IP/Optical awareness and correlation for traffic optimization

NANOG 78 San Francisco

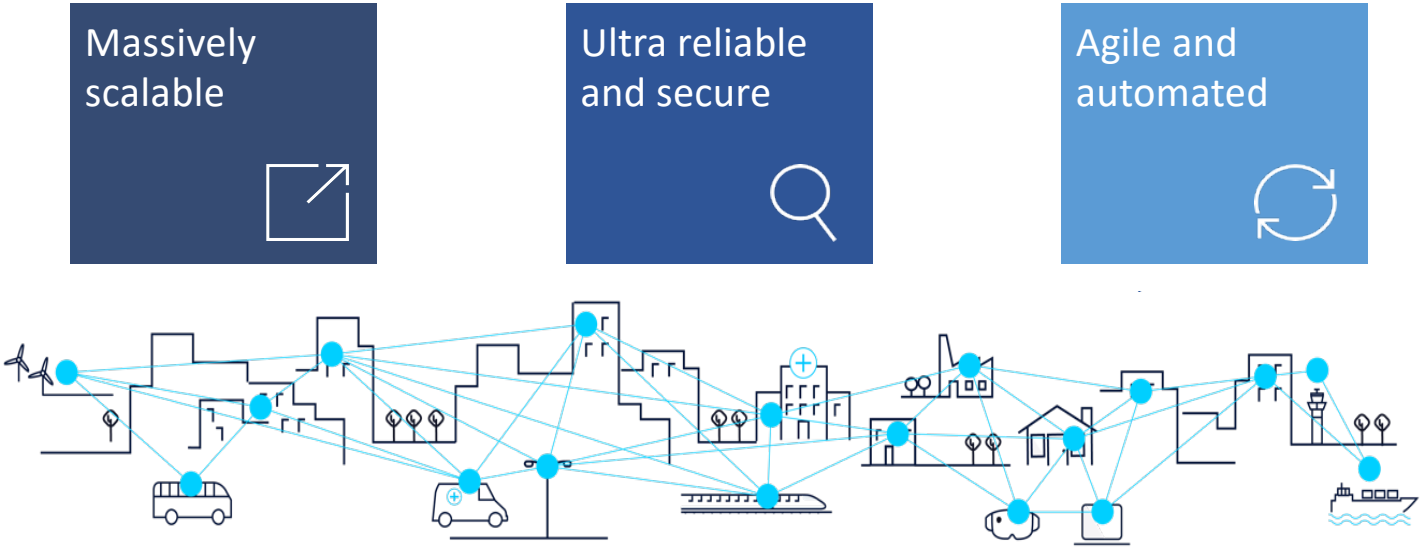
Filipe Correia

Filipe.Correia@nokia.com

Principal Consulting Engineer

The digital era of Cloud, IoT and 5G

IP and optical network evolution requirements

