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TECH FORUM 23



What IP Wave Can Do For You

David Stokes

Head of IP Solutions and IP Portfolio Marketing

IP Wave Portfolio

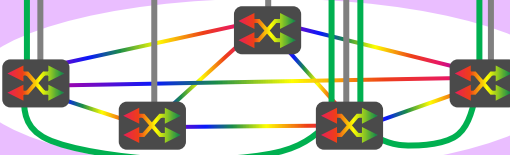
Muse
SDN Domain
Orchestrator



NPT
IP Routers



Apollo
Optical Networking
Systems



Ribbon
Professional
Services

Targets All Network Operator Types

Service Providers

- Converged multi-service aggregation
- Broadband backhaul
- Mobile – 4G/5G xHaul
- TDM to IP migration



Critical Infrastructure

- SCADA Backhaul (Power, Railway, Oil & Gas)
- U-Telco
- Smart City
- Defense





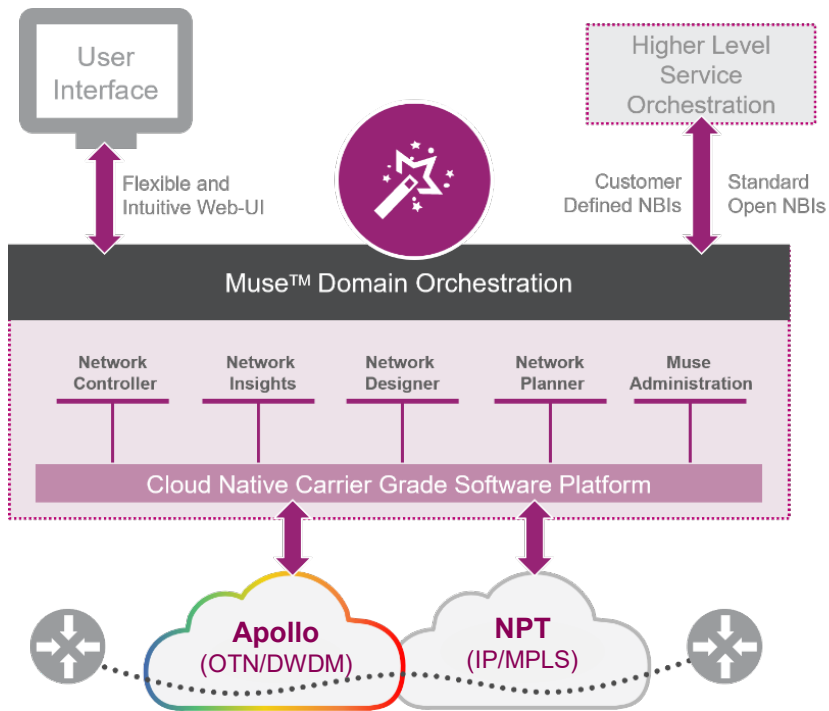
SDN Control and Automation with Muse

Transport Network Automation

The application of technology to deliver **connectivity services** and control the underlying **IP Optical network** with minimal human intervention



Muse SDN Domain Orchestrator



Live network control for topology commissioning, service provisioning, fault management, maintenance and automations.



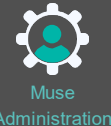
Self-Service BI application for analyzing the network inventory, performance, utilization and other KPIs.



Graphical Low-Code tools for designing service templates, network elements, tasks and automation workflows.



Topology design and optimization, optical services and equipment allocation, and export of required reports.



User management, authentication and authorization, licensing, system health, and more.



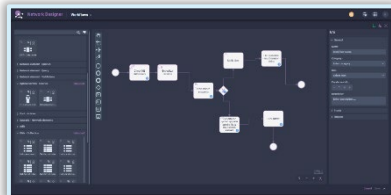
Muse Values

Intuitive Web UI



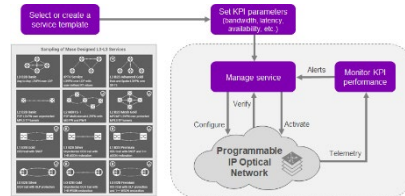
- Reduce mgmt complexity
- Tailor to NOC processes

Workflow Automation



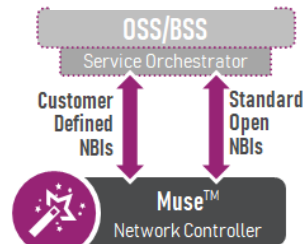
- Reduce OPEX
- Minimize human mistakes

Closed Loop Provisioning



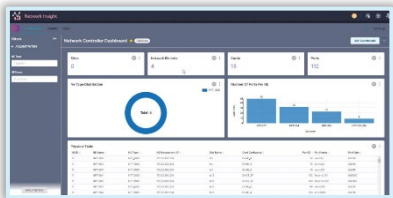
- Speed time to revenues
- Sell performance assured services

Flexible NBI



- Integrate within end-to-end SDN ecosystem

Insights & Analytics



- Better use of CAPEX
- Improve NOC efficiency

Network Health



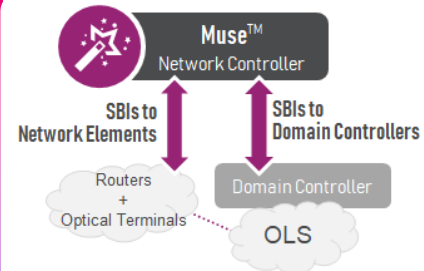
- Predictive maintenance
- Fast-accurate fault finding

Cloud Native



- DevOps and Customization
- Performance and Security

Flexible Multi-Vendor SBI



- Disaggregated solutions
- Remove vendor lock-in

The logo for Ribbon Tech Forum 23. The word "ribbon" is written in a lowercase, rounded, pinkish-red font. Below it, the words "TECH FORUM 23" are written in a white, uppercase, sans-serif font, enclosed within a thin white rectangular border.

