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GÉANT Network Infrastructure Evolution under GN4-3N

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What is GEANT

- A not-for-profit organization
- Supports collaboration and development amongst researchers, the dissemination of information & knowledge, and provide access to a portfolio of services and infrastructure resources
- Among the main goals is the reduction of digital divide
- Runs the pan-European network infrastructure dedicated to the Research and Education sector - The GEANT Network https://network.geant.org/
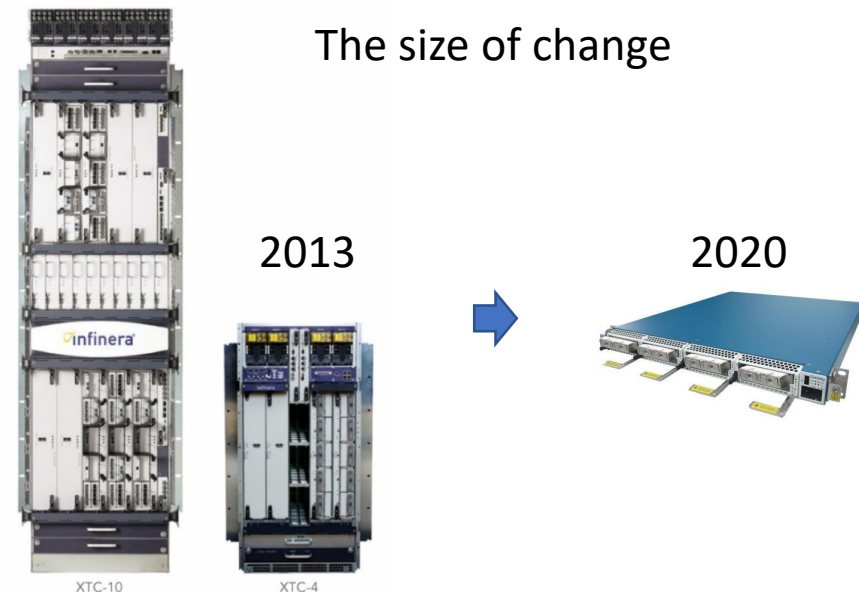- https://www.geant.org/

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What is GN4-3N

- With the IRU SGA the EC is funding a large infrastructure refresh project for GÉANT, GN4-3N – extract from the SGA objectives

*Go beyond the state-of-the-art by restructuring the backbone network through exploration and **procurement of long-term IRUs and associated equipment to increase the footprint**, stimulating the market in cross-border communications infrastructure **whilst decreasing the digital divide and reducing costs***

- 4 Years (2019 – 2022) project with about 50M EUR of capital 100% EC funded
- Three main areas of change:
  - DWDM Technology
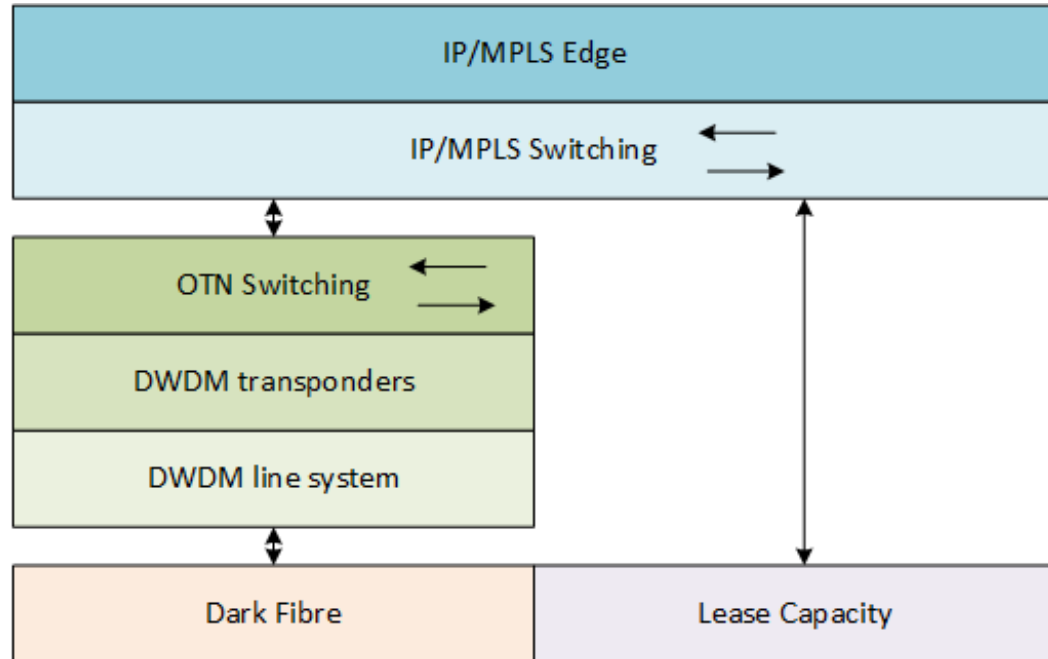 - Connectivity solutions
  - Topology