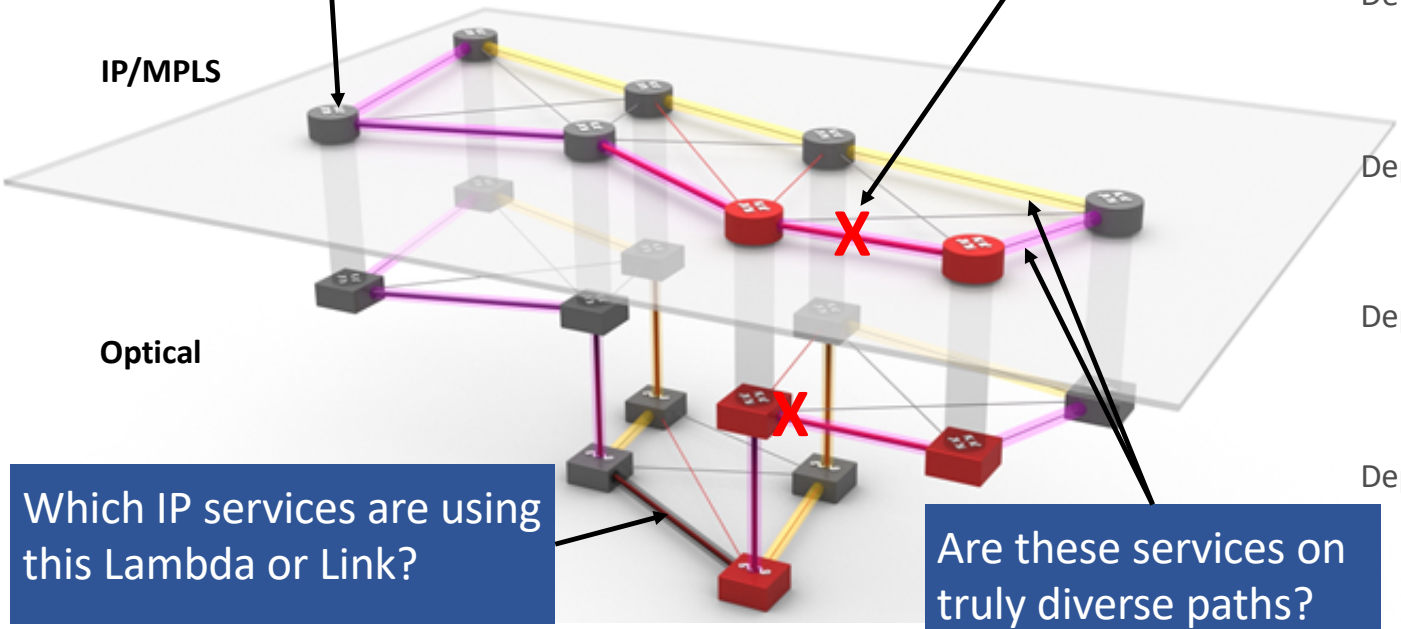


Understanding the dependencies and Impact of the layers

Multi-layer management and coordination

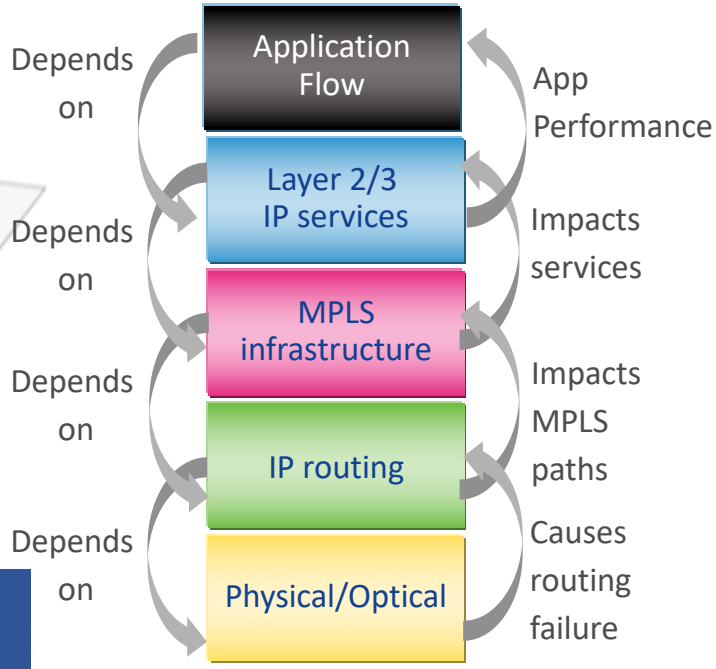
Is there a more optimal performance route for this service?

What optical issue caused the outage?



