



An Update on the European and Intercontinental Network Infrastructure

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With thanks to many of my colleagues for use of their slides

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GÉANT

Infrastructure and Services to advance Research,
Education, and Innovation on a global scale:



GÉANT Association

Membership Association of Europe's National
Research & Education Networks (NRENs)



GÉANT Network

Pan-European e-Infrastructure



Edu-x services

Portfolio of services for
Research and Education



Projects

Coordinates and participates
in EC-funded projects



Community

Conferences, Task Forces,
Special Interest Groups

GÉANT: European Membership Association

**38 European National
Research and Education
Networks (NRENs)
+ NORDUnet (5 Nordic NRENs)**

Reach:

**over 10,000 institutions and
50 million academic users**



GN4-3N Project

GN4-3N: EC Funded Infrastructure Project (2019-2022/2023)



Overall Goals & Objectives

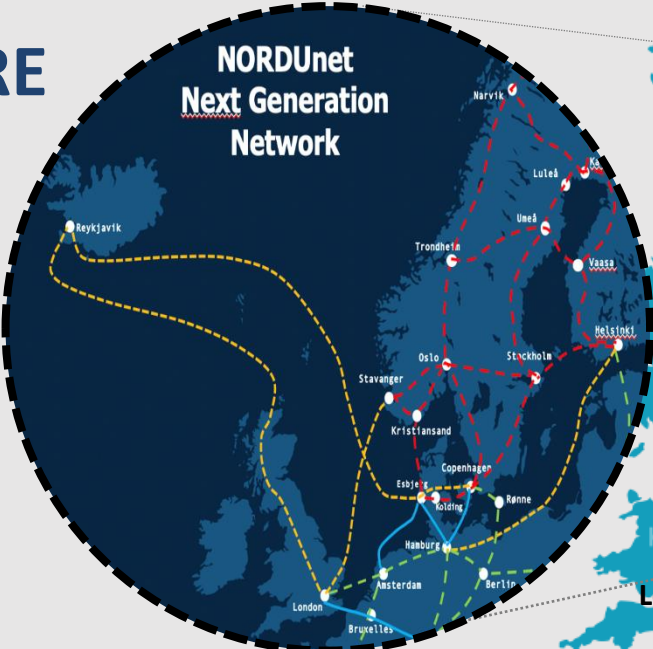
- Bridge the digital divide as far as transmission speeds and facilities are available, to all NRENs, within the budgetary limits defined by the project
- Ensure that the GÉANT network is based on a fibre footprint infrastructure that is guaranteed in the long term, and that provides the basis for excellent service to NREN partners, e-infrastructure projects, and the R&E community in general
- Work to make it financially sustainable

Project Approach

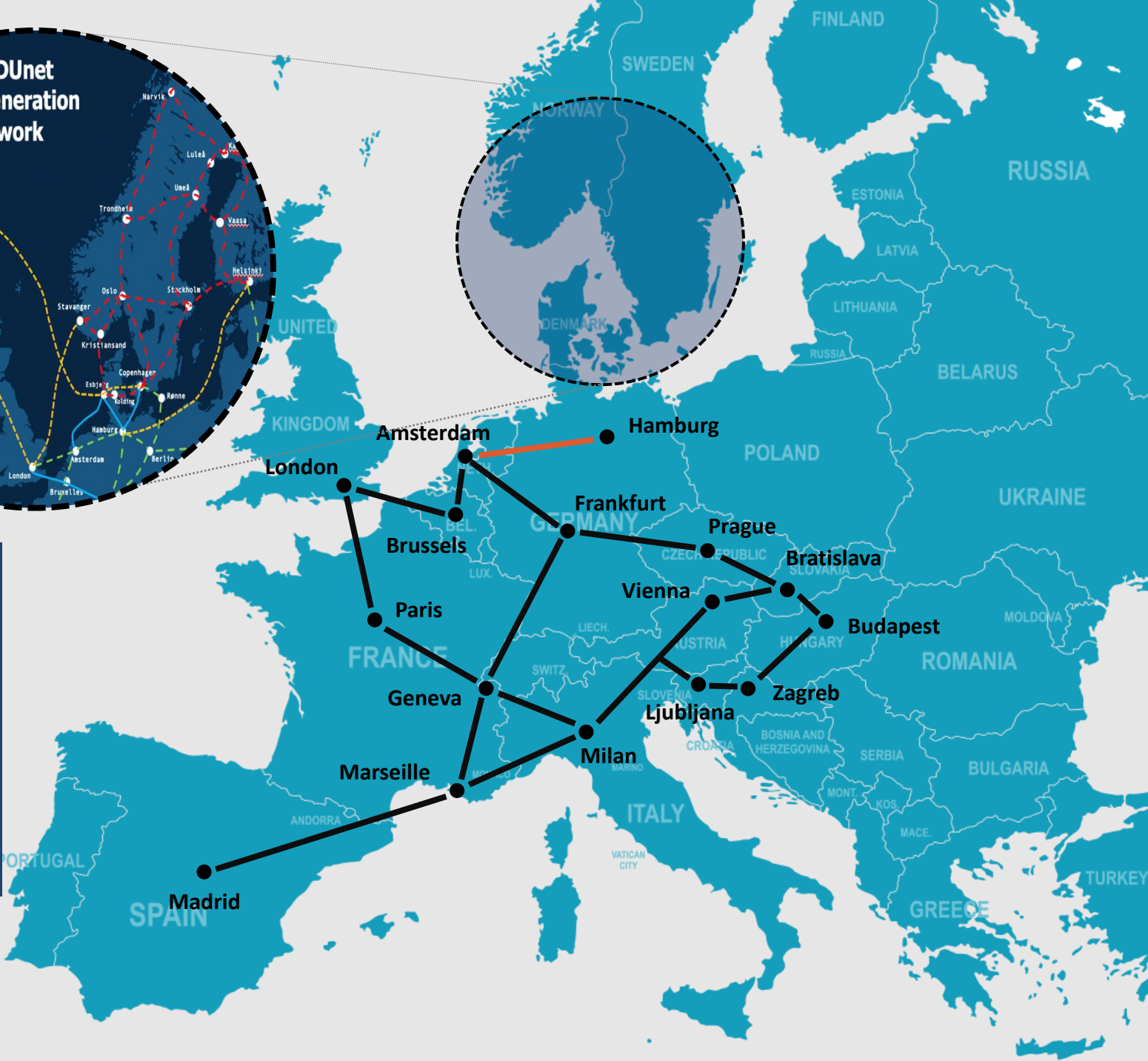
- Work was done with the NRENs in 2017/2018 to identify ambition and scope of the project
- This was very much a community effort, with workshops across Europe to identify capabilities, expectations, challenges.
- Consensus always important in investment projects



