EVOLUTION OF TRANSPORT NETWORKS FOR F5G SERVICES

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WILL TRANSPORT NETWORKS EXPERIENCE AND ARCHITECTURAL SHIFT?

BIFURCATION OF COHERENT OPTICS DEVELOPMENT

Pluggable Optics

OIF GEN-1 MSA 2012
CFP 100G 2015
CFP2-DCO 200G 2016
CFP2-DCO OSFP QSFP-DD 400G 2019
OSFP QSFP-DD 800G 2020
1.2T 2021

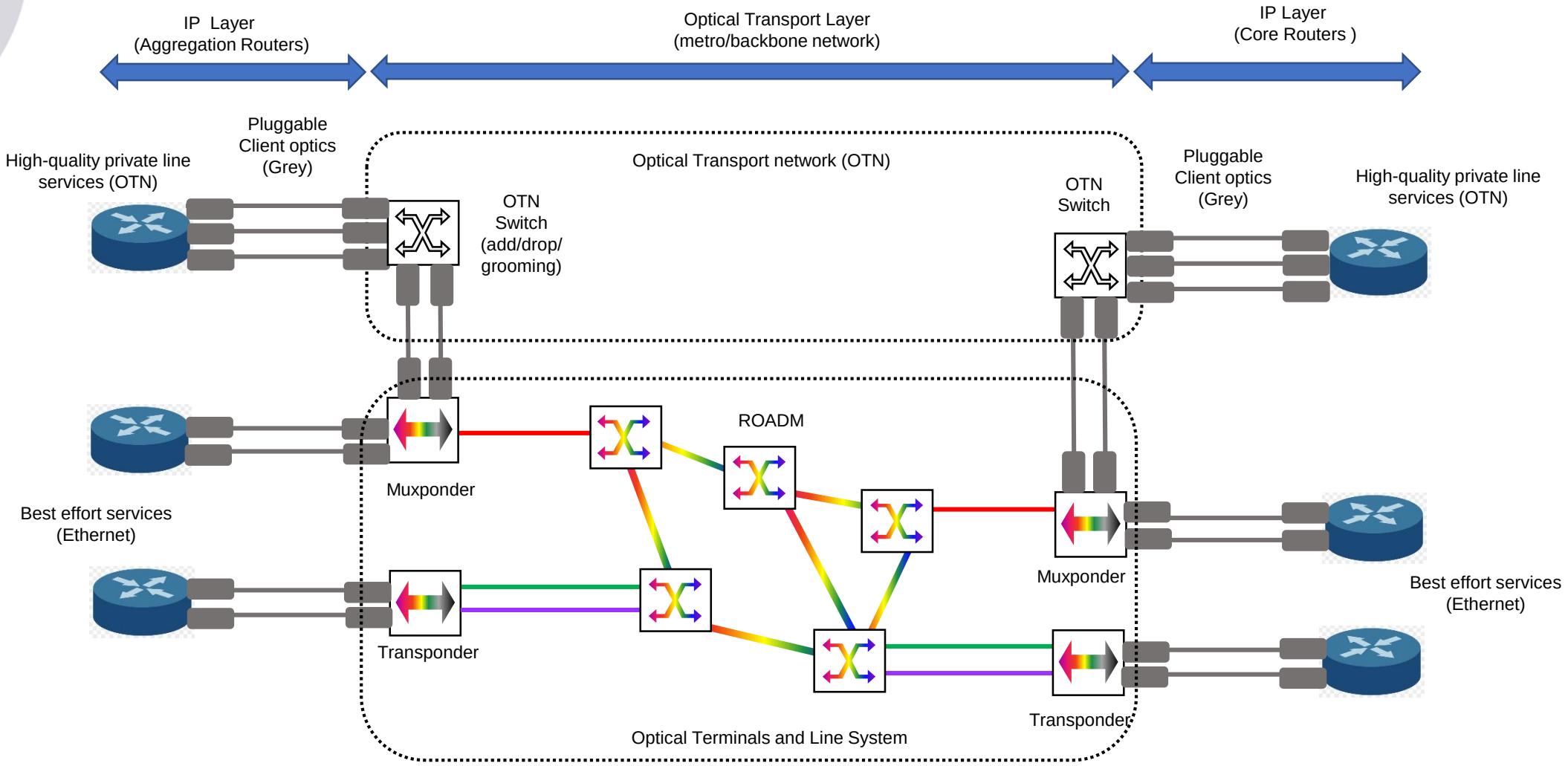
- Low-Power/cost
- Broad application (datacom and telecom)
- Standards and MSA driven
- Open Ecosystem
- Commodity DSP and optics
- Multi-vendor interoperability