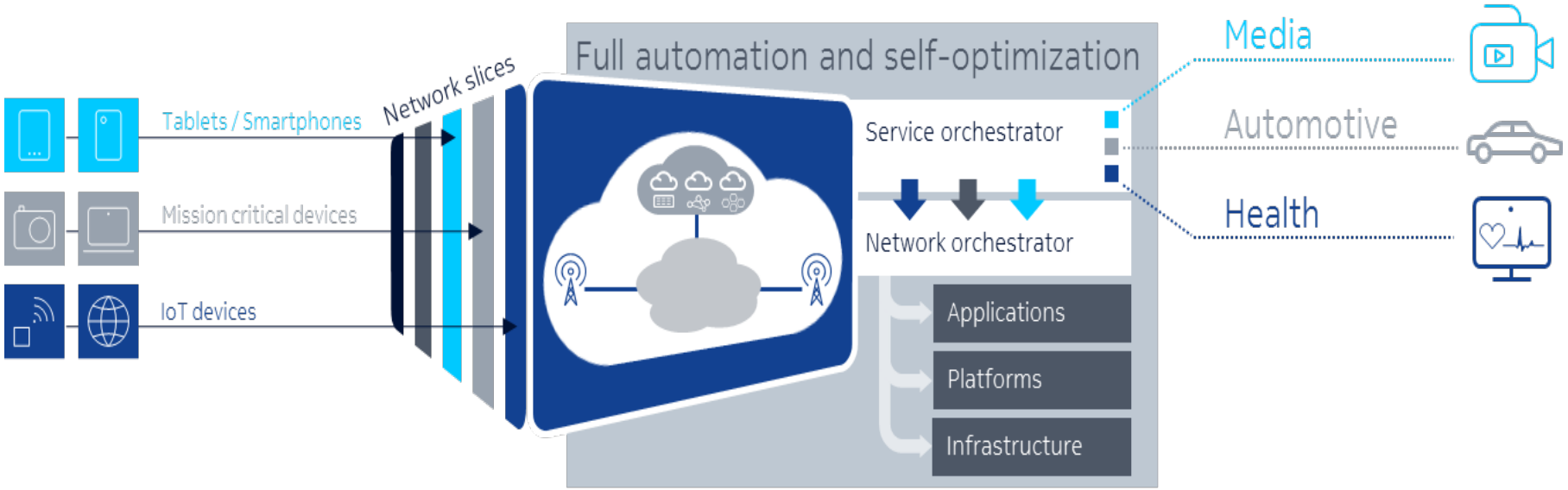
Which IP services are using this Lambda or Link?

Are these services on truly diverse paths?



Need for dynamic IP/Optical coordination: 5G with Network Slicing

Driving the need for SDN control and coordination



- Hard and soft slicing
- TE paths between network functions (PNF/VNF)
- L2 and L3 VPNs in all domains
- Open, standardized programming & monitoring

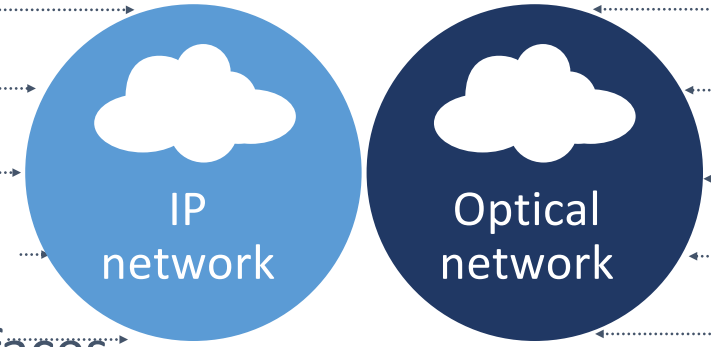
IP and optical network evolution

Technology enablers

IP evolution

Dynamic and reliable connectivity

- Segment routing
- Deterministic QoS
- Traffic engineering
- Streaming telemetry
- Programmable interfaces



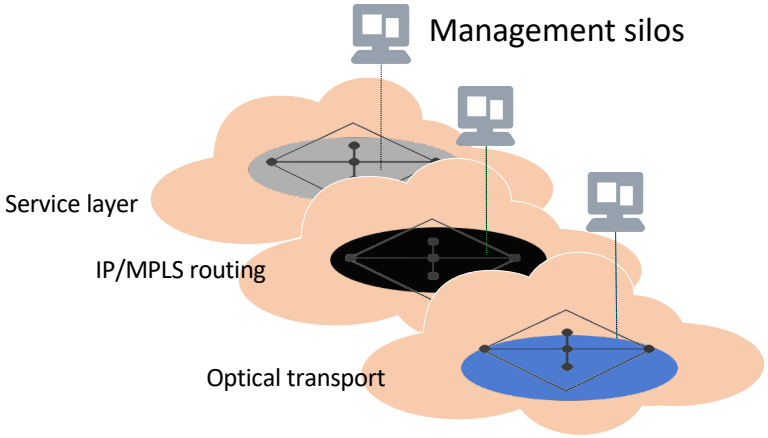
Optical evolution

Agile and scalable transport

- CDC-F wavelength routing
- Packet optical transport
- Network optimization
- Streaming telemetry
- Programmable interfaces

