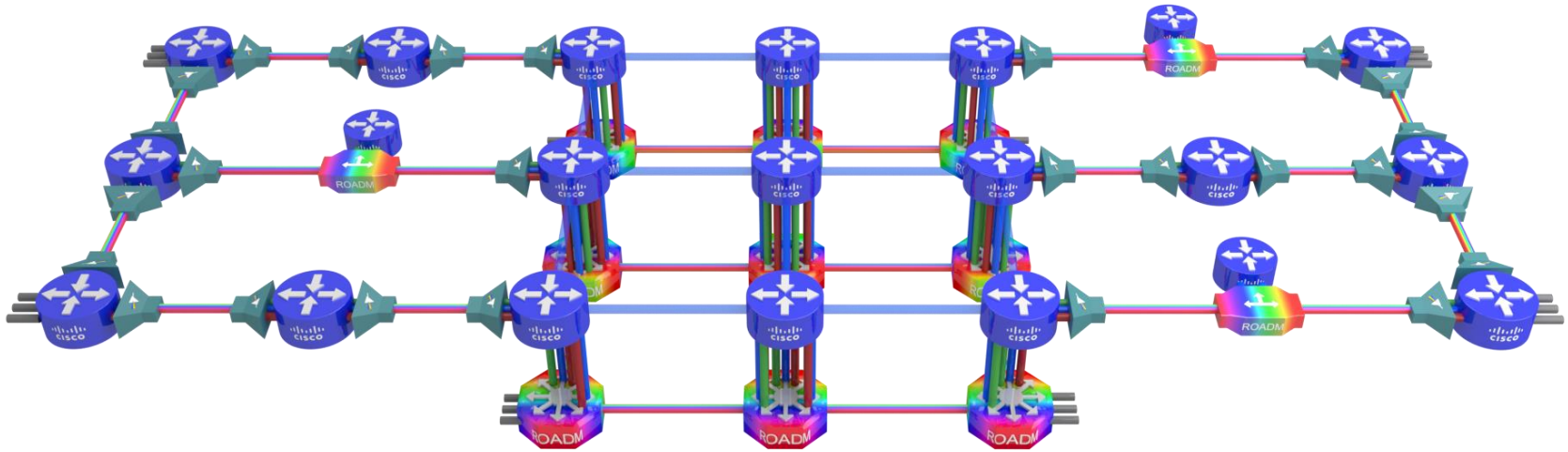
Leonardo Da Vinci

CTO of the Duke of Milan – 1482

# Agenda

- Routed Optical Networking Introduction
- Crosswork Automation Introduction
- RON Automation deep dive
- Optical Transport layer transformation
- Automation Demo
- Services layer transformation

# Routed Optical Networking introduction




Greenfield

Existing DWDM Layer with NCS 2000

Cisco optics over Ciena, Nokia, Huawei or Infinera line systems

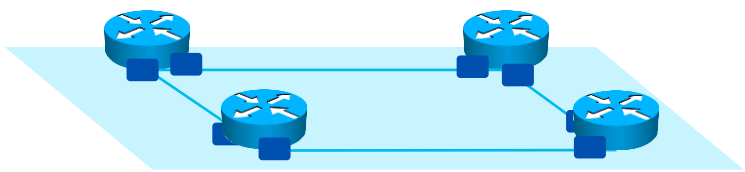
# Routed Optical Networking: Savings with Benefits

35% CapEx Savings*

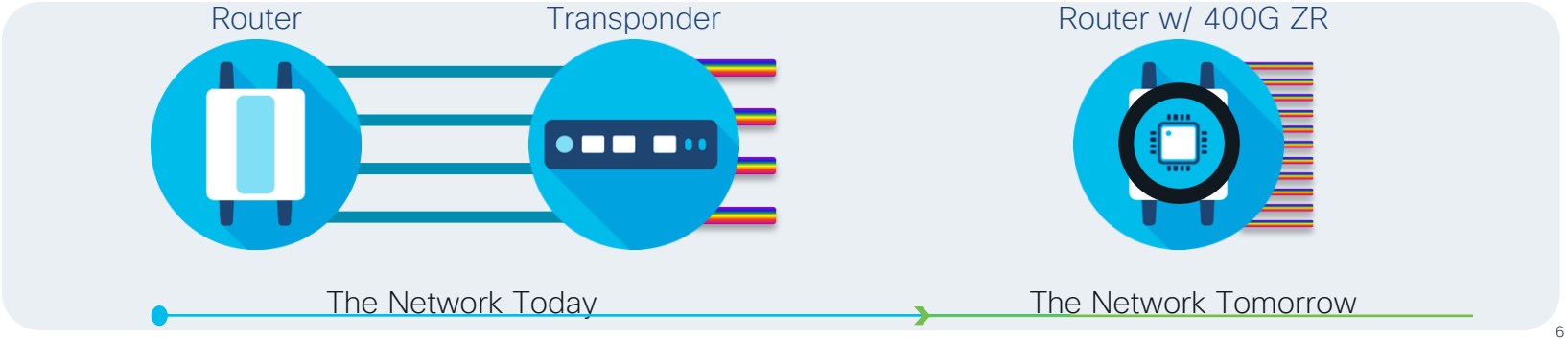
57% OpEx Savings*

45% TCO Savings*

*ACG Research, 2021

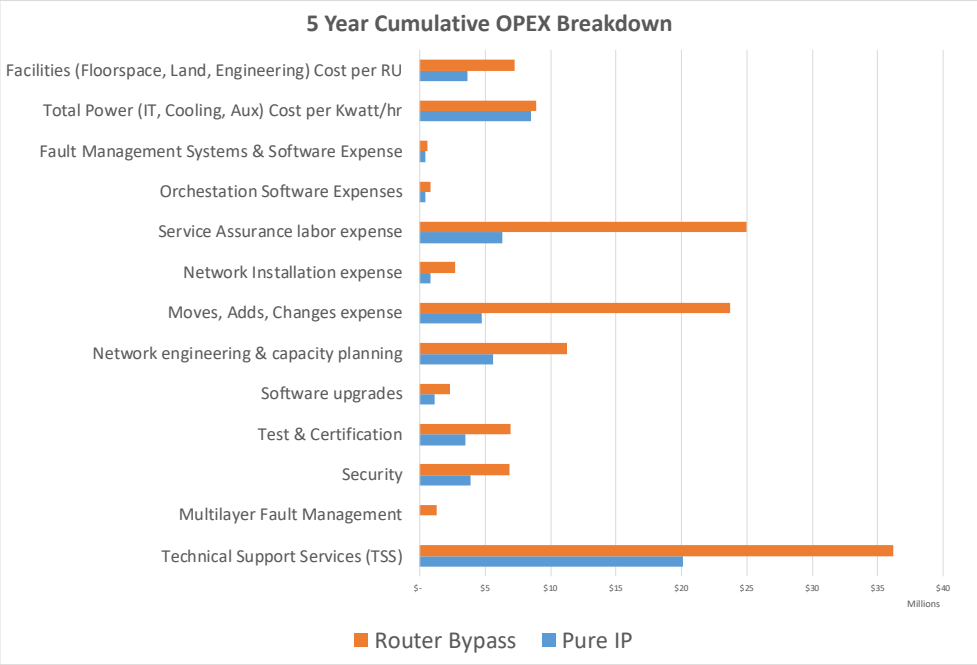


- **Agility** in capacity planning and service delivery
- **Simplicity** with Interoperability and standardization
- **Efficiency** with differentiated service delivery



# The Benefits of a Routed Optical Network

## Up to ~56% OpEx savings, 45% total TCO savings




Source: ACG Research

- Converges all services onto a single network layer
- Integrates transponders and “grey” optics
- Optimize usage of OTN Services and ROADMs
- Space, power and operational savings
- Shorter Time-to-Market for services