40G 2008
100G 2011
200G
400G 2013
800G 2018
1.2T 2019
2.4T …

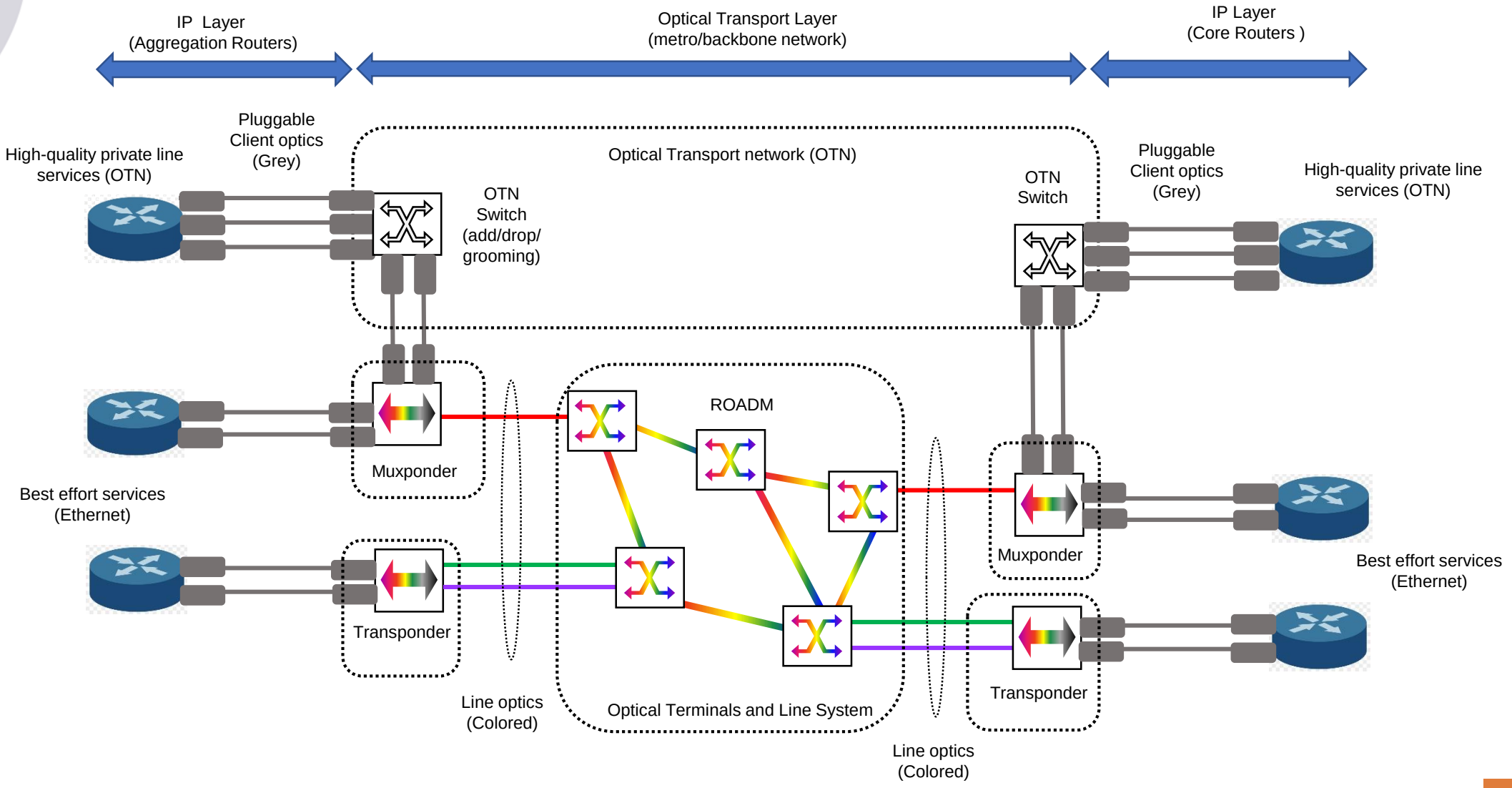
Integrated Transponder

- High-performance
- Telecom based systems
- Engineered systems
- Closed systems
- Custom ASIC and optics
- Vendor lock-in

