



ribbon

TECH FORUM 23



IP Routing and Packet Transport with NPT

David Stokes

Head of IP Solutions and IP Portfolio Marketing

IP Wave Portfolio

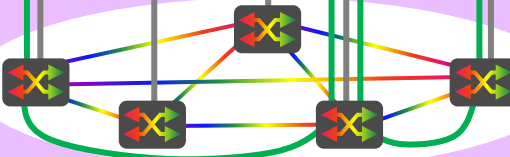
Muse
SDN Domain
Orchestrator



NPT
IP Routers



Apollo
Optical Networking
Systems



Ribbon
Professional
Services

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

NPT is Targeted At All Network Operator Types

Service Providers

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

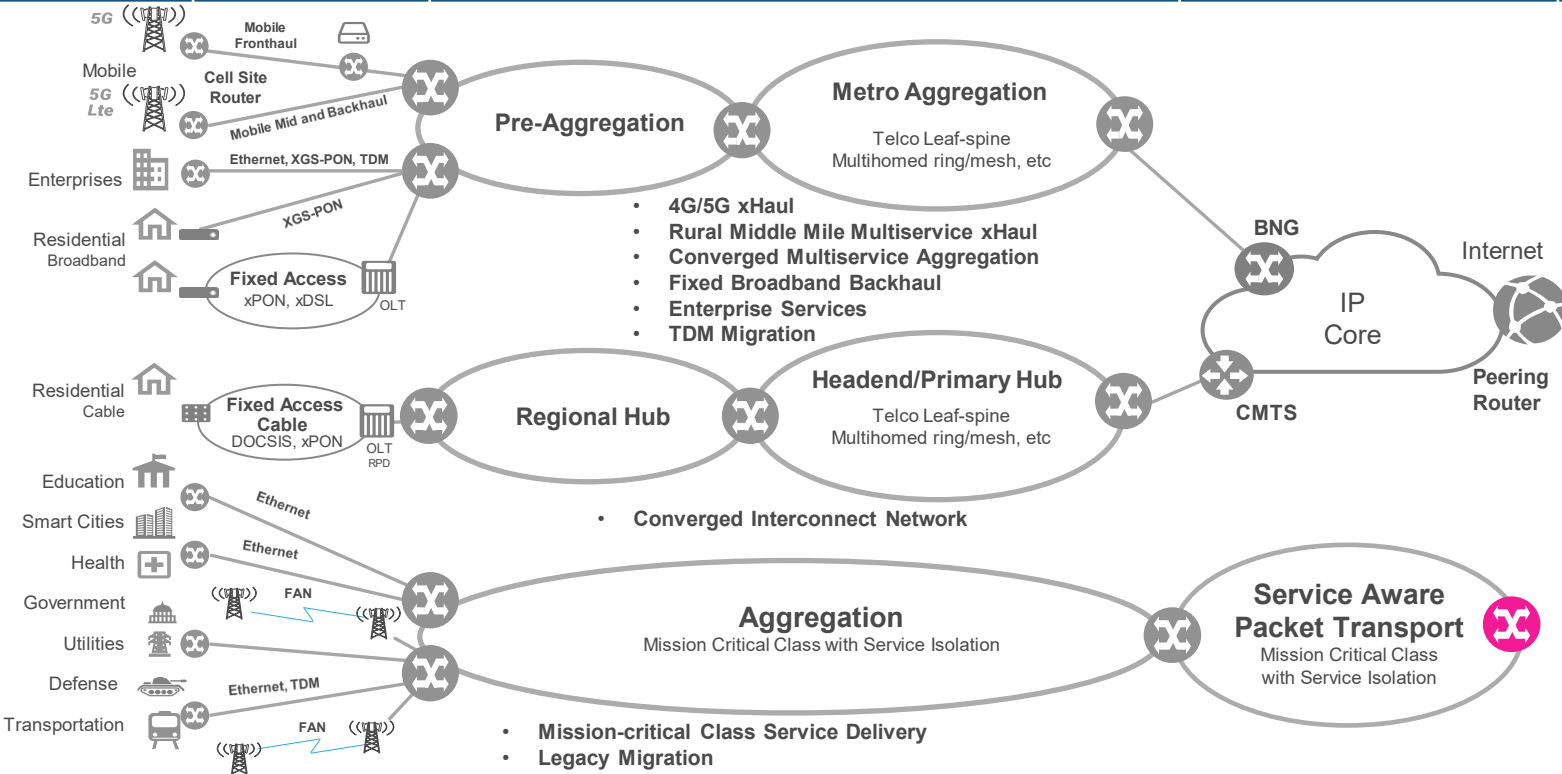


Critical Infrastructure

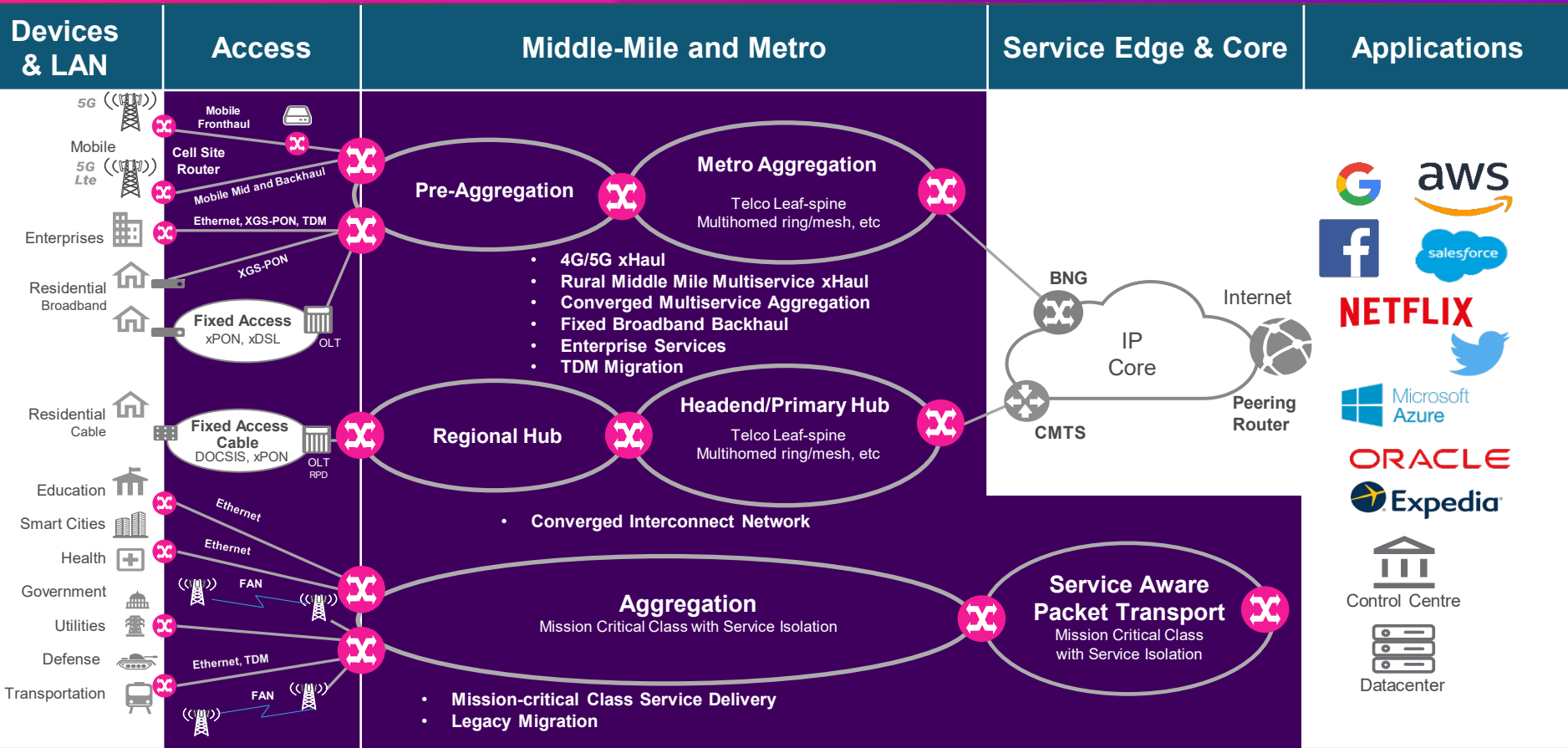
- SCADA Backhaul (Power, Railway, Oil & Gas)
- U-Telco
- Smart City
- Defense



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

OSS Ecosystem Integration

Muse

LightSoft

CLI

Open NBI

NPT

XDR Family

FlexiBle Disaggregated Routing

Optimized for High Performance

- 800G – 8T
- State of the art merchant silicon
- Integrated and disaggregated routers