# Crosswork Automation

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# Automation vision

Automate processes by bringing together visibility, insights and actions in a closed loop

**Visibility**

Verify and monitor customer experience

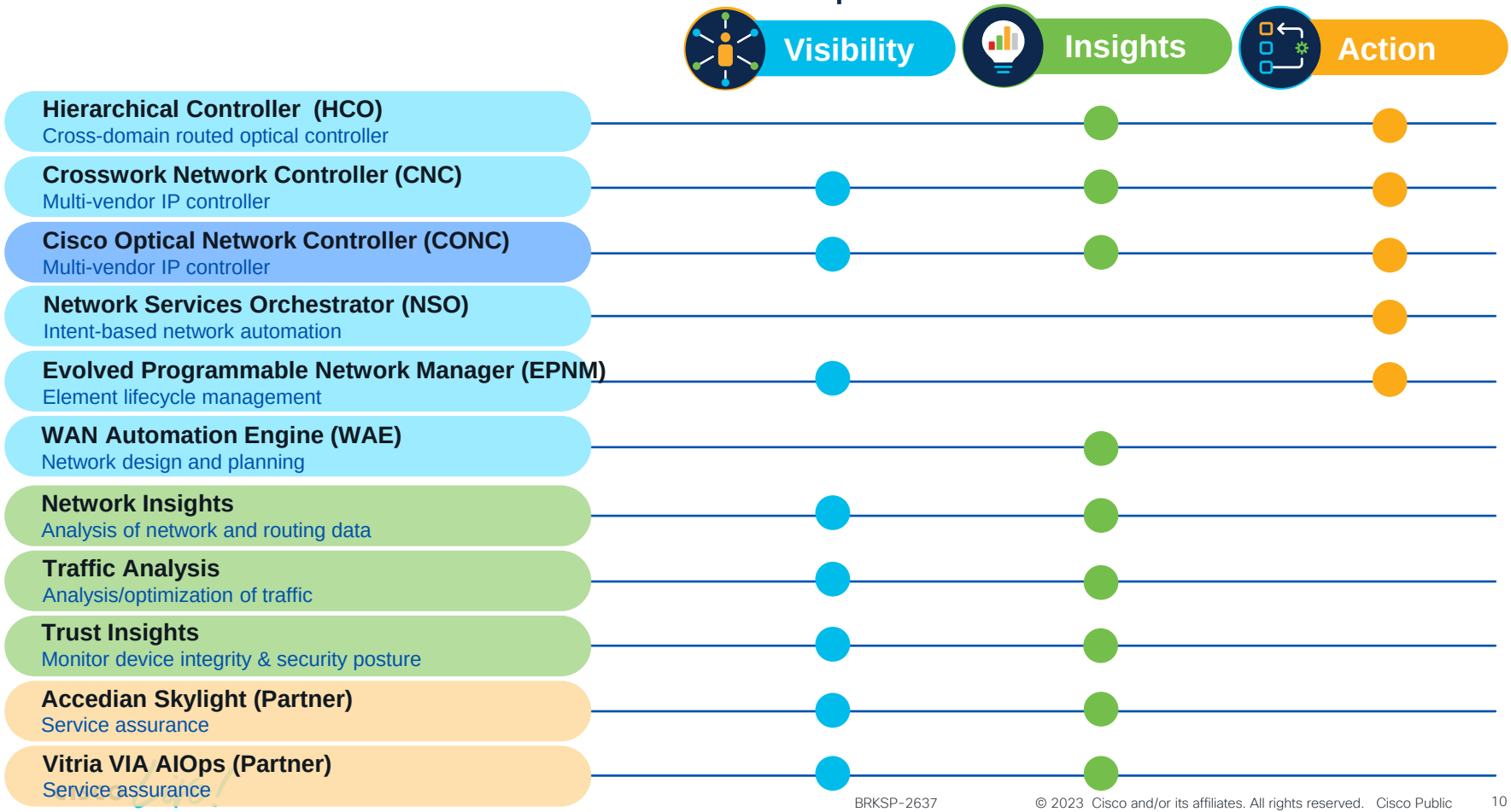
**Insights**

Correlate data, identify trends and patterns

**Action**

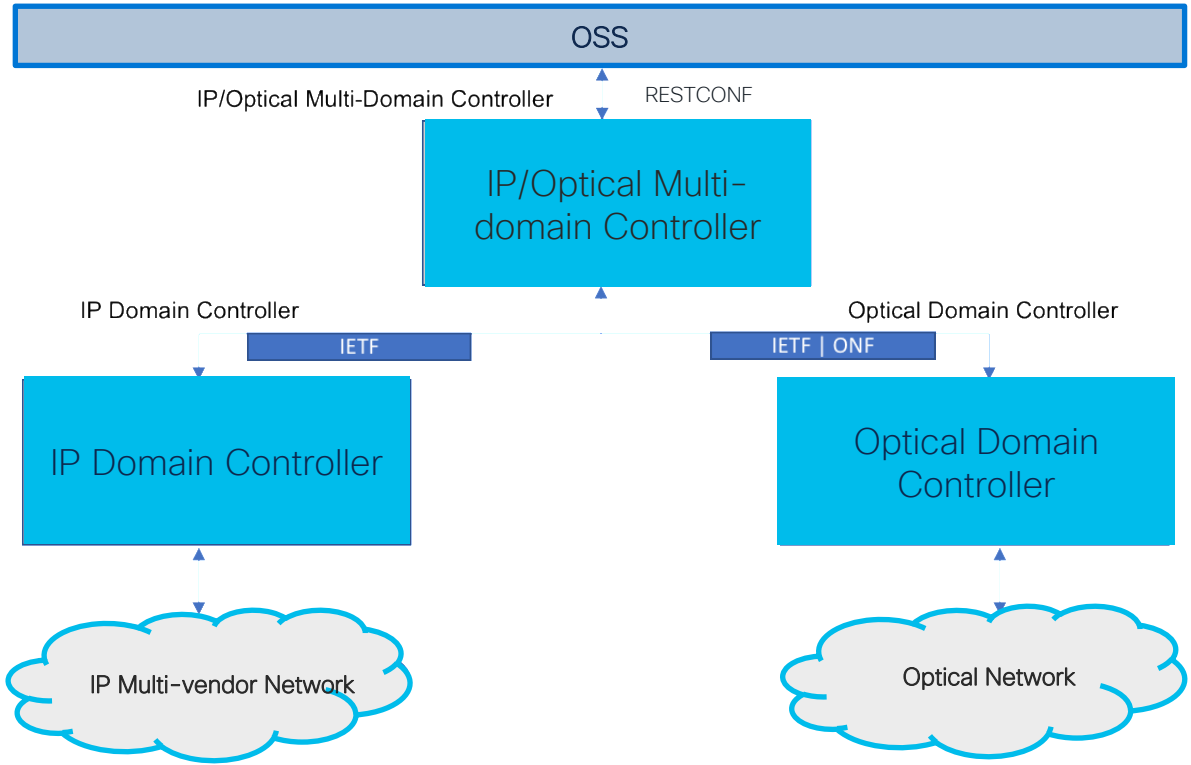
Automate processes to drive agility

# Cisco Crosswork™ automation portfolio

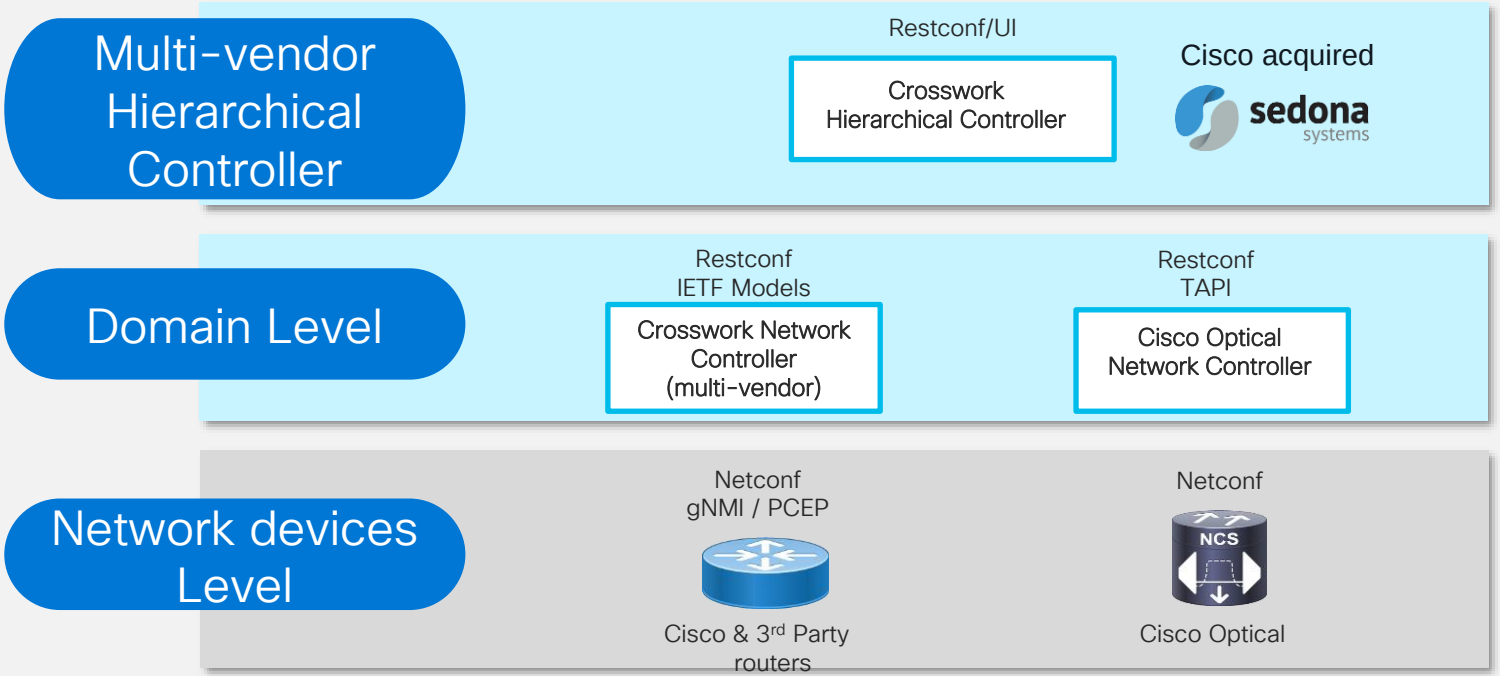


# Multilayer Multidomain Standard Automation Architecture
## Alignment to Standards – IETF ACTN*

*RFC 8453 Framework for Abstraction and Control of TE Networks (ACTN)



# Cisco implementation aligned to Standards



# RON Automation

simple ingredients for RON

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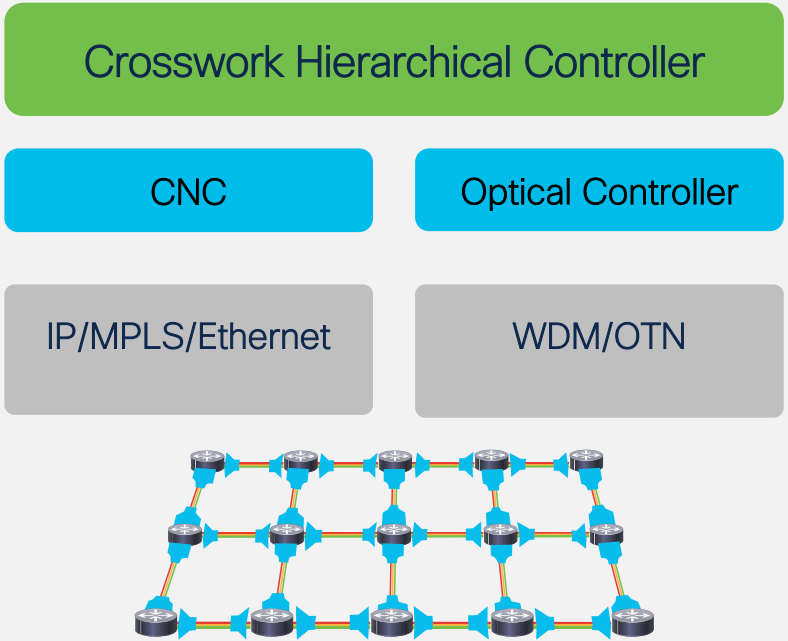
# RON control architecture

- A RON control solution contains at least:
  - Optical controller
  - Cisco Network controller (CNC)
  - Hierarchical controller (HCO)
- Opt. Controller and CNC are responsible for:
  - Discovering all layer details
  - Configuring services in the layer
- Hierarchical Controller RON is responsible for:
  - Single pane of glass/API
  - Understanding how the layers are connected