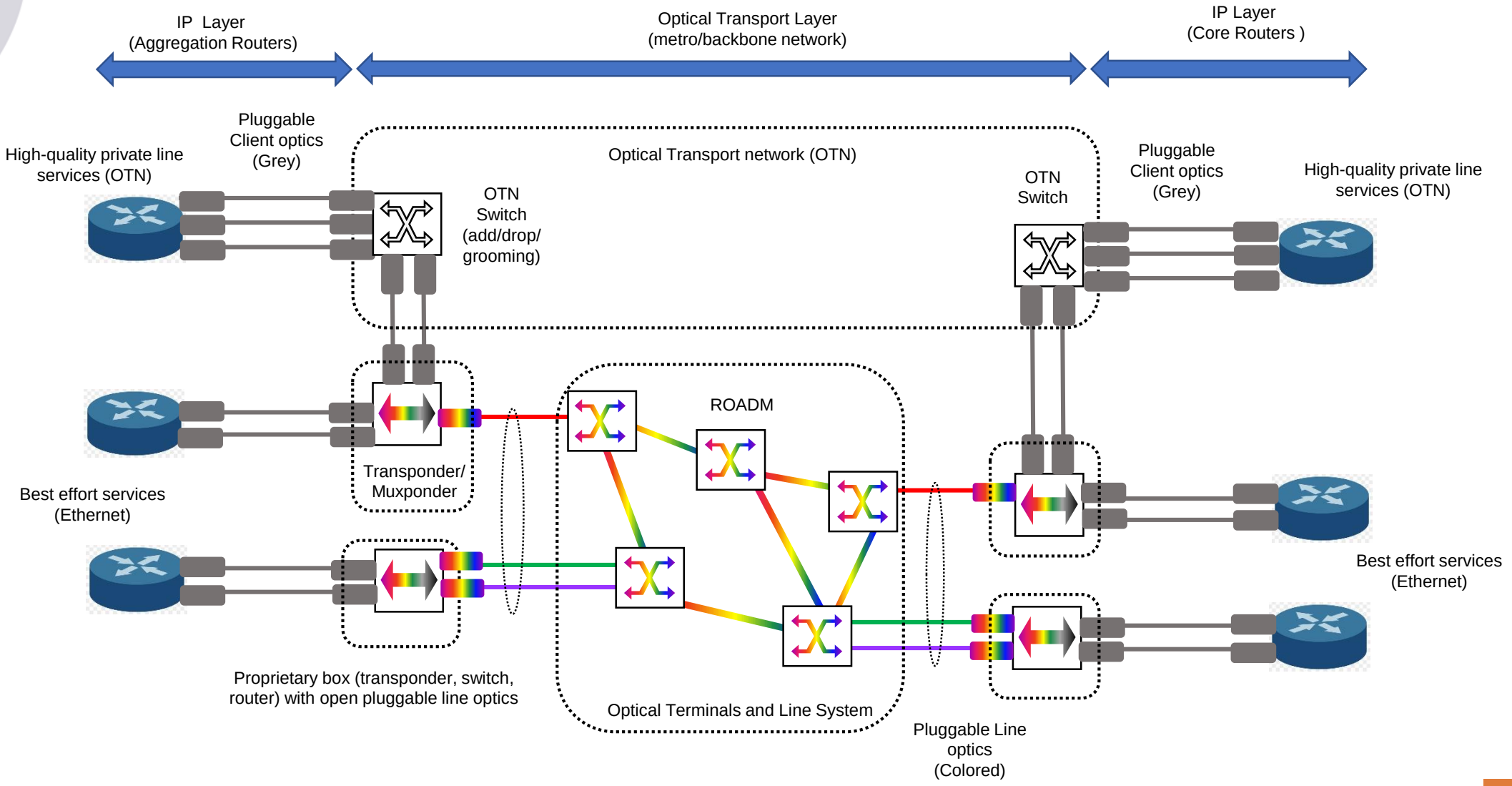
CURRENT METRO/REGIONAL NETWORK ARCHITECTURE: IP OVER OTN/WDM



NETWORK EVOLUTION: PARTIAL OPTICAL DISAGGREGATION

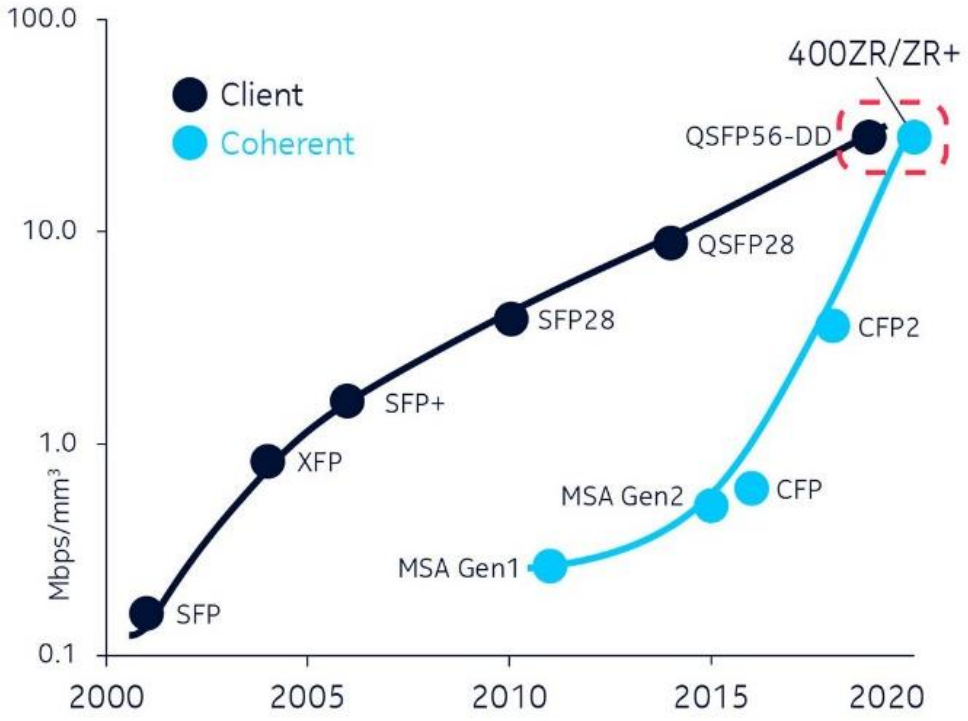


NETWORK EVOLUTION: PLUGGABLE COHERENT LINE OPTICS AT TRANSPONDER/MUXPONDER



CAN COHERENT PLUGGABLE MODULES BE INTEGRATED IN THE ROUTERS?

