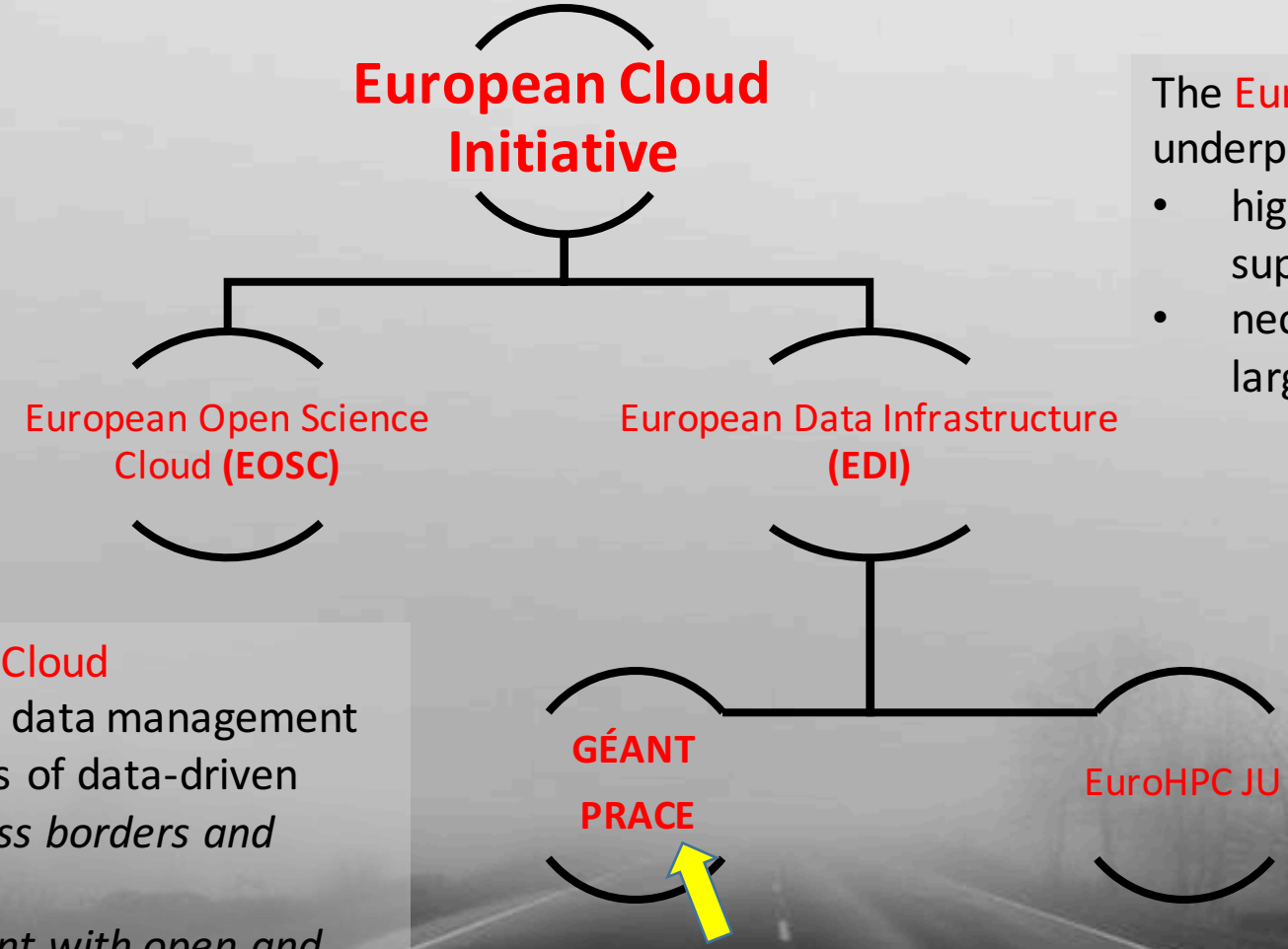
GÉANT
Networks • Services • People

GÉANT as the foundation of the European HPC ecosystem

Vincenzo Capone
Head of Research Engagement and Support

www.geant.org



The European Data Infrastructure (EDI) underpins the EOSC by deploying

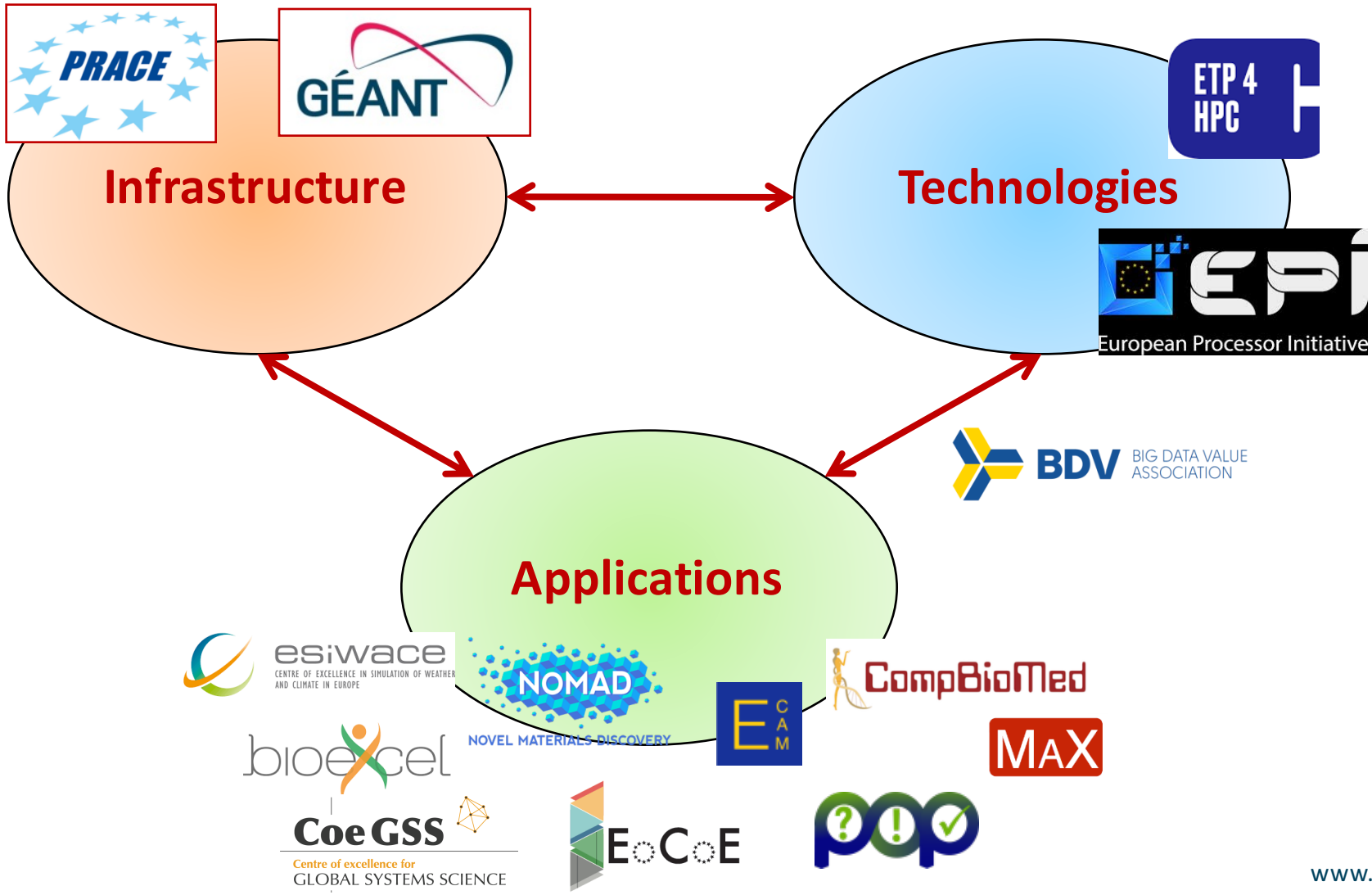
- high-bandwidth networks and supercomputing capacity
- necessary to access and process large datasets stored in the EOSC.

The European Open Science Cloud

- Aims to Lead in research data management and reap the full benefits of data-driven science, by offering *across borders and scientific disciplines*
  - *a virtual environment with open and seamless services for storage, management, analysis and re-use of research data,*

GEANT, PRACE and EuroHPC JU seen as part of EDI.

