
GÉANT
Networks • Services • People
The GÉANT Network:
a glimpse into the future
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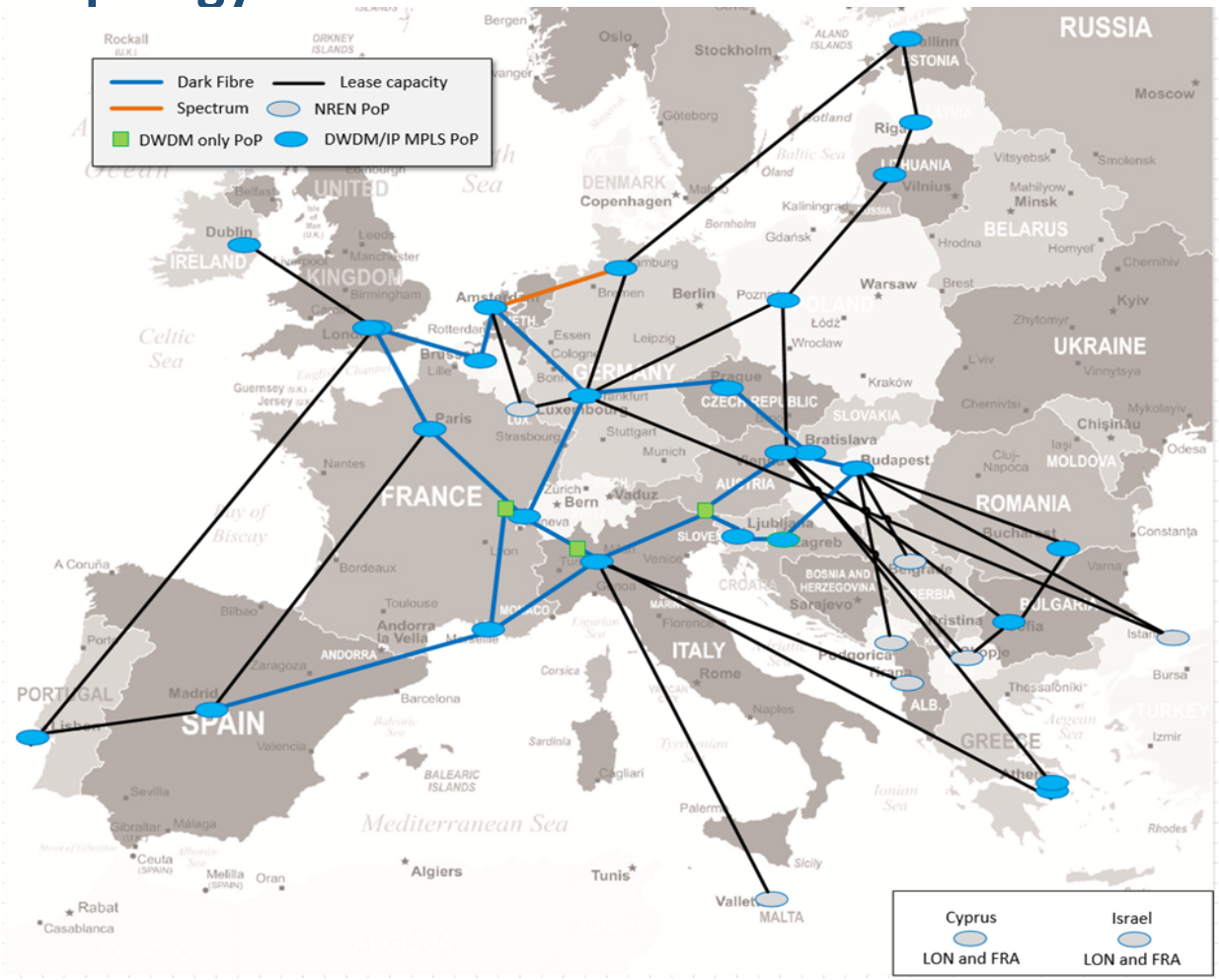
www.geant.org

GÉANT topology



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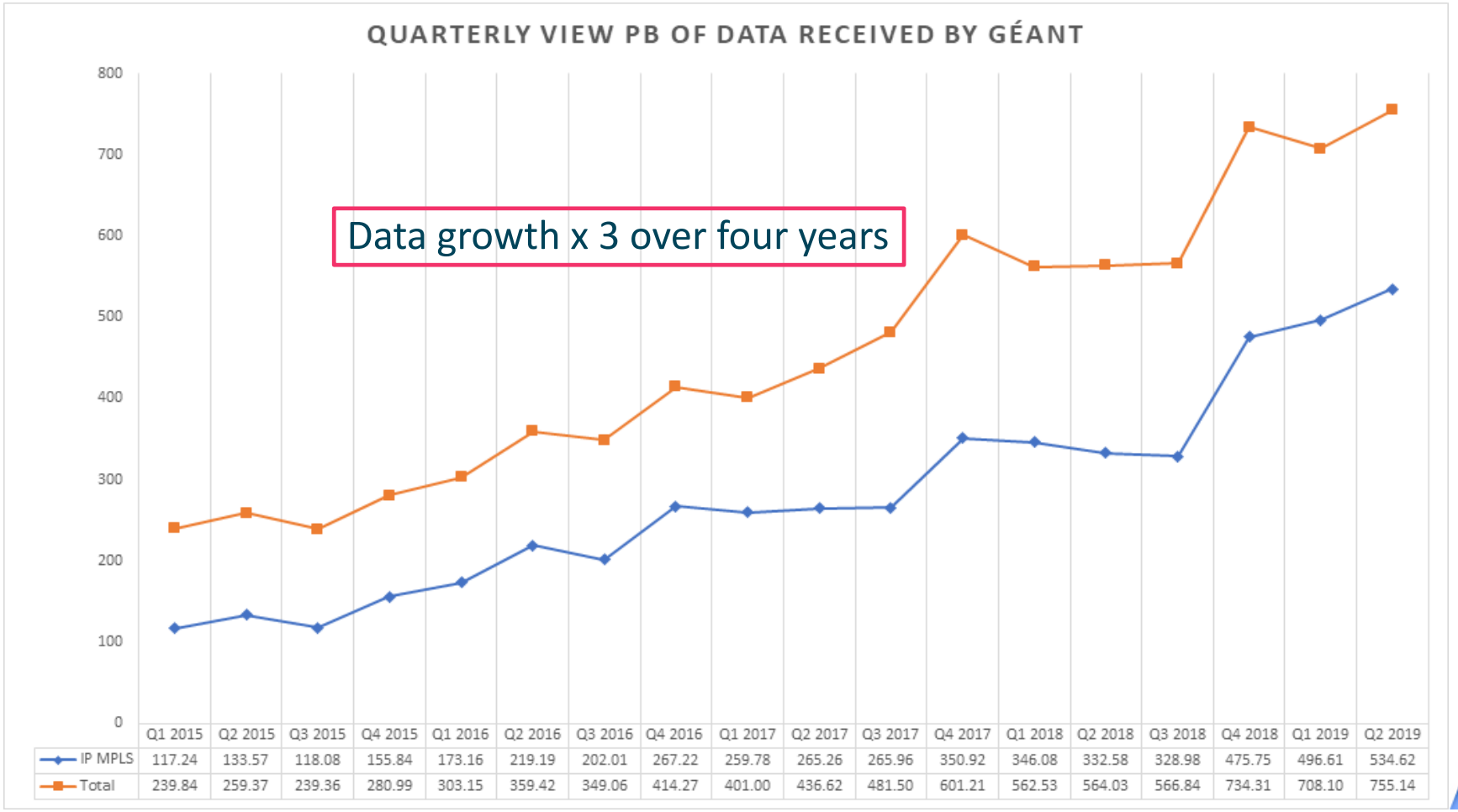
Challenges