Converged Management and Control evolution

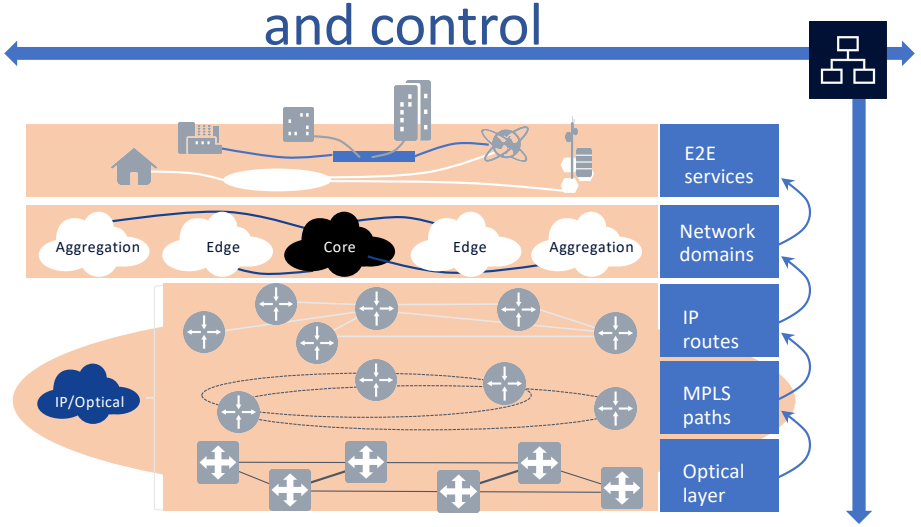
Present mode of operation



- Fragmented network resource & service view
- Operational silos of control and maintenance

Complex, error prone and labor intensive

Future Mode of transport orchestration and control



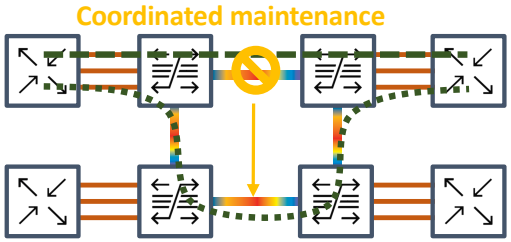
- Multi-vendor, multi-domain automation and optimization
- Open, standards-based network interface abstractions

Orchestrated, consistent and streamlined

Operator Benefits of IP/Optical correlation

Multi-layer transport operator needs

Simplify operation

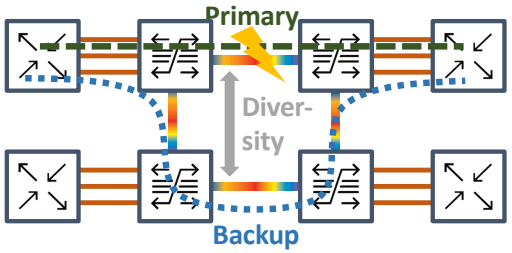


Multi-layer discovery and visibility

- Easy troubleshooting by multi-layer visibility and inventory
- Coordinate maintenance without error-prone manual processes
- What-if analysis to ensure IP traffic is never affected

➔ **OPEX reduction**

Improve resiliency



Multi-layer traffic engineering

- Ensure optical diversity for IP routing by SRLG sharing
- Comprehensive correlation of topology (e.g., for latency)
- Make IP layer aware of optical protection and restoration

➔ **Better service quality**

Increase utilization

Efficient use of IP resources

- Automate setup of dynamic optical services with resiliency
- Increase utilization of router ports by pooling (e.g., LAG, ECMP)
- Avoid redundant resiliency and leverage optical protection (1:N)

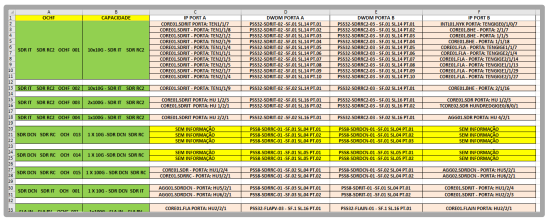
➔ **CAPEX saving**

Some use cases with multi-layer coordination

1. Topology discovery

The issue

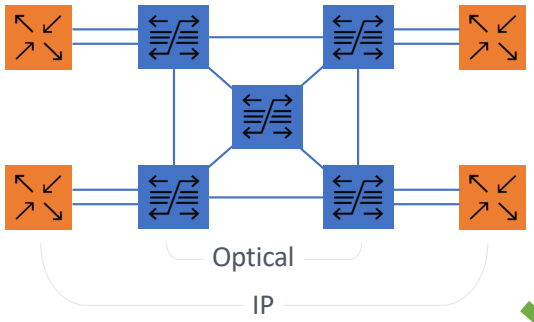
- Many operators track multilayer topologies manually, e.g. using spreadsheets
- Anecdotal evidence: >10% deviation from reality over time



?