The European HPC landscape



To support collaboration and development amongst researchers, the dissemination of information & knowledge, and provide access to a portfolio of services and infrastructure resources:

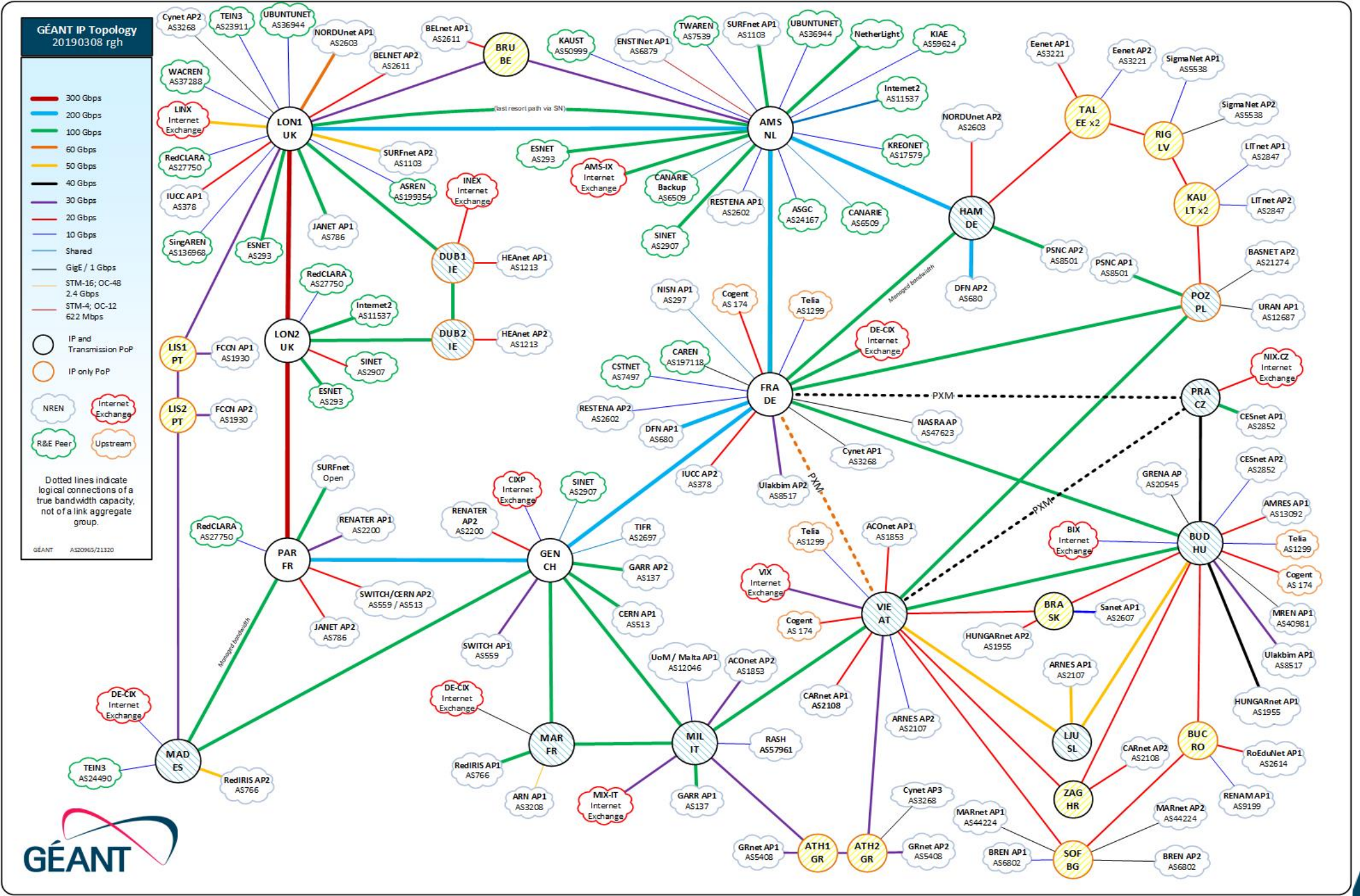
Runs a membership association for Europe's National Research & Education Networks (NRENs)
GÉANT Association

Coordinates and participates in EC-funded projects
Under Horizon 2020 the financial instrument for implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness

Operates a pan-European e-infrastructure
GÉANT network

Manages a portfolio of services for research & education
EduX

Organises and runs community events & working groups
TNC, task forces & special interest groups


GÉANT IP Topology
20190308 rgh
300 Gbps
200 Gbps
100 Gbps
60 Gbps
50 Gbps
40 Gbps
30 Gbps
20 Gbps
10 Gbps
Shared
GigE / 1 Gbps
STM-16; OC-48
2.4 Gbps
STM-4; OC-12
622 Mbps
IP and Transmission PoP
IP only PoP
NREN
Internet Exchange
R&E Peer
Upstream
Dotted lines indicate logical connections of a true bandwidth capacity, not of a link aggregate group.
GÉANT
AS20965/21320
LON1 UK
LON2 UK
AMS NL
BRU BE
FRA DE
PAR FR
GEN CH
MIL IT
MAR FR
MAD ES
LIS1 PT
LIS2 PT
DUB1 IE
DUB2 IE
HAM DE
VIE AT
BUD HU
PRA CZ
POZ PL
TAL EE x2
RIG LV
KAU LT x2
BRA SK
LJU SL
ZAG HR
BUC RO
SOF BG
ATH1 GR
ATH2 GR
Cynet AP2 AS3268
TEIN3 AS23911
UBUNTUNET AS36944
NORDUnet AP1 AS2603
BELnet AP1 AS2611
BELNET AP2 AS2611
KAUST AS50999
ENSTINet AP1 AS6879
TWAREN AS7539
SURFnet AP1 AS1103
UBUNTUNET AS36944
NetherLight
KIAE AS59624
Eenet AP1 AS3221
Eenet AP2 AS3221
SigmaNet AP1 AS5538
SigmaNet AP2 AS5538
Internet2 AS11537
NORDUnet AP2 AS2603
KREONET AS17579
LITnet AP1 AS2847
LITnet AP2 AS2847
WACREN AS37288
LINX Internet Exchange
RedCLARA AS27750
IUCC AP1 AS378
SingAREN AS136968
ESNET AS293
JANET AP1 AS786
SURFnet AP2 AS1103
ASREN AS199354
INEX Internet Exchange
HEAnet AP1 AS1213
RedCLARA AS27750
Internet2 AS11537
SINET AS2907
ESNET AS293
HEAnet AP2 AS1213
FCCN AP1 AS1930
FCCN AP2 AS1930
(last resort path via SN)
ESNET AS293
AMS-IX Internet Exchange
CANARIE Backup AS6509
RESTENA AP1 AS2602
ASGC AS24167
CANARIE AS6509
SINET AS2907
PSNC AP2 AS8501
PSNC AP1 AS8501
DFN AP2 AS680
BASNET AP2 AS21274
URAN AP1 AS12687
Managed bandwidth
NISN AP1 AS297
Cogent AS 174
Telia AS1299
DE-CIX Internet Exchange
CSTNET AS7497
CAREN AS197118
RESTENA AP2 AS2602
DFN AP1 AS680
NASRA AP AS47623
Cynet AP1 AS3268
IUCC AP2 AS378
Ulakbim AP2 AS8517
PXM
NIX.CZ Internet Exchange
CESnet AP1 AS2852
CESnet AP2 AS2852
GRENA AP AS20545
AMRES AP1 AS13092
Telia AS1299
Cogent AS 174
MREN AP1 AS40981
Ulakbim AP1 AS8517
HUNGARnet AP1 AS1955
SURFnet Open
RedCLARA AS27750
RENATER AP1 AS2200
SWITCH/CERN AP2 AS559 / AS513
JANET AP2 AS786
RENATER AP2 AS2200
CIXP Internet Exchange
SINET AS2907
TIFR AS2697
GARR AP2 AS137
CERN AP1 AS513
SWITCH AP1 AS559
Telia AS1299
ACOnet AP1 AS1853
VIX Internet Exchange
Cogent AS 174
BIX Internet Exchange
Sanet AP1 AS2607
HUNGARnet AP2 AS1955
ARNES AP1 AS2107
UoM / Malta AP1 AS12046
ACOnet AP2 AS1853
CARnet AP1 AS2108
ARNES AP2 AS2107
CARnet AP2 AS2108
RoEduNet AP1 AS2614
RENAM AP1 AS9199
DE-CIX Internet Exchange
TEIN3 AS24490
RedIRIS AP2 AS766
DE-CIX Internet Exchange
RedIRIS AP1 AS766
ARN AP1 AS3208
MIX-IT Internet Exchange
GARR AP1 AS137
RASH AS57961
Cynet AP3 AS3268
MARnet AP1 AS44224
MARnet AP2 AS44224
BREN AP1 AS6802
BREN AP2 AS6802
GRnet AP1 AS5408
GRnet AP2 AS5408