- The integration of the coherent pluggable modules is a key pillar for the Packet/Optical convergence.
- Integrating pluggable coherent optics into a router eliminates the need for an optical muxponder or transponder in the optical transport system.
- Pluggable coherent optics leverage multi-vendor form factors with standardized specifications, which allows interoperability for easier adoption and gains of scale.
- The maximum router capacity can be maintained with no density penalty.
- Main challenge: management of the optical resources in the IP routers



https://www.nokia.com/blog/ip-routing-for-the-400ge-era/

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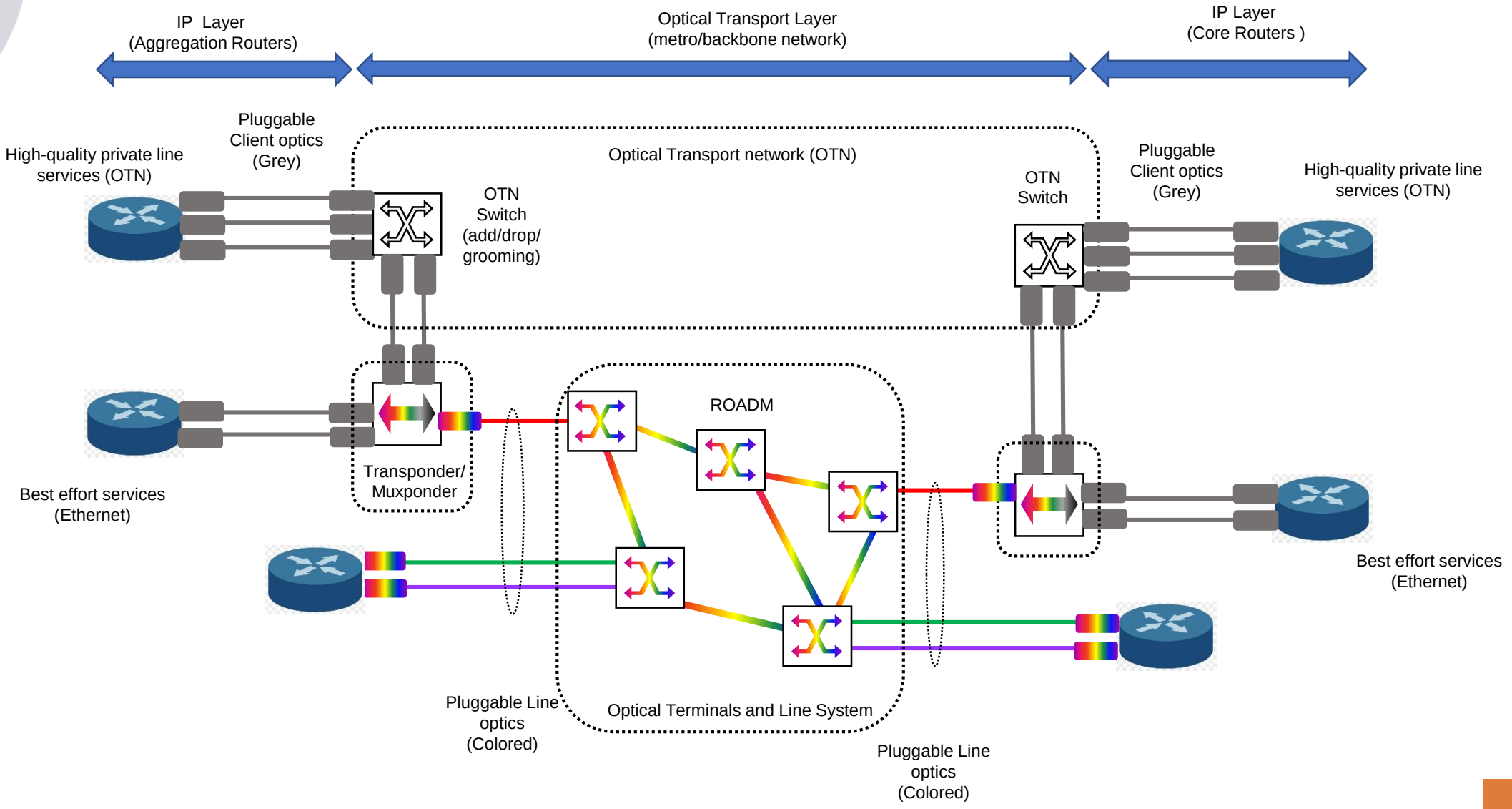
NETWORK EVOLUTION: INTEGRATION OF PLUGGABLE COHERENT LINE OPTICS AT ROUTER



SYSTEM VENDORS WITH 400G PLUGGABLE LINE OPITCS

TELIA CARRIER EMBRACES COHERENT PLUGGABLES USING ACACIA'S OPENZR+ MODULES AND CISCO ROUTERS

Telia Carrier is the first network operator to demonstrate 400G coherent connections between Cisco's NCS 5700 and Cisco 8000 platforms over a third-party open line system.