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DWDM technology

- Recent advances in DWDM transmission technologies allows for lowering cost of accessing capacity over Dark Fibre and provide a very good cost per additional bit once modern DWDM system is in place

- Disaggregation options providing a better long-term outlook

- Below some of the main technology changes involved:
  - Coherent transmission at 100Gbps+
  - Commoditisation of transponders HW
  - DCI formfactor for transponders
  - Disaggregated Line System design
  - Flexible grid
  - ROADM HW optimised for Data Centre Env.
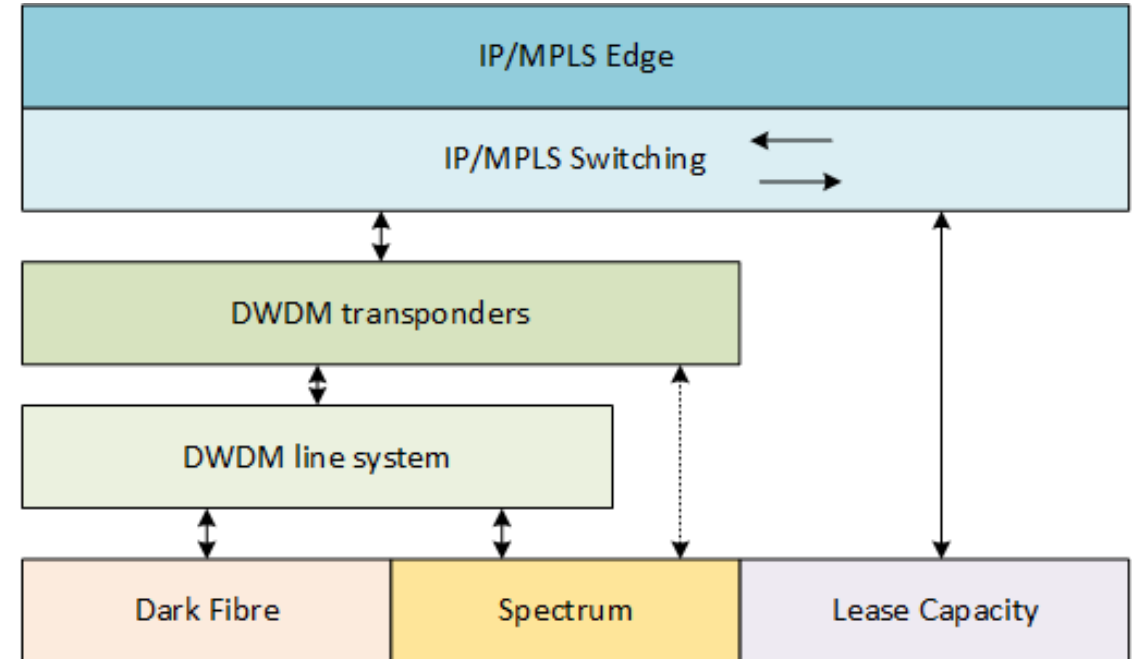 - 400G Eth optimised transponders