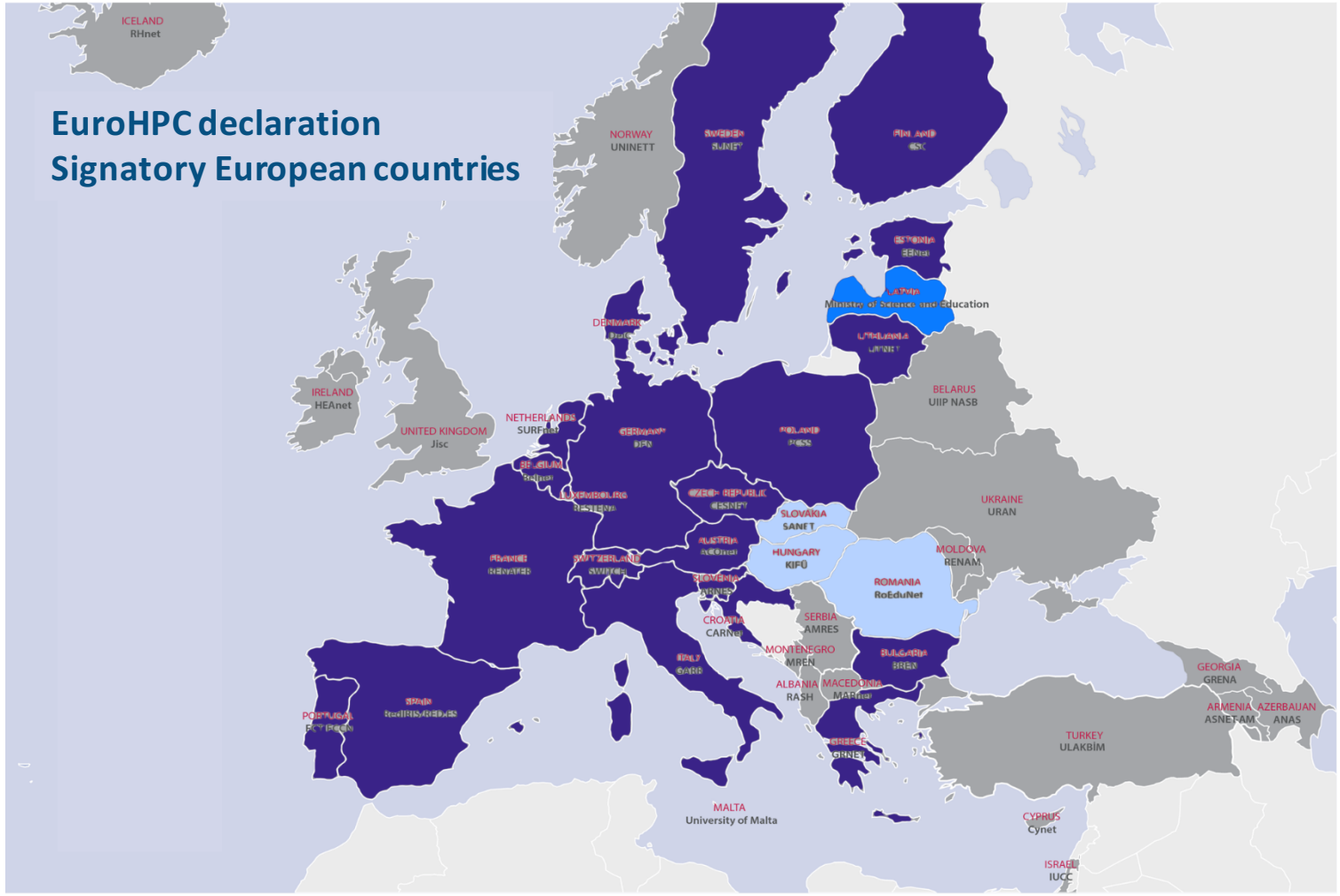
Membership Association

GÉANT Association supports and represents over 40 NRENs across Europe.

Together they support over 10,000 institutions and 50 million academic users.

GÉANT Community

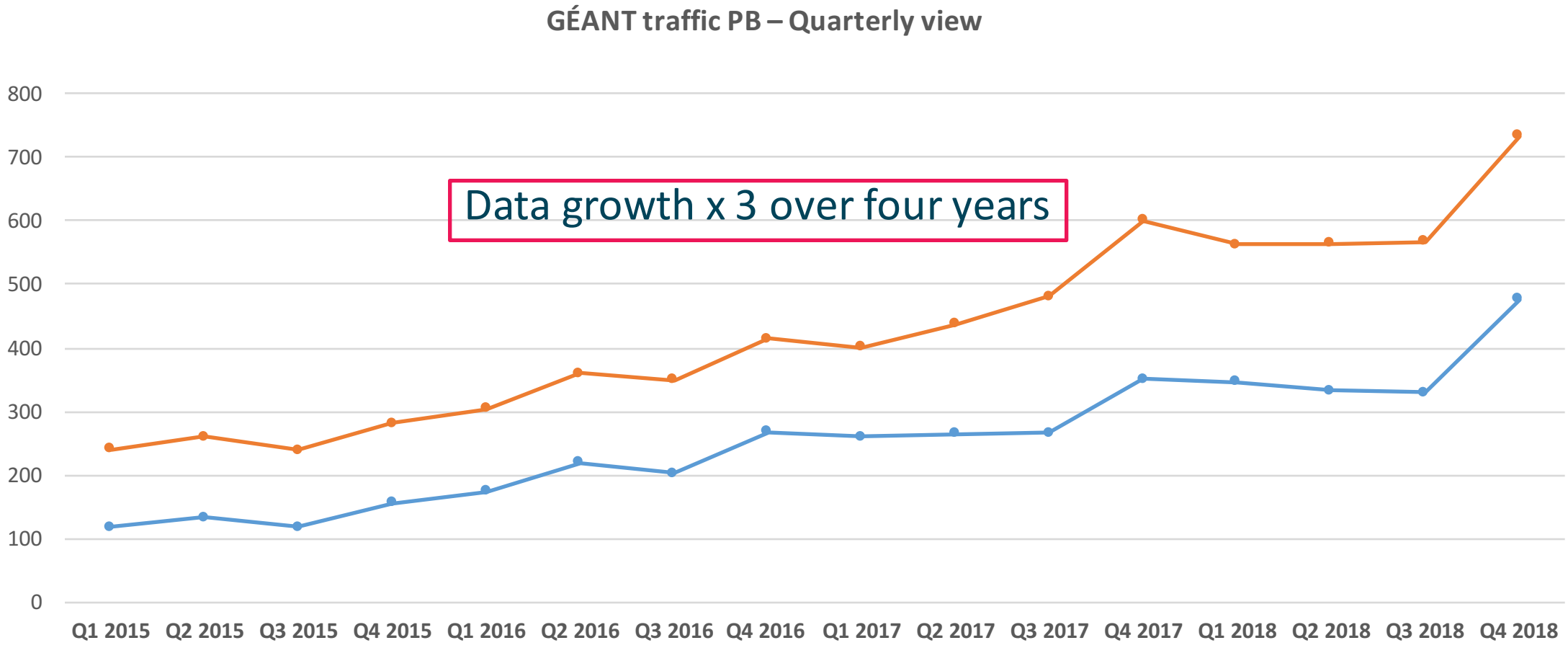
Well placed to serve EuroHPC - all current PRACE HPC sites are already using GÉANT and the NRENs



