

**tnc18** Trondheim, Norway  
10-14 June 2018  
*Intelligent networks, cool edges?*



# GÉANT Platform Evolution

## Platform Evolution

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Trondheim  
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# Scoping a new network – the process

tnc18



- Exponential growth in network traffic
  - Nearly 50% year on year growth
  - Traffic expected to double every 18 months
  - Find cost effective ways to support the traffic growth
- Increase space and power efficiencies
- Dependence on a single vendor solution

# GÉANT Network Traffic

## Network Traffic

Average volumes during 2017 were 3.13PB per day for the IP/MPLS network, average daily rate of 289Gbps

Average volumes including Lambdas are 4.79PB day or an average data rate of 444Gbps

Science traffic growth: 43%

Internet traffic growth : 26%

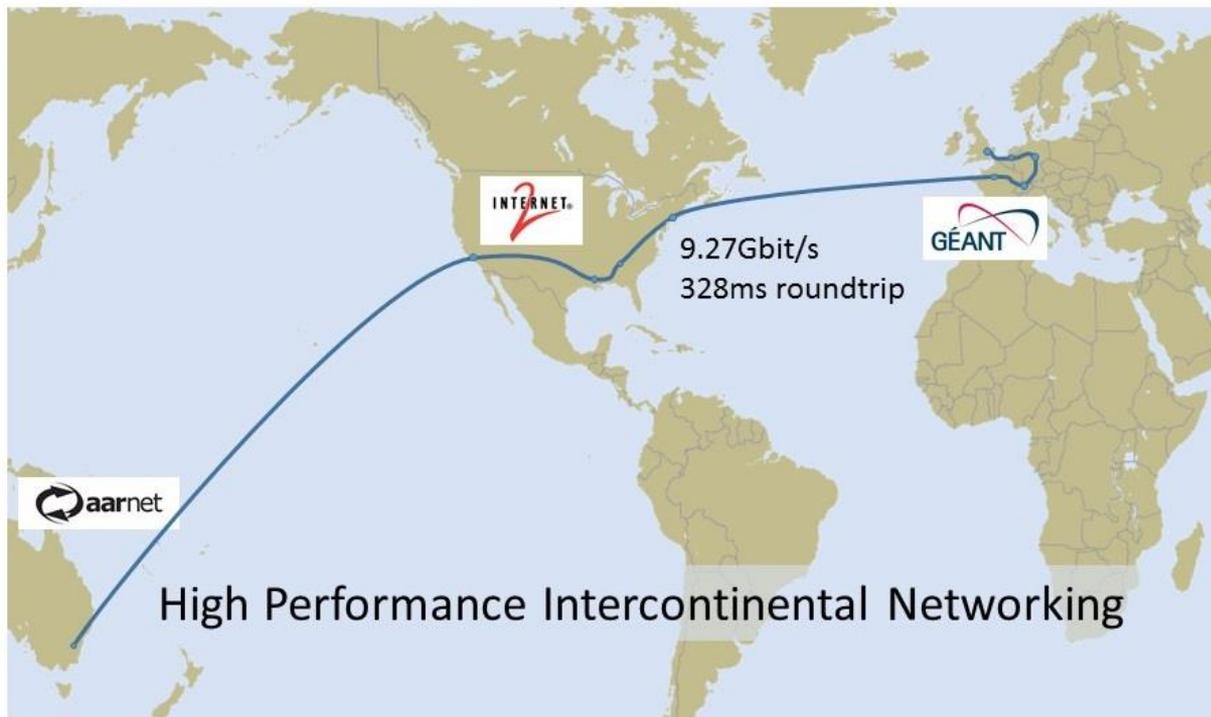
IP/MPLS Traffic growing at 47% YoY over last 2 years