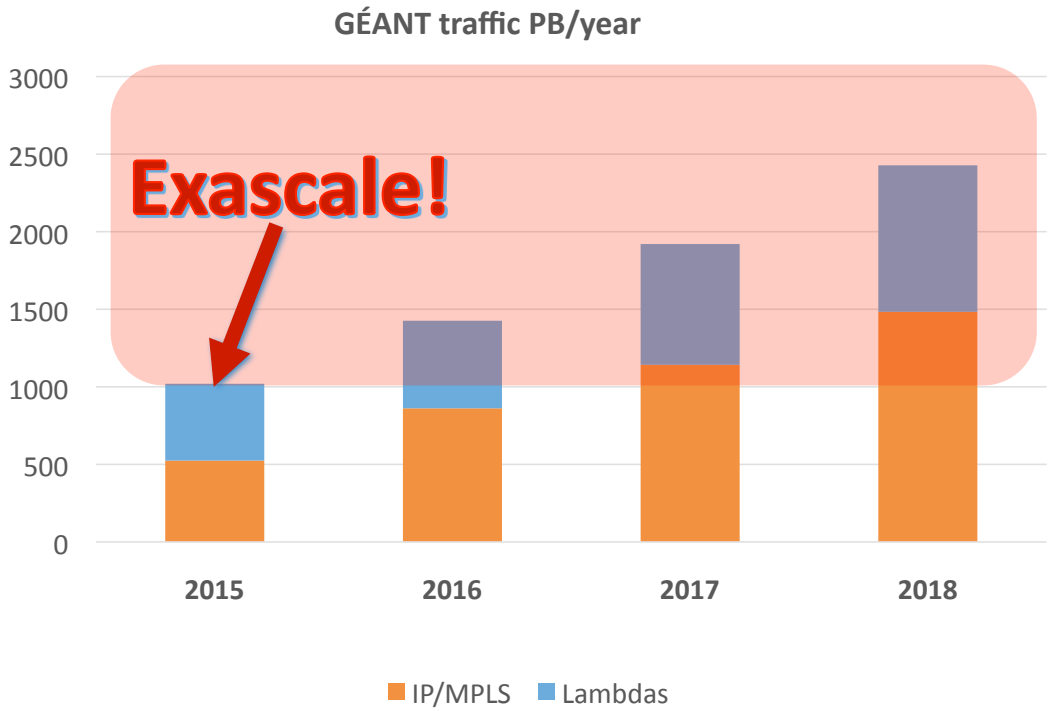
- Exponential traffic increase
- Flat (or shrinking) budget
- Need for programmability
- Reduce vendor lock-in
- Keep the existing mission and design rationale

Traffic trends



	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019
IP MPLS	117.24	133.57	118.08	155.84	173.16	219.19	202.01	267.22	259.78	265.26	265.96	350.92	346.08	332.58	328.98	475.75	496.61	534.62
Total	239.84	259.37	239.36	280.99	303.15	359.42	349.06	414.27	401.00	436.62	481.50	601.21	562.53	564.03	566.84	734.31	708.10	755.14

Network and Capacity Growth



- 2.4 EB of data received in 2018
- Long-term trend ~30% YoY

Enter the GN4-3N project

(formerly known as IRU-SGA)

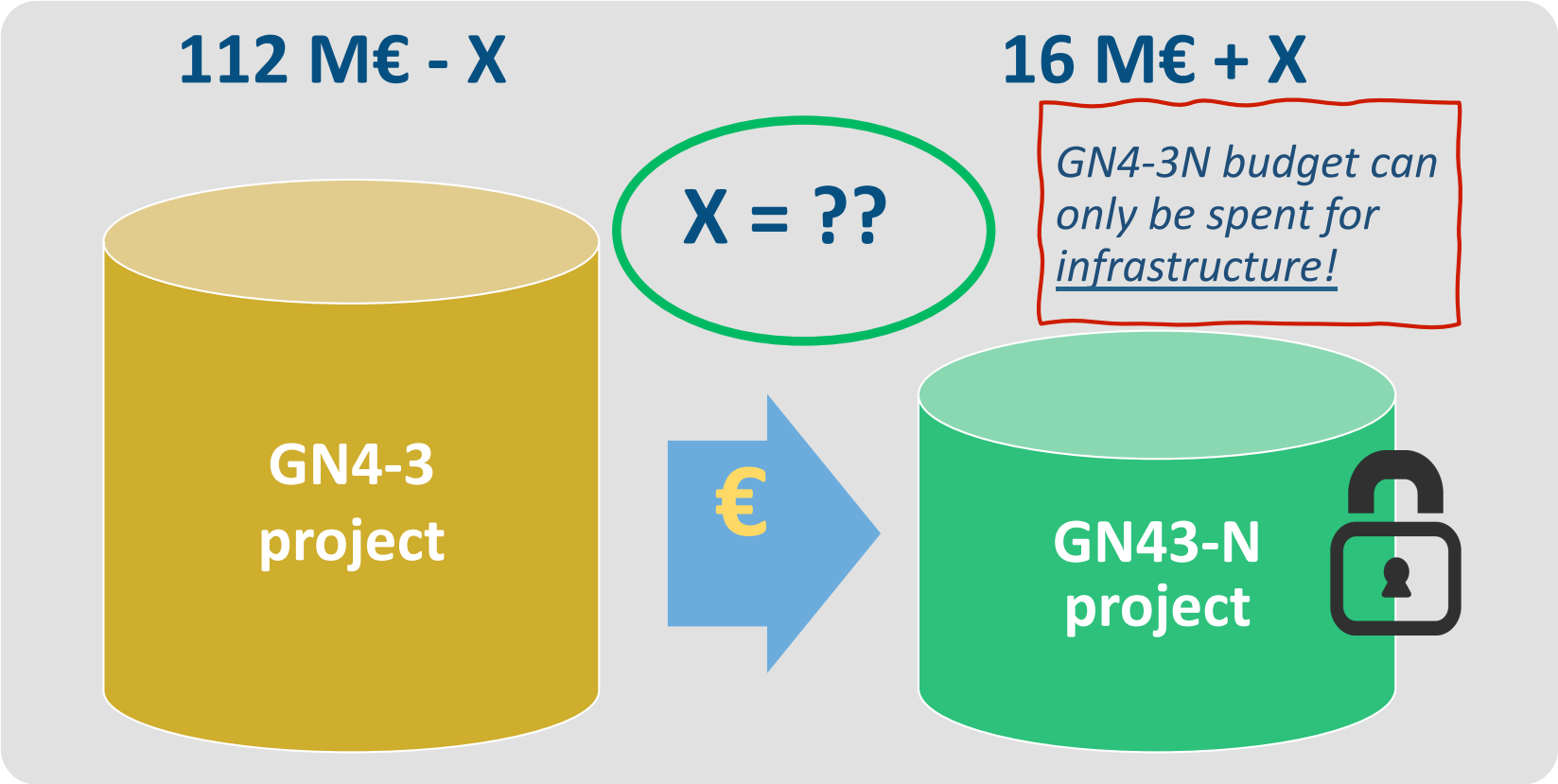
- EC created a funding vehicle to procure infrastructure on long terms contracts **and with 100% funding.**

> *"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**"*
>
> *"Improve the **minimum service level** of the smaller European NRENs and their users by ensuring connectivity speeds **of 100 Gbps** (where technically and economically feasible)"*

