Navigating the Future of Intercontinental Connectivity

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Head of International Relations
GÉANT

Internet2 Community Exchange 2023
Thursday, 11 May 2023
Charting Our Course

- GÉANT global connectivity waters
- Rigging the boat for the next cruise
- Setting Sail
- Charting the waters
- Addressing the digital divide

Source: T. Fryer

Source: https://www.flickr.com/photos/internetarchivebookimages/
GÉANT Global Connectivity Today!

Average global traffic in 2022 = 110 Gbps ingress / 105 Gbps egress

GÉANT global traffic growth = ca. 35% per year

~ 1.9 Tbps
Capacity and Traffic Distribution (2022)

Average Global Traffic Distribution by Region

Global capacity distribution by region
Navigating a History of Connectivity Delivery

- **Single Ownership**
  - GEANT
  - GEANT2
  - GÉANT
  - GÉANT

- **Cost-share**
  - ORIENT
  - ORIENT_plus
  - CAE-1
  - BELLA

- **Coordinated Planning & Back-up**
  - ACE
  - TransPAC
  - ANA
  - AER
  - NEA/m
  - BEAA

- **Regional Projects**
  - ALICE
  - alice2
  - CAREN
  - BELLA
  - TEIN2
  - TEIN3
  - Afri.ca
  - AsiaConnect

Time Frame:
- 2003
- 2022
The Cargo

**LHC**
- 200 sites across the globe
- 50% of GÉANT global traffic
- High Luminosity HLC from 2029

**Astronomy**
- Square Kilometre Array
  - Detectors in Australia and South Africa
  - 100 Gbps capacities required
- Chile:
  - Cherenkov Telescope Array
  - ESO – Very Large Telescope

**ITER – Fusion Research**
- Several PBs of data per year
- To be copied from France to multiple locations globally
Growing Cargo

- Growth forecast from large data movers (LHC, Astronomy, ITER, HPC, etc.)
Captain’s Orders: 2021-26 GÉANT Strategy

2021-26 GÉANT Strategy

- “…trusted partner for… global advanced R&E networking.”
- “…acknowledged worldwide as a leader for developing and supporting R&E networking communities, and global REN development.”
Shipmates

R&E Networking organisations

Team Europe approach:
• EU, Member States, European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD).
• With the private sector in order to leverage investments for a transformational impact securing digital global gateways.
BELLA on the EllaLink Submarine Cable System

First-ever direct GÉANT-RedCLARA interconnection

Transatlantic R&E connectivity needs met for next 25 years
- Spectrum available for use by European & Latin American NRENs
- Supports Copernicus traffic with dedicated wave

Secure capacities for specific R&E collaborations

GÉANT-RedCLARA latency reduced up to 2/3

Source: https://ella.link
BELLA Establishes Connectivity on EllaLink

Over 2 years for manufacture and deployment

Final Splice: 400km NE Mid-Atlantic ridge in early March 2021

BELLA connectivity went live in August 2021

Over 10 years in the making

BELLA – a key role in making EllaLink a reality

EllaLink Inauguration
Sines, Portugal - 1 June 2021
Enhancing Shipping Lane Usage (i)

- **Advanced North Atlantic (ANA) Collaboration:**
  - A collaborative effort to provide multiple, diverse links to support R&E collaboration across the North Atlantic
  - Individual Transatlantic links are provided on diverse paths by:

<table>
<thead>
<tr>
<th>100 Gbps</th>
<th>100 Gbps</th>
<th>100 Gbps</th>
<th>2 x 100 Gbps</th>
<th>4 x 100 Gbps</th>
<th>100 Gbps</th>
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<tbody>
<tr>
<td>PAR-NY</td>
<td>AMS-MONT</td>
<td>LON-WASH</td>
<td>NY-LON</td>
<td>WASH-GEN</td>
<td>AMS-NY</td>
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<td>NY-AMS</td>
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*Note: Diagram showing network connections.*
Enhancing Shipping Lane Usage (ii)

• CAE-1
  • A 10-year collaboration starting in 2019 to connect Europe and Asia-Pacific at 100 Gbps between London and Singapore

• Asia-Pacific Europe Ring (AER)
  • A collaboration of ten R&E networks and institutions to provide mutual back-up between Europe and Asia-Pacific across diverse links.
Enhancing Shipping Lane Usage (iii)

Bridging Europe, Africa and the Americas (BEAA):

• A collaboration of R&E networks in Europe, Africa and the Americas to provide mutual back-up via diverse links in the Southern Atlantic
Size of the Cargo Hold

- Dominance of content providers changing the wholesale market, however.....