GÉANT TRAFFIC



# R&E Networks Optimised for research data transfer

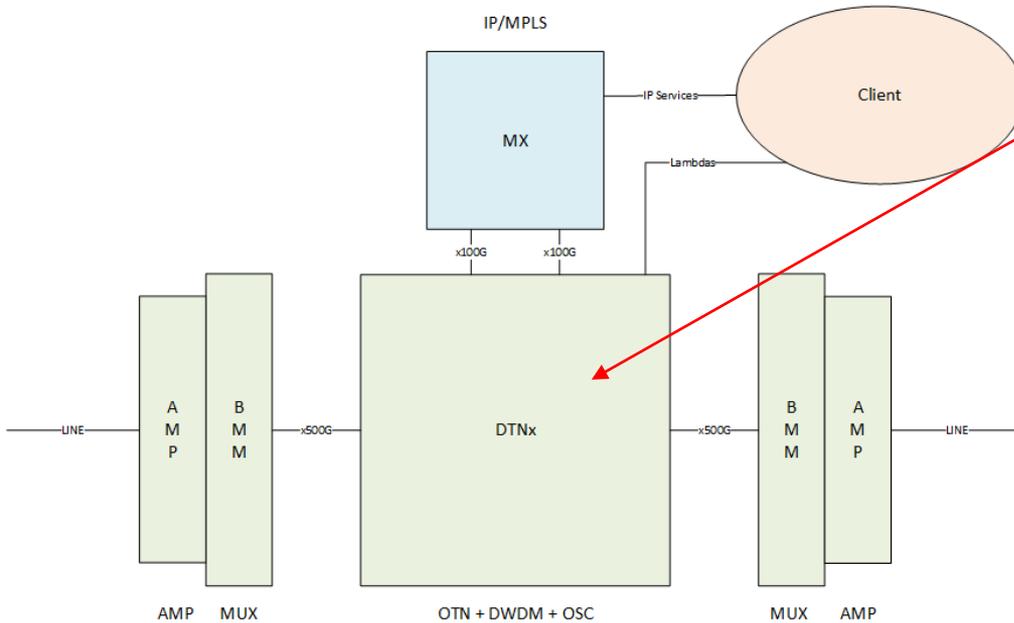
- Route GÉANT, ANA300, Internet2 & AARNet: RTT 304 ms.
- Throughput:
  - Average including slow start 9.09 Gbit/s
  - Plateau from 5s onwards 9.73 Gbit/s.
- NO TCP re-transmitted segments



## Current architecture

Problems with current architecture:

- OTN layer expensive
- OTN chassis **running out of slots** in central PoPs
- OTN useful for protection switching and multihop but traffic is **70% unprotected** and next hop
- OTN chassis are **DC powered** full rack cost is very high in some PoPs
- Proliferation of IP/MPLS interconnection with **OTN layer**



Content providers (FAANGs) are experiencing huge growth in traffic volume. They are driving innovation to ensure that their business models scale.

- Moving towards disaggregation
  - From a monolithic block to a modular, flexible and best in class
  - Clean separation between hardware and software – each innovate independently of other
- Transport Layer
  - Open Line System
  - Merchant Optics - Data Centre Interconnects (DCI) or External Transponders
- Packet Layer: Core of networking devices has always been ASICs
  - Merchant Silicon: until Broadcom came along there weren't many options available
  - Third Party NOS





- Data centre style 1 RU stackable form factor.
- Around **6 times reduction in cost** over traditional telecoms equipment architectures
- Significant increase in **density** and reduction in **power consumption**
- Next gen of **commodity pluggable optics** has excellent performance
- Modular – easy to scale up
- Easy **upgrade path** to new technology