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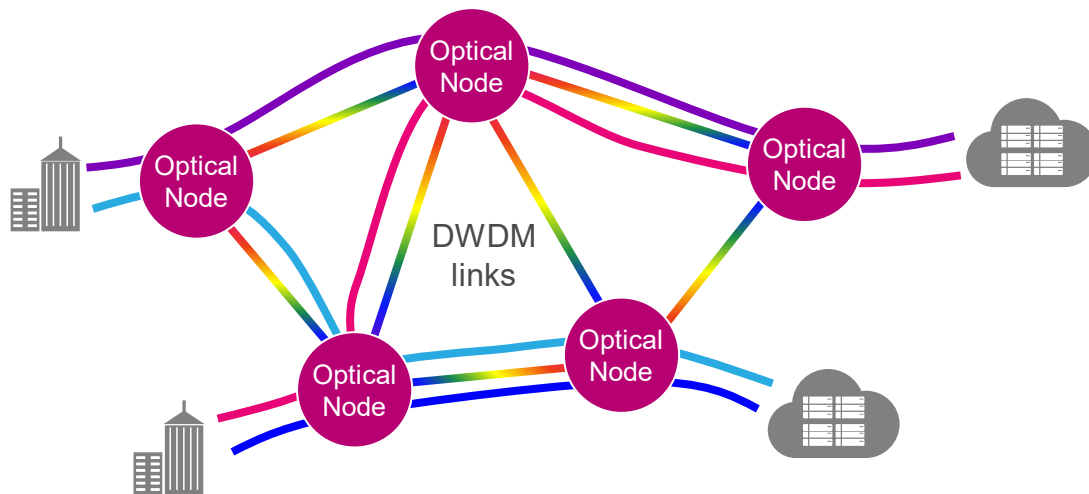
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Optical Networking with Apollo

Role of Optical Networks




Transport services transparently over wavelengths of light at a very low cost per bit

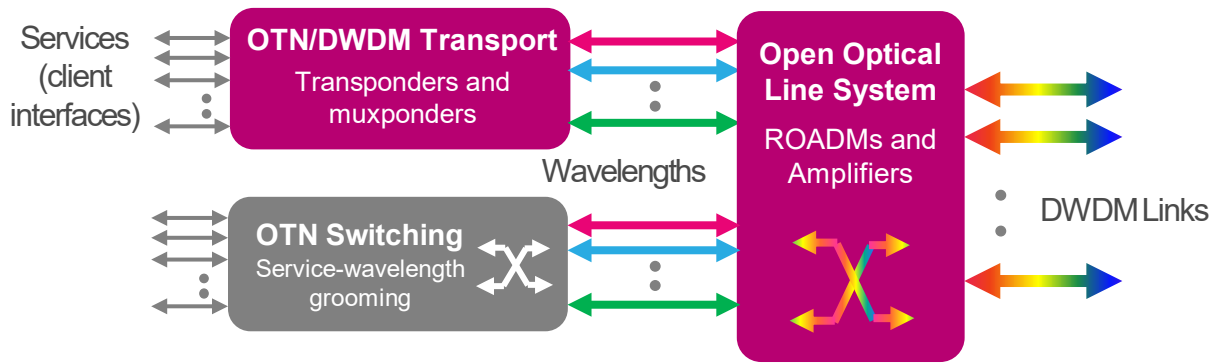
- **Transponders & muxponders** map services onto wavelengths
- **ROADMs** (reconfigurable optical add/drop multiplexers) route wavelengths over DWDM links
- **OTN switches** groom services traffic in about 30% of networks



DWDM (Dense Wavelength Division Multiplexing) links carry many wavelengths simultaneously

Apollo Optical Networking Portfolio

9400 Series High Density Applications	9600 Series Modular Applications	9900 Series OTN switching
 <p>9408 Optical Transport OLS (Roadmap)</p> <p>Data center residency optimized with telco NEBS</p>	<p>Rich set of optical transmission and line system cards, usable across all platforms without engineering rules</p> <p>Telco and data center</p>  <p>9603 9608/D 9624</p>	<p>Granular service control</p> <p>Used in about 30% of solutions</p>  <p>9901X 9904X 9914 9932</p> <p>400G 2.8T 5.6T 16T</p>



Apollo Capabilities

Capabilities	9400 High Density Transport	9600 Modular Transport	9900 OTN Switching
Service (client) interfaces	100/400GbE OTU4	1/10/25/100/400GbE SAN, TDM, OTN	1/10/100GbE SAN, TDM, OTN
Capacity-reach (performance) optimized line interfaces	5nm-140Gbaud 1200G	5nm-140Gbaud 800G	
Cost-power optimized line interfaces	7nm-64Gbaud 400G	7nm-64Gbaud 400G	7nm-64Gbaud 400G
ROADMs	(Roadmap for 32 degree)	20 degree CDC-F	4-degree
OTN Switching		10G ADM; 400G ADM	400G to 16T
Dynamic Restoration		WSON	ASON
L1 optical encryption	Yes, including options for PQC and QKD key distribution		
Monitoring	Optical performance monitoring and OTDR for fiber health monitoring		

Apollo Optical Networking Highlights

Next Gen High Density

9408 Optical Transport

OLS (roadmap)



Pay as you grow pluggables



4-degrees per 4RU

- 5nm-140Gbaud 1.2T
- Ultra-dense metro 400

F2B cooling plus Telco NEBS

Modular 400G+ Everywhere

Capacity-Reach Optimized

TM800_2 – 140Gbaud λs



5nm-140Gbaud pluggables

- Regional 800G
- Unlimited 400G

Metro Power-Cost Optimized

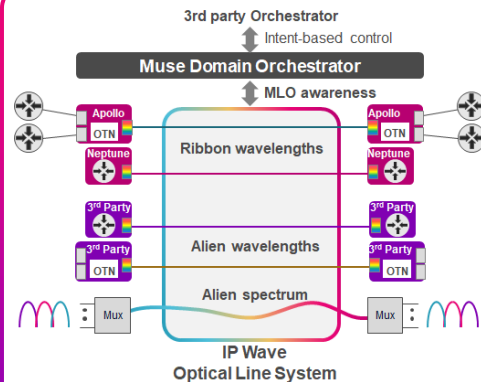
TM400_2



Multisource 400G ZR+ pluggables

- Pay-as-you-grow 400G
- OpenROADM interop

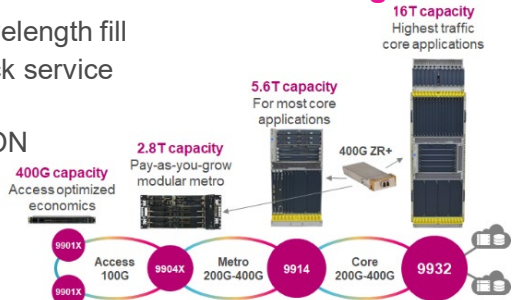
Super OLS



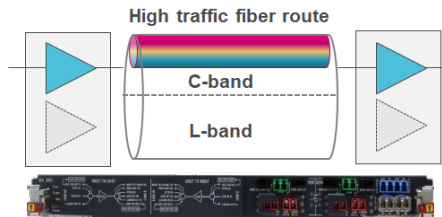
- Any wavelength
- Shared spectrum
- Dynamic WSON restoration
- Optical and fiber health

Access-to-Core OTN Switching

- Optimize wavelength fill
- Point-and-click service provisioning
- Dynamic ASON restoration