IP Wave rNOS

Supports entire NPT portfolio

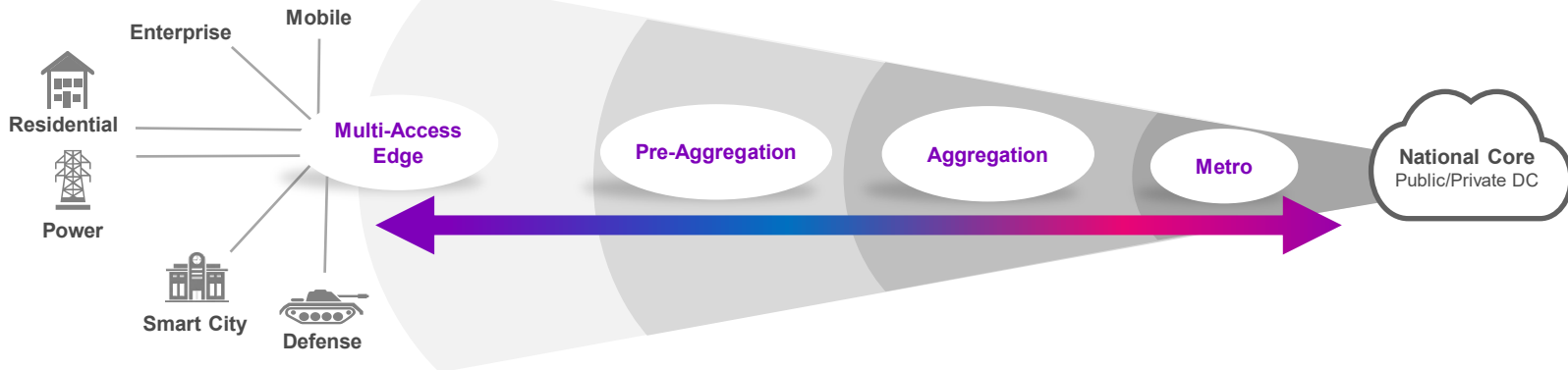
- Supports disaggregation
- Multi-stack MPLS
- Full IP/MPLS feature set
- Full Tailored Integration Services

AR Family

Access & Aggregation Routing

Optimized for High Availability

- Modular, high availability
- Optimized for business and mission critical services



NPT Product Portfolio

NPT AR Family

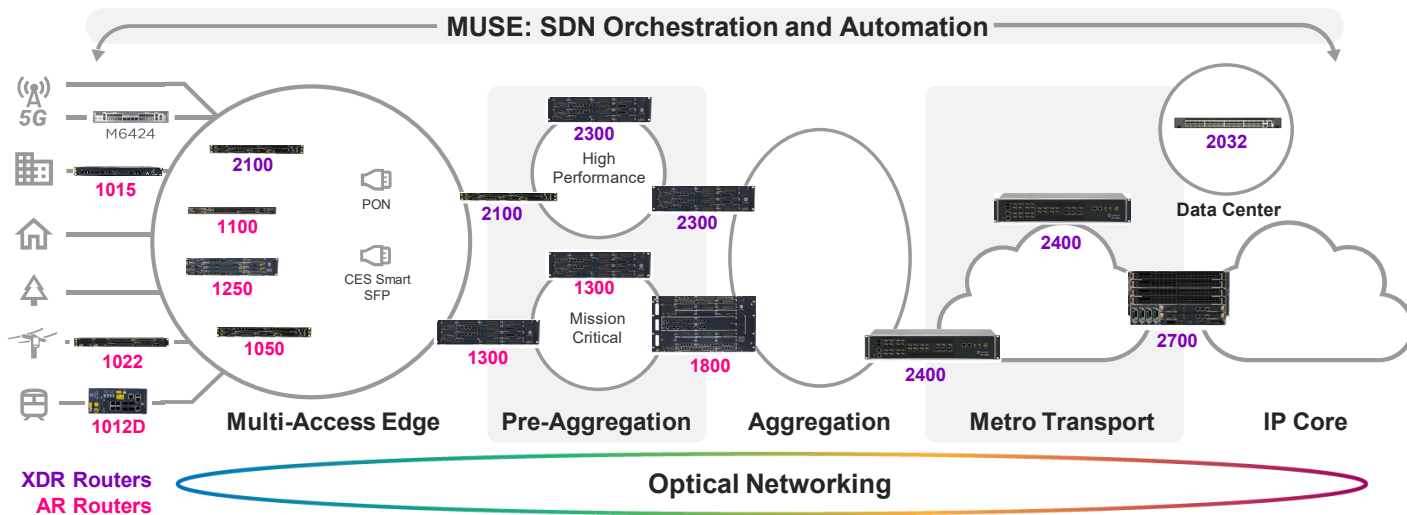
Access and Aggregation Routing

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

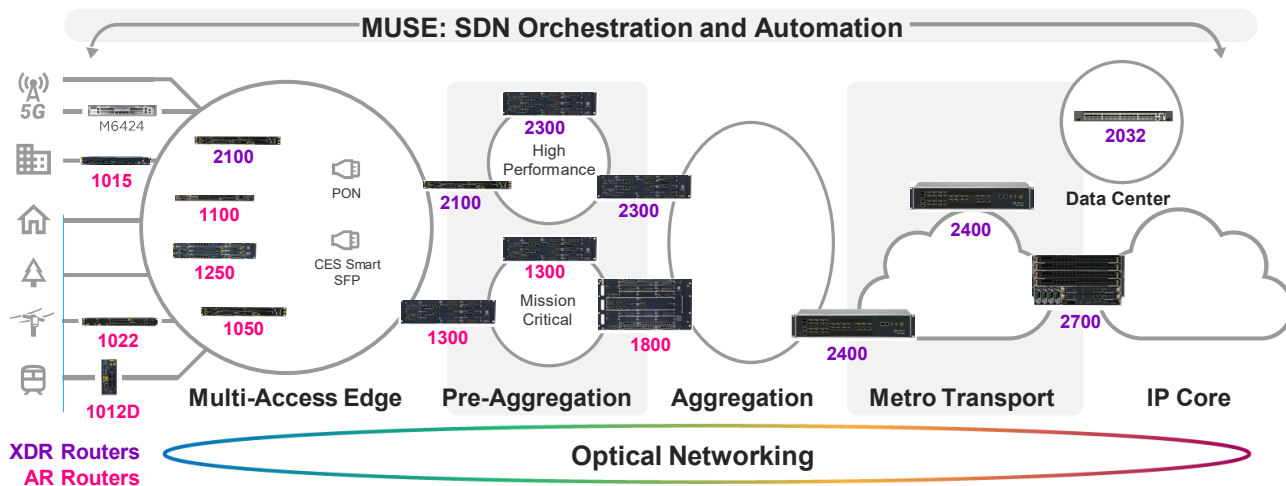
NPT XDR Family

Flexible Disaggregated Routing

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



NPT Product Portfolio



NPT XDR Family

FlexiBle Disaggregated Routing- Optimized for High Performance

	Access Routers	Aggregation Routers	Metro Routers	Data Centre Switch	
	NPT 2100	NPT 2300	NPT 2400	NPT 2700	NPT 2032
FIT	High Performance Access Edge & Pre-aggregation	High Performance Multiservice Aggregation	High Performance Metro Edge Aggregation Router	High-Capacity Aggregation and Metro Transport	Top of Rack Data Center Switch
Capacity	800G	2.4Tbps	4.8Tbps	8Tbps	3.2 Tbps
Silicon	Qumran 2a	Jericho 2C	Jericho 2	Jericho 2C	Trident 3
Height	1 RU	3 RU	2 RU	7 RU	1 RU

NPT AR Family

Access and Aggregation Routing - Optimized for High Availability

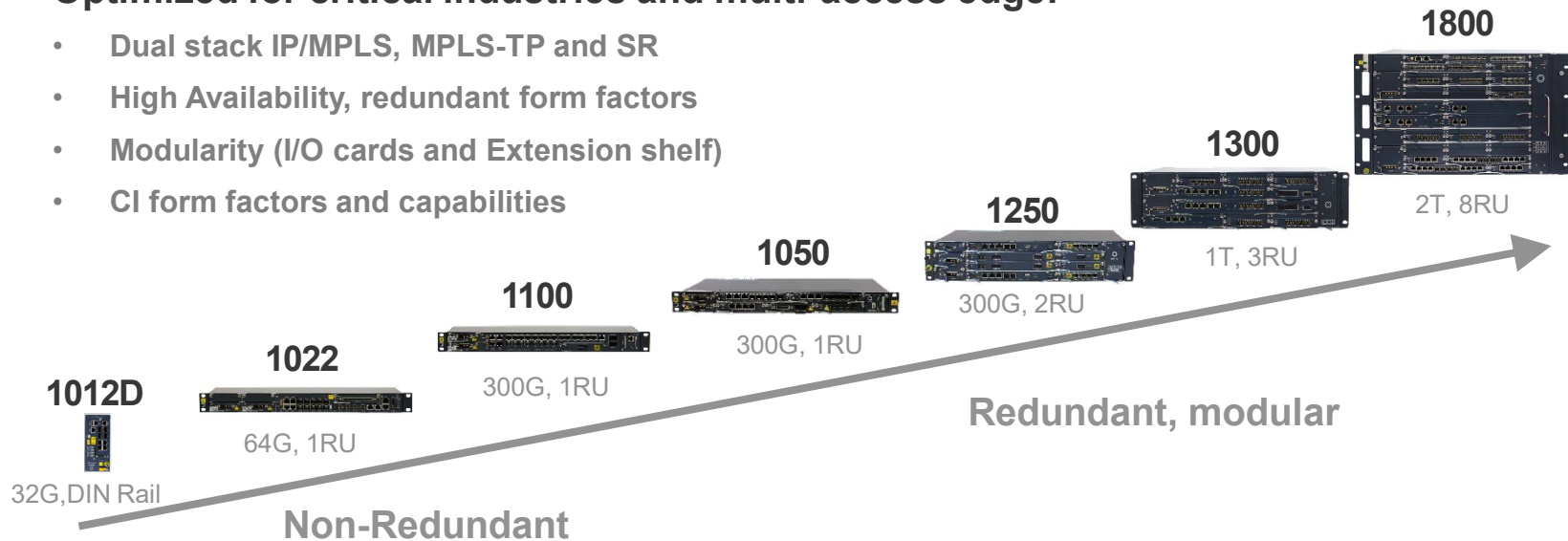
	Compact CPE Devices		Access Routers		Aggregation Routers			
	NPT 1012D	NPT 1022	M6424	NPT 1050	NPT 1100	NPT 1250	NPT 1300	NPT 1800
FIT	Critical infrastructures and CPE demarcation	High-capacity CPE and Access Router, 5G Optimized	Converged CPRI Fronthaul	High Availability Access Edge	Access Edge and Pre-aggregation, 5G optimized	High Availability Access Edge and Pre-aggregation	High Availability Multiservice Aggregation	High Availability Multiservice Aggregation
Capacity	32 Gbps	64 Gbps	800 Gbps	300 Gbps	300 Gbps	300 Gbps	1 Tbps	2 Tbps
Silicon	Qumran-UX	Qumran-UX	Monterey	Qumran-AX	Qumran-AX	Qumran-AX	Qumran-MX	Jericho+
Height	Din-Rail	1 RU	1 RU	1 RU	1 RU	2 RU	3 RU	8 RU