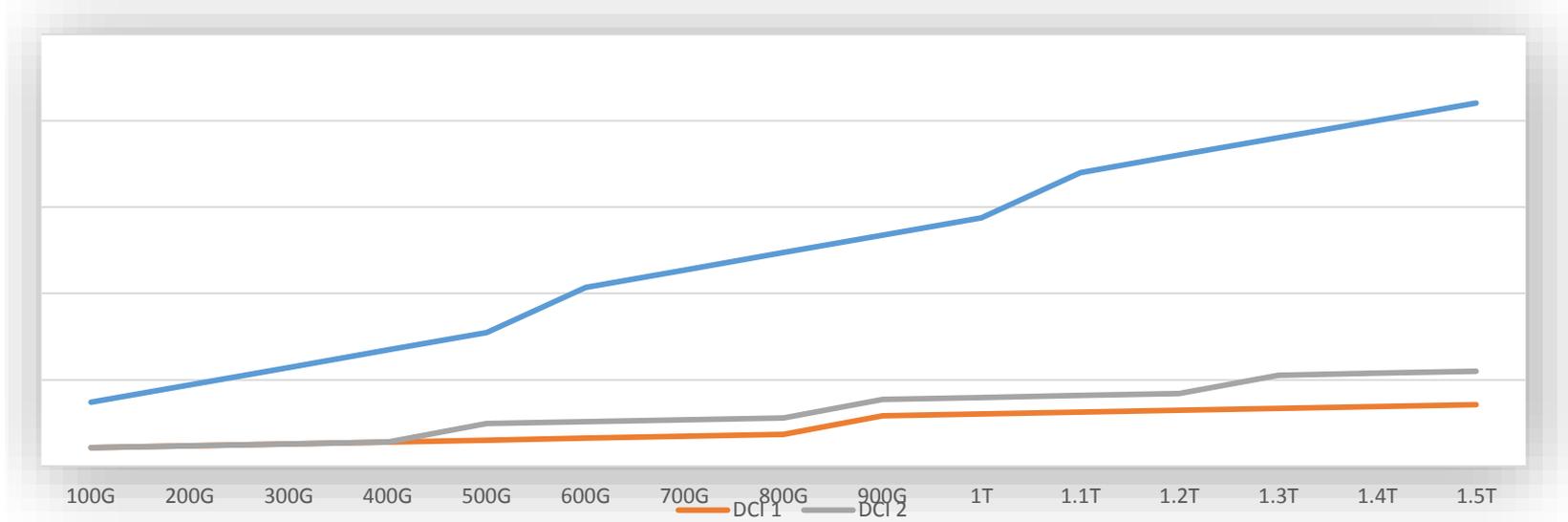


**Loss of equipment integrity – not designed to be highly available as per ETSI etc.**

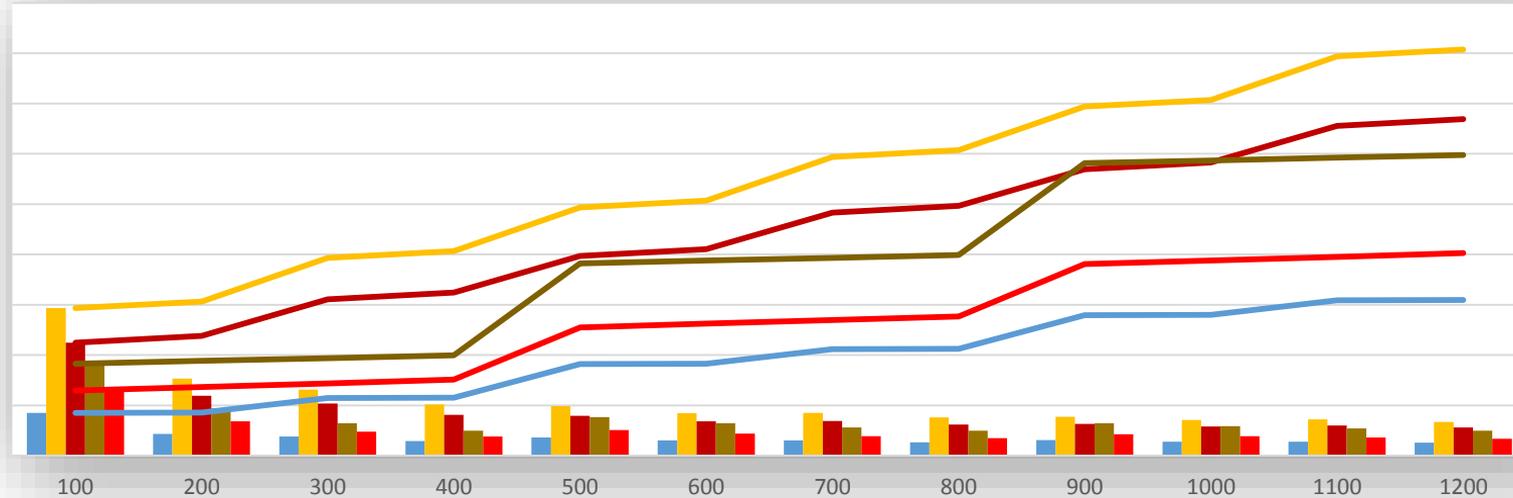
- No internal hardware redundancy
- No in-service upgrades
- Restricted temperature operation