The size of change

2013

2020

XTC-10   XTC-4

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Revised stack

Before GN4-3N

| IP/MPLS Edge |
| IP/MPLS Switching |
| OTN Switching |
| DWDM transponders |
| DWDM line system |
| Dark Fibre | Lease Capacity |

After GN4-3N

| IP/MPLS Edge |
| IP/MPLS Switching |
| DWDM transponders |
| DWDM line system |
| Dark Fibre | Spectrum | Lease Capacity |

- Revised stack with Disaggregation at the DWDM layer and elimination of OTN switching
- The new stack provides connectors (NRENs) with the option to access the infrastructure at a lower layer, "Spectrum" services

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DWDM system of choice

- GÉANT selected Infinera FlexILS for the Open Line System (OLS) and Infinera Grooves G30s DCIs as transponders.

- The Line system is Flexible grid capable

- Grove G30 DCIs supports 400Gbps today
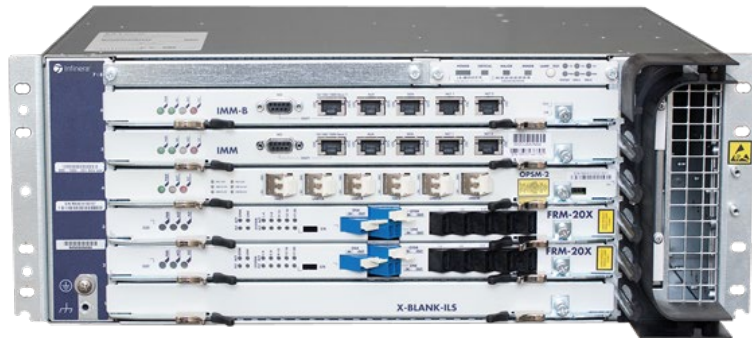
FlexILS MTC6 chassis with cards