NPT AR Family

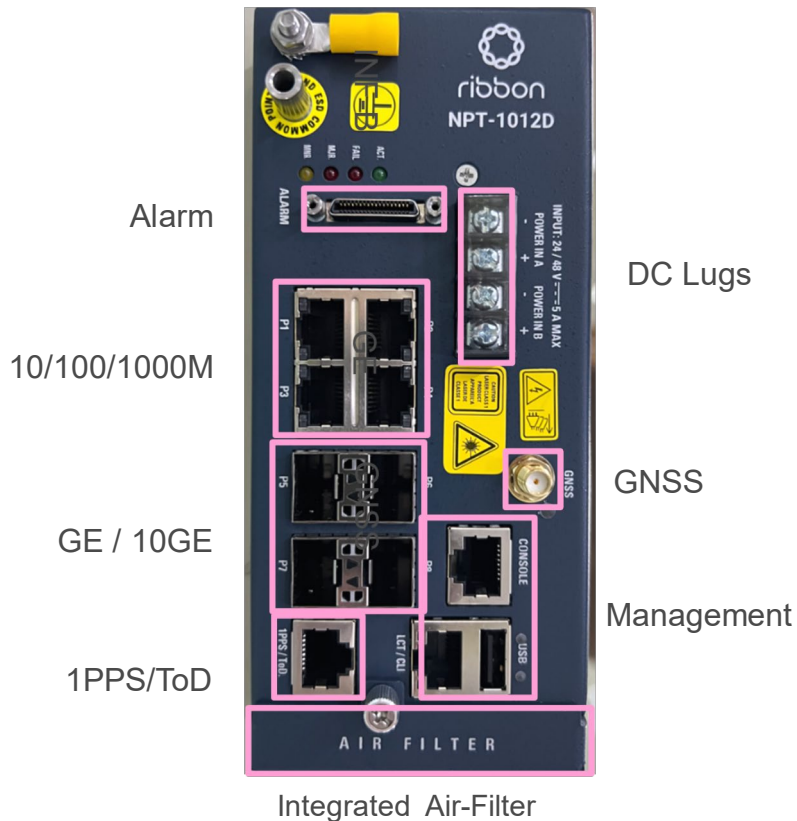
Access and Aggregation Routing

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



New Additions To NPT AR Family: NPT 1012D



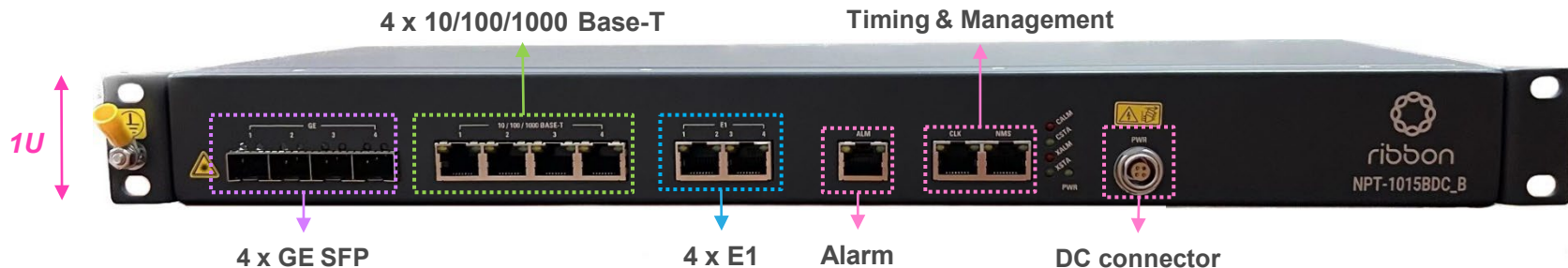
DESCRIPTION

- 1RU, Modular architecture
- Qumran-UX with 32G non-blocking Switching capacity
- 44G Fan-Out
- Temperature Hardened (-20c) – (+65)
- SDN interfaces – NETCONF/YANG

INTERFACES

- 4 x 1/10G
- 4 x 1G (RJ45, 10/100/1000Base-T)
- USB – Zero Touch Installation - ZTI
- Timing : GNSS, 1PPS, TOD, BIT, G.8273.2 Class C

New Additions To NPT AR Family: NPT 1015



DESCRIPTION

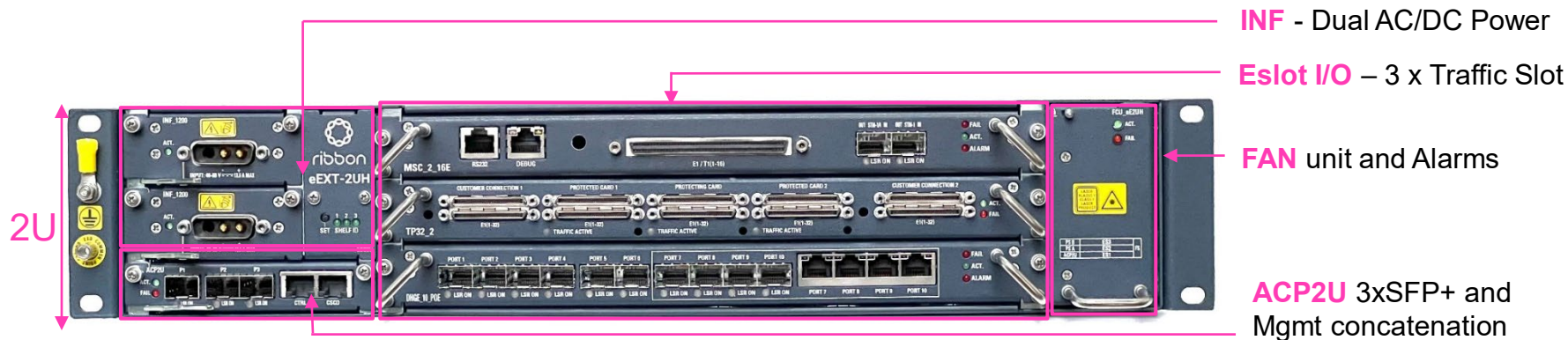
L2 CPE

- 1RU
- 8G non-blocking Switching capacity & Fan-Out
- Fanless & Temperature hardened -5°C to +50°C (-13°F to 149°F)
- Typical power dissipation : DC 25W, AC 27W
- Multi-Service applications (Ethernet / CES)

INTERFACES

- 4 x GE
- 4 x 10/100/1000M Base-T
- 4 x E1 (SATO P)
- Timing : BITS T3/4, 1588v2 G.8275.1, G8275.2 Class C.
- Few Inter-op limitations, mostly around :
- PW 1:1 protection, , 802.1ag CFM / Y.1731 and CES with DCR clock.

New Additions To NPT AR Family: eEXT-2UH



Expansion shelf with High slot capacity

- Supports 3 x E-slot I/O modules
- 10G switching capacity per E-slot
- Management Concatenation options (up to 3 units)

Port Fan-out:

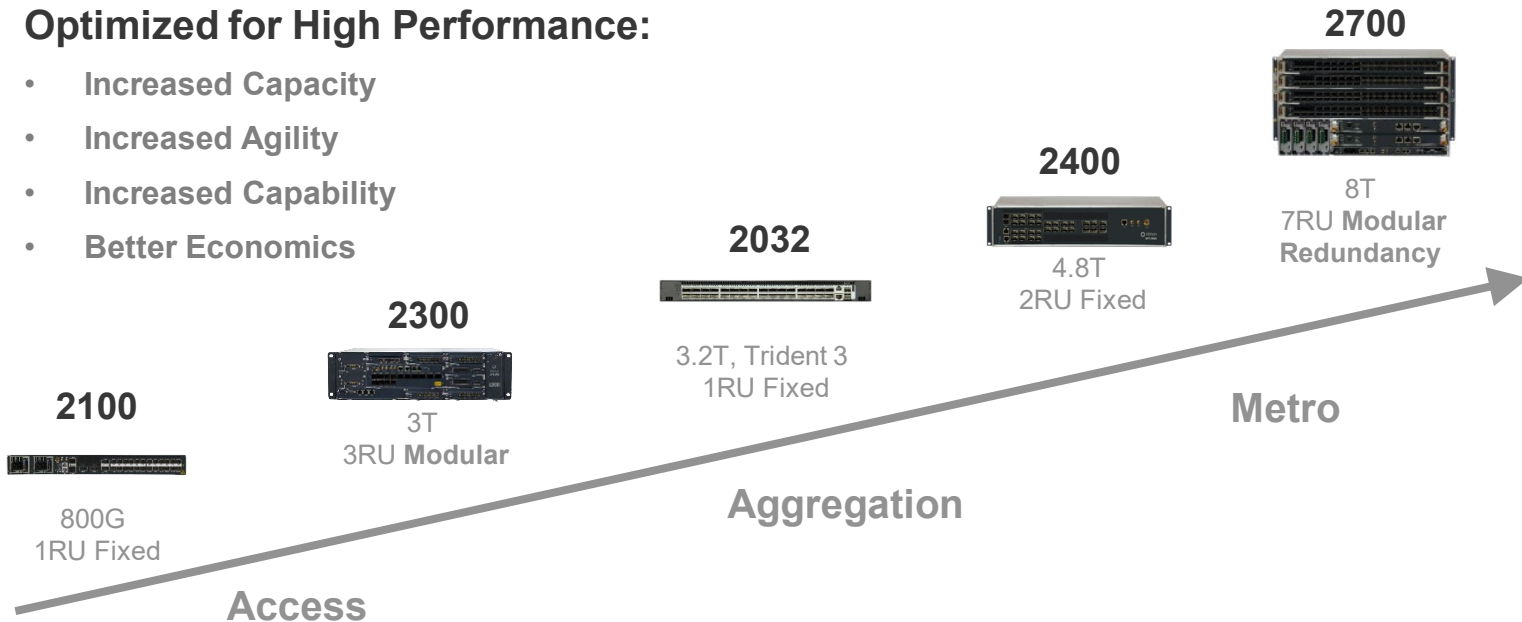
- GE , PoE+
- Legacy – PCM interfaces
- Optical components – AMP , DCF
- CES