# A cost comparison DCI vs. carrier grade DWDM/OTN



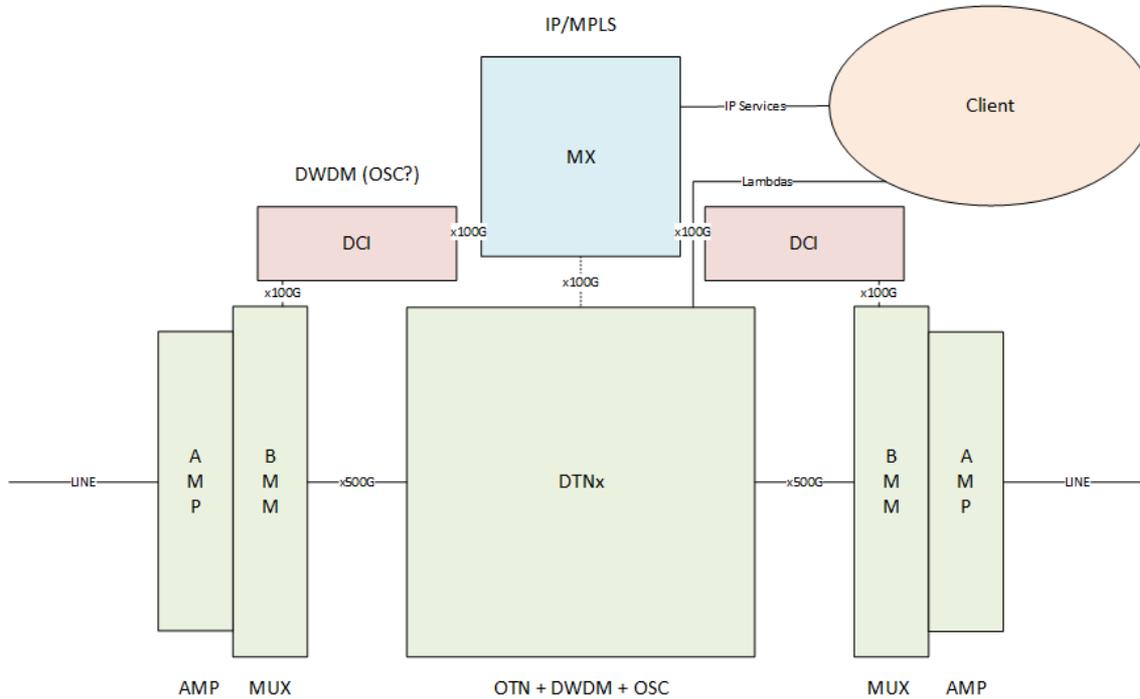
- Blue line is carrier-grade DWDM with OTN. Grey/Orange are DCI boxes
- HW cost of delivering capacity between adjacent PoPs over a fibre link (€/Bps)
- Analysis by Sebastiano Buscaglione and Matthew Gordon, August 2017



- HW cost of capacity between adjacent PoPs over a fibre (€/Bps) for a range of DCI
- High variation in cost between DCI solutions – prices compressed towards lower level in tender process
- Analysis by Sebastiano Buscaglione and Matthew Gordon, August 2017

- GÉANT has chosen the Coriant Groove G30 product.
- 1 RU stackable
- 4 sleds, each up to 4 x 100G
- Optics are based on Acacia CFP2 ACO
  - 200G up to 1000km with 16 QAM modulation
  - 150G up to 2000km with 8 QAM modulation
  - 100G up to 5000km with DP-QPSK
- Client side is QSFP28
- *Next generation to support 600Gbps using 64QAM*