- R&E networks are big enough to make a splash

Continued demand fuelling investment
Shipping Forecast

- Aging submarine network estate fuelling replacement
- Silicone shortages
- Geopolitical concerns
- Security of supply

- Less populous routes/markets of interest emerging
- Carbon efficient computing
- Price erosion – regionalised
- New technologies: 400Gbps / spectrum
**Setting Sail**

- **Sustainability:** Distribution of capex/opex EUR/Gbit acceptability and lifetime efficacy
- **Network Topology:** Optimisation, Resilience, Traffic patterns, Gateways, Spectrum/capacity, Requiring upgrade
- **Other issues:** Existing contracts expiring, Requiring upgrade
- **International co-ordination:** Peer capability and capacity, Models for collaboration, Position on equity
- **User demands:** Background growth rates – 35%, Step-change use cases, e.g. ITER, LHC
- **Strategic Opportunities:** EU Global Gateway and role for GÉANT
- **Market Engagement:** New routes, New services/pricing step change, Innovative commercial models

**Planning**

**Procurement/Contracting**

**Implementation**

- **Partner collaboration & user demand**
- **Market engagement**
Different Shapes and Sizes

- Fibre pair Anchor Tenancy
- Spectrum Anchor Tenancy
- Spectrum IRU
- Capacity Lease
- Capacity IRU
- Fibre Pair: Cable Consortium Member
#HorizonEU Funding for Intercontinental Connectivity

- GN5 Framework Partnership Agreement (FPA) signed
  - 7-year strategic framework for R&E networking projects
- GN5 IC1 (Intercontinental Connectivity) SGA (project) approved; signature process in progress.
  - **Funding:** 15M EUR
  - **Started:** 1 December 2022
  - **Duration:** 3 years
  - Outcomes: long-term connectivity to at least two continents and planning for further activities
Harnessing Cable Systems for Earth Observation

Existing and future submarine cables provide huge potential as seismic sensors.

**SUBMERSE project:**
- Proof of concept:
  - Use of using existing telecommunication systems to monitor earth and oceans without disrupting telecoms traffic
- Funded by EU
- Started 1 May 2023
- Duration – 36 months
Charting the Waters
The Traditional Chart

Dark shading: connected to regional network
Light shading: eligible to connect to regional network

Multiples of 100Gbps
100Gbps
Multiples of 10Gbps
1-10Gbps
<1Gbps

May 2022
The GÉANT Interactive Chart

Connects GÉANT to: CANARIE; ESnet; Internet2; SINET; TWAREN Link forms part of Advanced North Atlantic (ANA) collaboration and is provided by GÉANT and complements transatlantic connectivity provided by ESnet and the Indiana University NEAAR Project

https://map.geant.org
Addressing the Digital Divide
## EaPConnect – Eastern Partnership Countries

| Budget: | €10.5 Million  
95% EU funding via DG NEAR |
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<tr>
<td>Duration:</td>
<td>60 months – July 2020 to July 2025</td>
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<tr>
<td>Website:</td>
<td><a href="https://eapconnect.eu/">https://eapconnect.eu/</a></td>
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<td>Coordinator:</td>
<td>GÉANT</td>
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<td><strong>Beneficiaries:</strong></td>
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• IIAP NAS RA (Armenia)  
• AzScienceNet (Azerbaijan)  
• UIIP NASB / BASNET (Belarus) (until March 2022)  
• GRENA (Georgia)  
• RENAM (Moldova)  
• URAN (Ukraine) |
| **Associate Partners** |  
• DFN; GARR; GRNET; RoEduNet; LITNET; PSNC |
| **Previous Phase:** | €13M (95% EU funding)  
July 2015 until February 2021 (extension) |
## Central Asia