FIBRE INFRASTRUCTURE AT START OF GN4-3N



Fibre Network at start of project
 14 countries (+5 NORDUnet) on fibre
 Shorter term contracts => higher maintenance costs, to be replaced
Other countries on (typically high cost) leased lines



	
Commercial Dark Fibre	NREN Spectrum

Before:
Fibre And Spectrum
Infrastructure
Short Term Contracts



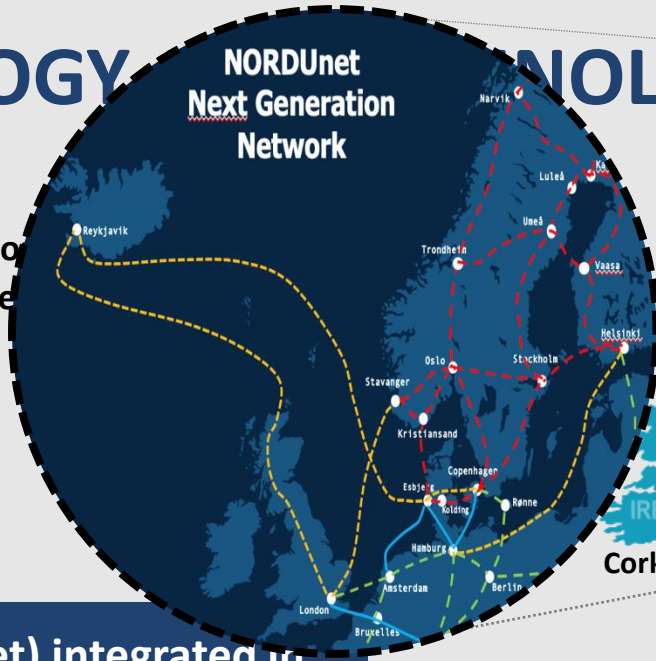
NOW:

**Fibre and Spectrum Infrastructure –
*Long Term Contracts: 21 year***



FINAL TOPOLOGY

- Dark Fibre IRU
- Leased Spectrum (10% of total)
- N x 100G Leased Service



30 countries (+5 NORDUnet) integrated in this infrastructure

Investment cost for this network: 50.8 M€

Infrastructure ensured for 15 to 21 years

Energy :from 8,8 W/km to 3,08 W/km

Considerable NREN contributions

Spectrum more accessible & available than expected

Western ring now running at 800 Gbit/s

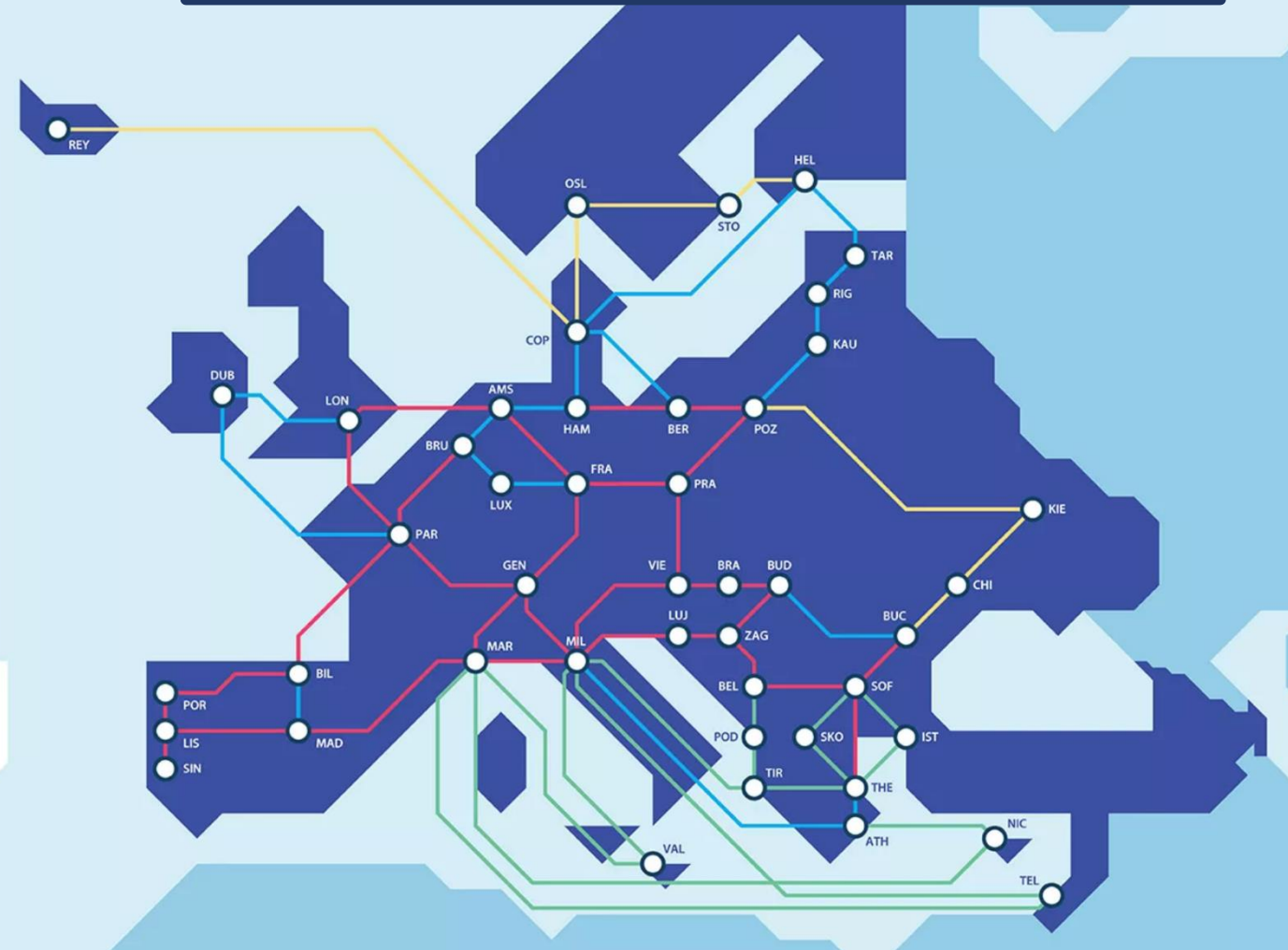
2019 – 2023 projects:

- European footprint
- EC-funded investment
- 50 million project

Result: the new GÉANT network

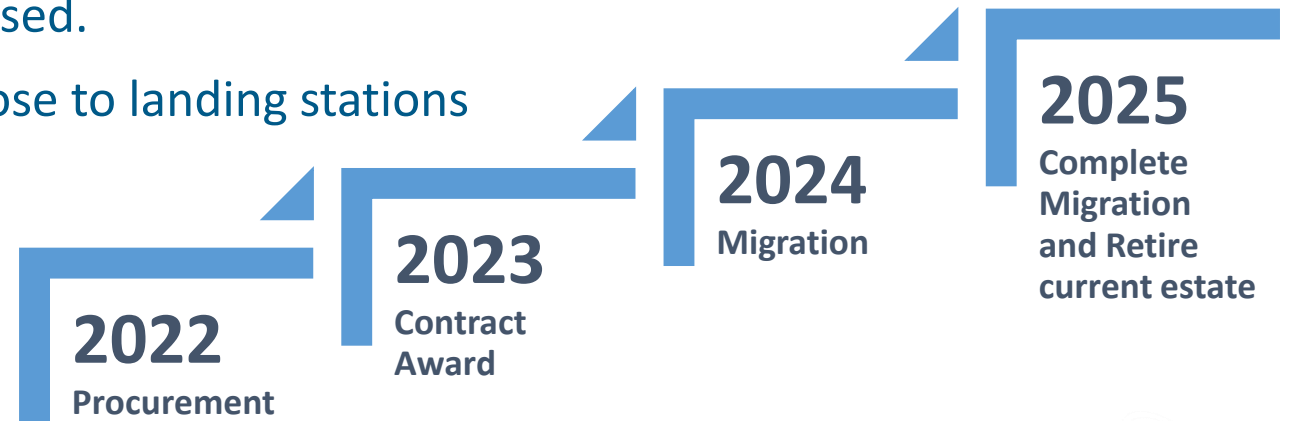
- Fiber and spectrum
- 32 + 5 countries
- Long term control

Long Term Approach: Invest in Infrastructure



Packet Layer Renewal

- **3-year project** started early 2022
- Provide High-speed network availability to the edges of Europe
- The Juniper MX960/480 reached the maximum capacity of the platform at 1Tbps per slot and the last MPC10 line cards at 2 x 400Gbps have been deployed.
- GÉANT has procured Nokia 7750 SR-7s and SR-2se for the IP/MPLS router refresh, both capable of 18Tbps per slot and fully redundant in both fabric and control.
- The Nokia FP5 based line cards support 400G optics today and will support 800G optics when the specification is finalised and released.
- Enabling global partners to connect at or close to landing stations



IP Network Upgrades GN5-1 Period 1 (End of March 2024)