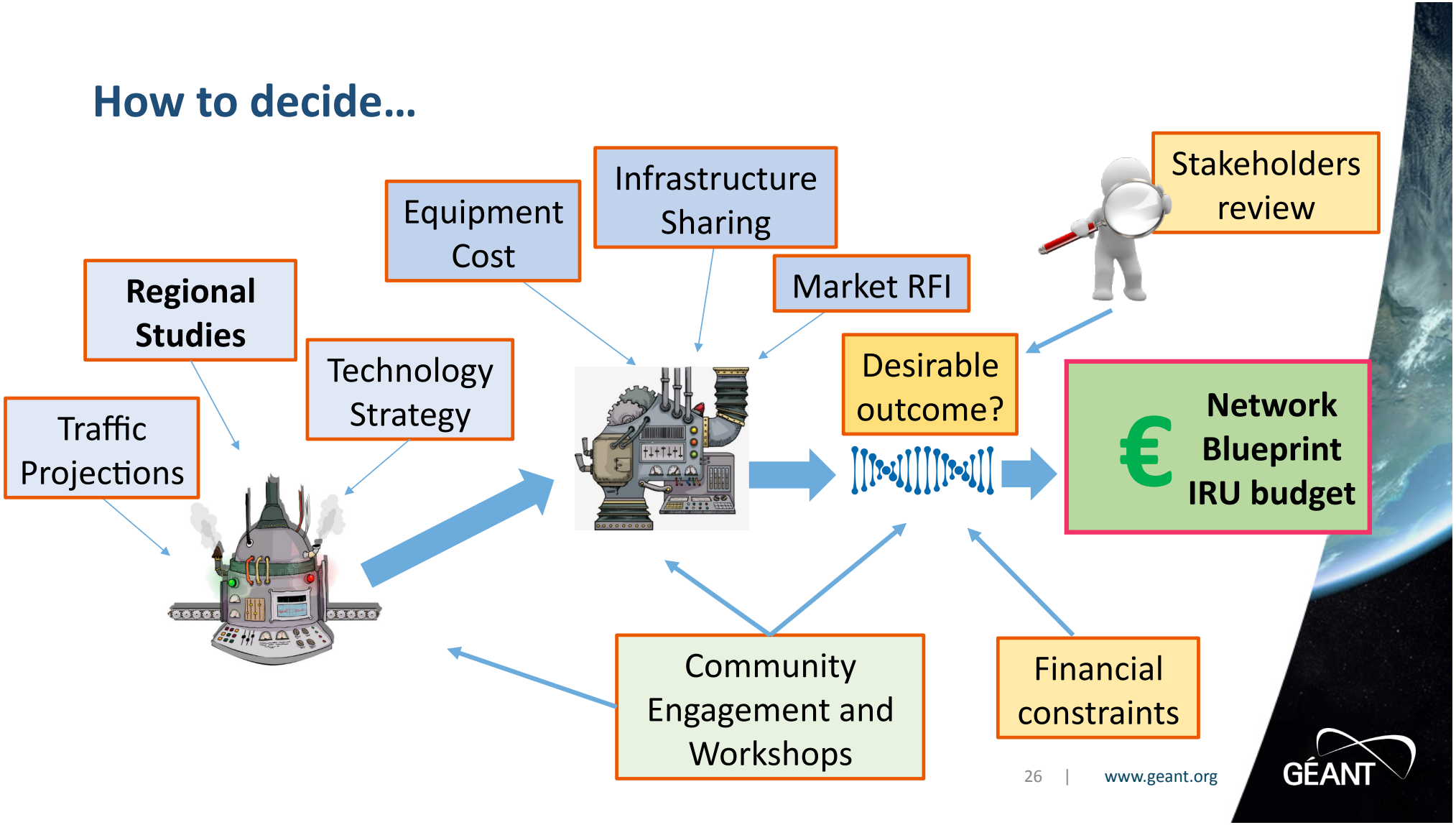
Extract from objective for the IRU SGA

- Funding cycle 2019-2022
- Budget at least 16M€, out of total 4-year GÉANT project budget of 128M€

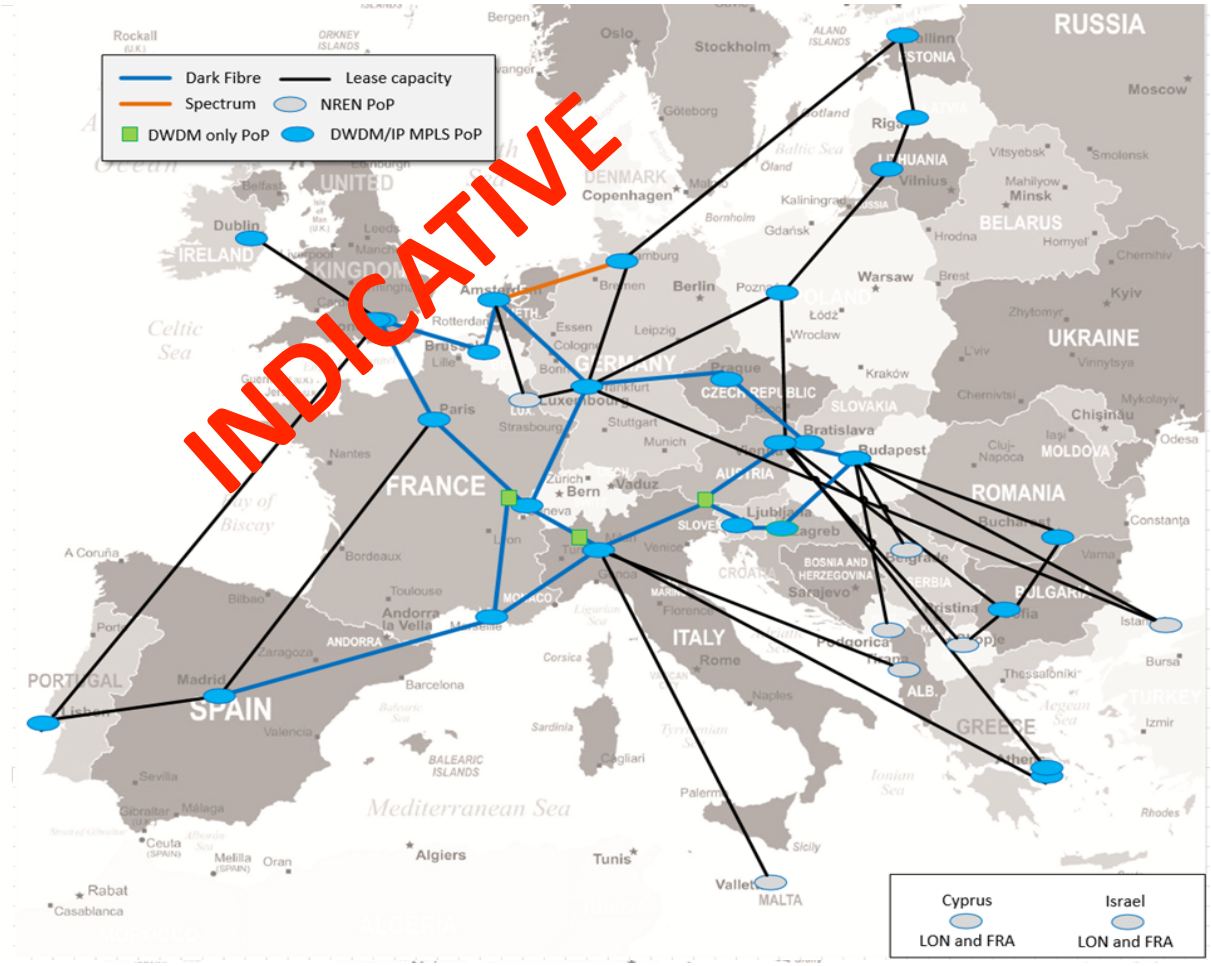
First things first: what's the budget?



How to decide…



GÉANT future topology (in progress)



Based on Infinera DTN-X and Juniper MX Platform

24 countries on fiber (+10):
UK, **IE, PT**, ES, FR, BE, NL, DE, **EE, LV, LT, PL**, AT, CZ, SK, CH, HU, IT, SI, HR, RO, **BG, GR, RS**

14 countries connected on:

- UK, BE, FR, CH, DE, AT, NL, HU, HR, IT, SI, SK, CZ, ES

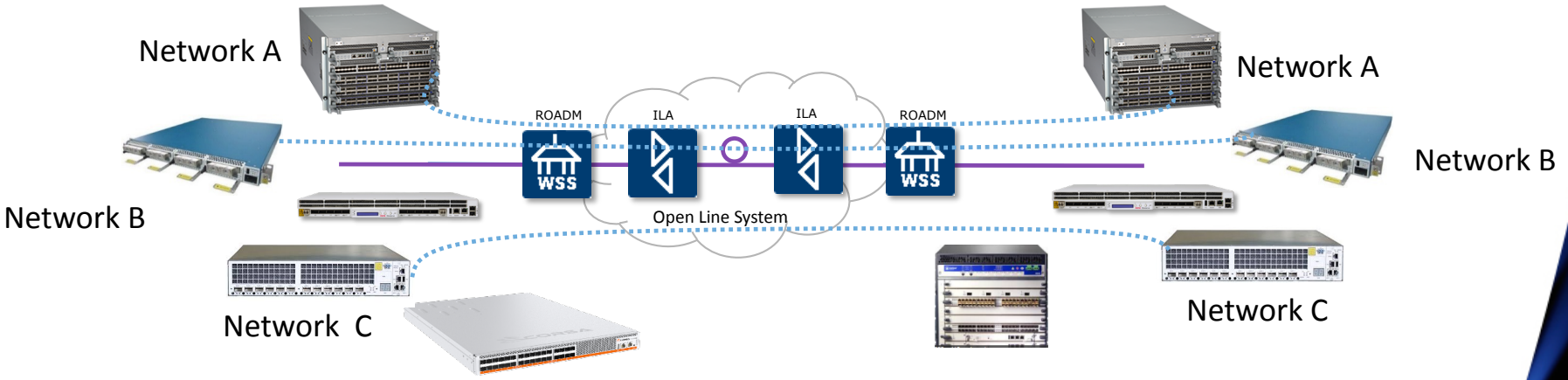
For the remaining countries:

- standard leased capacity (minimal 10GE, might be 100GE by end of project)
- or additional DF/spectrum as part of regional extension

Mix of DWDM and leased capacity.