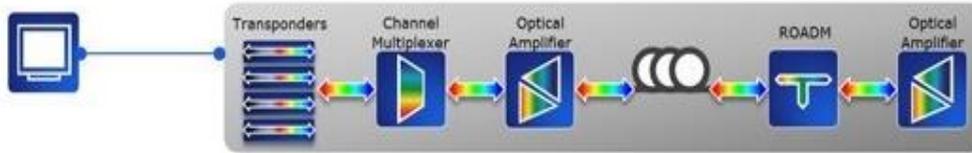




- Use DCI to provision bandwidth for high capacity IP/MPLS trunks
- DCIs are up to 6x cheaper than carrier grade transmission
- Keep OTN layer for link management and lambda provisioning greatly simplifying DCI role and minimising risk
- Integration of DCI allows for growth offset and generate enough spares

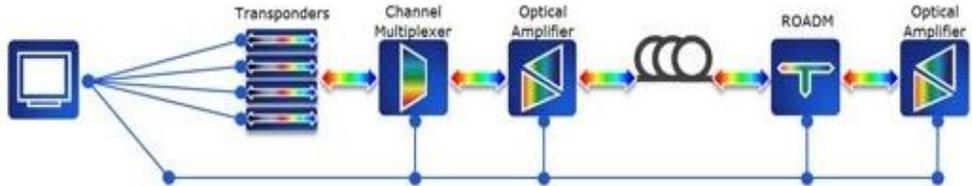
# Medium-term solution: Open Line system.

- No Disaggregation: Entire transport network acts as one element



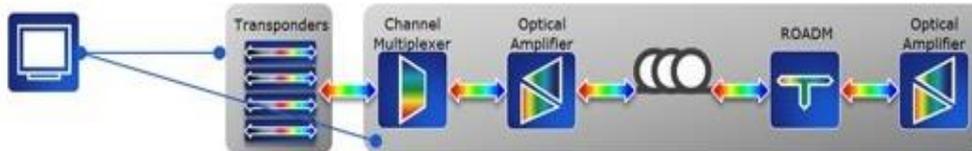
Current closed interop model

- Fully Disaggregated: Everything is a separate network element



Long-term vision. But open standards and management under development

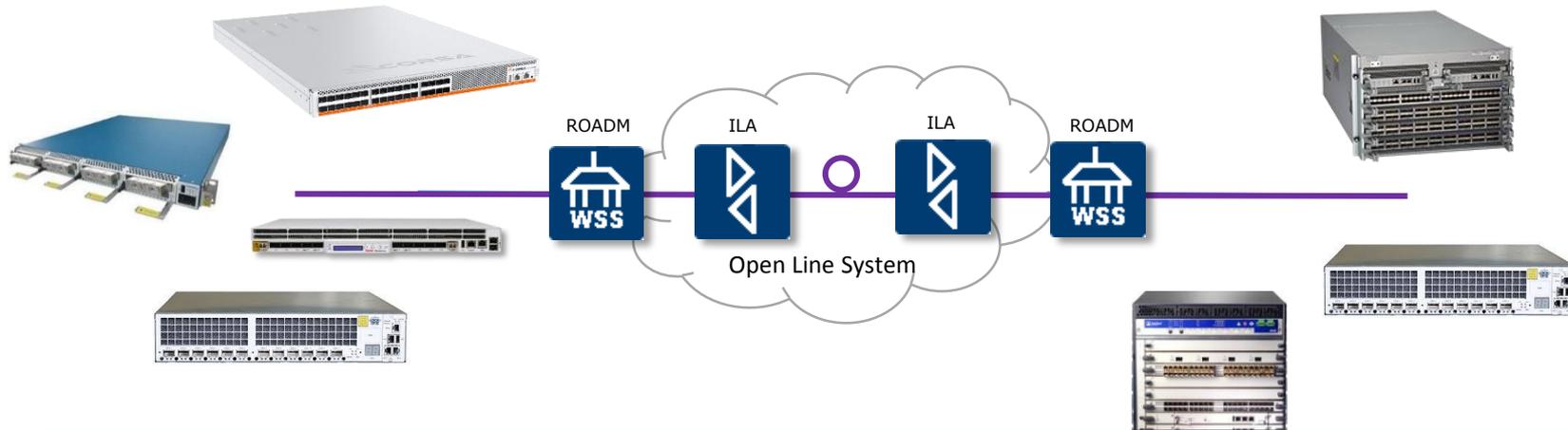
- Partially: Transponding is one element, OOLS is second.