NPT XDR Family

Flexible Disaggregated Routing

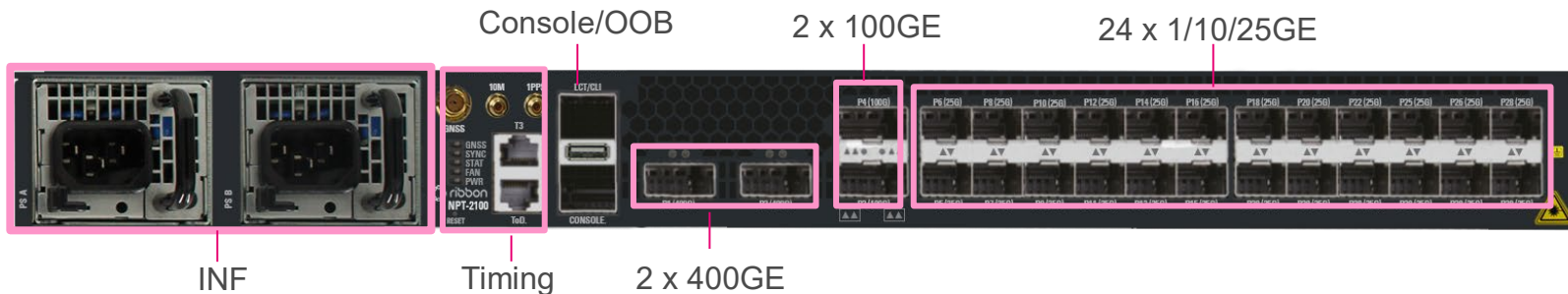
Optimized for High Performance:

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



New Additions To NPT XDR Family: NPT 2100

Launched and Deployed in 2023



DESCRIPTION

- 1RU, Fixed
- DNX 7th gen - Broadcom Q2A
- Modular , Redundant
- Power (AC/DC) and FAN (5xUnits) level
- Hardened (-40c) – (+65)
- Dimension (WxDxH): 440 x 300 x 44mm (1RU)
- SDN interfaces – NETCONF/YANG

INTERFACES

- 2 x QSFP_DD (100G/200G/400G) – FlexE capable
- 2 x QSFP28 (100G/50G)
- 24 x SFP28 (25G/10G/1G)
- Timing: 1PPS, 10MHz, GNSS ANT, ToD and BITS (8273.2 Class C)

New Additions To NPT XDR Family: NPT 2300



Description

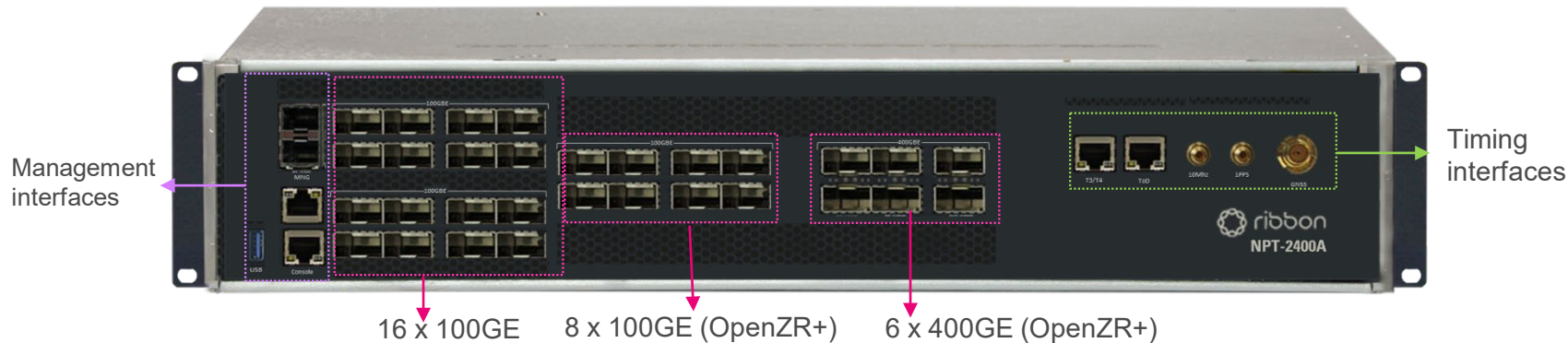
High Performance Multiservice Aggregation

- Jericho 2C with 2.4 T packet processing, 3T Fan-out ports
- Compact platform (only 3U) with modular architecture
- Commons redundancy (Fan, input power)
- Modular design, 7xtraffic slots for multi service applications (Ethernet, CES, MACsec)
- Add on extension for PCM, GBE and optical amplifiers
- SDN interfaces: NETCONF/YANG

Interfaces

- 4x400G, 7xOTUC-2 (CFP2)
- 30x100G (QSFP28/DD) , 88x25G, 88x10G, 178 GE ports (CSFP + eEXT-2HU)
- Coherent interfaces for 400G/200G/100G QSFP_DD ZR/ZR+
- Multi rate support - 1G/10G/25G, 100/200/400G
- Fan-out ports – 4x10G/25G, 4x/100G

New Additions To NPT XDR Family: NPT 2400



Description

High Performance Metro Edge Aggregation

- Broadcom Jericho2 BCM88690
- 2RU, Fixed
- Modular , Redundant – Power (AC/DC) and FAN (4xUnits) level
- Operational Temp: -5 °C - 50 °C
- Dimensions: 436.0 mm (W) x 762.0 mm (D) x 87.7 mm (H)
- Airflow: Front to Back

Interfaces

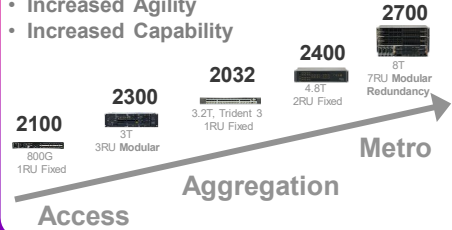
- 24x100GE QSFP28 (support 8x100G OpenZR+)
- 6x400G QSFP-DD
- Up to 48x10GE/25GE breakout interfaces
- Timing: GNSS, ToD, 1PPS and 10MHz, BITS
- SyncE and IEEE 1588V2 (T-GM,T-BC/OC)

IP Routing and Packet Transport: NPT Highlights

XDR Family

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

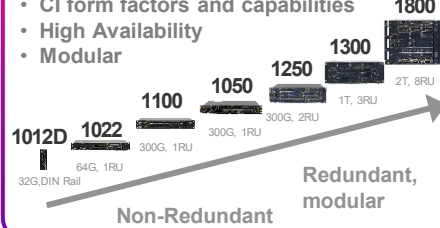
- Increased Capacity
- Increased Agility
- Increased Capability



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

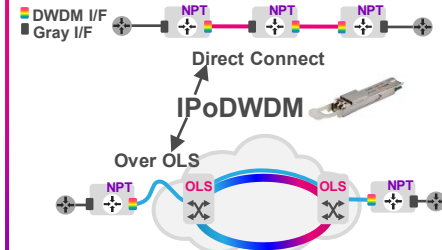
IP Router



Router Software (NOS)
Merchant Silicon
Router Hardware



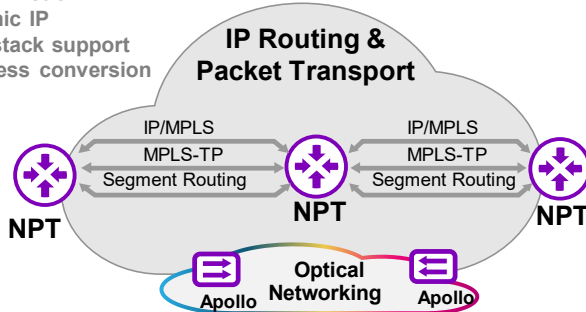
IPoDWDM



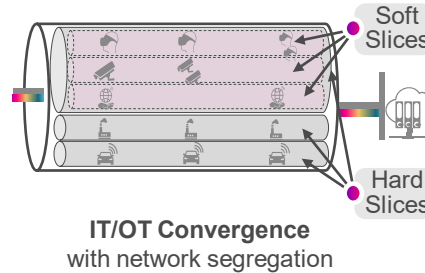
- 400G ZR+
- IPoDWDM (hop-by-hop)
- IP Optical multilayer