Estimated NRC: 50 M€

Technological Enabler – Open Line System



Revolution of the transport

Vendor Proprietary Network Controller

- Proprietary and Closed APIs
- Vendor-Specific data model

Disaggregate: Open Optical Line System

Multi-vendor Open Network Controller/Orchestrator

- Open and Standard APIs
- Open data model

NMS

NMS

DCIs

Open Optical Line SYSTEM

GÉANT

Options for the packet layer

Option 1

Keep using the existing platform where high-density line cards are needed

Option 2

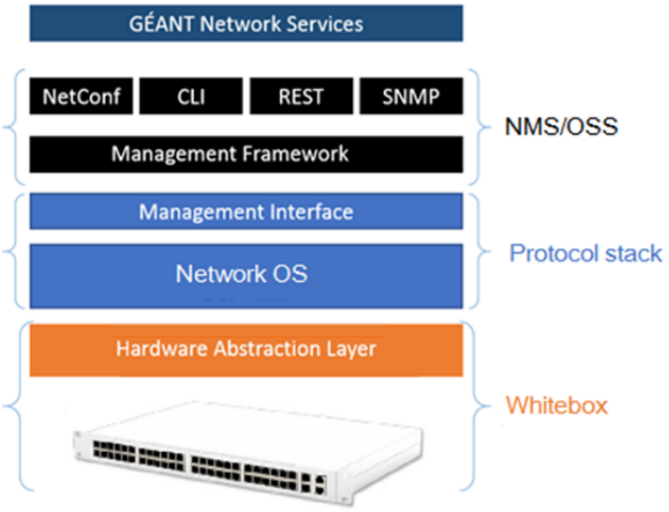
Replace medium-sized MX-480 devices in smaller PoPs with MX-204s

Option 3 ?

White/Brite Boxes: Open Hardware and Open Network Operating System

Fully decoupled evolution

New Ecosystems



Bigger is not always better

Enter the MX204

4x QSFP – 1x100G or 4x10G

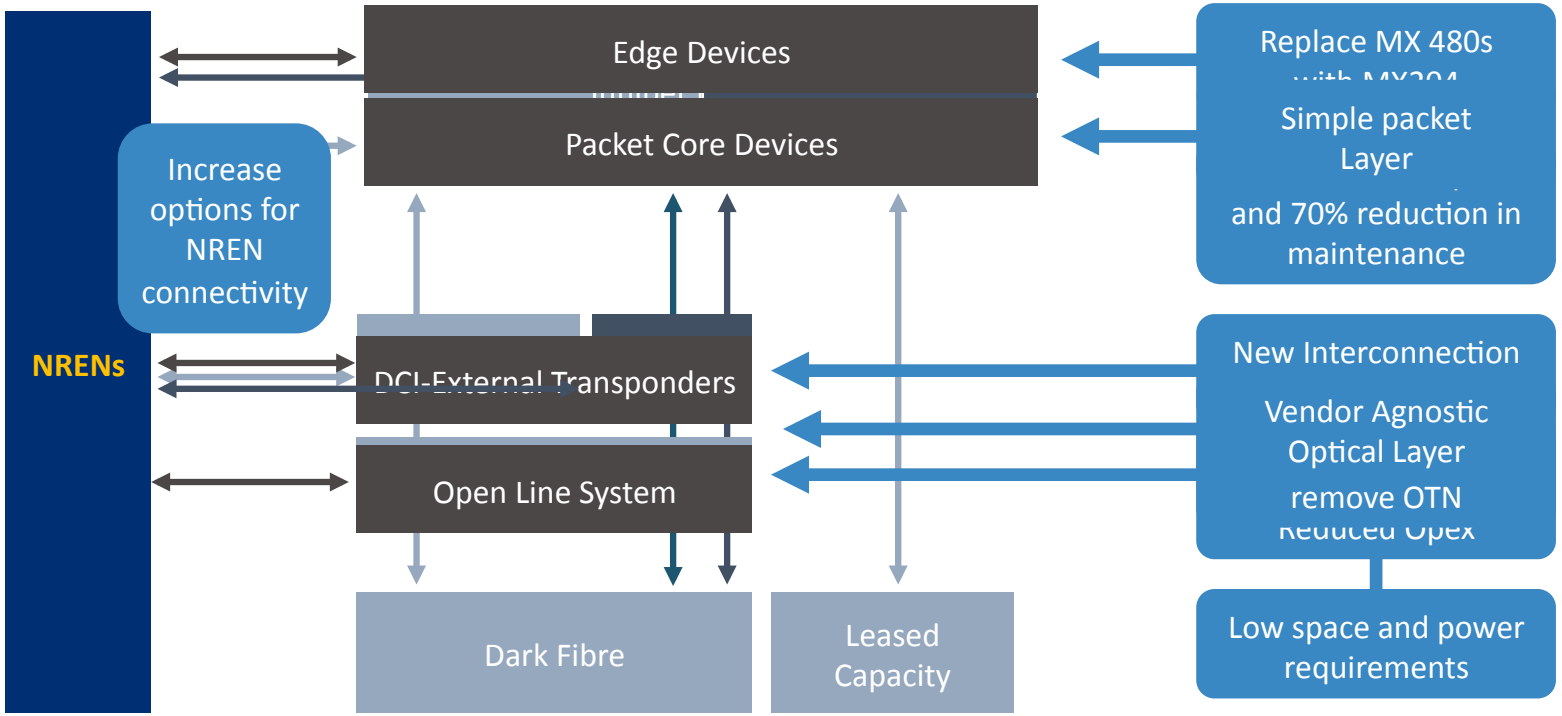
8x SFP – 1G or 10G

400G total switching capacity
Enhanced QoS
PTP support
Dual PSU
Single routing engine