# HCO Use Cases

**Multi-domain optical**

- Visualization of all optical layers across multiple domains/vendors
- Service assurance based on multi-layer root-cause + optical perf monitoring
- Circuit creations across domains

**Multi-domain IP**

- Visualization of TE tunnels/policies and services over IP topologies and domains
- Assurance based on RCA + traffic and OAM PM and prediction + simulations
- Provision new L2-L3-VPNs across domains using NSO engine

**RON**

- Visualization of ZR+ links across IP and OLS gears + ZR-OLS link validation
- ZR Link assurance based on IP traffic and optical span monitoring + TCAs
- Provision new ZR link over OLS + new PLE over IP and OTN gears

**Multi-layer**

- Visualization of IP to optical topologies and services, cross-links auto discovery
- Multi-layer RCA, simulations to find SRLGs, failure impact
- ML PCE as API

RON

- Visualization of ZR+ links across IP and OLS gears + ZR-OLS link validation
- ZR Link assurance based on IP traffic and optical span monitoring + TCAs
- Provision new ZR link over OLS + new PLE over IP and OTN gears

## Visualization

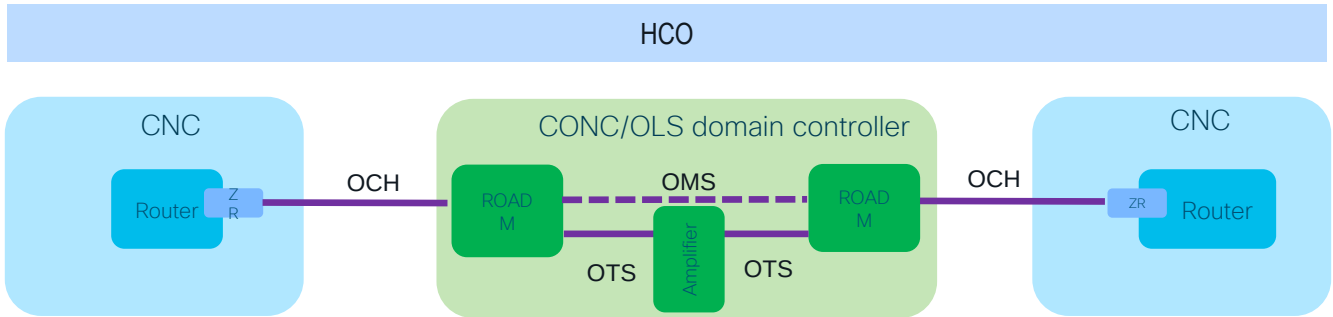
- Show ZR+ links over OLS
- ZR-OLS link connectivity check
- Mapping of services to photonic layers