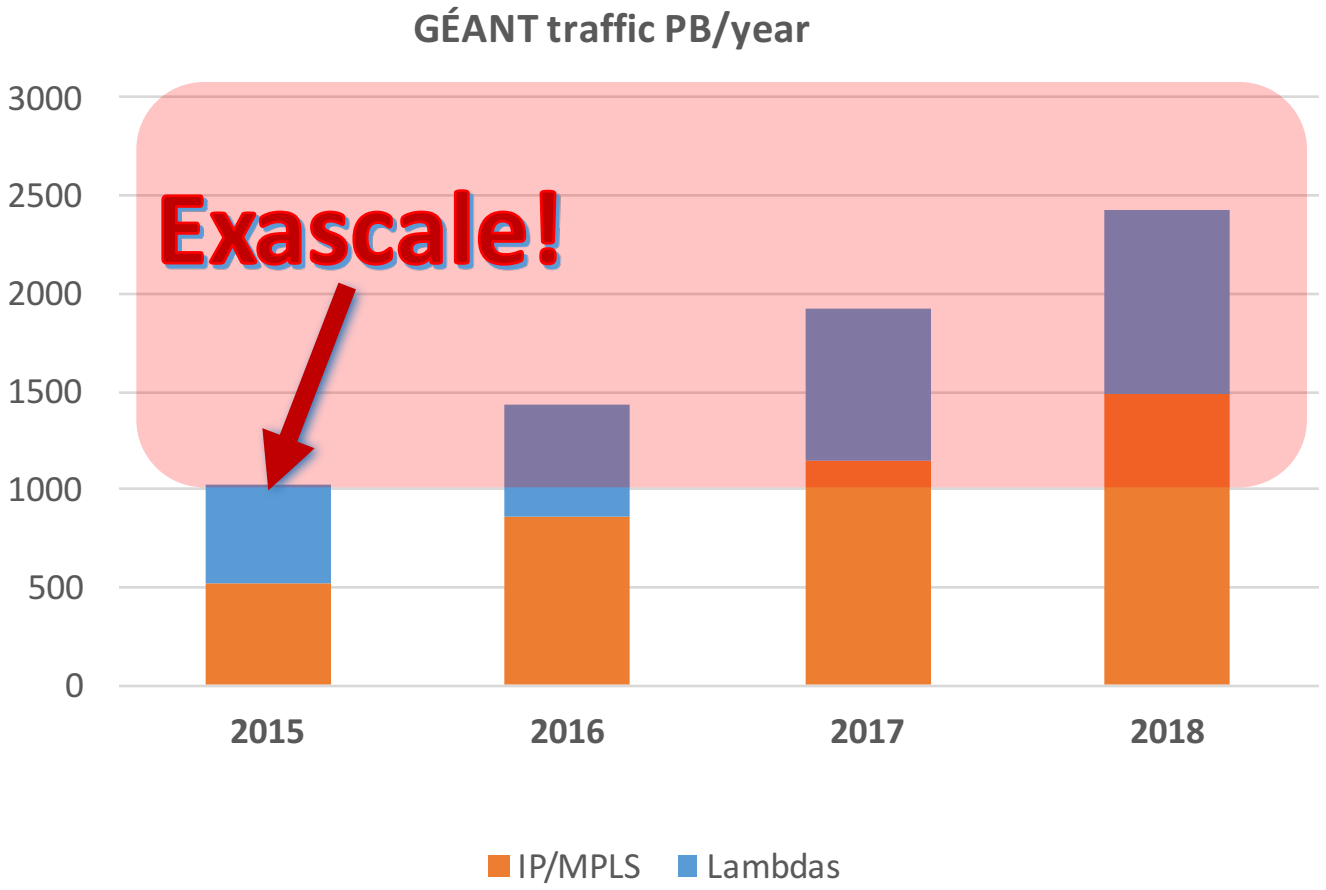
European road to Exascale

- **Mission**: Establish an integrated world-class supercomputing and data infrastructure and support a highly competitive and innovative HPC and Big Data ecosystem
- **Objectives**
  1. ***An integrated world-class supercomputing and data infrastructure***
     - 2 pre-exascale + 2-3 petascale by 2020; 2 exascale by 2022/2023 (1 EU tech); post-exascale infrastructure by 2027
     - federation of HPC infrastructures at European level
     - hybrid HPC/Quantum infrastructure
  2. ***Research and innovation for a HPC and Big Data ecosystem***
     - an integrated European HPC R&I agenda
     - independent HPC technology supply
     - excellence in HPC applications and use
     - HPC Competence Centres, training/skills, outreach

Traffic trends

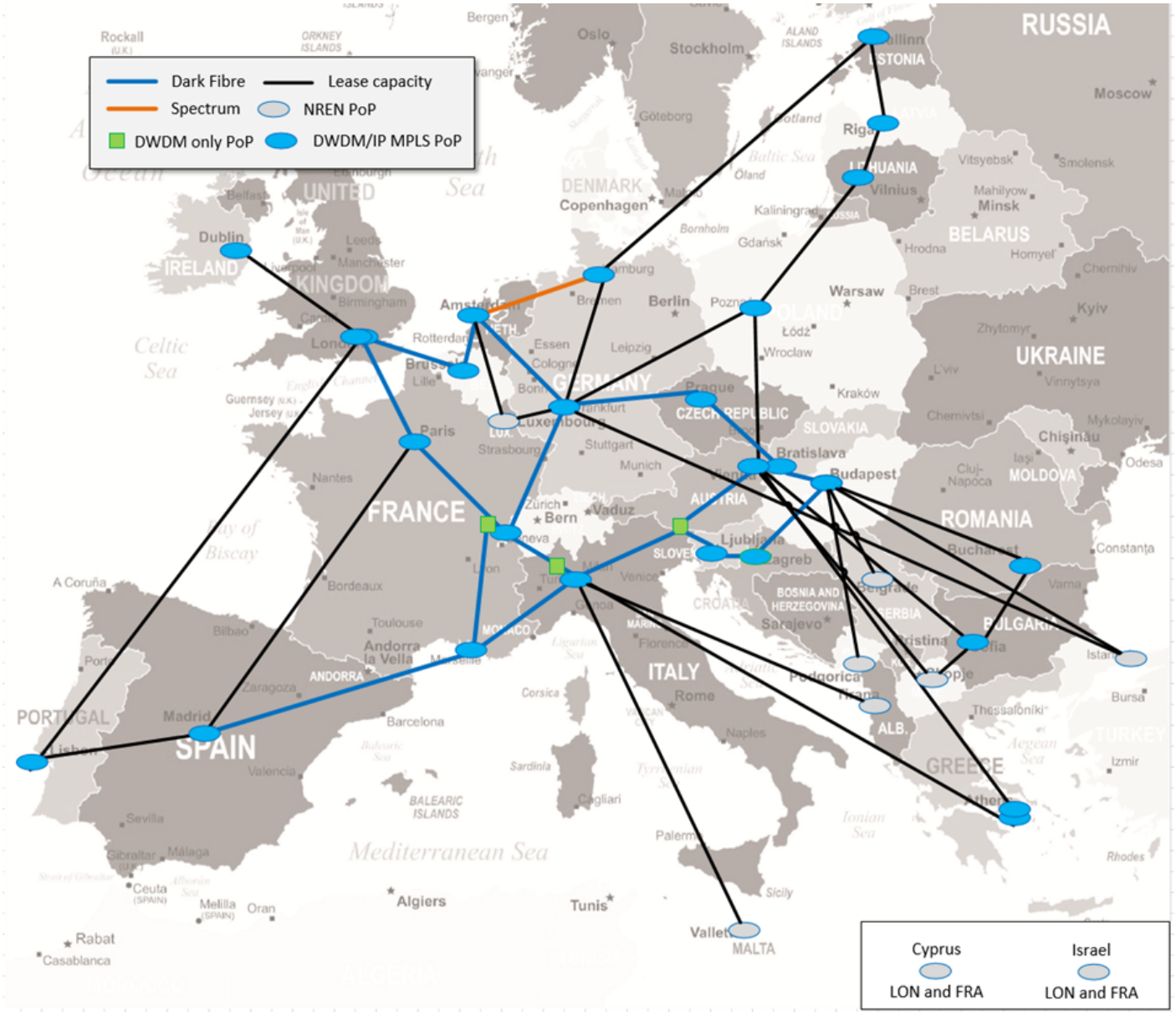


Network and Capacity Growth



- 2.4 EB of data received in 2018
- 26.4% growth from 2017 (29.9% for IP/MPLS)
- Longer term trend ~30%

GÉANT current topology



Based on Infinera DTN-X and Juniper MX Platform

14 countries connected on fiber

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

Mix of DWDM and leased capacity.

Challenges

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

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***

Extract from objective for the IRU SGA

The origin of an idea

Equipment Cost

Infrastructure Sharing

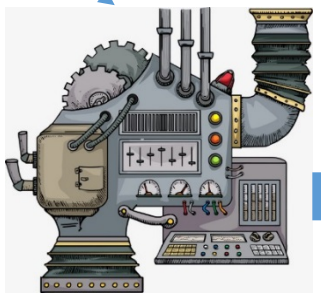
Stakeholders review

Regional Studies

Market RFI

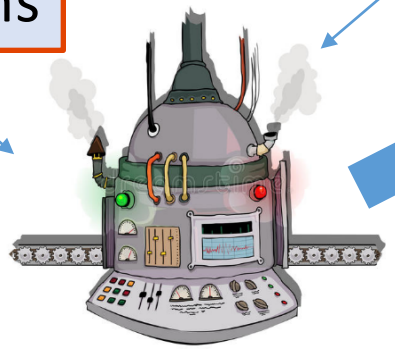
Technology Strategy

Traffic Projections



Desirable outcome?