The solution

- Automated detection of the multi-layer topology
  - Leverage deterministic linkages such as LLDP snooping or comparison of traffic counts to auto determine IP/Optical linkage



The value

- Reduced probability of service outages
- Simpler troubleshooting
- Tighter latency control

2. Optically disjoint IP routing

The Issue

- **Lack of insight and control**
- **Inherent multi-layer layer** problem
- **Dynamic optical networks** with protection and/or restoration
- **A priory analysis** is cumbersome

Solution

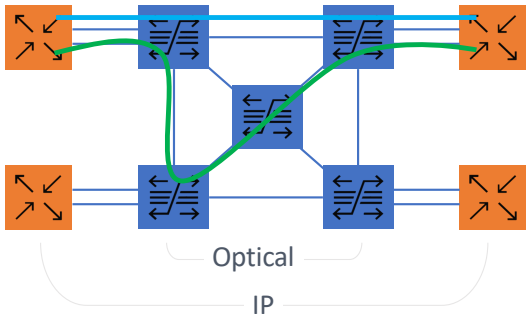
- Leverage defined Shared Risk Groups defined on optical links, to ensure IP controllers take into account in Path Computation diversity at optical link level as well.

Value

- **Avoid needless service outages**
- **Better resiliency** for IP services by full diversity
- **Avoid shared risks** for IP/MPLS LSPs inside optical network
- **No manual configuration** of Shared Risk Link Groups (SRLGs)
  and full control over optical topology exposure

☑ **Better resiliency**
☑ **Avoid shared risk**

Link Diversity



3. Diversity analysis

The issue

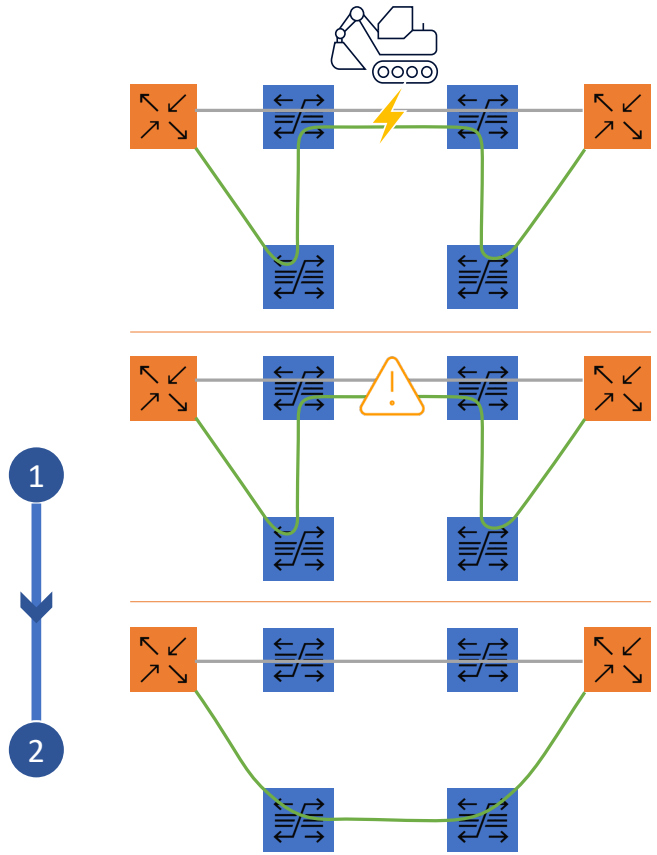
- While path diversity is needed for IP links or for IP services, paths may not be fully diverse in the optical domain
- A failure could impact both primary & backup paths

The solution

- Perform real time diversity analysis
- Establish/compute diverse path as necessary