STOCKHOLM, December 16, 2020 – Telia Carrier announced today that it is preparing to converge their IP and optical networking layers to simplify their networks. Using Acacia's 400G coherent modules that are plugged directly into Cisco routers, this architecture will enable Telia Carrier to address increasing bandwidth demand while significantly reducing both capital and operational expenditures.

Juniper Networks lays out silicon photonics based pluggable optical module plans

Add Juniper Networks (NYSE:JNPR) to the list of systems vendors getting into the pluggable optical transceiver space (alongside Ciena and Infinera). The switch and router vendor has announced initial plans to market 100G QSFP28 and 400G QSFP-DD devices leveraging the silicon photonics expertise it brought in-house via its 2016 acquisition of Aurrion.

Author – Stephen Hardy

Mar 26th, 2019

Nokia launches WaveFabric Elements optical portfolio for 400G ecosystem

May 21, 2020

Nokia launched it's 5th generation coherent solution. This includes new PSE-5 DSPs, new CSTAR silicon photonics from its Elenion acquisition, and pluggable CFP2-DCO and QSFP-288DD pluggable modules. The announcement outlined Nokia's strategy to focus on solutions optimized for 400GbE and use pluggable 400ZR modules as an alternative to complex modulation and 800G. Scott Wilkinson, the Lead Analyst at Cignal AI, said:

Infinera offers Infinite Network pluggable coherent module strategy details

Infinera (NASDAQ: INFN), as part of its Infinite Network strategy announcement February 19, revealed that it will offer pluggable coherent modules to the market as part of its plans to meet edge network demands. The company has since supplied additional details about this aspect of the Infinite Network.

Author — Stephen Hardy

Feb 26th, 2019

Press releases

ADVA unveils new DCI OLS for the 400ZR era

30 March 2021

News summary:

- Large-scale DCI networks need to rapidly and affordably expand to address soaring data demand
- 400ZR technology meets requirements for high capacity and high density
- Next-generation ADVA DCI open line system is fully optimized for 400ZR and tested with leading pluggable transceivers

Ciena Introduces WaveLogic 5 to Fuel the Content Economy

February 20, 2019

Ciena announced its latest generation of coherent technology with a dual strategy of pushing coherent speeds to 800Gbs as well as delivering low power pluggable 400ZR solutions. These products build on nearly a decade of vertically integrated coherent development within the company.

Huawei Aims High with the OptiXtrans DC908 DCI Platform Launch

2019-09-29 1445

Summary Bullets

• Huawei launched its new Data Center Interconnect (DCI) platform — the Huawei OptiXtrans DC908 — at HUAWEI CONNECT in Shanghai, re-entering the highly contested DCI market with a compelling product.

• The Huawei OptiXtrans DC908 features leading platform capacity and density, as well as support for electrical and optical modules in the same box, making it applicable for a wide range of use cases.

Huawei has already gained traction in the growing DCI market with its OSN902 platform. However, its new Huawei OptiXtrans DC908 product represents a much more ambitious entry into the DCI market fray.

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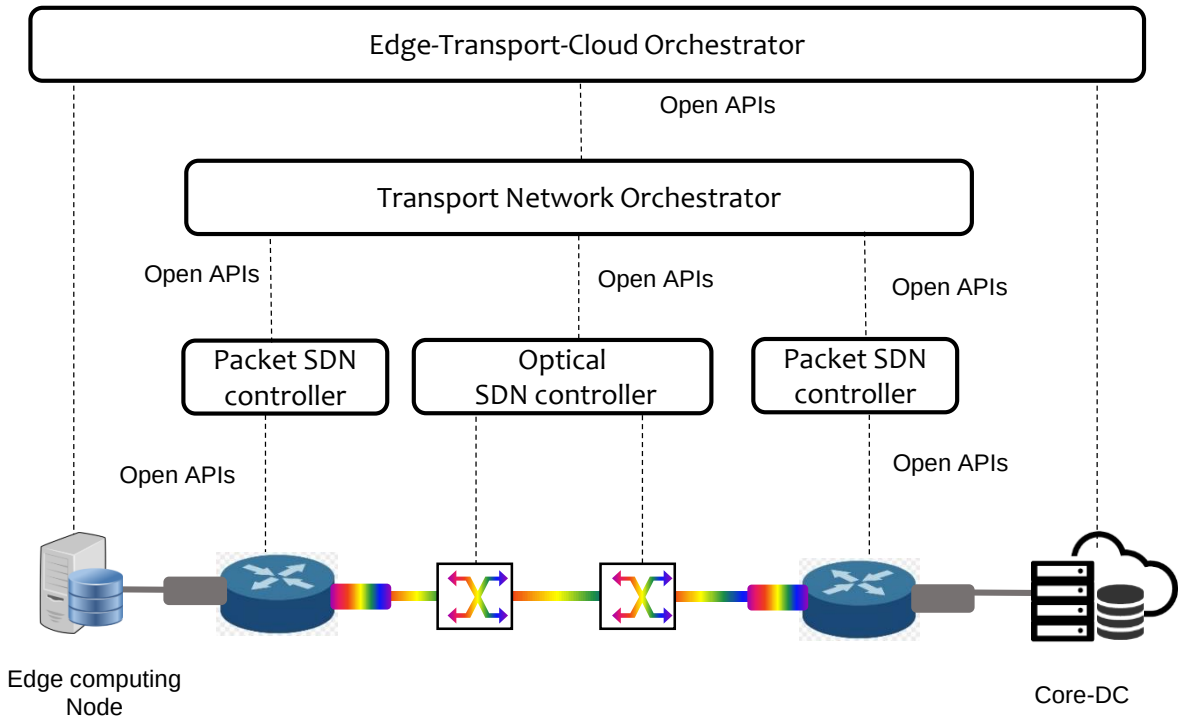
TRANSPORT NETWORK ORCHESTRATOR