Medium term solution. Open access, single management plane for OLS

# OLS gives flexibility

- Technology is moving faster in the packet and transponders than the amplifiers and WSS.
- Alien waves allow transponders from multiple vendors to operate on a single line system.
- Still benefit from a single vendor providing end-to-end optical management: Channel & span equalization, DCN connectivity (OSC), ALS, Alarm reporting ect.



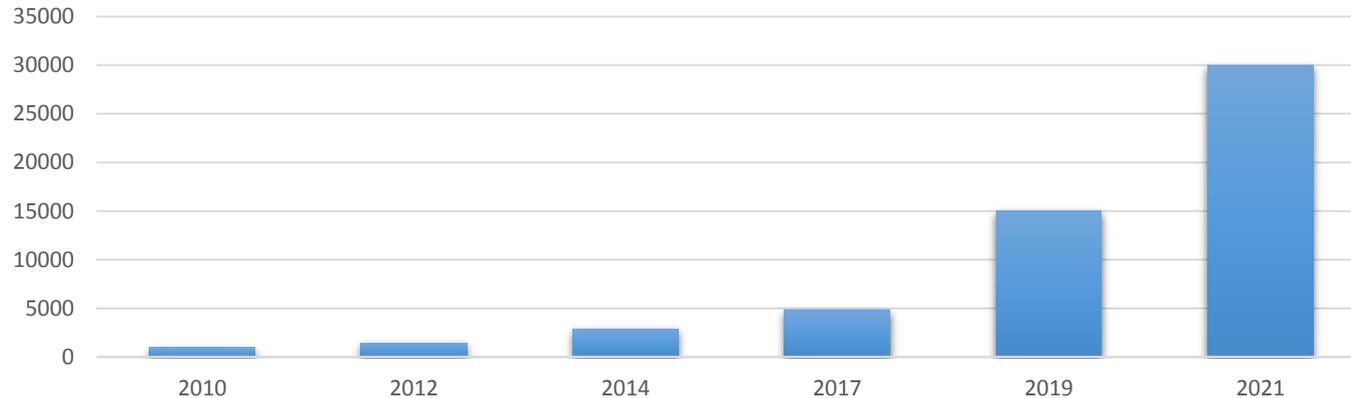
# GÉANT Packet Layer Evolution

- Current cost per bit paid on IP/MPLS is based on the requirements of the most complex service/s but flow requirement are very diverse
- GÉANT investigating three options for replacement of current GÉANT packet platform
  - Deploy high-density line cards in existing platform to support the traffic growth
  - Find an alternative and cost-effective solution to replace existing platform with another vendor equipment or smaller platform e.g. MX204s
  - Disaggregated solution - White box and third party NOS

# The IP/MPLS layer – Upgrading MXs

Good upgrade path on MX960/480 means we can keep the system in place for a little longer than expected  
Flex Ethernet coming on next-gen interface cards will solve elephant flow issue on 100G links