Beyond 100G and Towards Terabit

- **Backbone reconfiguration complete:** Introduced new routes as part of GN4-3N project, enhancing network capacity and resilience.
- **Western Ring Transformation:** Doubled capacity with a 2x400G deployment.
- **Central Ring Enhancement:** Consistent 300G capacity across major nodes, including a new high-speed shortcut between Frankfurt and Prague.
- **Eastern Ring Achievement:** Solidified at 200G, completing the high-capacity circuit through key Eastern nodes.
- Brussels-Paris link upgraded to 100G



GN5-IC1 Project

An Opportunity: GN5-IC1 (International Connectivity) Project

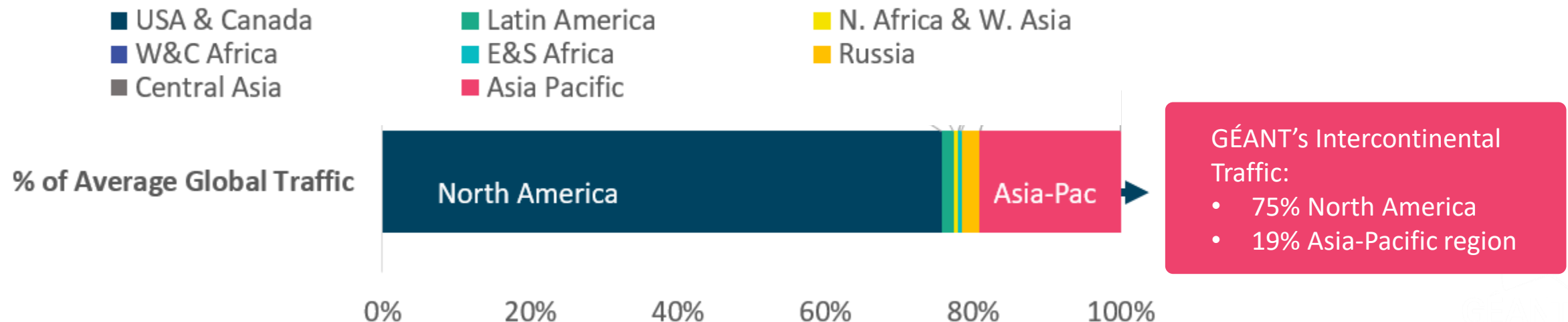
3 year GÉANT project starts Dec2022 - €15M EC funding



Two main objectives

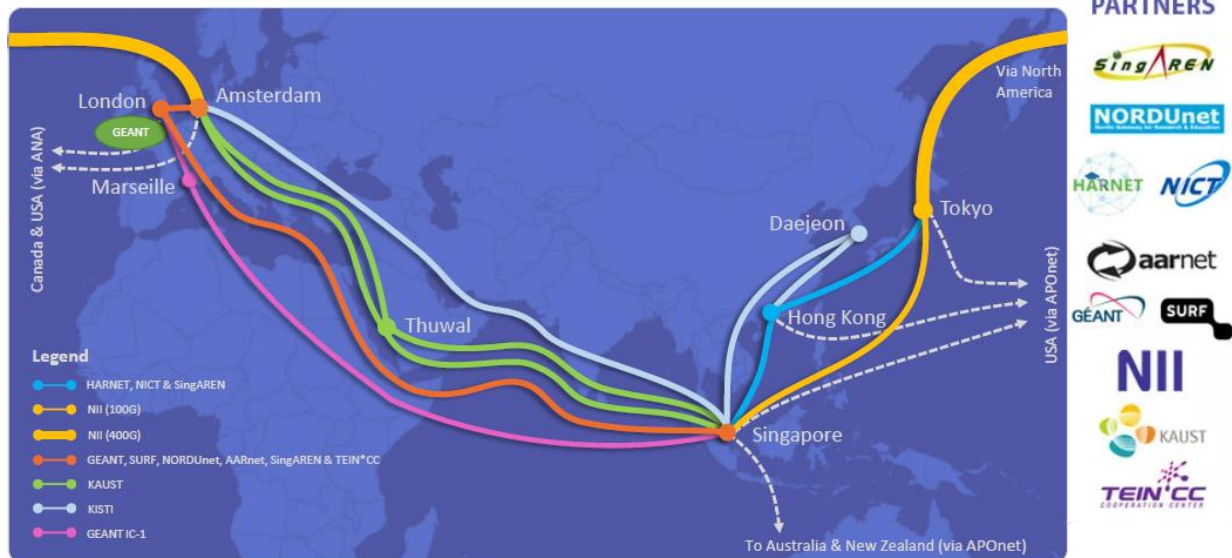
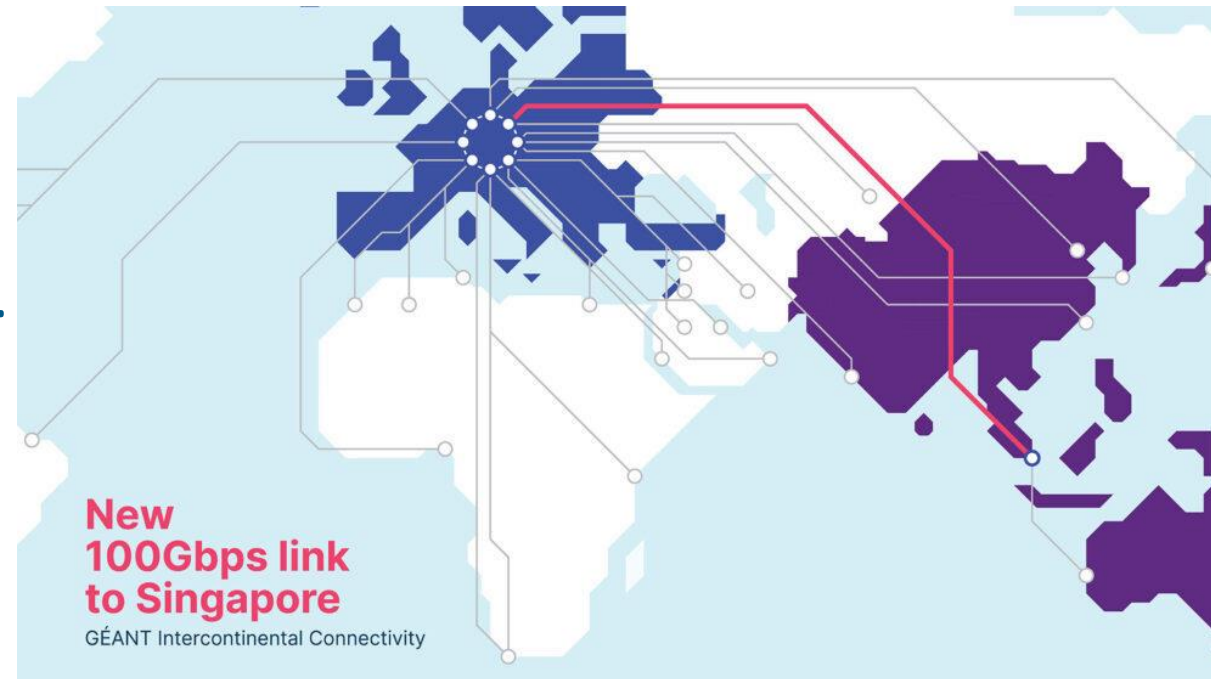
- Objective 1: Procure connectivity to at least 2 world regions
- Objective 2: Create intercontinental connectivity investment plan