Multi-Stack MPLS

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



Network Slicing

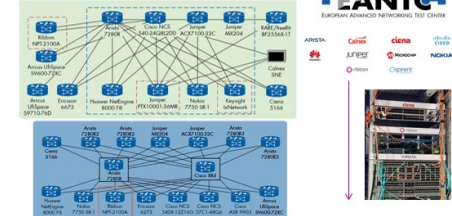


Proven Interoperability

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 1588 Class C PTP over MACsec
2021	SR domain & Timing domain
2022	SR-MPLS TE & EVPN
2023	EVPN-VPWS / SR-TE & FlexAlgo



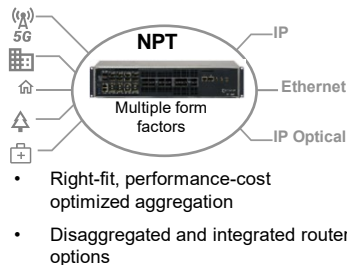
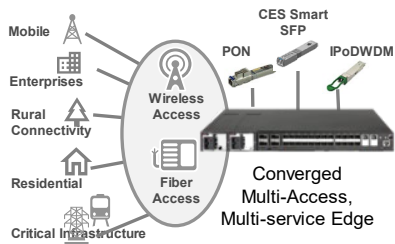
- SR-MPLS: VPN services and SR-TE**
 - SR-TE Per-Destination traffic steering
 - SR-TE FlexAlgo & TLFA
 - SR-MPLS PCE initiated LSP - interop with PCE (Cisco/Jumper/ Nokia)
- EVPN-MPLS**
 - EVPN VPWS
 - EVPN VPLS
 - Multihoming PE
 - MAC Mobility



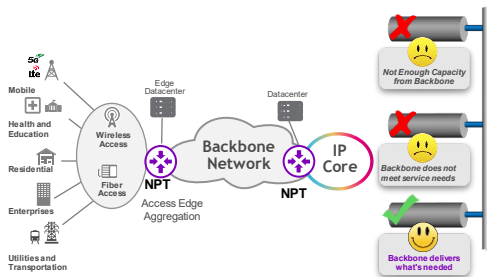
NPT Applications

IP Routing and Packet Transport Applications with NPT

Multi-Access Edge and Optimized Aggregation

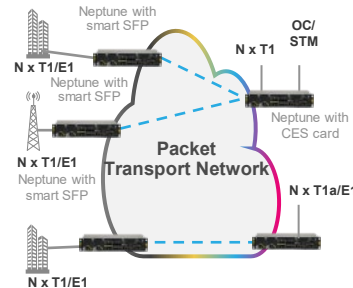


New Middle Mile



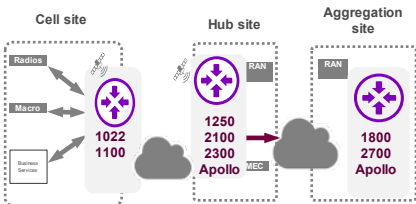
Great broadband needs more than big access pipes

TDM to IP Migration



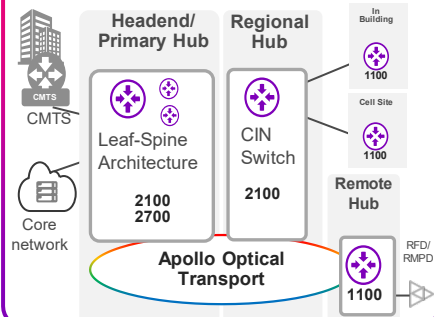
Multiservice xHaul

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

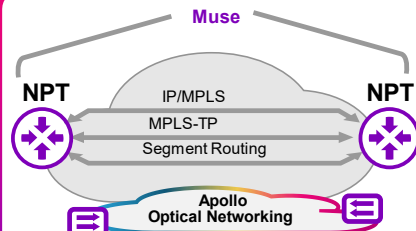


- DSCG
- Cost optimized
- Multiservice
- IP Optical
- Capacity
- Performance

CIN



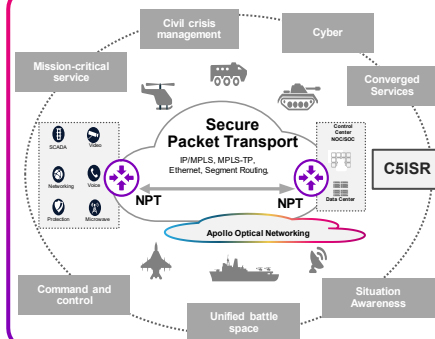
Critical Infrastructure



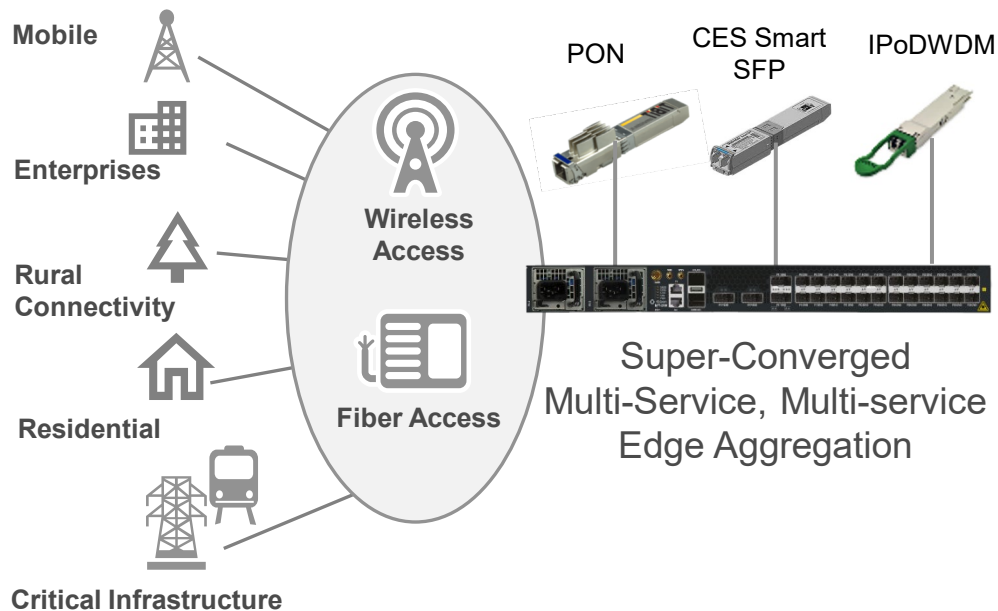
Packet Solutions Optimized for CI

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

Defense

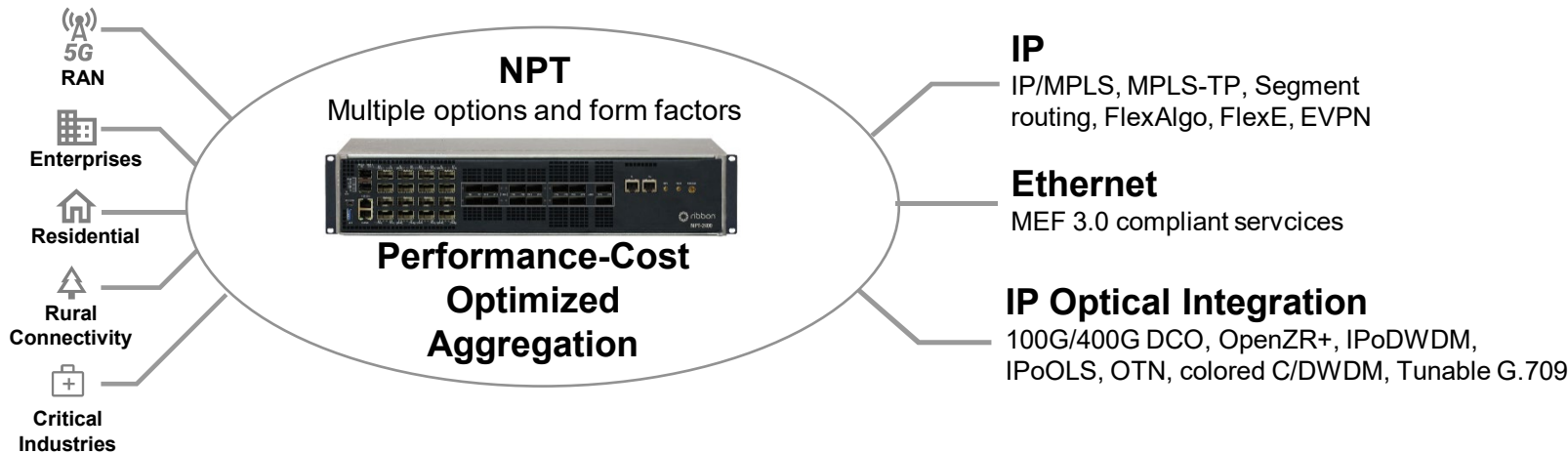


NPT: Super Converged Multi-Service, Multi-Access Edge Aggregation



- **Support network convergence**
 - Ethernet/IP, MBH, 5G xhaul and TDM migration all in a single platform
- **Multiple form factors:**
 - Modular/fixed
 - Redundant/non-redundant
 - Integrated/disaggregated
 - Airflow: Front to back/ Left to right
- **Deployment flexibility**
 - Low noise, low power, temperature hardened make NPT suitable for deployment in street cabinet, office or CO environments

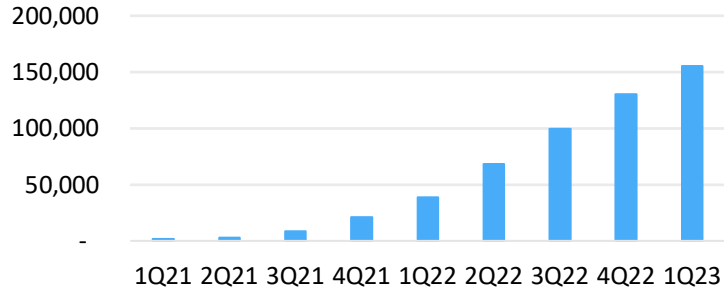
NPT for Right-fit, Performance-Cost Optimized Aggregation