C+L Band



Pay as you grow for extra capacity
 Where you need it – When you need it

Open Control Interfaces

Open ROADM OPENCONFIG
 ONF gNMI telemetry
 Optical overlay for SDN applications

Apollo – Connecting the World with Light



Powerful

10G to 1.2T



Modular

Precisely meets customer needs



Intelligent

Advanced SDN features



Open

Multivendor solutions

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IP Routing and Packet Transport with NPT

IP Routing - Global trends



Traffic Growth

- Internet
- Mobile
- VOD
- Online Gaming



Capacity

- IP links growth from 10G to 100G
- Trend to 400G



Topology

- Transition from p2p to rings and mesh topologies
- Distributed DC



Network Simplification

- Less protocols
- Programmability



Openness

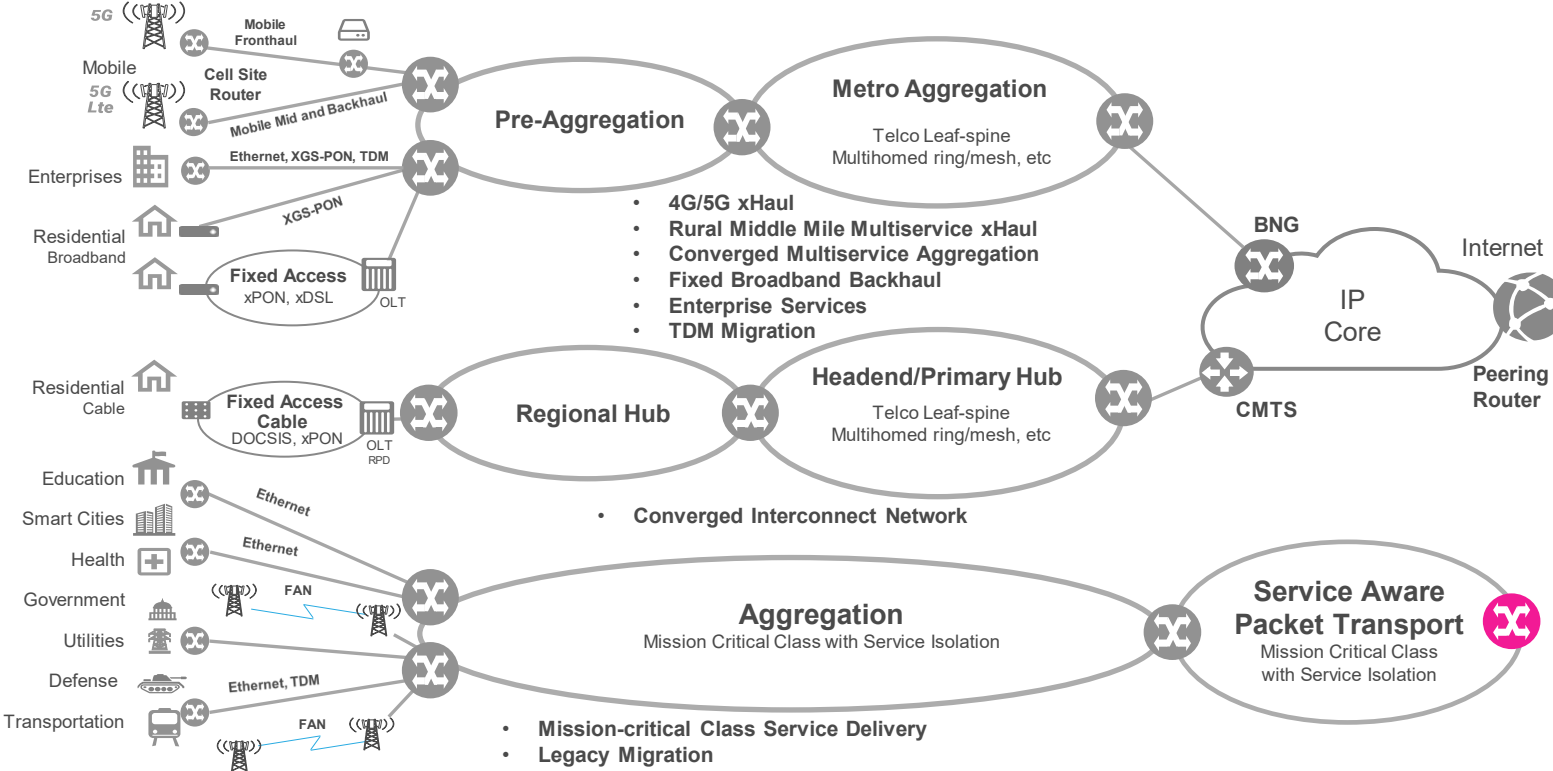
- Standard interfaces
- Decoupling Software from Hardware