## Assurance

- ZR+ link assurance, navigate in layers to get L2, L1, L0 performance summary and graphs – find root cause throughout span
- Color span loss and TCAs on ports
- Plan to perform integration with 3rd party OLS

## Provisioning

Create new ZR+ link over OLS, validate ZR-OLS cross-links and provision OCH level and IP level



## Multi-layer

- Visualization of IP to optical topologies, cross-links auto discovery
- Multi-layer RCA

### Complete

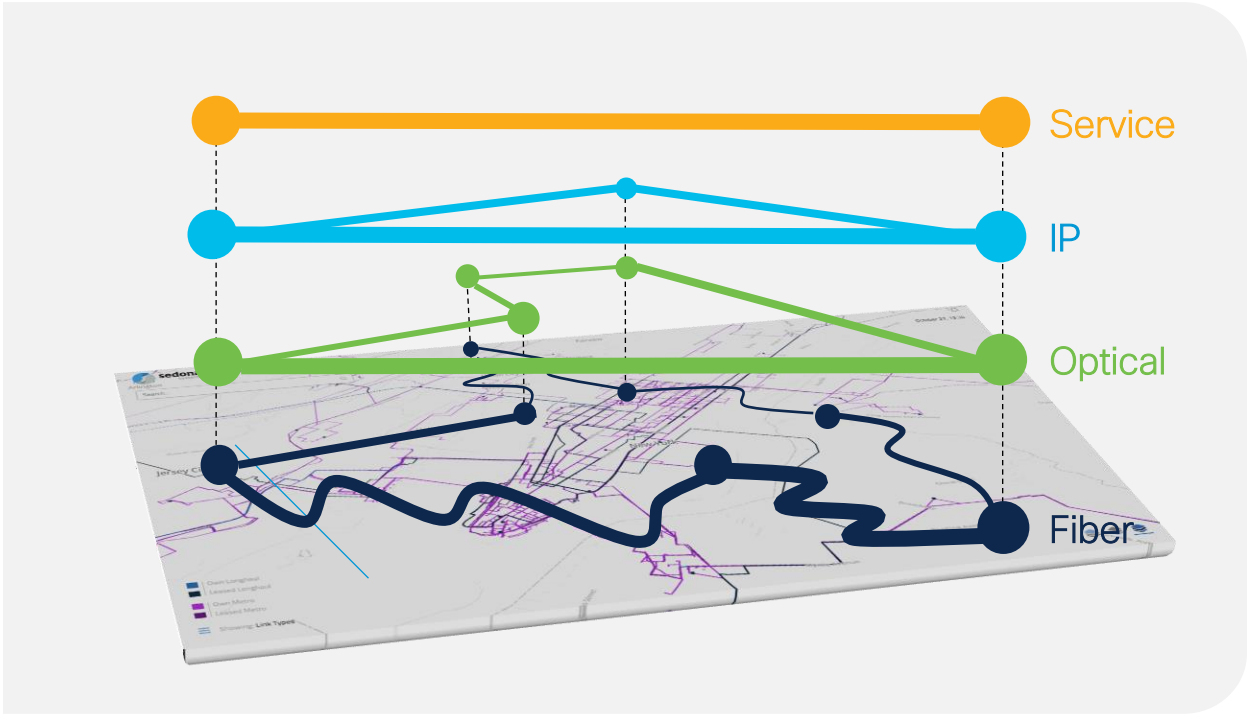
Multilayer, multivendor, and multidomain topology, traffic, and services (SDN and legacy)

### Up to date

automatically and continuous discovery – directly from the network

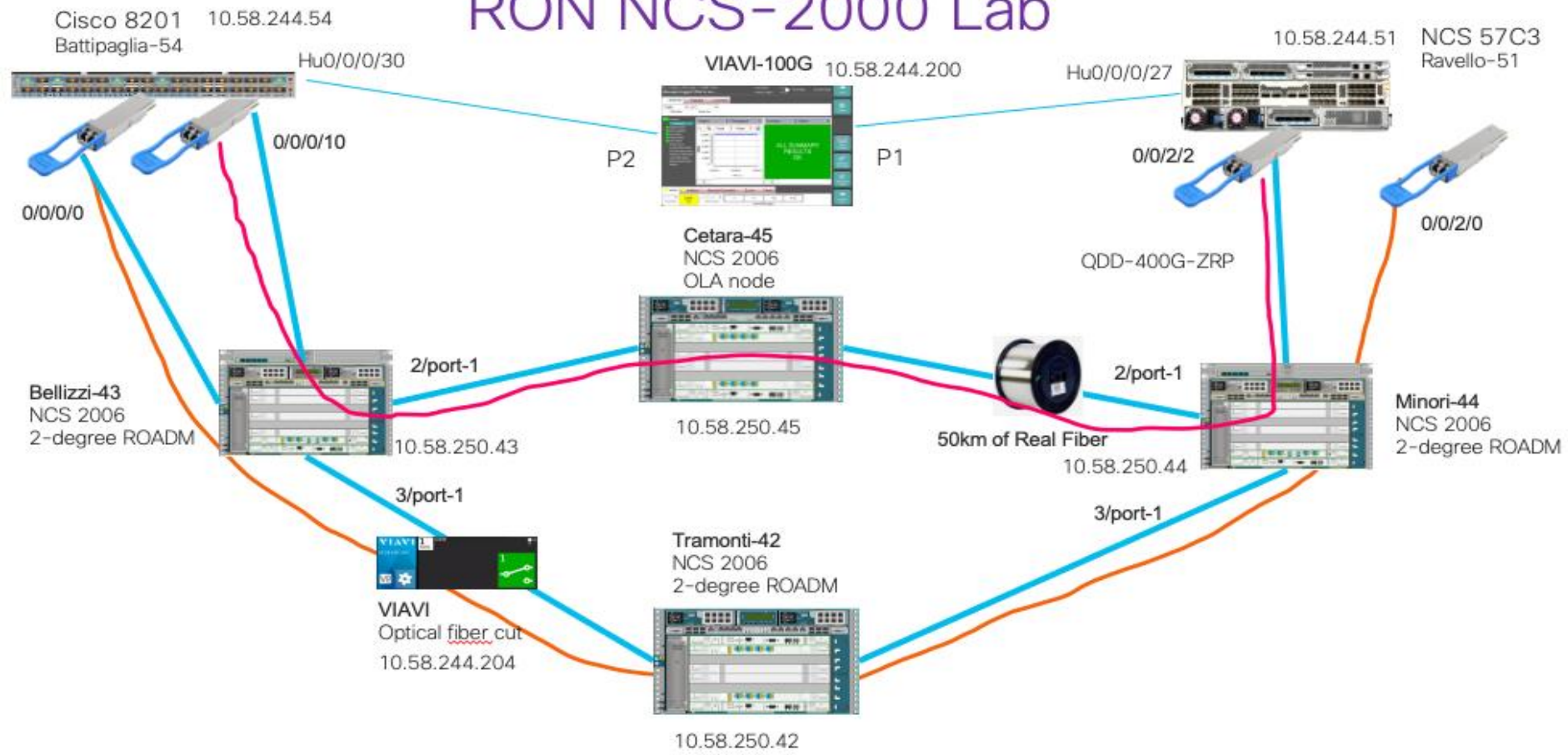
### Correlated

dynamically deducing cross-domain connectivity (auto-discovery is a CX service)