The value

- Reduced probability of service outages



4. Coordinated operational control

Maintenance coordination; hitless optical reversion

The issue

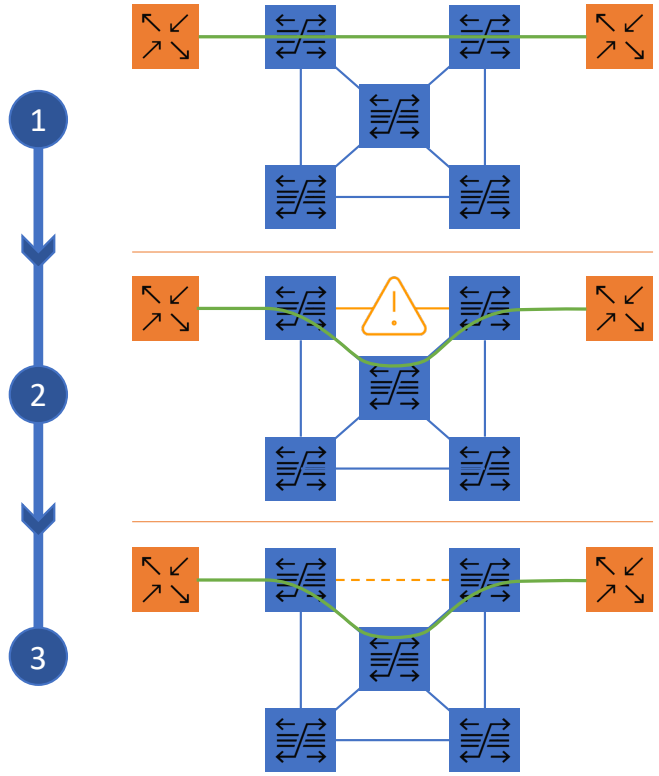
- Changes in the optical topology affect IP traffic

The solution

- Maintenance coordination:
  - Move IP traffic away from links that will be taken out of service
- Hitless Optical reversion
  - Before restoring an optical failure (i.e. switching back to the nominal path), move IP traffic off the link that will be affected

The value

- Improved customer satisfaction



5. Cost-effective multi-layer protection

Save on network equipment

The issue

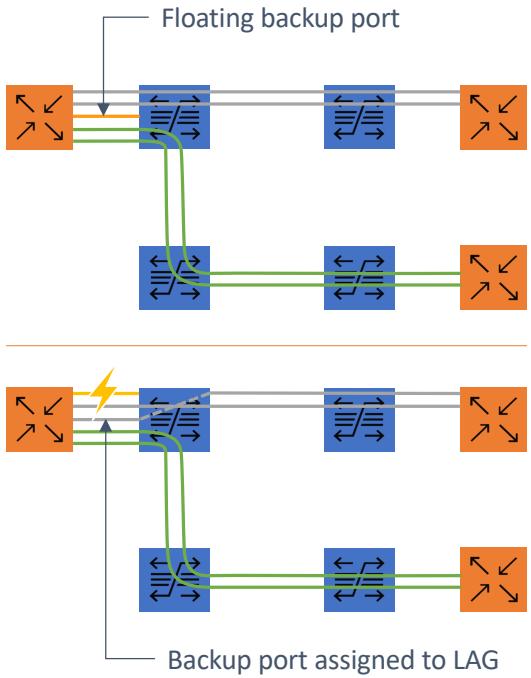
- 1:1 protection of router ports is inefficient for many applications
- Protection solely in the IP domain (FRR) is expensive

The solution

- Spare, floating backup ports (1:N) protect against router port, optical port, or link failures
- Floating ports save router resources