Groove G30 with CHM1 transponder cards

Connectivity solutions

- Footprint will be based largely one Fibre on 15years IRUs

- Some areas will be served by portions of a fibre 1/2 or 1/4

- A fibre carry today more than 24Tbps of traffic in most cases

- Long terms contracts and ownership of infrastructure will bring stability, capacity and predictability of costs across the whole footprint
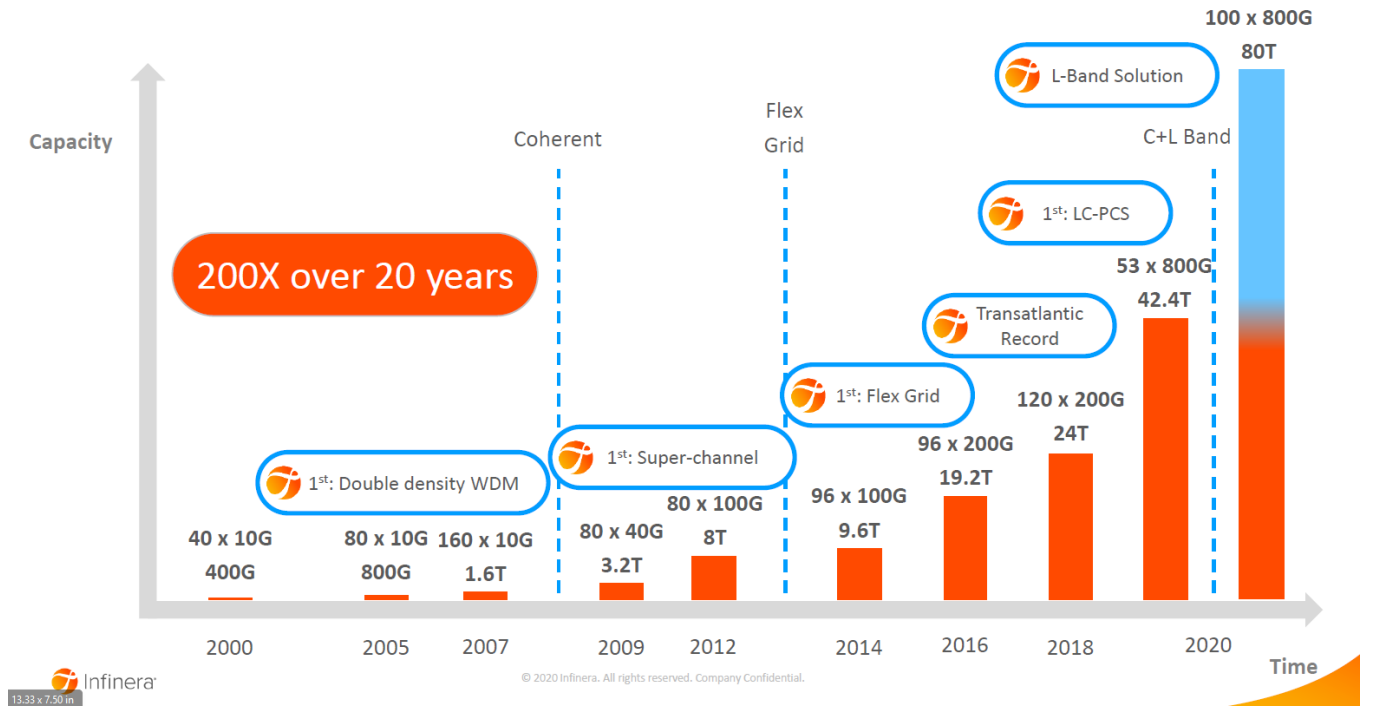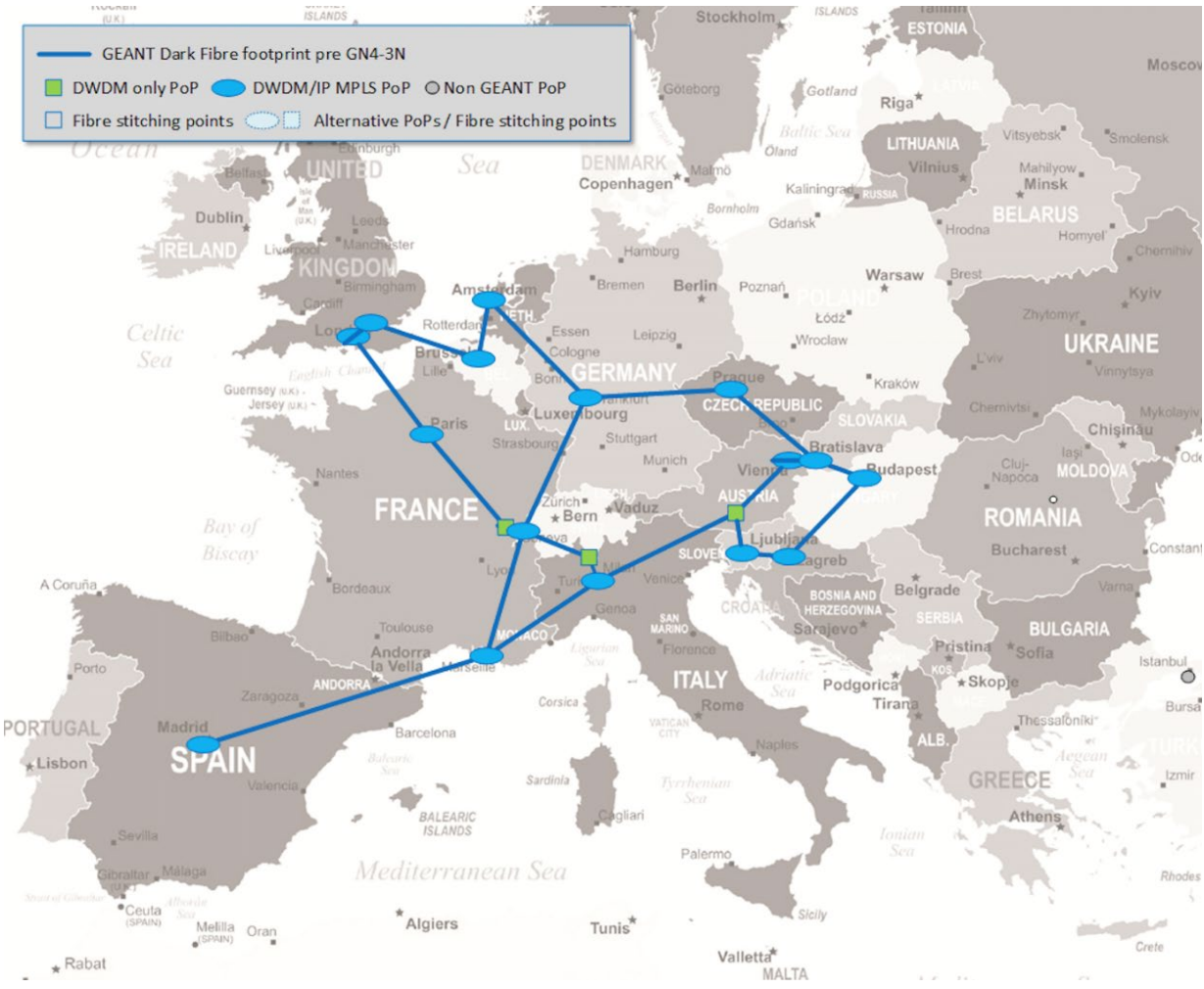
Evolution of DWDM Capacity over Time