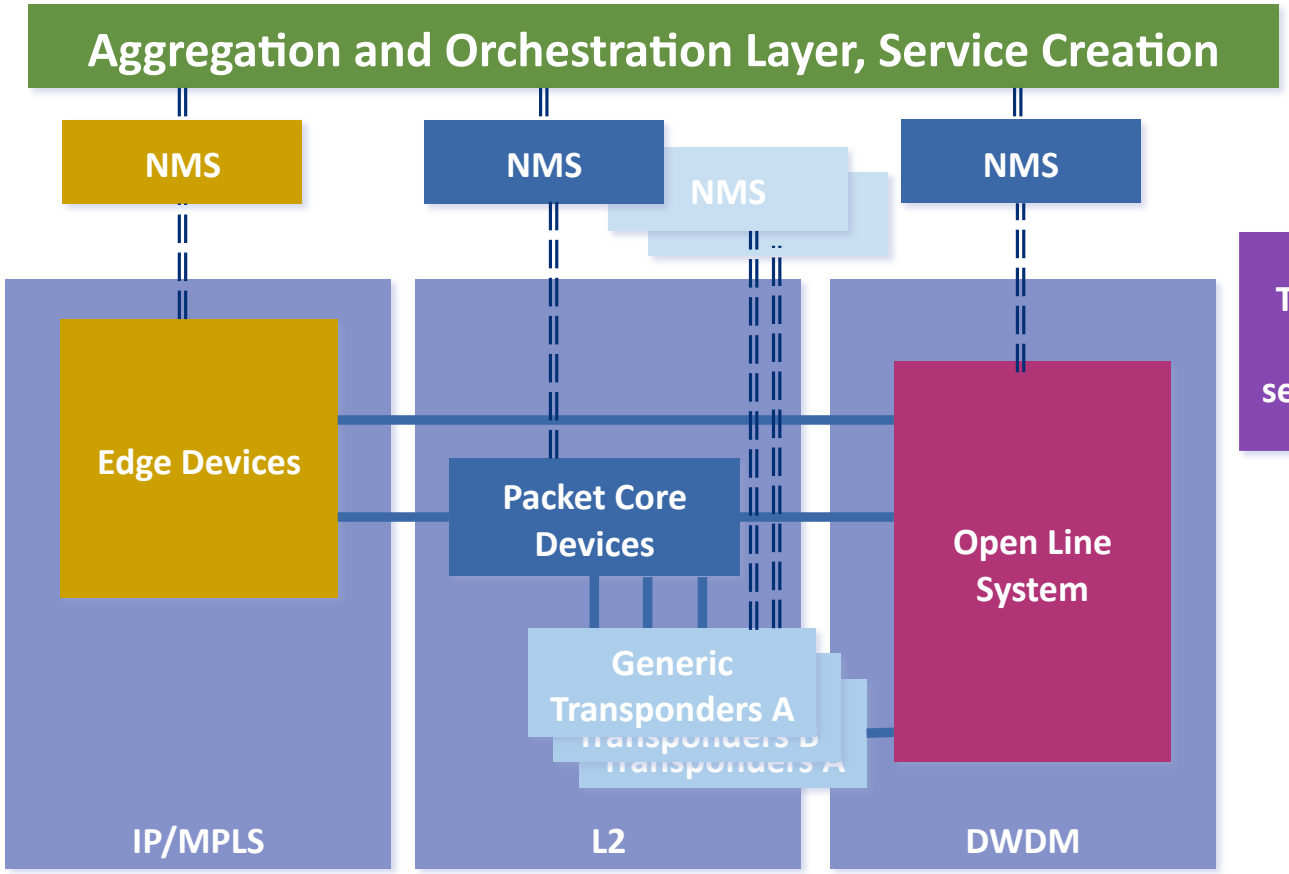
~80% OPEX reduction

~70% less power

Putting it all together

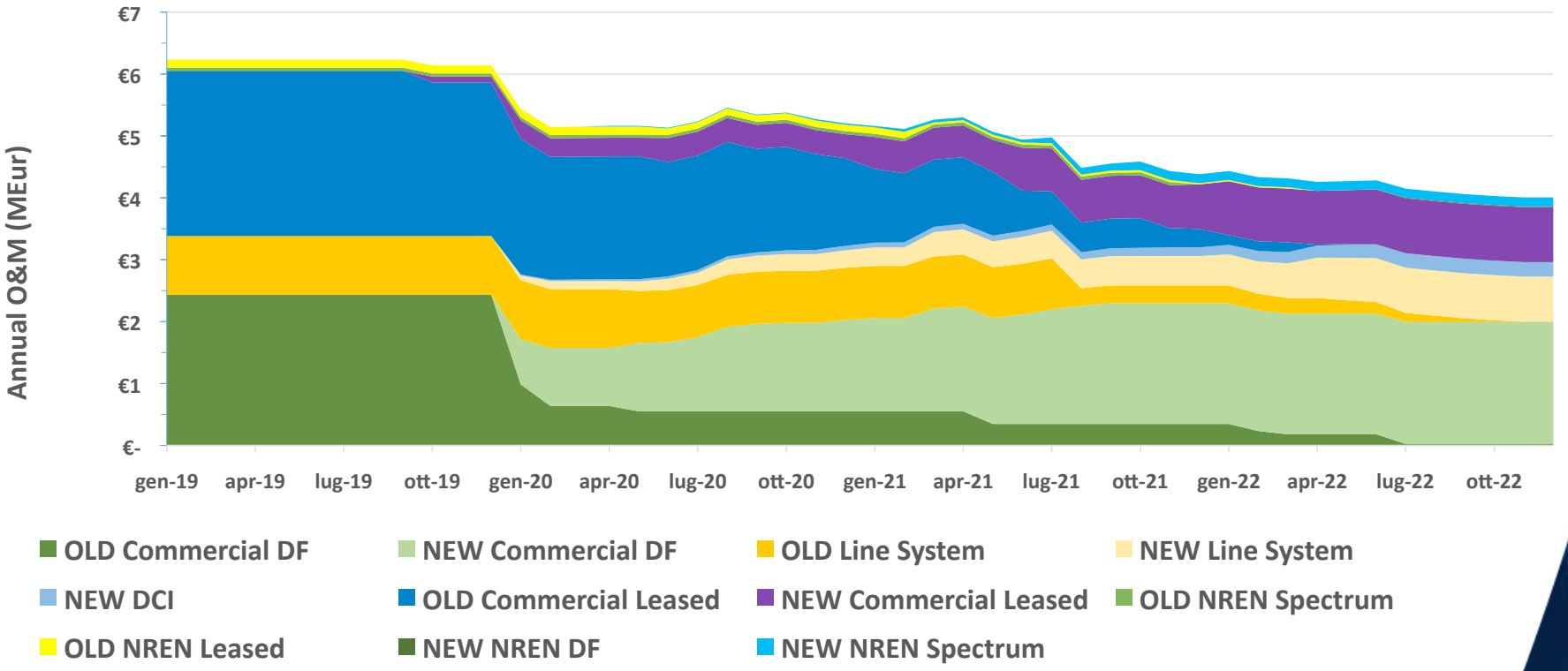


Managing a Disaggregated Network

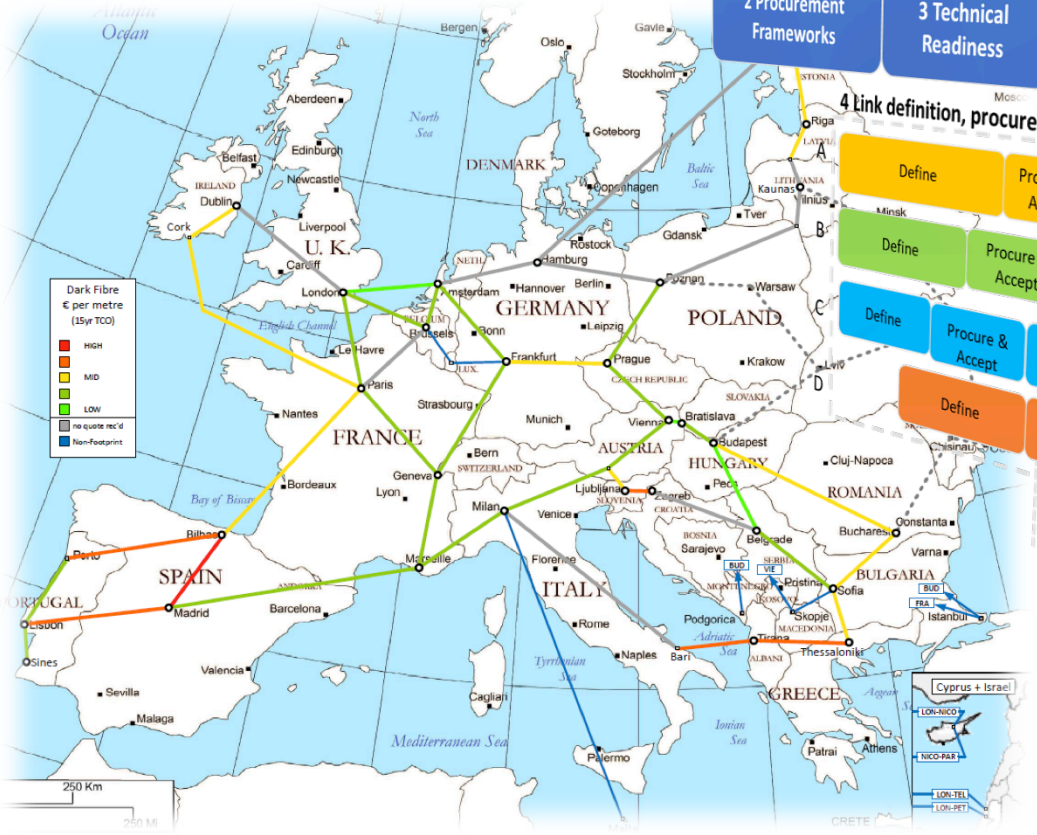


This network is only one part of the service supply chain…

Costs projection



GN4-3N Planning



Phase 1

2019

2020

Phase 2

2021

2022

1 Project Set-up

2 Procurement Frameworks

3 Technical Readiness

4 Link definition, procurement and transition

Define

Procure & Accept

Transition

Define

Procure & Accept

Transition

Define

Procure & Accept

Transition

Define

Procure & Accept

Transition

5 Finalisation

Flexibility and control

- **Vendor and Technology Agnostic A… …ecture**
- **Disaggregate:** de-couple i… …tion cycles and accelerate innovation
- **…crease optic… …nect** NRENs to different platform depending on the… …ls
- **Reduce space… …wer requirements** by allowing smaller form… …rs