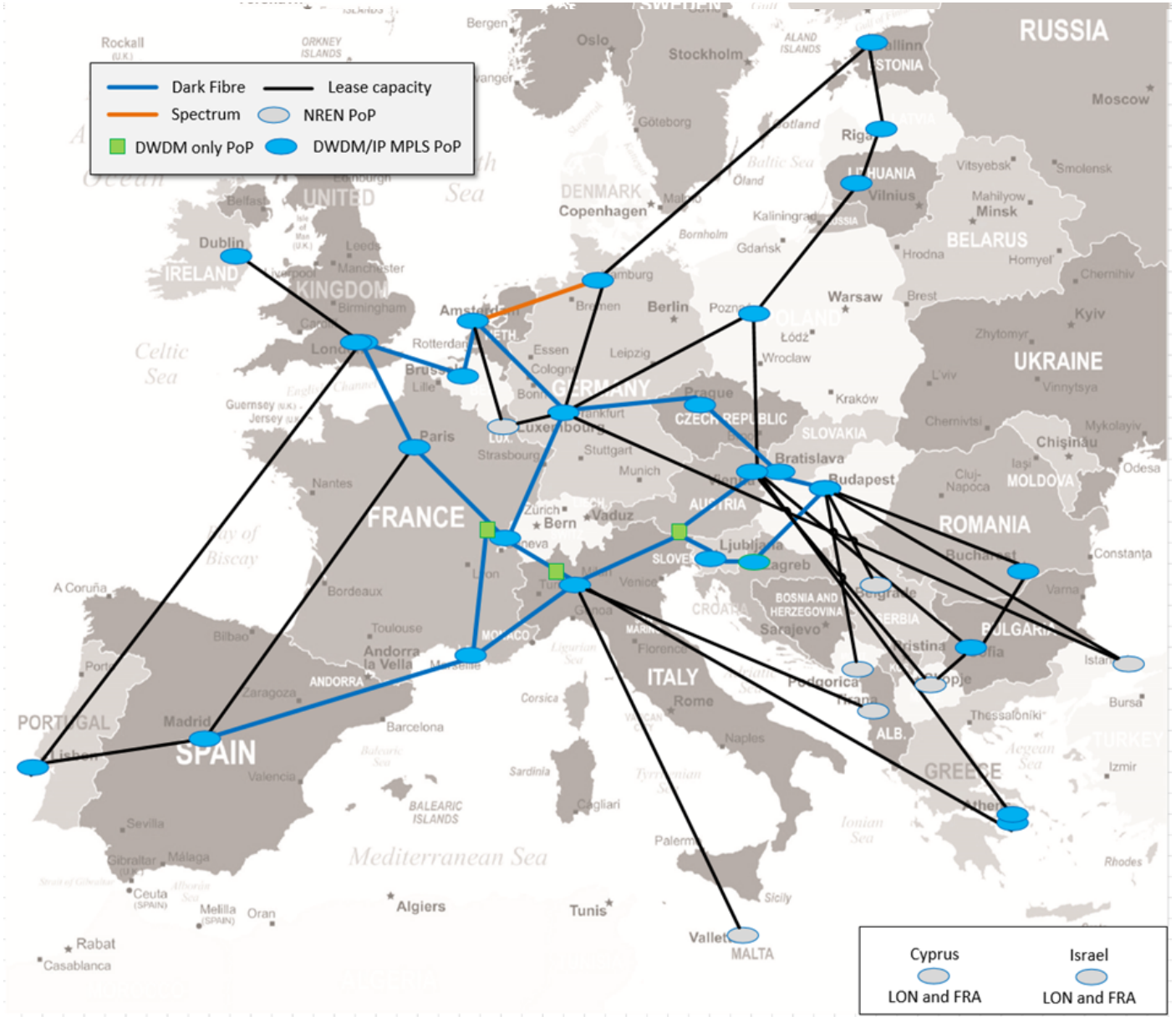
Network Blueprint IRU budget



Community Engagement and Workshops

Financial constraints

GÉANT future topology (in progress)