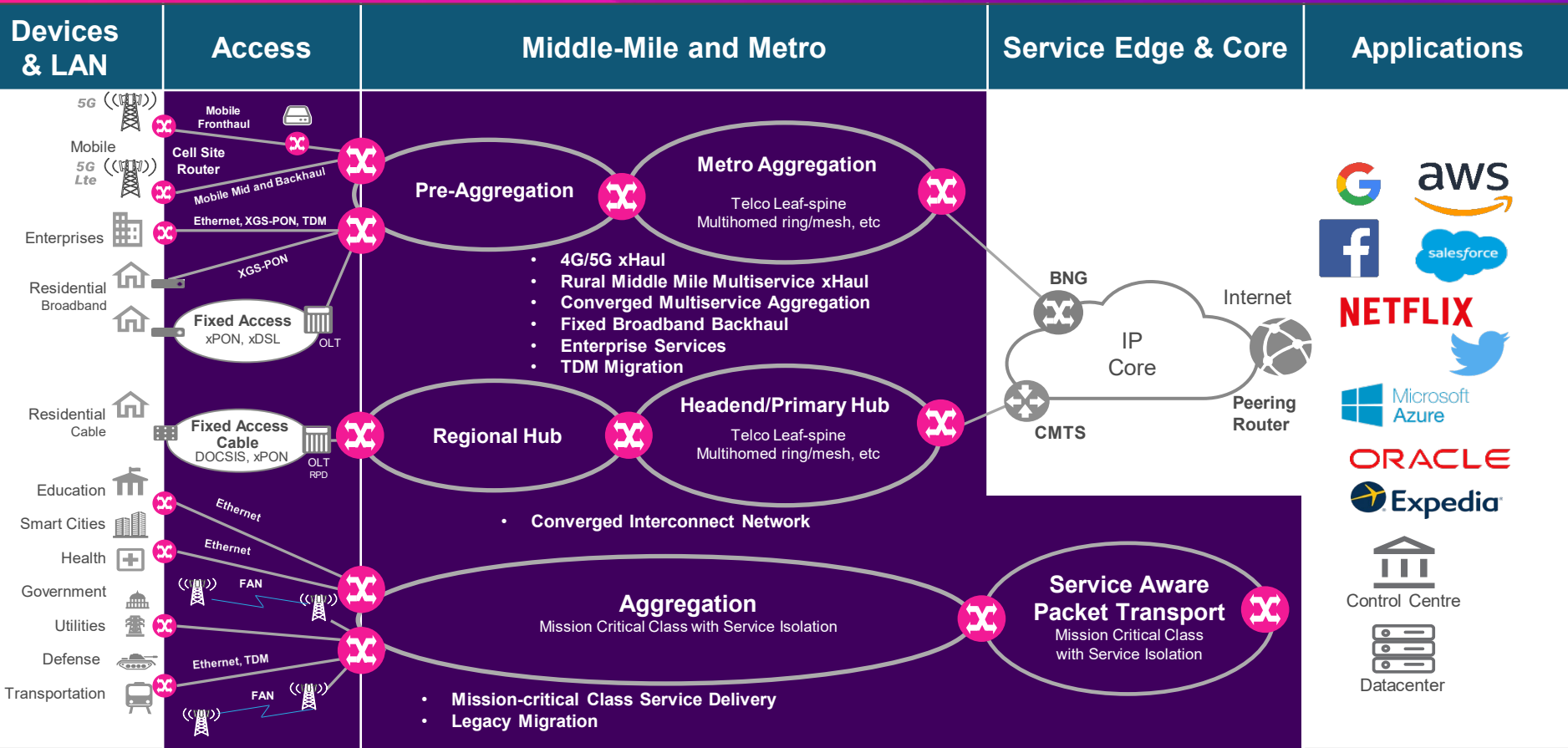
Network Convergence

- TCO savings
- Additional revenues

High-Level Service Delivery Architecture



High-Level Service Delivery Architecture - Where NPT Plays



NPT Three Key Pillars



IP Transport

State of the art IP Wave rNOS



Open, disaggregated

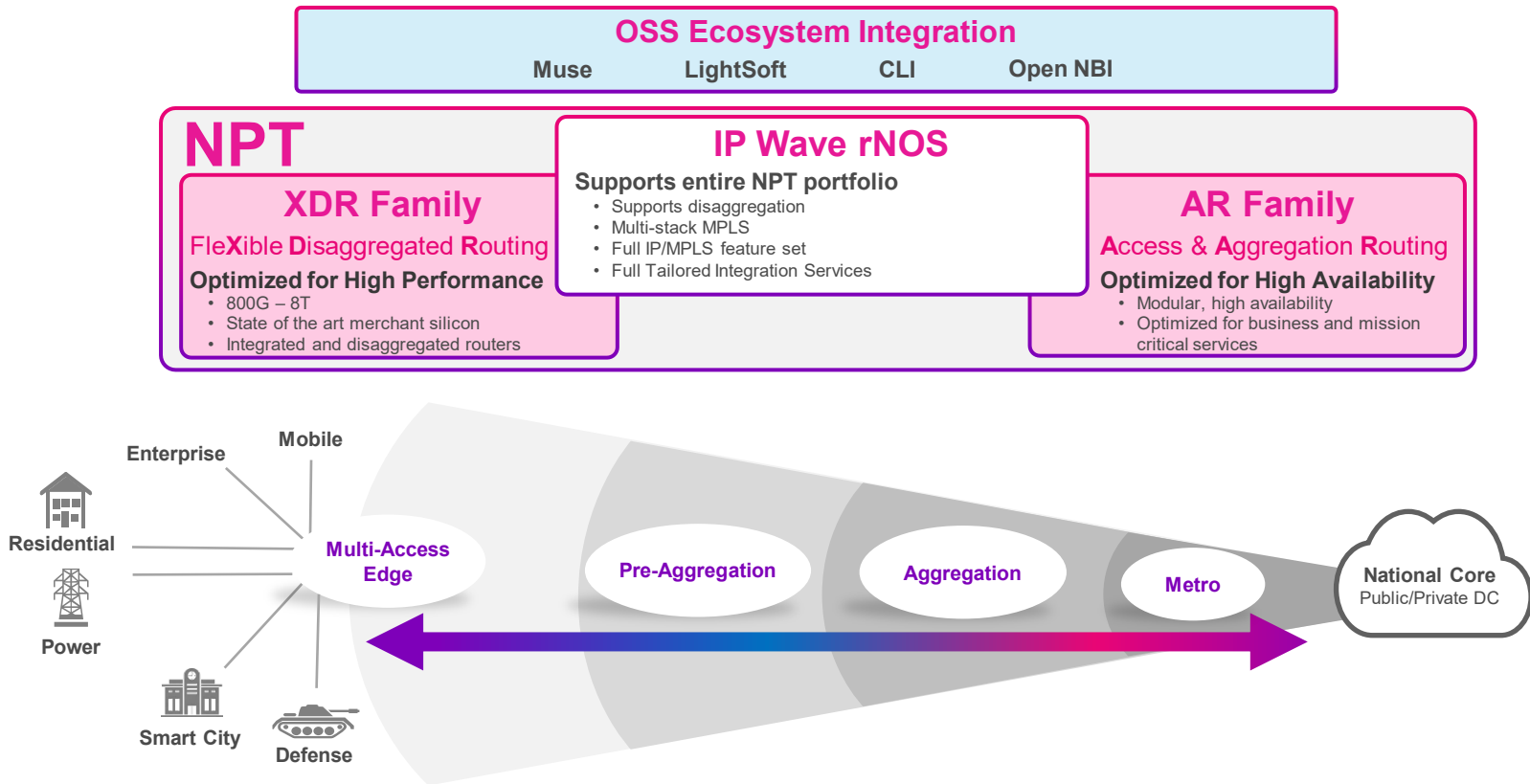
Ready for a new open world



Multiservice

Is our DNA

IP Routing Optimized for Aggregation and Transport



NPT Product Portfolio

NPT AR Family

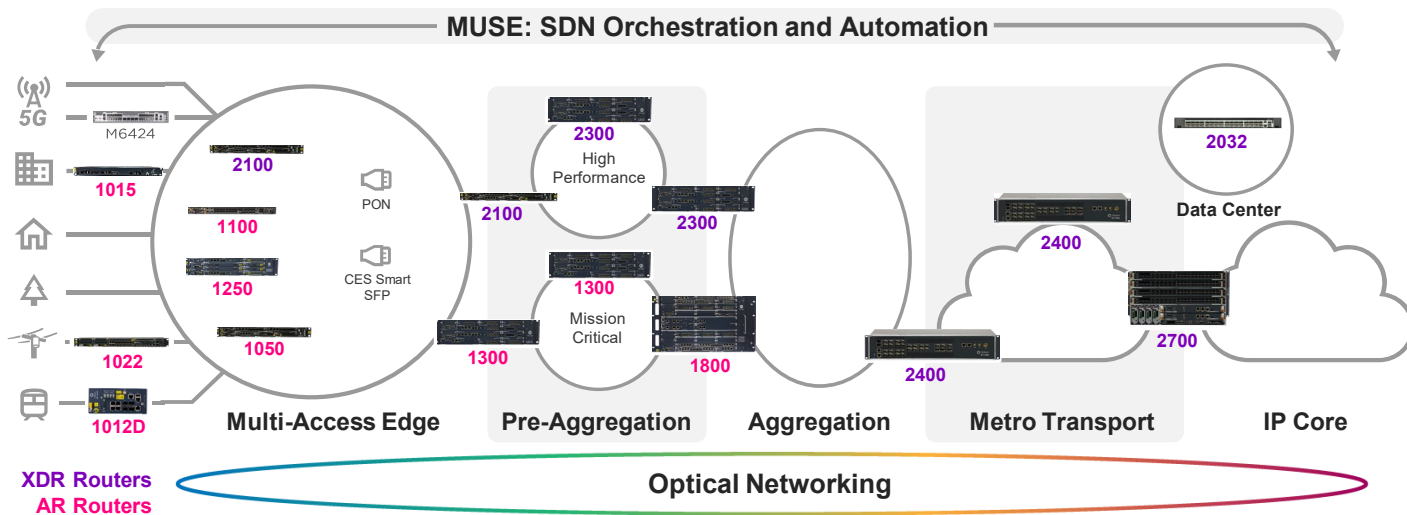