Region selection driven by the Global Challenge – Connectivity and Traffic Growth



First GN5-IC1 Region: Connectivity between Europe and Asia

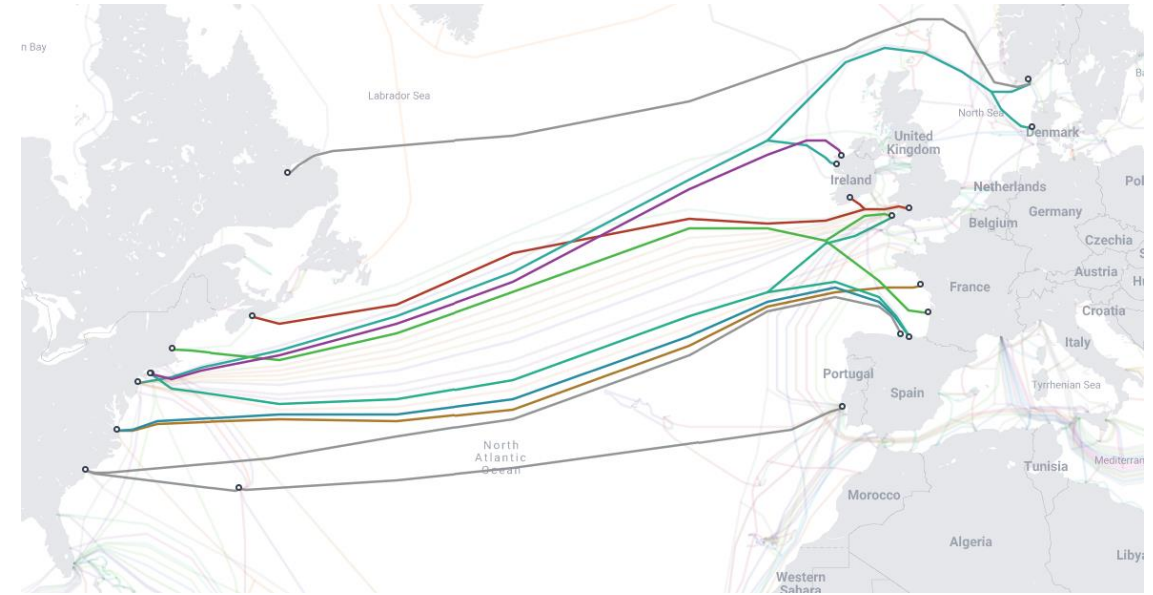
- New 100G link Marseille to Singapore Lands at the SingAREN Open Exchange.
- Along the Asia Africa Europe-1 (AAE-1) cable.
- Under a 7-year Indefeasible Rights of Use (IRU).
- In collaboration with regional partners
- Status: Operational.



- Contributes to the capabilities of the recently expanded **Asia-Pacific Europe Ring**.
- Provide mutual back-up
- Improve network reliability and
- Ensure greater network resilience.