Open and disaggregated architecture

Differentiate from commercial providers

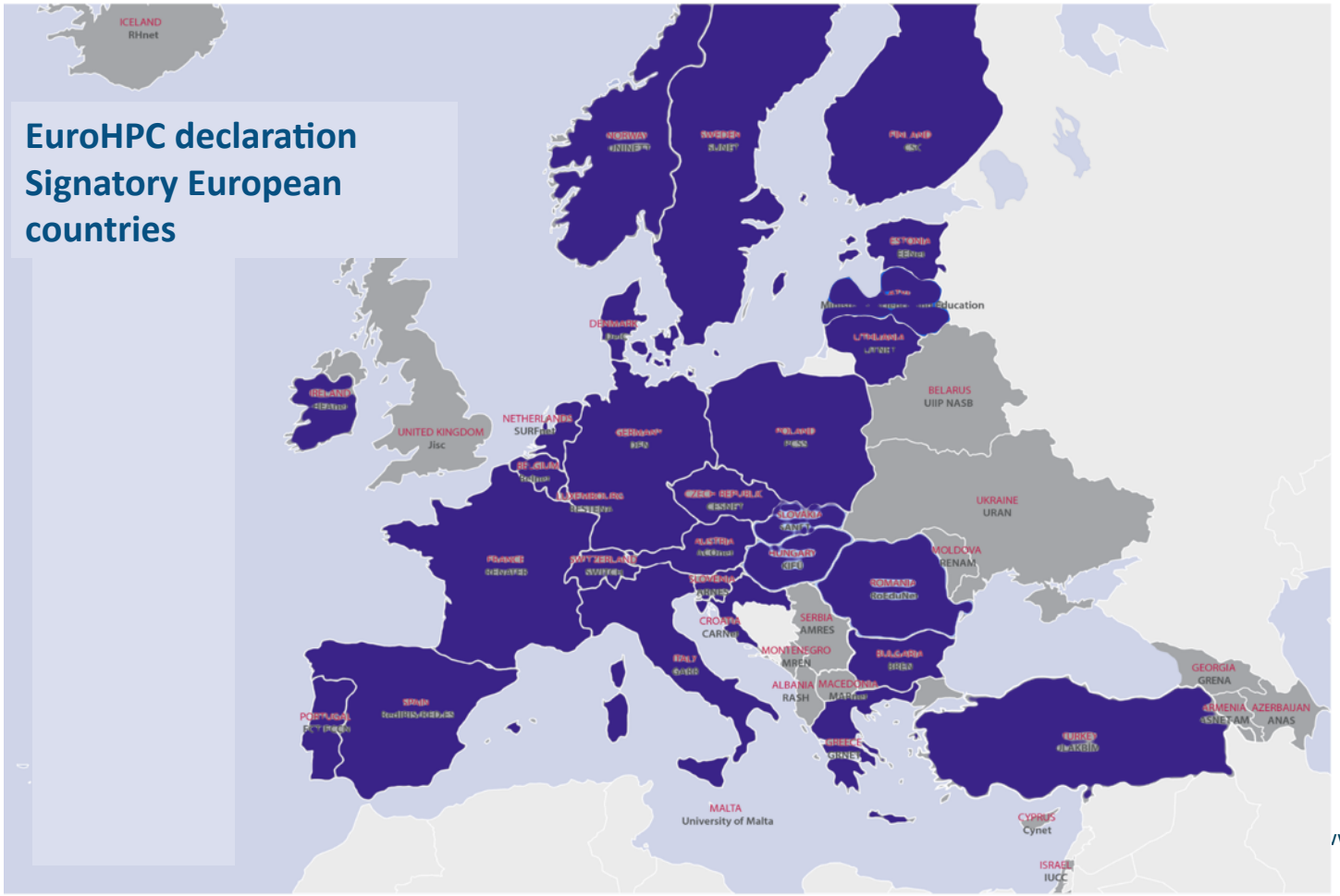
Deliver advanced services for R&E users

What it means for the end users

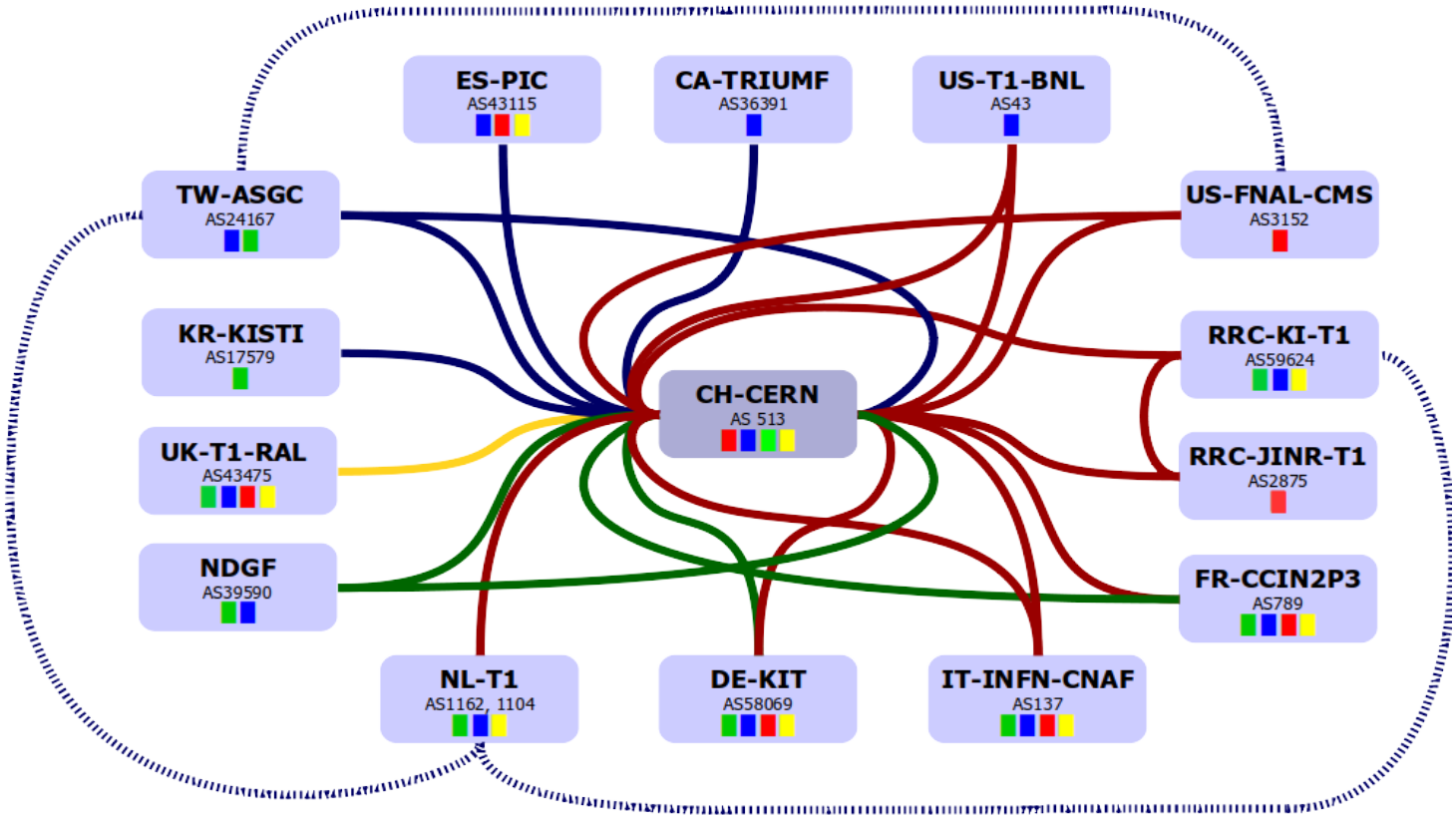
- Very large capacity available from day 1
- Additional capacity very cheap to add
- Advanced capabilities and rapid deployment
- Uncontested and unrestricted data flow

(Avg user): mmhhh, ok... So what?