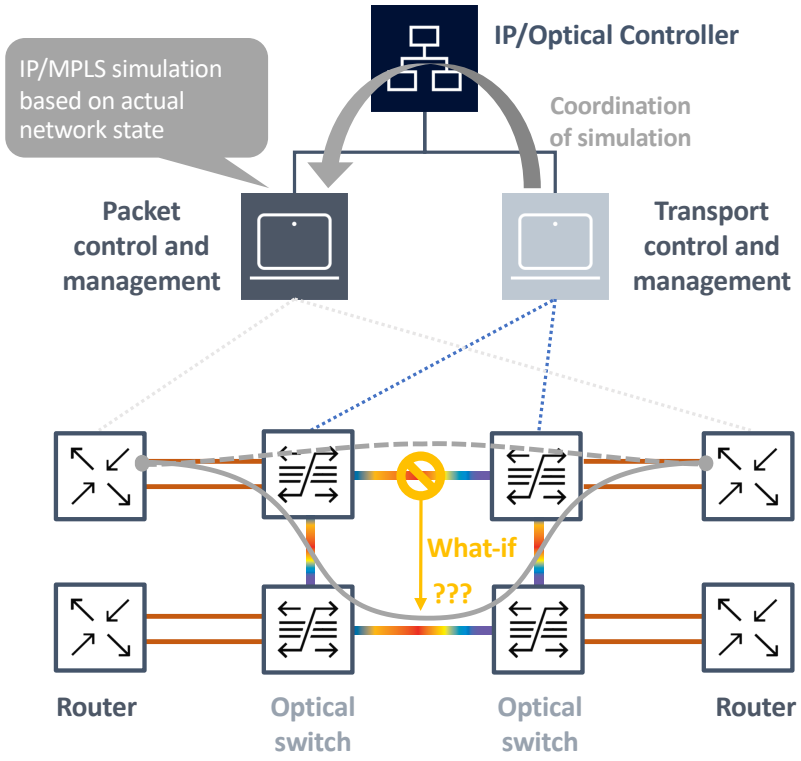
The value

- Save on network equipment



6. Multi-layer what-if analysis

Use case of simulation of IP/MPLS impact of optical events



Multi-layer visibility and impact analysis

- Analyze changes by multi-layer simulation
  - Leverage IP/MPLS simulation and assurance capabilities for “what-if” analysis
  - Support network planning and troubleshooting by multi-layer visibility
  - Avoid error prone manual processes and failures
- Example workflow
  1. Select optical fiber
  2. Automatically discover all IP links using optical services on this fiber
  3. Launch IP/MPLS simulation to study impact of maintenance event or failure
  4. Plan remedies by IP/MPLS optimization

7. Cross-domain connection management

Standards based hierarchical interworking of domain controllers

The issue

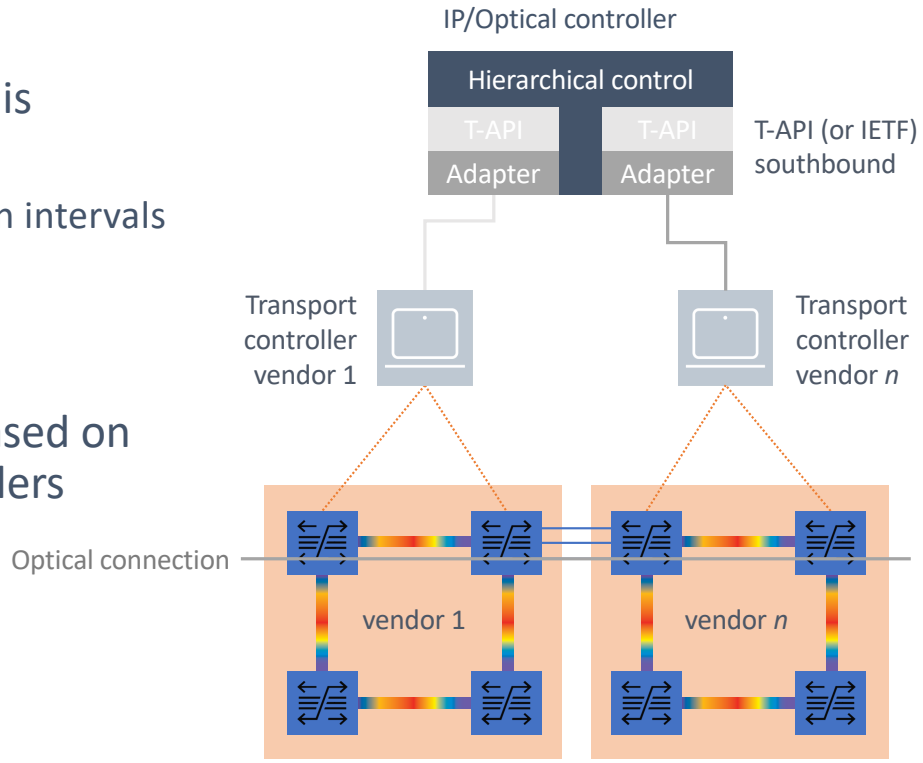
- Cross-domain connection management is cumbersome
  - Expensive OSS systems with long integration intervals
  - Manual, error-prone processes

The solution

- Automated connection management based on standard protocols with domain controllers