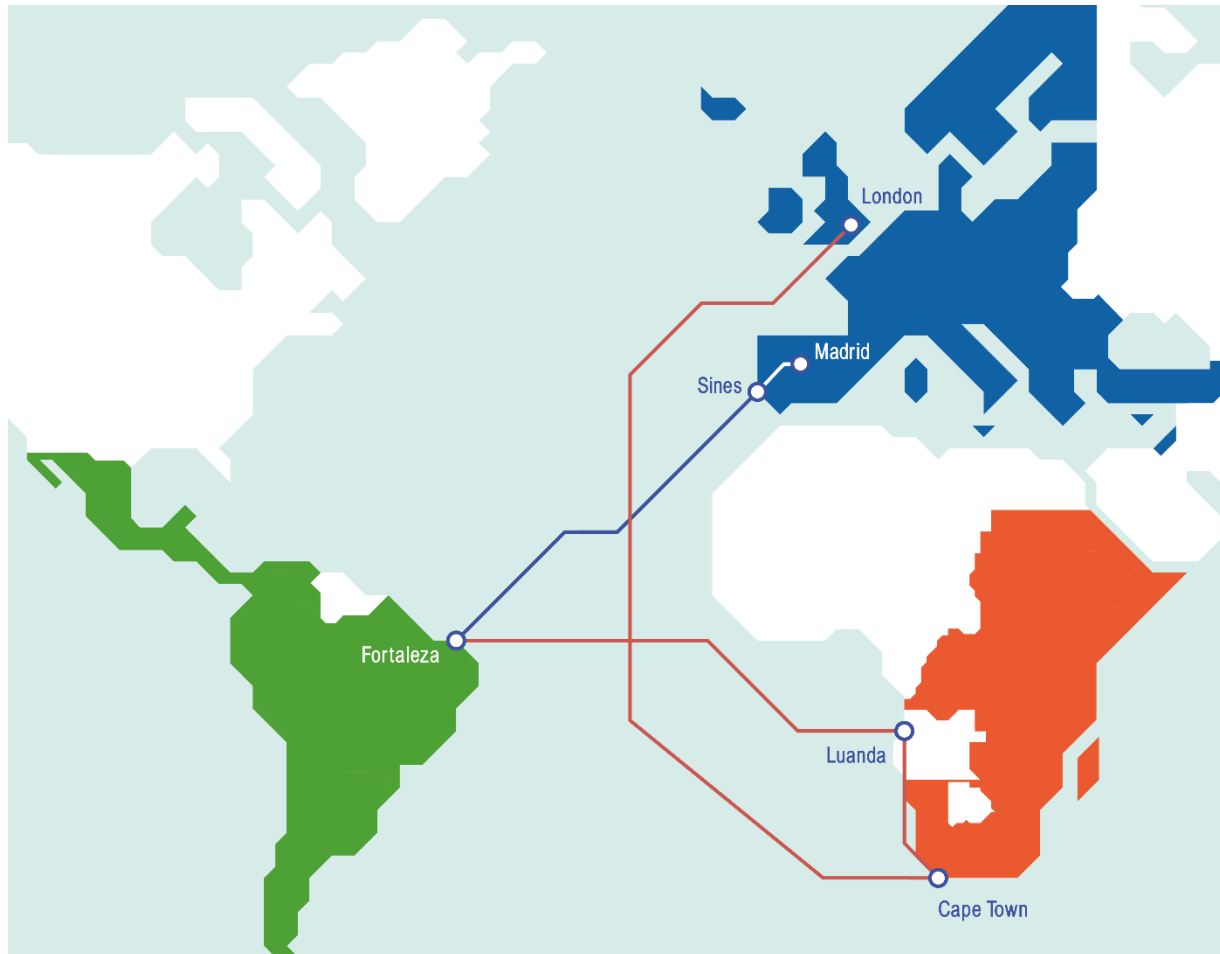
Next GN5-IC1 Region: Connectivity to North America

- **Spectrum**
- GN5-IC1 has a budget of € 13.5M
- Driven by analysis of General Purpose and estimates of HL-LHC traffic.
- GÉANT aim to have 25% of a fibre pair on each of **two** cable systems.
- Most important is the collaboration with our partners.
- ESnet are making a similar investment.
- Ambition is to share spectrum on up to 4 cable systems. Potential of 20 Tbit/s.
- Status: GÉANT consulting to avoid compliance and tax challenges. Minimise presence in US by using Managed Spectrum?



Bridging Europe, Africa and the Americas

Bridging Europe, Africa and the Americas



BEAA MoU

- Signed 17th December 2021
- Three-year duration, renewable by mutual agreement
- To provide mutual back-up for all parties across links included in the collaboration:
 - Brazil-Agola (FIU)
 - Agola-South Africa (TENET/SANReN)
 - South Africa-UK (TENET/SANReN)
 - Portugal/Spain-Brazil (BELLA)