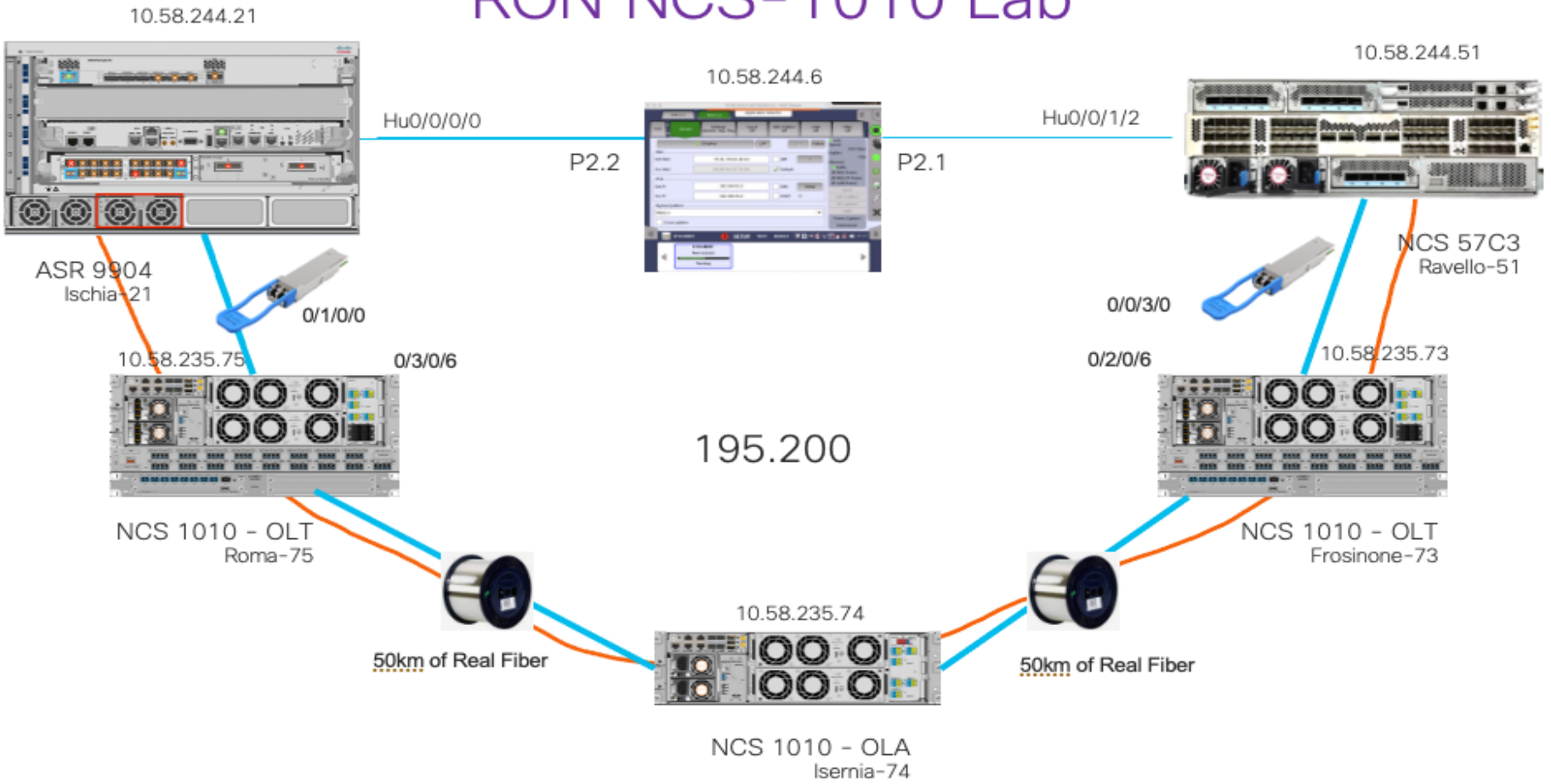


# Demo

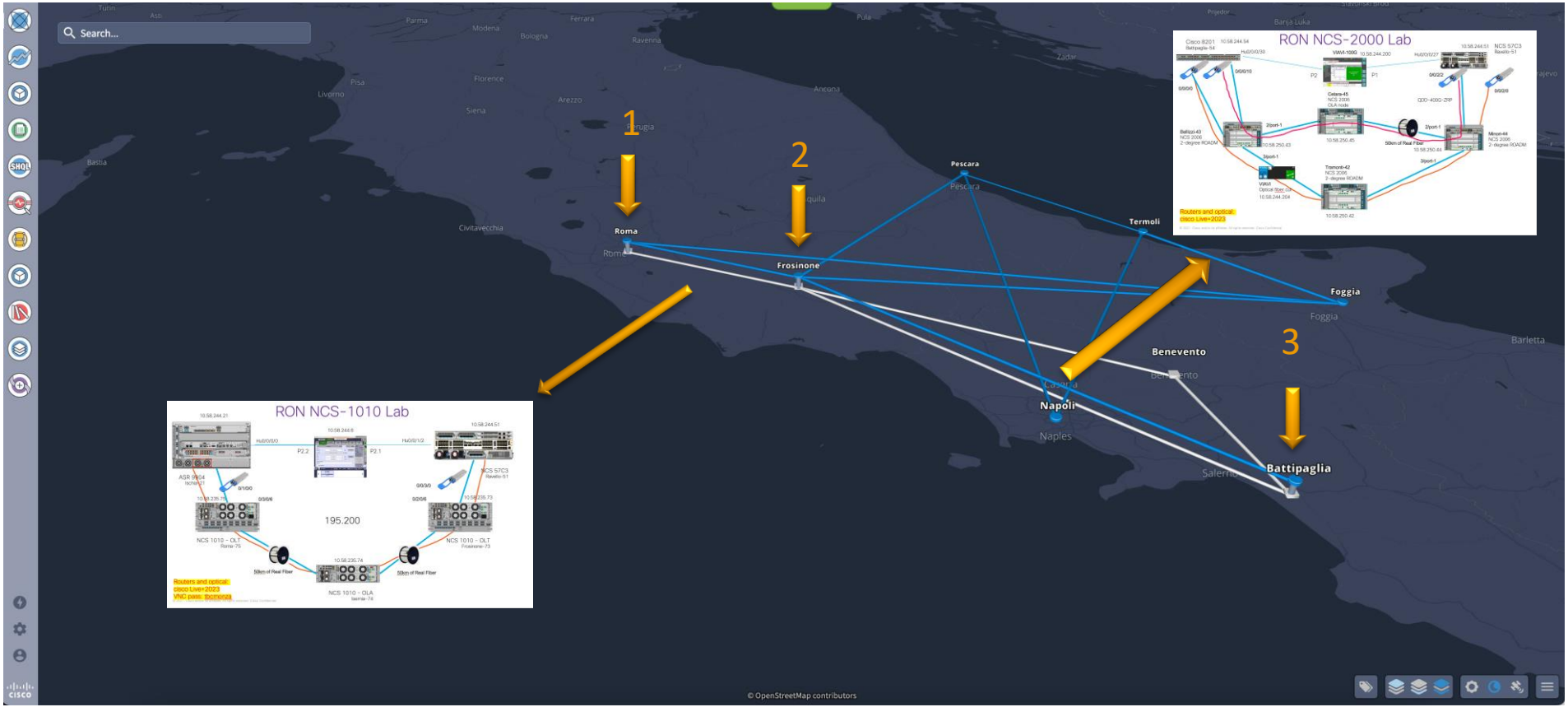
# RON NCS-2000 Lab



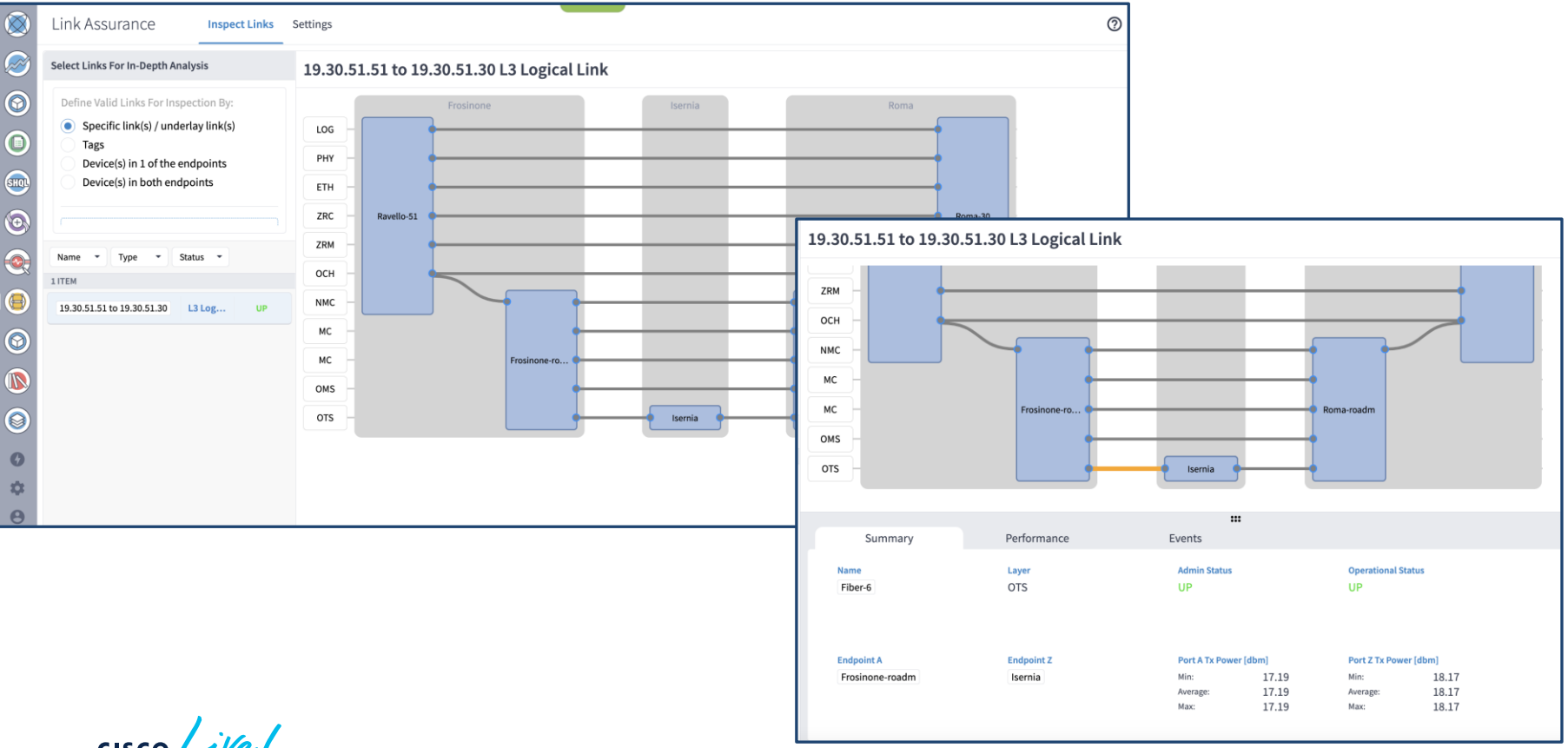
# RON NCS-1010 Lab



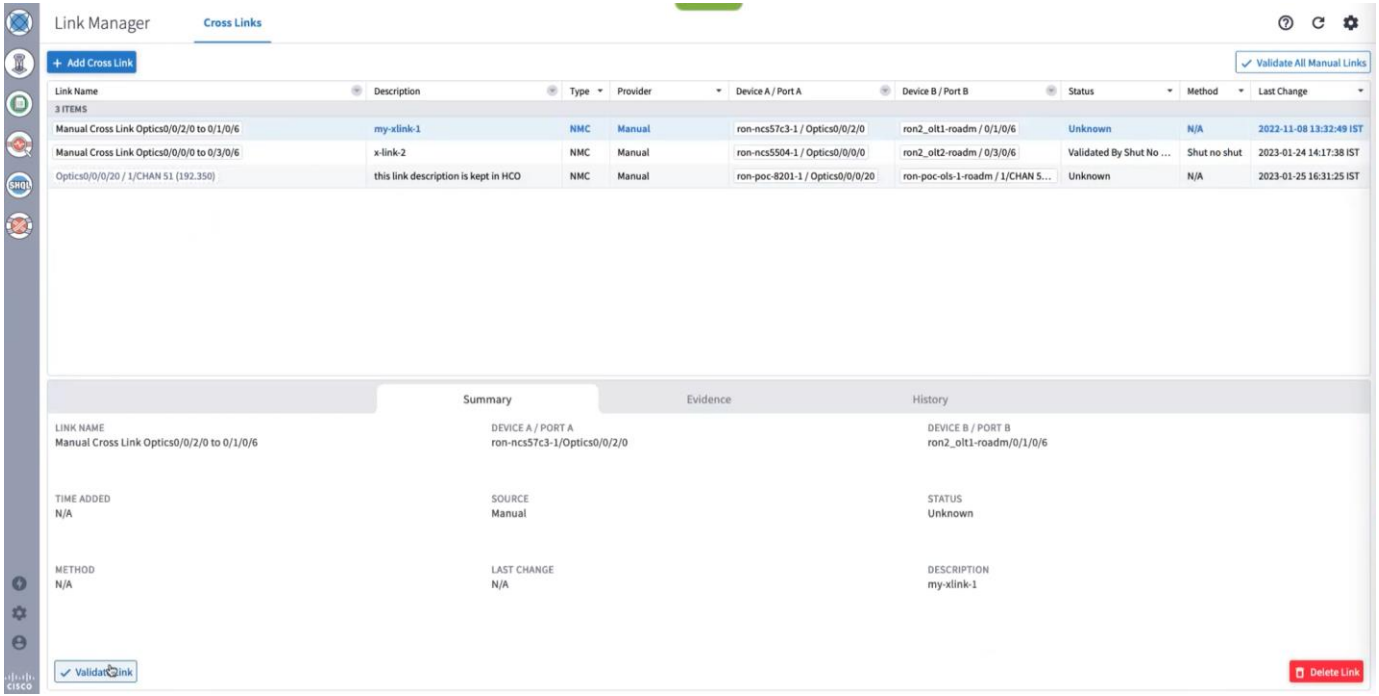
# Lab topology in HCO



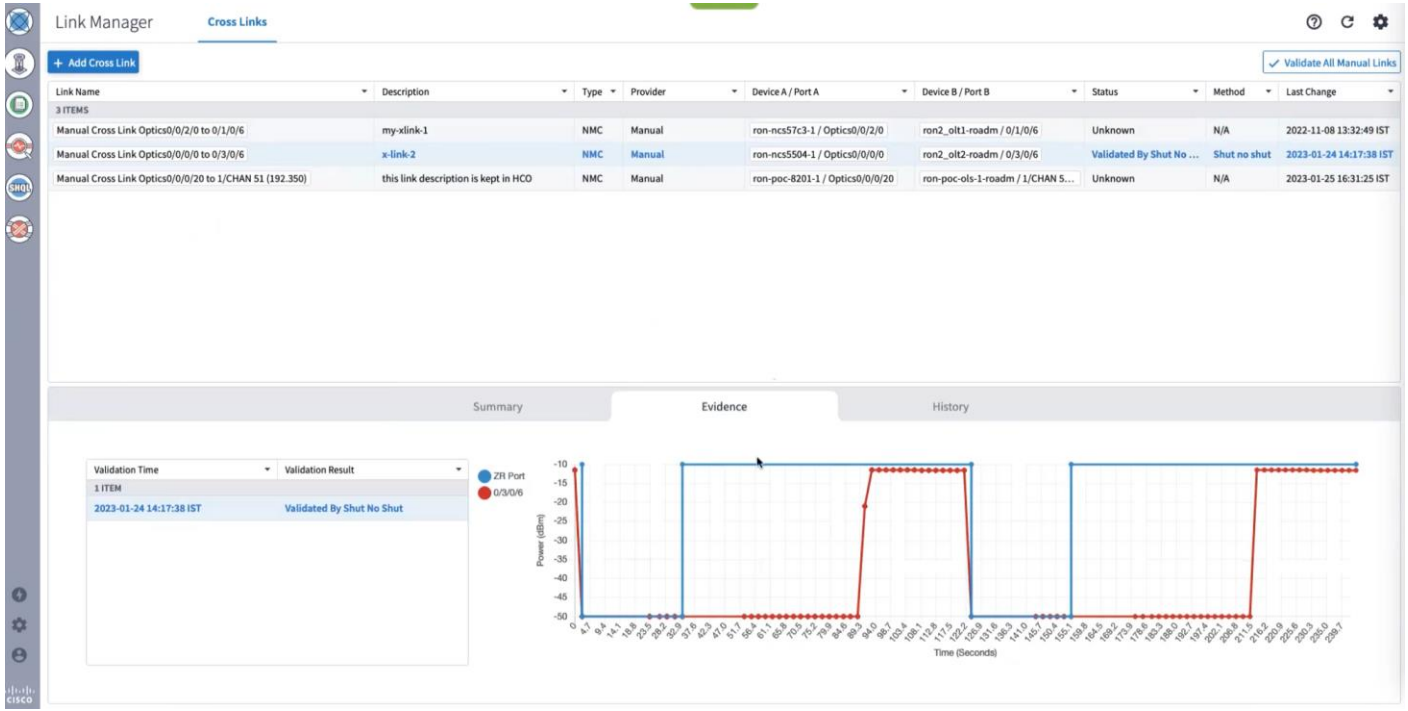
# HCO - RON Link Assurance



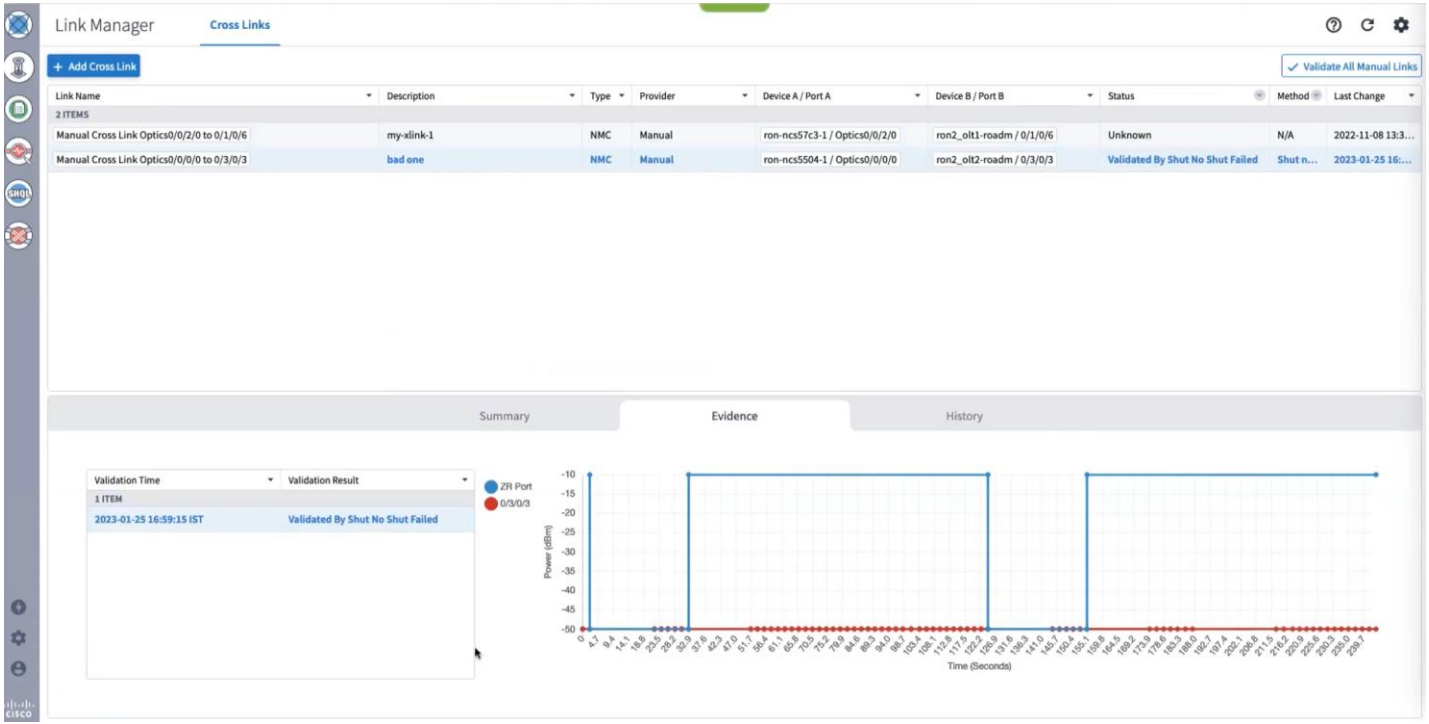
# Link Manager App



# Optical X-Link Validation



# Optical X-Link Validation Failed