Access and Aggregation Routing

- NPT 1015
- NPT 1012D
- NPT 1022
- NPT 1050
- NPT 1100
- NPT 1250
- NPT 1300
- NPT 1800

NPT XDR Family

Flexible Disaggregated Routing

- NPT 2032
- NPT 2100
- NPT 2300
- NPT 2400

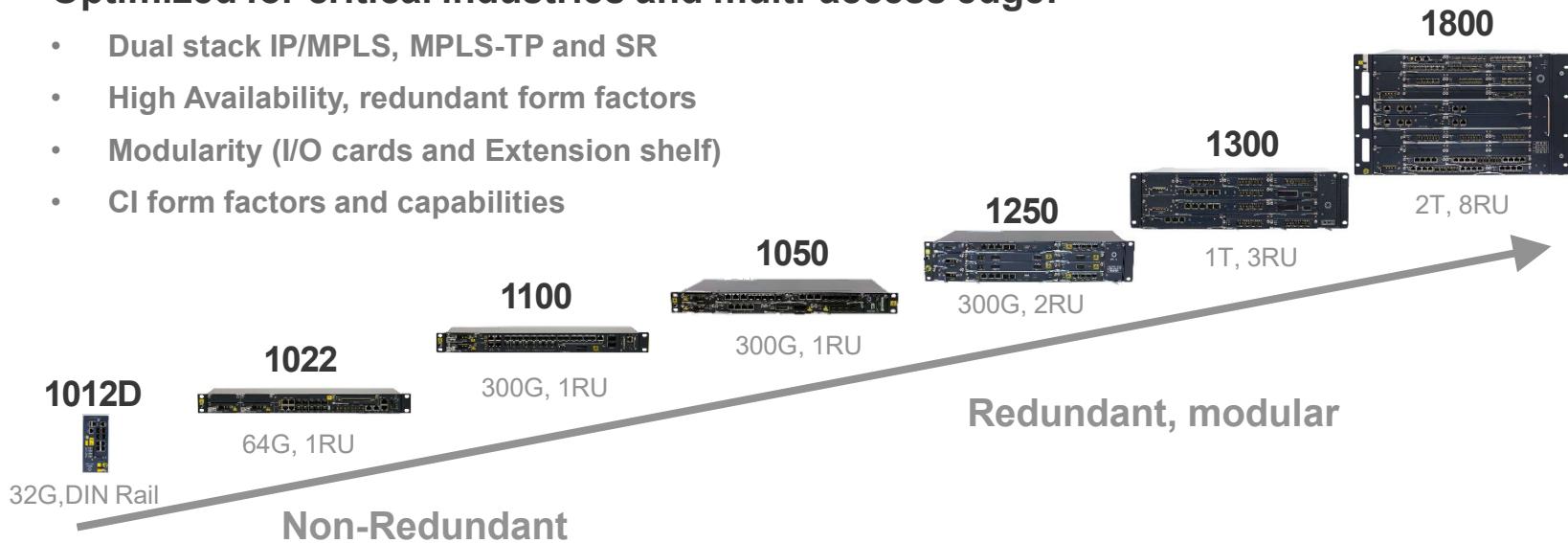


NPT AR Family

Access and Aggregation Routing

Optimized for critical industries and multi-access edge:

- Dual stack IP/MPLS, MPLS-TP and SR
- High Availability, redundant form factors
- Modularity (I/O cards and Extension shelf)
- CI form factors and capabilities