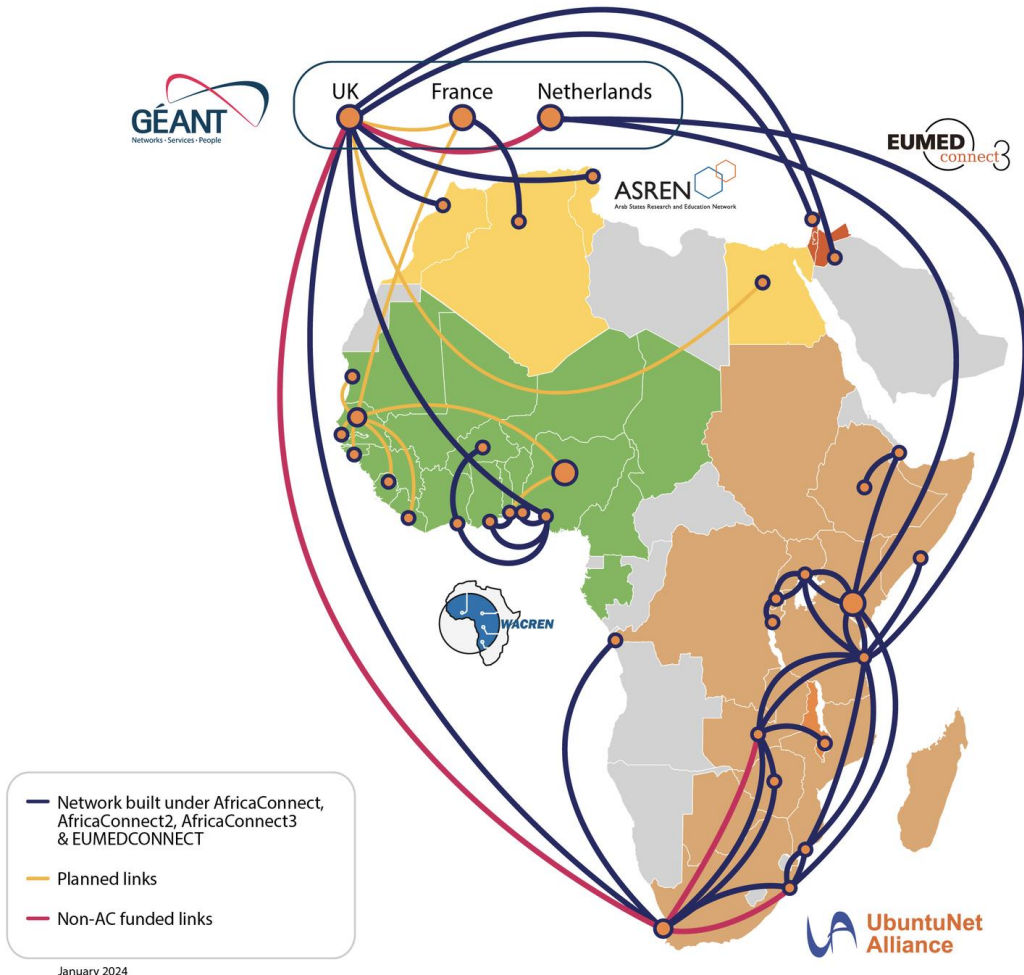
Connectivity of NRENs in Africa



Since AfricaConnect started in 2011, **23 out of 38 African NRENs** have been connected to their regional network:

- **UbuntuNet Alliance 13:** Botswana, Burundi, DRC, Kenya, Malawi, Mozambique, Rwanda, Somalia, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.
- **WACREN 6:** Ghana, Nigeria and Togo, Benin, Burkina Faso and Côte d'Ivoire.
- **ASREN 4:** Algeria, Egypt, Morocco and Tunisia.

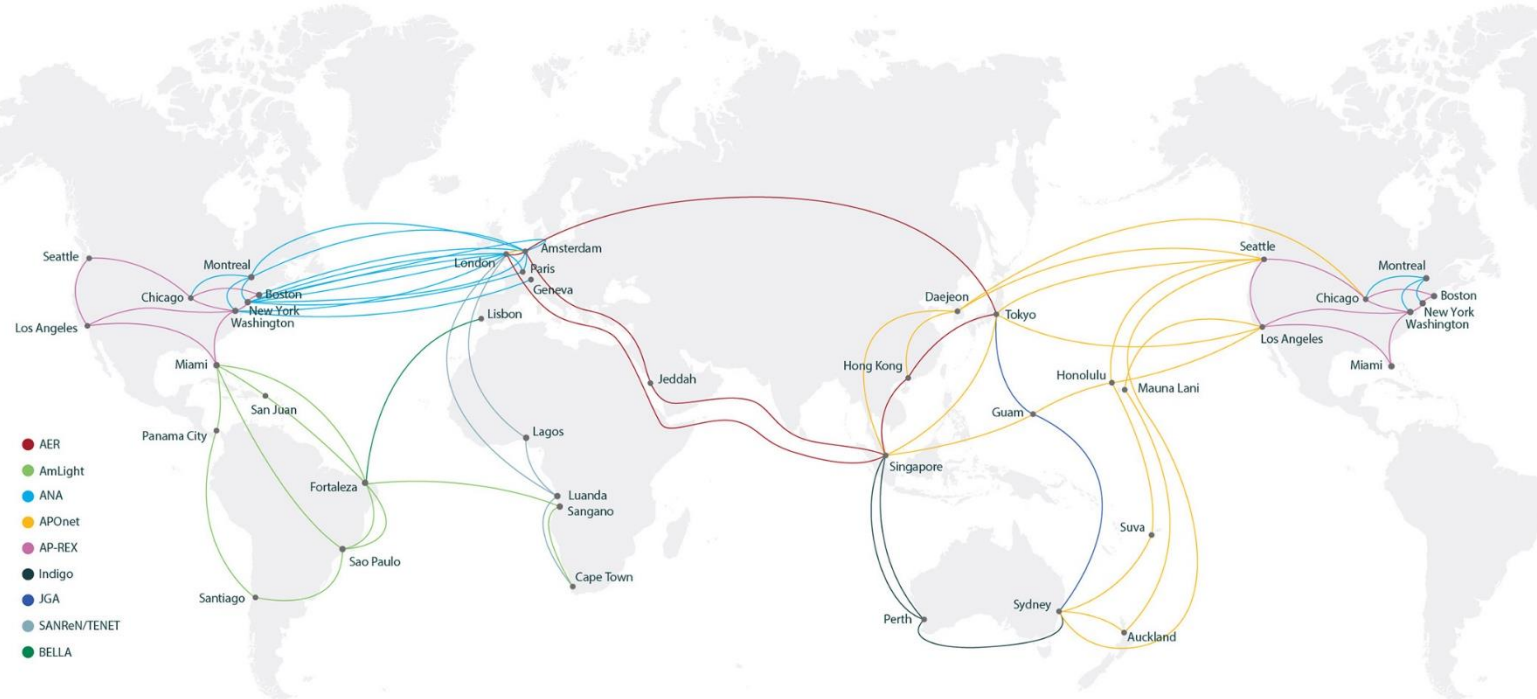
Ethiopia due to be to be connected in 2024.