# Introducing RON Automation Starter

- It is an entry level automation solution for RON when no IP topology and service management is required

- What it provides:
  - Router inventory discovery
  - ZR links topology disocvery and visualization
  - RON link provisioning
  - RON link assurance
- No IP topology and services

# Circuit Style Segment Routing

# Why Circuit Style SR

Challenges:

- Deliver bandwidth-guarantee services with path protection over Segment Routing
- Leverage Segment Routing infrastructure to carry any kind of connection-oriented service including OTN, TDM

Solution:

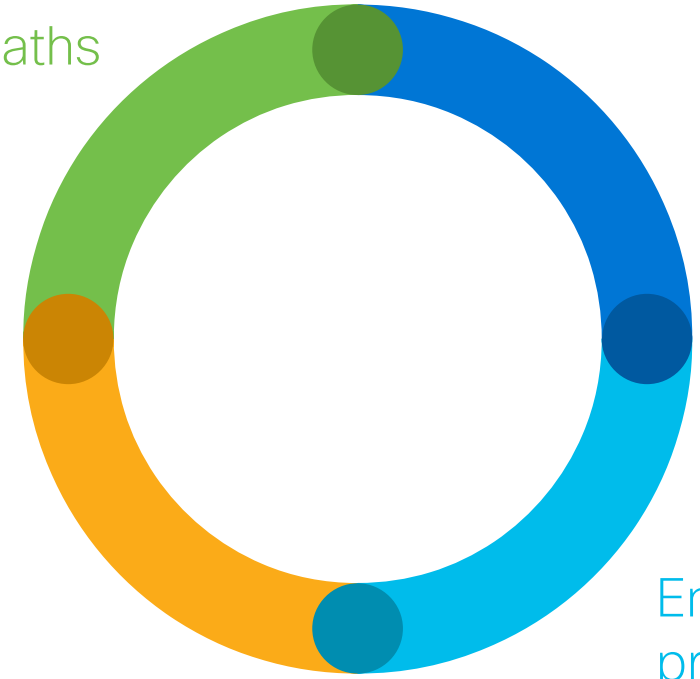
- Pre-book some bandwidth in the network to be used by these Circuit-Style policies
- Use the SDN Controller for bandwidth bookkeeping and path computation
- Use the SDN Controller to compute bi-directional, co-routed paths with path protection (under 50ms)