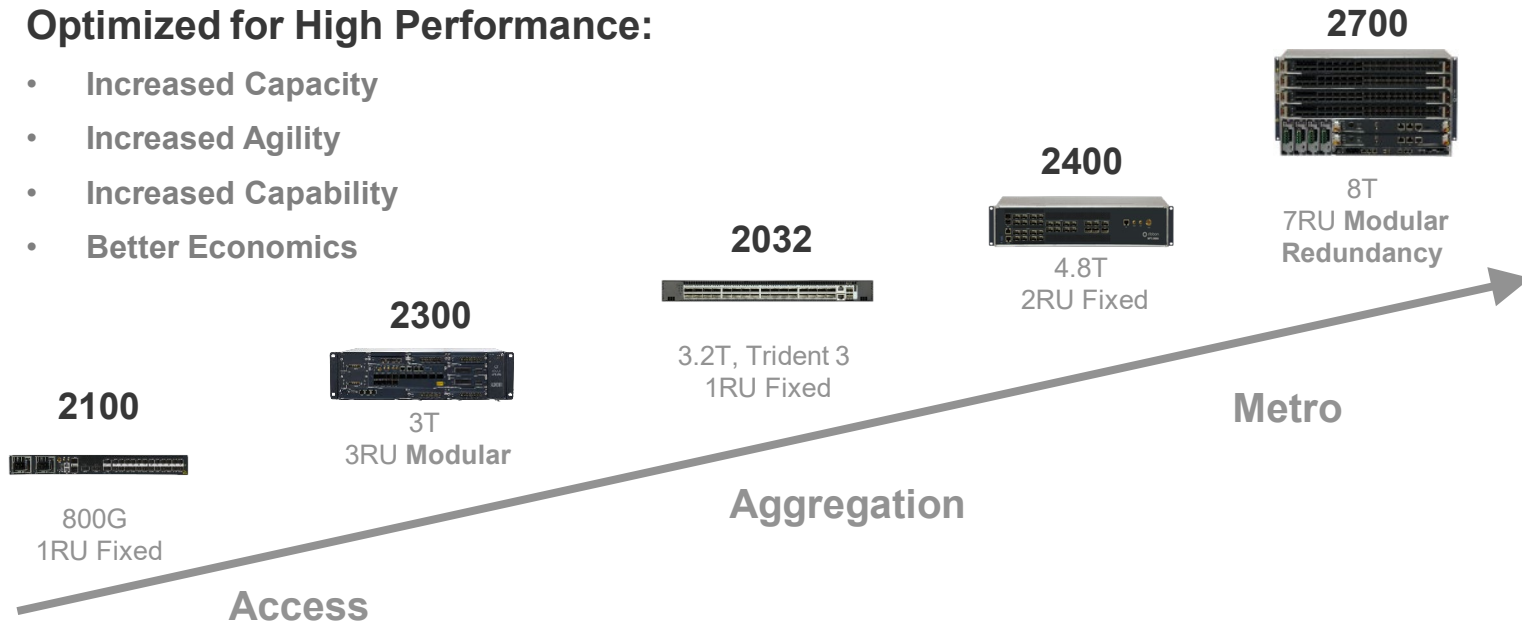


NPT XDR Family

Flexible Disaggregated Routing

Optimized for High Performance:

- Increased Capacity
- Increased Agility
- Increased Capability
- Better Economics

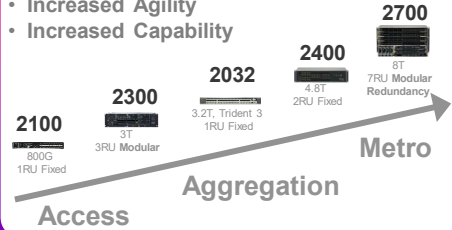


IP Routing and Packet Transport: NPT Highlights

XDR Family

**Flexible Disaggregated Routing
Optimized for High Performance:**

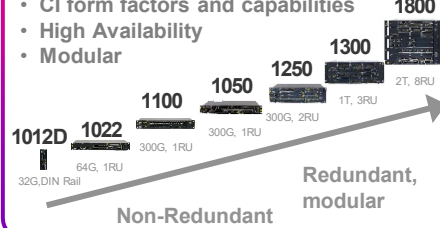
- Increased Capacity
- Increased Agility
- Increased Capability



AR Family

**Access and Aggregation Routing
Optimized for CI :**

- Multi-stack IP/MPLS, MPLS-TP and SR
- CI form factors and capabilities
- High Availability
- Modular



IP Wave rNOS

- Common NOS
- Disaggregation
- Multiple deployment models
- Accelerated innovation

IP Router

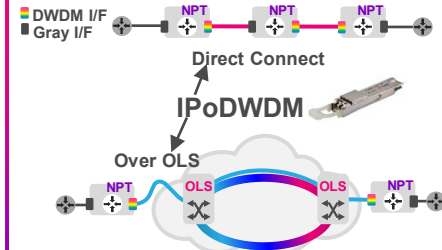


Router Software
(NOS)
Merchant
Silicon



Router
Hardware

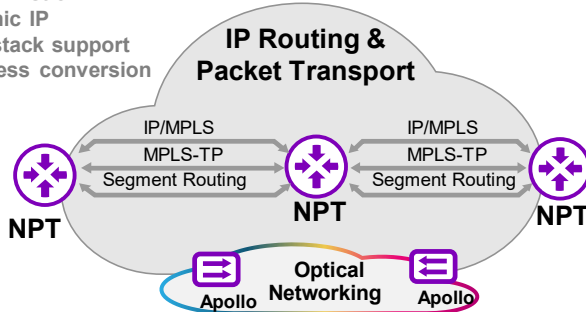
IPoDWDM



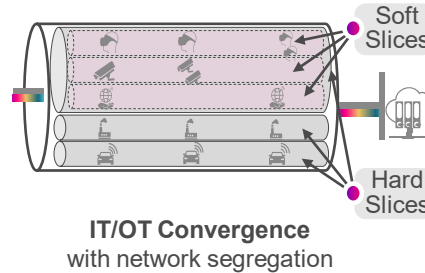
- 400G ZR+
- IPoDWDM (hop-by-hop)
- IP Optical multilayer

Multi-Stack MPLS

- Deterministic IP
- Dynamic IP
- Multi-stack support
- Seamless conversion



Network Slicing

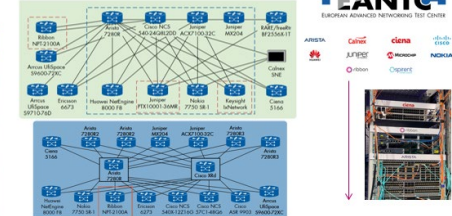


Proven Interoperability

Interoperability: EANTC 2013 - 2023

Ribbon Participation

Year	Test Area
2013	MPLS-TP / I588v2
2016	LDP FRR / L2VPN
2017	NETCONF / L3VPN
2018	Segment Routing NETCONF
2019	SR-TE / PCE
2020	FlexE TSB Class C PTP over MACsec
2021	SR domain & Timing domain
2022	SR-MPLS TE & EVPN
2023	EVPN-VPWS / SR-TE & FlexAlgo



- SR-MPLS: VPN services and SR-TE**
 - SR-TE Per-Destination traffic steering
 - SR-TE FlexAlgo & TLFA
 - SR-MPLS PCE initiated LSP - interop with PCE (Cisco/Jumper/ Nokia)
- EVPN-MPLS**
 - EVPN VPWS
 - EVPN VPLS
 - Multihoming PE
 - MAC Mobility

The background features a dark blue grid pattern that recedes into the distance, creating a sense of depth. Scattered throughout the grid are small, glowing red and orange dots. The entire scene is framed by a bright blue neon border with rounded corners. At each of the four corners, there is a white star icon.