- **Seamless IPoDWDM and IPoOT**
- **Right-fit IP protocols** and capabilities to meet service delivery requirements (SLAs), for all services supported by all operators (xHaul, Broadband Backhaul, CIN, CI)
- **Multiple form factors:** modular/fixed, redundant/non-redundant, integrated/disaggregated

IPoDWDM and IPoOT with ZR / Open ZR+ modules

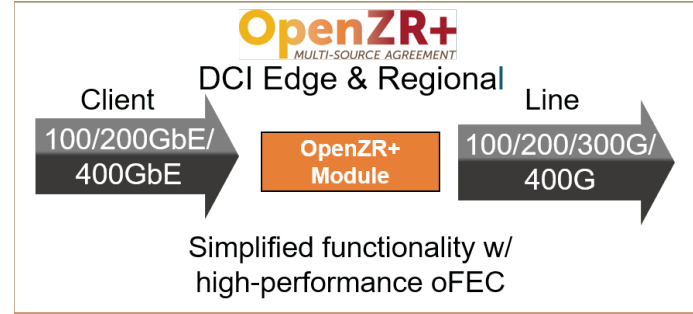
Growing Global 400G ZR cumulative shipments



Source: Omdia

© 2023 Omdia

OpenZR+ Multi-Source Agreement (MSA)



400G ZR use cases



- FEC - CFEC
- Power 15W
- Speed 400Gb
- 10dbm
- OIF standard
- Gray

400G OpenZR use cases

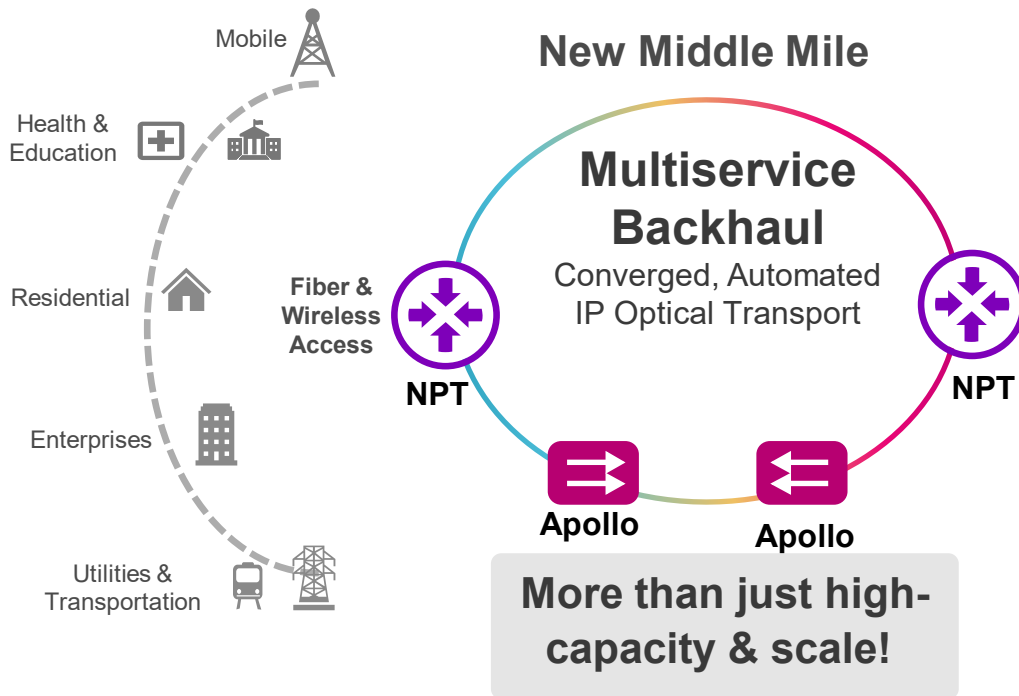


- FEC - oFEC
- Power 25W
- oFEC Coherent
- Speed 100Gb / 200Gb / 400Gb
- OpenZR+ MSA standard
- X5 higher price

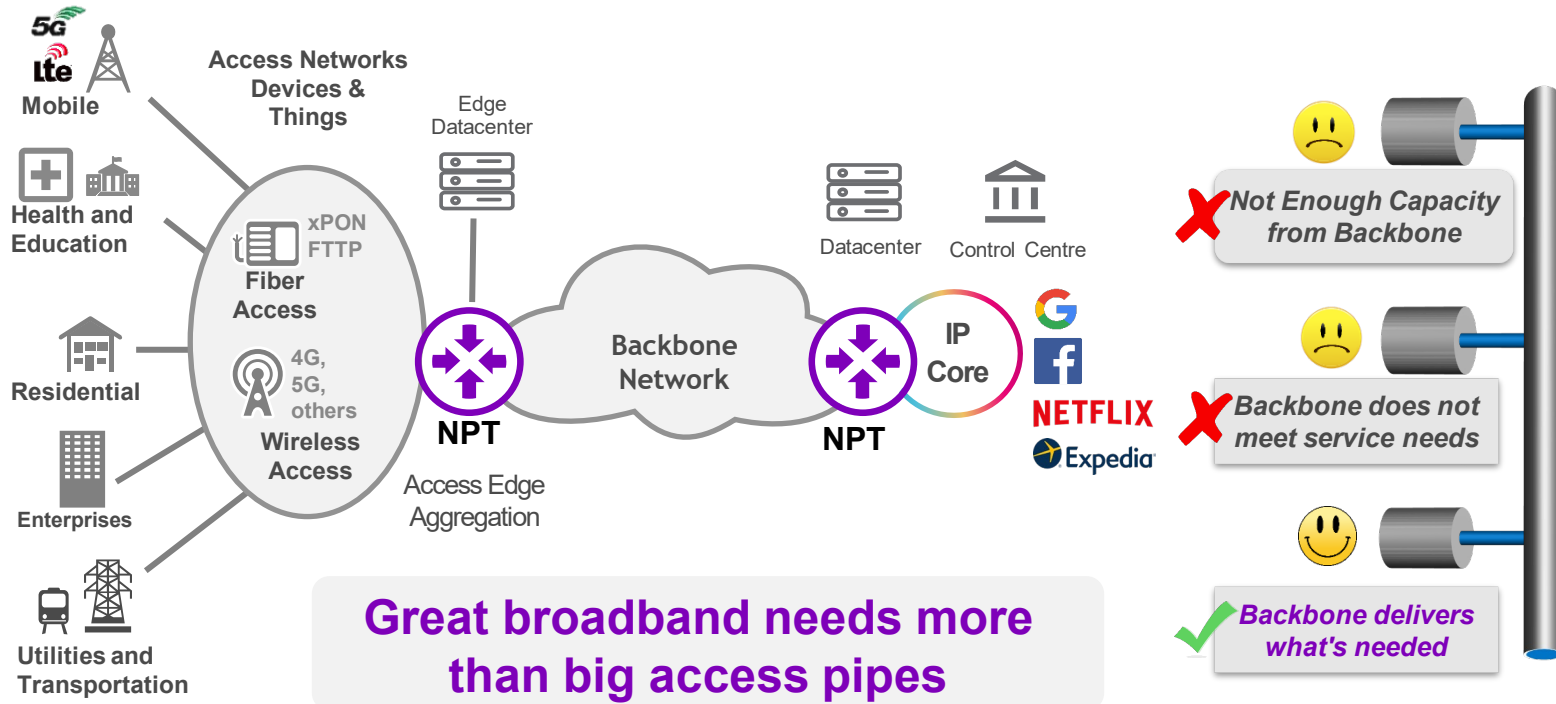
The New Middle-Mile

New Scalable Middle Mile is Essential

- Cost-Effective
- Service Aware
- Operational simplicity
- Built to Last – Avoid