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

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

<u>Investment required: 48 M€</u>

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

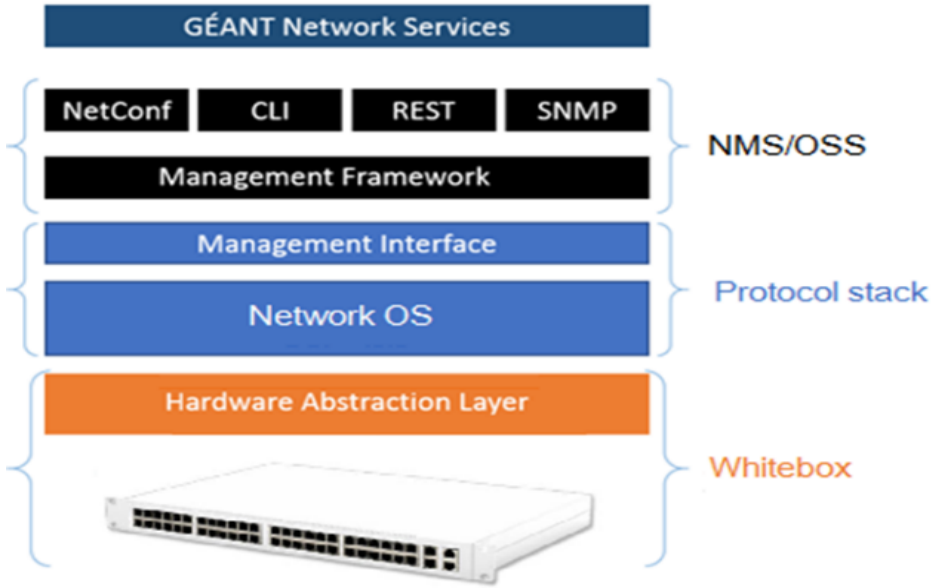
NMS

DCIs

Open Optical Line SYSTEM

Opening the packet layer

Options: (cost) effective solutions



Bigger is not always better

Enter the MX204

4x QSFP – 1x100G or 4x10G

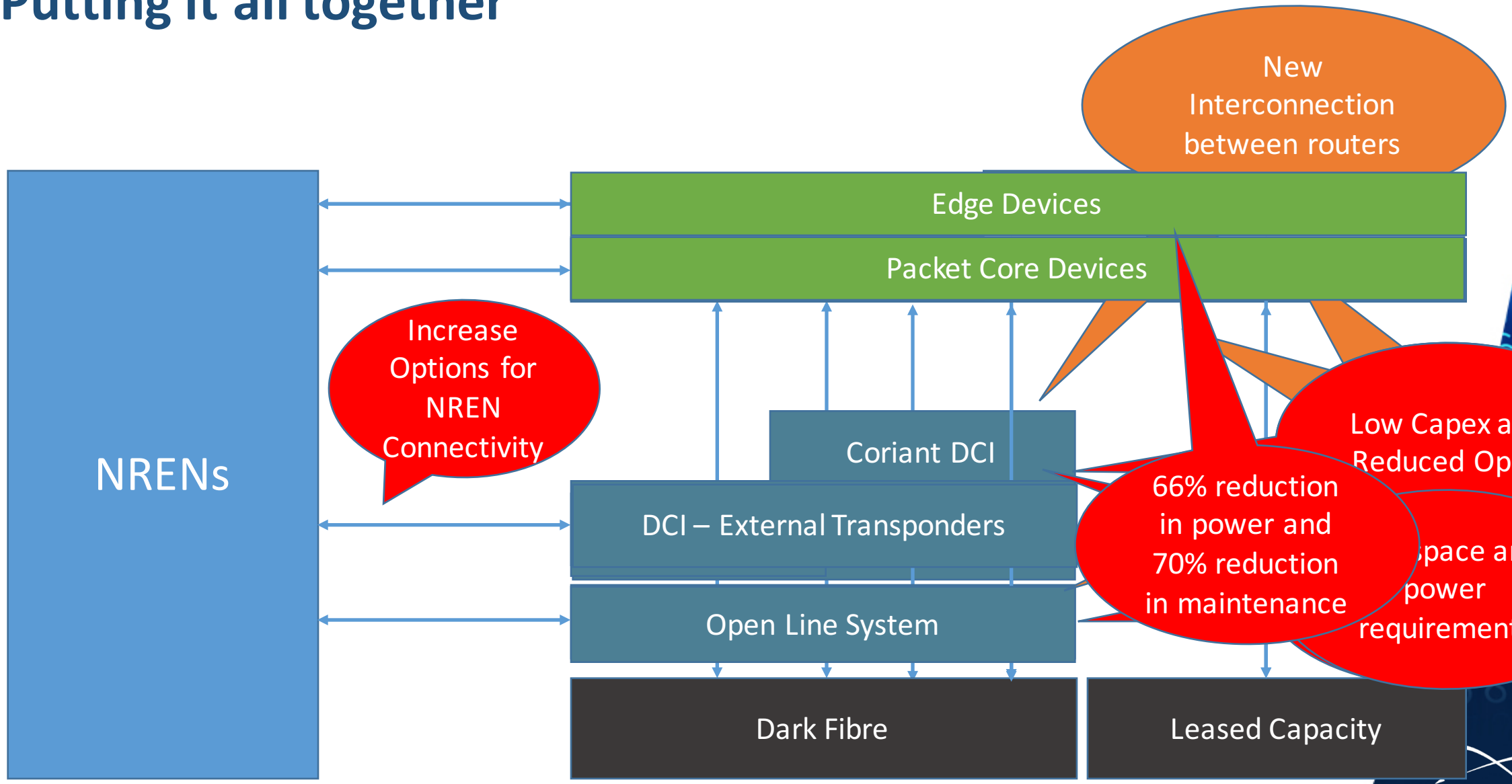
8x SFP – 1G or 10G

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

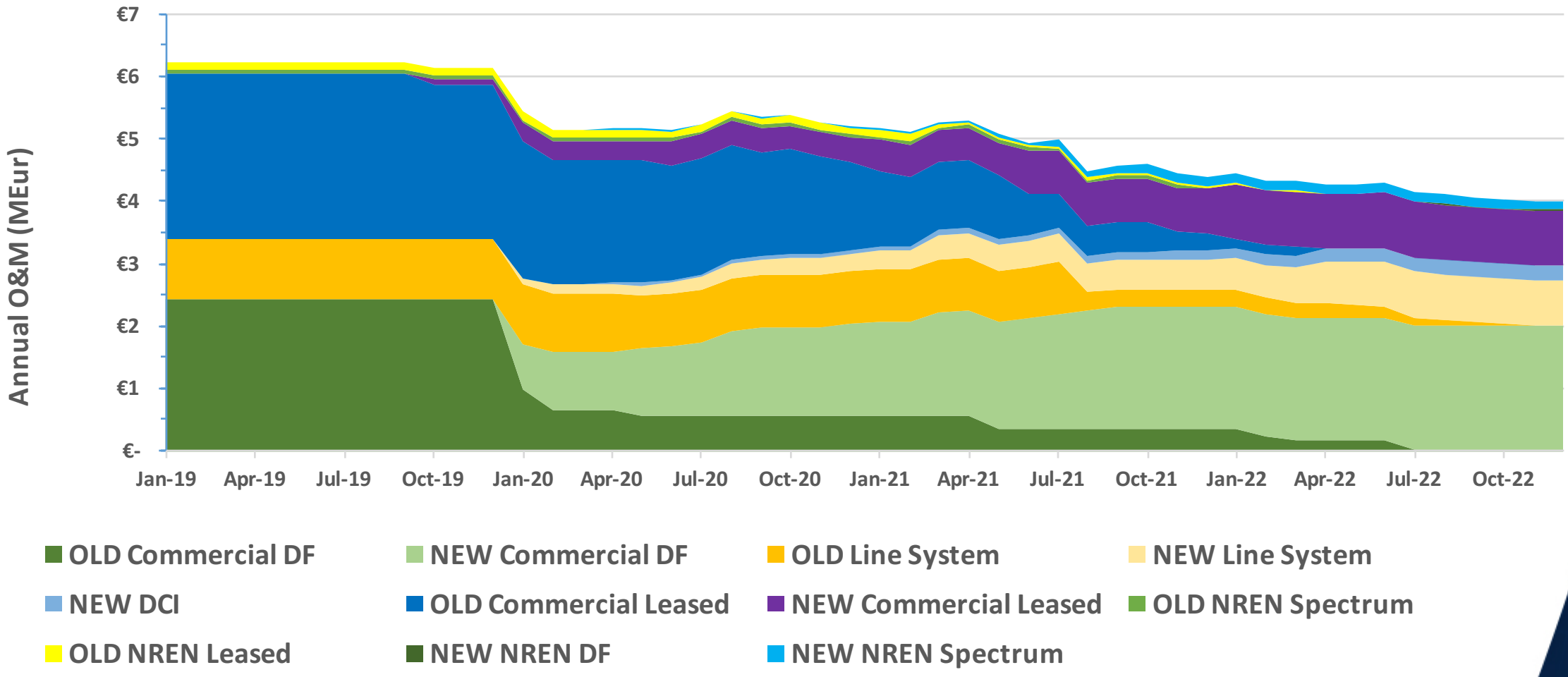
~80% OPEX reduction

~70% less power

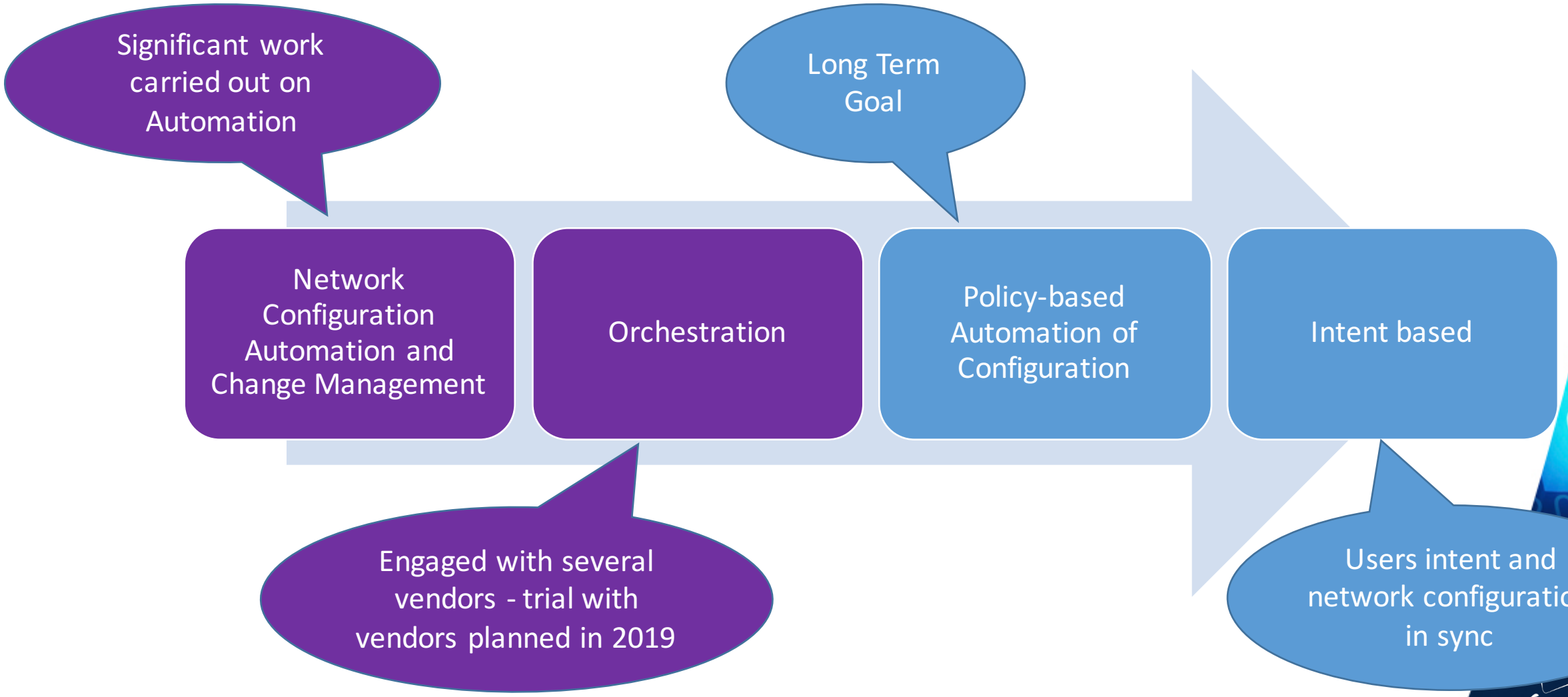
Putting it all together



Cost projection



A new management model



Flexibility and control

- **Vendor and Technology Agnostic A… …cture**
- **Disaggregate:** de-couple i… …tion cycles and accelerate innovation
- **Increase optio… …nect** NRENs to different platform depending on th… …ds
- **Reduce spac… …ower requirements** by allowing smaller form… factors