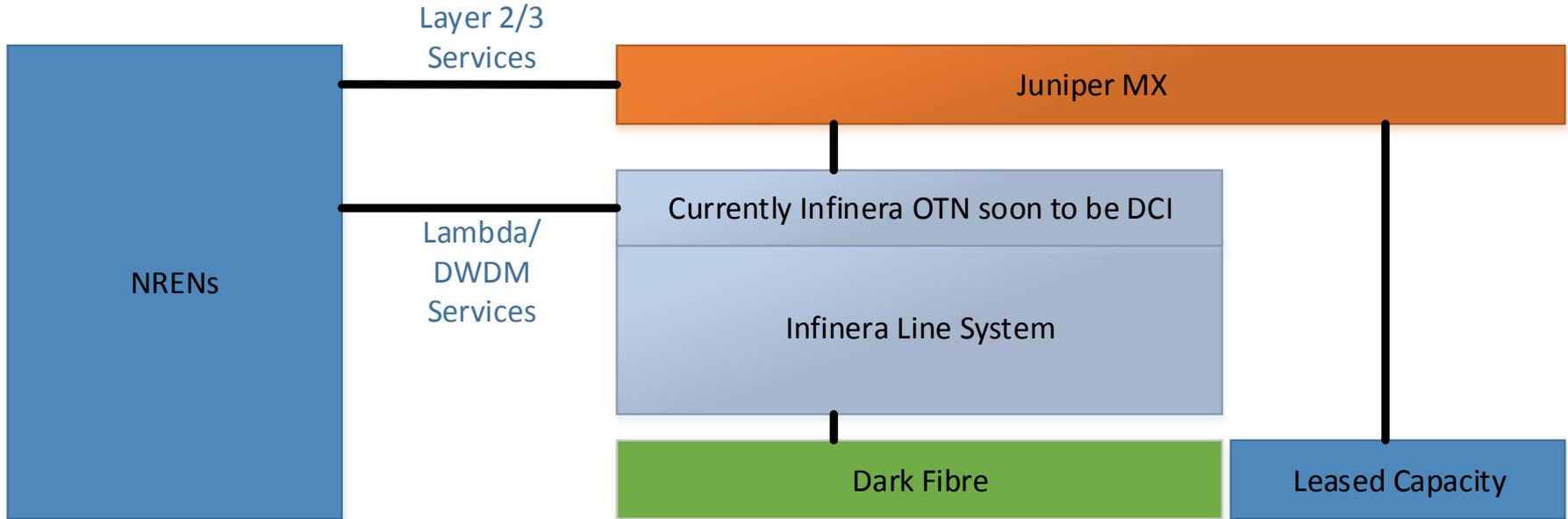
MX 960 total system capacity - Gbps

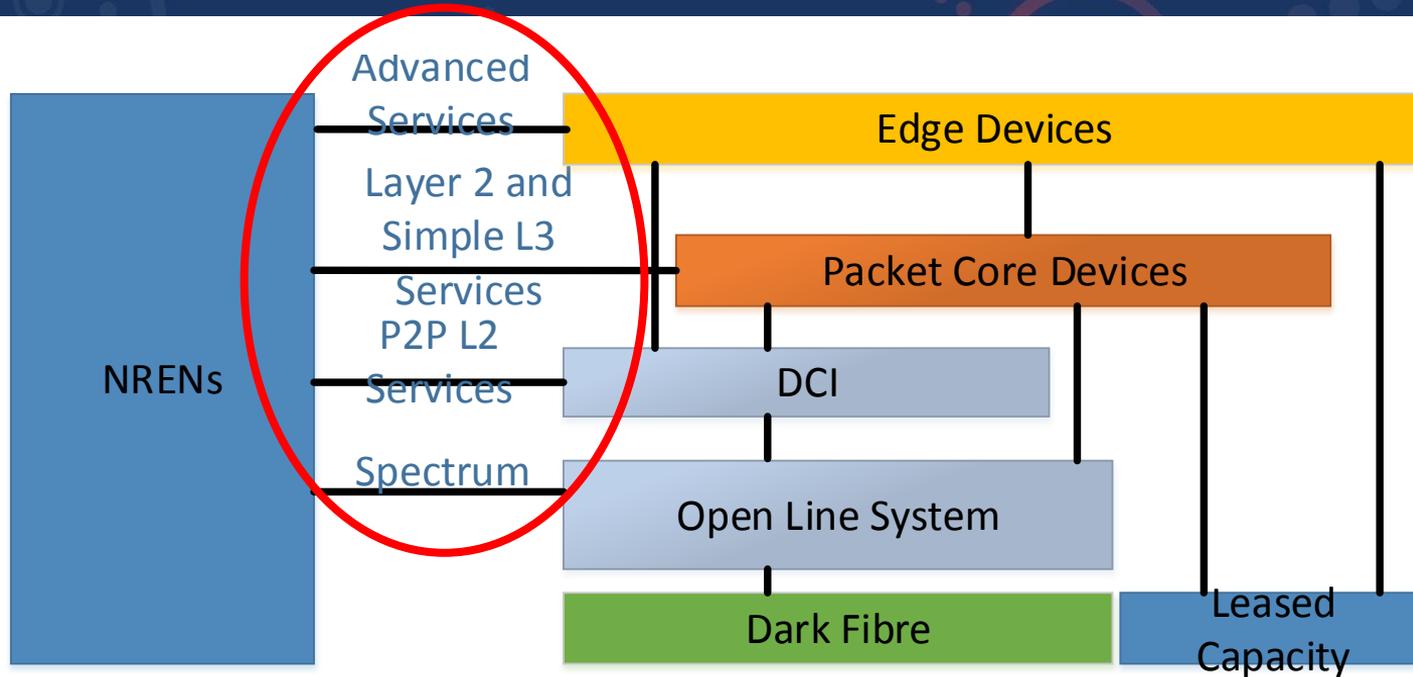


30x in 10 Years

Slot capacity evolution:  
MPC3 – 1x100G → MPC4 – 2x100G → MPC7 4x100G → MPC10 15x100G FlexE



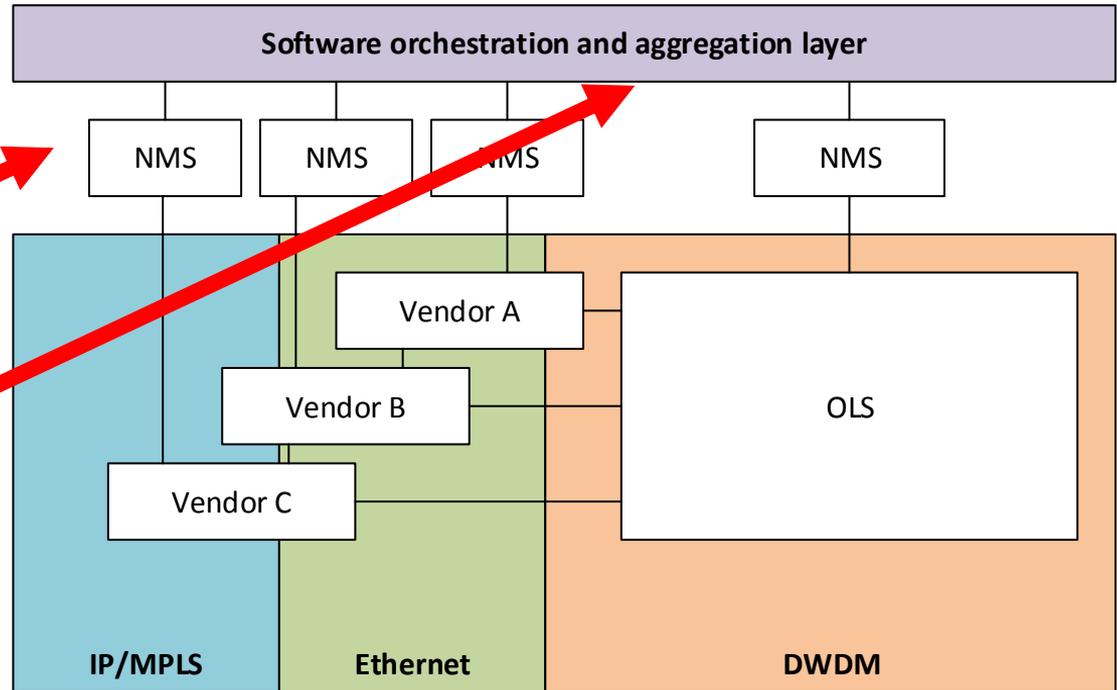




Increase the options for connectivity between clients and network allows for new services and better mapping of services requirements to technology and cost

Disaggregation and modularisation of infrastructure will result in the use of specialised equipment from different vendors each having its own management system.

Aggregation of information and orchestration will have to be provided by upper software layer.



- IRU money is a total game changer
- Collaborative and Transparent process and Engagement with community
- Infrastructure sharing will strengthen the collaboration
- Moving towards open technologies e.g. OLS and commodity hardware
- How to build/evolve NMS/Orchestration Platform?

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**Thank you**  
**Any Questions?**

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