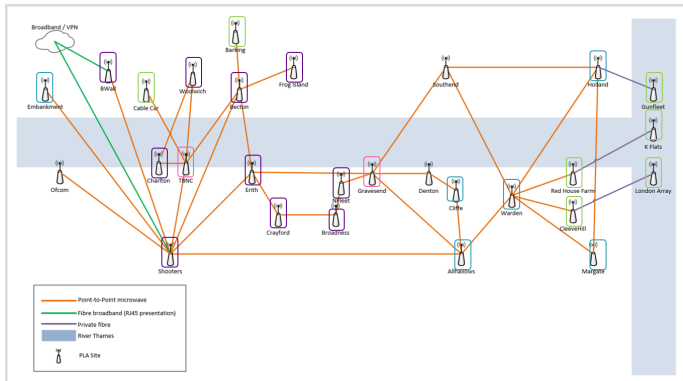
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Case Studies: Features in Practice

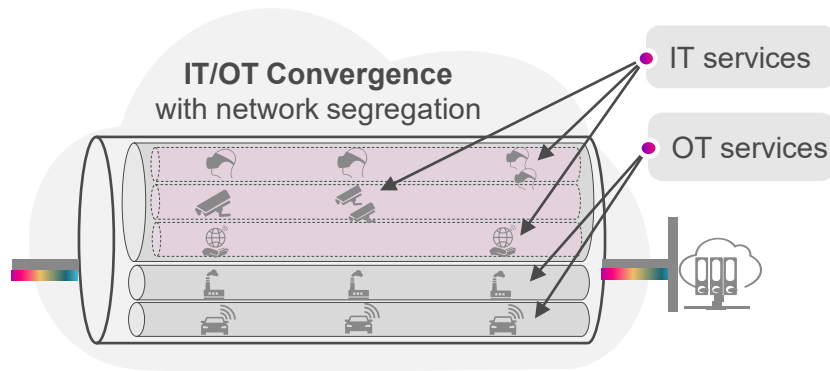
Critical Infrastructure Modernization: Deterministic Packet Transport

Port Authority



- Field proven packet transport processes and technology network for safety critical services
- High availability, deterministic packet transport with NPTs best-in-class MPLS-TP

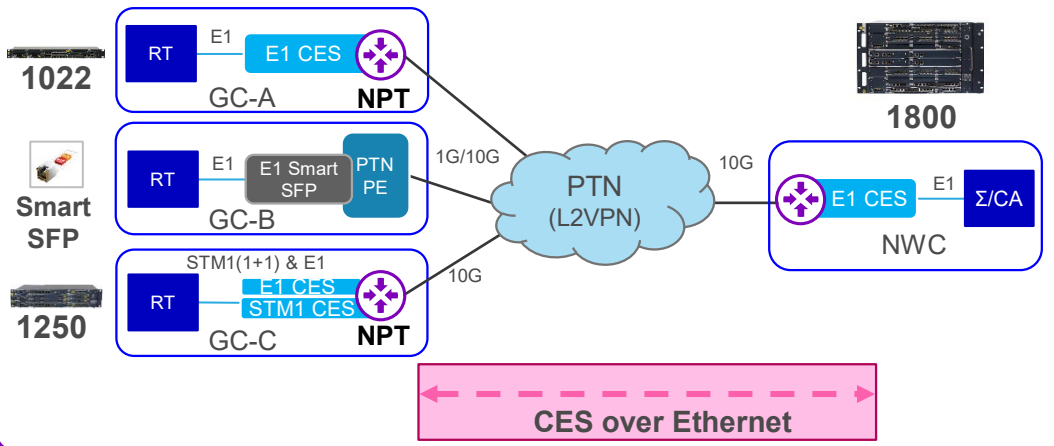
Large Utility



- Complete IP Optical network with **multi-layer slicing** based on SR-TE, Flex- Algo, FlexE, MPLS-TP, Wavelengths

Service Providers and Critical Infrastructure: TDM Migration

Tier 1 Service Provider



- Edge aggregation for SDH circuits
- 22,000 ports to be migrated within 3 years

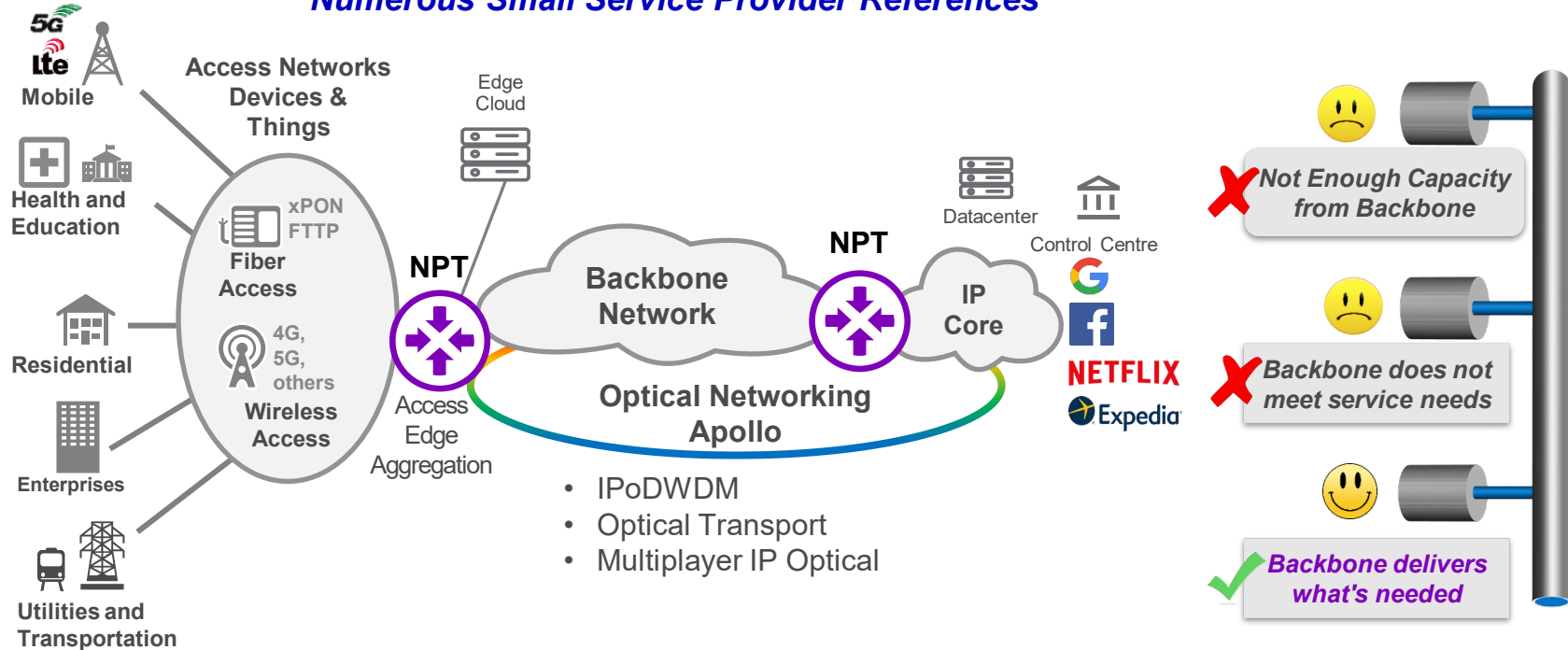
European Power Company



- **Field proven, risk-free**, for migrating legacy network, using **CES in conjunction with MPLS-TP**
- **Multi-stack IP/MPLS and MPLS-TP**