EuroHPC


EuroHPC declaration
Signatory European countries
ICELAND
RHnet
UNITED KINGDOM
Jisc
NETHERLANDS
SURF
BELARUS
UIIP NASB
UKRAINE
URAN
MOLDOVA
RENAM
SERBIA
AMRES
MONTENEGRO
MREN
ALBANIA
RASH
GEORGIA
GRENA
AZERBAIJAN
ANAS
MALTA
University of Malta
CYPRUS
Cynet
ISRAEL
IUCC

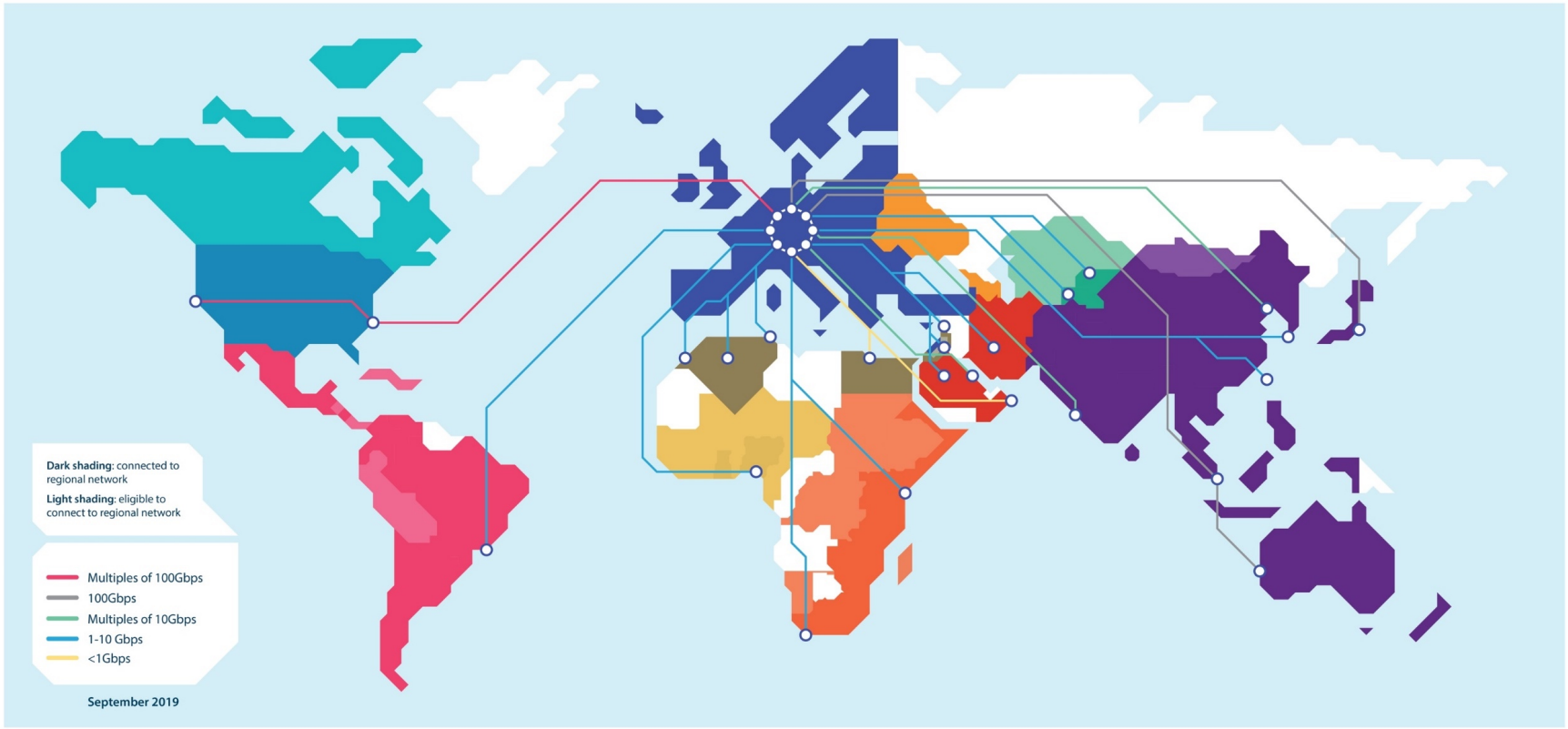
LHCOPN


ES-PIC
AS43115
CA-TRIUMF
AS36391
US-T1-BNL
AS43
TW-ASGC
AS24167
US-FNAL-CMS
AS3152
KR-KISTI
AS17579
RRC-KI-T1
AS59624
CH-CERN
AS 513
UK-T1-RAL
AS43475
RRC-JINR-T1
AS2875
NDGF
AS39590
FR-CCIN2P3
AS789
NL-T1
AS1162, 1104
DE-KIT
AS58069
IT-INFN-CNAF
AS137
T0-T1 and T1-T1 traffic
T1-T1 traffic only
= Alice = Atlas = CMS = LHCb
edoardo.martelli@cern.ch 20190506
10Gbps
20Gbps
30Gbps
40Gbps
100Gbps

Novel use-cases

- Ultrahigh-speed DC interconnection
- Distributed data centres
- Disaster recovery/high availability

AT THE HEART OF GLOBAL RESEARCH AND EDUCATION NETWORKING



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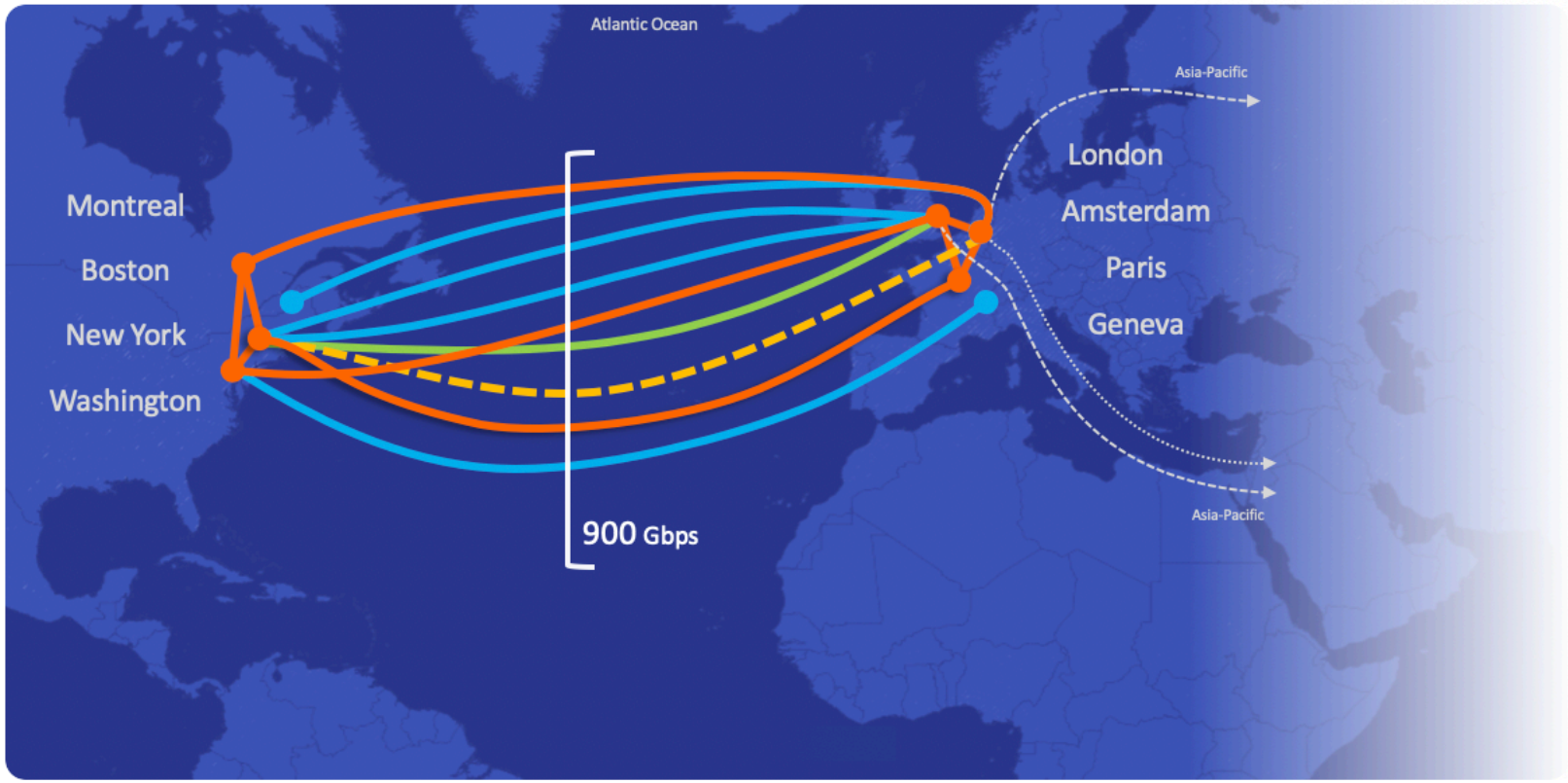