Outcome:

- One unified Segment Routing infrastructure can be used to carry any kind of services, including the most demanding

# Circuit-Style Segment Routing (CS-SR) in a Nutshell

Traffic engineered paths
- bidirectional
- co-routed
- guaranteed latency
- persistent

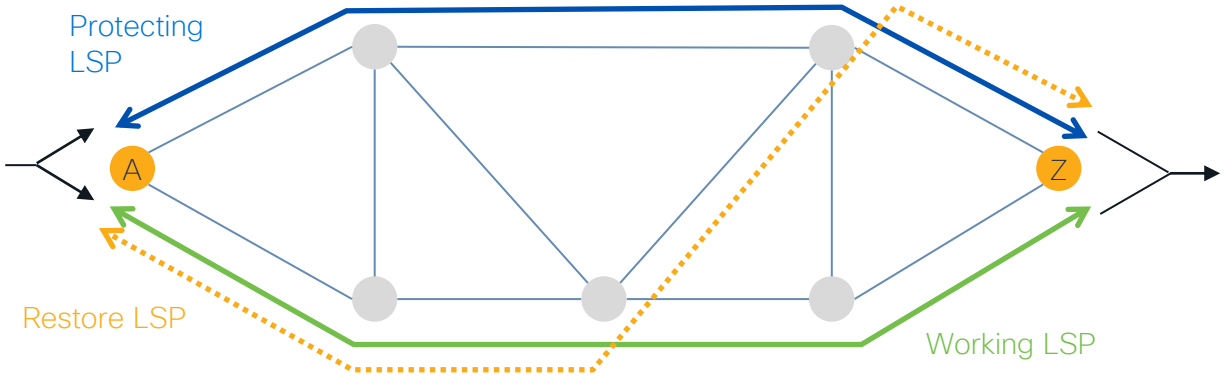


Strict bandwidth commitment

Path OAM

End-to-end path protection & restoration

# Circuit-Style Use Cases: Guaranteed Bandwidth, TDM2IP, PLE…




Guaranteed Bandwidth Services

TDM2IP

Private Line Emulation

## Circuit-style SR (CS-SR)

- Guaranteed bandwidth
- persistent, co-routed, bi-directional paths
- 1:1 End-to-end path protection and restoration

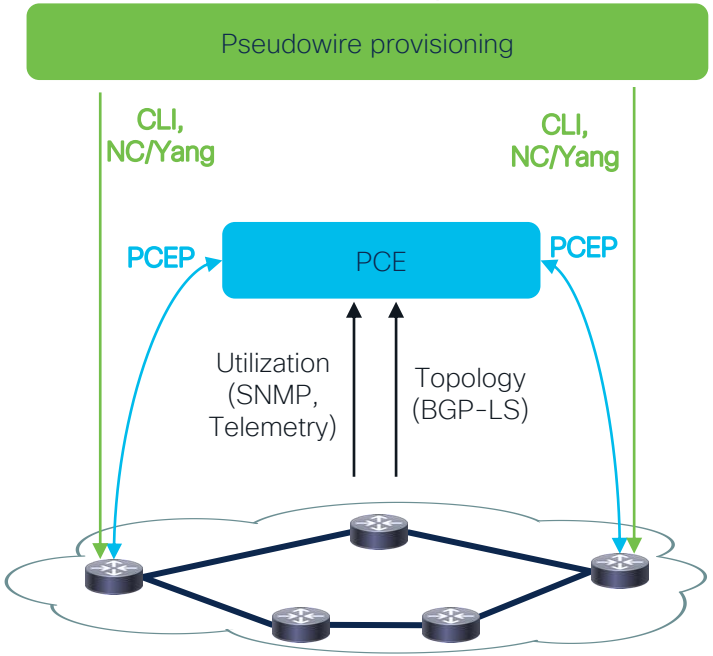
# CS-SR Standardization at IETF is underway

- draft-schmutzer-pce-cs-sr-policy
  - Informational draft describing the overall solution
- draft-sidor-pce-circuit-style-pcep-extensions
  - Standards draft defining required PCEP extensions
- Presented at IETF113
- Broad industry support from operators and vendors

# Provisioning Workflows

# PLE using “Circuit-style” segment routing

- PLE pseudowire has a distinct bandwidth requirement assigned
- Pseudowire is mapped to a CS-SR policy
- Headend router requests a path via PCEP from a central PCE
  - Bandwidth
  - Path constraints
- The path is encoded via a list of adjacency SIDs in the packet header
- The central PCE maintains a real time view of
  - the network topology (BGP-LS)
  - All path/bandwidth requests (PCEP)



# CS-SR Policies Visualization and Operations

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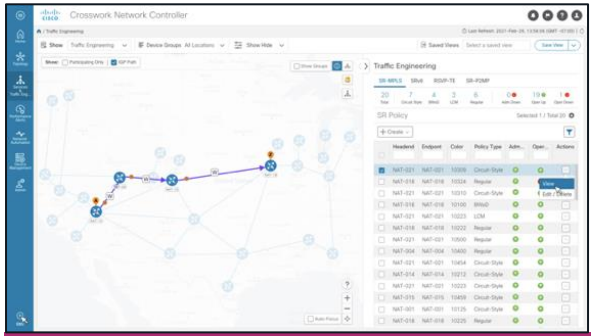
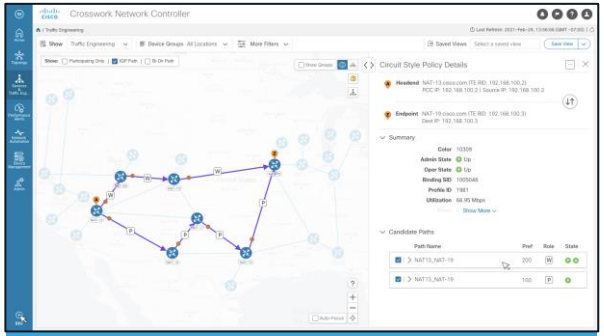
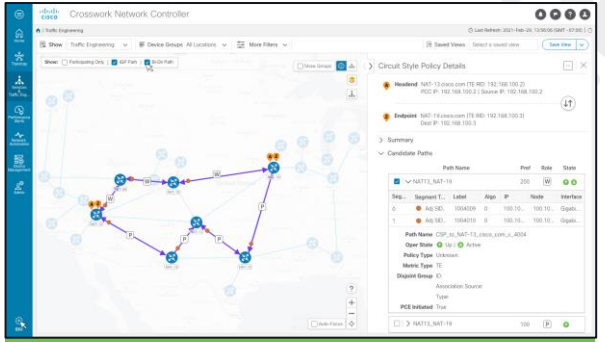
# CS SR Policy Overlay in Crosswork Automation




CS SR-TE Policy Listing




CS policy details
Path Protection




CS Policy details
co-routed bidirectional

- Modern look and feel
- Seamless and consistent experience across various Crosswork application workflows
- Detailed information about CS SR Policies, Path Protection, Co-routed Bidirectional

# Key Takeaways

- RON Automation is based on HCO leveraging domain controllers
- HCO is the tool for configuration, visibility and operations
- RON automation starter package
- Crosswork Automation the key tool for Connection-oriented services

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