Service Provider Modernization: The New Middle Mile

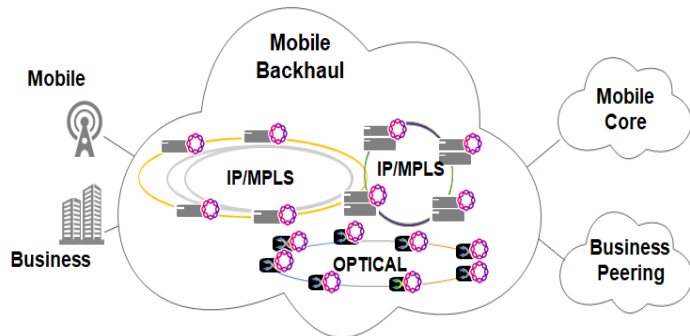
Numerous Small Service Provider References



Great broadband needs more than big access pipes

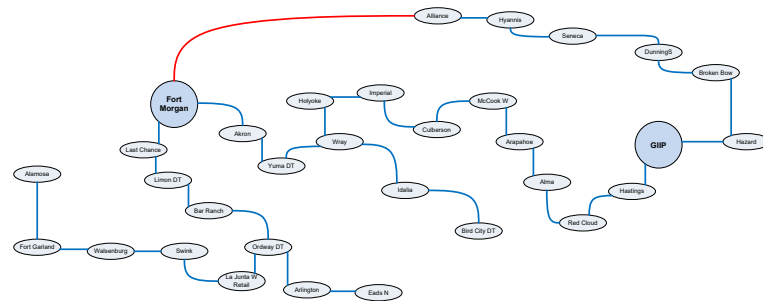
Multiservice xHaul

Super large MNO in India



- Modernize for 5G readiness
- Upgrade from MPLS-TP to IP/MPLS using NPT dual stack routers
- Proven interworking with Cisco and Nokia
- Supports enterprise solutions

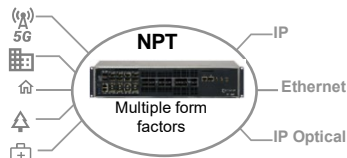
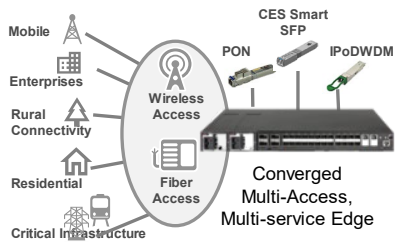
Mid-size MNO in US



- For own use and xHaul wholesaling
- Integrated IP Optical solution
- 1G and 10G aggregation with MPLS
- 200G DWDM optical backbone scalable to 400G

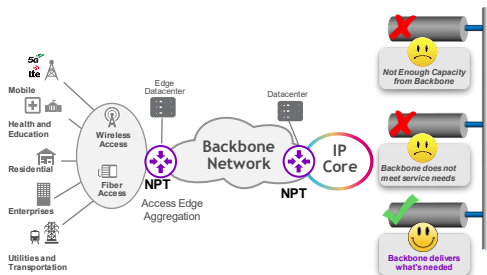
IP Routing and Packet Transport Applications with NPT

Multi-Access Edge and Optimized Aggregation



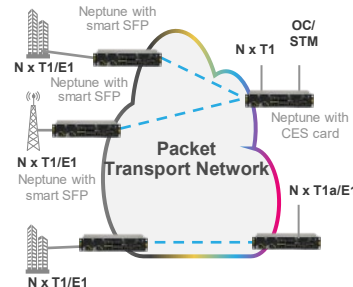
- Right-fit, performance-cost optimized aggregation
- Disaggregated and integrated router options

New Middle Mile



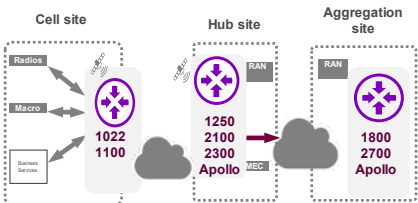
Great broadband needs more than big access pipes

TDM to IP Migration



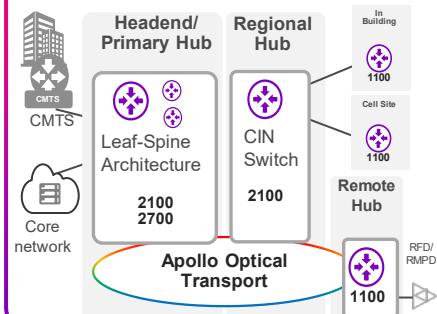
Multiservice xHaul

- 5G native features
- Multi-tenancy supports solutions for both MNO and wholesalers

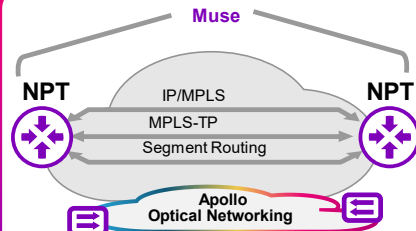


- DSCG
- Cost optimized
- Multiservice
- IP Optical
- Capacity
- Performance

CIN



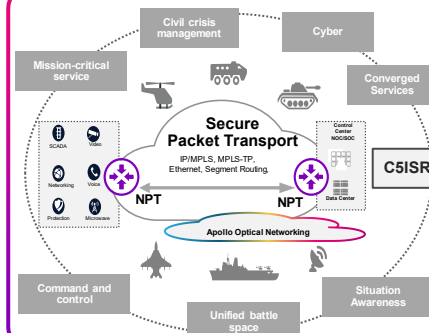
Critical Infrastructure



Packet Solutions Optimized for CI

- Risk-free migration
- Secure and survivable
- Multi-stack IP

Defense





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