- Efficient management of transport IP/Ethernet and OTN/optical resources.
- Enable integration of edge/cloud and transport resources
- CTTC is leading the ETSI Open-Source Group TeraFlowSDN (TFS).
- It relies on the first release of the open-source transport SDN controller developed in the H2020 TeraFlow project, led by Ricard Vilalta from CTTC.
- Main challenge: definition of open and standard APIs



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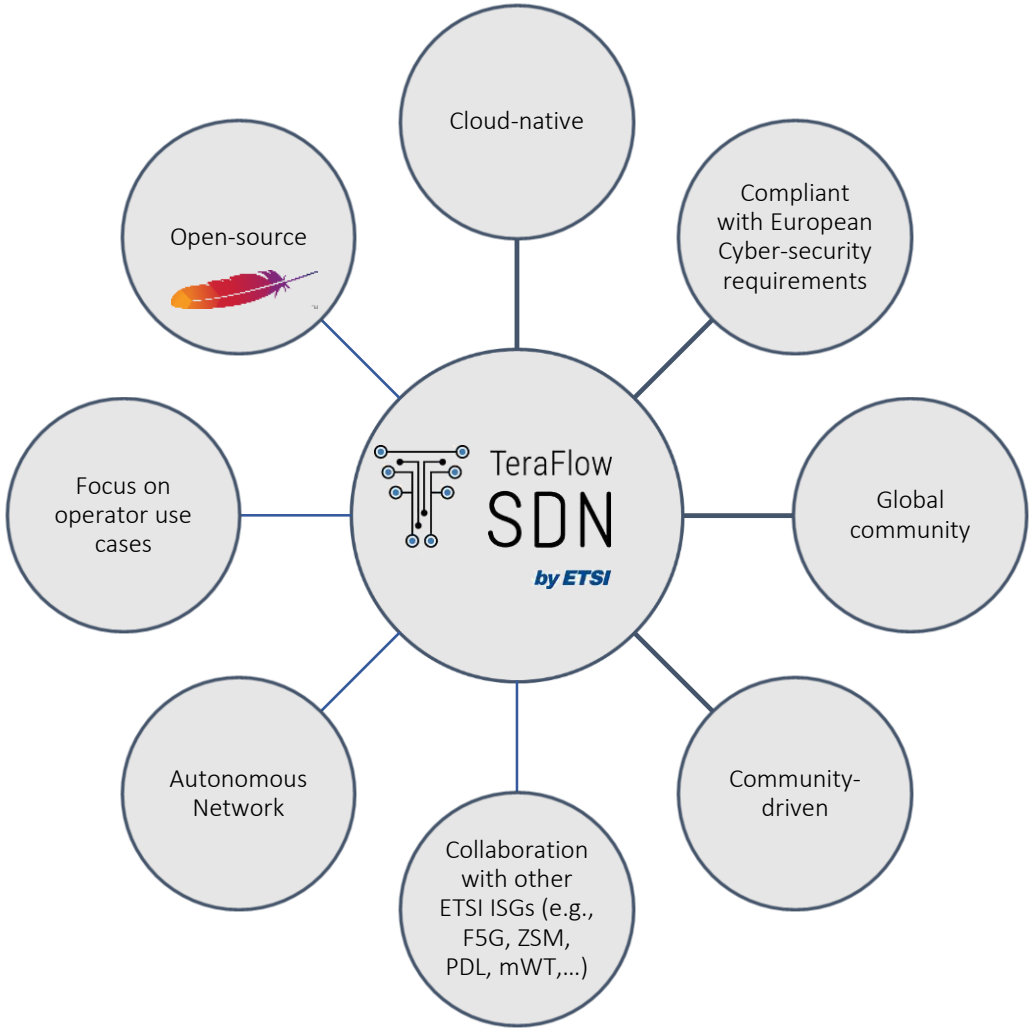
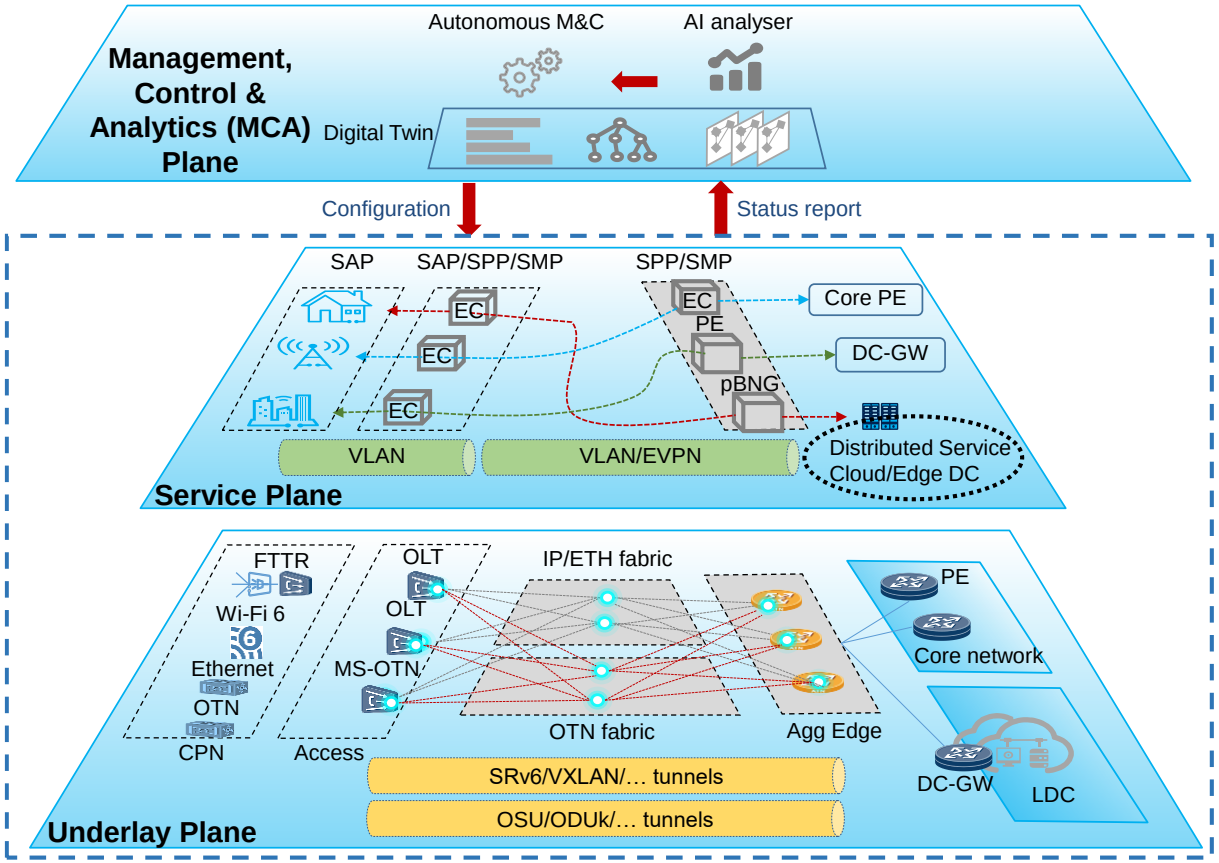
ETSI TeraFlowSDN