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<tr>
<th>GÉANT Connects To:</th>
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<td>• CAREN CC - <a href="https://www.redclara.net/">https://www.redclara.net/</a></td>
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<tr>
<td>• Central Asian R&amp;E Network</td>
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<tr>
<td>• CAREN CC connects:</td>
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<tr>
<td>• KRENA (Kyrgyzstan)</td>
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<td>• TARENA (Tajikistan)</td>
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<th>EU-funded projects</th>
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<td>• Previous: CAREN Central Asia</td>
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<td>• 3 phases, 2010-2019</td>
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<th>eduroam</th>
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<td>• Kazakhstan; Kyrgyzstan; Tajikistan</td>
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<tr>
<td>• Kyrgyzstan</td>
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Latin America

| GÉANT Connects To: | • RedCLARA - https://www.redclara.net/  
|                   |   • Latin American Research and Education Network  
|                   |   • 10 NREN members across the region; other countries across the regional eligible to join RedCLARA  
| EU-funded projects | • BELLA-T  
|                    |   • Previous Projects  
|                    |   • BELLA-S (2016-2021)  
|                    |   • ALICE & ALICE2 (2003-2012)  
|                    |   • ELCIRA (2012-2014)  
|                    |   • MAGIC (2015-2017)  
| Other Collaborations: | • BELLA Programme  
|                     | • BEAA (Bridging Europe, Africa and the Americas) collaboration  
| eduroam | • Argentina; Brazil; Chile; Colombia; Costa Rica; Ecuador, Mexico; Peru; Uruguay  
| eduGAIN | • Brazil; Chile; Colombia; Ecuador; Mexico  

BELLA II
Building the Europe Link to Latin America and the Caribbean
Asi@Connect – Asia-Pacific

Fourth phase of EU funding phase for Asia-Pacific R&E networking

Objectives:

- Increase internet connectivity for R&E between Asia and Europe (GÉANT)
- Improve intra-regional connectivity across Asia-Pacific
- Support UN Sustainable Development Goals (SDGs) through improved access to education and research resources
- Promote international R&E collaboration between Asian and European partners
- Expand geographical coverage of the network to include other Asian countries
- Promote broadening of SDG-relevant user applications supported by the TEIN network, and increase the use of the TEIN network.
- Enhance human capacity of the Asi@Connect partners
Africa is contributing to only 2% of the world's research output**

Africa has only 326.4 researchers per million people, while the European Union has 4069.2*

Internet penetration in Africa is behind other parts of the world (24.2% in Africa vs 48.4% in the rest of the world)*

Tech investment in Africa significantly trails investment in tech in other continents, i.e. Asia

Access to reliable and affordable connectivity in Africa hinders students and researchers’ potential

www.africaconnect3.net
A Pan-African Network in the making

22 out of 38 African NRENs connected

- Burundi, DRC, Kenya, Malawi, Mozambique, Rwanda, Somalia, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.
- Ghana, Nigeria and Togo, Benin, Burkina Faso and Côte d'Ivoire.
- Algeria, Egypt, Morocco and Tunisia.

Next Countries to be connected: Mali and Ethiopia.
Developing R&E Services

• Service outreach to science communities, deployment of R&E applications and access to repositories

• Trust and Identity for seamless access

• Proactive Cybersecurity for NRENs and their Digital Assets

• Federated Identity Management for Libraries
Scientific Use Cases in Africa

- Astronomical collaborations with South Africa
- Fishery Management in Somalia
- Remote Surgery assistance in Uganda
- Food security in Kenya Sequencing cassava virus genomes

https://www.inthefieldstories.net
NRENs contribute to the United Nations Sustainable Development Goals

- **5** Gender Equality
- **8** Decent Work and Economic Growth
- **13** Climate Action
- **17** Partnerships for the Goals
EU-Mediterranean: 1\textsuperscript{st} EU Global Gateway for R&E Networking

200 Gbps end-to-end international connectivity:
Algeria, Egypt, Morocco, Tunisia
Additional EU-funding support for Neighbourhood South

- Discussions underway on project proposal for Neighbourhood South (North Africa & Eastern Mediterranean countries) – EUMED+
- To support NRENs and ASREN in North Africa in preparations for delivery of Medusa connectivity
- Support NRENs in the region, including Eastern Mediterranean, where EU funding stopped in December 2021

- Expected duration: 4 years
- To Start 1 January 2024
As part of the GÉANT 2020 Framework Partnership Agreement (FPA), the project receives funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).
Set to Sail & Explore

- Delivery of intercontinental connectivity evolving;
- GÉANT aims ensure long-term security of supply;
- Funding mechanisms in place;
- Collaboration across the globe will be crucial:
  - Information-sharing;
  - Planning;
  - Infrastructure delivery;
- Commitment to reducing digital divide remains strong;
- New discoveries await us!
Time to lower the anchor!