Open and disaggregated architecture

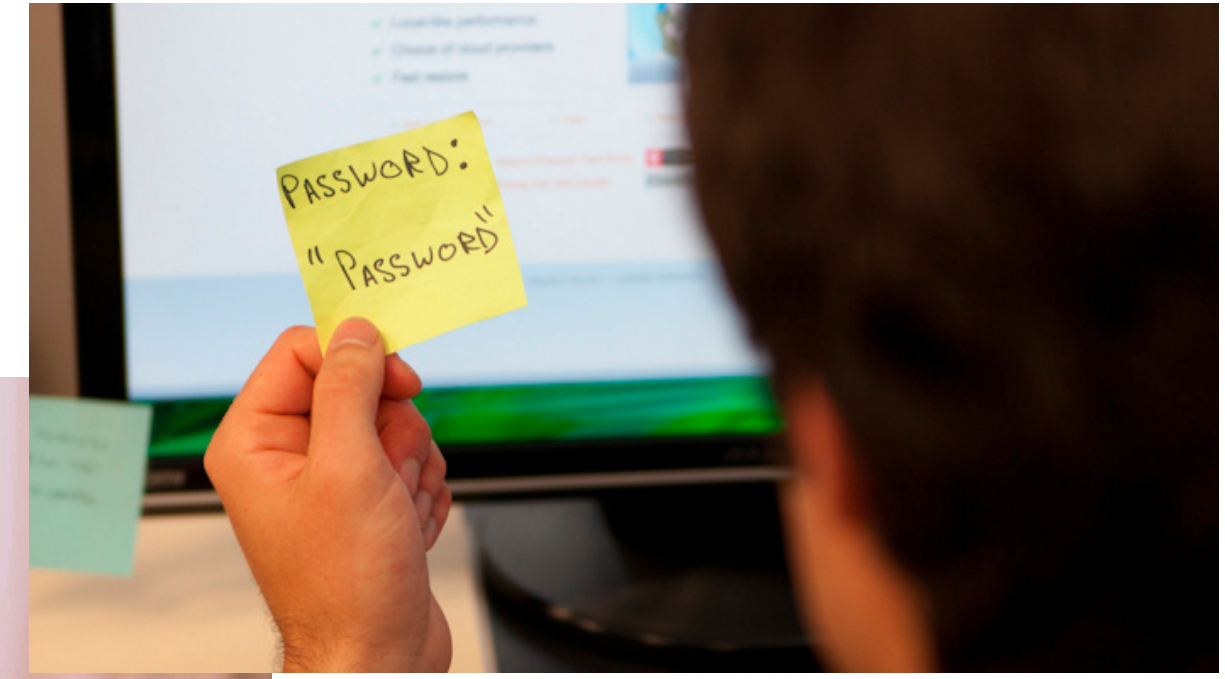
Differentiate from commercial providers

Deliver advanced services for R&E users

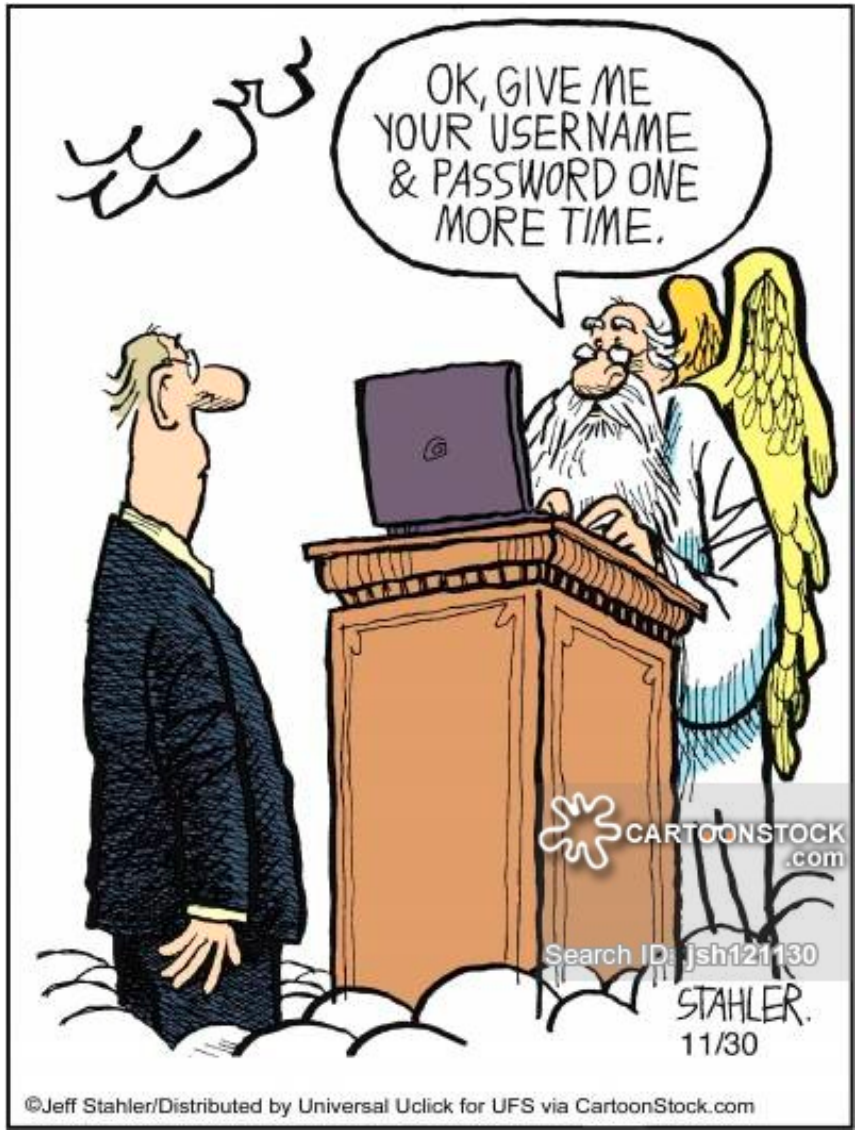
What it means for the end users

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

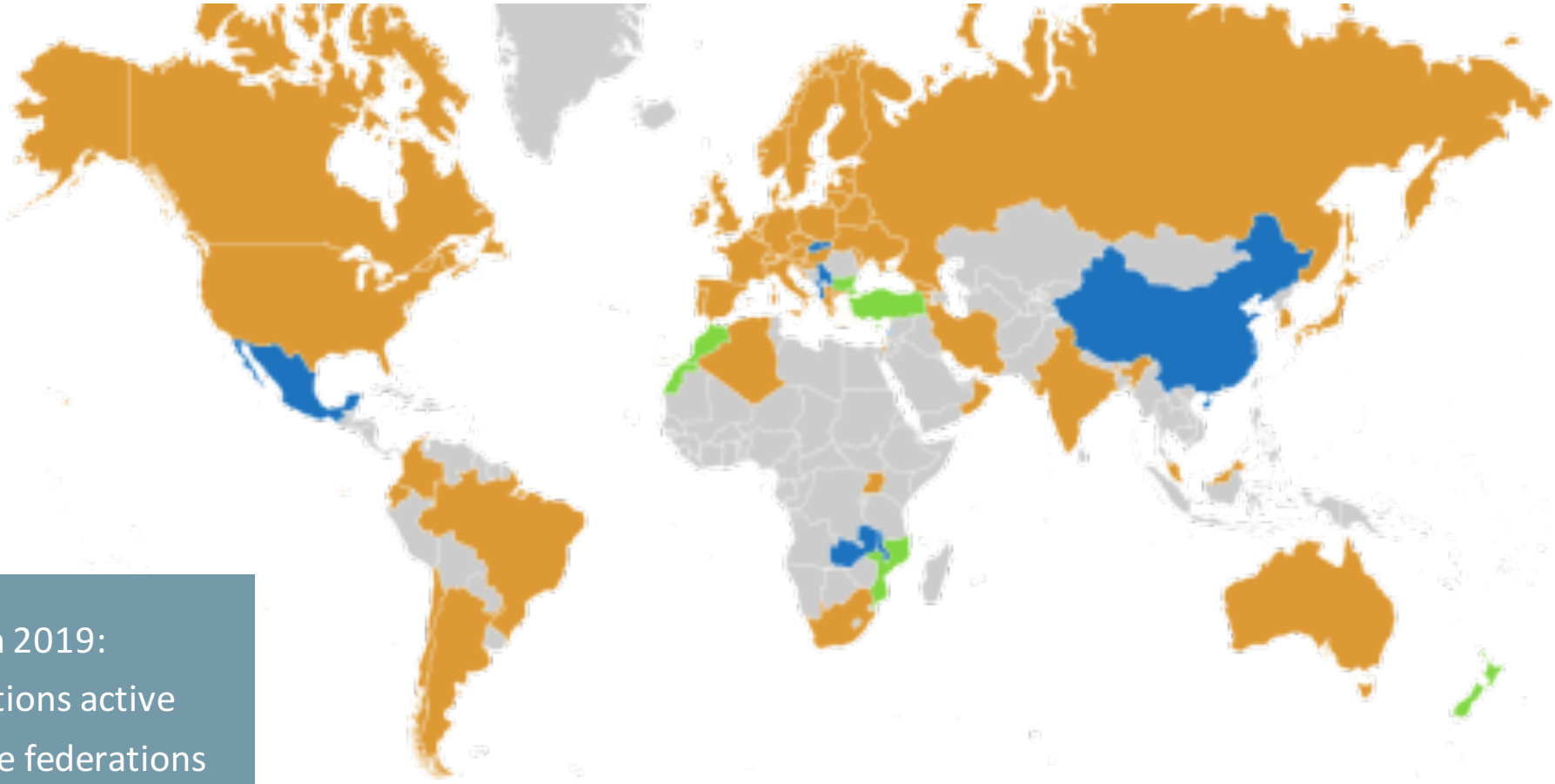
The users' bane…



…vs. SysAdmin needs



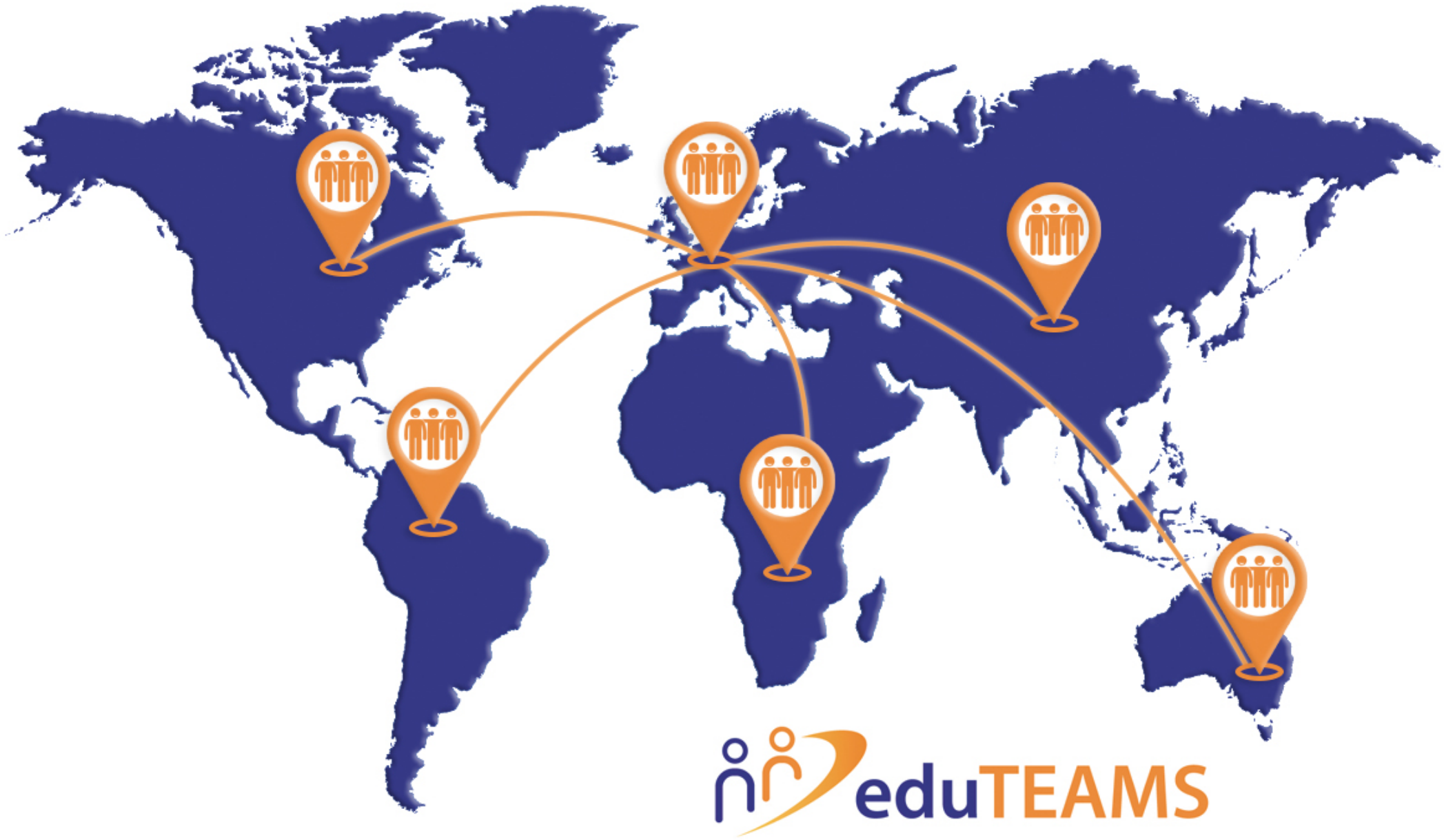
eduGAIN – the federation of federations



March 2019:
60 Federations active
10 Candidate federations
5418 entities

eduGAIN

GÉANT


eduTEAMS

What it is, what it can do

https://www.eduteams.org

A service to enable use of federated identity management in research & academic collaborations

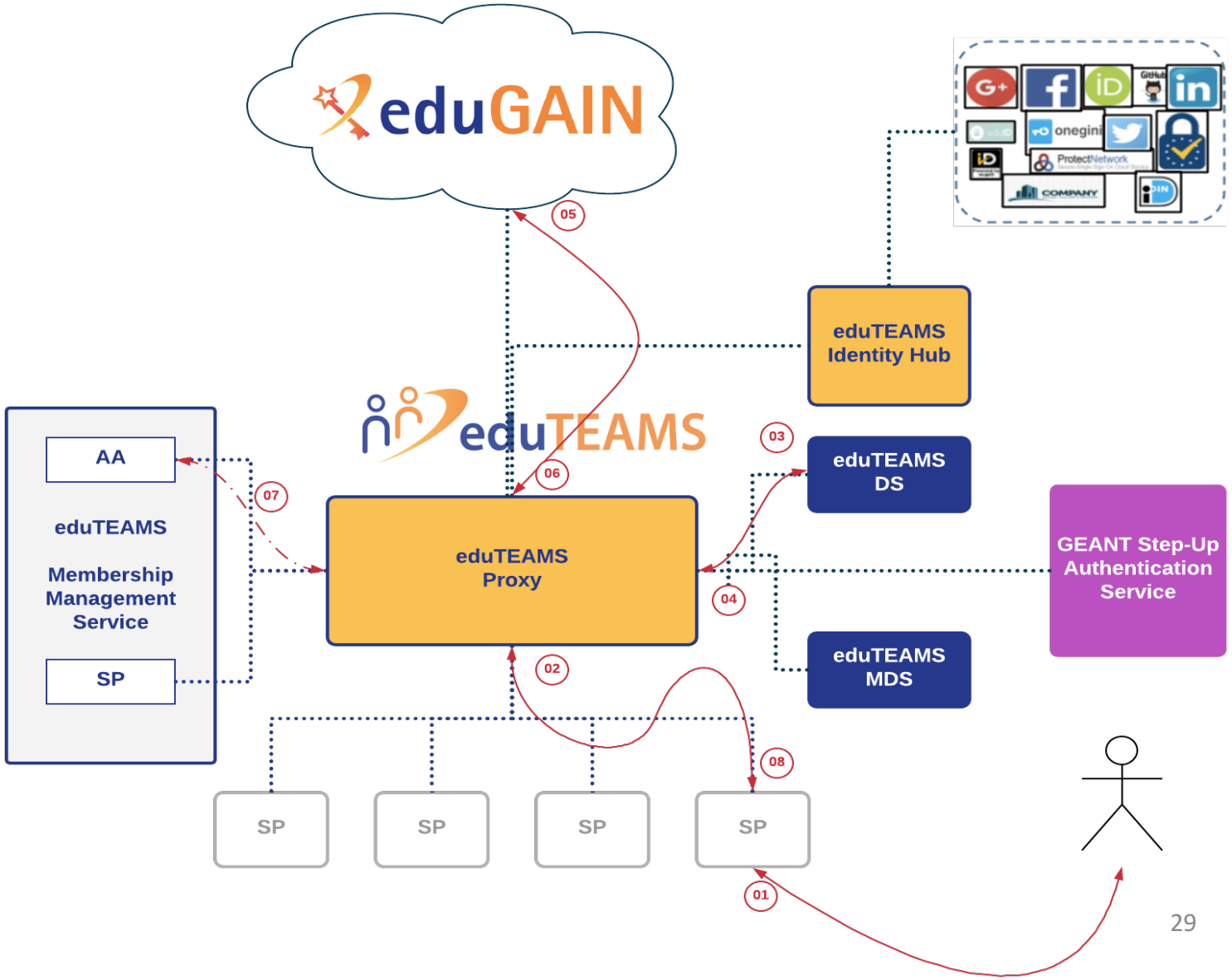
Components

- Proxy & Identity Hub
- Membership Management service
- Discovery Service
- Metadata Service
- Second Factor Authentication (Pilot!)

Characteristics

- Full implementation AARC Blueprint Architecture
- Single- and multi-tenant options
- Sustainability and strategic partnerships

How it works


eduGAIN
05
eduTEAMS Identity Hub
eduTEAMS
03
eduTEAMS DS
06
AA
07
eduTEAMS
Membership Management Service
SP
eduTEAMS Proxy
04
GEANT Step-Up Authentication Service
eduTEAMS MDS
02
08
SP
SP
SP
SP
01

The ideal model for HPC users

Thank you!

vincenzo.capone@geant.org

@EnzinoCapone

www.geant.org

@GEANTnews

© GEANT Limited on behalf of the GN4 Phase 2 project (GN4-2).
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).