Capacity

200X over 20 years

Coherent

Flex Grid

L-Band Solution

100 x 800G
80T

C+L Band

1st: LC-PCS

53 x 800G
42.4T

Transatlantic Record

120 x 200G
24T

1st: Flex Grid

96 x 200G
19.2T

1st: Super-channel

96 x 100G
9.6T

1st: Double density WDM

80 x 100G

80 x 40G
3.2T

8T

40 x 10G
400G

80 x 10G
800G

160 x 10G
1.6T

| 2000 | 2005 | 2007 | 2009 | 2012 | 2014 | 2016 | 2018 | 2020 |

Time

Infinera

13.33 x 7.50 in

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The footprint

Legend:
- GEANT Dark Fibre footprint pre GN4-3N
- DWDM only PoP
- DWDM/IP MPLS PoP
- Non GEANT PoP
- Fibre stitching points
- Alternative PoPs / Fibre stitching points

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Equal opportunities for NRENs

- Substrate based on Dark Fibre (and portions/spectrum) covering almost totality of the long-term footprint
- Cost of additional Gigabit at the DWDM layer reduces by about 90% where GÉANT self provisions compared to previous system
- Area where GÉANT self provision (run own DWDM system) expand greatly from covering 14 countries over 10.000Kms to 24+ over more than 30.000Kms
- Cost per Gigabit is the same across the entire Fibre footprint
- Self provisioning means much faster capacity deployment
- Substrate running costs are reduced compared to the previous iteration based on mix of short-term lease capacity and medium-term lease of DF

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What changes for ARNES and Slovenia

- ARNES will keep being served by a full Dark Fibre connected in Ljubljana
- Additional PoP in Ljubljana to improve geographical resiliency and one access point will be moved to Zagreb from Vienna
- Connectivity will be at 200Gbps from the start for both access points with upgrade path to 400Gbps
- OSNR on Fibre is optimised for support of 400Gbps today, meaning that access to this capacity level is cost optimised
- Significant improvement in the modularity and capability of the Optical network means that both PoPs will allow for access to Spectrum services or dedicated transponders for very high bandwidth applications such as HPC

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Hvala

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