The value

- Faster time to market
- Faster service delivery
- Cost savings



8. Coordinated assurance and troubleshooting

The issue

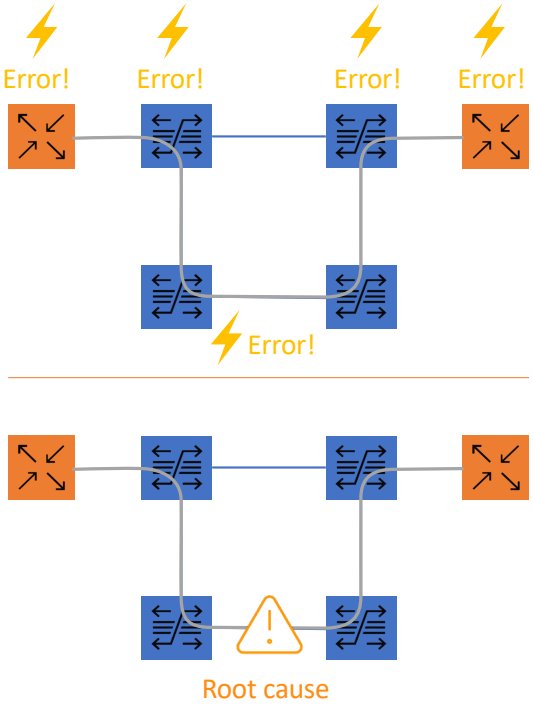
- Problem symptoms can mask root causes
- Cross-domain navigation and inter-team communications are problematic

The solution

- Alarm correlation allows rapid root cause identification
- Cross-domain navigation allows fault locus to be rapidly identified and issue resolved

The value

- Efficient troubleshooting operations
- Rapid resolution of service affecting issues



9. Coordinated assurance and troubleshooting

High availability with augmented intelligence

The issue

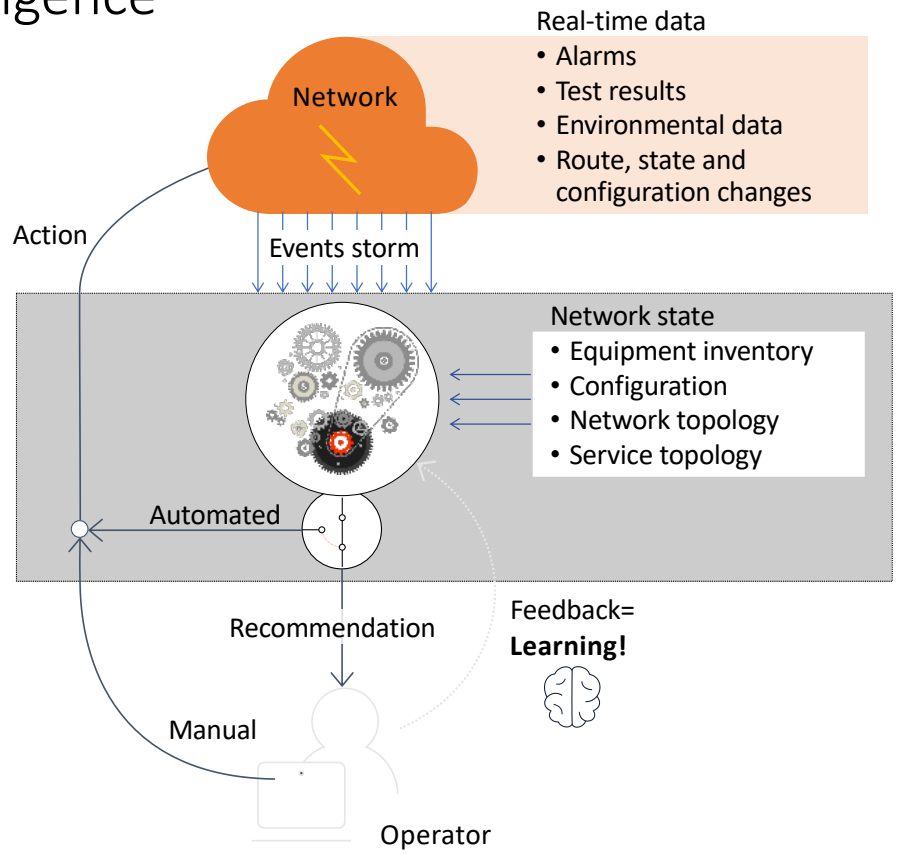
- Too much data to process

The solution

- Machine learning assistance to predict, detect & solve incidents.

The value

- Improve network availability
- Fix problems before they arise
- Accelerate troubleshooting
- Ongoing learning



In conclusion … Why multi-layer and multi-domain coordination?

Cross-domain, automated coordination

Benefits

- ✓ Simplify operations (OPEX)
- ✓ Increase network utilization (CAPEX)
- ✓ Improve network resiliency
- ✓ Speed up planning and troubleshooting processes

Q&A


NOKIA