F5G Network Architectures: Dual Plane and E2E Slicing

➢ **Main Driving force: Emerging of High-quality services**

F5G Network Architecture



Source: F5G-004 – F5G Network Architecture

https://www.etsi.org/deliver/etsi_gs/F5G/001_099/004/01.01.01_60/gs_F5G004v010101p.pdf

3) From "management & control" to "management, control & analytics"

To enable more intelligent operation of the fixed networks and the services

2) Decoupling service plane and underlay plane

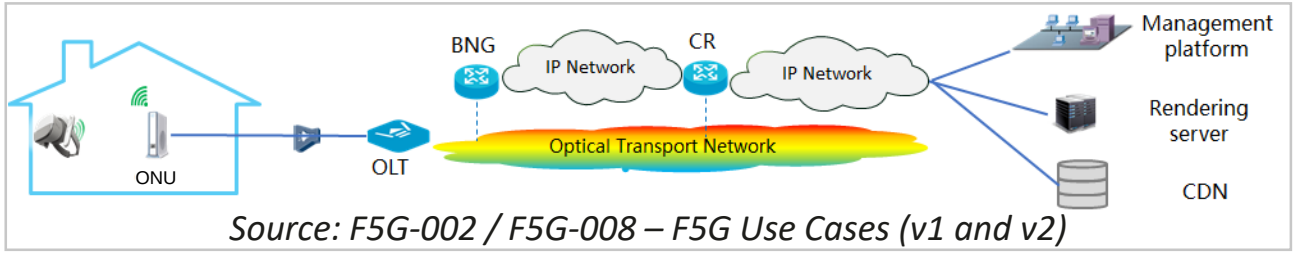
To allow faster deployment of new services without / with less upgrade of the network infrastructure

1) OTN and IP/Eth Dual underlay planes

To allow using OTN to carry the high-quality services
New solutions are needed

Typical High-Quality Services and Their Requirements

Cloud Virtual Reality



Source: F5G-002 / F5G-008 – F5G Use Cases (v1 and v2)