Atlantic Ocean
Asia-Pacific
London
Amsterdam
Paris
Geneva
Asia-Pacific
Montreal
Boston
New York
Washington
900 Gbps

EU-China

中国科技网
China Science & Technology Network

10G terrestrial route (BIJ-FRA)

CERNET

10G sea-cable (BIJ-LON)

CAE-1

BELLA programme

- BELLA-S
  - Transatlantic spectrum IRU for 25 years
- BELLA –T
  - Builds long-term 100Gbps backbone in South America

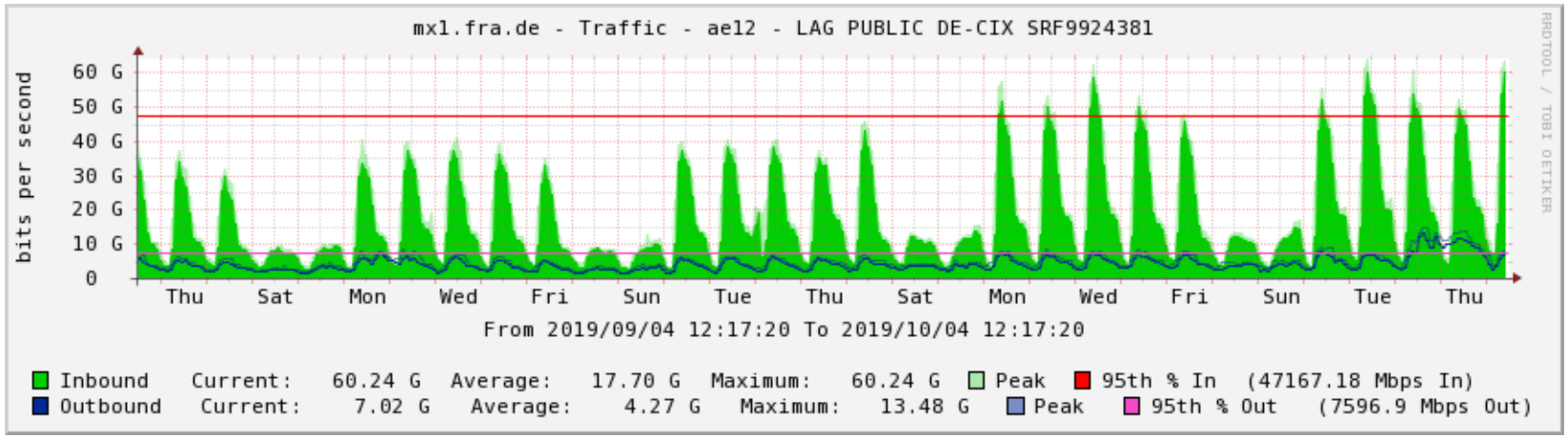
- 100Gbps GÉANT-RedCLARA interconnection
- 100Gbps for Copernicus
- Ability to light up to 43 more channels

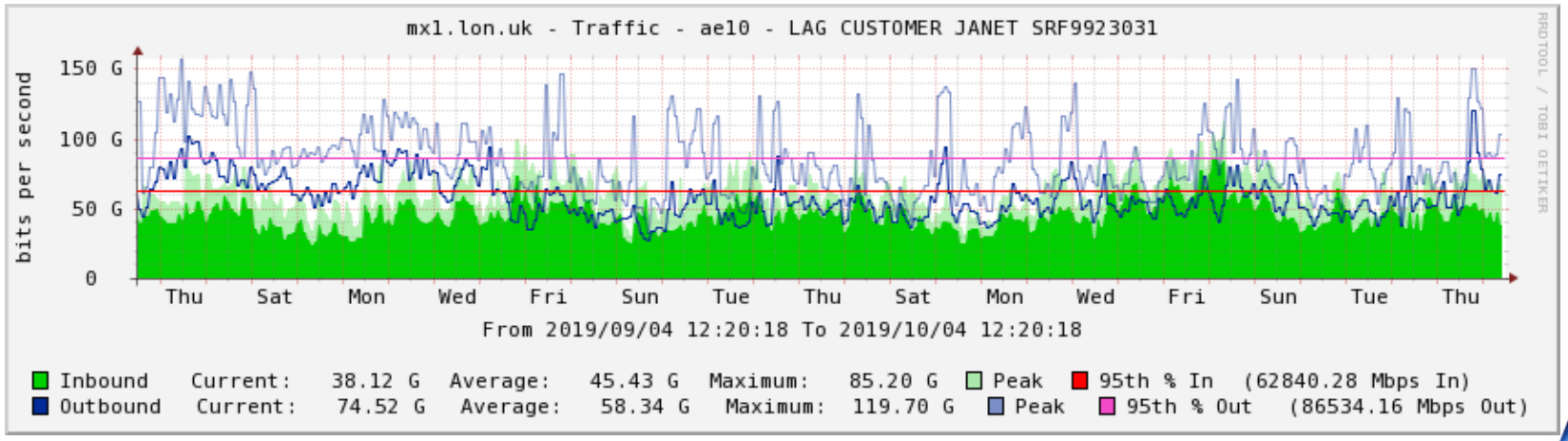
All BELLA connectivity is on schedule to go live by end of 2020.

Who's going to benefit from all this?

WLCG
Worldwide LHC Computing Grid

Not the usual internet traffic

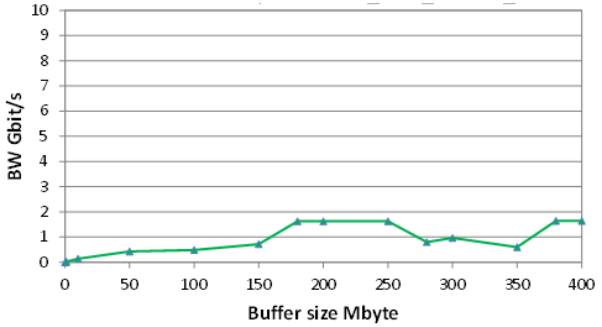




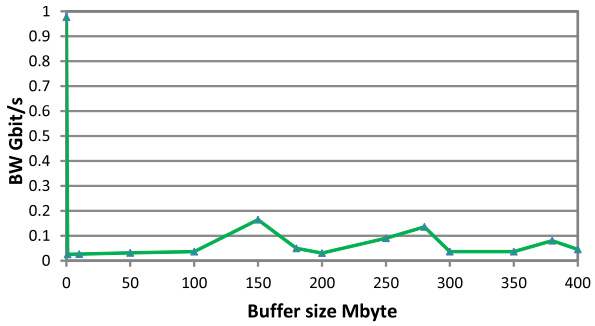
“My Network is different”

Public Internet

Geneva to Canberra

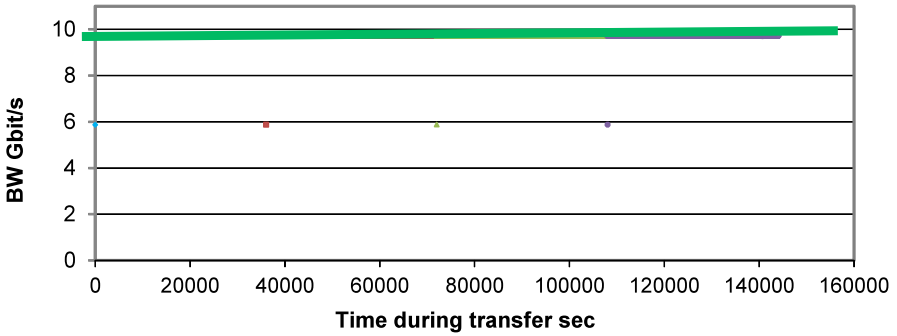


Geneva to Canberra



GÉANT and R&E partners

Geneva to Canberra GÉANT + R&E networks US to Australia



R&E networks are designed for different goals than the Internet

Comparative Times for a 100TByte data transfer.

File Size (TB)		Data rate (Gbit/s)	Time taken (Hours)	Time Taken (Days)
NREN	100	9.27	34.0	1.4
ISP A	100	1.72	183.2	7.6
ISP B	100	0.11	2864.3	119.3

The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 731122 (GN4-2).