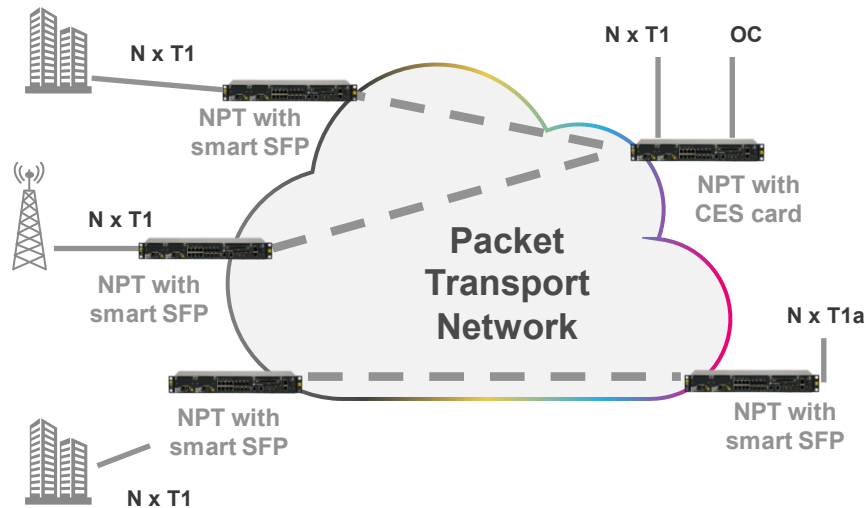
NPT for Rural Broadband Delivery



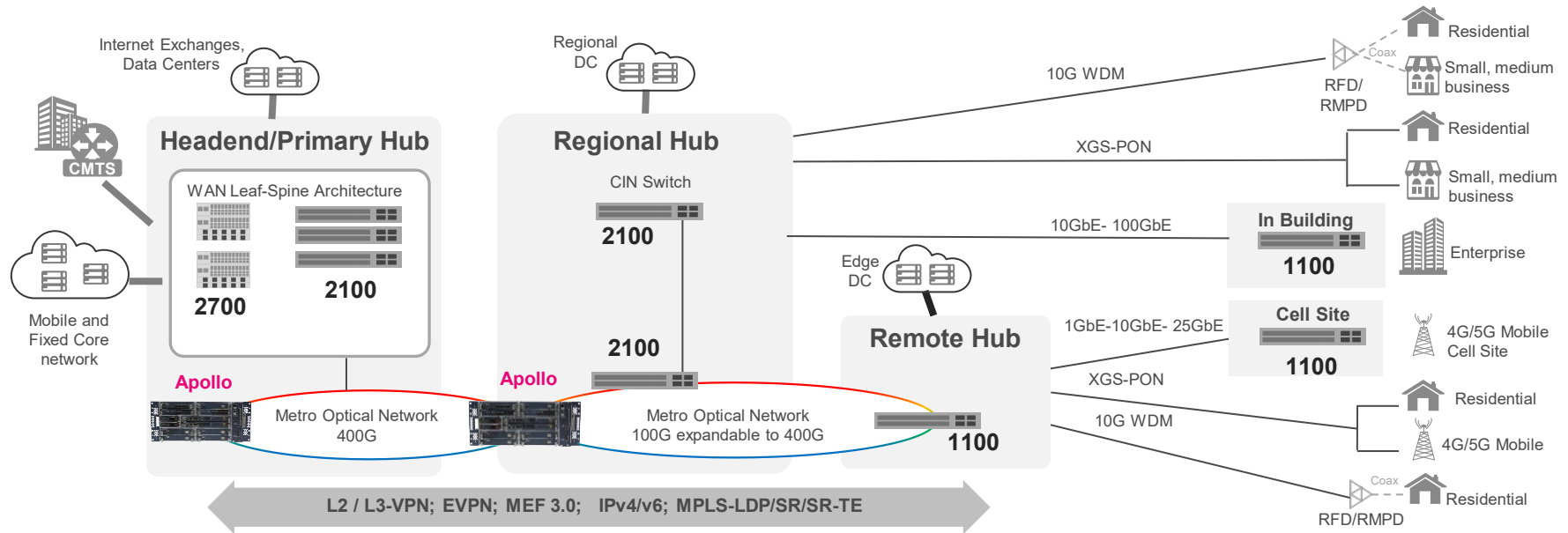
TDM to IP Migration: Circuit Emulation Services on NPT

Seamless and risk-free transport of legacy circuits

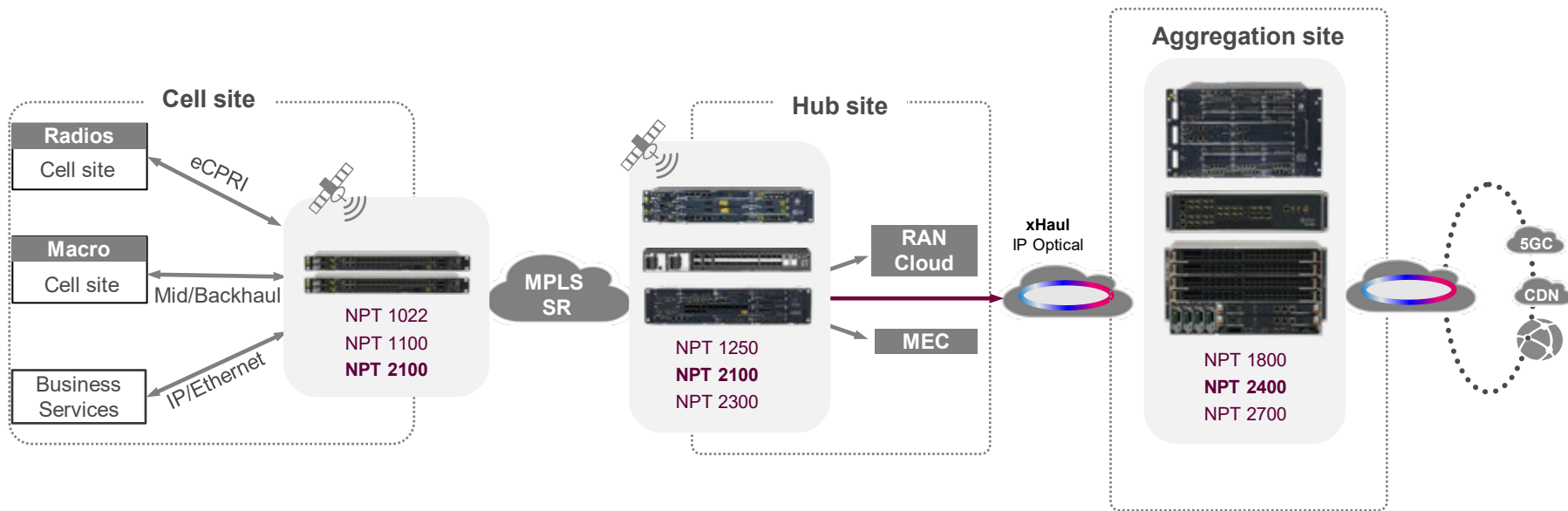
- **Comprehensive CES technology**
 - Both smart SFP pluggables and service cards
 - Supports SAToP, CESoPSN and CEP
- **Multiple Applications supported**
 - TDM aggregation
 - Voice Trunk Migration
 - Legacy Service Migration
- **Proven expertise**
 - Field proven processes for network migration
 - Supported many different solutions environments



NPT for Converged Interconnect Network (CIN) for Cable Cos



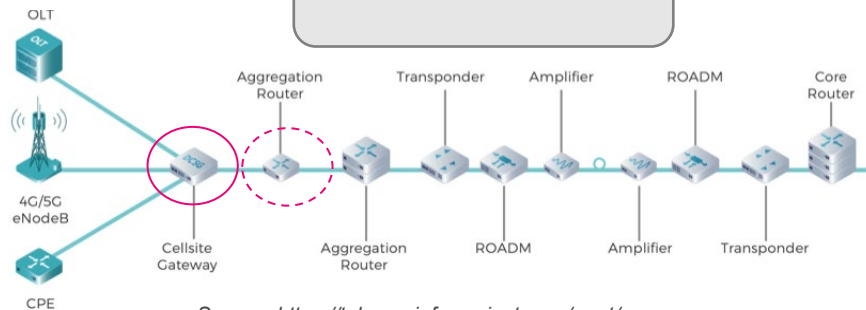
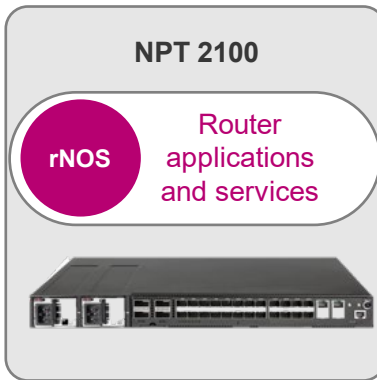
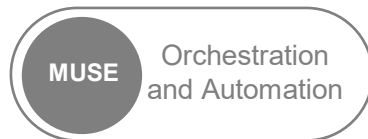
Ribbon NPT X-Haul Solution – Full solution



- 5G Synchronisation PTP 1588, Class C/D, GNSS Receiver
- Open and Programmable – SR-TE, FlexAlgo, PCEP

Ribbon NPT X-Haul Solution - NPT 2100 as a DCSG

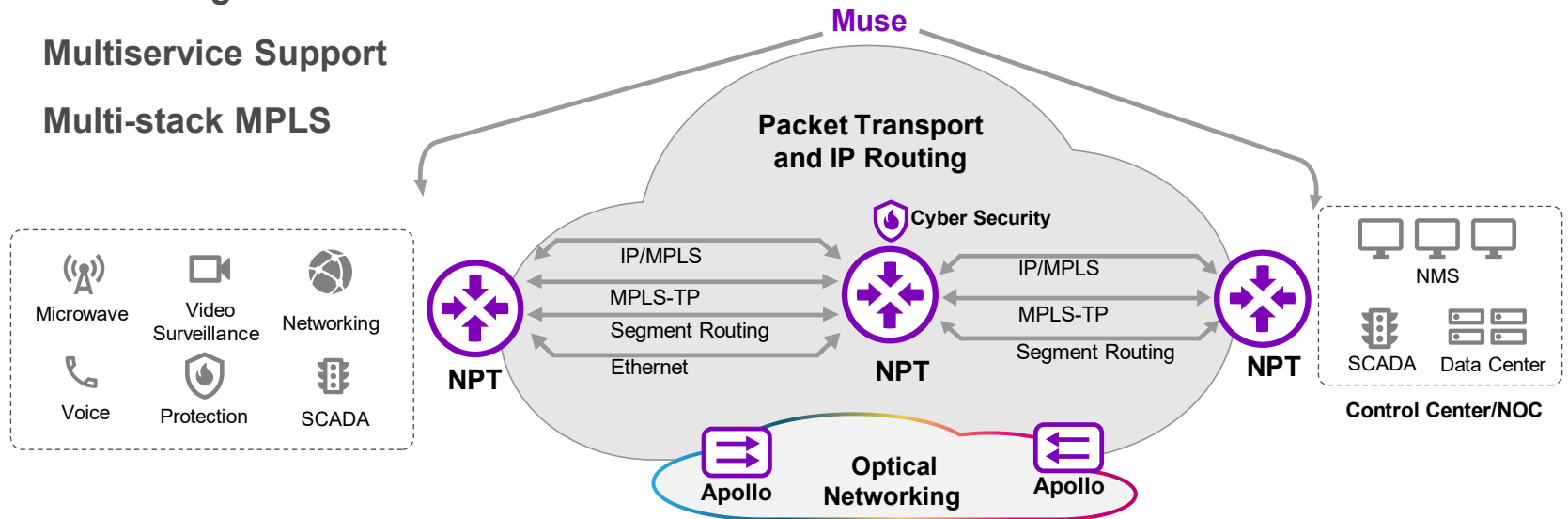
- **White-box cell site router (CSR) supporting 5G and previous RAN generations**
 - 1RU 800G based on Broadcom Q2A
- **IPWave rNOS provides fully featured CSR**
 - Full Layer 2, Layer 3 and SR/MPLS features
 - Wide range of Ethernet connectivity 1GE, 10GE, 25GE, 100GE, 400GE
- **Integrated into MUSE**
Domain Orchestrator