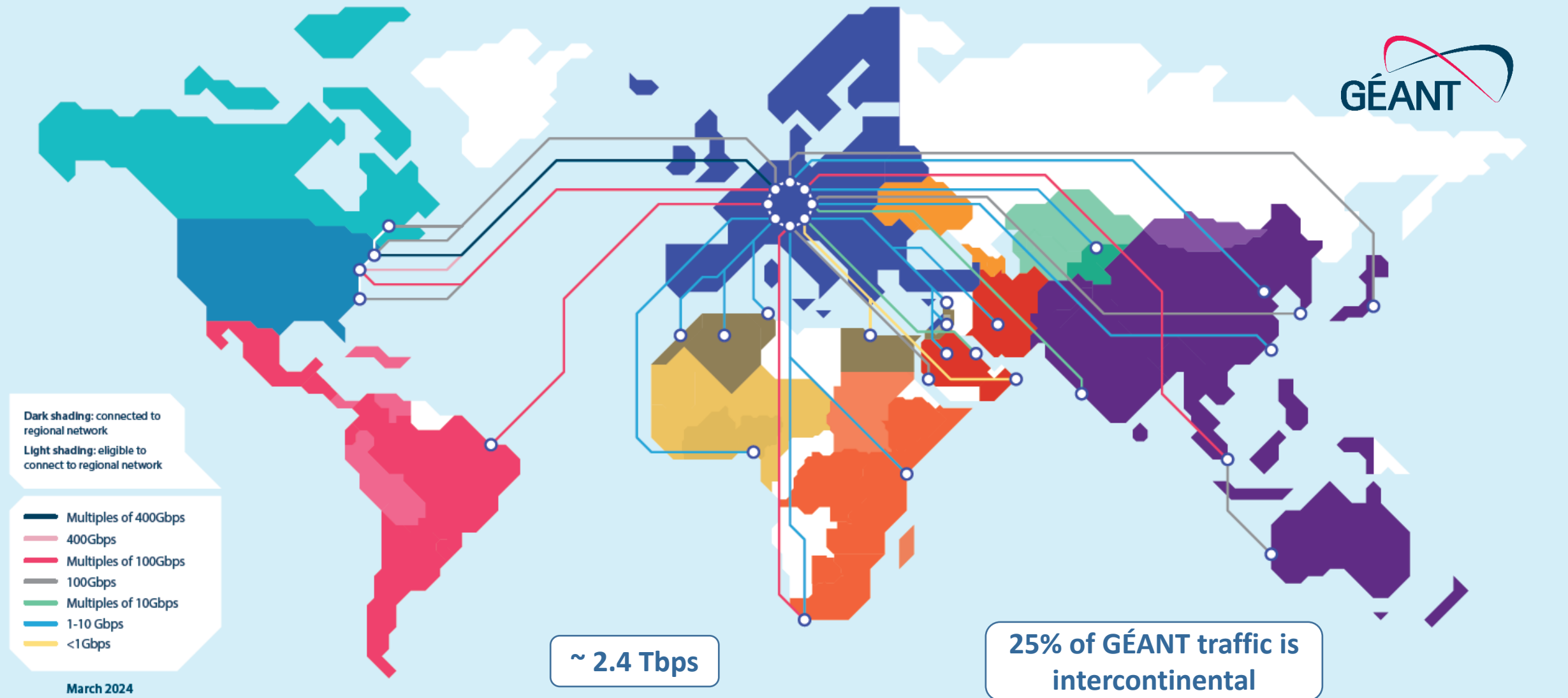


Global Partnerships is the Key

- Operating at intercontinental scale needs partnerships
 - Investment pooling/coordination
 - Resiliency coordination
 - Technical – services on the links
 - Technical – driving global services

- Operating at a global scale needs...
 - Coordination
 - Resilience
 - Technology/service coordination
 - Topology?





Canada & USA	Latin America	Europe	North Africa & Eastern Mediterranean	West & Central Africa	Eastern & Southern Africa	Central Asia	Asia-Pacific	Other R&E Networks



Thank You

Any questions?

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