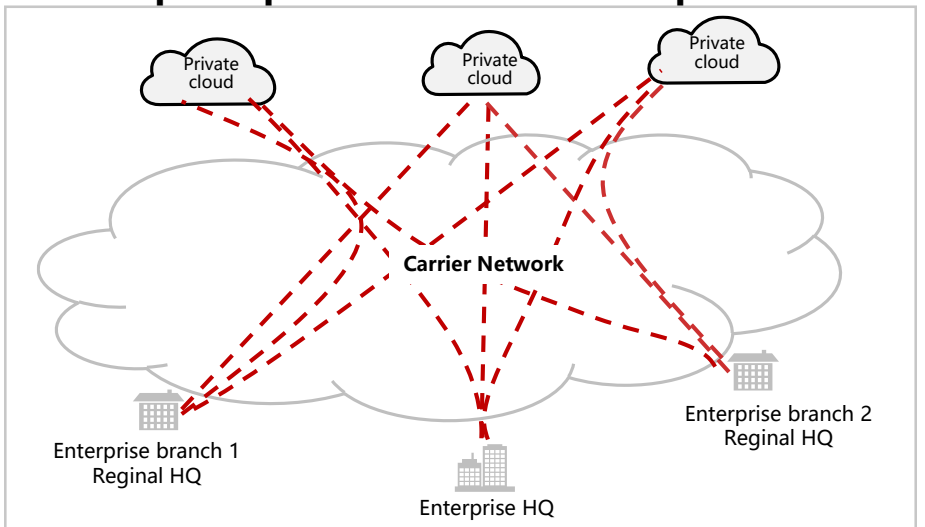
Phase	Fair-experience	Comfortable-experience	Ideal-experience	Ultimate-experience
Typical full-view resolution	4K	8K	12K	24K~
Typical terminal resolution	2-3K	4K	8K	16K~
Bitrate	≥40Mbps	≥65Mbps	≥270Mbps	≥770Mbps
Bandwidth	≥80Mbps	≥130Mbps	≥540Mbps	≥1540Mbps
RTT requirement	20ms	20ms	10ms	8ms
Delay jitter	<15ms	<15ms	<10ms	<7ms
Packet loss rate	$\leq 10^{-5}$	$\leq 10^{-6}$	$\leq 10^{-7}$	$\leq 10^{-7}$

Source: F5G-003 – F5G Technology Landscape

Ultra-strict QoS requirements

- **Ultra-high performance channel** through home, access and metro network
- **Dynamic channel** driven by VR applications

Enterprise private lines to multiple clouds



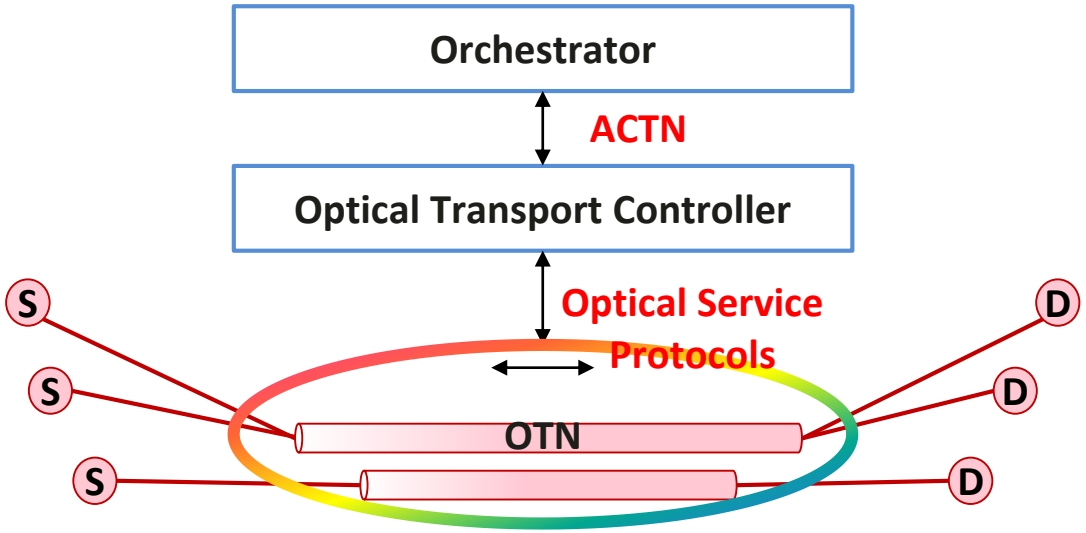
Source: F5G-002 / F5G-008 – F5G Use Cases (v1 and v2)

- high and **guaranteed bandwidth** (Gbps), **low latency**
- High **availability** (99.999%)
- high **security**
- P2P private lines → **Multi-cloud access**
  - To visit different applications running in different (private or public) cloud DCs

Optical network is a proper choice for 2B & 2H high-quality services

Potential Cooperation between CTTC and ETSI ISG-F5G

ACTN + Optical Service Protocols:
A full solution for optical service network



- **Standards cooperation:**
  - Be a supporter of the creation of this potential new work item (WI) in ISG F5G
  - Make contributions in future ISG F5G meetings
- **Outreach activities:**
  - Sharing this research direction in academic conferences / industry forums (e.g., OFC, ECOC) by speeches, papers, etc.
  - Communicating with interested parties (e.g., by organizing workshops among CTTC, European operators and ETSI ISG-F5G), to promote the value of the full solution for optical service network.

Thank you!

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H2020 TeraFlow Project (101015857)

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