Source: <https://telecominfraproject.com/oopt/>

NPT for Critical Infrastructures

- Deterministic Packet Transport
- Proven Migration
- Multiservice Support
- Multi-stack MPLS

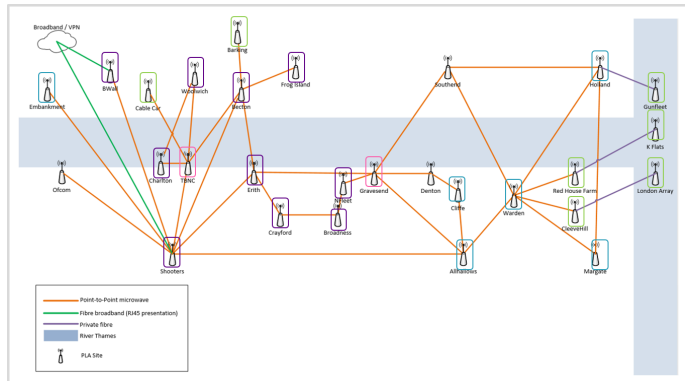




Case Studies: Features in Practice

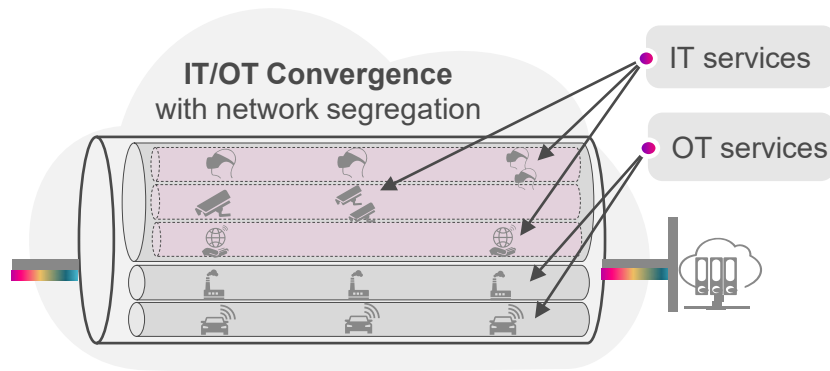
Critical Infrastructure Modernization: Deterministic Packet Transport

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

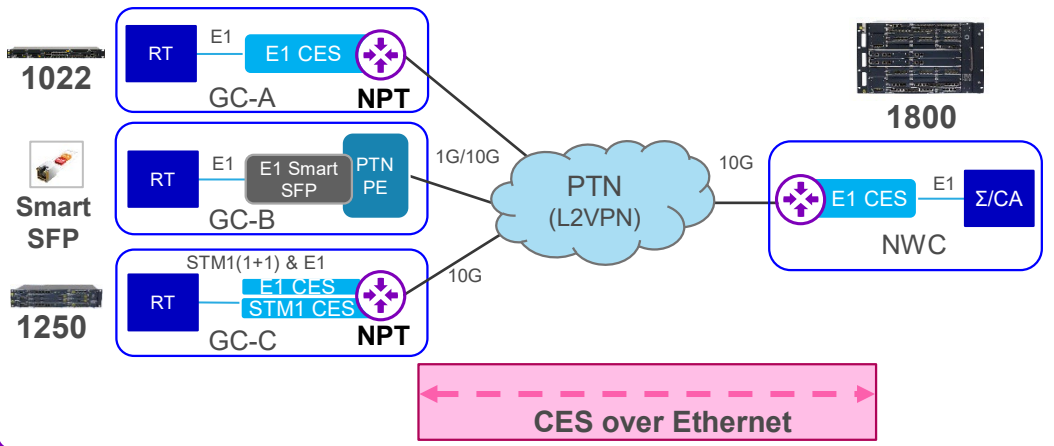
Large Utility



- 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

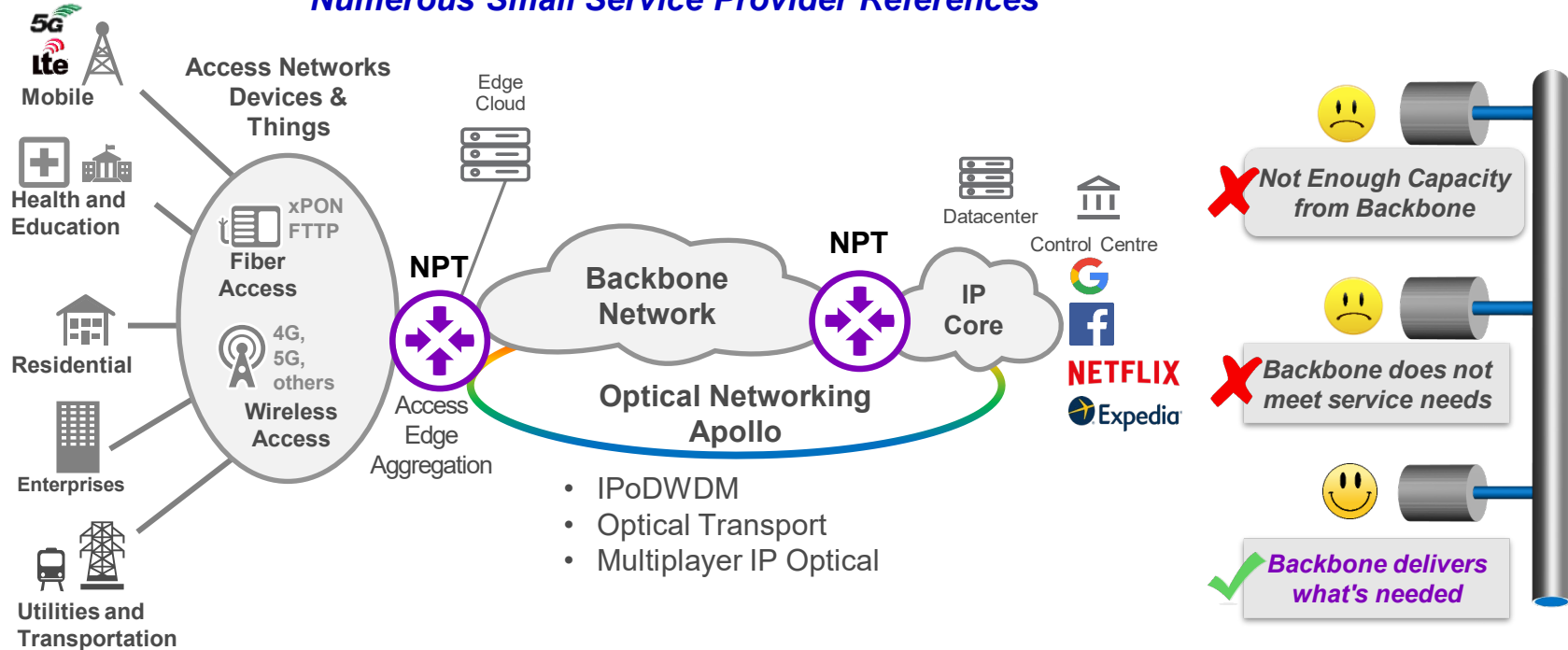
European Power Company



- **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

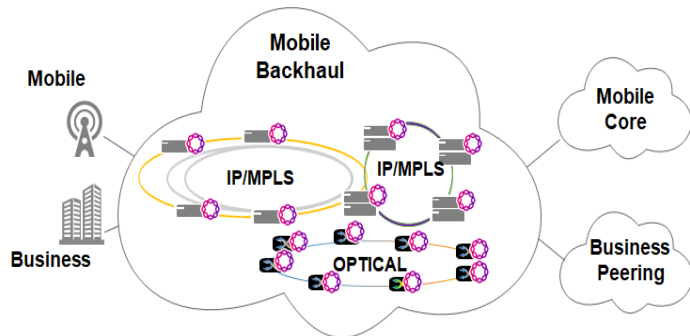
Numerous Small Service Provider References



Great broadband needs more than big access pipes

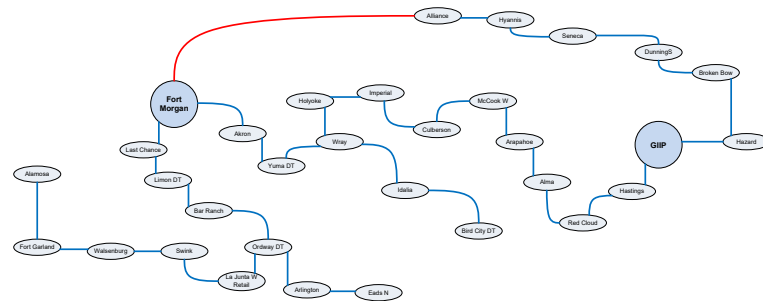
Multiservice xHaul

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

NPT Delivering Solutions in 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



ribbon

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